

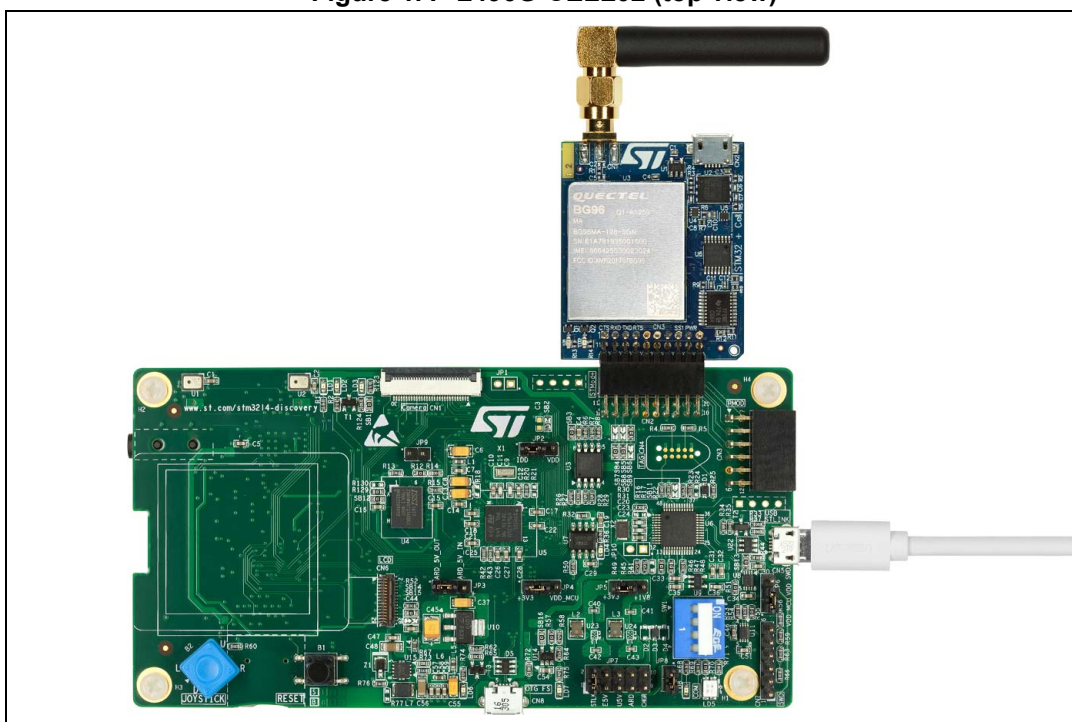
STM32 Discovery pack for LTE IoT cellular to cloud

Introduction

The STM32 Discovery pack for LTE IoT cellular to cloud (P-L496G-CELL02) is a turnkey development platform for cellular and cloud technology-based solutions.

The pack contains an STM32L496AG-based low-power Discovery main board with preloaded firmware and an STMod+ cellular LTE IoT worldwide expansion board with an antenna.

Figure 1. P-L496G-CELL02 (top view)



1. Picture is not contractual.

Contents

1	Features	6
2	Ordering information	7
3	Development environment	8
3.1	System requirements	8
3.2	Development toolchains	8
4	Conventions	9
5	Hardware layout and configuration	10
5.1	Board layouts	10
5.2	Cellular STMod+ expansion board	11
5.2.1	Modem power supply and reset	12
5.2.2	SIM selection	12
5.2.3	Modem firmware update	12
5.3	Embedded ST_LINK/V2-1	13
5.3.1	Drivers	13
5.4	Main board power supply	13
5.4.1	Power supply sources	13
5.5	Main board reset sources	14
5.6	Main board boot options	14
6	P-L496G-CELL02 troubleshooting	16
7	P-L496G-CELL02 product information	17
7.1	Product marking	17
7.2	P-L496G-CELL02 product history	18
7.3	Board revision history	18
8	Federal Communications Commission (FCC) and ISED Canada (IC) Compliance Statements	19
8.1	FCC Compliance Statement	19
8.2	ISED Compliance Statement	20

