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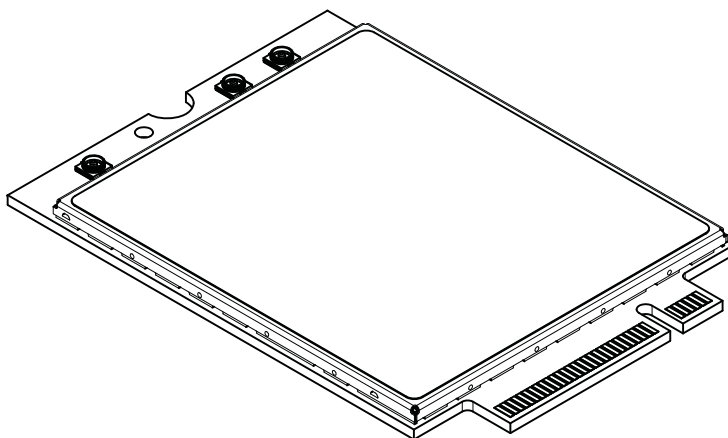
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Product Technical Specification & Customer Design Guidelines

AirPrime EM7455



SIERRA
WIRELESS®

4116236

Rev 9

Proprietary and Confidential
Contents subject to change

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Revision History

Revision number	Release date	Changes
1	September 2014	Initial release
2	October 2014	Updated data rates (Table 1-1), LTE features on page 17 , standards (Table 2-1), system block (Figure 3-1), Rx sensitivity (Table 4-4 , Table 4-5), Tx power tolerance band listings (Table 4-6), DC power consumption (Table 5-3)

Revision number	Release date	Changes
3	February 2015	<p>Updated Table 4-4 on page 48 (LTE sensitivity) Updated Table 4-5 on page 49 (UMTS sensitivity) Updated Table 4-6 on page 49 (Tx power) Corrected typo in Table 3-4 on page 32 (UIM_GND/UIM2_GND) Updated Table 4-7 on page 49 (# of satellites)</p>
4	June 2015	<p>Updated Carrier Aggregation combinations (Table 1-2 on page 16) Added Windows 8.1 and Windows 10 references Updated RF block diagram (Figure 3-2 on page 25) Updated Antenna control section Added Envelope correlation coefficient to Table B-1 on page 75 Removed RFFE Updated Table 5-1, Averaged standby DC power consumption, on page 49 Power consumption values measured at 25C (changed from 30) Removed LTE Band 17</p>
5	September 2015	<p>Added LTE B30 Removed LTE CA B30+B29 Updated Table 4-4 on page 48 (LTE sensitivity) Updated Table 4-5 on page 49 (UMTS sensitivity) Updated Table 4-6 on page 49 (Tx power) Updated Thermal considerations on page 64 (heatsink recommendation)</p>
6	September 2015	<p>Updated Table 5-1, Averaged standby DC power consumption, on page 51 Updated Table 5-2, Averaged call mode DC power consumption, on page 52 Updated Table 5-7, Power-on/off timing parameters (single enumeration), on page 56</p>
7	April 2016	<p>Updated module weight (Table 7-1 on page 61) Added notes indicating signals should not be driven until device is powered on, in Host interface pin assignments on page 25 and Power on/off timing on page 55. Added Packaging on page 97 Added signal strength for acquisition time values (Table 4-7 on page 49) Relabeled 'Max' column to 'Typ', specified voltage (Table 5-2 on page 52) Added max current value (Table 5-3 on page 52) Updated power-on/off timing values Updated temperature description/details to reflect device performance, including: <ul style="list-style-type: none"> • Physical features on page 16—Clarified temperature range as 'ambient'. • Physical features on page 16—Added AT!PCTEMP to note and adjusted suggested 'best performance' max temperature. • Table 5-5 on page 54—Added explanatory note for TEMP_HI_WARN state. • Table 7-1 on page 61—Clarified temperature range as 'ambient' Adjusted GNSS tracking sensitivity specification to -160 dBm from -161 dBm to reflect tolerance range of measurement (Table 4-7 on page 49). Added Figure 7-5, Copper Pad Location on Bottom Side of Module, on page 65. Updated USIM and USIM2 voltages in Table 3-1 on page 26. Added GPIO numbers to ANT_CTRL signal names in Table 3-1 on page 26. Modified note indicating USB2.0 and 3.0 support in USB interface on page 31. Added LTE bandwidth support (Table 4-2 on page 46) and LTE CA Bandwidth Support on page 101 Added minimum pulse width to RESET# description in Table 3-7 on page 38.</p>

