RTR6285™ RF Transceiver IC

Device Specification (Advance Information)

80-VD861-1 Rev. A

December 6, 2006

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Revision history

Revision	Date	Description
A	December 2006	Initial release

1 Overview

1.1 Documentation overview

This document is part of a set of documents that describes the QUALCOMM RTR6285 RFIC and how best to use it. The RTR6285 device supports quadband UMTS (bands 1 through 6 and bands 8 through 9), quadband GSM/EDGE, GPS, and UMTS diversity handset operation with direct conversions between RF and baseband using zero-IF (ZIF) radio architectures.

Technical RTR6285 IC information is distributed over four documents (Table 1-1). Each is a self-contained document, but thorough understanding of the IC and its applications requires studying all four. The device description given in the next section is a good place to start. All released RTR6285 documents are posted on the QCT Developers Connection (https://chips.qualcomm.com) and are available for download.

Table 1-1 RTR6285 documents

Doc. no.	Title and description
80-VD861-1 (this document)	*RTR6285 RF Transceiver IC Device Specification* The primary objective of this document is to convey all RTR6285 electrical and mechanical specifications. Additional information includes pin assignment definitions, PCB mounting specifications, packing methods and materials, and part reliability. This document can be used by company purchasing departments to facilitate procurement.
80-VD861-3	*RTR6285 RF Transceiver IC User Guide* This document provides detailed descriptions of all RTR6285 functions and interfaces, defining how to control the IC and explaining the resulting operating modes.
80-VD861-6	*radioOne® 6285 F Series RF Chipset Design Guidelines* This document tries to anticipate and answer questions hardware engineers might have when incorporating the radioOne 6285 F-series RF chipset into their product designs. Example applications are presented and specific design topics such as layout guidelines, power distribution recommendations, external component recommendations, troubleshooting techniques (and more) are addressed.
80-VD861-4	*RTR6285 RF Transceiver IC Revision Guide* This document provides a history of RTR6285 IC revisions and changes to its device specification. It explains how to identify the various IC revisions, discusses known issues (or bugs) for each revision and how to work around them, and lists performance specification changes between each revision of the *RTR6285 RF Transceiver IC Device Specification*.

This RTR6285 device specification is organized as follows:

Chapter 1	Provides an overview of RTR6285 documentation, gives a high-level functional description of the RTR6285 IC, lists the device features, and lists terms and acronyms used throughout this document
Chapter 2	Defines the IC pin assignments
Chapter 3	Defines the IC electrical performance specifications, including absolute maximum ratings and recommended operating conditions
Chapter 4	Defines the IC mechanical specifications, including dimensions, thermal characteristics, moisture sensitivity, and markings
Chapter 5	Discusses packing methods and materials for RTR6285 shipments
Chapter 6	Presents procedures and specifications for mounting the RTR6285 IC on printed circuit boards (PCBs)
Chapter 7	Presents RTR6285 IC reliability data, including definition of the qualification samples and a summary of qualification test results

1.2 Device description

The RTR6285 device is a highly integrated radio frequency complementary metal oxide semiconductor (RF CMOS) transceiver IC.

The functional block diagram for the RTR6285 IC is shown in Figure 1-1.

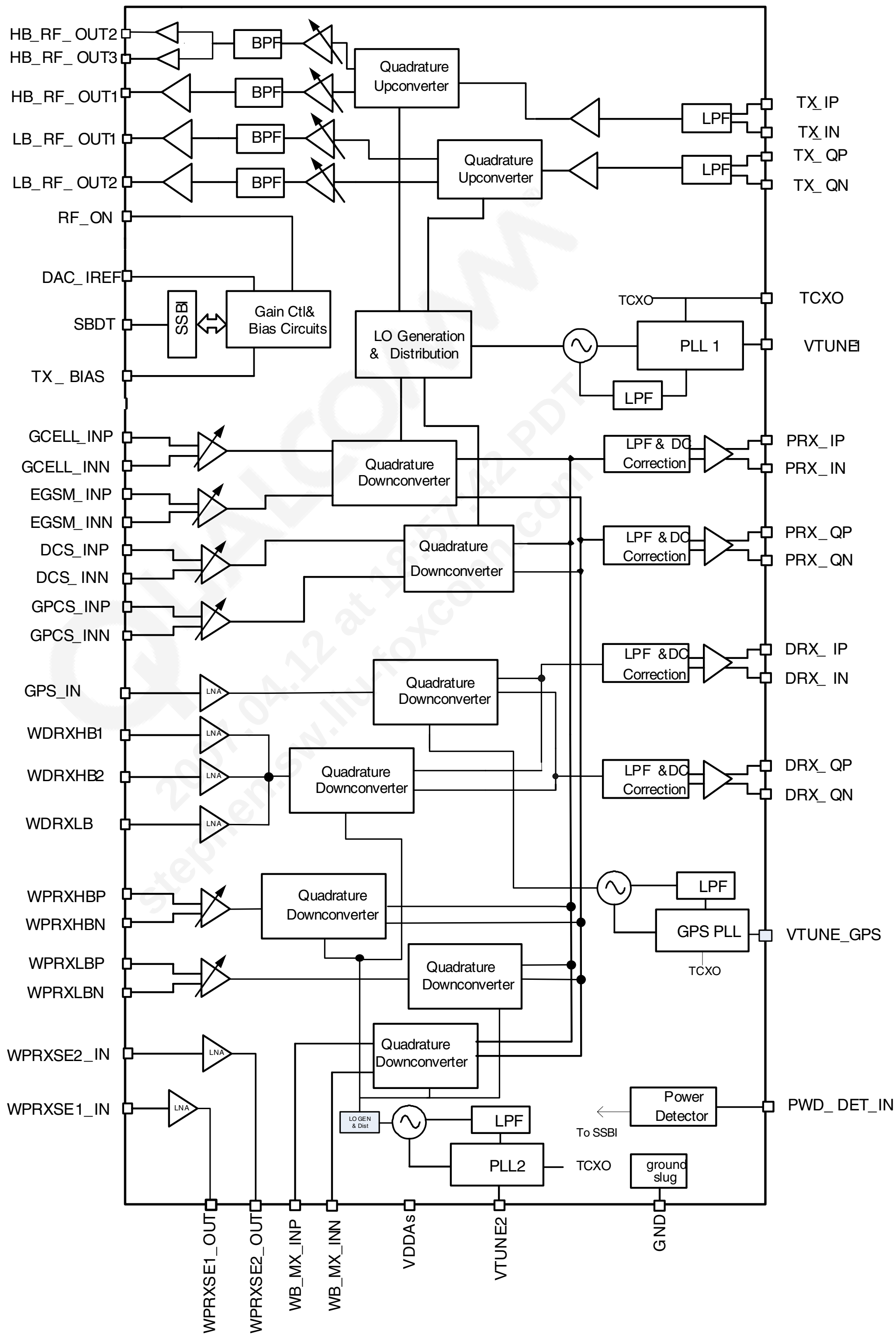


Figure 1-1 **RTR6285 IC functional block diagram**

The RTR6285 IC supports multi-band, multi-mode diversity phones with GPS.

- Receiver paths:
  - GSM/EDGE 850
  - GSM/EDGE 900
  - GSM/EDGE 1800
  - GSM/EDGE 1900
  - Two single-ended UMTS inputs
  - Two differential UMTS inputs
  - Three single-ended UMTS diversity inputs
  - GPS receive
- Transmitter paths:
  - Two low-band Tx paths for:
    - GSM/EDGE 850
    - GSM/EDGE 900
    - UMTS 800/850/900
  - Three high-band Tx paths for:
    - GSM/EDGE 1800
    - GSM/EDGE 1900
    - UMTS 1700/AWS/1800
    - UMTS 1900
    - UMTS 2100

Numerous secondary functions also are integrated on-chip:

- LNAs for UMTS Rx operation
- Quadrate demodulator to support UMTS Rx operation
- Three fractional-N synthesizers with on-chip VCOs and loop filters:
  - PLL1 and on-chip VCO support all transmitters of GSM 850/900/1800/1900 and UMTS low and high bands. It also serves all receivers of GSM 850/900/1800/1900.
  - PLL2 and on-chip VCO support primary and diversity receivers of UMTS high and low bands.
  - PLL3 and on-chip VCO support GPS receiver.

- Transceiver LO generation and distribution circuits:
  - GSM/EDGE 850/900/1800/1900 Rx
  - GSM/EDGE 850/900/1800/1900 Tx
  - UMTS high and low bands primary and diversity RX
  - UMTS high and low bands TX
- Quadrature modulators to support GSM/GPRS/EDGE polar Tx and WCDMA/HSDPA Tx operations
- Integrated power detector
- Analog support functions
- Reference signal for the Mobile Station Modem™ (MSM™) device transmit DACs
- Transmit gain control
- Bias control
- Digital control circuits and interfaces
- Single-line serial bus interface (SSBI)
- Thermometer for temperature measurement

The device is fabricated using an advanced RF CMOS process that accommodates high-frequency, high-precision analog circuits and low-power CMOS functions. Designed to operate with low-voltage power supplies, it is compatible with single-cell Li-Ion batteries.

The RTR6285 IC is available in the 68-pin micro-quad flat no lead (68 mQFN) package that includes a large center ground slug for improved RF grounding, mechanical strength, and thermal continuity.

The RTR6285 ZIF architecture and highly integrated implementation minimizes handset PCB size and material cost. Major RTR6285 functional blocks are described in the following sections.

1.2.1 Primary receive signal paths

The RTR6285 receive paths include four GSM/EDGE Rx signal paths that support GSM 850, GSM 900, GSM 1800, and GSM 1900 bands and four WCDMA Rx signal paths (two single-ended and two differential) for one UMTS low-band and three UMTS high bands.

The quad-band GSM/EDGE Rx paths start from the handset front-end circuits (GSM Rx filters and antenna switch module). The four differential inputs are amplified with gain-stepped LNA circuits. Gain control is provided through software and serial interface. The LNA outputs drive the RF ports of quadrature RF-to-baseband downconverters. The downconverted baseband outputs are multiplexed and routed to lowpass filters (one I and one Q) whose passband and stopband characteristics supplement MSM device processing. These filter circuits allow DC offset corrections, and their differential outputs are buffered to interface with the MSM IC.

The two RTR6285 UMTS single-ended inputs accept UMTS 2100/1900/1800/1700 input signals from the handset RF front-end filters. The UMTS Rx inputs are provided with on-chip LNAs that amplify the signal before second-stage filters that provide differential signals to a shared downconverter. This second-stage input is configured differentially to optimize second-order intermodulation and common mode rejection performance. The gain of the UMTS front-end amplifier and the UMTS second-stage differential amplifier is adjustable, under MSM control, to extend the dynamic range of the receivers.

The second-stage UMTS Rx amplifiers drive the RF ports of the quadrature RF-to-baseband downconverters. The downconverted UMTS Rx baseband outputs are routed to lowpass filters having passband and stopband characteristics suitable for UMTS Rx processing. These filter circuits allow DC offset corrections, and their differential outputs are buffered to an interface shared with GSM Rx to the MSM IC. The UMTS baseband outputs are turned off when the RTR6285 is downconverting GSM signals and turned on when the UMTS is operating.

The RTR6285 UMTS differential input paths stay on-chip; off-chip interstage filtering is not required. Other than this, the architecture is similar to the single-ended inputs.

1.2.2 Transmit signal paths

The RTR6285 transmit includes four transmit signal paths (two high bands and two low bands) supporting multi-bands and multi-modes GSM/GPRS/EDGE polar transmit and WCDMA/HSDPA transmit architectures.

The transmit path begins with differential baseband signals (I and Q) from the MSM device. These analog input signals are buffered, filtered by low-path filter, corrected for DC offsets, amplified, and then applied to the quadrature upconverter mixers.

The upconverter outputs are amplified by multiple variable gain stages that provide transmit AGC control. SSBI is used to do the gain control. The specified driver amplifier output level is achieved while supporting the GSM/EDGE and UMTS transmit standard's requirements for GSM ORFS, carrier and image suppression, WCDMA ACLR, spurious emissions, Rx-band noise, and so forth.

Again, the upconverter LO signals are generated by circuits discussed in Section 1.2.3. These upconverters translate the polar GMSK-modulated or 8-PSK modulated baseband PM signals and/or WCDMA baseband signals directly to the RF signals, which are filtered and feed into the GSM/EDGE polar PA and/or WCDMA PA. The WCDMA TX power is coupled back to the RTR6285 internal power detector input pin, PWD_DET_IN, using a coupler for power measurement.