Revision history	21
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List of tables

Table 1. Ordering information 7

Table 2. ON/OFF conventions 9

Table 3. STMod+ connector pin description 11

Table 4. Boot settings 14

Table 5. Product history 18

Table 6. Board revision history 18

Table 7. Document revision history 21



List of figures

Figure 1. P-L496G-CELL02 (top view). 1

Figure 2. Main board and expansion LTE IoT modem top view 10

Figure 3. Main board and expansion LTE IoT modem bottom view 11

Figure 4. USB Composite Device driver installation. 13

1 Features

- STM32L496AGI6 Arm^{®(a)} Cortex[®]-M3 core-based microcontroller with 1 Mbyte of flash memory and 320 Kbytes of RAM in a UFBGA169 package
- USB OTG HS
- On-board current measurement
- SAI audio codec
- ST-MEMS digital microphones
- 8-Mbit PSRAM
- Two user LEDs
- User and reset push-buttons
- 4-direction joystick with selection button
- Board connectors:
 - 8-bit camera
 - LCD flat cable
 - USB Micro-AB
 - Stereo headset jack including analog microphone input
 - microSD[™] card
 - ARDUINO[®] Uno V3 expansion connector
 - STMod+ expansion connector
- Board expansion features:
 - Quectel BG96 worldwide cellular modem LTE Cat M1/Cat NB1/EGPRS module 300 kbps downlink, 375 kbps uplink
 - Modem reset red LED and modem signaling green LED
 - Switchable SIM interface: eSIM and micro SIM
 - Pulse SMA antenna for frequency ranges: 824 / 900 / 1800 / 1900 / 2100 MHz. Might this antenna not be suitable for your LTE band, use the Pulse SPDA24700 antenna instead.
- Flexible power supply options: ST-LINK USB V_{BUS}, USB connector, or external sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32Cube MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench[®], MDK-ARM, and STM32CubeIDE



a. Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 Ordering information

To order the P-L496G-CELL02 Discovery pack, refer to [Table 1](#).

Table 1. Ordering information

Order code	Board reference	Target STM32
P-L496G-CELL02	MB1261 ⁽¹⁾ MB1329 ⁽²⁾	STM32L496AGI6

1. Main board
2. Cellular daughterboard

3 Development environment

3.1 System requirements

- Multi-OS support Windows^{®(a)} 10, Linux^{®(b)} 64-bit, or macOS^{®(c)}
- USB Type-A or USB Type-C[®] to Micro-B cable

3.2 Development toolchains

- IAR Systems[®] - IAR Embedded Workbench^{®(d)}
- Keil[®] - MDK-ARM^(d)
- STMicroelectronics - STM32CubeIDE

-
- a. Windows is a trademark of the Microsoft group of companies.
 - b. Linux[®] is a registered trademark of Linus Torvalds.
 - c. macOS[®] is a trademark of Apple Inc. registered in the U.S. and other countries.
All other trademarks are the property of their respective owners.
 - d. On Windows[®] only.

4 Conventions

[Table 2](#) defines some conventions used in the present document.

Table 2. ON/OFF conventions

Convention	Definition
Jumper JPx ON	Jumper fitted
Jumper JPx OFF	Jumper not fitted
Jumper JPx [1-2]	Jumper fitted between Pin 1 and Pin 2
Solder bridge SBx ON	SBx connections closed by 0 Ω resistor
Solder bridge SBx OFF	SBx connections left open
Resistor Rx ON	Resistor soldered
Resistor Rx OFF	Resistor not soldered

5 Hardware layout and configuration

Figure 2 illustrates the connection between the STM32L496AGI6-based Discovery main board and the modem expansion board. The connection is done through the STMod+ connector.

5.1 Board layouts

There is no LCD with the STM32L496AGI6-based Discovery main board in this pack. For the main board detailed description, refer to the user manual *Discovery kit with STM32L496AG* (UM2160) at www.st.com.

