CELLULAR

MPCI-L2 series

LTE/DC-HSPA+/EGPRS Mini PCIe modules

Data Sheet

Abstract

Technical data sheet describing MPCI-L2 series multi-mode cellular modules. The modules are a complete and cost efficient LTE/3G/2G multi-mode solution offering up to 150 Mb/s download data rate and up to 50 Mb/s upload data rate, covering up to six LTE bands, up to five WCDMA/DC-HSPA+ bands and up to four GSM/EGPRS bands. The modules have the industry standard PCI Express Mini Card form factor, which enables easy integration into an application board and is also ideal for manufacturing of small series.



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This document applies to the following products:

Name	Type number	Firmware version	Application version	PCN / IN
MPCI-L200	MPCI-L200-00S-00	09.71	A01.15	UBX-14044437
	MPCI-L200-00S-01	09.71	A01.30	UBX-16026448
	MPCI-L200-02S-00	15.90	A01.00	UBX-15029946
MPCI-L201	MPCI-L201-01S-00	09.93	A01.07	UBX-15031360
	MPCI-L201-02S-00	09.93	A01.20	UBX-16022569
MPCI-L210	MPCI-L210-00S-00	09.71	A01.15	UBX-14044437
	MPCI-L210-02S-00	15.63	A01.03	UBX-15029946
	MPCI-L210-60S-00	09.94	A01.00	UBX-15021694
	MPCI-L210-60S-01	09.94	A01.01	UBX-16005471
MPCI-L220	MPCI-L220-02S-00	15.93	A01.00	UBX-16025501
MPCI-L280	MPCI-L280-02S-00	15.63	A01.03	UBX-15029946

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1 Functional description

1.1 Overview

The MPCI-L2 series comprises complete and cost efficient LTE/3G/2G multi-mode cellular modules in the industry standard PCI Express Mini Card form factor, which enables an easy integration into an application board and it is also ideal for manufacturing of small series.

MPCI-L2modules support up to six LTE bands, up to five UMTS/DC-HSPA+ bands and up to four GSM/(E)GPRS bands for data transmission over different regions and network operators.

With LTE Category 4 data rates of 150 Mb/s (downlink) and 50 Mb/s (uplink), the modules are ideal for applications requiring the highest data-rates and high-speed internet access.

Typical applications are industrial computing, ruggedized terminals, video communications, wireless routers, alarm panels and surveillance, digital signage and payment systems.

1.2 Product features

Module	LTE		UMTS			GSM		Interfaces					Audio		Features								Grade		
	LTE FDD category	Bands	HSDPA category	HSUPA category	Bands	GPRS/EDGE multi-slot class	Bands	UART	USB 2.0	SDIO (Master)	DDC (I^2C)	GPIOs	Analog audio	Digital audio	Network indication	Antenna supervisor	MIMO 2x2 / Rx Diversity	Jamming detection	Embedded TCP/UDP stack	Embedded HTTP,FTP	FOTA	Dual stack IPv4/IPv6	Standard	Professional	Automotive
MPCI-L200	4	2,4,5 7,17	24	6	850/900 AWS 1900/2100	12	Quad		●						●		●		■	■	■	●			
MPCI-L201	4	2,4,5 13,17	24	6	850/1900				●						●		●		●	●	●	●			
MPCI-L210	4	1,3,5 7,8,20	24	6	850/900 1900/2100	12	Quad		●						●		●		■	■	■	●			
MPCI-L220	4	1,3,5 8,19	24	6	850/900 2100				●						●		●		●	●	●	●			
MPCI-L280	4	1,3,5 7,8,28	24	6	850/900 1900/2100	12	Quad		●						●		●		●	●	●	●			

● = supported by all product versions ■ = supported by all product versions except versions "00","60"

Table 1: MPCI-L2 series main features summary

1.3 Block diagram

As described Figure 1, each MPCI-L2 series module integrates one TOBY-L2 series module, which represents the core of the device, providing the related LTE/3G/2G modem and processing functionalities. Additional signal conditioning circuitry is implemented for PCI Express Mini Card compliance, and two U.FL connectors are available for easy antennas integration.

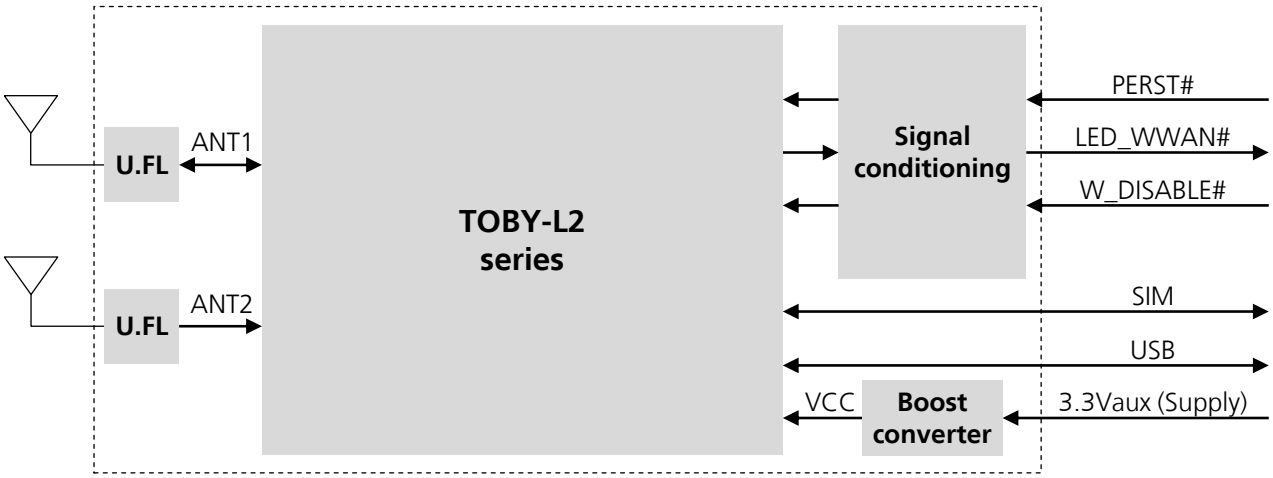


Figure 1: MPCI-L2 series block diagram

1.4 Product description

MPCI-L2 series modules provide 4G LTE, 3G WCDMA/DC-HSPA+, 2G GSM/(E)GPRS multi-mode technology:

- MPCI-L200 and MPCI-L201 are mainly designed for operation in America
- MPCI-L210 is mainly designed for operation in Europe, Asia and other countries
- MPCI-L220 is mainly designed for operation in Japan
- MPCI-L280 is mainly designed for operation in south-east Asia and Oceania

