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AirPrime EM7565

Product Technical Specification

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate the Sierra Wireless modem in areas where blasting is in progress, where explosive atmospheres may be present, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. The Sierra Wireless modem can transmit signals that could interfere with this equipment.

Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE POWERED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

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Contact Information

Sales information and technical support, including warranty and returns	Web: sierrawireless.com/company/contact-us/ Global toll-free number: 1-877-687-7795 6:00 am to 6:00 pm PST
Corporate and product information	Web: sierrawireless.com

Revision History

Revision number	Release date	Changes
1	April 2017	Initial release
2	June 2017	Added Power On/Off Timing for the USB section
3	June 2017	Updated notes indicating how long host must wait to drive signals at power-on (in Host Interface Pin Assignments, Power On/Off Timing for the USB, and Power On Timing for PCIe Port)
4	June 2017	Corrected appendix table/figure numbering and TOC formatting
5	July 2017	Added uplink carrier aggregation combinations Removed Bands 252/255

Contents

List of Tables

List of Figures

1: Introduction

The Sierra Wireless EM7565 Embedded Module is an M.2 module that provides LTE, UMTS, and GNSS connectivity for notebook, ultrabook, tablet computers, and M2M applications over several radio frequency bands.

Supported RF bands

The modem, based on Qualcomm's MDM9250 baseband processor, supports data operation on LTE and UMTS networks over the bands described in Table 1-1, with LTE carrier aggregation (CA) as described in Table 1-2.

Table 1-1: Supported RF Bands

RAT	Bands																								
	1	2	3	4	5	6	7	8	9	12	13	18	19	20	26	28	29	30	32	41	42	43	46	48	66
LTE[a]	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F[b]	F	F[b]	T	T	T	T[b]	T[b,c]	F
UMTS[d]	Y	Y	Y	Y	Y	Y		Y	Y				Y		N/A					N/A					
GNSS	• GPS: 1575.42 MHz • GLONASS: 1602 MHz • BeiDou: 1561.098 MHz • Galileo: 1575.42 MHz • QZSS: 1575.42 MHz																								
	•	•																							

a. (LTE) Downlink MIMO support (2x2; 4x2)
   F=FDD; T=TDD
   Data rates: Downlink (Cat 12 with 3CA, 256QAM=600 Mbps; Cat 9 with 3CA, 64QAM=450 Mbps), Uplink (Cat 13 with 2CA contiguous, 64QAM=150 Mbps)
b. Downlink only
c. B48 support pending future release
d. UMTS (DC-HSPA+, HSPA+, HSPA, UMTS)
   Diversity support
   Data rates: Downlink (Cat 24, up to 42 Mbps), Uplink (Cat 6, up to 11 Mbps)

Table 1-2: Carrier Aggregation Combinations

Downlink	Uplink
TBD	CA_1C
TBD	CA_3C
TBD	CA_7C
TBD	CA_41C
TBD	CA_42C

Physical Features

- M.2 form factor—WWAN Type 3042-S3-B (in WWAN—USB 3.0 Port Configuration 2), as specified in *[8] PCI Express NGFF (M.2) Electromechanical Specification Revision 1.0*. (Note: Any variations from the specification are detailed in this document.)
- Ambient operating temperature range:
  - Class A (3GPP compliant): -30°C to +TBD°C
  - Class B (operational, non-3GPP compliant): -40°C to +TBD°C (reduced operating parameters required)

Important: *The internal module temperature (reported by AT!PCTEMP) must be kept below TBD°C. For best performance, the internal module temperature should be kept below TBD°C. Proper mounting, heat sinks, and active cooling may be required, depending on the integrated application.*

Application Interface Features

- USB interface (QMI) for Linux and Android
- MBIM for Windows 8.1, Windows 10, and Linux
- AT command interface (*[1] AT Command Set for User Equipment (UE) (Release 6) (Doc# 3GPP TS 27.007)*, plus proprietary extended AT commands) in *[2] AirPrime EM75xx AT Command Reference (forthcoming)*
- Software Development Kits (SDK),including API (Application Program Interface) functions:
  - Windows 8.1, Windows 10
  - Linux
- Support for active antenna control via dedicated antenna control signals (ANTCTL0:3)
- Dynamic power reduction support via software and dedicated GPIO (DPR)

Note: OMA DM and FOTA support is operator-dependent.