Figure 2. Main board and expansion LTE IoT modem top view

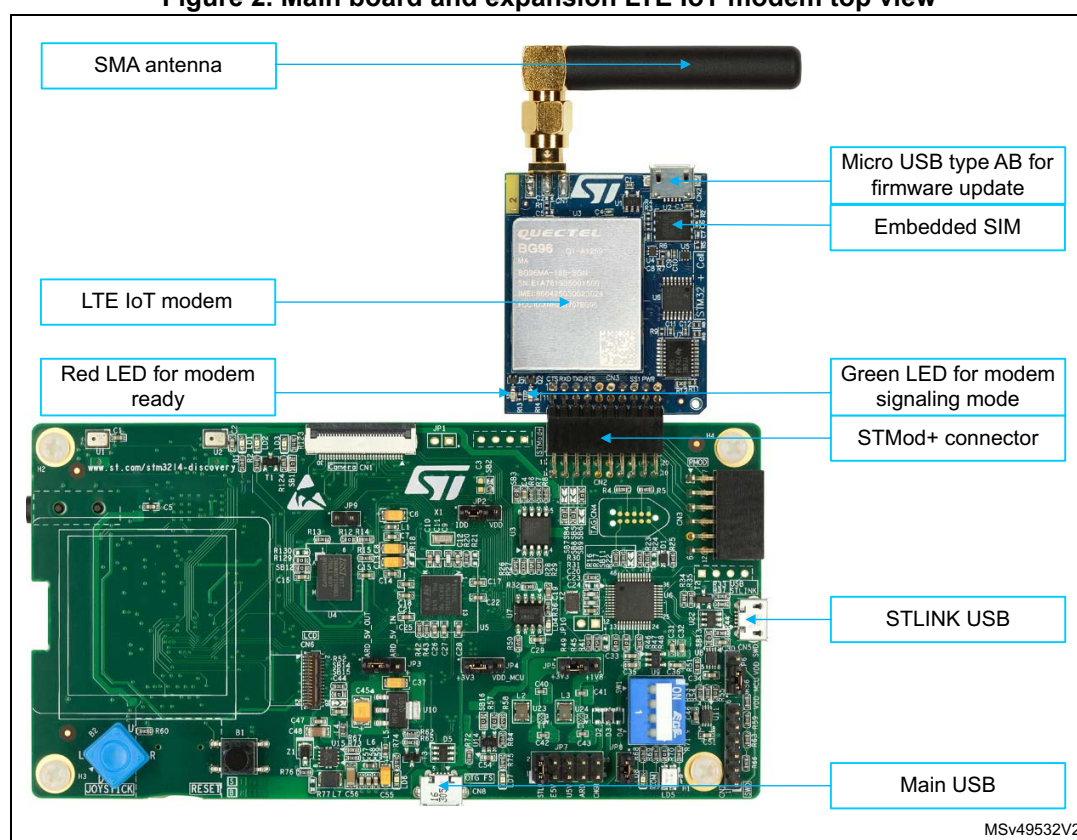
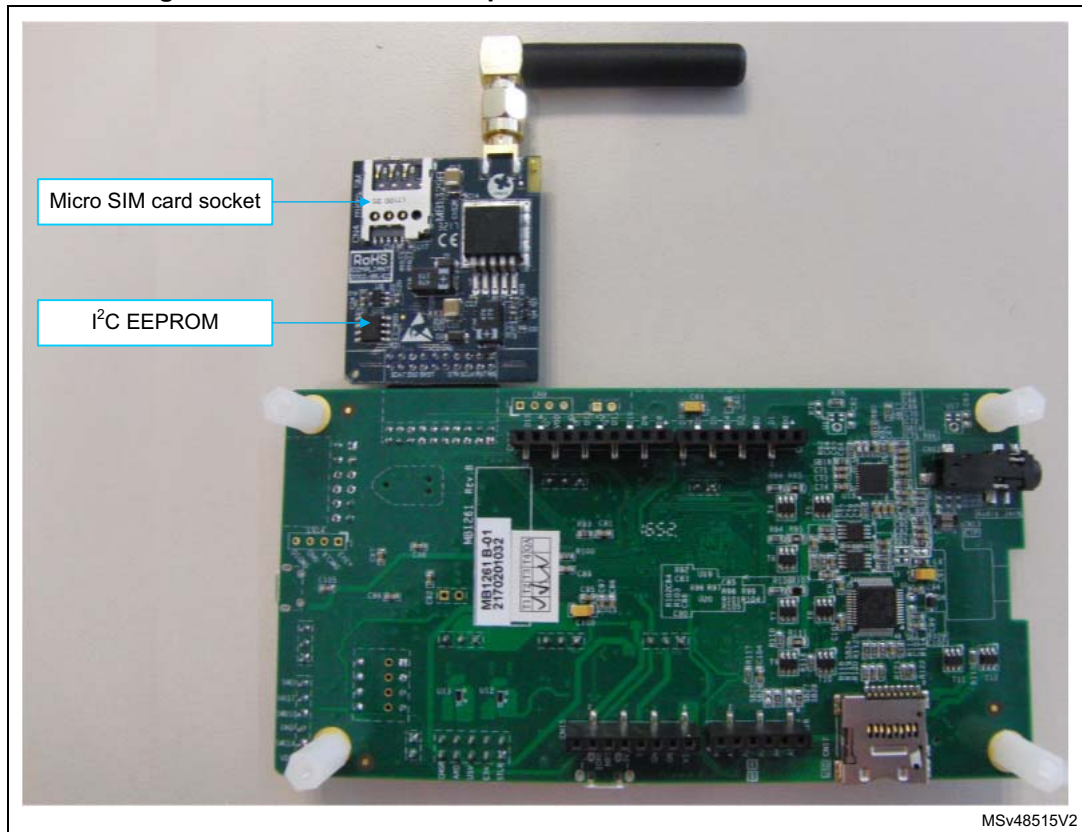