4G LTE	3G UMTS/HSDPA/HSUPA	2G GSM/GPRS/EDGE
3GPP Release 9 Long Term Evolution (LTE) Evolved Uni.Terrestrial Radio Access (E-UTRA) Frequency Division Duplex (FDD) DL Multi-Input Multi-Output (MIMO) 2 x 2	3GPP Release 8 Dual-Cell HS Packet Access (DC-HSPA+) UMTS Terrestrial Radio Access (UTRA) Frequency Division Duplex (FDD) DL Rx diversity	3GPP Release 8 Enhanced Data rate GSM Evolution (EDGE) GSM EGPRS Radio Access (GERA) Time Division Multiple Access (TDMA) DL Advanced Rx Performance Phase 1

Band support[1]:
• MPCI-L200:
  • Band 17 (700 MHz)
  • Band 5 (850 MHz)
  • Band 4 (1700 MHz)
  • Band 2 (1900 MHz)
  • Band 7 (2600 MHz)
• MPCI-L201:
  • Band 17 (700 MHz)
  • Band 13 (750 MHz)
  • Band 5 (850 MHz)
  • Band 4 (1700 MHz)
  • Band 2 (1900 MHz)
• MPCI-L210:
  • Band 20 (800 MHz)
  • Band 5 (850 MHz)
  • Band 8 (900 MHz)
  • Band 3 (1800 MHz)
  • Band 1 (2100 MHz)
  • Band 7 (2600 MHz)
• MPCI-L220:
  • Band 19 (850 MHz)
  • Band 5 (850 MHz)
  • Band 8 (900 MHz)
  • Band 3 (1800 MHz)
  • Band 1 (2100 MHz)
• MPCI-L280:
  • Band 28 (750 MHz)
  • Band 5 (850 MHz)
  • Band 8 (900 MHz)
  • Band 3 (1800 MHz)
  • Band 1 (2100 MHz)
  • Band 7 (2600 MHz)
	Band support:
	• MPCI-L200:
	  • Band 5 (850 MHz)
	  • Band 8 (900 MHz)
	  • Band 4 (AWS, i.e. 1700 MHz)
	  • Band 2 (1900 MHz)
	  • Band 1 (2100 MHz)
	• MPCI-L201:
	  • Band 5 (850 MHz)
	  • Band 2 (1900 MHz)
	• MPCI-L210:
	  • Band 5 (850 MHz)
	  • Band 8 (900 MHz)
	  • Band 2 (1900 MHz)
	  • Band 1 (2100 MHz)
	• MPCI-L220:
	  • Band 19 (850 MHz)
	  • Band 8 (900 MHz)
	  • Band 1 (2100 MHz)
	• MPCI-L280:
	  • Band 5 (850 MHz)
	  • Band 8 (900 MHz)
	  • Band 2 (1900 MHz)
	  • Band 1 (2100 MHz)
		Band support:
		• MPCI-L200:
		  • GSM 850 MHz
		  • E-GSM 900 MHz
		  • DCS 1800 MHz
		  • PCS 1900 MHz
		• MPCI-L210:
		  • GSM 850 MHz
		  • E-GSM 900 MHz
		  • DCS 1800 MHz
		  • PCS 1900 MHz
		• MPCI-L280:
		  • GSM 850 MHz
		  • E-GSM 900 MHz
		  • DCS 1800 MHz
		  • PCS 1900 MHz

[1] MPCI-L2 series modules support all the E-UTRA channel bandwidths for each operating band according to 3GPP TS 36.521-1 [11].

4G LTE	3G UMTS/HSDPA/HSUPA	2G GSM/GPRS/EDGE
LTE Power Class • Class 3 (23 dBm) for LTE mode	WCDMA/HSDPA/HSUPA Power Class • Class 3 (24 dBm) for UMTS/HSDPA/HSUPA mode	GSM/GPRS (GMSK) Power Class • Class 4 (33 dBm) for GSM/E-GSM band • Class 1 (30 dBm) for DCS/PCS band EDGE (8-PSK) Power Class • Class E2 (27 dBm) for GSM/E-GSM band • Class E2 (26 dBm) for DCS/PCS band

Data rate
• LTE category 4: up to 150 Mb/s DL, 50 Mb/s UL
	Data rate
	• MPCI-L200, MPCI-L201:
	  • HSDPA cat.14, up to 21 Mb/s DL[2]
	  • HSUPA cat.6, up to 5.6 Mb/s UL
	• MPCI-L210, MPCI-L220, MPCI-L280:
	  • HSDPA cat.24, up to 42 Mb/s DL
	  • HSUPA cat.6, up to 5.6 Mb/s UL
		Data rate[3]
		• GPRS multi-slot class 12[4], CS1-CS4, up to 85.6 kb/s DL/UL
		• EDGE multi-slot class 12[4], MCS1-MCS9 up to 236.8 kb/s DL/UL

Table 2: MPCI-L2 series LTE, 3G and 2G characteristics

1.5 AT command support

The MPCI-L2 series modules support AT commands according to 3GPP standards TS 27.007 [1], 27.005 [2] and the u-blox AT command extension.

For the complete list of all the supported AT commands and their syntax, see the u-blox AT Commands Manual [3].

RIL (Radio Interface Layer) software for Android is available for MPCI-L2 series modules free of charge. See the Android RIL Production delivery [4] application note for the supported software deliveries and more information.

[2] HSDPA category 24 capable
[3] GPRS/EDGE multi-slot class determines the number of timeslots available for upload and download and thus the speed at which data can be transmitted and received, with higher classes typically allowing faster data transfer rates.
[4] GPRS/EDGE multi-slot class 12 implies a maximum of 4 slots in DL (reception) and 4 slots in UL (transmission) with 5 slots in total.

1.6 Supported features

Table 3 lists some of the main features supported by MPCI-L2 series modules. For more details see the TOBY-L2 / MPCI-L2 System Integration Manual [5] and u-blox AT Commands Manual [3].