- OMA DM (Open Mobile Alliance Device Management)
- FOTA (Firmware Over The Air)

Modem Features

- LTE / DC-HSPA+ / HSPA+ / HSPA / UMTS (WCDMA) operation
- Multiple (up to 16) cellular packet data profiles
- Traditional modem COM port support for AT commands
- USB suspend / resume
- Sleep mode for minimum idle power draw
- SIM application tool kit with proactive SIM commands
- Enhanced Operator Name String (EONS)
- Mobile-originated PDP context activation / deactivation
- Support QoS QCI (3GPP Release 12)
- Static and Dynamic IP address. The network may assign a fixed IP address or dynamically assign one using DHCP (Dynamic Host Configuration Protocol).

- PAP and CHAP support
- PDP context type (IPv4, IPv6, or IPv4v6)
- RFC1144 TCP/IP header compression

LTE Features

- Carrier aggregation:
  - DL LTE-FDD
    - 20 MHz intraband non-contiguous
    - 40 MHz interband
  - DL LTE-TDD
    - 40 MHz intraband contiguous and non-contiguous
    - 40 MHz interband
  - UL LTE
    - 40 MHz intraband contiguous
- CSG support (LTE Femto)
- LTE Advanced receivers (NLIC, eICIC, feICIC)
- Basic cell selection and system acquisition
  - PSS/SSS/MIB decode
  - SIB1–SIB16 decoding
- NAS/AS security procedures
  - Snow 3G/AES/ZUC security
- CQI/RI/PMI reporting
- Paging procedures
  - Paging in Idle and Connected mode
- Dedicated bearer
  - Network-initiated dedicated bearer
  - UE-initiated dedicated bearer
- Multiple PDN connections (IPv4 and IPv6 combinations), subject to operating system support.
- Connected mode intra-LTE mobility
- Idle mode intra-LTE mobility
- iRAT between LTE/3G for idle and connection release with redirection
- Detach procedure
  - Network-initiated detach with reattach required
  - Network-initiated detach followed by connection release

Short Message Service (SMS) Features

- Mobile-originated and mobile-terminated SMS over IMS
- Mobile-originated and mobile-terminated SMS over SGs

Position Location (GNSS)

- Customizable tracking session
- Automatic tracking session on startup
- Concurrent standalone GPS, GLONASS, Galileo, BeiDou, and QZSS
- Assisted GPS (A-GPS) SUPL1.0

- Assisted GPS/GLONASS SUPL2.0
- gpsOneXTRA 1.0/2.0/3.0/3.1
- GNSS reception on dedicated connector or diversity connector

Supporting Documents

Several additional documents describe module design, usage, integration, and other features. See References on page 92.

Accessories

A hardware development kit is available for AirPrime M.2 modules. The kit contains hardware components for evaluating and developing with the module, including:
- Development board
- Cables
- Antennas
- Other accessories

For over-the-air LTE testing, ensure that suitable antennas are used.

Required Connectors

Table 1-3 describes the connectors used to integrate the EM7565 Embedded Module into your host device.

Table 1-3: Required Host-Module Connectors[a]

Connector type	Description
RF cables	• Mate with M.2-spec connectors • Three connector jacks (I-PEX 20448-001R-081 or equivalent)
EDGE (67 pin)	• Slot B compatible—Per the M.2 standard (*[8] PCI Express NGFF (M.2) Electromechanical Specification Revision 1.0*), a generic 75 pin position EDGE connector on the motherboard uses a mechanical key to mate with the 67 pin notched module connector. • Manufacturers include LOTES (part #APCI0018-P001A01), Kyocera, JAE, Tyco, and Longwell.
SIM	• Industry-standard connector. See SIM Interface on page 28 for details.

a. Manufacturers/part numbers are for reference only and are subject to change. Choose connectors that are appropriate for your own design.

Ordering Information

To order, contact the Sierra Wireless Sales Desk at +1 (604) 232-1488 between 8 AM and 5 PM Pacific Time.