Figure 3. Main board and expansion LTE IoT modem bottom view



5.2 Cellular STMod+ expansion board

The expansion board is an LTE IoT modem based on the Quectel BG96 module. The BG96 is a series of LTE Cat M1/Cat NB1/EGPRS modules offering a maximum data rate of 300kbps downlink and 375kbps uplink. The connection with the STM32L496AGI6-based Discovery main board is done through the STMod+ connector.

Table 3. STMod+ connector pin description

STMod+ IOX=pin x	Pin name	Pin function
pin 1	CTSS	Modem UART CTS
pin 2	RXDS	Modem UART RXD
pin 3	TXDS	Modem UART TXD
pin 4	RTSS	Modem UART RTS
pin 5	GND	Ground
pin 6	VCC	+5V
pin 7	STMod+ IO7	I2C clock for EEPROM
pin 8	Sim_select1	Sim selection IO1 always set to 1
pin 9	PWRen	Modem power enable

Table 3. STMod+ connector pin description (continued)

STMod+ IOX=pin x	Pin name	Pin function
pin 10	I2C	I2C data for EEPROM
pin 11	RIS	Modem ring indicator RI
pin 12	RST	Modem reset
pin 13	sim_CLK	SIM clock
pin 14	DTRS	Modem wake-up
pin 15	VCC	+5V
pin 16	GND	Ground
pin 17	Sim_RST	Sim reset
pin 18	Sim_select0	Sim selection IO0, 0 for plastic SIM and 1 for embedded SIM
pin 19	Sim_DATA	Sim data
pin 20	STAS	Modem status

5.2.1 Modem power supply and reset

The cellular board is supplied through the 5V on the STMod+ connector (pins 6 and 15). Pin 9 (power enable) activates the modem. A few seconds after this pin is driven, the red LED is on to indicate that the modem is ready. The green LED starts flashing to indicate that the modem is scanning for cell synchronization. At this time AT command can be sent using UART.

