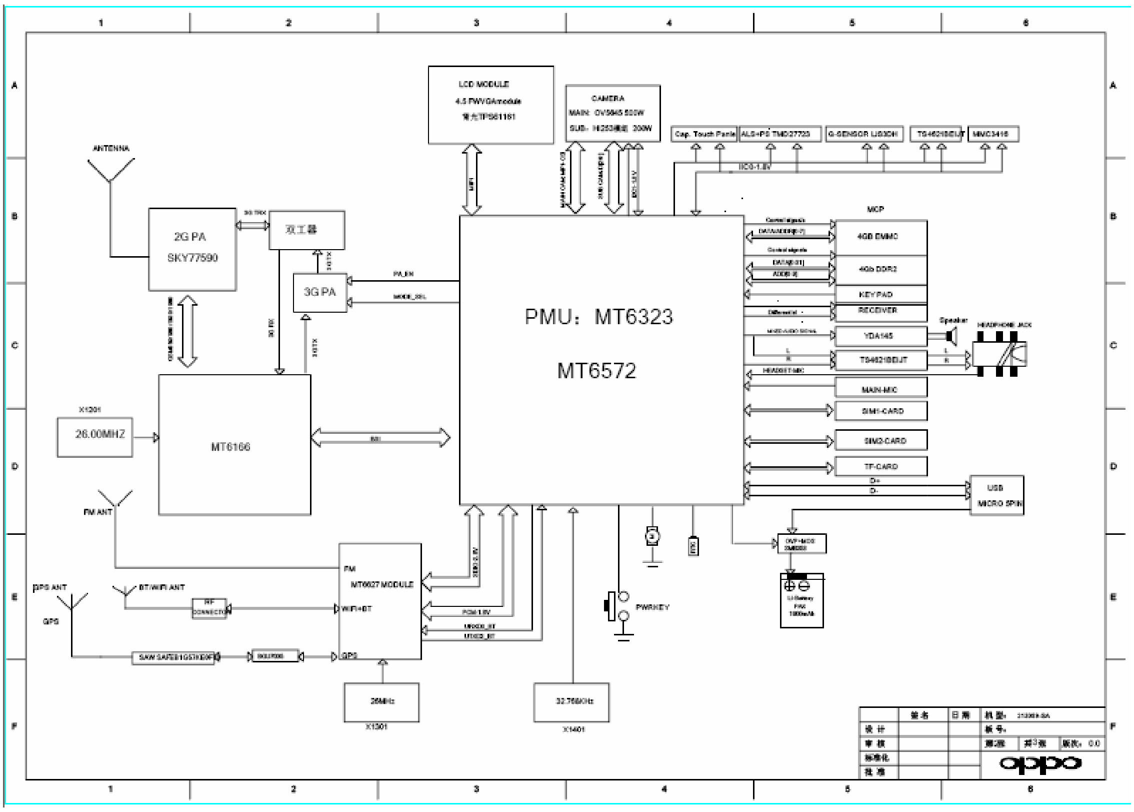
Description of Operation

OPPO R829 use MTK MT6582 platform design.

Platform:MT6572(BB)+MT6323(PMIC)+MT6166(modem)+MT6627(BT/WIFI/GPS/FM).



Band Mode: GSM Quad band(850/900/1800/1900 MHz) WCDMA:850/900/2100MHz

Network: GSM:GPRS,WCDMA:HSPA

3G DataRate: HSDPA—21Mbps, HSUPA—5.7Mbps

Display: 16M TFT color, 854×480 FWVGA, 4.5

Memory: EMMC 4GB NAND Flash+4Gb RAM

Bluetooth Version: BT Ver.2.1+EDR

USB - Standard & Speed: USB 2.0 480Mbps

WiFi: Support IEEE 802.11b/g/n wireless

GPS Guide: GPS/AGPS

IM: Support AIM. MSN. Google messenger and GTALK

Email: Support:POP、IMAP、SMTP，AOL and GMAIL

Ringtone format: MP3、AAC、AAC+、WMA

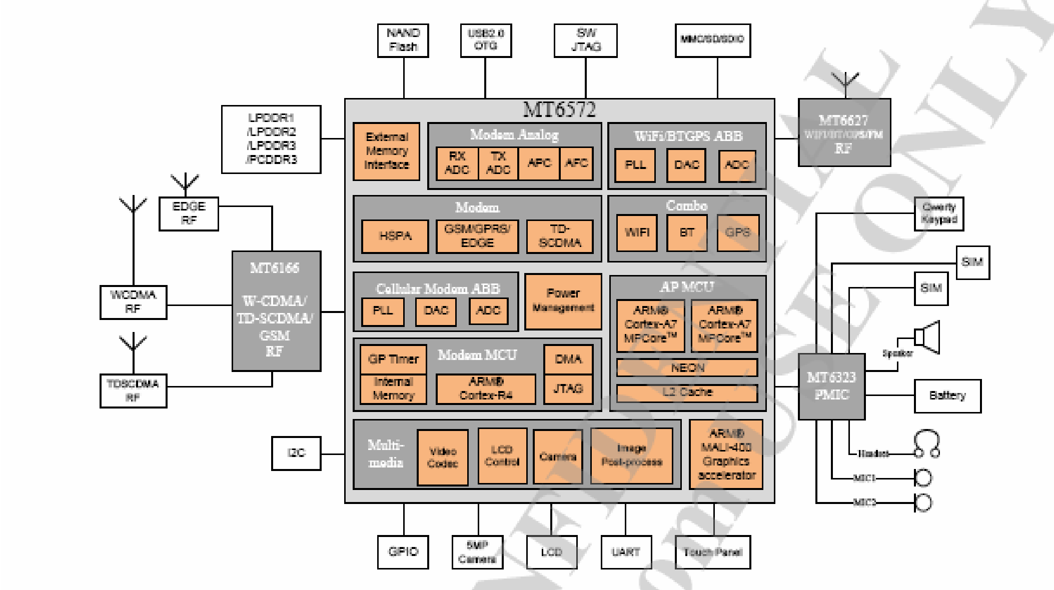
Wallpaper format: JPG、BMP、PNG、GIF

Audio format: MP3、AAC、AAC+、WMA、MPEG4、WAV、MIDI、REAL、AUDIO、OGG

Vedio format: H264,streaming media、3GPP、MPEG4,Codec 3GP,YouTube vedio player

MT6582:

MediaTek MT6572 is a highly integrated 3G System-on-chip (SoC) which incorporates advanced features, e.g. HSPA modem, Dual-core ARM® Cortex-A7 MPCore™ operating at 1.2 GHz, 3D graphics (OpenGL|ES 2.0), 5M camera, LPDDR2 up to 667MHz and high-definition 720p video decoder. MT6572 helps phone manufacturers build high-performance 3G smart phones with PC-like browser, 3D gaming and cinema class home entertainment experiences.



Blockdiagram

AP MCU subsystem

- Dual-core ARM® Cortex-A7 MPCore™ operating at 1.2GHz
- NEON multimedia processing engine with SIMDv2/VFPv4 ISA support
- 32KB L1 I-cache and 32KB L1 D-cache
- 256KB unified L2 cache
- DVFS technology with adaptive operating voltage from 1.05V to 1.26V

General

- Smartphone,3 MCU subsystems architecture
- SLC NAND flash and eMMC bootloader
- Supports LPDDR-1/LPDDR-2/LPDDR-3/PD-DDR3

MD MCU subsystem

- ARM® Cortex-R4 processor with maximum 480MHz operation frequency
- 32KB I-cache, 16KB D-cache
- 256KB TCM (tightly-coupled memory)
- DSP for running modem/voice tasks, with maximum 245.76MHz operation frequency
- High-performance AXI and AHB bus
- General DMA engine and dedicated DMA channels for peripheral data transfer
- Watchdog timer for system error recovery
- Power management for clock gating control

Supports integrated WIFI/BlueTooth/GPS

- Supports single antenna for Bluetooth and WLAN, GPS
- Self calibration
- Supports TCXO & TSX
- Best-in-class current consumption performance
- Intelligent BT/WLAN coexistence scheme that goes beyond PTA signaling (for example, transmit window and duration that take into account protocol exchange sequence, frequency, etc.)

GPS

- Supports GPS/QZSS/SBAS (WAAS/MSAS/EGNOS/GAGAN)
- Best-in-class sensitivity performance
- Full A-GPS capability (E911/SUPL/EPO/HotStill)
- Active interference cancellation for up to 8 in-band tones
- Low-power operational modes
- 5Hz update rate

3G UMTS FDD supported features (with MT6166)

- CPC (DTX in CELL_DCH, UL DRX DL DRX), HS-SCCH-less, HS-DSCH
- MAC-ehs
- Uplink Cat.6, throughput up to 5.7Mbps
- Downlink Cat. 14, throughput up to 21Mbps
- Fast dormancy
- ETWS
- Network selection enhancements

Wi-Fi

- Single-band (2.4GHz) single stream 802.11 b/g/n MAC/BB/RF
- 802.11 d/h/k compliant
- Security: WFA WPA/WPA2 personal, WPS2.0, WAPI (Hardware)
- QoS: WFA WMM, WMM PS
- Supports 802.11n optional features: STBC, A-MPDU, Blk-Ack, RIFS, MCS feedback, 20/40MHz coexistence (PCO), unscheduled PSMP
- Supports 802.11w protected managed frames
- Supports Wi-Fi Direct (WFA P-2-P standard) Supports HotSpot 2.0 Passpoint
- Per packet TX power control

BlueTooth

- Bluetooth specification v2.1+EDR
- Bluetooth specification 3.0+HS compliance
- Bluetooth v4.0 Low Energy (LE)
- Rx sensitivity: GFSK -95dBm, DQPSK -94dBm, 8-DPSK -88dBm
- Best-in-class BT/Wi-Fi coexistence performance
- Up to 4 piconets simultaneously with background inquiry/page scan
- Supports Scatternet
- Packet Loss Concealment (PLC) function for better voice quality
- Low-power scan function to reduce power consumption in scan modes

Display

- Supports landscape or portrait panel resolution up to qHD (960x540)
- Supports 8/9/16/18-bit host interface (MIPI DBI)
- Supports 8/9/16/18/24/32-bit serial interfaces
- Supports landscape or portrait panel resolution up to qHD (960x540)
- Supports 8/9/16/18-bit host interface (MIPI DBI)
- Supports 8/9/16/18/24/32-bit serial interfaces
- Supports 16/18/24-bit RGB interfaces (MIPI DPI)
- MIPI DSI interface (3 data lanes)
- Embedded LCD gamma correction
- Supports true colors
- 4 overlay layers with per-pixel alpha channel and gamma table
- Supports spatial and temporal dithering
- Supports side-by-side format output to stereo 3D panel in both portrait and landscape modes
- Supports color enhancement
- Supports adaptive contrast enhancement
- Supports image/video/graphic sharpness enhancement
- Supports dynamic backlight scaling

Graphics

- OpenGL ES 1.1/2.0 3D graphic accelerator
- OpenVG1.1 vector graphics accelerator

Video

- H.264 decoder: Baseline 720p @ 30fps
- H.264 decoder: Main/high profile 720p@30fps
- MPEG-4 SP/ASP decoder: 720p @ 30fps
- DIVX3/DIVX4/DIVX5/DIVX6/DIV X HD/XVID decoder: 720p @ 30fps
- VP8 decoder: 720p @ 30fps
- VC-1 decoder: 720p @ 30fps
- MPEG-4 encoder: Simple profile 720p @ 30fps
- H.263 encoder: 720p @ 30fps
- H.264 encoder: Baseline profile VGA @ 24fps

Image

- Supports 5 MP Capture up to 15fps
- Supports MIPI CSI-2 high-speed camera serial interface with 2 data lane (for main) + 2 data lane (for sub)
- Supports face detection and visual tracking
- Supports zero shutter delay image capture
- Supports capturing image when recording video
- Supports JPEG decoder for baseline decoding up to 29.4M pixel/sec; supports progressive format decoding
- Supports JPEG encoder for baseline encoding up to 17.5M pixel/sec

MT6166:

The MT6166 is a RF transceiver targeted at high speed 2G/3G-FDD/TDD multi-mode smart phone and tablet computers implanted in 40nm CMOS. The RF transceiver function is fully integrated. This document briefly introduces the RF macros in MT6166.