Integration Requirements

Sierra Wireless provides, in the documentation suite, guidelines for successful module integration and offers integration support services as necessary.

When integrating the EM7565 Embedded Module, the following items must be addressed:

- **Mounting**—Effect on temperature, shock, and vibration performance
- **Power supply**—Impact on battery drain and possible RF interference
- **Antenna location and type**—Impact on RF performance
- **Regulatory approvals**—As discussed in Regulatory Compliance and Industry Certifications on page 60.
- **Service provisioning**—Manufacturing process
- **Software**—As discussed in Software Interface on page 54.
- **Host interface**—Compliance with interface voltage levels

⟩⟩ 2: Standards Compliance

The EM7565 Embedded Module complies with the mandatory requirements described in the following standards. The exact set of requirements supported is network operator-dependent.

Table 2-1: Standards Compliance

Technology	Standards
LTE	• 3GPP Release 12[a]
UMTS	• 3GPP Release 9

a. Some auxiliary functions support Release 13.

3: Electrical Specifications

The system block diagram in Figure 3-1 represents the EM7565 module integrated into a host system. The module includes the following interfaces to the host:

- Full_Card_Power_Off#—Input supplied to the module by the host—active-low to turn the unit off, or active-high to turn the unit on.
- W_DISABLE#—Active low input from the host to the EM7565 disables the main RF radio.
- GPS_DISABLE#—Active low input from the host to the EM7565 disables the GNSS radio receiver.
- WAKE_ON_WAN#—Active low output used to wake the host when specific events occur.
- WWAN_LED#—Active-low LED drive signal provides an indication of RADIO ON state, either WWAN or GNSS.
- RESET#—Active low input from the host used to reset the module.
- Antenna—Three RF connectors (main (Rx/Tx), GNSS, and auxiliary (diversity/MIMO/GNSS)). For details, see RF Specifications on page 35.
- Antenna control—Four signals that can be used to control external antenna switches.
- Dynamic power control—Signal used to adjust Tx power to meet FCC SAR requirements. For details, see Tx Power Control on page 53.).
- Dual SIM—Supported through the interface connector. The SIM cavities / connectors must be placed on the host device for this feature.
- SIM detect—Internal pullup on the module detects whether a SIM is present or not:
  - If a SIM is not inserted, the pin must be shorted to ground.
  - If a SIM is present, the pin will be an open circuit.
- USB—USB 2.0 and USB 3.0 interfaces to the host for data, control, and status information.
- PCIe port—Interface to the host for data. (Alternative to USB 3.0 interface.)