The low-band drive amplifiers are used to transmit the polar phase modulated (PM) signal for GSM/EDGE 850/900 while the high-band driver amplifiers are for the GSM/EDGE 1800/1900. By using the radioOne architecture, the same high-band transmit path can be used to transmit the UMTS 2100/1900/1800/1700 signal, and the low-band transmit path can be used to transmit the UMTS 800/850/900 signal, depending on the application.

The envelope path is used in polar mode of operation for GSM and EDGE. Input from the MSM IC, the baseband envelope (AM) current signal is applied directly to the ramp control pin of the GSM/EDGE polar PA to modulate the power supply of the PA so that the polar-modulated GSM/EDGE signal in the MSM device can be recovered and transmitted.

1.2.3 Secondary WCDMA and GPS receive paths

The three secondary WCDMA input paths stay on-chip; off-chip interstage filtering is not required. The three LNA outputs are routed to a single RF-to-baseband quadrature downconverter; again, only one LNA is active at a time. The GPS input path is followed by a dedicated downconverter. The GPS downconverter and secondary WCDMA downconverter outputs are multiplexed to drive a single set of baseband filter and buffer circuits. The secondary baseband output (in-phase and quadrature differential signals) is routed through the DRX_I/Q pins to the MSM device for further processing. This baseband interface supports WCDMA and GPS modes, whichever is active on the secondary path.

1.2.4 LO generation and distribution circuits

The integrated LO generation and distribution circuits are driven by internal VCOs to support various modes to yield highly flexible quadrature LO outputs that drive all GSM/EDGE, UMTS band and GPS upconverters and downconverters; with the help of these LO generation and distribution circuits, true ZIF architecture is employed in all GSM and UMTS band receivers and transmitters to translate the signal directly from RF to baseband and from baseband to RF.

Three fully functional fractional-N synthesizers, including VCOs and loop filters, are integrated within the RTR6285 IC. The first synthesizer (PLL1) creates the transceiver LOs that support the UMTS transmitter, and all four GSM band receivers and transmitters including: GSM 850, GSM 900, GSM 1800, and GSM 1900. The second synthesizer (PLL2) provides the LO for the UMTS primary and secondary receivers. The third synthesizer (PLL3) provides the LO for the GPS receiver. An external TCXO input signal is required to provide the synthesizer frequency reference to which the PLL is phase- and frequency-locked. The RTR6285 IC integrates most of PLL loop filter components on-chip except three off-chip loop filter series capacitors, and significantly reduces off-chip component requirement. With the integrated fractional-N PLL synthesizers, the RTR6285 has the advantages of more flexible loop bandwidth control, fast lock time, and low-integrated phase error.

1.2.5 Other integrated analog functions

The RTR6285 IC includes a single Tx analog baseband interface that is multiplexed between the transmitter paths to deliver the MSM IC output signal to the active path. The Tx baseband interface has four lines that are configured as two differential pairs – one pair for the in-phase component and one pair for the quadrature component. The Tx baseband interface is active during any single transmit mode (GSM, EDGE, WCDMA). The transmit baseband signals are generated by digital-to-analog converter (DAC) circuits within the MSM IC. Their performance is highly dependent upon the DAC reference signal, pin 67 (DAC_IREF), provided by the RTR6285 IC.

One external resistor set several RTR6285 IC internal operating currents (charge pump currents, signal path bias currents, and others). External resistors are required for pin 68 (TX_RBIAS) for bias control circuits; refer to the RF CMOS platform schematic for details.

1.2.6 Digital interfaces

Most control and status commands are communicated through the RTR6285 MSM device-compatible single-line serial bus interface (SSBI), enabling efficient initialization, WCDMA transmit gain control, control of device operating modes and parameters, verification of programmed parameters, and frequency lock status reports. The MSM device SSBI controller is the master while the RTR6285 IC is a slave.

The RTR6285 IC also provides a digital I/O pin for time-critical control signal:

- Pin 26: RF_ON – RF feature enable signal for UMTS transmitter ON; used as part of the power-up sequence in GSM mode.

1.3 IC features

- Integral to the QUALCOMM MSM6260™-series, MSM6280A™ and MSM7200A™-series chipset
- Multiband, multimode operation: UMTS 800/850/900, UMTS AWS/1700/1800/1900/2100, GSM/EDGE 850/900, and GSM/EDGE 1800/1900
- UMTS Diversity
- GPS
- GPRS/EDGE compliant
- Direct frequency conversions from analog baseband to RF and vice versa
- GSM 850, GSM 900, GSM 1800, and GSM 1900 receive signal path circuits
- UMTS receive signal path circuits
- GSM 850, GSM 900, GSM 1800, and GSM 1900 transmit signal path circuits
- UMTS transmit signal path circuits
- Dedicated ZIF RF-to-baseband quadrature downconverters
- Dedicated ZIF baseband-to-RF quadrature upconverters
- Dedicated gain-stepped LNA circuits
- RF AGC amplifiers, filter, and driver amplifier
- Dedicated gain control circuits
- Shared baseband lowpass filters, DC correction, and analog interface to the MSM
- Baseband interface from the MSM device with amplifiers and lowpass filters
- Baseband interface from the MSM device with amplifiers, DC correction, and lowpass filters

- Fully integrated fractional-N synthesizer PLL1, VCO, and loop filter components for GSM/EDGE Tx/Rx and UMTS Tx operations
- Fully integrated fractional-N synthesizer PLL2, VCO and loop filter components for UMTS Rx operation
- Fully integrated fractional-N synthesizer PLL3, VCO and loop filter components for GPS operation
- Integrated LO generation and distribution circuits supporting multi-band and multi-mode operations
- Transmit power control range supports the UMTS standards
- Power reduction features via MSM device control extends handset talk-time and standby time
- Bias control circuits
- Integrated power detector
- Integrated thermometer
- Single-line serial bus interface (SSBI)
- Selective circuit power-down
- Available in a small, thermally efficient package (68 pin mQFN)

Refer to the *RTR6285 RF Transceiver IC User Guide* (80-VD861-3) for more detailed descriptions of each RTR6285 function and control interface.

1.4 Terms and acronyms

A summary of terms and acronyms used within this document is provided for the reader's convenience.

Term or acronym	Definition
6285 series	The QUALCOMM chipset recommended for multi-modes, multi-bands for UMTS, GSM, and EDGE handsets
8-PSK	8-phase shift keying
ACLR	Adjacent channel leakage power ratio
AGC	Automatic gain control
AltCLR	Alternate channel leakage power ratio
AM-AM	Vamp to output amplitude characteristic of transmitter
AM-PM	Vamp to output phase characteristic of transmitter
API	Application programming interface
CP	Charge pump
DAC	Digital-to-analog converter
DSB	Double-side band

Term or acronym	Definition
DS-WCDMA	Direct sequence WCDMA (referred to as UMTS 1900, UMTS 2100 in this document)
EDGE	Enhanced data rates for global evolution
GSM 850	GSM at 850 MHz band
GSM 900	EGSM at 900 MHz band
GSM 1800	DCS at 1800 MHz band
GSM 1900	GSM at 1900 MHz band
FAQ	Fast acquisition
GMSK	Gaussian minimum shift keying
GPRS	General packet radio service
GSM	Group Special Mobile or Global System for Mobile Communications
HSDPA	High-speed downlink packet access
IIP_2	Second order input intercept point
IIP_3	Third order input intercept point
Li	Lithium
LNA	Low-noise amplifier
LO	Local oscillator
MSM	Mobile Station Modem™
P_1 dB desense	Power of blocker for 1 dB desense sensitivity
PA	Power amplifier
PAR	Peak-to-average ratio
PCB	Printed circuit board
PDM	Pulse density modulation
PLL	Phase-locked loop
PM	Power management
QFN	Quad flat no lead
radioOne	The QUALCOMM brand chipset that implements a ZIF radio architecture
RFL	Radio frequency LNA
RFR	Radio frequency receiver
RTR	Radio frequency transceiver
SSBI	Single-wired serial bus interface
SiGe	Silicon germanium
UMTS, UMTS 1900	Universal Mobile Telecommunications System at 1900 MHz
UMTS, UMTS 2100	Universal Mobile Telecommunications System at 2100 MHz
VCO	Voltage-controlled oscillator
VCTCXO	Voltage-controlled temperature-compensated crystal oscillator. Referred to as TCXO in this document.

Term or acronym	Definition
WCDMA	Wideband CDMA (referred to as UMTS 1900, UMTS 2100 in this document)
Zero-IF	A radio architecture that converts received signals directly from RF to baseband and baseband to RF, eliminating the intermediate frequency (IF).
ZIF	Zero-IF

2 Pin Definitions

The RTR6285 IC is available in the 68 mQFN package that includes a large center ground slug for electrical grounding, mechanical strength, and thermal continuity. Pin assignments are illustrated (Figure 2-1) and defined (Table 2-1) in this chapter.

2.1 Pin assignments

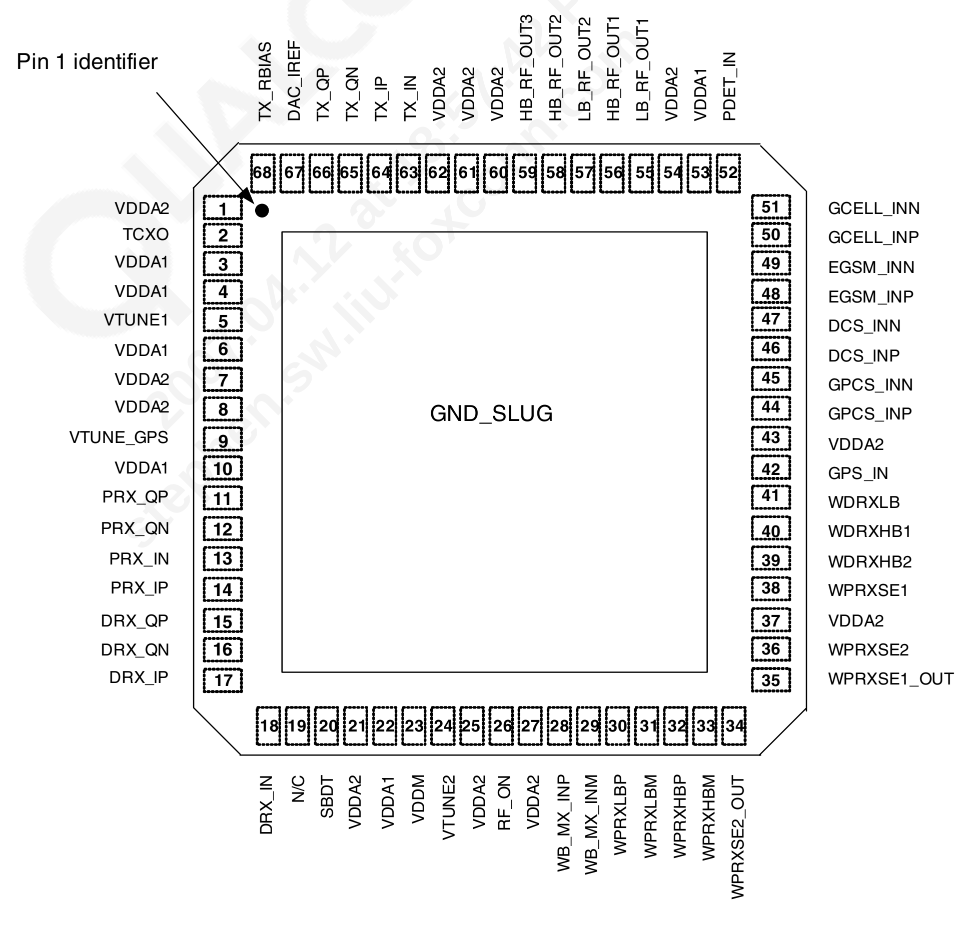


Figure 2-1 RTR6285 IC pin assignments (top view)

NOTE The center slug must be soldered directly to the PCB RF ground plane.