Feature	Description
Network Indication	LED_WWAN# signal provides the Wireless Wide Area Network status indication as specified by the PCI Express Mini Card Electromechanical Specification [9].
Embedded TCP and UDP stack[5]	Embedded TCP/IP and UDP/IP stack including the Direct Link mode for TCP and UDP sockets. Sockets can be set in Direct Link mode to establish a transparent end to end communication with an already connected TCP or UDP socket via serial interface.
FTP[5], FTPS[6]	File Transfer Protocol as well as Secure File Transfer Protocol (SSL encryption of FTP control channel) functionalities are supported via AT commands.
HTTP[5], HTTPS[6]	Hyper-Text Transfer Protocol as well as Secure Hyper-Text Transfer Protocol (SSL encryption) functionalities are supported via AT commands.
Embedded TLS 1.2[6]	With the support of X.509 certificates, Embedded TLS 1.2 provides server and client authentication, data encryption, data signature and enables TCP/IP applications communicate over a secured and trusted connection. The feature can be configured and enabled by +USECMNG and +USECPRF AT commands.
DNS[5]	Support for DNS functionality.
Dual stack IPv4/IPv6	Both Internet Protocol version 4 and Internet Protocol version 6 are supported in parallel.
BIP[5]	Bearer Independent Protocol for Over-the-Air SIM provisioning. The data transfer to/from the SIM uses either an already active PDP context or a new PDP context established with the APN provided by the SIM card.
Multiple PDP contexts	Up to 8 PDP contexts can be activated, and multi secondary PDP contexts be associated to a primary PDP context
SMS via IMS[7]	Allows SMS via embedded IP Multimedia Subsystem (IMS)
Firmware update Over AT commands (FOAT)	Firmware module upgrade over AT command interface (USB). The feature can be enabled and configured through the +UFWUPD AT command.
Firmware update Over The Air (FOTA)[5]	Firmware module update over the LTE/3G/2G air interface. The feature can be enabled and configured through the +UFWINSTALL AT command.
LTE DL MIMO 2x2 and 3G DL Rx Diversity	Improved cellular link quality and reliability on all operating bands.
Smart Temperature Supervisor[8]	Constant monitoring of the module board temperature: • Warning notification when the temperature approaches an upper or lower predefined threshold • Shutdown notified and forced when the temperature value is outside the specified range (shutdown suspended in case of an emergency call in progress) The Smart Temperature Supervisor feature can be enabled and configured through the +USTS AT command. ☞ The sensor measures board temperature, which can differ from ambient temperature.
Power saving	The power saving configuration is by default disabled, but it can be configured using the +UPSV AT command. When power saving is enabled, the module automatically enters the low power idle-mode whenever possible, reducing current consumption. During idle-mode, the module processor core runs with the internal RTC 32 kHz reference clock.
Fast Dormancy	The Fast Dormancy feature, defined in 3GPP Rel.8, allows reduction of current consumption and network utilization during periods of data inactivity. It can be activated by +UFDAC and +UDCONF=61 AT commands.

Table 3: Some of the main features supported by MPCI-L2 series modules

[5] Not supported by "00" and "60" product versions
[6] Not supported by "00", "01", "60" and MPCI-L201-02S product versions.
[7] Not supported by "00", "60", MPCI-L200-02S, MPCI-L210-02S, MPCI-L220-02S and MPCI-L280-02S product versions.
[8] Not supported by "00", "01" and "60" product versions.

2 Interfaces

2.1 Module supply input

MPCI-L2 series modules must be supplied through the **3.3Vaux** pins by a DC power supply. The voltage must be stable, because during this operation the current drawn from **3.3Vaux** can vary significantly, based on the power consumption profile of the LTE/3G/2G systems (see TOBY-L2 / MPCI-L2 System Integration Manual [5]).

2.2 Antenna RF interfaces

The modules have two RF interfaces over two standard U.FL connectors (Hirose U.FL-R-SMT) with a characteristic impedance of 50 Ω. The primary RF port (**ANT1**) supports both Tx and Rx, providing the main antenna interface, while the secondary RF port (**ANT2**) supports Rx only for the LTE MIMO 2x2 and 3G Rx diversity configurations.

2.3 System functions

2.3.1 Module power-on

MPCI-L2 series can be switched on by:

- Rising edge on the **3.3Vaux** pin to a valid voltage for module supply, i.e. applying module supply.

2.3.2 Module power-off

MPCI-L2 series can be properly switched off by:

- Sending the AT+CFUN=127 command (see the u-blox AT Commands Manual [3]) to configure the module in the halt mode, and then removing the **3.3Vaux** supply. In this way, the current parameter settings are saved in the module's non-volatile memory and a proper network detach is performed.

An abrupt under-voltage shutdown occurs on MPCI-L2 modules when the **3.3Vaux** supply is suddenly removed. If this is done without previously configuring the module in the halt mode, the storage of the current parameter settings in the module's non-volatile memory and the proper network detach are not performed.

An over-temperature or an under-temperature shutdown occurs on MPCI-L2 modules when the temperature measured within the cellular module reaches the dangerous area, if the optional Smart Temperature Supervisor feature (not supported by the "00", "01" and "60" product versions) is enabled and configured by the AT+USTS command. For more details see the TOBY-L2 / MPCI-L2 System integration Manual [5] and the u-blox AT Commands Manual [3].

2.3.3 Module reset

MPCI-L2 series can be reset (rebooted) by:

- AT+CFUN command (see the u-blox AT Commands Manual [3]).
- AT+CPWROFF command (see the u-blox AT Commands Manual [3]): this behavior differs than TOBY-L2 modules, where MPCI-L2 series modules will boot back up, rather than remain powered off, due to the MPCI-L2 series module's internal configuration.

In both cases, an "internal" or "software" reset of the module is executed: the current parameter settings are saved in the module's non-volatile memory and a proper network detach is performed.

An abrupt "external" or "hardware" reset of MPCI-L2 series modules occurs when a low level is applied on the **PERST#** pin (which is normally set high by an internal pull-up) for a valid time period (see section 4.2.7). In this case the current parameter settings are not saved in the module's non-volatile memory and a proper network detach is not performed. **PERST#** line should be driven by open drain, open collector or contact switch.

2.4 SIM interface

A SIM card interface is provided on the **UIM_PWR**, **UIM_DATA**, **UIM_CLK**, **UIM_RESET** pins of the system connector as well as on a micro-SIM (3FF) card holder solderable on the back side of the board: the high-speed SIM/ME interface is implemented as well as the automatic detection of the required SIM supporting voltage.

Both 1.8 V and 3 V SIM types are supported (1.8 V and 3 V ME). Activation and deactivation with automatic voltage switch from 1.8 V to 3 V is implemented, according to ISO-IEC 7816-3 specifications. The SIM driver supports the PPS procedure for baud-rate selection, according to the values proposed by the SIM card/chip.

2.5 USB interface

MPCI-L2 series modules include a high-speed USB 2.0 compliant interface with maximum 480 Mb/s data rate, representing the interface for any communication with an external host application processor. The module itself acts as a USB device and can be connected to any USB host equipped with compatible drivers.