The EM7565 has two main interface areas—the host I/O connector and the RF ports. Details of these interfaces are described in the sections that follow.
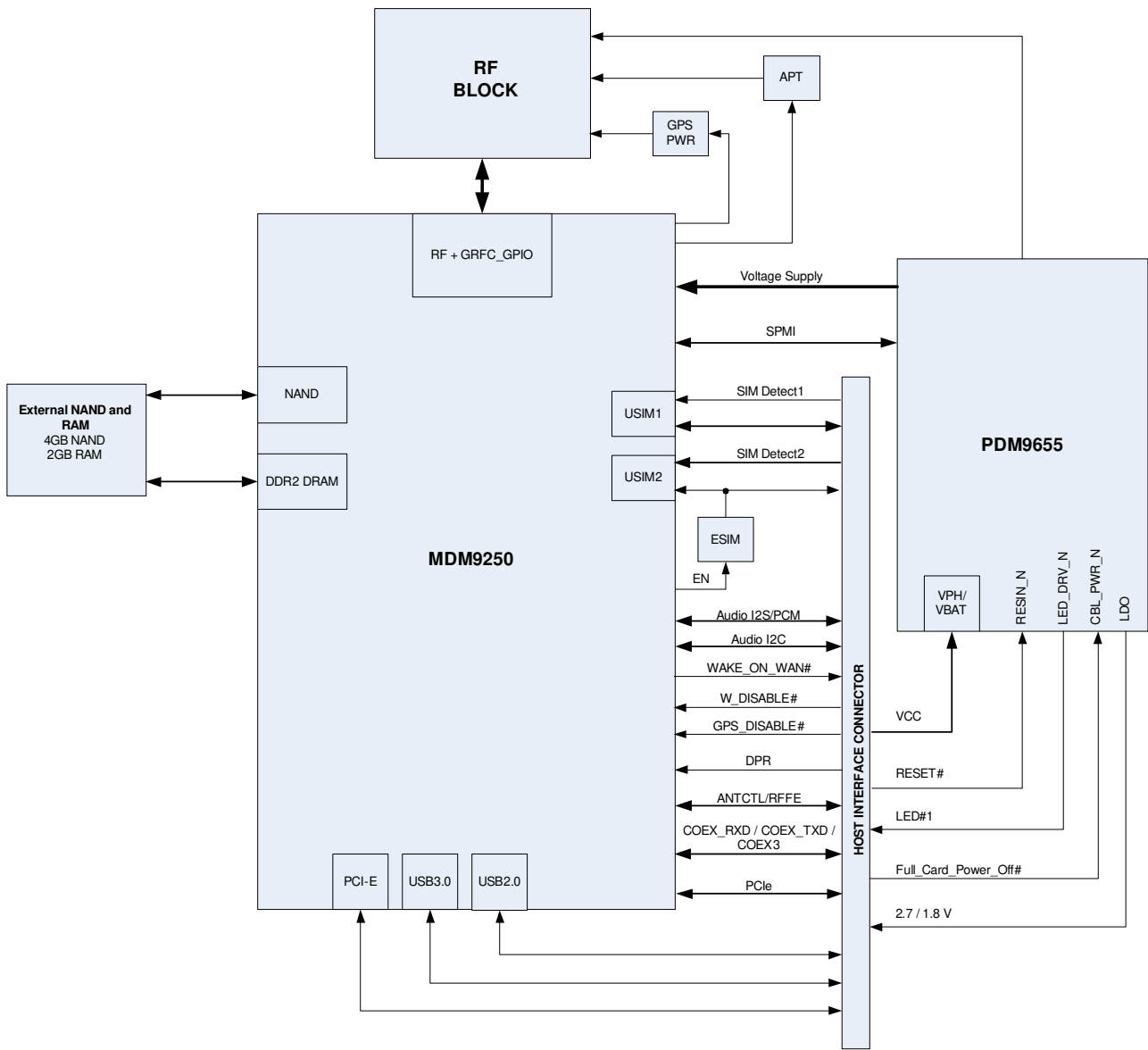