- Full multi-mode RF solution (GGE/WCDMA/TDSCDMA) through to 3GPP Release 8 (HSPA+)
  - *21.1Mbps peak DL (Cat. 24: 64QAM)*
  - *11.5Mbps peak UL (Cat. 7: 16QAM)*
  - *SAW-less Quad-band support in GGE mode (GSM850/900/1800/1900)*
  - *3G-FDD bands support: Band 1,2,5,8.*
  - *3G-TDSCDMA bands support: Band 34,39,40.*

- Direct Conversion (3G), Two Point Modulation (TPM) for GMSK and Small Signal Polar for 8-PSK
  - No external SAW filters required for transmitter (WCDMA//GGE)
  - Dedicated power detection circuits for power control over specific power range

- Hybrid Direct-Conversion (3G) / Low-IF (GGE, DC-HSDPA) receiver
  - *No external SAW filters required for receiver (GGE)*

- Low supply current & operation directly from DC-DC converter

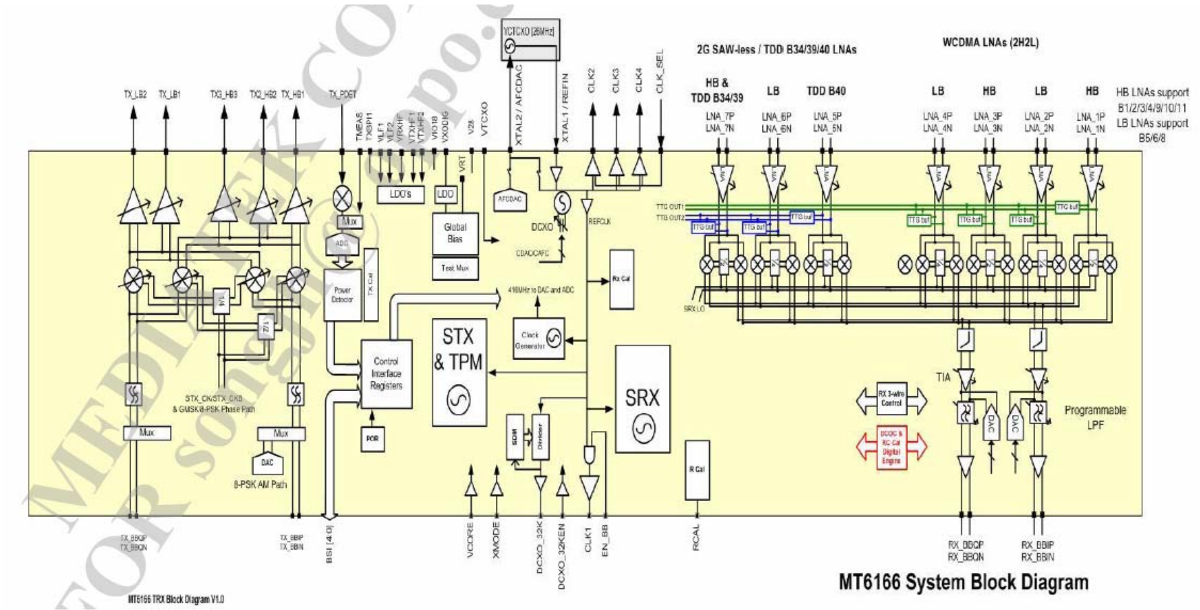
- 26MHz internal DCXO or external VCTCXO operation (with integrated AFC DAC)
  - Three low noise additional Clock Drivers for clocking connectivity / peripheral IC's
  - Ultra Low power 32KHz mode

- Support RF Calibration features for key Rx and Tx specifications (Image rejection, LO feedthrough, DC offset)