The **USB_D+** / **USB_D-** lines carry the USB serial bus data and signaling, providing all the functionalities for the bus attachment, configuration, enumeration, suspension or remote wakeup according to the Universal Serial Bus Revision 2.0 specification [6].

MPCI-L2 series modules provide by default the following set of USB functions:

- CDC-ACM modem: AT commands interface is available over this modem COM port
- RNDIS network adapter: Ethernet-over-USB connection is available over this network adapter

The USB of MPCI-L2 series modules can be configured by the AT+UUSBCONF command to select different sets of USB functions available in a mutually exclusive way. The configured USB profile can thus consist of a specific set of functions with various capabilities and purposes, such as:

- CDC-ACM for AT commands and data
- CDC-ACM for diagnostic
- RNDIS for Ethernet-over-USB
- CDC-ECM for Ethernet-over-USB

For more details regarding USB configurations and capabilities, see the TOBY-L2 / MPCI-L2 System integration Manual [5] and the u-blox AT Commands Manual [3], +UUSBCONF AT command.

USB drivers are available for the following operating system platforms:

- Windows Vista
- Windows 7
- Windows 8
- Windows 8.1
- Windows 10
- Windows Embedded CE 6.0[9]
- Windows Embedded Compact 7[9]
- Windows Embedded Compact 2013[9]

MPCI-L2 series modules are compatible with standard Linux/Android USB kernel drivers.

[9] For more details see the Windows Embedded OS USB Driver Installation Application Note [7]

2.6 W_DISABLE#

MPCI-L2 series includes the **W_DISABLE#** active-low input signal to disable the radio operations as specified by the PCI Express Mini Card Electromechanical Specification [9].

2.7 LED_WWAN#

MPCI-L2 series includes the **LED_WWAN#** active-low open drain output to provide the Wireless Wide Area Network status indication as specified by the PCI Express Mini Card Electromechanical Specification [9].

3 Pin definition

3.1 Pin assignment

No	PCI Express Mini Card E.M. Spec. Rev. 2.0	MPCI-L2	Voltage domain	I/O	Description	Remarks
1	WAKE#	NC		N/A		Internally not connected
2	3.3Vaux	3.3Vaux	3.3Vaux	I	MPCI supply input	Connect to external 3.3 V supply. See 4.2.2 for detailed electrical specs.
3	COEX1	NC		N/A		Internally not connected
4	GND	GND	GND	N/A	Ground	Connect to ground
5	COEX2	NC		N/A		Internally not connected
6	1.5V	NC		N/A		Internally not connected
7	CLKREQ#	NC		N/A		Internally not connected
8	UIM_PWR	UIM_PWR	SIM	O	SIM supply output	1.8 V or 3.0 V output according to the SIM card/chip voltage type. See 4.2.6 for detailed electrical specs.
9	GND	GND	GND	N/A	Ground	Connect to ground
10	UIM_DATA	UIM_DATA	SIM	I/O	SIM data input/output	Internal 4.7 kΩ pull-up to UIM_PWR. See 4.2.6 for detailed electrical specs.
11	REFCLK-	NC		N/A		Internally not connected
12	UIM_CLK	UIM_CLK	SIM	O	SIM clock output	3.25 MHz output for SIM card/chip. See 4.2.6 for detailed electrical specs.
13	REFCLK+	NC		N/A		Internally not connected
14	UIM_RESET	UIM_RESET	SIM	O	SIM reset output	Reset output for SIM card/chip. See 4.2.6 for detailed electrical specs.
15	GND	GND	GND	N/A	Ground	Connect to ground
16	UIM_SPU	NC		N/A		Internally not connected
17	UIM_IC_DM	NC		N/A		Internally not connected
18	GND	GND	GND	N/A	Ground	Connect to ground
19	UIM_IC_DP	NC		N/A		Internally not connected
20	W_DISABLE1#	W_DISABLE#		I	Wireless disable input	Internal 22 kΩ pull-up to 3.3Vaux. See 4.2.8 for detailed electrical specs.
21	GND	GND	GND	N/A	Ground	Connect to ground
22	PERST#	PERST#		I	MPCI reset input	Internal 45 kΩ active pull-up to 3.3 V. See 4.2.7 for detailed electrical specs.
23	PERn0	NC		N/A		Internally not connected
24	3.3Vaux	3.3Vaux	3.3Vaux	I	MPCI supply input	Connect to external 3.3 V supply. See 4.2.2 for detailed electrical specs.
25	PERp0	NC		N/A		Internally not connected
26	GND	GND	GND	N/A	Ground	Connect to ground
27	GND	GND	GND	N/A		Connect to ground
28	1.5V	NC		N/A		Internally not connected
29	GND	GND	GND	N/A	Ground	Connect to ground
30	SMB_CLK	NC		N/A		Internally not connected

No	PCI Express Mini Card E.M. Spec. Rev. 2.0	MPCI-L2	Voltage domain	I/O	Description	Remarks
31	PETn0	NC		N/A		Internally not connected
32	SMB_DATA	NC		N/A		Internally not connected
33	PETp0	NC		N/A		Internally not connected
34	GND	GND	GND	N/A	Ground	Connect to ground
35	GND	GND	GND	N/A	Ground	Connect to ground
36	USB_D-	USB_D-	USB	I/O	USB Data Line D-	90 Ω nominal differential impedance. Pull-up, pull-down and series resistors as required by USB 2.0 specifications [6] are part of the USB pin driver and need not be provided externally. See 4.2.5 for detailed electrical specs.
37	GND	GND	GND	N/A	Ground	Connect to ground
38	USB_D+	USB_D+	USB	I/O	USB Data Line D+	90 Ω nominal differential impedance. Pull-up, pull-down and series resistors as required by USB 2.0 specifications [6] are part of the USB pin driver and need not be provided externally. See 4.2.5 for detailed electrical specs.
39	3.3Vaux	3.3Vaux	3.3Vaux	I	MPCI supply input	Connect to external 3.3 V supply. See 4.2.2 for detailed electrical specs.
40	GND	GND	GND	N/A	Ground	Connect to ground
41	3.3Vaux	3.3Vaux	3.3Vaux	I	MPCI supply input	Connect to external 3.3 V supply. See 4.2.2 for detailed electrical specs.
42	LED_WWAN#	LED_WWAN#		O	LED indicator output	Open drain active low output. See 4.2.9 for detailed electrical specs.
43	GND	GND	GND	N/A	Ground	Connect to ground
44	LED_WLAN#	NC		N/A		Internally not connected
45	Reserved	NC		N/A		Internally not connected
46	LED_WPAN#	NC		N/A		Internally not connected
47	Reserved	NC		N/A		Internally not connected
48	1.5V	NC		N/A		Internally not connected
49	Reserved	NC		N/A		Internally not connected
50	GND	GND	GND	N/A	Ground	Connect to ground
51	W_DISABLE2#	NC		N/A		Internally not connected
52	3.3Vaux	3.3Vaux	3.3Vaux	I	MPCI supply input	Connect to external 3.3 V supply. See 4.2.2 for detailed electrical specs.