If the power supply is not enough in signaling mode, the USB connector can provide an additional power supply.

5.2.2 SIM selection

A switchable SIM interface is provided on the cellular modem board. The user selects either the embedded SIM or the plastic SIM.

Set pin Sim_select0 to LOW to select the plastic SIM, or HIGH to select the embedded SIM.

5.2.3 Modem firmware update.

The modem firmware can be updated using the micro USB connector provided on the modem:

1. First install the USB drivers of the modem from Quectel.
2. Install Qflash from Quectel and load the firmware.
3. Press start and reset the modem to download the firmware.

5.3 Embedded ST_LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated into the STM32L496AGI6-based Discovery main board. Compared to ST-LINK/V2 the changes are listed in [Section 5.3.1](#).

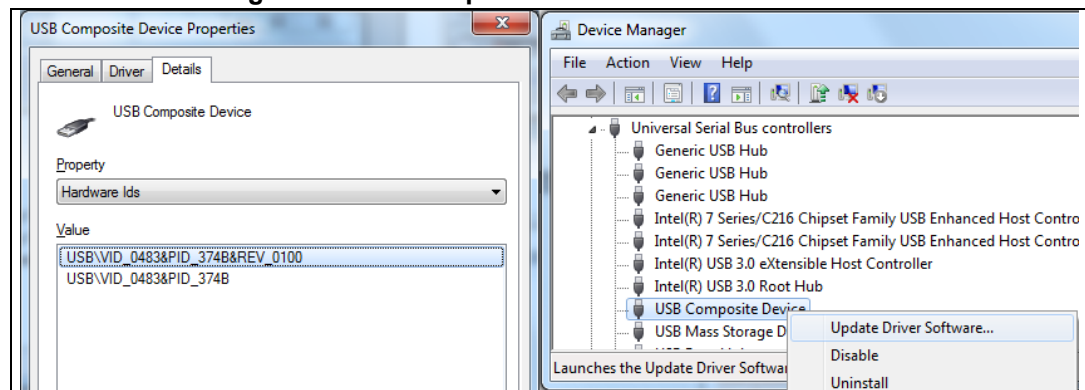
5.3.1 Drivers

The ST-LINK/V2-1 requires a dedicated USB driver, available on www.st.com for Windows 7 and 8. On Windows XP, the ST-LINK/V2-1 driver requires WinUSB to be installed before using the ST-LINK/V2-1. It is either available from the Microsoft website or included in the USB driver for ST-LINK/V2 for XP.

When the STM32L496AGI6-based Discovery main board is connected to the PC before the driver is installed, some STM32L496AGI6-based Discovery main board interfaces might be declared as *Unknown* in the PC device manager. In this case, the user must install the driver files, and update the driver of the connected device from the device manager.

Note: Prefer using the 'USB Composite Device' handle for a full recovery.

Figure 4. USB Composite Device driver installation.



5.4 Main board power supply

5.4.1 Power supply sources

The STM32L496AGI6-based Discovery main board can be powered by the following sources:

- STLK from the ST-LINK/V2-1 USB connector CN5 with 500 mA current limitation
- Power mechanism of supplying the board by STLINK/V2-1
- Programing/debugging when the power supply is not from ST-LINK/V2-1

It is mandatory to power the board first using the user USB FS connector CN8 or the VIN pin of ARDUINO® connector CN15 before connecting the USB cable from ST-LINK/V2-1 CN5 to the PC. Proceeding this way ensures that the enumeration succeeds using the external power source.

The following power sequence procedure must be respected:

1. Put a jumper in JP3 at location U5V to use power from user USB CN8 or at location E5V to use power from VIN of ARDUINO® connector CN15.
2. Connect the corresponding external power source.
3. Check that the green LED LD8 is turned ON.
4. Connect the PC to ST-LINK/V2-1 USB connector CN5.