2.2 Pin descriptions

Table 2-1 RTR6285 IC pin descriptions

Pin Number	Pin name for RTR6285 IC	Type	Pin description
1	VDDA2	P	Analog power supply
2	TCXO	AI	TCXO signal input, 19.2 MHz
3	VDDA1	P	Analog power supply
4	VDDA1	P	Analog power supply
5	VTUNE1	AO	PLL1 off-chip loop filter series cap
6	VDDA1	P	Analog power supply
7	VDDA2	P	Analog power supply
8	VDDA2	P	Analog power supply
9	VTUNE_GPS	AO	GPS off-chip loop filter series cap
10	VDDA1	P	Analog power supply
11	PRX_QP	AO	Primary path RX Q positive output
12	PRX_QN	AO	Primary path RX Q negative output
13	PRX_IN	AO	Primary path RX I negative output
14	PRX_IP	AO	Primary path RX I positive output
15	DRX_QP	AO	Diversity/GPS path RX Q positive output
16	DRX _QN	AO	Diversity/GPS path RX Q negative output
17	DRX _IP	AO	Diversity/GPS path RX I positive output
18	DRX_IN	AO	Diversity/GPS path RX I negative output
19	N/C	--	Not connected
20	SBDT	IO	SSBI data digital CMOS input.
21	VDDA2	P	Analog power supply
22	VDDA1	P	Analog power supply
23	VDDM	P	MSM digital I/O power supply voltage. Connect to the MSM PAD VDD voltage.
24	VTUNE2	AO	PLL2 off-chip loop filter series cap
25	VDDA2	P	Analog power supply
26	RF ON	DI	RF enable signal, used for enabling WCDMA TX, and used as part of power-up sequence in GSM modes
27	VDDA2	P	Analog power supply
28	WB_MX_INP	AI	WCDMA mixer positive input
29	WB_MX_INM	AI	WCDMA mixer negative input
30	WPRXLBP	AI	WCDMA primary RX low-band LNA input for differential duplexer path positive input
31	WPRXLBM	AI	WCDMA primary RX low-band LNA input for differential duplexer path negative input

Table 2-1 RTR6285 IC pin descriptions (continued)

Pin Number	Pin name for RTR6285 IC	Type	Pin description
32	WPRXHBP	AI	WCDMA primary RX high-band LNA input for differential duplexer path positive input
33	WPRXHBM	AI	WCDMA primary RX high-band LNA input for differential duplexer path negative input
34	WPRXSE2_OUT	AO	WCDMA primary RX single-ended LNA output
35	WPRXSE1_OUT	AO	WCDMA primary RX single-ended LNA output
36	WPRXSE2	AI	WCDMA primary RX single-ended LNA input
37	VDDA2	P	Analog power supply
38	WPRXSE1	AI	WCDMA primary RX single-ended LNA input
39	WDRXHB2	AI	WCDMA diversity high-band single-ended LNA input
40	WDRXHB1	AI	WCDMA diversity high-band single-ended LNA input
41	WDRXLB	AI	WCDMA diversity low-band single-ended LNA input
42	GPS_IN	AI	GPS RX LNA input
43	VDDA2	P	Analog power supply
44	GPCS_INP	AI	GSM PCS RX LNA positive input
45	GPCS_INN	AI	GSM PCS RX LNA negative input
46	DCS_INP	AI	GSM RX high-band LNA positive input
47	DCS_INN	AI	GSM RX high-band LNA negative input
48	EGSM_INP	AI	GSM RX low-band LNA positive input
49	EGSM_INN	AI	GSM RX low-band LNA negative input
50	GCELL_INP	AI	GSM RX low-band LNA positive input
51	GCELL_INN	AI	GSM RX low-band LNA negative input
52	PDET_IN	AI	Power detector input pin
53	VDDA1	P	Analog power supply
54	VDDA2	P	Analog power supply
55	LB_RF_OUT1	AO	1^{st} low-band drive amp RF output. Used for GSM.
56	HB_RF_OUT1	AO	1^{st} high-band drive amp RF output. Used for GSM.
57	LB_RF_OUT2	AO	2^{nd} low-band drive amp RF output. Used for WCDMA.
58	HB_RF_OUT2	AO	2^{nd} high-band drive amp RF output. Used for WCDMA.
59	HB_RF_OUT3	AO	3^{rd} high-band drive amp RF output. Used for WCDMA.
60	VDDA2	P	Analog power supply
61	VDDA2	P	Analog power supply
62	VDDA2	P	Analog power supply
63	TX_IN	AI	TX_I negative input
64	TX_IP	AI	TX I positive input

Table 2-1 RTR6285 IC pin descriptions (continued)

Pin Number	Pin name for RTR6285 IC	Type	Pin description
65	TX_QN	AI	TX Q negative input
66	TX_QP	AI	TX Q positive input
67	DAC_IREF	AO	MSM TX DAC reference current, current source output
68	TX_RBIAS	AI	Bias current setting resistor
--	Gnd slug		Global ground for the chip

Notes:

Type definitions:

AI = analog input

AO = analog output

DI = digital input from MSM device

DO = digital output to MSM device

P = power or ground

--- = do not connect

VDDA1s are connected to 2.7 V (nominal) supply.

VDDA2s are connected to 2.1 V (nominal) supply.

3 Electrical Specifications

3.1 Absolute maximum ratings

Operating the RTR6285 IC under conditions beyond its absolute maximum ratings (Table 3-1) may damage the device. Absolute maximum ratings are limiting values to be considered individually when all other parameters are within their specified operating range. Functional operation and specification compliance under any absolute maximum rating condition, or after exposure to any of these conditions, is not guaranteed or implied. Exposure may affect the device reliability.

Table 3-1 Absolute maximum ratings

Parameter		Rating
V_{DDA}, V_{DDM}	Power supply voltage	-0.5 to 3.2 V
V_{IN}	Voltage applied to any input or output pin (see note)	-0.5 V to V_{DDX} V
Input power level	Maximum survival LNA input power level	TBD
T_S	Storage temperature	-55 °C to +150 °C
t_{sc}	Short circuit duration to GND or V_{DD}	1 sec
V_{HBM}	Electrostatic discharge rating, human body model	TBD
V_{CDM}	Electrostatic discharge rating, charge device model	TBD

Note: V_{DDX} is the supply voltage associated with the input or output pin to which the test voltage is applied.

3.2 Recommended operating conditions

Operating conditions include parameters that are under the control of the user: power supply voltage and ambient temperature (Table 3-2). The RTR6285 IC meets all performance specifications listed in Section 3.3 through Section 3.8 and their subsections when used within the recommended operating conditions unless otherwise noted in those sections (provided the absolute maximum ratings have never been exceeded).

Table 3-2 Recommended operating conditions

Parameter		Min	Typ	Max	Units
V_{DDA1}	Supply voltage, analog circuits	2.6	2.7	2.8	V
V_{DDA2}	Supply voltage, analog circuits	2.0	2.1	2.17	V
V_{DDM}	Supply voltage, I/O circuits		2.6		V
T_C	Case operating temperature	-20	+25	+85	°C

Notes:

1. Analog supply pins (V_{DDA}) may be powered down while the digital I/O supply pin (V_{DDM}) is powered up.

3.3 Power supply and digital logic characteristics

This section includes physical characteristics such as I/O capacitance and DC characteristics such as digital I/O levels and power supply currents (Table 3-3). Supply currents are based on RTR6285 IC operation at room temperature (+25 °C) using default parameter settings and nominal supply voltages (V_{DDA} = V_{DDM} = 2.6 V). See the detail setting in Section 3.4.

Table 3-3 Current consumption (TBD)

Table 3-4 DC electrical characteristics

Parameter	Symbol	Condition	Minimum	Maximum	Units
Logic high-level input voltage	V_{IH}		0.65*V_{DDd}	-	V
Logic low-level input voltage	V_{IL}		-	0.35* V_{DDd}	V
Logic high-level output voltage	V_{OH}	V_{DD} = Minimum	V_{DDd} – 0.45	-	V
Logic low-level output voltage	V_{OL}	V_{DD} = Maximum	-	0.45	V
Logic input leakage current	I_L	V_{DD} = Maximum V_{in} = GND to V_{DD}	–100	+100	nA
Input capacitance (digital inputs)	C_{in-d}		-	5	pF
Load capacitance (digital outputs)	C_{l-d}		-	15	pF
Logic low-level output current	I_{OL}			-6	mA
Logic high-level output current	I_{OH}		6		mA

3.4 GSM/EDGE receive specifications

The RTR6285 IC includes four receive signal paths: GSM 850, GSM 900, GSM 1800, and GSM 1900. Specifications for all paths are presented in the following sections.

3.4.1 GSM 850/900 receive signal path

The GSM 850 and GSM 900 receive signal path specifications in this subsection are based on the test input described in the notes following Table 3-5. This test input allows measurements using standard 50-ohm single-ended test equipment even though the RTR6285 IC requires a differential signal at the GSM 850 input (pins 30 and 31). Handset implementations are expected to accomplish this single-ended to differential transformation using a SAW filter; the filter, matching components; and PCB traces must provide adequate amplitude and phase balance (≤ 1 dB and ≤ 5 degrees, respectively).

Table 3-5 GSM 850/900 receive signal path specifications

Parameter	Comments	Min	Typ	Max	Unit	Notes
RF input						
Input frequency range	GSM 850 band, downlink	869		894	MHz	
	GSM 900 band, downlink	925		960	MHz	
Input VSWR	Based on 100-ohm differential source impedance; includes matching network.			2:1	---	
LO generation and distribution – see Section 3.8						
RF-to-baseband signal path (valid for all gain modes unless noted otherwise)						
Gain variation	Over frequency range Over temperature		2.5 0.6		dB dB	
Survivable input level		0			dBm	
Residual sideband level	Due to amplitude and phase imbalance		TBD		dB	
Residual output DC			TBD		mV	
LO to RF leakage	Differential, in RF channel, at LNA input		TBD		dBm	
Gain mode 0						
Gain			72.5		dB	2
Noise figure	Double sideband		2.8		dB	6
P1 dB desense (in band)	In-band signal = -101 dBm		-60		dBm	
P1 dB desense (blocking @ 3 MHz offset)			-25		dBm	3
Input IP_3		-17			dBm	4
Input IP_2	In-band tone power = -101 dBm	40			dBm	5
Gain mode 1						
Gain			57.5		dB	2
Noise figure	Double sideband		3.6		dB	6
P1 dB desense (in band)			-60		dBm	
Gain mode 2						
Gain			40		dB	2
Noise figure	Double sideband		7		dB	6
P1 dB desense (in band)			-43		dBm	

Table 3-5 GSM 850/900 receive signal path specifications (continued)

Parameter	Comments	Min	Typ	Max	Unit	Notes
Gain mode 3						
Gain			27.5		dB	2
Noise figure	Double sideband		30		dB	6
P1 dB desense (in band)			-26.6		dBm	
Gain mode 4						
Gain			10.5		dB	2
Noise figure	Double sideband		35		dB	6
P1 dB desense (in band)			-26.6		dBm	

Notes:

1. The analog baseband output pins from RTR6285 are connected to the MSM ICs. Individual trace and load capacitance should not to exceed 15 pF on the I or Q lines to the MSM. The I and Q load resistance and capacitance should be equal.
2. Gain values account for unit conversion from the total input power (dBm) to the output voltage (dBV_{RMS}) of one component (I or Q).
3. Out-of-band jammer (blocker) input power that reduces the in-band output signal power by 1 dB.
4. Test conditions for third-order input intercept point measurements: CW input jammer level = -49 dBm at 800 kHz offset, CW input jammer level = -49 dBm at 1650 kHz offset.
5. Test conditions for in-band second-order input intercept point measurements: CW input jammer #1 level = -33 dBm at 6000 kHz offset, CW input jammer #2 level = -33 dBm at 6050 kHz offset.
6. Noise figure must be met for 2:1 source VSWR in a 100-ohm system. Noise figure or output noise voltage is integrated from 100 Hz to 100 kHz.
7. Performance specifications are based on measurements taken using a hybrid power splitter to create two 50-ohm outputs that are 180 degrees out-of-phase (Figure 3-1). The result is a 100-ohm differential input to the test board connected by two coaxial cables, with calibrated traces to the RTR6285 input and its matching components. The matching circuit for IC-level testing is different than recommended handset designs. See *RTR6285 Device User Guide* for recommendations. Performance specifications listed in the table include the matching networks but not the hybrid splitter, coaxial cables, or calibrated PCB traces.

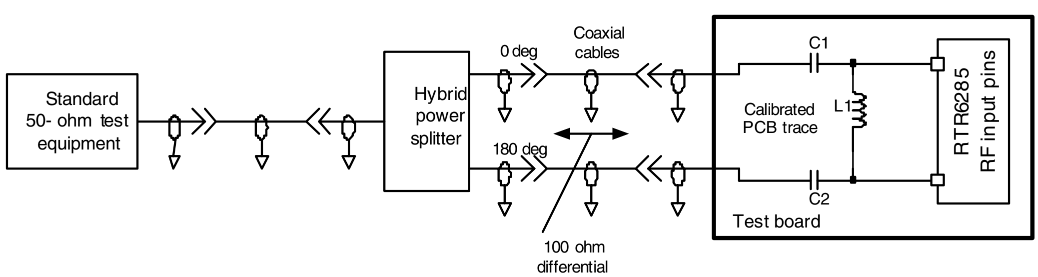


Figure 3-1 RF input test setup

3.4.2 GSM 1800/1900 receive signal path

The GSM1800 receive signal path specifications given in this subsection are based on the test input described in the Table 3-6 notes. This test input allows measurements using standard 50-ohm single-ended test equipment even though the RTR6285 IC requires a differential signal at the GSM 1800 input (pins 36 and 37). Handset implementations are expected to accomplish this single-ended to differential transformation using a SAW filter; the filter, matching components, and PCB traces must provide adequate amplitude and phase balance (≤ 1.5 dB and ≤ 15 degrees, respectively).