Table 4: MPCI-L2 series system connector pin assignment

4 Electrical specifications

Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may cause permanent damage. These are stress ratings only. Operating the module at these or at any conditions other than those specified in the Operating Conditions sections (chapter 4.1) of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Operating condition ranges define those limits within which the functionality of the device is guaranteed.

Where application information is given, it is advisory only and does not form part of the specification.

4.1 Absolute maximum rating

Limiting values given below are in accordance with the Absolute Maximum Rating System (IEC 134).

Symbol	Description	Condition	Min.	Max.	Unit
3.3Vaux	Module supply voltage	Input DC voltage at 3.3Vaux pins	–0.3	6.3	V
USB	USB D+/D- pins	Input DC voltage at USB interface pins		3.6	V
SIM	SIM interface	Input DC voltage at SIM interface pins	–0.3	3.6	V
PERST#	MPCI reset input	Input DC voltage at PERST# input pin	–0.3	6.0	V
W_DISABLE#	Wireless disable input	Input DC voltage at W_DISABLE# input pin	–0.3	3.6	V
LED_WWAN#	LED indicator output	Input DC voltage at LED_WWAN# output pin	–0.3	6.0	V
Rho_ANT	Antenna ruggedness	Output RF load mismatch ruggedness at ANT1 / ANT2		10:1	VSWR
Tstg	Storage Temperature		–40	85	°C

Table 5: Absolute maximum ratings

The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection devices.

4.1.1 Maximum ESD

Parameter	Min	Typical	Max	Unit	Remarks
ESD sensitivity for all pins except ANT1 / ANT2			1000	V	Human Body Model according to JESD22-A114
ESD sensitivity for ANT1 / ANT2			1000	V	Human Body Model according to JESD22-A114
ESD immunity for ANT1 / ANT2			4000	V	Contact Discharge according to IEC 61000-4-2
			8000	V	Air Discharge according to IEC 61000-4-2

Table 6: Maximum ESD ratings

u-blox cellular modules are Electrostatic Sensitive Devices and require special precautions when handling. See section 7.2 for ESD handling instructions.

4.2 Operating conditions

Unless otherwise indicated, all operating condition specifications are at an ambient temperature of 25°C.

Operation beyond the operating conditions is not recommended and extended exposure beyond them may affect device reliability.

4.2.1 Operating temperature range

Parameter	Min.	Typical	Max.	Unit	Remarks
Normal operating temperature	–20	+25	+65	°C	Normal operating temperature range (fully functional and meet 3GPP specifications)
Extended operating temperature	–40		+85	°C	Extended operating temperature range (RF performance may be affected outside normal operating range, though module is fully functional)

Table 7: Environmental conditions

4.2.2 Supply/power pins

Symbol	Parameter	Min.	Typical	Max.	Unit
3.3Vaux	Module supply operating input voltage[10]	3.00	3.30	3.60	V

Table 8: Input characteristics of Supply/Power pins

[10] Input voltage at **3.3Vaux** must be above the normal operating range minimum limit to switch-on the module.

4.2.3 Current consumption

Mode	Condition	Tx power	Min	Typ	Max	Unit
Idle-Mode (Power Saving enabled by AT+UPSV, module in low power idle-mode, equivalent to +CFUN=4 or +COPS=2)	Averaged current value over a 100-ms period, USB connected and suspended			1.8		mA
Cyclic Idle/Active-Mode (Power Saving enabled by AT+UPSV, Module registered with network)	Averaged current value over a 10-minute period, USB interface suspended			3.9		mA
Active-Mode (Power Saving disabled by AT+UPSV, Module registered with network)	Averaged current value over a 10-minute period, USB interface not suspended			59		mA
2G Connected Mode (Tx / Rx call enabled)	Pulse current during a 1-slot GMSK Tx burst, 850/900 MHz bands	Maximum		2.6		A
	Averaged current value over a 10-second period, 2G GMSK call, 1 Tx + 1 Rx slot, 850/900 MHz	Maximum		380		mA
	Averaged current value over a 10-second period, 2G GMSK call, 1 Tx + 1 Rx slot, 1800/1900 MHz	Maximum		295		mA
3G Connected Mode (Tx / Rx call enabled)	Averaged current value over a 10-second period, 3G call with Low data rate	Minimum		245		mA
		0 dBm		265		mA
		12 dBm		365		mA
		18 dBm		505		mA
		Maximum		680		mA
	Averaged current value over a 10-second period, 3G call with Maximum data rate	Maximum		790		mA
LTE Connected Mode (Tx / Rx call enabled)	Averaged current value over a 10-second period, LTE call with Low data rate	Minimum		395		mA
		0 dBm		415		mA
		12 dBm		520		mA
		18 dBm		650		mA
		Maximum		815		mA
	Averaged current value over a 10-second period, LTE call with Maximum data rate	Maximum		880		mA

Table 9: Module 3.3Vaux supply current consumption

4.2.4 LTE/3G/2G RF characteristics

MPCI-L2 series LTE/3G/2G RF characteristics are specified in the TOBY-L2 series Data Sheet [10].

4.2.5 USB pins

USB data lines (**USB_D+** / **USB_D-**) are compliant to the USB 2.0 high-speed specification. The values in Table 10 are for information only. See the USB 2.0 specifications [6] for detailed electrical characteristics.

Parameter	Min.	Typical	Max.	Unit	Remarks
High-speed squelch detection threshold (input differential signal amplitude)	100		150	mV	
High speed disconnect detection threshold (input differential signal amplitude)	525		625	mV	
High-speed data signaling input common mode voltage range	–50		500	mV	
High-speed idle output level	–10		10	mV	
High-speed data signaling output high level	360		440	mV	
High-speed data signaling output low level	–10		10	mV	
Chirp J level (output differential voltage)	700		1100	mV	
Chirp K level (output differential voltage)	–900		–500	mV	

Table 10: USB pins characteristics

4.2.6 SIM pins

The SIM pins are a dedicated interface to the external SIM card/chip. The electrical characteristics fulfill regulatory specification requirements. The values in Table 11 are for information only.