Figure 3-1: System Block Diagram
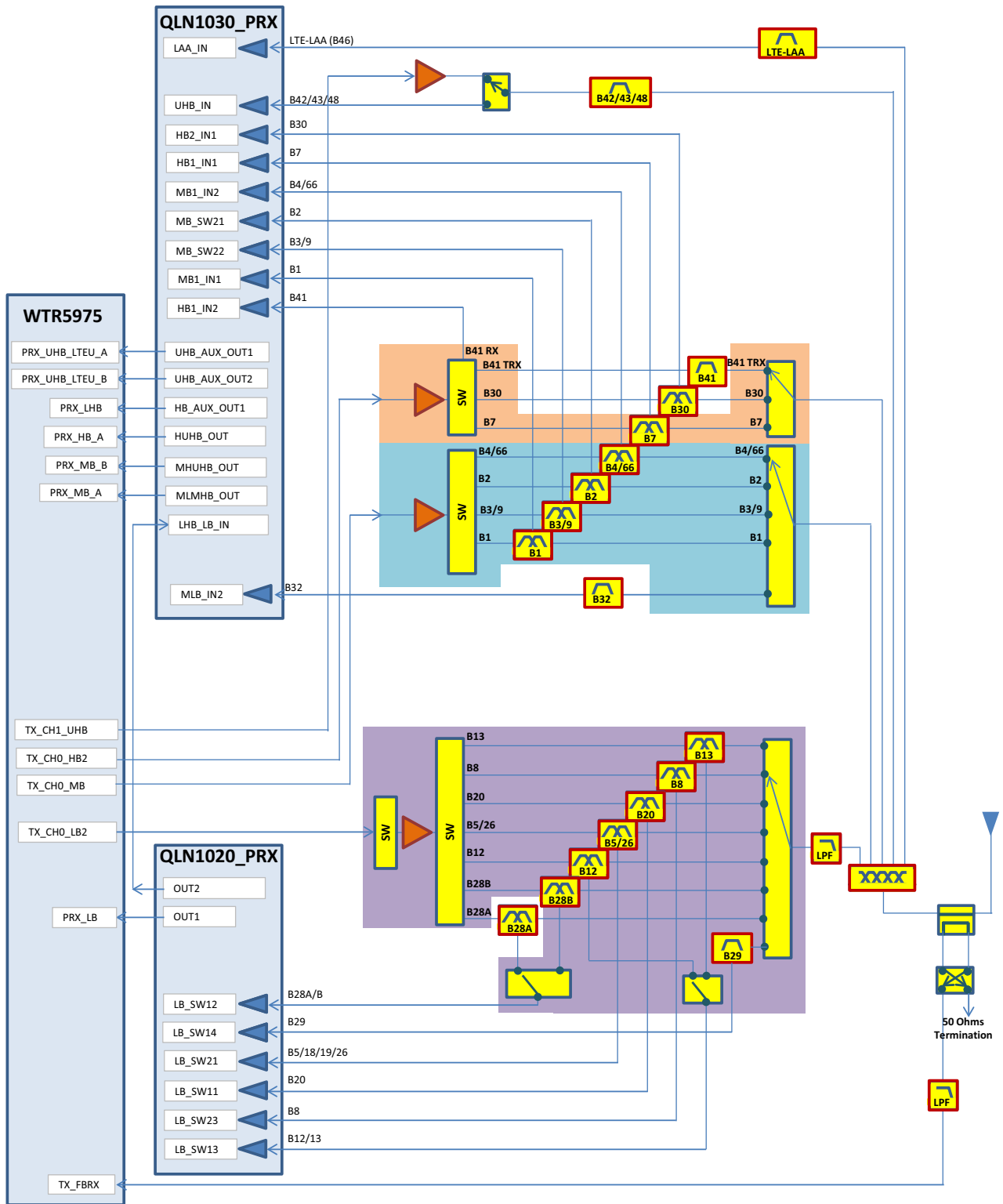
Figure 3-2: Expanded RF (Transmit) Block Diagram
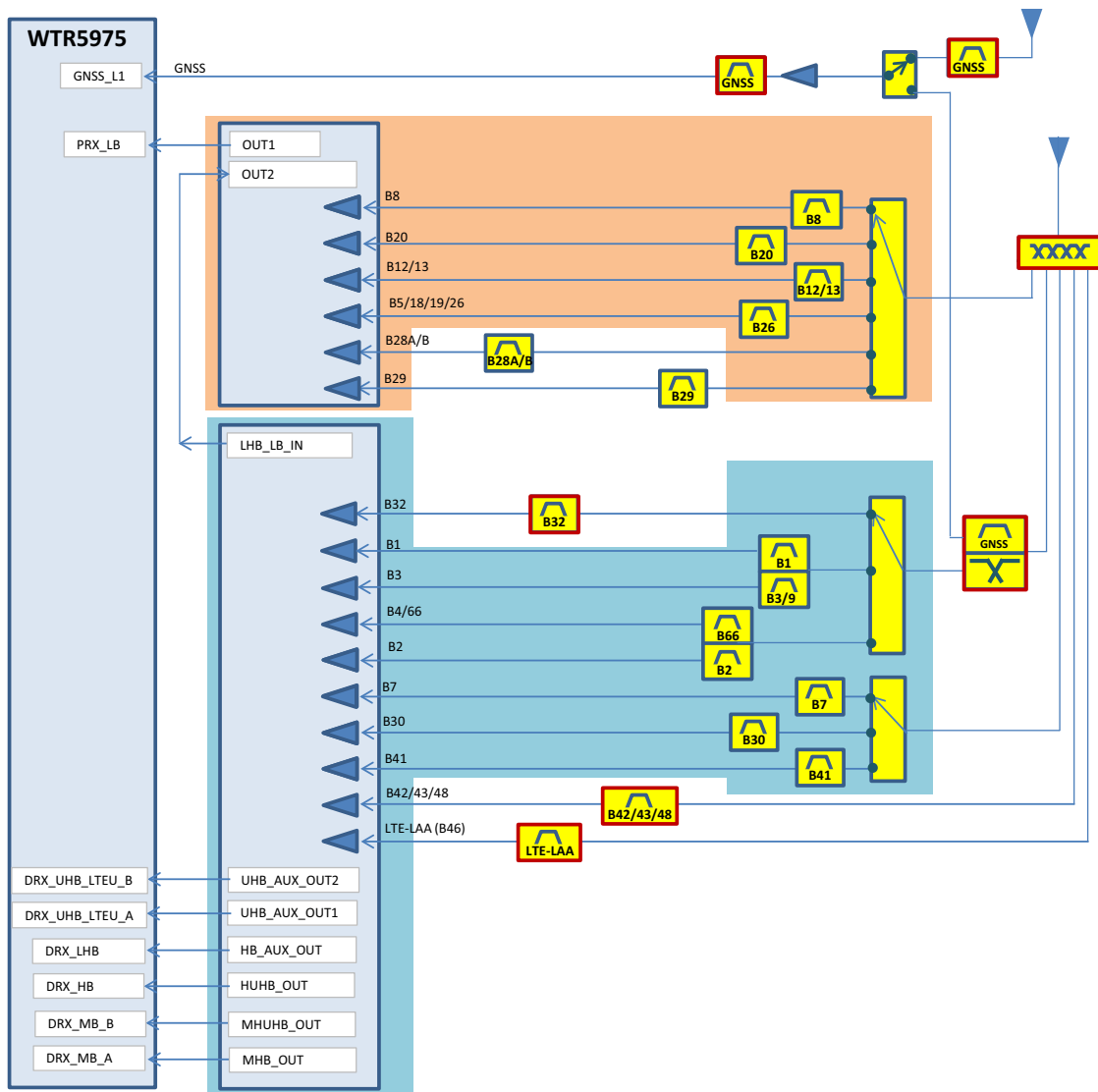
Figure 3-3: Expanded RF (Receive/GNSS) Block Diagram