Table 3-6 GSM 1800/1900 receive signal path specifications

Parameter	Comments	Min	Typ	Max	Unit	Notes
RF input						
Input frequency range	GSM1800 band, downlink	1805		1880	MHz	
	GSM1900 band, downlink	1930		1990	MHz	
Input VSWR	Based on 100-ohm differential source impedance; includes matching network.			2:1	---	
LO generation and distribution – see Section 3.8						
RF-to-baseband signal path (valid for all gain modes unless noted otherwise)						
Gain variation	Over frequency range Over temperature	-1.25 -0.3		+1.25 +0.3	dB dB	
Survivable input level		0			dBm	
Residual sideband level	Due to amplitude and phase imbalance		TBD		dB	
Residual output DC			TBD		mV	
LO to RF leakage	Differential, in RF channel, at LNA input		TBD		dBm	
Gain mode 0						
Gain			72.5		dB	2
Noise figure	Double sideband		2.8		dB	6
P1 dB desense (in band)			-65		dBm	
P1 dB desense (blocking @ 3 MHz offset)	In-band signal = -99 dBm		-26		dBm	3
Input IP_3		-17			dBm	4
Input IP_2	In-band tone power = -101 dBm	40			dBm	5
Gain mode 1						
Gain			57.5		dB	2
Noise figure	Double sideband		3.6		dB	6
P1 dB desense (in band)			-60		dBm	
Gain mode 2						
Gain			40		dB	2
Noise figure	Double sideband		7		dB	6
P1 dB desense (in band)			-43		dBm	
Gain mode 3						
Gain			27.5		dB	2
Noise figure	Double sideband		30		dB	6
P1 dB desense (in band)			-26		dBm	

Table 3-6 GSM 1800/1900 receive signal path specifications (continued)

Parameter	Comments	Min	Typ	Max	Unit	Notes
Gain mode 4						
Gain			10.5		dB	2
Noise figure	Double sideband		35		dB	6
P1 dB desense (in band)			-26.6		dBm	

Notes:

1. The analog baseband output pins from RTR6285 are connected to the MSM ICs. Individual trace and load capacitance should not to exceed 15 pF on the I or Q lines to the MSM/RFR. The I and Q load resistance and capacitance should be equal.
2. Gain values account for unit conversion from the total input power (dBm) to the output voltage (dBV_{RMS}) of one component (I or Q).
3. Out-of-band jammer (blocker) input power that reduces the in-band output signal power by 1 dB.
4. Test conditions for third-order input intercept point measurements: CW input jammer level = -49 dBm at 800 kHz offset, CW input jammer level = -49 dBm at 1650 kHz offset.
5. Test conditions for in-band second-order input intercept point measurements: CW input jammer #1 level = -33 dBm at 6000 kHz offset, CW input jammer #2 level = -33 dBm at 6050 kHz offset.
6. Noise figure must be met for 2:1 source VSWR in a 100-ohm system. Noise figure or output noise voltage is integrated from 100 Hz to 100 kHz.
7. Performance specifications are based on measurements taken using a hybrid power splitter to create two 50-ohm outputs that are 180 degrees out-of-phase (Figure 3-1). The result is a 100-ohm differential input to the test board connected by two coaxial cables, with calibrated traces to the RTR6285 input and its matching components. The matching circuit for IC-level testing is different than recommended handset designs. See *RTR6285 Device User Guide* for recommendations. Performance specifications listed in the table include the matching networks but not the hybrid splitter, coaxial cables, or calibrated PCB traces.

3.5 GSM/EDGE transmit signal path specifications

The RTR6285 IC includes significant circuits for supporting GSM/EDGE polar transmit signal paths, which include low-band path for GSM 850 and GSM 900, and high-band path for GSM 1800 and GSM 1900. The baseband I/Q signals from MSM are directly upconverted to RF frequency using ZIF architecture. Specifications for each set of transmitter circuits are given in the following sections.

3.5.1 GSM 850/900 transmit signal paths

Table 3-7 GSM 850/900 (low-band) signal path specifications

Specification	Comments	Min	Nom	Max	Units	Notes
Operating frequency	GSM 800 band	824		849	MHz	
	GSM 900 band	880		915	MHz	
Output power			13		dBm	1
Output power variation	Over temperature	TBD		TBD	dB	
Sideband suppression	67.7 kHz CW I & Q (quadrature) sine wave input		-35		dBc	1

Table 3-7 GSM 850/900 (low-band) signal path specifications (continued)

Specification	Comments	Min	Nom	Max	Units	Notes
Carrier suppression	67.7 kHz CW I & Q (quadrature) sine wave input		-35		dBc	1
Output spectrum 200 kHz (30 kHz RBW) 250 kHz (30 kHz RBW) 400 kHz (30 kHz RBW) 1.8 MHz (100 kHz RBW) 3 MHz (100 kHz RBW) 6 MHz (100 kHz RBW)	PN 9 GMSK modulation			 -33 -36 -63 -68 -70 -76	 dBc dBc dBc dBc dBc dBc	1
Output noise 10 MHz offset 20 MHz offset	Include the LO phase noise and fractional spurs		 -152 -163		 dBc/Hz dBc/Hz	1
Spurs at output in RX band Spurs greater than -112dBc	LB, output spurs no more than 5 cases			-90	dBc	
RMS phase error accuracy	With RSB and DC cal		2		Degree	1
Output VSWR	824 to 849 MHz and 890 to 915 MHz			2:1		

Notes:

1. Measured low-band RF outputs.
2. For output spectrum measurement, these requirements are in dBc relative to a measurement in 30 kHz on the carrier using the specified resolution bandwidth.

3.5.2 GSM 1800/1900 transmit signal paths

Table 3-8 GSM 1800/1900 (high-band) signal path specifications

Specification	Comments	Min	Nom	Max	Units	Note
Operating frequency	GSM1800	1705		1785	MHz	
	GSM1900	1850		1910	MHz	
Output power			11		dBm	1
Output power variation	Over temperature	TBD		TBD	dB	
Sideband suppression	67.7 kHz CW I & Q (quadrature) sine wave input		TBD		dBc	1
Carrier suppression	67.7 kHz CW I & Q (quadrature) sine wave input		TBD		dBc	1
Output spectrum 200 kHz (30 kHz RBW) 250 kHz (30 kHz RBW) 400 kHz (30 kHz RBW) 1.8 MHz (100 kHz RBW) 3 MHz (100 kHz RBW) 6 MHz (100 kHz RBW)	PN 9 GMSK modulation			 -33 -36 -63 -68 -70 -76	 dBc dBc dBc dBc dBc dBc	1

Table 3-8 GSM 1800/1900 (high-band) signal path specifications (continued)

Specification	Comments	Min	Nom	Max	Units	Note
Output noise 10 MHz offset 20 MHz offset	Include the LO phase noise and fractional spurs		 -151 -157		 dBc/Hz dBc/Hz	1
Spurs at output in RX band Spurs greater than -112 dBc	HB, output spurs no more than 5 cases		-90		dBc	
RMS phase error accuracy	With RSB and DC cal		3		Degree	1
Output VSWR	1705 to 1880 MHz, 1850 to 1910 MHz			2:1		

Notes:

1. Measured high-band RF outputs.
2. For output spectrum measurement, these requirements are in dBc relative to a measurement in 30 kHz on the carrier using the specified resolution bandwidth.

3.6 WCDMA primary receive signal path specifications

3.6.1 WCDMA balanced high-band primary receive specifications

Table 3-9 WCDMA balanced high-band primary receive specifications

Specification	Comments	Min	Typ	Max	Units
RF input frequency range	UMTS IMT band	2110		2170	MHz
RF input impedance	Differential		100		Ohms
Input return loss	All gain states	10			dB
Gain mode 0	G0				
Voltage conversion gain			58		dB
Noise figure	Small signal		3.0		dB
Input IP3	Jammers 1 and 2 at -44 dBm		-7		dBm
Input IP2			TBD		dBm
Gain mode 1	G1				
Voltage conversion gain			46		dB
Noise figure			TBD		dB
Input IP3	Jammers 1 and 2 at -28 dBm		-7		dBm
Input IP2			40		dBm
Gain mode 2	G2				
Power gain			34		dB
Noise figure			TBD		dB
Input IP3	Use jammers 5 and 6		-21.5		dBm

Table 3-9 WCDMA balanced high-band primary receive specifications (continued)

Specification	Comments	Min	Typ	Max	Units
Gain mode 3	G3				
Voltage conversion gain			22		dB
Noise figure	DSB		TBD		dB
Input IP3	Use jammers 5 and 6		-9.5		dBm
Gain mode 4	G4				
Voltage conversion gain			10		dB
Noise figure	DSB		TBD		dB
Input IP3	Use jammers 5 and 6		-4.5		dBm

3.6.2 WCDMA balanced low-band primary receive specifications

Table 3-10 WCDMA balanced low-band primary receive specifications

Specification	Comments	Min	Typ	Max	Units
RF input frequency range	UMTS Cell band	869		894	MHz
	UMTS 900 band	925		960	MHz
RF input impedance	Differential		100		Ohms
Input return loss	All gain states	10			dB
Gain mode 0	G0				
Voltage conversion gain			58		dB
Noise figure	Small signal		3.0		dB
Input IP3	Jammers 1 and 2 at -44 dBm		-7		dBm
Input IP2			TBD		dBm
Gain mode 1	G1				
Voltage conversion gain			46		dB
Noise figure			TBD		dB
Input IP3	Jammers 1 and 2 at -28 dBm		-7		dBm
Input IP2			40		dBm
Gain mode 2	G2				
Power gain			34		dB
Noise figure			TBD		dB
Input IP3	Use jammers 5 and 6		-21.5		dBm
Gain mode 3	G3				
Voltage conversion gain			22		dB
Noise figure	DSB		TBD		dB
Input IP3	Use jammers 5 and 6		-9.5		dBm

Table 3-10 WCDMA balanced low-band primary receive specifications (continued)

Specification	Comments	Min	Typ	Max	Units
Gain mode 4	G4				
Voltage conversion gain			10		dB
Noise figure	DSB		TBD		dB
Input IP3	Use jammers 5 and 6		-4.5		dBm

3.6.3 WCDMA unbalanced primary receive specifications (high bands only)

Table 3-11 WCDMA unbalanced primary RX specification (high bands only)

Specification	Comments	Min	Typ	Max	Units
RF input frequency range	UMTS AWS band	2110		2155	MHz
	UMTS 1900 band	1930		1990	MHz
	UMTS 1800 band	1805		1880	MHz
	UMTS 1700 band	1845		1880	MHz
LNA gain mode 0	G0				
Input return loss	50 ohms w/external match	10			dB
Output return loss	50 ohms w/external match	10			dB
Power gain			16		dB
Noise figure	Small signal		1.6		dB
Input IP3	Jammers 1 and 2 at -30 dBm		-5		dBm
Reverse isolation			19		
LNA gain mode 1	G1				
Input return loss	50 ohms w/external match		8		dB
Output return loss	50 ohms w/external match		8		dB
Power gain			-6		dB
Noise figure			6		dB
Input IP3	Jammers 1 and 2 at -20 dBm		0		dBm
Reverse isolation			2		
LNA gain mode 2	G2				
Input return loss	50 ohms w/external match		22		dB
Output return loss	50 ohms w/external match		20		dB
Power gain			-20		dB
Noise figure			20		dB
Input IP3	Jammers 1 and 2 at -12 dBm		13		dBm
Reverse isolation			19		

Table 3-11 WCDMA unbalanced primary RX specification (high bands only) (continued)

Specification	Comments	Min	Typ	Max	Units
Mixer high-gain mode					
Input VSWR	100-ohm differential, external match			2:1	
Voltage conversion gain			42		dB
Noise figure	Double side band		11		dB
Input IP3	AWS band: jammers 1 and 2 at -30 dBm; in-band tone at -86 dBm		-2		dBm
	PCS, DCS and 1700 band: jammers 1 and 2 at -30 dBm, in-band tone at -81 dBm		0		dBm
Input IP2	Jammers 3 and 4 at -28 dBm; in-band tone at -86 dBm		45		dBm
Mixer low-gain mode					
Input VSWR	100-ohm differential, external match			2:1	
Voltage conversion gain			26		dB
Noise figure	Double side band		27		dB
Input IP3	Jammers 1 and 2 at -32 dBm; in-band tone at -60 dBm		-5		dBm
Input IP2	Jammers 3 and 4 at -32 dBm; in-band tone at -60 dBm		30		dBm

Notes: The test frequencies are listed below:

Band	In-band RF	1	2	3	4	5	6
Cell low	871.5	867.9	865.5	861.4	861.2	871	870.8
Cell high	891.5	895.1	897.5	901.6	901.8	892	892.2
EGSM low	927.5	923.9	921.5	917.4	917.2	927	926.8
EGSM high	957.5	961.1	963.5	967.6	967.8	958	958.2
DCS low	1807.5	1803.9	1801.5	1817.4	1817.6	1807	1806.8
DCS high	1877.5	1881.1	1883.5	1867.6	1867.4	1878	1878.2
PCS low	1932.5	1928.9	1926.5	1942.4	1942.6	1932	1931.8
PCS high	1987.5	1991.1	1993.5	1977.6	1977.4	1988	1988.2
IMT low	2112.5	2108.9	2106.5	2122.4	2122.6	2112	2111.8
IMT high	2167.5	2171.1	2173.5	2157.6	2157.4	2168	2168.2

3.7 WCDMA transmit signal path specifications

The RTR6285 WCDMA transmit paths share the same transmit paths as GSM and support multi-transmit modes: UMTS 2100, UMTS 1900, and UMTS 1800 on high-band transmit drivers, and UMTS 800 and UMTS 850 on low-band transmit drivers.

