Getting started with the LTE connectivity expansion board for STMod+ connector compatible evaluation boards

Introduction

The STEVAL-STMODLTE expansion board adds LTE connectivity to evaluation boards hosting the STMod+ expansion connector. It embeds an LTE cellular modem and an eSIM with a worldwide coverage.

The expansion board can be used only with the furnished antenna and is compatible with all STMicroelectronics Discovery kits featuring an STMod+ connector, such as the STM32L496G-DISCO, and with any STMod+ compatible evaluation board.

The package, combined with any compatible evaluation board, represents an ideal development platform for cellular and cloud technology-based solutions.

Figure 1. STEVAL-STMODLTE expansion board

1 Overview

The STEVAL-STMODLTE expansion board main features are:

- LTE connectivity expansion for evaluation boards hosting the STMod+ connector
- Embedded Quectel BG96 FCC and IC certified LTE module (FCC ID: XMR201707BG96 and IC: 10224A-201709BG96)
- Modem reset red LED and modem signaling green LED
- ST Incard eSIM
- Switchable SIM interface, eSIM and MicroSIM
- Pulse SMA antenna for the following frequency ranges: 824/900/1800/1900/2100 MHz
- Modem firmware can be easily upgraded through the dedicated micro-B USB connector

2 Board components

Figure 2 shows the STEVAL-STMODLTE top side main components:

1. Penta band (EU/US GSM/WCDMA) right angle stubby antenna, model W1900 by Pulse Larsen Antennas, for M2M applications, with a frequency range of 850/900/1800/1900/2100 MHz

Table 1. Antenna electrical specifications

Frequency (MHz)	Max Gain(dBi)	Efficiency (% / dB)	Return loss min. (dB)	Impedance (Ω)	Operating temperature (°C)
824 ÷ 960	1.0 (peak) -0.5 (min.)	65 / -1.8 (peak) 50 / -3.0 (min.)	-4	50	-40 ÷ 85
1710 ÷ 1990	2.0 (peak 0.5 (min.)	65 / -1.8 (peak) 50 / -3.0 (min.)	-6		
1920 ÷ 2170	2.5 (peak) 2.0 (min.)	65 / -1.8 (peak) 50 / -3.0 (min.)	-6		

Important:
As required by the U.S. Federal Communications Commission normative (cfr. section 15.203 Antenna requirement), no antenna other than that furnished shall be used with the device. The antenna must be professionally installed and the user cannot replace it with a different one.

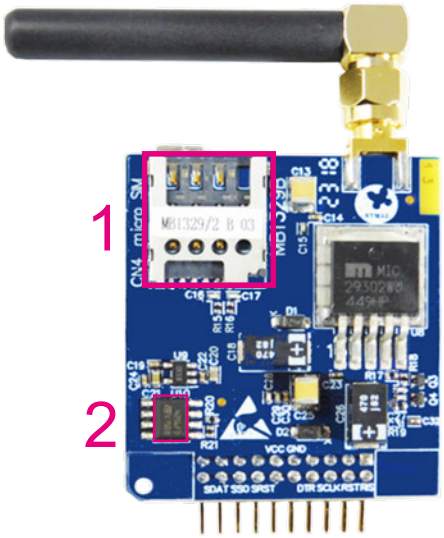
2. Micro USB type AB for firmware update
3. ST Incard eSIM
4. STMod+ for connection with compatible mother boards
5. Green LED for modem signaling mode
6. Red LED indicating the modem is ready for operation
7. Quectel BG96 LTE Cat M1/Cat NB1/EGPRS module offering maximum data rates of 375 kbps downlink and uplink and featuring global frequency bands and ultra-low power consumption

Figure 2. STEVAL-STMODLTE expansion board main components - top view

Figure 3 shows the STEVAL-STMODLTE bottom side main components:

1. Micro SIM card socket
2. I²C EEPROM

Figure 3. STEVAL-STMODLTE expansion board main components - bottom view



2.1 STMod+ connector

The STEVAL-STMODLTE STMod+ connector allows physical connection with any compatible mother board.