Host Interface Pin Assignments

The EM7565 host I/O connector provides pins for power, serial communications, and control. Pin assignments are listed in Table 3-1.

Refer to the following tables for pin details based on interface types:

- Table 3-2, Power and Ground Specifications, on page 26
- Table 3-3, USB Interfaces, on page 26
- Table 3-5, SIM Interface Signals, on page 28
- Table 3-6, Module Control Signals, on page 31

> Note: On any given interface (USB, SIM, etc.), leave unused inputs and outputs as no-connects.

> Note: The host should not drive any signals to the module until >100 ms from the start of the power-on sequence.

Table 3-1: Host Interface (75-pin) Connections—Module View[a]

Pin	Signal name	Pin type[b]	Description	Direction[c]	Active state	Voltage levels (V)		
						Min	**Typ**	**Max**
1	CONFIG_3 (NC in default module configuration)		Reserved—Host must not repurpose this pin.					
2	VCC	V	Power source	Input	Power	3.135	3.7	4.4
3	GND	V	Ground	Input	Power	-	0	-
4	VCC	V	Power source	Input	Power	3.135	3.7	4.4
5	GND	V	Ground	Input	Power	-	0	-
6	Full_Card_Power_Off#[d]	PD	Turn modem on	Input	High	0.7	-	4.4
			Turn modem off	Input	Low	-0.3	-	0.5
7	USB_D+[d]	-	USB data positive	Input/Output	Differential	-	-	-
8	W_DISABLE#[e]	PU	Wireless Disable (main RF radio)	Input	Low	-	-	0.4
9	USB_D-[d]	-	USB data negative	Input/Output	Differential	-	-	-
10	WWAN_LED#	OC	LED Driver	Output	Low	0	-	0.15
11	GND	V	Ground	Input	Power	-	0	-
12	Key	Notch location						
13	Key	Notch location						
14	Key	Notch location						
15	Key	Notch location						
16	Key	Notch location						
17	Key	Notch location						
18	Key	Notch location						
19	Key	Notch location						
20	NC (For audio interface pin usage, see Audio Support on page 64.)		Reserved—Host must not repurpose this pin.					
21	CONFIG_0 (GND in default module configuration)		Reserved—Host must not repurpose this pin.	Output	-		0	