If this order is not respected, the board might be powered by V_{BUS} first from ST-LINK, and the following risks might be encountered:

1. If the board requires more than 500 mA current, the PC might be damaged, or limit the current. As a consequence, the board is not powered correctly.
2. The enumeration step requires 500 mA. Thus, there is a risk that the request is rejected and enumeration does not succeed if the PC does not provide such current.

5.5 Main board reset sources

The reset signal of the STM32L496AGI6-based Discovery main board is active LOW and the reset sources include:

- Reset button B1
- Embedded ST-LINK/V2-1, SW1 set to ON (default setting)
- ARDUINO® connector CN15 pin 3

5.6 Main board boot options

After reset, the microcontroller STM32L496AGI6 might boot from the 3 following embedded memory locations depending on bits BOOT0 and BOOT1:

- Boot from the user flash memory
- Boot from the ICP (in-circuit programming)
- Boot from the SRAM

The selection of the memory space for the boot is done by two bits, BOOT0 and BOOT1. A user option bit (bit[23], nBOOT1) defines the value of BOOT1. Specifically, when this bit is set (put to 1), the empty flag status toggles and keeps this new status until the next OBL or until a new set.

Table 4. Boot settings

nBOOT1 (OPTR[23])	nBOOT0 (OPTR[27])	BOOT0 pin (PH3)	BOOT0 SW configuration OPTR[26])	Main flash empty	Boot memory space alias
X	X	0	1	0	User flash memory is aliased at address 0x0000_0000
X	X	0	1	1	Test flash memory is aliased at address 0x0000_0000
1	X	1	1	X	Test flash memory is aliased at address 0x0000_0000

Table 4. Boot settings (continued)

nBOOT1 (OPTR[23])	nBOOT0 (OPTR[27])	BOOT0 pin (PH3)	BOOT0 SW configuration OPTR[26])	Main flash empty	Boot memory space alias
0	X	1	1	X	Embedded SRAM is aliased at address 0x0000_0000
1	1	X	0	X	User flash memory is aliased at address 0x0000_0000
1	0	X	0	X	Test flash memory is aliased at address 0x0000_0000
0	0	X	0	X	Embedded SRAM is aliased at address 0x0000_0000

6 P-L496G-CELL02 troubleshooting

On some P-L496G-CELL02, the BG96 modem might remain in test mode. Therefore, it is necessary to put the modem in signaling mode to be able to connect to a cellular network for the first time.

It concerns only the modems shipped with the following firmware revision:
BG96MAR02A05M1G

If the user is unable to connect to a cellular network with the BG96MAR02A05M1G firmware, the AT command 'AT+CFUN=1' must be sent to the modem.

The user might run the demonstration software preloaded in the Discovery board to do that:

1. Open a terminal on the PC (Tera Term).
2. Connect the BG96 to the Discovery board.
3. Connect the Discovery board to the PC using the OTG FS USB connector CN8.
4. Reset the Discovery by pressing the reset button B1. Press the joystick UP button until the following message appears to indicate that the user might send AT commands to the BG96 modem:
 - Welcome to STM32-Cellular to Cloud (STM32-C2C)
 - AT commands terminal: connection to PC with USB-OTG FS is needed.
 - Modem is using eSIM.

 - RDY
 - AT terminal ready... Press the joystick button to restart the AT terminal using the micro SIM (if present).
 - AT+CMEE=2

 - OK
 - ATE1

 - OK
5. Verify the firmware revision by typing 'at+cgmr', if the firmware is BG96MAR02A05M1G, follow the next step.
6. Put the modem in signaling mode by entering the command 'AT+CFUN=1', the modem must respond OK.
7. Confirm that the modem is in signaling mode by entering the command 'AT+CFUN?', the modem must respond +CFUN: 1.
8. This operation must be performed only once.

7 P-L496G-CELL02 product information

7.1 Product marking

The stickers located on the top or bottom side of all PCBs provide product information:

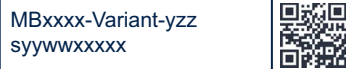
- First sticker: product order code and product identification, generally placed on the main board featuring the target device.