Revision number	Release date	Changes
8	April 2016	Corrected indication of areas needing heat dissipation (bottom instead of top) in Thermal considerations on page 64 , and updated recommendation wording in general. Removed 'future' from Galileo support in Position location (GNSS) on page 18
9	May 2016	Corrected ripple voltage value in Power supply noise on page 56 Updated maximum current in Miscellaneous DC power consumption on page 52 Added 'Important' notes regarding Band 30 Tx output power, and Band 30 restriction for external vehicle antennas, in Important compliance information for North American users on page 68

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1: Introduction

The Sierra Wireless EM7455 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 MDM9230 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

Technology	Bands															Data Rates / Notes
	1	2	3	4	5	7	8	12	13	20	25	26	29	30	41	
LTE	F	F	F	F	F	F	F	F	F	F	F	F	F	F	T	Data rates: <ul style="list-style-type: none"> Downlink (Cat 6): FDD: 300 Mbps TDD: 222 Mbps Uplink (Cat 6): FDD: 50 Mbps TDD: 26 Mbps Notes: <ul style="list-style-type: none"> Downlink MIMO support (2x2; 4x2) F=FDD; T= TDD
DC-HSPA+ HSPA+ UMTS	Y	Y	Y	Y	Y		Y							N/A	Data rates: <ul style="list-style-type: none"> Downlink (Cat 24): Up to 42 Mbps Uplink (Cat 6): Up to 5.76 Mbps Notes: <ul style="list-style-type: none"> Diversity support 	
GNSS	<ul style="list-style-type: none"> GPS: 1575.42 MHz GLONASS: 1602 MHz BeiDou: 1561.098 MHz Galileo¹: 1575.42 MHz 															

1. Future firmware upgrade

Table 1-2: Carrier Aggregation combinations

1 + 8
2 + 2/5/12/13/29
3 + 7/20
4 + 4/5/12/13/29
5 + 2/4/30
7 + 3/7/20
8 + 1
12 + 2/4/30
13 + 2/4
20 + 3/7
30 + 5/12
41 + 41

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 +70°C
 - Class B (operational, non-3GPP compliant): -40°C to +85°C (reduced operating parameters required)

Important: *The internal module temperature (reported by AT!PCTEMP) must be kept below 90°C. For best performance, the internal module temperature should be kept below 80°C. Proper mounting, heat sinks, and active cooling may be required, depending on the integrated application.*

Application interface features

- USB interface (QMI) for Windows 7, Linux, and Android
- MBIM for Windows 8.1 and Windows 10
- 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 EM74xx/MC74xx AT Command Reference (Doc# 4117727)*

- Software Development Kits (SDK), including API (Application Program Interface) functions:
 - Windows 7, 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)
- OMA DM (Open Mobile Alliance Device Management)
- FOTA (Firmware Over The Air)

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

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 profile
 - Release 99 QoS negotiation—Background, Interactive, and Streaming
 - Release 97—Precedence Class, Reliability Class, Delay Class, Peak Throughput, Mean Throughput
- 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). IP Packet Data Protocol context supports dual 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

- 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 for LTE
- Mobile-originated and mobile-terminated SMS over SGs for LTE

Position location (GNSS)

- Customizable tracking session
- Automatic tracking session on startup
- Concurrent standalone GPS, GLONASS, Galileo, and BeiDou
- Assisted GPS (A-GPS) SUPL1.0
- Assisted GPS/GLONASS SUPL2.0
- gpsOneXTRA 3.0 with GPS + GLONASS + BeiDou support
- GPS/GLONASS on dedicated connector or diversity connector
- BeiDou on dedicated connector, or on diversity connector with reduced performance
- Galileo on dedicated connector or diversity connector (future firmware upgrade)

Supporting documents

Several additional documents describe module design, usage, integration, and other features. See [References on page 99](#).

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 EM7455 Embedded Module into your host device.

Table 1-3: Required host-module connectors¹

Connector type	Description
RF cables	<ul style="list-style-type: none"> • Mate with M.2-spec connectors • Three connector jacks (I-PEX 20448-001R-081 or equivalent)
EDGE (67 pin)	<ul style="list-style-type: none"> • Slot B compatible—Per the M.2 standard (<i>[8] PCI Express NGFF (M.2) Electromechanical Specification Revision 1.0</i>), 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	<ul style="list-style-type: none"> • Industry-standard connector. See SIM interface on page 32 for details.