Parameter	Min.	Typical	Max.	Unit	Remarks
UIM_PWR supply output	1.76	1.80	1.85	V	1.8 V SIM type
	2.84	2.90	2.94	V	3.0 V SIM type
Low-level input	–0.30		0.63	V	1.8 V SIM type
	–0.30		0.80	V	3.0 V SIM type
High-level input	1.17		2.10	V	1.8 V SIM type
	2.00		3.30	V	3.0 V SIM type
Low-level output		0.00	0.45	V	1.8 V SIM type, Max value at I_{OL} = +2.0 mA
		0.00	0.40	V	3.0 V SIM type, Max value at I_{OL} = +2.0 mA
High-level output	1.35	1.80		V	1.8 V SIM type, Min value at I_{OH} = –2.0 mA
	2.60	2.90		V	3.0 V SIM type, Min value at I_{OH} = –2.0 mA
Input / Output leakage current	–500		500	nA	0 V < V_{IN} < 0.63 V or 1.17 V < V_{IN} < 2.10 V 0 V < V_{IN} < 0.80 V or 2.00 V < V_{IN} < 3.30 V
Clock frequency on UIM_CLK		3.25		MHz	
Internal pull-up on UIM_DATA		4.7		kΩ	Internal pull-up to UIM_PWR supply

Table 11: SIM pins characteristics

4.2.7 PERST# pin

Pin Name	Parameter	Min.	Typical	Max.	Unit	Remarks
PERST#	Low-level input	0.00		1.10	V	
	High-level input	2.60		3.70	V	
	L-level input current		-82		µA	
	Pull-up resistance	35	45		kΩ	Internal active pull-up to 3.3 V
	PERST# low time	2.1			s	Low time to reset the module

Table 12: PERST# pin characteristics

4.2.8 W_DISABLE# pin

Pin Name	Parameter	Min.	Typical	Max.	Unit	Remarks
W_DISABLE#	Low-level input	0.00		0.80	V	
	High-level input	2.00		3.60	V	
	Pull-up resistance		22		kΩ	Internal pull-up to 3.3Vaux

Table 13: W_DISABLE# pin characteristics

4.2.9 LED_WWAN# pin

Pin Name	Parameter	Min.	Typical	Max.	Unit	Remarks
LED_WWAN#	Low-level output		0.00	0.40	V	Open-drain output Max value at I_{OL} = +9.0 mA

Table 14: LED_WWAN# pin characteristics

5 Mechanical specifications

MPCI-L2 series modules are fully compliant to the 52-pin PCI Express Full-Mini Card Type F2 form factor, with top-side and bottom-side keep-out areas, with 50.95 mm nominal length, 30 mm nominal width and all the other dimensions as defined by the PCI Express Mini Card Electromechanical Specification [9] except for the card thickness (nominal value is 3.7 mm), as described in Figure 2. MPCI-L2 series modules weight is about 9.7 g.

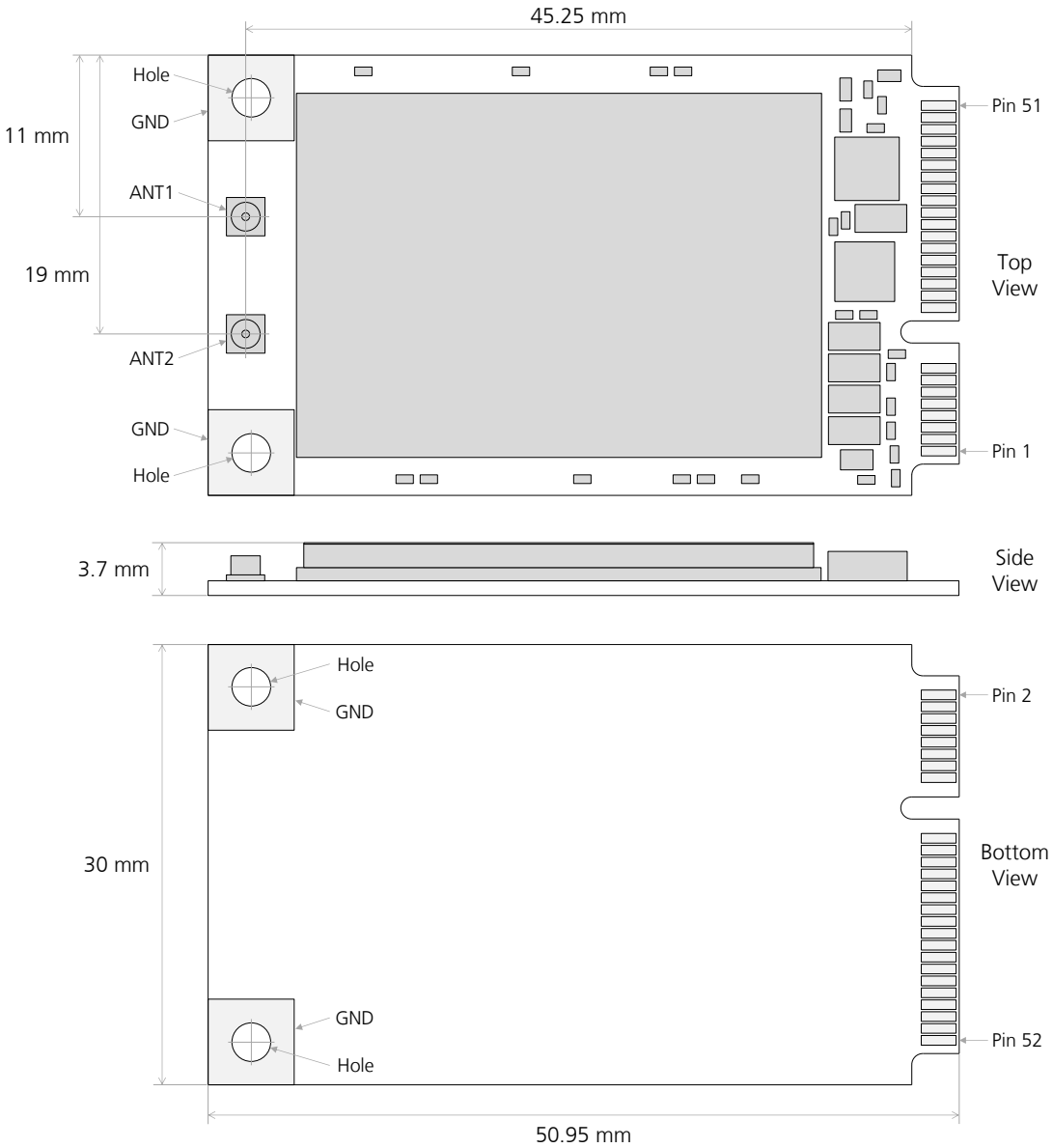


Figure 2: MPCI-L2 series mechanical dimensions (top view, side view, bottom view)

For further details regarding mechanical specifications see the PCI Express Mini Card Electromechanical Specification [9].