3.7.1 UMTS high-band transmit signal path

Table 3-12 UMTS high-band Tx specifications

Parameter	Comments	Min	Typ	Max	Unit	Notes
RF output						
Output frequency range	UMTS 2100 band UMTS 1900 UMTS 1800 UMTS 1700 UMTS AWS	1920 1850 1710 1749.9 1710		1980 1910 1785 1784.9 1785	MHz MHz MHz MHz	
Maximum output power (average channel power)	UMTS 2100 band UMTS 1900 UMTS 1800/1700/AWS		8 9 9		dBm dBm dBm	7
Minimum output power			-80		dBm	
Output VSWR	50 ohms nominal, external series capacitor required		2:1		---	
Output amplitude variation @ gain control of 50%	Part – part Vdd Temperature		±4.5 ±0.5 ±3		dB dB dB	
Baseband-to-RF signal path						
Gain flatness	Over output frequency range at 90% of gain control		±1		dB	
Adjacent channel leakage rejection (ACLR1) @ rated power	f_C ± 5.0 MHz		-43		dBc/ 3.84 MHz	1, 2, 6
Alternate channel leakage rejection (ACLR2) @ rated power	f_C ± 10.0 MHz		-60		dBc/ 3.84 MHz	1, 2, 6
Rx band noise power @ rated output power and duplexer offset	UMTS 2100 Rx UMTS 1900 Rx UMTS 1800 Rx UMTS 1700/AWS		-131 -131 -137 -129		dBm/Hz	3
Composite suppression (carrier and image)	Within Tx band @ rated output power		-34		dBc	4
Composite suppression (carrier and image)	Within Tx band @ -45 dBm output power		-31		dBc	4
Carrier suppression	1920 MHz to 1980 MHz		-30		dBc	5

Notes:

1. Measured at rated output power using specification compliant waveforms as per Annex A, Section A.2.1, Table A.1 of 3GPP Technical Specification – UE Radio Transmission and Reception (FDD), 3GPP/ TS25.101. Ratio of power in 3.84 MHz bandwidth at specified offset to in-band power.
2. Stated specification or -85 dBm, whichever is higher; measured with a filter that has a root-raised cosine (RRC) filter response, roll-off = 0.22 and a bandwidth equal to the 3.84 MHz chip rate.
3. The receive band specification is at rated average output power.
4. A composite specification combing the carrier and baseband image is provided as a limit specification, maximum Po and -30 dBm Po. This composite specification shall be met if the

suppression of carrier frequency and suppression baseband image performance fail their individual specifications herein.

5. Suppression of carrier frequency fout = RF LO is measured at maximum Po and -30 dBm Po.
6. Evaluated with worst cases of HSDPA waveform.
7. UTRA/FDD UL Reference Measurement Channel (12.2 kbps) (12.2/60/15 kbps - info bit rate/DPDCH/DPCCH) (DPCCH/DPDCH <= 12/15), (HS-DPCCH/DPCCH = 19/15), with a root-raised cosine (RRC) filter response, roll-off alpha=0.22 and bandwidth equal to the chip rate.

3.7.2 UMTS low-band transmit signal path

Table 3-13 UMTS low-band Tx specifications

Parameter	Comments	Min	Typ	Max	Unit	Notes
RF output						
Output frequency range	UMTS 800 band UMTS 850 band UMTS 900 band	824 830 925		849 840 960	MHz MHz MHz	
Maximum output power (average channel power)			9		dBm	7
Minimum output power			-80		dBm	
Output VSWR	50 ohms nominal, external series capacitor required		2:1		---	
Output amplitude variation @ gain control range =50%	Part – part Vdd Temperature		±4.5 ±0.5 ±3		dB dB dB	
Baseband-to-RF signal path						
Gain flatness	Over output frequency range at 90% gain control range		±1		dB	
Gain temperature coefficient			±0.1		dB/deg C	
Adjacent channel leakage rejection (ACLR1)	f_C ± 5.0 MHz		-43		dBc/ 3.84 MHz	1, 2, 6
Alternate channel leakage rejection (ACLR2)	f_C ± 10.0 MHz		-53		dBc/ 3.84 MHz	1, 2, 6
Rx band noise power	UMTS 800 Rx: 869 to 894 MHz UMTS 850 Rx: 875 to 885 MHz UMTS 900 Rx 925 to 960 MHz @ rated output power		-135 -135 -140		dBm/Hz	3
Composite suppression (carrier and image)	Within Tx band @ rated output power		-34		dBc	4
Composite suppression (carrier and image)	Within Tx band @ -45 dBm output power		-31		dBc	4
Carrier suppression	824 to 849 MHz 830 to 840 MHz		-30		dBc	5

Note: See the table notes following Table 3-12 in Section 3.7.1

3.7.3 RMS power detector

Table 3-14 RMS power detector specifications

Specification	Comments	Min	Nom	Max	Units	Note
Input frequency range	UMTS 800 UMTS 850 UMTS 1800 UMTS 1900 UMTS 2100 UMTS 900	824 830 1710 1850 1920 880		849 840 1785 1910 1980 915	MHz MHz MHz MHz MHz MHz	
Input RF power	50-ohm input impedance	-20	0	2	dBm	1
Output accuracy	Input RF power from -4 to 0 dBm		0.25		dB	
	Other RF powers		0.5		db	

Note:

1. The output of the power amplifier is coupled to the power detector with a coupling ratio of 26 dB.

3.8 WCDMA secondary receive signal path specifications

3.8.1 WCDMA high-band secondary receive signal path specifications

Table 3-15 WCDMA high-band DRX performance specifications

Parameter	Comments	Min	Typ	Max	Unit	Notes
RF input						
Input frequency range UMTS 2100 UMTS 1900 UMTS1800 UMTS1700 UMTS AWS		 2110 1930 1805 1749.9 1710		 2170 1990 1880 1784.9 1755	 MHz MHz MHz MHz MHz	
Input VSWR (in-band)	50-ohm external match			2:1	–	
RF-to-baseband signal path						
Noise figure Highest gain mode (G0) Mid-high gain mode (G1) Mid gain mode (G2) Mid-low gain mode (G3) Lowest gain mode (G4)	Double sideband		 4 13 27 40 52		 dB dB dB dB dB	1

Table 3-15 WCDMA high-band DRX performance specifications (continued)

Parameter	Comments	Min	Typ	Max	Unit	Notes
Output load capacitance	I and Q, each differential			8	pF	2

Notes:

1. NF = CNR_{in}/CNR_{out}. Double-sideband noise integrated from 1 kHz to 1.92 MHz (I).
2. Differential capacitance not to exceed 8 pF on I or Q lines to MSM. I and Q load capacitance should be equal.

3.8.2 WCDMA low-band DRX performance specifications

Table 3-16 WCDMA low-band DRX performance specifications

Parameter	Comments	Min	Typ	Max	Unit	Notes
RF input						
Input frequency range UMTS 800 UMTS 900		 869 925		 894 960	 MHz MHz	
Input VSWR (in-band)	50-ohm external match			2:1	–	
RF-to-baseband signal path						
Noise figure Highest gain mode (G0) Mid-high gain mode (G1) Mid gain mode (G2) Mid-low gain mode (G3) Lowest gain mode (G4)	Double sideband		 4 13 27 40 52		 dB dB dB dB dB	1
Output load capacitance	I and Q, each differential			8	pF	2

Notes:

1. NF = CNR_{in}/CNR_{out}. Double-sideband noise integrated from 1 kHz to 1.92 MHz (I).
2. Differential capacitance not to exceed 8 pF on I or Q lines to MSM. I and Q load capacitance should be equal.

3.9 GPS path specifications

3.9.1 GPS signal path specifications

Table 3-17 GPS signal path specifications

Parameter	Comments	Min	Nom	Max	Unit
Input frequency	L1 = 1575.42MHz	1575.32		1575.52	MHz
Input impedance	Single-ended		50		Ohms
Input return loss		10			dB
Voltage conversion gain			85		dB
Noise figure			TBD		dB

Table 3-17 GPS signal path specifications (continued)

Parameter	Comments	Min	Nom	Max	Unit
Max output load capacitance	Differential	8			pF
Input IP3	Jammer 1: -65 dBm @ L1+47.4 MHz Jammer 2: -45 dBm @ L1+94.6 MHz Signal: -100 dBm @ L1+0.15 MHz		TBD		dBm
Input IP2			TBD		dBm

3.10 Transceiver LO generation specifications

The RTR6285 IC includes three integrated PLL circuits:

- PLL1 supports the transceiver LO generation functions used for all GSM/EDGE (GSM 850, GSM 900, GSM 1800, and GSM 1900), transmitter for UMTS (UMTS 800, UMTS 850, UMTS 900, UMTS 1700, UMTS 1800, UMTS 1900, and UMTS 2100).
- PLL2 supports only UMTS primary and secondary Rx operation (UMTS 1700, UMTS 1800, UMTS 1900, and UMTS 2100).
- PLL3 supports the GPS receive chain.

Table 3-18 RTR6285 PLLs reference input specification

Specification	Comments	Min	Typ	Max	Unit
Nominal input frequency	From VCTCXO		19.2		MHz
Input impedance	2 pF parallel capacitance, typical		50		kohms
Input amplitude	AC coupled	0.8		1.0	Vpp

Table 3-19 GSM/EDGE Rx LO performance specifications

Specification	Comments	Min	Typ	Max	Units
GSM 900 (EGSM) RX	All integer multiples of 200 kHz	915		960	MHz
GSM 850 (GCELL) RX	All integer multiples of 200 kHz	869		894	MHz
GSM 1800 (DCS) RX	All integer multiples of 200 kHz	1805		1880	MHz
GSM 1900 (GPCS) RX	All integer multiples of 200 kHz	1930		1990	dBc
PLL setting time	Within ±0.1 ppm, includes coarse tuning. Measured from end of SBI to final frequency.			160	μs

Table 3-19 GSM/EDGE Rx LO performance specifications (continued)

Specification	Comments	Min	Typ	Max	Units
Phase noise (850/900)	Offset				
	400 kHz		-123		dBc/Hz
	600 kHz		-126		dBc/Hz
	800 kHz		-129		dBc/Hz
	1.6 MHz		-136		dBc/Hz
	3 MHz		-144		dBc/Hz
	6 MHz		-151		dBc/Hz
	10 MHz		-152		dBc/Hz
	≥ 20 MHz		-153		dBc/Hz
Phase noise (1800/1900)	Offset				
	400 kHz		-119		dBc/Hz
	600 kHz		-124		dBc/Hz
	800 kHz		-127		dBc/Hz
	1.6 MHz		-132		dBc/Hz
	3 MHz		-140		dBc/Hz
	6 MHz		-146		dBc/Hz
	10 MHz		-148		dBc/Hz
	≥ 20 MHz		-150		dBc/Hz

Table 3-20 GSM/EDGE Tx LO performance specifications

Specification	Notes	Min	Typ	Max	Units
GSM 900 (EGSM) Tx	All integer multiples of 200 kHz	880		915	MHz
GSM 800 (GCELL) Tx	All integer multiples of 200 kHz	824		849	MHz
GSM 1800 (DCS) Tx	All integer multiples of 200 kHz	1705		1785	MHz
GSM 1900 (GPCS) Tx	All integer multiples of 200 kHz	1850		1910	dBc
PLL setting time	Within ±0.1 ppm, includes coarse tuning. Measured from end of SSBI to final frequency.			180	μs
Phase noise @ GSM 800/900	Offset				
	400 kHz		-122		dBc/Hz
	1.8 MHz		-136		dBc/Hz
	3 MHz		-139		dBc/Hz
	6 MHz		-146		dBc/Hz
	10 MHz		-158		dBc/Hz
	≥ 20 MHz		-166		dBc/Hz