1. 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 EM7455 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 67](#).
- **Service provisioning**—Manufacturing process
- **Software**—As discussed in [Software Interface on page 59](#).
- **Host interface**—Compliance with interface voltage levels

2: Standards Compliance

The EM7455 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	<ul style="list-style-type: none">• 3GPP Release 11
UMTS	<ul style="list-style-type: none">• 3GPP Release 9

3: Electrical Specifications

The system block diagram in [Figure 3-1](#) represents the EM7455 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_DISABLE1#**—Active low input from the host to the EM7455 disables the main RF radio.
- **W_DISABLE2#**—Active low input from the host to the EM7455 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 41](#).
- **Antenna control**—Four signals that can be used to control external antenna switches—two for high band, and two for low band.
- **Dynamic power control**—Signal used to adjust Tx power to meet FCC SAR requirements. For details, see [Tx power control on page 57](#)).
- **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.
- **COEX**—Three signals that can be used to implement wireless coexistence between the unit's radio and other radios.

The EM7455 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.

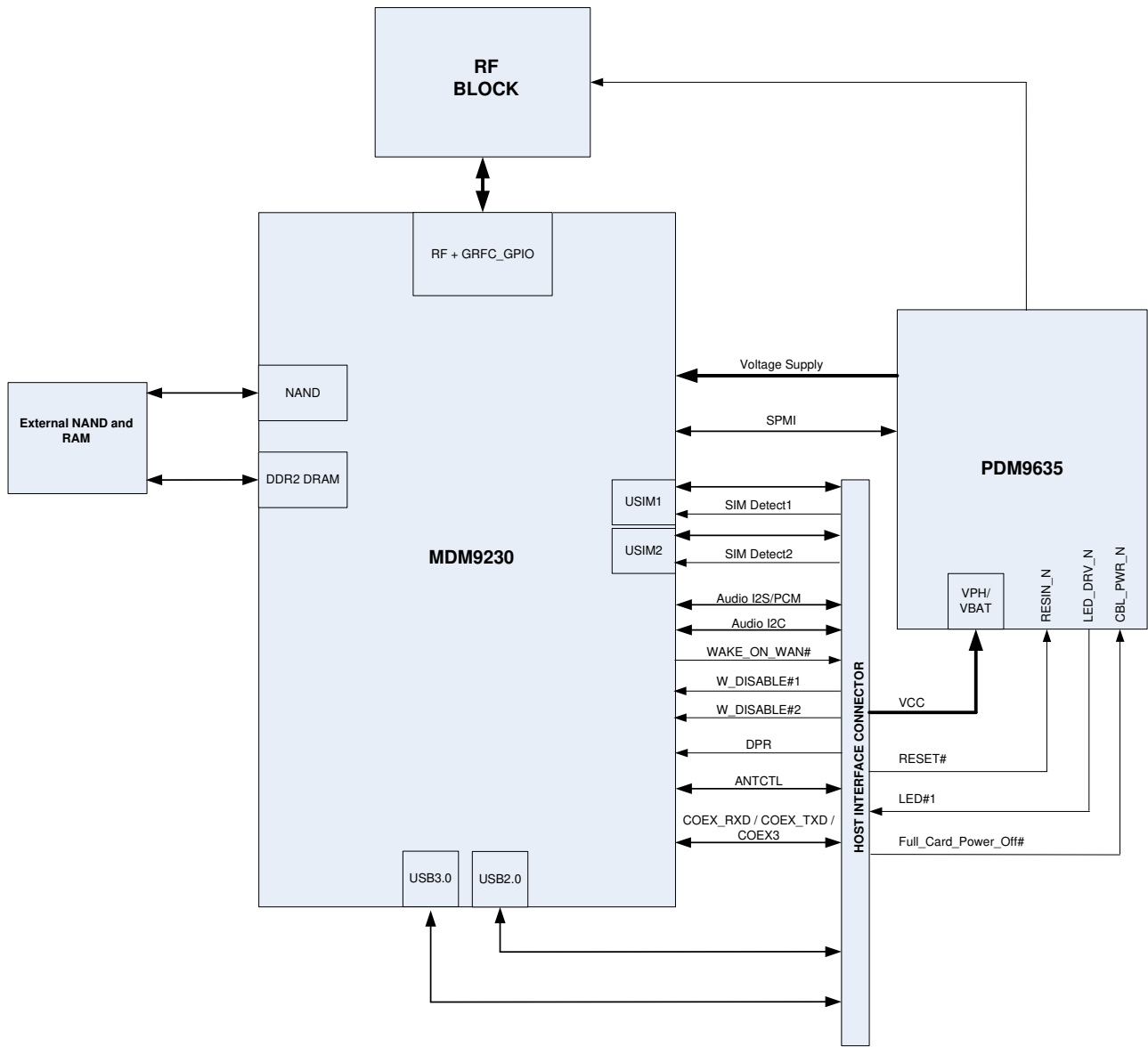


Figure 3-1: System block diagram

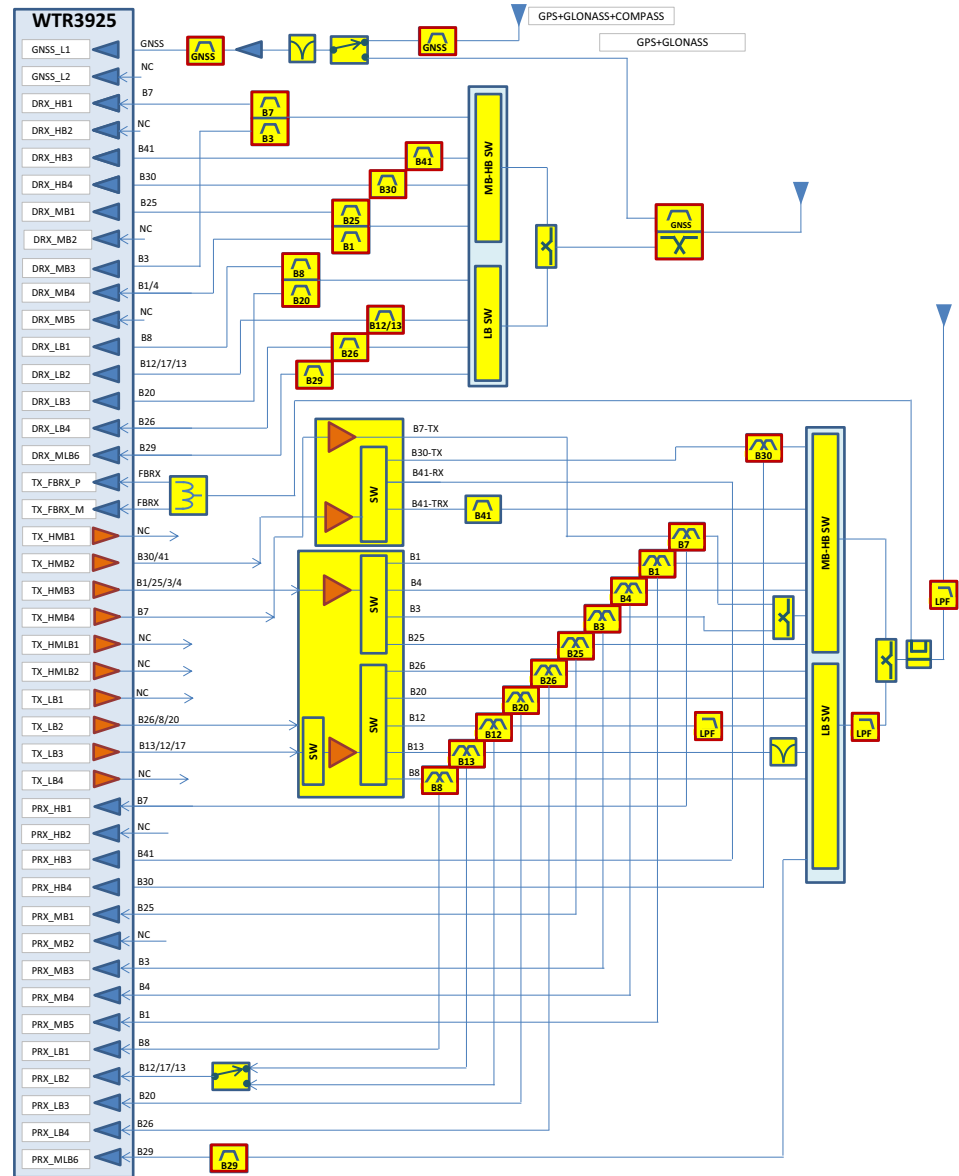


Figure 3-2: Expanded RF block diagram

Host interface pin assignments

The EM7455 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 31
- [Table 3-3, USB interfaces](#), on page 31
- [Table 3-4, SIM interface signals](#), on page 32
- [Table 3-5, Module control signals](#), on page 35