Table 3-1: Host Interface (75-pin) Connections — Module View[a] (Continued)

Pin	Signal name	Pin type[b]	Description	Direction[c]	Active state	Voltage levels (V)		
						Min	Typ	Max
22	NC (For audio interface pin usage, see Audio Support on page 64.)		Reserved—Host must not repurpose this pin.					
23	WAKE_ON_WAN#[d]	OC	Wake Host	Output	Low	0		0.1
24	NC (For audio interface pin usage, see Audio Support on page 64.)		Reserved—Host must not repurpose this pin.					
25	DPR	-	Dynamic power control	Input	High	1.17	1.80	2.10
				Input	Low	-0.3	-	0.63
26	GPS_DISABLE#[e]	PU	Wireless disable (GNSS radio)	Input	Low	-	-	0.4
27	GND	V	Ground	Input	Power	-	0	-
28	NC (For audio interface pin usage, see Audio Support on page 64.)		Reserved—Host must not repurpose this pin.					
29	USB3.0_TX-		USB 3.0 Transmit Data negative	Output	Differential	-	-	-
30	UIM1_RESET[d]	O	SIM Reset	Output	Low	0	-	0.45
					High	2.55 (3V SIM) 1.35 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.90 (1.8V SIM)
31	USB3.0_TX+		USB 3.0 Transmit Data positive	Output	Differential	-	-	-
32	UIM1_CLK[d]	O	SIM Clock	Output	Low	0	-	0.45
					High	2.55 (3V SIM) 1.35 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.90 (1.8V SIM)
33	GND	V	Ground	Input	Power	-	0	-

Table 3-1: Host Interface (75-pin) Connections — Module View[a] (Continued)

Pin	Signal name	Pin type[b]	Description	Direction[c]	Active state	Voltage levels (V)		
						Min	**Typ**	**Max**
34	UIM1_DATA[d]	-	SIM IO pin	Input	Low	-0.30 (3V SIM) -0.30 (1.8V SIM)	-	0.60 (3V SIM) 0.35 (1.8V SIM)
					High	2.10 (3V SIM) 1.17 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.30 (3V SIM) 2.10 (1.8V SIM)
				Output	Low	0	-	0.40
					High	2.55 (3V SIM) 1.35 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.90 (1.8V SIM)
35	USB3.0_RX-		USB 3.0 Receive Data negative	Input	Differential	-	-	-
36	UIM1_PWR[d]	V	SIM VCC supply	Output	Power	2.90 (3V SIM) 1.75 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.85 (1.8V SIM)
37	USB3.0_RX+		USB 3.0 Receive Data positive	Input	Differential	-	-	-
38	NC		Reserved					
39	GND	V	Ground	Input	Power	-	0	-
40	SIM_DETECT_2		SIM2 indication	Input		0 V — SIM not present Open circuit — SIM present		
41	PCIE_TXM		PCIe Negative Transmit Data	Output	Differential	-	-	-
42	UIM2_DATA[d]	-	SIM2 IO pin	Input	Low	-0.30 (3V SIM) -0.30 (1.8V SIM)	-	0.60 (3V SIM) 0.35 (1.8V SIM)
					High	2.10 (3V SIM) 1.17 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.30 (3V SIM) 2.10 (1.8V SIM)
				Output	Low	0	-	0.40
					High	2.55 (3V SIM) 1.35 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.90 (1.8V SIM)
43	PCIE_TXP		PCIe Positive Transmit Data	Output	Differential	-	-	-

Table 3-1: Host Interface (75-pin) Connections — Module View[a] (Continued)