Table 3-20 GSM/EDGE Tx LO performance specifications (continued)

Specification	Notes	Min	Typ	Max	Units
Phase noise @ GSM 1800/1900	Offset				
	400 kHz		-120		dBc/Hz
	1.8 MHz		-136		dBc/Hz
	3 MHz		-139		dBc/Hz
	6 MHz		-146		dBc/Hz
	10 MHz		-150		dBc/Hz
	≥ 20 MHz		-158		dBc/Hz

Table 3-21 Table 3-21 WCDMA Rx LO performance specifications

Specification	Comments	Min	Nom	Max	Units
Cell band LO frequencies	All integer multiples of 100 kHz	871.4		891.6	MHz
UMTS 900 band LO frequencies	All integer multiples of 200 kHz	927.4		957.6	MHz
IMT band LO frequencies	All integer multiples of 200 kHz	2112.4		2167.6	MHz
AWS band LO frequencies	All integer multiples of 100 kHz	2112.4		2167.6	MHz
PCS band LO frequencies	All integer multiples of 100 kHz	1932.4		1987.6	MHz
UMTS 1800 band LO frequencies	All integer multiples of 200 kHz	1807.4		1877.6	MHz
Integrated phase noise (DSB)	Integrated from 1 kHz to 1.92 MHz		30		dBc
Phase noise[1,2] (SSB)	> 3.5 MHz offset, all bands and paths		-130		dBc/Hz
	> 5 MHz offset, all bands and paths		-135		dBc/Hz
Lock time	Time to settle to 0.1 ppm frequency error. Measured from end of SBI write.		280		µs

Table 3-22 WCDMA Tx LO performance specifications

Parameter	Notes	Min	Nom	Max	Units
Frequency	UMTS 800	824		849	MHz
	UMTS 850	830		840	MHz
	UMTS 900	880		915	MHz
	UMTS 1800	1710		1785	MHz
	UMTS 1900	1850		1910	MHz
	UMTS 2100	1920		1980	MHz
Phase noise	Offset				
	10 MHz		-140		dBc/Hz
	20 MHz		-146		dBc/Hz

4 Mechanical Specifications

4.1 IC package physical dimensions

The 68 mQFN package has an 8 mm x 8 mm body size, with a height of 0.9 mm, and 0.4 mm pitch. The large center slug must be soldered to PCB ground for electrical ground, mechanical support, and thermal relief. For a complete detailed mechanical drawing, refer to the QUALCOMM *QFN Package User Guide* (80-V5243-1).

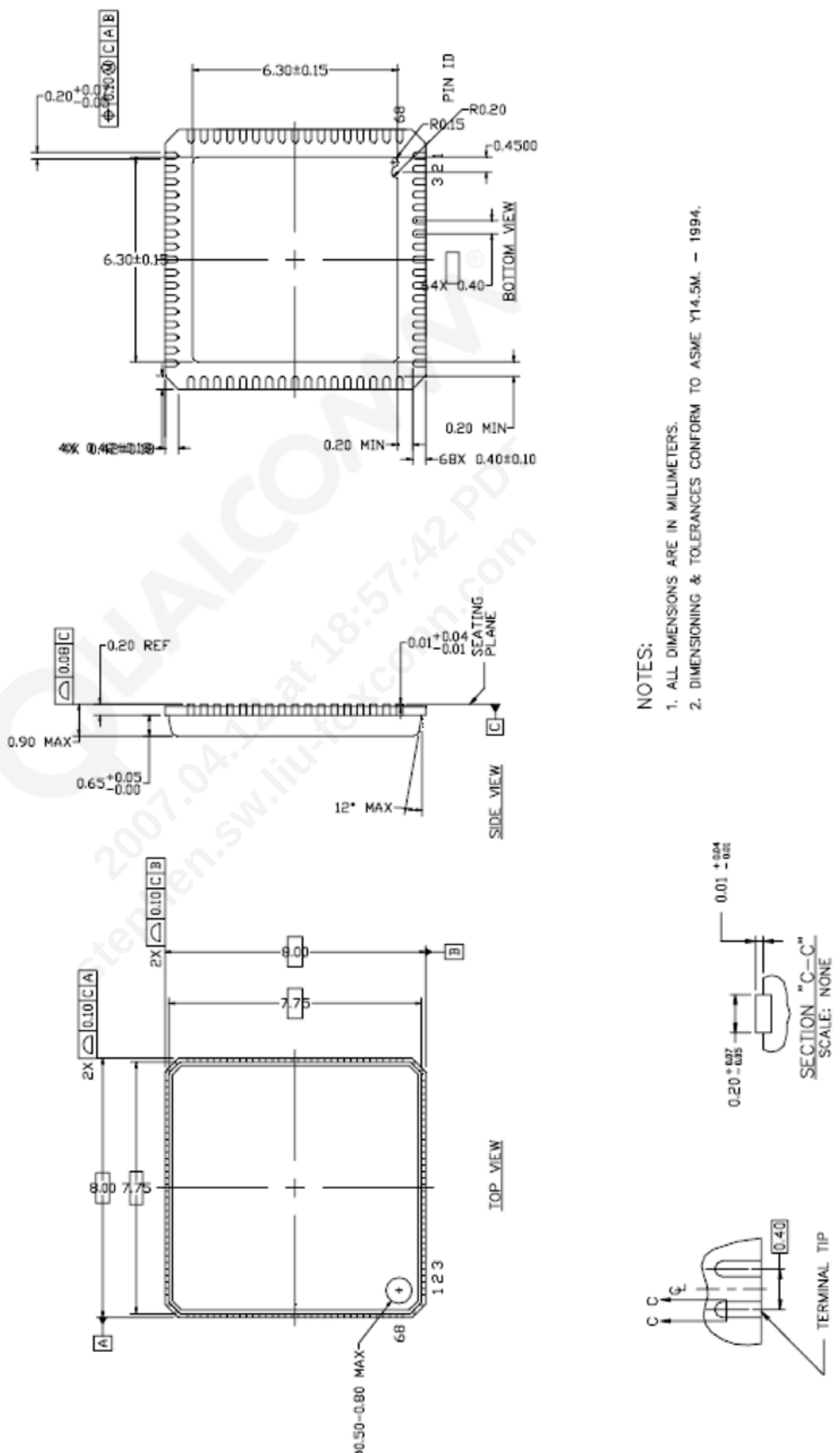


Figure 4-1 68 mQFN package outline drawing

4.2 Moisture sensitivity level

Plastic-encapsulated surface mount packages are sensitive to damage induced by absorbed moisture and temperature. QCT follows the latest revision of IPC/JEDEC J-STD-020. Each package type is classified for moisture sensitivity by starting with a known dry part and soaking it at various temperatures, relative humidity, and durations. After soaking, the packages are subjected to three reflows at one of the peak temperature conditions.

The RTR6285 device is rated for a moisture sensitivity level of 3 (MSL 3). Standard component classification for the 68 mQFN is 230 °C maximum body temperature. High-temperature classification (lead-free solder) is 250 °C maximum body temperature. All body temperatures are measured on the top surface of the IC.

4.3 IC device marking

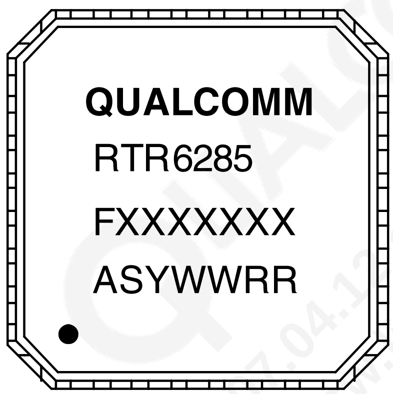


Figure 4-2 RTR6285 device marking (top view – not to scale)

Table 4-1 Device marking line descriptions

Line	Marking	Description
1	QUALCOMM	QUALCOMM name or logo
2	RTR6285	QUALCOMM product name
3	FXXXXXXX	F = Wafer fab code XXXXXXX = last seven characters of assembly lot number
4	ASYWWRR	A = Assembly site code S = Assembly sub lot number Y = Single digit year WW = Week code RR = Device version code

5 Packing Methods and Materials

This chapter defines packing methods and materials for shipping RTR6285 ICs in a tape and reel carrier.

5.1 Tape/reel information

The single-feed tape carrier for this device is illustrated in Figure 5-1. The tape width is 16 mm and the pitch of the parts placed on the tape is 12 mm. The reels are 13 inches in diameter with 7-inch hubs. Each reel contains 2000 devices.

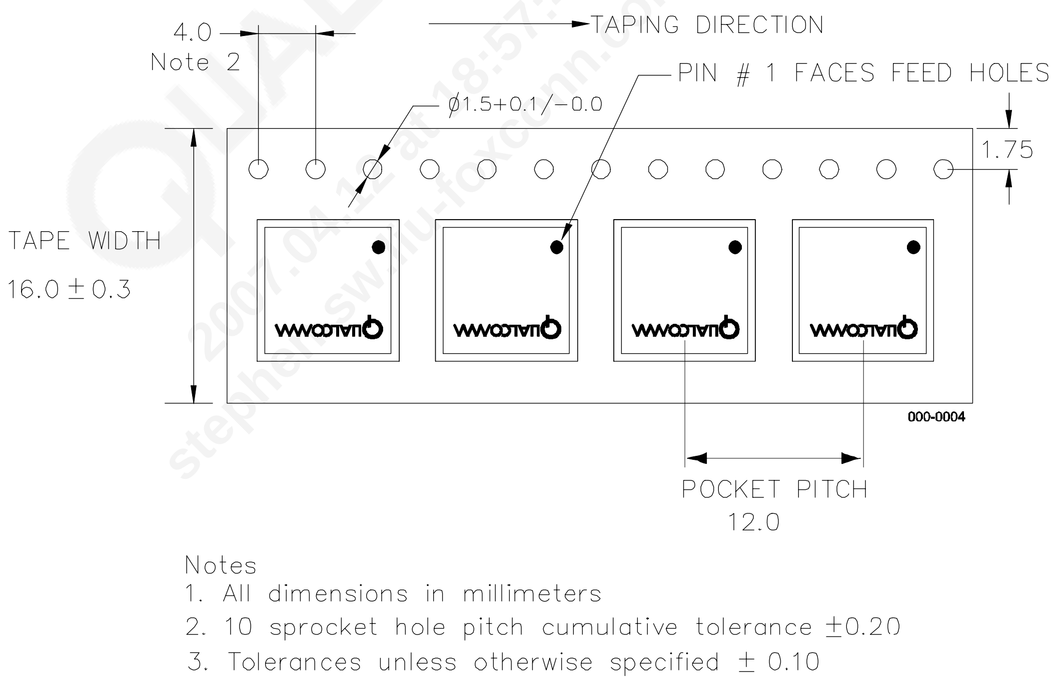


Figure 5-1 Tape dimensions for 68 mQFN

5.2 Shipment packing

Units shipped in the tape and reel carrier conform to the EIA-481 industry standard and are handled and packed as indicated in Figure 5-2 through Figure 5-5.

Since the RTR6285 IC is a moisture-sensitive device for a reflow temperature of 250 °C (+0 °C/-5 °C), packing materials must include a moisture barrier bag, desiccant, and humidity indicator card. These items are discussed in Section 5.3 and its subsections.