Example:

Product order code
Product identification

- Second sticker: board reference with revision and serial number, available on each PCB.

Example:



On the first sticker, the first line provides the product order code, and the second line the product identification.

On the second sticker, the first line has the following format: “*MBxxxx-Variant-yyy*”, where “*MBxxxx*” is the board reference, “*Variant*” (optional) identifies the mounting variant when several exist, “*y*” is the PCB revision and “*zz*” is the assembly revision, for example B01. The second line shows the board serial number used for traceability.

Parts marked as “*ES*” or “*E*” are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event will ST be liable for the customer using any of these engineering samples in production. ST’s Quality department must be contacted prior to any decision to use these engineering samples to run a qualification activity.

“*E*” or “*ES*” marking examples of location:

- On the targeted STM32 that is soldered on the board (for an illustration of STM32 marking, refer to the STM32 datasheet *Package information* paragraph at the www.st.com website).
- Next to the evaluation tool ordering part number that is stuck or silk-screen printed on the board.

Some boards feature a specific STM32 device version, which allows the operation of any bundled commercial stack/library available. This STM32 device shows a “*U*” marking option at the end of the standard part number and is not available for sales.

To use the same commercial stack in their applications, the developers might need to purchase a part number specific to this stack/library. The price of those part numbers includes the stack/library royalties.

7.2 P-L496G-CELL02 product history

Table 5. Product history

Order code	Product identification	Product details	Product change description	Product limitations
P-L496G-CELL02	P-L496G-CELL02/	MCU: – STM32L496AGI6 revision B	Initial revision	No limitation
		MCU errata sheet: – <i>STM32L496xx/4A6xx device errata (ES0335)</i>		
		Boards: – MB1261-L496G-A01 (main board) – MB1329-L496-B01 (cellular daughterboard)		
	PBL496GCEL2\$AU1	MCU: – STM32L496AGI6 revision B	– STM32L4 with LTE cellular module – Packaging: plastic blister replaced by a carton box – Removed SIM card	No limitation
		MCU errata sheet: – <i>STM32L496xx/4A6xx device errata (ES0335)</i>		
		Boards: – MB1261-CELL02-B06 (main board) – MB1329-L496G-B03 (cellular daughterboard)		

7.3 Board revision history

Table 6. Board revision history

Board reference	Board variant and revision	Board change description	Board limitations
MB1261 (main board)	MB1261-L496G-A01	Initial revision	No limitation
	MB1261-CELL02-B06	Dedicated variant CELL02 was created for P-L496G-CELL02 with replacement of some EOL components.	
MB1329 (cellular daughterboard)	MB1329-L496G-B01	Initial revision	No limitation
	MB1329-L496G-B03	Removed some EOL components	

8 Federal Communications Commission (FCC) and ISED Canada (IC) Compliance Statements

8.1 FCC Compliance Statement

Part 15.19

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Part 15.21

Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

Part 15.105

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: Use only shielded cables.

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8.2 ISED Compliance Statement

Compliance Statement

ISED Canada ICES-003 Compliance Label: CAN ICES-3 (B) / NMB-3 (B).

Déclaration de conformité

Étiquette de conformité à la NMB-003 d'ISDE Canada : CAN ICES-3 (B) / NMB-3 (B).

Revision history

Table 7. Document revision history

Date	Revision	Changes
1-Mar-2018	1	Initial version
10-Apr-2018	2	Added <i>P-L496G-CELL02 Information</i>
30-Mar-2023	3	Document reshuffled from <i>Features</i> to <i>Conventions</i> sections to the latest standards Added <i>P-L496G-CELL02 product information</i> Updated <i>Federal Communications Commission (FCC) and ISED Canada (IC) Compliance Statements</i> Removed <i>Demonstration software</i> , <i>Technology partners</i> , and <i>Expansion board schematics</i>

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