- Temperature Measurement sub-system

3GPP LTE and its variants (FDD and TDD) – requires WTR1605L IC variant

TD-SCDMA



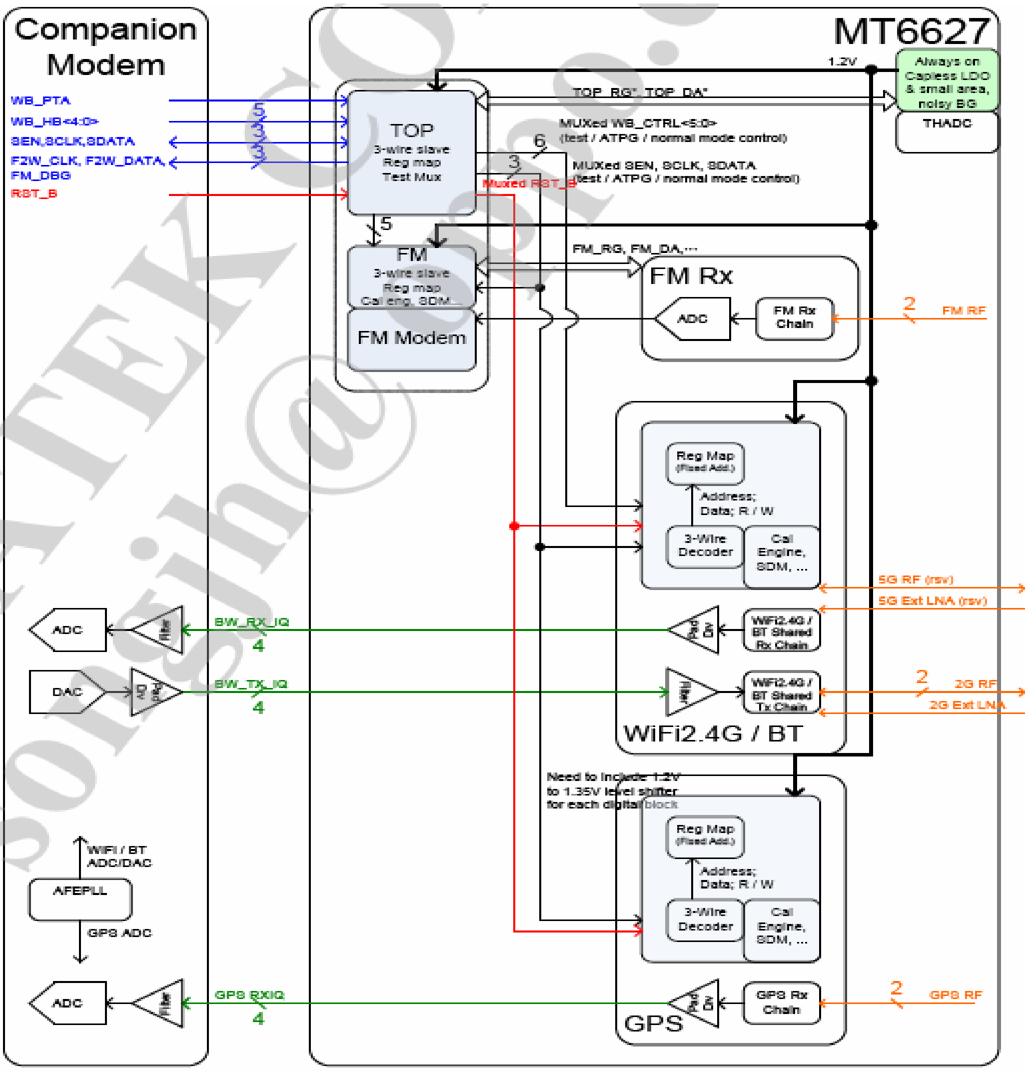
MT6166 System Block Diagram

MT6627:

MT6627 is a 4-in-1 connectivity chip which contains a WiFi/Bluetooth transcevier, a GPS receiver, and a FM receiver front-ends, along with integrated passive device (IPD) in a QFN40 pacakge. Simplified block diagram and how MT6627 connects to a companion modem is shown in Figure 1. In Figure 1, RF input / output are labeled in orange, IF interface to companion chip in green, and control / reset in blue and red, respectively. An always on low-dropout regulator (ALDO) provides supply voltage to top control logics in MT6627. The top control logics can control each subsystem independently. Each subsystem also has dedicated LDOs, too. A thermal sensor and its ADC (analog-to-digital converter) is provided to monitor MT6627 temperature variation. MT6627 does not have its dedicated crystal oscillator. It either uses an external (maybe temperature compensated) oscillator, or uses the clock source from companion chips in the platform such as MT6166.

For WiFi and Bluetooth, MT6627 provides an advanced switching mechanism which allows fast switching between WiFi and BT modes. Hardware sharing and reuse is maximized. The transceiver front-ends are on MT6627 while the ADC/DAC (analog-to-digital converter / digital-to-analog converter) are in the companion modem chip. The interface driver / receiver buffer are designed to drive PCB trace loading. The GPS/Glonass IP in MT6627 supports both standards, depending on if the companion modem supports Glonass or not. Its partition is similar to WiFi / Bluetooth such that the ADC/DAC is in the companion modem chip. In contrast, the FM system integrates the modem and ADC in MT6627, and no interface drivers / buffers are required.

- MT6627 is 4-in-1 connectivity RF chip which contains front-ends of a 2.4GHz WiFi and Bluetooth transceiver, a GPS/Glonass receiver, and an FM receiver.
- MT6627 supports integrated passive device to save footprint on PCB and cost due to WiFi / Bluetooth / GPS external BoM (bill of materials) in a 40-pin QFN package.
- Supports WiFi external LNA and GPS external LNA.



WLAN

- Single-band (2.4GHz) single stream 802.11 b/g/n RF
- Support WiFi and Bluetooth TDD operation and single-antenna topology with integrated TR-switch
- Integrated PA with max 22 dBm CCK output power
- Typical RX sensitivity with companion chip modem: -77.5 dBm at 11g 54Mbps mode
- Support external LNA with an auxiliary RX input
- Integrated power detector to support per packet TX power control
- Built-in calibrations for PVT variation
- One fully integrated frequency synthesizer for both WiFI/BT supporting multiple crystal clock frequencies

Bluetooth

- Bluetooth specification v2.1+EDR
- Bluetooth specification 3.0+HS compliance
- Bluetooth v4.0 Low Energy (LE)
- Integrated PA with 10dBm (class 1) transmit power
- Typical Rx sensitivity with companion chip modem: GFSK -95dBm, DQPSK -94dBm, 8-DPSK -88dBm
- Low-power scan function to reduce the power consumption in scan modes

FM

- 65-108MHz with 50kHz step
- Supports RDS/RBDS
- Digital stereo modulator/demodulator
- Digital audio interface (I2S)
- Fast seek time 30ms/channel
- Stereo noise reduction
- Audio sensitivity 5dBμVemf ((S+N)/N=26dB)
- Audio S/N 60dB
- Anti-jamming
- Integrated short antenna

GPS

- RF supports GPS, GALILEO, GLONASS & BEIDOU
- Built-in calibrations for PVT variation
- Typical RX tracking sensitivity of -165dBm.
- Support external LNA
- Multi-mode filters for different GNSS receiver modes.