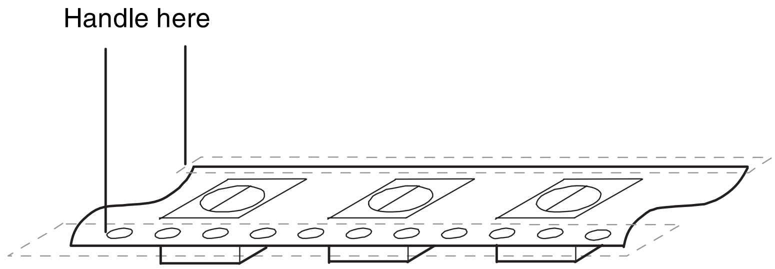


Figure 5-2 Tape handling

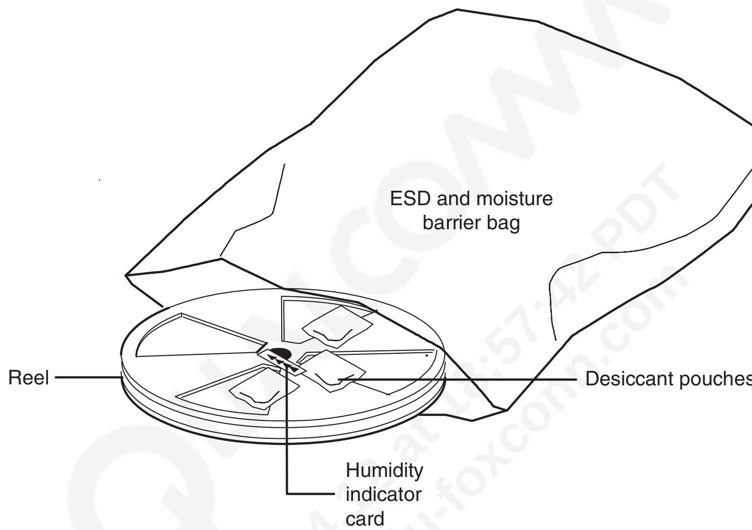


Figure 5-3 Bag packing for tape and reel

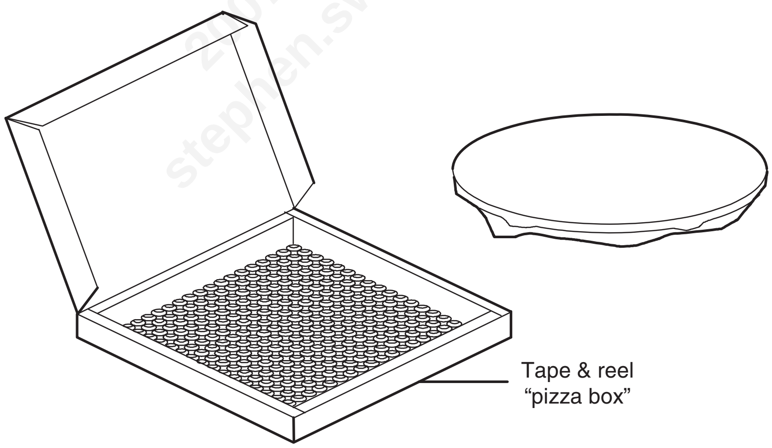


Figure 5-4 Box packing for tape and reel

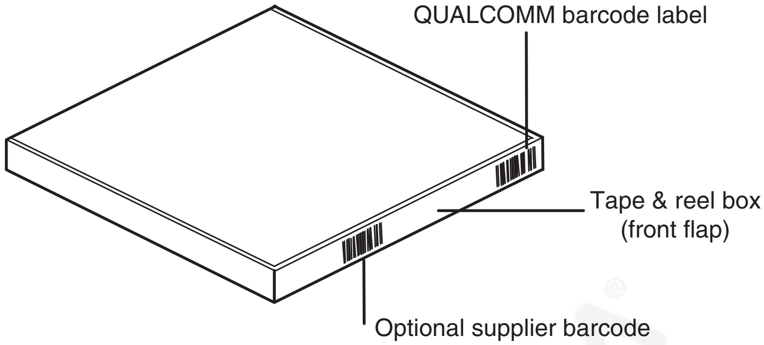


Figure 5-5 Tape and reel box

5.3 Packing materials

Moisture-sensitive surface mount technology (SMT) components packed on tape and reel are shipped in desiccant packing. Each shipment contains units that have been baked dry and are enclosed in sealed moisture barrier bags (MBBs) with desiccant pouches and humidity indicator cards (HIC). The RTR6285 IC is considered a moisture-sensitive product, and must use these packing materials.

5.3.1 Shipping box

The barcode label on the shipping box provides the necessary information for incoming inspection or inventory control (see Figure 5-6 for an example). The minimum information to be included is:

- QUALCOMM trading company ID
- QUALCOMM item ID
- Supplier lot code
- Short description (family and series)
- Supplier date code
- Quantity
- Country of origin

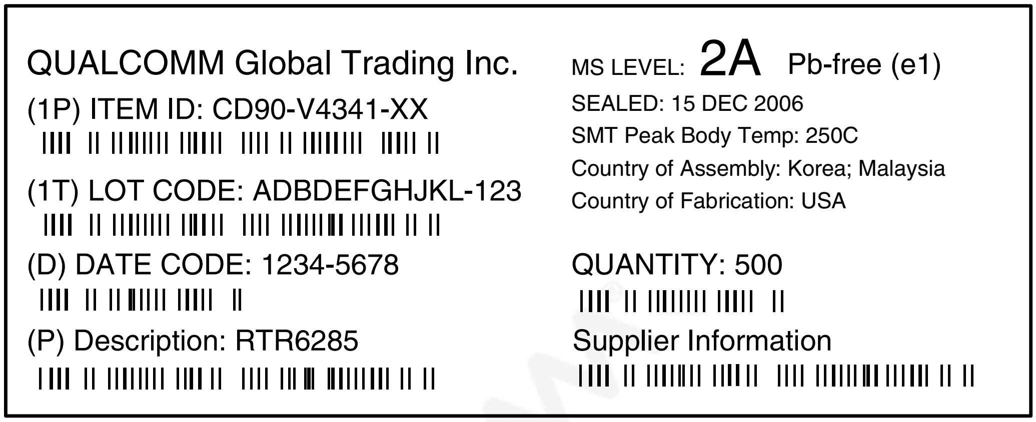


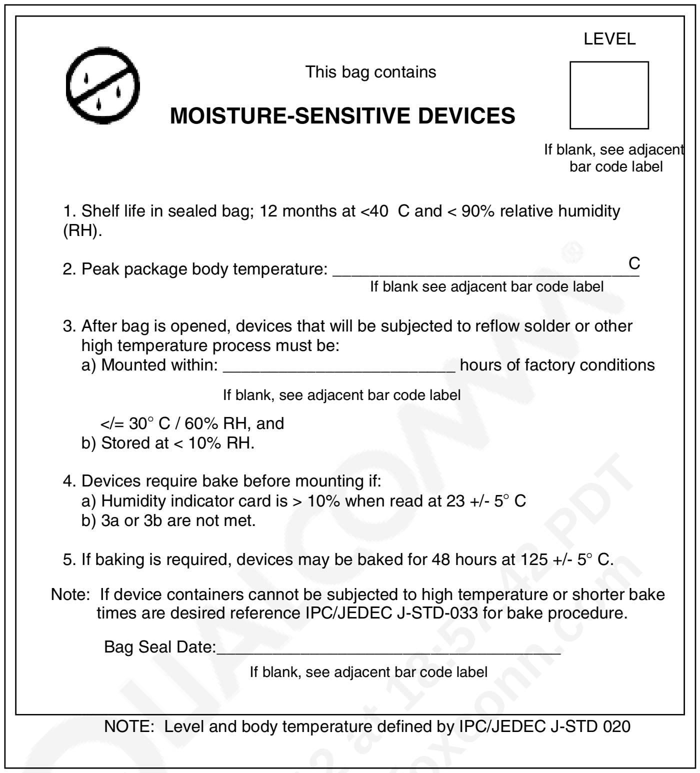
Figure 5-6 Example barcode label

5.3.2 Moisture barrier bag

Inside the shipping box is a moisture barrier bag containing components. The bag is strong, ESD-safe, and allows **minimal** moisture transmission. It is sealed at the factory and should be handled carefully to avoid puncturing or tearing of the materials. A moisture sensitivity caution label (see Figure 5-7) on the bag outlines precautions that must be taken with desiccant packed units. This label indicates the seal date of the enclosed MBB and the remaining shelf life. This bag protects the enclosed devices from moisture exposure and should not be opened until the devices are ready to be board mounted. The MBB is required for moisture-sensitive devices.

5.3.3 Labels

Labels relevant to this process include the barcode label described and illustrated in Figure 5-6. The moisture sensitivity caution label (see Figure 5-7) outlines precautions that must be taken when handling desiccant-packed units if they are to be kept dry. The moisture sensitivity caution label also contains the date that the bag was sealed (MM/DD/YY), the IPC/JEDEC J-STD-020 moisture sensitivity level, and the maximum floor life. The remaining storage life of the units in the bag is determined from the seal date. All components are guaranteed to have 12 months of shelf life starting from the seal date on this label. The moisture sensitivity caution labels are required for moisture sensitive devices.


LEVEL

This bag contains

MOISTURE-SENSITIVE DEVICES

If blank, see adjacent bar code label

1. Shelf life in sealed bag; 12 months at <40 C and < 90% relative humidity (RH).

2. Peak package body temperature: ______________________________ C
If blank see adjacent bar code label

3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be:
a) Mounted within: ______________________ hours of factory conditions
If blank, see adjacent bar code label
</= 30° C / 60% RH, and
b) Stored at < 10% RH.

4. Devices require bake before mounting if:
a) Humidity indicator card is > 10% when read at 23 +/- 5° C
b) 3a or 3b are not met.

5. If baking is required, devices may be baked for 48 hours at 125 +/- 5° C.

Note: If device containers cannot be subjected to high temperature or shorter bake times are desired reference IPC/JEDEC J-STD-033 for bake procedure.

Bag Seal Date:_________________________________
If blank, see adjacent bar code label

NOTE: Level and body temperature defined by IPC/JEDEC J-STD 020

Figure 5-7 Moisture sensitivity caution label

5.3.4 Desiccant

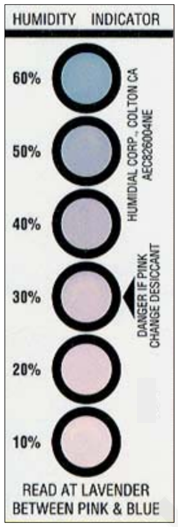
Each MBB contains one or more pouches of desiccant to absorb moisture that may be present in the bag. The humidity indicator card (see Figure 5-8) should be used as the primary method to determine whether the enclosed parts have absorbed excessive moisture. Do not bake or reuse the desiccant once it is removed from the MBB. Desiccant is required for moisture sensitive devices.

5.3.5 Humidity indicator cards

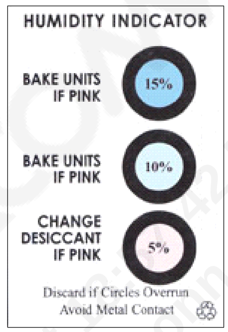
Along with the desiccant pouches, the MBB contains a humidity indicator card (HIC). This card is a moisture indicator and is included to show the user the approximate relative humidity level within the bag. Representations of the HIC are shown in Figure 5-8. The HIC indicates if there is excessive moisture in the bag. If the moisture level is excessive the units must be rebaked. The HIC is reversible and can be reused. The HIC is required for moisture sensitive devices.

A three-button 5-10-60 HIC (right side of Figure 5-8) is used to replace the three-button 5-10-15 HIC (middle of Figure 5-8) in the packaging to comply with new specification per J-STD-033B. New 60% RH button on the HIC allows for identification of RH limit on MSL 2 product packaging. If the 60% button is *not blue* for level 2 parts or the 5% button is *pink* and the 10% button is *not blue* for level 2A-5A parts on a three-button 5-10-60

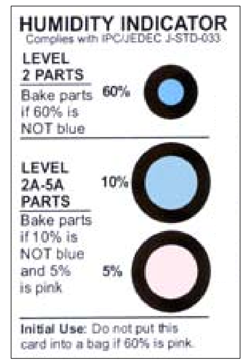
HIC, the components have exceeded the limit for moisture exposure and must be rebaked. If the 20% button is *pink* and the 30% button is *not blue* on a six-button HIC (left side of Figure 5-8), or the 5% button is *pink* and the 10% button is *not blue* on a three-button 5-10-15 HIC for parts of all levels, the components have exceeded the limit for moisture exposure and must be rebaked. The HIC is reversible and can be reused. The HIC is required for all moisture-sensitive devices.



Six-button HIC



Three-button 5-10-15 HIC



Three-button 5-10-60 HIC

Figure 5-8 Example humidity indicator cards

6 PCB Mounting Specifications

6.1 Recommended characterization

The SMT process can be optimized for board-level reliability through careful characterization tests. The following tests should be conducted on PCB test vehicles:

- Bend to failure
- Bend cycle
- Tensile pull
- Drop shock
- Temperature cycling

In addition, the IC land pattern, stencil design, and reflow profile should be characterized prior to PCB production release. These topics are discussed in the following sections.

6.2 Pad and stencil design

In general, the PCB land pattern is the same size as the package terminal. Solder paste is typically printed with the same dimensions as the land pattern. *However, this is not the case for the 68 mQFN package.* Figure 6-1 shows the recommended land pattern dimensions and Figure 6-2 shows the recommended solder stencil dimensions.