6 Qualification and approvals

6.1 Reliability tests

Tests for product family qualifications according to ISO 16750 “Road vehicles - Environmental conditions and testing for electrical and electronic equipment“, and appropriate standards.

6.2 Approvals

Products marked with this lead-free symbol on the product label comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS).

MPCI-L2 series modules are RoHS compliant.

No natural rubbers, hygroscopic materials, or materials containing asbestos are employed.

The following table summarizes the main approvals for MPCI-L2 series modules.

Certification scheme	MPCI-L200	MPCI-L201	MPCI-L210	MPCI-L220	MPCI-L280
GCF (Global Certification Forum)	•	•[11]	•		•
PTCRB (PCS Type Certification Review Board)	•	•[11]	•		•
R&TTE (Radio & Telecommunications Terminal Equipment EU Directive)	•		•		•
Notified Body number	1588		1588		1588
CE (Conformité Européenne)	•		•		•
Notified Body number	1588		1588		1588
FCC (United States Federal Communications Commission)	•	•	•		•
FCC identification number	Contains FCC ID XPYTOBYL200	Contains FCC ID XPYTOBYL201	Contains FCC ID XPYTOBYL210		Contains FCC ID XPYTOBYL280
ISED (Innovation, Science and Economic Development)[12]	•	•	•		•
ISED certification number	Contains IC 8595A-TOBYL200	Contains IC 8595A-TOBYL201	Contains IC 8595A-TOBYL210		Contains IC 8595A-TOBYL280
Anatel (Brazilian Certification)	•				•
RCM (Australian Regulatory Compliance Mark)			•		•
NCC (Taiwanese National Communications Commission)			•		•
KC (Korean Certification)			•		
Giteki Mark (Japanese Certification)			•	•	
SoftBank (Japanese network operator)			•		
AT&T (US network operator)	•	•[11]			
Verizon (US network operator)		•[11]			

Table 15: MPCI-L2 series main certification approvals summary

For the complete list of approvals and for specific details on all country and network operators’ certifications, see our website www.u-blox.com or please contact the u-blox office or sales representative nearest you.

[11] TOBY-L201
[12] formerly known as IC - Industry Canada

7 Product handling

7.1 Packaging

MPCI-L2 modules are delivered as hermetically sealed trays of 32 pieces, 5 trays in 1 package (160 units in total), to enable efficient production, production lot set-up and tear-down. For more information about packaging, see the u-blox Package Information Guide [8].

Quantities of less than 160 pieces are also available. Contact u-blox for more information.

7.2 ESD precautions

MPCI-L2 series modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling MPCI-L2 series modules without proper ESD protection may destroy or damage them permanently.

MPCI-L2 series modules are Electrostatic Sensitive Devices (ESD) and require special ESD precautions typically applied to ESD sensitive components.

Table 6 reports the maximum ESD ratings of the MPCI-L2 series modules.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates MPCI-L2 series module.

ESD precautions should be implemented on the application board where the module is mounted, as described in the TOBY-L2 / MPCI-L2 System Integration Manual [5].

Failure to observe these recommendations can result in severe damage to the device!

8 Default settings

Item	AT Settings	Comments
USB interface	Enabled	MPCI-L2 series modules provide by default the following set of USB functions: • CDC-ACM for AT command and data • RNDIS for Ethernet-over-USB connection The USB can be configured by the AT+UUSBCONF command to select different sets of USB functions available in mutually exclusive way, configuring the active USB profile consisting of a specific set of functions with various capabilities and purposes (for more details, see the TOBY-L2 / MPCI-L2 System Integration Manual [5] and the u-blox AT Commands Manual [3], +UUSBCONF AT command).
Power Saving	AT+UPSV=0	Disabled
Network registration	AT+COPS=0	Self network registration

Table 16: Default settings

9 Labeling and ordering information

9.1 Product labeling

The labels of MPCI-L2 series modules include important product information as described in this section.

Figure 3, Figure 4 and Figure 5 illustrate the label of MPCI-L2 series modules, which is placed on the bottom side of the modules, including: the u-blox logo, Pb-free marking, product type number, production lot, certification numbers and production country.



Figure 3: Label of MPCI-L2 series modules (except MPCI-L210-60S and MPCI-L220)

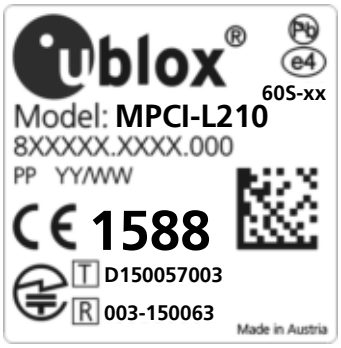


Figure 4: Label of MPCI-L210-60S modules

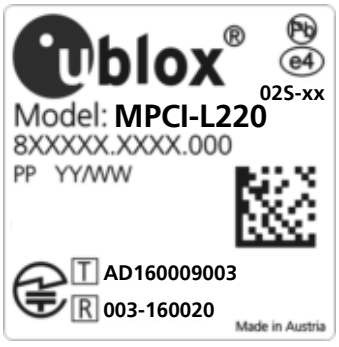


Figure 5: Label of MPCI-L220 modules

9.2 Explanation of codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all u-blox products, independent of packaging and quality grade. The **Ordering Code** includes options and quality, while the **Type Number** includes the hardware and firmware versions. Table 17 details these 3 different formats:

Format	Structure
Product Name	MPCI-TGVV
Ordering Code	MPCI-TGVV-MMQ
Type Number	MPCI-TGVV-MMQ-XX

Table 17: Product Code Formats

Table 18 explains the parts of the product code.