Table 2. STMod+ connector pin-out details

Pin number	Pin name	Pin function
1	CTSS	Modem UART CTS
2	RXDS	Modem UART RXD
3	TXDS	Modem UART TXD
4	RTSS	Modem UART RTS
5	GND	Ground
6	VCC	+5 V
7	STMod+ IO7	I²C clock for EEPROM
8	Sim_select1	SIM selection IO1: always set to 1
9	PWRen	Modem power enable
10	I2C	I²C data for EEPROM
11	RIS	Modem ring indicator RI
12	RST	Modem reset
13	sim_CLK	SIM clock
14	DTRS	Modem wake-up
15	VCC	+5 V
16	GND	Ground
17	Sim_RST	SIM reset
18	Sim_select0	SIM selection IO0: 0 for plastic external SIM and 1 for embedded SIM

Pin number	Pin name	Pin function
19	Sim_DATA	SIM data
20	STAS	Modem status

3 X-CUBE-CELLULAR

The X-CUBE-CELLULAR cellular software expansion for STM32Cube consists of a set of libraries and application examples for STM32L4 series MCUs acting as hosts for cellular connectivity applications, driving STMod+ compatible cellular-modem add-on boards such as the STEVAL-STMODLTE.

X-CUBE-CELLULAR enables connection to the Internet through the cellular network by using the provided baseline and its main features are:

- STMicroelectronics framework for devices based on LPWAN cellular networks
- FreeRTOS™ for easy integration into a complete platform
- Easy portability across different STM32 microcontroller series thanks to STM32Cube and STM32CubeMX
- BSD-like socket APIs for data plane
- TCP-UDP/IP connectivity with IP stack on host or modem
- Flexible and modular software architecture for easy integration of other modems
- PC terminal boot menu for device firmware customization (API key, APN, band)
- Connected application examples

4 Modem power supply

The STEVAL-STMODLTE expansion board is supplied through the 5V on the STMod+ connector (pins 6 and 15).

The modem is enabled by the power enable pin 9. When this pin is driven, a few seconds later, the red LED switches on indicating the modem is ready for operation, and the green LED starts flashing signaling the modem is scanning for cellular synchronization. AT command, then, can be sent via UART.

If the power supply is not enough, in signaling mode, additional power supply can be provided through the USB connector.

5 SIM selection

The STEVAL-STMODLTE offers the possibility of switching between the embedded SIM or a plastic external SIM.
You just have to set *Sim_select0* pin to:

- LOW to select the plastic external SIM
- HIGH to select the embedded SIM

6 Modem firmware update

The modem firmware can be updated using the micro USB connector (see Figure 2) and following the procedure below.

Step 1. Install the USB drivers of the modem from Quectel.

Step 2. Install Qflash from Quectel and upload the firmware.

Step 3. Press start and reset the modem to download the firmware.