WBT IPD

- Integrated matching network, balance band-pass filter, GPS-WBT diplexer.
- Fully integrated in one IPD die
- Support single and dual antenna operation.

GPS IPD

- Integrated high-pass type matching network and 5^{th}-order ellipse low-pass filter.
- Fully integrated in one IPD die
- Support single and dual antenna operation.

2.4G receiver specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,412	-	2,484	MHz
RX sensitivity	1 Mbps DSSS		-95		dBm
	2 Mbps DSSS		-92.5		dBm
	5.5 Mbps DSSS		-90		dBm
	11 Mbps DSSS		-87.5		dBm
RX Sensitivity	6 Mbps OFDM		-91.5		dBm
	9 Mbps OFDM		-89.5		dBm
	12 Mbps OFDM		-88.5		dBm
	18 Mbps OFDM		-86		dBm
	24 Mbps OFDM		-83		dBm
	36 Mbps OFDM		-79		dBm
	48 Mbps OFDM		-75.5		dBm
	54 Mbps OFDM		-74		dBm
RX sensitivity BW = 20MHz Green field 800nS guard interval Non-STBC	MCS 0		-91		dBm
	MCS 1		-87.5		dBm
	MCS 2		-85.5		dBm
	MCS 3		-82.5		dBm
	MCS 4		-79.5		dBm
	MCS 5		-75		dBm
	MCS 6		-73.5		dBm
	MCS 7		-72		dBm
RX sensitivity BW = 40MHz Green field 800nS guard interval Non-STBC	MCS 0		-88		dBm
	MCS 1		-84.5		dBm
	MCS 2		-82.5		dBm
	MCS 3		-79.5		dBm
	MCS 4		-76.5		dBm
	MCS 5		-72		dBm
	MCS 6		-70.5		dBm
	MCS 7		-68.5		dBm
Maximum receive level	11 Mbps DSSS			-1	dBm
	6 Mbps OFDM			-6	dBm
	54 Mbps OFDM			-6	dBm
	MCS0			-6	dBm
	MCS7			-6	dBm
Adjacent channel rejection (30MHz offset)	1 Mbps DSSS			40	dB
Adjacent channel rejection (25MHz offset)	11 Mbps DSSS			40	dB
Adjacent channel rejection (25MHz offset)	6 Mbps OFDM			37	dB
	54 Mbps OFDM			25	dB
Adjacent channel rejection (25MHz offset), BW = 20MHz	MCS 0			33	dB
	MCS 7			18	dB
Adjacent channel rejection (40MHz offset), BW = 40MHz	MCS 0			33	dB
	MCS 7			18	dB
Blocking level for 1dB RX sensitivity degradation	776 ~ 794 MHz CDMA2000		TBD		dBm
	824 ~ 849 MHz GSM		TBD		dBm
	880 ~ 915 MHz GSM		TBD		dBm
	1,710 ~ 1,785 MHz GSM		TBD		dBm
	1,850 ~ 1,910 MHz GSM		TBD		dBm
	1,850 ~ 1,910 MHz WCDMA		TBD		dBm
	1,920 ~ 1,980 MHz WCDMA		TBD		dBm

RF transmitters

radioOne ZIF architecture – direct upconversion from analog baseband to RF

Transmit signal path circuits:

Nine transmitter outputs: four low band, four mid band, and one high band
Baseband interface from the baseband device with amplifiers and lowpass filters
Baseband-to-RF quadrature upconverters: dedicated high band and shared low/mid band
RF AGC amplifiers and filters

2.4G transmitter specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,412	-	2,484	MHz
Output power VBAT = 3.6V	802.11b, 1~11 Mbps DSSS		19		dBm
	802.11g, 6 ~54Mbps OFDM		16		dBm
	802.11n, HT20 MCS0~7		16		dBm
	802.11n, HT40 MCS0~7		14		dBm
EVM	802.11b, 1~11 Mbps DSSS @Pout=17dBm		25		%
	802.11g, 6 ~54Mbps OFDM @Pout=14dBm		-31		dB
	802.11n, HT20 MCS0~7 @Pout=14dBm		-31		dB
	802.11n, HT40 MCS0~7 @Pout=12dBm		-31		dB
TX power accuracy	-40~85 °C, 2~18dBm			±1.5	dB
Loadpull variation at VSWR = 2:1	Output power variation			±1.5	dB
	EVM degradation		4		dB
Transmitted power (Data rate = 1M, Pout = 20dBm)	76 ~ 108 MHz			-148	dBm/Hz
	776 ~ 794 MHz			-147	dBm/Hz
	869 ~ 960 MHz			-148	dBm/Hz
	925 ~ 960 MHz			-148	dBm/Hz
	1,570 ~ 1,580 MHz			-148	dBm/Hz
	1,805 ~ 1,880 MHz			-147	dBm/Hz
	1,930 ~ 1,990 MHz			-145	dBm/Hz
	2,110 ~ 2,170MHz			-138	dBm/Hz
Harmonic output power (Data rate = 1M, Pout = 20dBm)	2nd harmonic			-20	dBm/MHz
	3rd harmonic			-62	dBm/MHz

Bluetooth BDR receiver specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,402		2,480	MHz
Receiver sensitivity	BER < 0.1%		-92		dBm
Max. usable signal	BER < 0.1%	-17	3		dBm
C/I co-channel	Co-channel selectivity (BER < 0.1%)	-	4	11	dB
C/I 1MHz	Adjacent channel selectivity	-	-14	0	dB

Parameter	Description	Min.	Typ.	Max.	Unit
	(BER < 0.1%)				
C/I 2MHz	2nd adjacent channel selectivity (BER < 0.1%)	-	-47	-30	dB
C/I ≧3MHz	3rd adjacent channel selectivity (BER < 0.1%)	-	-51	-40	dB
C/I image channel	Image channel selectivity (BER < 0.1%)	-	-26	-9	dB
C/I image 1MHz	1MHz adjacent to image channel selectivity (BER < 0.1%)	-	-49	-20	dB
Out-of-band blocking	30MHz to 2,000MHz	-7			dBm
	2,001MHz to 2,339MHz	-24			dBm
	2,501MHz to 3,000MHz	-24			dBm
	3,001MHz to 12.75GHz	-7			dBm
Intermodulation	Max. interference level to maintain 0.1% BER	-36	-22		dBm