Code	Meaning	Example
PPPP	Form factor	MPCI
TG	Platform (Technology and Generation) • Dominant technology: G: GSM; U: HSUPA; C: CDMA 1xRTT; N: NB-IoT; R: LTE low data rate (Cat 1 and below); L: LTE high data rate (Cat 3 and above) • Generation: 1…9	L2
VV	Variant function set based on the same platform [00…99]	00
MM	Major product version [00…99]	00
Q	Product grade • S = professional • A = automotive	S
XX	Minor product version (not relevant for certification)	Default value is 00

Table 18: Part identification code

9.3 Ordering information

Ordering No.	Product
MPCI-L200-00S	LTE bands 2 / 4 / 5 / 7 / 17, DC-HSPA+ bands 1 / 2 / 4 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in America 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L200-02S	LTE bands 2 / 4 / 5 / 7 / 17, DC-HSPA+ bands 1 / 2 / 4 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in America, supporting embedded TCP/UDP, HTTP/FTP, TLS/SSL, smart temperature supervisor 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L201-01S	LTE bands 2 / 4 / 5 / 13 / 17, DC-HSPA+ bands 1 / 2 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in America, supporting embedded TCP/UDP, HTTP/FTP 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L201-02S	LTE bands 2 / 4 / 5 / 13 / 17, DC-HSPA+ bands 1 / 2 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in America, supporting embedded TCP/UDP, HTTP/FTP, smart temperature supervisor 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L210-00S	LTE bands 1 / 3 / 5 / 7 / 8 / 20, DC-HSPA+ bands 1 / 2 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in Europe, Asia and other countries 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L210-60S	LTE bands 1 / 3 / 5 / 7 / 8 / 20, DC-HSPA+ bands 1 / 2 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module approved by SoftBank Japanese mobile network operator 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L210-02S	LTE bands 1 / 3 / 5 / 7 / 8 / 20, DC-HSPA+ bands 1 / 2 / 5 / 8, (E)GPRS band 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in Europe, Asia and other countries, supporting embedded TCP/UDP, HTTP/FTP, TLS/SSL, smart temperature supervisor 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L220-02S	LTE bands 1 / 3 / 5 / 8 / 19, DC-HSPA+ bands 1 / 8 / 19 module, PCI Express Mini Card module mainly designed for operation in Japan, supporting embedded TCP/UDP, HTTP/FTP, TLS/SSL, smart temperature supervisor 51 x 30 x 3.7 mm, 160 pcs/package
MPCI-L280-02S	LTE bands 1 / 3 / 5 / 7 / 8 / 28, DC-HSPA+ bands 1 / 2 / 5 / 8, (E)GPRS bands 850 / 900 / 1800 / 1900, PCI Express Mini Card module mainly designed for operation in South East-Asia and Oceania, supporting embedded TCP/UDP, HTTP/FTP, TLS/SSL, smart temperature supervisor 51 x 30 x 3.7 mm, 160 pcs/package

Table 19: Product ordering codes

Appendix

A Glossary

Name	Definition
3FF	Third Form Factor (micro-SIM card)
ACM	Abstract Control Model
CDC	Communications Device Class
DDC	Display Data Channel (I^2C compatible) Interface
DL	Down-link (Reception)
DRX	Discontinuous Reception
ECM	Ethernet networking Control Model
ERS	External Reset Input Signal
ESD	Electrostatic Discharge
FOAT	Firmware update Over AT commands
FOTA	Firmware update Over The Air
FW	Firmware
GMSK	Gaussian Minimum-Shift Keying modulation
GND	Ground
GPIO	General Purpose Input Output
H	High
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
I	Input (means that this is an input port of the module)
IMEI	International Mobile Equipment Identity
L	Low
LGA	Land Grid Array
LTE	Long Term Evolution
MIMO	Multi-Input Multi-Output
N/A	Not Applicable
O	Output (means that this is an output port of the module)
OD	Open Drain
PCN / IN	Product Change Notification / Information Note
PD	Pull-Down
PU	Pull-Up
RNDIS	Remote Network Driver Interface Specification
SDIO	Secure Digital Input Output
SIM	Subscriber Identity Module
T	Tristate
TBD	To Be Defined
UART	Universal Asynchronous Receiver-Transmitter serial interface
UL	Up-link (Transmission)
USB	Universal Serial Bus

Table 20: Explanation of abbreviations and terms used

Related documents

[1] 3GPP TS 27.007 - AT command set for User Equipment (UE)

[2] 3GPP TS 27.005 - Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)

[3] u-blox AT Commands Manual, Docu No UBX-13002752

[4] u-blox Android RIL Production delivery Application note, Docu No UBX-13002041

[5] u-blox TOBY-L2 / MPCI-L2 series System Integration Manual, Docu No UBX-13004618

[6] Universal Serial Bus Revision 2.0 specification, http://www.usb.org/developers/docs/usb20_docs/

[7] u-blox Windows Embedded OS USB Driver Installation Application Note, Docu No UBX-14003263

[8] u-blox Package Information Guide, Docu No UBX-14001652

[9] PCI Express Mini Card Electromechanical Specification, Revision 2.0, April 21, 2012

[10] u-blox TOBY-L2 series Data Sheet, Docu No UBX-13004573

[11] 3GPP TS 36.521-1 - Evolved Universal Terrestrial Radio Access; User Equipment conformance specification; Radio transmission and reception; Part 1: Conformance Testing

For regular updates to u-blox documentation and to receive product change notifications register on our homepage.

Revision history

Revision	Date	Name	Status / Comments
R01	20-Dec-2013	jpod / sses	Initial release
R02	14-Oct-2014	lpah / sses	Advance Information document status Updated module power-on, power-off and reset description Updated module thickness and improved mechanical description Minor corrections in PERST#, W_DISABLE#, LED_WWAN# description Added module current consumption values Added and updated other minor electrical characteristics
R03	28-Jan-2015	sses	Early Production Information document status
R04	19-Aug-2015	sses	Objective Specification document status Added description of MPCI-L200-02S, MPCI-L210-02S and MPCI-L210-60S versions.
R05	25-Sep-2015	lpah	Advance Information status
R06	14-Oct-2015	sses	Objective Specification document status Added description of MPCI-L280-02S version
R07	26-Nov-2015	lpah	Document status changed to Early Production Information
R08	22-Dec-2015	lpah / sses	Added description of MPCI-L201-01S version
R09	31-Mar-2016	sses	Updated features planned for future product versions. Minor other corrections and description improvements.
R10	27-Apr-2016	lpah	Extended document applicability to MPCI-L210-60S-01
R11	15-Jul-2016	sses	Document status reverted to Objective Specification Added description of MPCI-L201-02S version
R12	28-Sep-2016	sses	Document status updated to Advance Information Updated support of some minor features in specific product versions
R13	21-Oct-2016	lpah	Document status updated to Early Production Information. Extended document applicability to MPCI-L220-02S and MPCI-L280-72S
R14	25-Nov-2016	lpah	Extended document applicability to MPCI-L200-00S-01 and removed document applicability to MPCI-L280-72S

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