It is recommended to use either a 100 µm or 127 µm thick stencil. These pattern dimensions are provided as a basis for SMT development using 68 mQFN packages; however, the pattern might require slight modifications to allow for equipment and material differences from those listed in this specification. It is important to fully characterize your SMT process for optimal results. Daisy chain packages are suitable for SMT characterization.

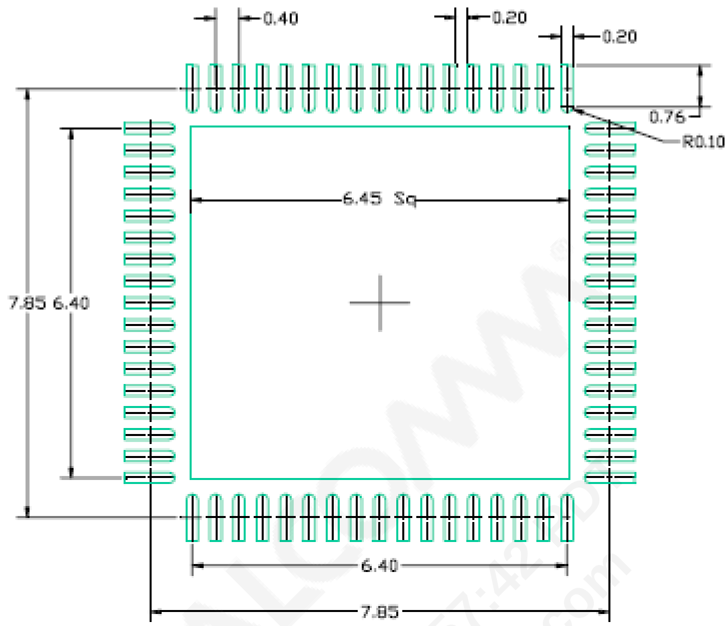


Figure 6-1 68 mQFN land pattern drawing

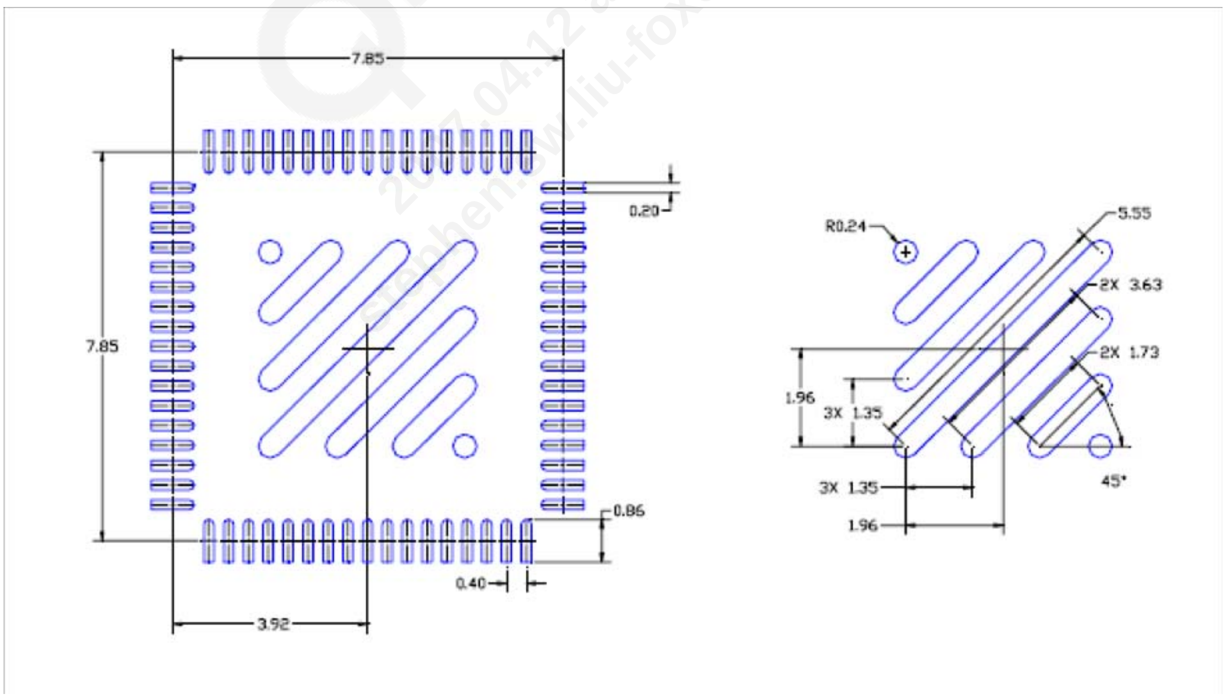


Figure 6-2 68 mQFN stencil pattern drawing with 100 μm stencil thickness

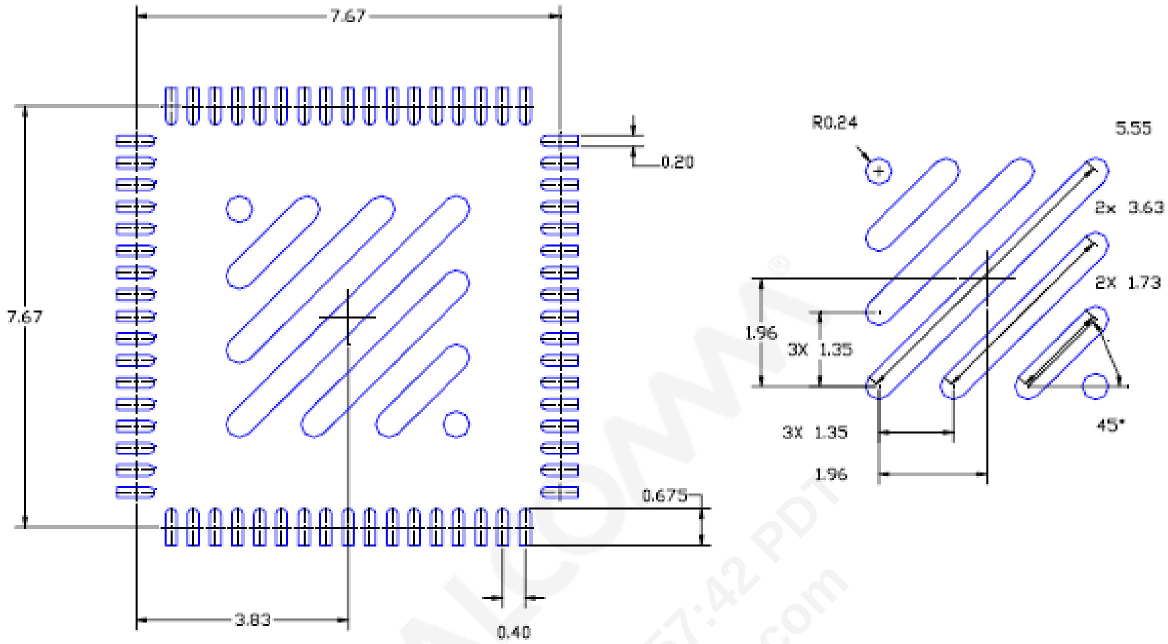


Figure 6-3 68 mQFN stencil pattern drawing with 127 µm stencil thickness

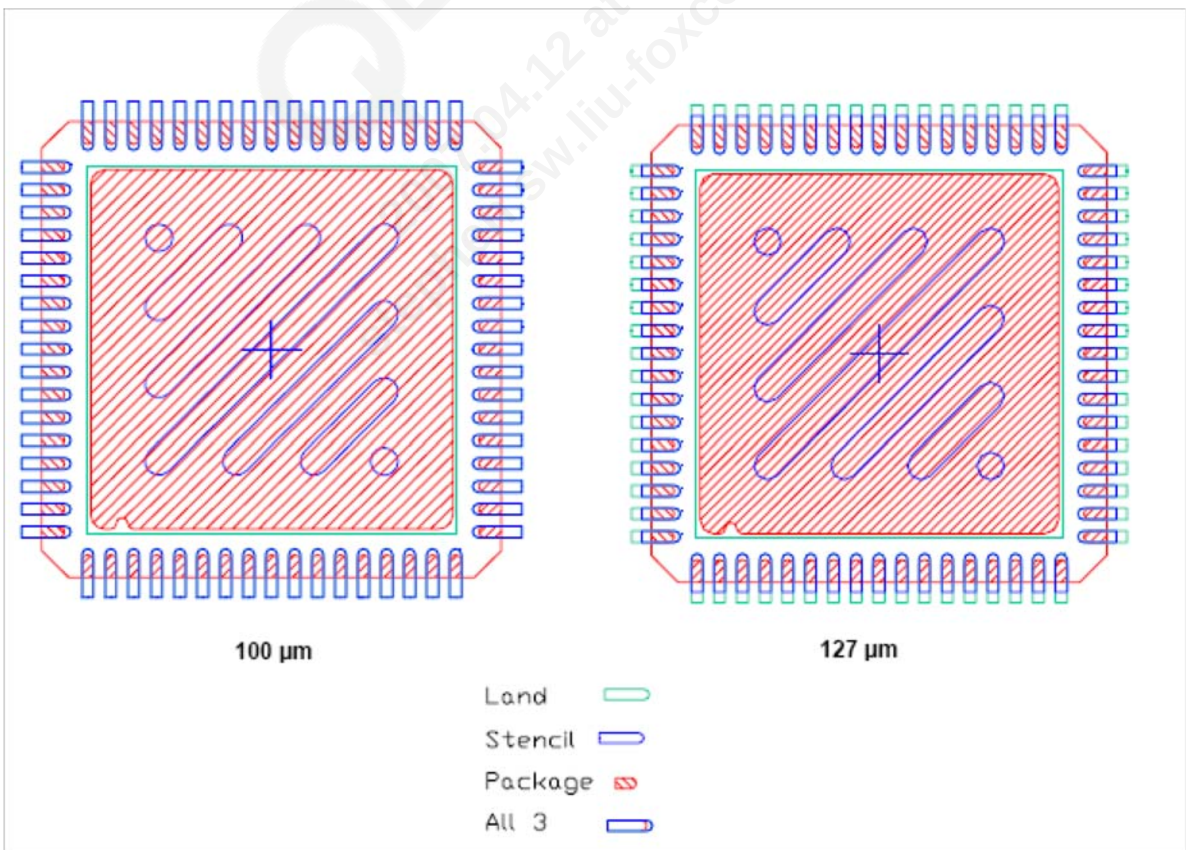


Figure 6-4 68 mQFN composite land and stencil pattern

6.3 Solder reflow

Solder paste manufacturing conditions should follow paste vendor recommendations for printing and reflow profile. See Table 6-1 for typical conditions and maximum component heat exposure. ***The device is qualified for three reflow cycles.***

Table 6-1 Typical reflow profile conditions and max component heat exposure

Profile zones (temp. measured at solder joint)	Description	Condition
Preheat	Initial heating	3 °C/second max 100 – 150 °C
Soak	Dry out and flux activation	100 – 200 °C 60 to 180 seconds typical
Reflow	Time above solder paste melting point 183 or 217 °C	60 – 150 seconds Follow solder paste vendor recommendations
	Peak temperature Max component heat exposure*	250 °C Recommended max. heat exposure to QCT product during manufacturing
Cool down	Cool rate	6 °C/second max

* Temperatures are measured at the solder joint. Component heat exposure units are measured with thermocouple at the top surface of QCT component.

6.4 Conditions for storage after unpacking

All products supplied by QUALCOMM CDMA Technologies (QCT) should be handled using the precautions described in the *QCT Products Component Handbook* (80-24909-1), which includes information on ESD and moisture sensitivity.

6.4.1 Storage conditions

If stored in a sealed moisture barrier, anti-static bag as described in this document, the RTR6285 IC in its 68 mQFN package has a shelf life of 12 months, provided the storage conditions are 40 °C or less, and 90% relative humidity (RH) or less.

6.4.2 Exposure duration

After unpacking, the 68 mQFN must be soldered to a PCB within the time listed on the moisture bag label, with factory conditions of 30 °C or less, and 60% RH or less. The RTR6285 IC in the 68 mQFN package has 168 hours (1 week) out-of-bag exposure time.

6.4.3 Baking

It is not necessary to bake the parts if the conditions of Section 6.4.1 and Section 6.4.2 have been satisfied.

Baking is required if any condition from Section 6.4.1 and Section 6.4.2 has not been satisfied. The component-level baking conditions are 125 °C, ± 5 °C for 24 hours. Components cannot be baked in tape and reels (typically supplied by QCT) at this elevated temperature. If the out-of-bag exposure time is exceeded, parts must be baked for a longer time at lower temperatures. See the moisture sensitive caution label on each shipping bag for baking information.

7 Part Reliability

7.1 Reliability qualification summary

TBD

7.2 Qualification sample description

TBD