Bluetooth BDR transmitter specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,402	-	2,480	MHz
Output power	At max power output level		7		dBm
Power control step		2	4	8	dB
ICFT	Initial carrier frequency drift	-75	3	75	kHz
Carrier frequency drift	One slot packet (DH1)	-	6	25	kHz
	Three slot packet (DH3)	-	6	40	kHz
	Five slot packet (DH5)	-	6	40	kHz
	Max. drift rate	-	180	400	Hz/us
Modulation characteristic	$\Delta f1_{avg}$	140	156	175	kHz
	$\Delta f2_{max}$ (for at least 99% of all $\Delta f2_{max}$)	115	145	-	kHz
	$\Delta f2_{avg}/\Delta f1_{avg}$	0.8	0.98	-	
20-dB bandwidth		-	922	1,000	kHz
In-band spurious emission	±2MHz offset		-45	-23	dBm
	±3MHz offset		-51	-43	dBm
	>±3MHz offset		-48	-43	dBm
Out-of-band spurious emission	30MHz to 1GHz			-39	dBm
	1GHz to 12.75GHz			-33	dBm
	1.8GHz to 1.9GHz			-50	dBm
	5.15 to 5.3GHz			-50	dBm

Bluetooth EDR receiver specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,402	-	2,480	MHz
Receiver sensitivity	π/4 DQPSK (BER < 0.01%)	-	-91	-67	dBm
	8PSK (BER < 0.01%)	-	-84	-67	dBm
Max. usable signal	π/4 DQPSK (BER < 0.1%)	-17	3	-	dBm
	8PSK (BER < 0.1%)	-17	3	-	dBm
C/I co-channel	π/4 DQPSK (BER < 0.1%)	-	8	13	dB
	8PSK (BER < 0.1%)	-	14	21	dB
C/I 1MHz	π/4 DQPSK (BER < 0.1%)	-	-12	0	dB
	8PSK (BER < 0.1%)	-	-6	5	dB
C/I 2MHz	π/4 DQPSK (BER < 0.1%)	-	-50	-30	dB
	8PSK (BER < 0.1%)	-	-42	-25	dB
C/I ≧3MHz	π/4 DQPSK (BER < 0.1%)	-	-51	-40	dB
	8PSK (BER < 0.1%)	-	-44	-33	dB
C/I image channel	π/4 DQPSK (BER < 0.1%)	-	--30	-7	dB
	8PSK (BER < 0.1%)	-	-25	0	dB
C/I image 1MHz	π/4 DQPSK (BER < 0.1%)	-	-49	-20	dB
	8PSK (BER < 0.1%)	-	-41	-13	dB

Bluetooth EDR transmitter specification:

Parameter	Description		Min.	Typ.	Max.	Unit
Frequency range			2,402		2,480	MHz
Output power	π/4 DQPSK			4		dBm
	8PSK			4		dBm
Relative transmit power	π/4 DQPSK		2	-1.7	8	dB
	8PSK		2	-1.7	8	dB
Frequency stability	ω_0	π/4 DQPSK	-10	3	10	kHz
		8PSK	-10	3	10	kHz
	ω_i	π/4 DQPSK	-75	6	75	kHz
		8PSK	-75	6	75	kHz
	$\lvert\omega_0+\omega_i\rvert$	π/4 DQPSK	-75	7	75	kHz
		8PSK	-75	7	75	kHz
Modulation accuracy	RMS DEVM	π/4 DQPSK	-	4	20	%
		8PSK	-	4	13	%
	99% DEVM	π/4 DQPSK	-	8	30	%
		8PSK	-	8	20	%
	Peak DEVM	π/4 DQPSK	-	9	35	%
		8PSK	-	13	25	%
In-band spurious emission	±1MHz offset	π/4 DQPSK		-40	-26	dB
		8PSK		-39	-26	dB
	±2MHz offset	π/4 DQPSK		--35	-23	dBm
		8PSK		-33	-23	dBm
	±3MHz offset	π/4 DQPSK		-45	-43	dBm
		8PSK		-45	-43	dBm

Bluetooth LE receiver specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,402		2,480	MHz
Receiver sensitivity (*)	PER < 30.8%		-95	-67	dBm
Max. usable signal	PER < 30.8%	-7	-1		dBm
C/I co-channel	Co-channel selectivity (PER < 30.8%)		4	21	dB
C/I 1MHz	Adjacent channel selectivity (PER < 30.8%)		-12	15	dB
C/I 2MHz	2^{nd} adjacent channel selectivity (PER < 30.8%)		-30	-17	dB
C/I ≧3MHz	3^{rd} adjacent channel selectivity (PER < 30.8%)		-33	-27	dB
C/I Image channel	Image channel selectivity (PER < 30.8%)		-25	-9	dB
C/I Image 1MHz	1MHz adjacent to image channel selectivity (PER < 30.8%)		-25	-15	dB
Out-of-band blocking	30MHz to 2,000MHz			-27	dBm
	2,001MHz to 2,339MHz			-32	dBm
	2,501MHz to 3,000MHz			-32	dBm
	3,001MHz to 12.75GHz			-27	dBm

Bluetooth LE transmitter specification:

Parameter	Description	Min.	Typ.	Max.	Unit
Frequency range		2,402	-	2,480	MHz
Output power(*)	At max. power output level	-23	0	7	dBm
Carrier frequency offset and drift	Frequency offset	-150	2	150	kHz
	Frequency drift	-50	2	50	kHz
	Max. drift rate	-20	3	20	Hz/us
Modulation characteristic	$\Delta f1_{avg}$	225	251	275	kHz
	$\Delta f2_{max}$ (For at least 99% of all $\Delta f2_{max}$)	185	215		kHz
	$\Delta f2_{avg}/\Delta f1_{avg}$	0.8	0.88		
In-band spurious emission	±2M offset		-53	-23	dBm
	>±3MHz offset		-57	-33	dBm

GPS mode

Parameter	Condition	Min	Typ	Max	Unit
RF input frequency			1575.42		MHz
LO frequency	LO frequency is 4.092 MHz lower than RF		1571.42		MHz
LO leakage	Measured at balun matching network input at LNA high gain		-70		dBm
Input return loss	Single-ended input and external matched to 50□ source using balun matching network for all gain	-10			dB
Gain (Av) (Note 1)	High current mode with max PGA gain	80	78	76	dB
	Low current mode with max PGA gain			58	
PGA Gain range			24		dB
PGA Gain step			2		dB
Gain compression	Blocker -25dBm CW at 1710MHz, relative to uncompressed gain, max PGA gain		1	2	dB
NF	High current mode with max PGA gain		3.75		dB
ΔNF at Gain=62dB	relative to NF at max Gain		0.5	1	dB
ΔNF at Gain=52dB	relative to NF at max Gain		2	3	dB
NF under compression	Blocker -25dBm CW at 1710MHz, max gain		9	12	dB
Input IP3, inband	max gain, 5M/10M offset@-60dBm	-33	-28		dBm
Input IP3, outband	max gain, ~2000M/2400M@-40dBm	-13	-8		dBm
Input IP2, outband	max gain, ~800M/2400M@-40dBm	+32	+37		dBm
Input P1 dB, inband	PGA gain=0dB, offset 500 k	-56	-53		
Frequency response, relative to 4.092MHz, (GPS/Galileo)	At offset +-3MHz		-12/-6		
	At offset +-10MHz		-40/-34		
	At offset +-20MHz		-60/-54		
	At offset +-100MHz		-100/-94		
Gain ripple, GPS	4.092+-1MHz		1.0	1.5	dB
Gain ripple, Galileo	4.092+-2MHz		2.0	3.0	dB
Delay ripple, GPS	4.092+-1MHz		60	110	ns
Delay ripple, Galileo	4.092+-2MHz		40	70	ns
Image rejection	All mode		35		dB
DC offset			±50	±100	mV
RX Current	High current mode		7.2		mA

GPS/GLONASS mode

Parameter	Condition	Min	Typ	Max	Unit
RF input frequency			1575.42		MHz
LO frequency			1588.608		MHz
LO leakage	Measured at balun matching network input at LNA high gain		-70		dBm
Input return loss	Differential input and external matched to 50□ source using balun matching network for all gain	-10			dB
Gain (Av) (integrated average over Fc+-4M)	High current mode with max PGA gain	80	76	70	dB
	Low current mode with max PGA gain			52	
PGA Gain range			24		dB
PGA Gain step			2		dB
Gain compression	Blocker -25dBm CW at 1710MHz, relative to uncompressed gain, max PGA gain		1	2	dB
NF (integrated average over Fc+-4M)	High current mode with max PGA gain		4		dB
ΔNF at Gain=56dB	relative to NF at max Gain		0.5	1	dB
ΔNF at Gain=46dB	relative to NF at max Gain		2	3	dB
NF under compression	Blocker -25dBm CW at 1710MHz, max gain		7	10	dB
Input IP3, inband	max gain, +10M/+20M offset@-70dBm	-50	-45		dBm
Input IP3, outband	max gain, ~2000M/2400M@-40dBm	-15	-10		dBm
Input IP2, outband	max gain, ~800M/2400M@-40dBm	+30	+35		dBm
Input P1 dB, inband	PGA gain=0dB, offset 500 k	-58	-55		dBm
Frequency response (relative to 13.14M)	At 0~23MHz		3	4	dB
	At 33MHz		-25	-22	
	At 53MHz		-43	-40	
	At 120MHz		-66	-63	
	At 180MHz		-85	-82	
LPF 3 dB bandwidth	(recom. 4th order Butterworth BW=15M)		TBD		MHz
Gain ripple	13+-1MHz		0.5	1.0	dB
	13+-4MHz		2.0	3.0	
Delay ripple	13+-4MHz		10	14	ns
Image rejection	All gain mode		35		dB
DC offset			±50	±100	mV
RX Current	High current mode		8.1		mA

GPS/BEIDOU mode

Parameter	Condition	Min	Typ	Max	Unit
RF input frequency			1561		MHz
LO frequency	LO frequency is 4.092 MHz lower than RF		1568.2		MHz
LO leakage	Measured at balun matching network input at LNA high gain		-70		dBm
Input return loss	Differential input and external matched to 50□ source using balun matching network for all gain	-10			dB
Gain (Av) (integrated average over Fc+-4M)	High current mode with max PGA gain	80	76	70	dB
	Low current mode with max PGA gain			52	
PGA Gain range			24		dB
PGA Gain step			2		dB
Gain compression	Blocker -25dBm CW at 1710MHz, relative to uncompressed gain, max PGA gain		1	2	dB
NF (integrated average over Fc+-2M)	High current mode with max PGA gain		4		dB
ΔNF at Gain=56dB	relative to NF at max Gain		0.5	1	dB
ΔNF at Gain=46dB	relative to NF at max Gain		2	3	dB
NF under compression	Blocker -25dBm CW at 1710MHz, max gain		7	10	dB
Input IP3, inband	max gain, +10M/+20M offset @-70dBm	-50	-45		dBm
Input IP3, outband	max gain, ~2000M/2400M@ -40dBm	-15	-10		dBm
Input IP2, outband	max gain, ~800M/2400M @ -40dBm	+30	+35		dBm