Pin	Signal name	Pin type[b]	Description	Direction[c]	Active state	Voltage levels (V) Min	Voltage levels (V) Typ	Voltage levels (V) Max
44	UIM2_CLK[d]	O	SIM2 Clock	Output	Low	0	-	0.45
					High	2.55 (3V SIM) 1.35 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.90 (1.8V SIM)
45	GND	V	Ground	Input	Power	-	0	-
46	UIM2_RESET[d]	O	SIM2 Reset	Output	Low	0	-	0.45
					High	2.55 (3V SIM) 1.35 (1.8V SIM)	-	3.10 (3V SIM) 1.90 (1.8V SIM)
47	PCIE_RXM		PCIe Negative Receive Data	Input	Differential	-	-	-
48	UIM2_PWR[d]	V	SIM2 VCC supply	Output	Power	2.90 (3V SIM) 1.75 (1.8V SIM)	3.00 (3V SIM) 1.80 (1.8V SIM)	3.10 (3V SIM) 1.85 (1.8V SIM)
49	PCIE_RXP		PCIe Positive Receive Data	Input	Differential	-	-	-
50	PCIE_PERST_N		PCIe Reset	Input	Low	TBD	TBD	TBD
51	GND	V	Ground	Input	Power	-	0	-
52	PCIE_CLKREQ_N		PCIe Clock Request	Output	Low	TBD	TBD	TBD
53	PCIE_REFCLKM		PCIe Negative Reference Clock	Input	Differential	-	-	-
54	PCIE_PEWAKE_N		PCIe Wake	Output	Low	TBD	TBD	TBD
55	PCIE_REFCLKP		PCIe Positive Reference Clock	Input	Differential	-	-	-
56	NC (For audio interface pin usage, see Audio Support on page 64.)		Reserved—Host must not repurpose this pin.					
57	GND	V	Ground	Input	Power	-	0	-
58	NC (For audio interface pin usage, see Audio Support on page 64.)		Reserved—Host must not repurpose this pin.					
59	ANTCTL0 (GPIO1)		Customer-defined external switch control for multiple antennas	Output	High	1.35	-	1.80
				Output	Low	0	-	0.45
60	Reserved—Host must not repurpose this pin and should leave it not connected.							
61	ANTCTL1 (GPIO2)		Customer-defined external switch control for multiple antennas	Output	High	1.35	-	1.80
				Output	Low	0	-	0.45

Table 3-1: Host Interface (75-pin) Connections—Module View[a] (Continued)

Pin	Signal name	Pin type[b]	Description	Direction[c]	Active state	Voltage levels (V) Min	Typ	Max
62	Reserved—Host must not repurpose this pin and should leave it not connected.							
63	ANTCTL2 (GPIO3)		Customer-defined external switch control for multiple antennas	Output	High	1.35	-	1.80
				Output	Low	0	-	0.45
64	Reserved—Host must not repurpose this pin and should leave it not connected.							
65	ANTCTL3 (GPIO4)		Customer-defined external switch control for multiple antennas	Output	High	1.35	-	1.80
				Output	Low	0	-	0.45
66	SIM_DETECT[d]	PU	SIM indication	Input		0 V—SIM not present Open circuit—SIM present		
67	RESET#	PU	Reset module	Input	Low	-0.3		0.63
68	NC		Reserved					
69	CONFIG_1 (GND in default module configuration)		Reserved—Host must not repurpose this pin.	Output	-		0	
70	VCC	V	Power source	Input	Power	3.135	3.7	4.4
71	GND	V	Ground	Input	Power	-	0	-
72	VCC	V	Power source	Input	Power	3.135	3.7	4.4
73	GND	V	Ground	Input	Power	-	0	-
74	VCC	V	Power source	Input	Power	3.135	3.7	4.4
75	CONFIG_2 (NC in default module configuration)	V	Reserved	Output	-	-		-

a. All values are preliminary and subject to change.
b. I—Input; O—Digital output; OC—Open Collector output; PU—Digital input (internal pull up); PD—Digital input (internal pull down); V—Power or ground
c. Signal directions are from module's point of view (e.g. 'Output' from module to host, 'Input' to module from host.)
d. Required signal
e. Sierra Wireless recommends that the host implement an open collector driver where a Low signal will turn the module off or enter low power mode, and a high signal will turn the module on or leave low power mode.