WBT IPD

	Freq	Spec (dB)
2.4G Insertion Loss dip + bal + mn	2.4GHz	<3
Band-1 Rx Rejection	2167.6MHz	20.8
Band-1 (24dBm) Rejection	1977.6MHz	22.1
Band-2 (24dBm) Rejection	1907.6MHz	19.1
Band-5 (23.5dBm) Rejection	846.6MHz	11
GSM 850 (32.8dBm) Rejection	848.8MHz	21
GSM900 (32.9dBm) Rejection	914.8MHz	21
DCS1800 (30.8dBm) Rejection	1784.8MHz	18.1
PCS1900 (30dBm) Rejection	1909.8MHz	25.1

GPS IPD

	Freq	Spec (dB)
1.5G diplexer Insertion Loss	1.5GHz	0.75
1.5G LPF Insertion Loss	1.5GHz	1
Band-1 Rejection	1920MHz	26
Band-2 Rejection	1850MHz	30
WiFi Rejection	2412MHz	12

The Phone can only support GSM850/1900, WCDMA 850 bands for FCC market.
The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The unique hopping sequence is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1600 hops/s and the 1MHz symbol rate as defined for the basic data rate.

All Bluetooth units participating in a piconet are time- and hop-synchronized to the channel.
The channel is divided into time slots, each 625 µs in length. In the time slots, master and slave can transmit packets. A TDD scheme is used where master and slave alternatively transmit. The RF hop frequency shall remain fixed for the duration of the packet. For a single packet, the RF hop frequency to be used is derived from the current Bluetooth clock value. For a multi-slot packet, the RF hop frequency to be used for the entire packet is derived from the Bluetooth clock value in the first slot of the packet. The RF hop frequency in the first slot after a multi-slot packet shall use the frequency as determined by the current Bluetooth clock value. If a packet occupies more than one time slot, the hop frequency applied shall be the hop frequency as applied in the time slot where the packet transmission was started.

5 types of hopping sequences are defined:
- A page hopping sequence with 32 unique wake-up frequencies distributed equally over the 79MHz, with a period length of 32.
- A page response sequence covering 32 unique response frequencies that all are in an one-to-one correspondence to the current page hopping sequence.
- An inquiry sequence with 32 unique wake-up frequencies distributed equally over the 79MHz, with a period length of 32. (Note: The headset does never use this sequence)
- A inquiry response sequence covering 32 unique response frequencies that all are in an one-to-one correspondence to the current inquiry hopping sequence.
- A channel hopping sequence which has a very long period length, which does not show repetitive patterns over a short time interval, but which distributes the hop frequencies equally over the 79MHz during a short time interval.

Hopping information:
In this application note, we will only consider the frequency hopping form of spread spectrum, as this technique is more suited to relatively low-data rate, low-power systems. Frequency hopping, as implied by the name, is performed by changing carrier frequencies while communicating. In a typical system, the frequency hopping will be of the so-called slow variety, which means that several data symbols (bits) are transmitted during each hop. A rate between 50 and several hundred hops per second is practical. The lock time of the PLL when changing frequencies is 100us-200us (depending on the loop filter), while the time required to reprogram the needed registers using a 1 MHz clock is on the order of 50-60us. The time during a hop when data cannot be received or transmitted is termed the blanking interval. The dwell time is the time spent in each channel.

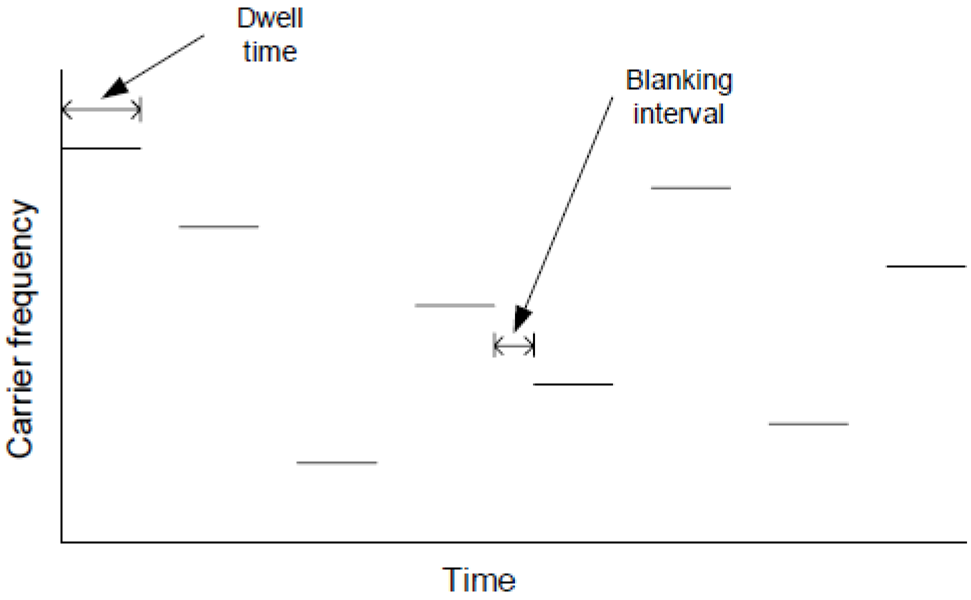


Figure 1 Frequency hopping terminology

Since spread-spectrum technology has its roots in military applications, much of the terminology refers to enemy "jammers" of varying complexity. In commercial systems, intelligent jamming is not a primary threat. Most of the time, the "jamming" signal will merely be another device trying to utilise the same frequency band for communicating. These devices will typically not be as devious as intelligent enemy jammers might be, so the security requirements can be eased a bit compared to military applications. The so-called "narrowband jammer" is probably the most representative threat seen in civilian applications. Interference from multi-path reflections is also a serious threat. These reflections can cause large frequency- and location-dependent drops in signal strength. Frequency hopping combats multi-path reflections by ensuring frequency diversity.