7 Bill of materials

Table 3. **STEVAL-STMODLTE bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	11	C1, C3, C10, C11, C12, C14, C22, C23, C24, C30, C32	100 nF, 16 V, X7R, ±10%, 0402	Capacitor	YAGEO	CC0402KRX7R7BB104
2	2	C13, C25	100 µF, 6V3, X5R, ±10%, 1210	Capacitor	AVX	12106D107KAT2A
					Murata	GRM32ER60J107ME20L
3	2	C18, C26	470 µF, 6.3 V ±20%, C7343	Capacitor	SANYO	6TPB470M
4	1	C19	10 nF, 16 V, X7R, ±10%, 0402	Capacitor	YAGEO	CC0402KRX7R7BB103
5	2	C2, C5	5.1 pF, 50 V, NPO, ±0.25 pF, 0402	Capacitor	YAGEO	CC0402CRNPO9BN5R1
6	1	C20	10 µF, 6V3, X5R, ±10%, 0603	Capacitor	YAGEO	CC0603KRX5R5BB106
7	1	C21	2.2 µF, 10 V, X5R, ±10%, 0603	Capacitor	YAGEO	CC0603KRX5R6BB225
					KEMET	C0603C225K8PACTU
8	3	C4, C28, C31	10 pF, 50 V,NPO, ±5%, 0402	Capacitor	YAGEO	CC0402JRNPO9BN100
9	9	C6, C7, C8, C9, C15, C16, C17, C27, C29	33 pF, 50 V, ±5%, 0402, COG	Capacitor	YAGEO	CC0402JRNPO9BN330
10	1	CN1	SMA-J-P-H-ST-EM1	RF SMA connector PCB edge	SAMTEC	SMA-J-P-H-ST-EM1
11	1	CN2	10104111-0001LF	USB, micro AB receptacle	FCI	10104111-0001LF
12	1	CN3	Header 10x2 STMod+	Header 20 pins, 2 rows	ATOM	PH200210C-07000
					SAMTEC	TMM-110-01-L-D-RA
13	1	CN4	786463001	Micro SIM socket microsim	MOLEX	786463001
14	2	D1, D2	MMSZ5V1T1G	Zener diode	ON SEMICONDUCTOR	MMSZ5V1T1G
15	1	LD1	RED	LED	OSRAM OPTO SEMICONDUCTORS	LS Q976-NR-1
16	1	LD2	GREEN	LED	OSRAM OPTO SEMICONDUCTORS	LG Q396-PS-35

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
17	4	Q1, Q2, Q3, Q4	DTC043ZEBTL	Buffer transistor	ROHM	DTC043ZEBTL
18	1	R1	0 R, 0402, ±5%	Resistor	YAGEO	RC0402JR-070RL
19	1	R11	120 K, 0402, ±1%	Resistor	YAGEO	RC0402FR-07120KL
20	1	R12	10 K, 0603, ±1%	Resistor	YAGEO	RC0603FR-0710KL
21	2	R13, R14	2K2, 0402, ±1%	Resistor	YAGEO	RC0402FR-072K2L
22	1	R17	100 K, 0402, ±1%	Resistor	YAGEO	RC0402FR-07100KL or RT0402FRE07100KL
23	1	R18	47 K, 0402, ±1%	Resistor	YAGEO	RC0402FR-0747KL
24	1	R19	470 R, 0402, ±1%	Resistor	YAGEO	RC0402FR-07470RL
25	6	R2, R4, R5, R6, R15, R16	18 R, 0402, ±5%	Resistor	YAGEO	RC0402JR-0718RL
26	2	R20, R21	10 K, 0402, ±1%	Resistor	YAGEO	RC0402FR-0710KL
27	2	R3, R7	15 K, 0402, ±5%	Resistor	YAGEO	RC0402JR-0715KL
28	1	R8	15 K, 0402, ±5%	Resistor	YAGEO	RC0402JR-0715KL
29	2	R9, R10	51 K, 0402, ±1%,	Resistor	YAGEO	RC0402FR-0751KL
30	1	U1	STMPS2171	Enhanced single channel power switch	ST	STMPS2171STR
31	1	U10	M24256D-FMN6TP	256-Kbit serial I^2C bus EEPROM	ST	M24256D-FMN6TP
32	1	U2		Embedded SIM	-	-
33	1	U3	BG96	Cellular modem	QUECTEL	BG96MA-128-SNN
34	2	U4, U5	ESDA6V8AV6	ESD protection	WILLSEMI	ESDA6V8AV6
35	1	U6	SN74CB3Q3257PW	Multiplexer switch	TEXAS INSTRUMENTS	SN74CB3Q3257PW
36	1	U7	TXS0108EPWR	Bidirectional level shifter	TEXAS INSTRUMENTS	TXS0108EPWR
37	1	U8	MIC29302WU	Adjustable LDO, V_{OUT} = 1V 25-to-25 V,3 A,V_{INmax} = 26 V	MICREL	MIC29302WU
38	1	U9	LD3985M33R	Ultra low drop-low noise BiCMOS voltage, regulators low ESR capacitor compatible	ST	LD3985M33R
39	1			Antenna	PULSE	W1900

8 Schematic diagrams

Figure 4. **STEVAL-STMODLTE circuit schematic (1 of 4)**

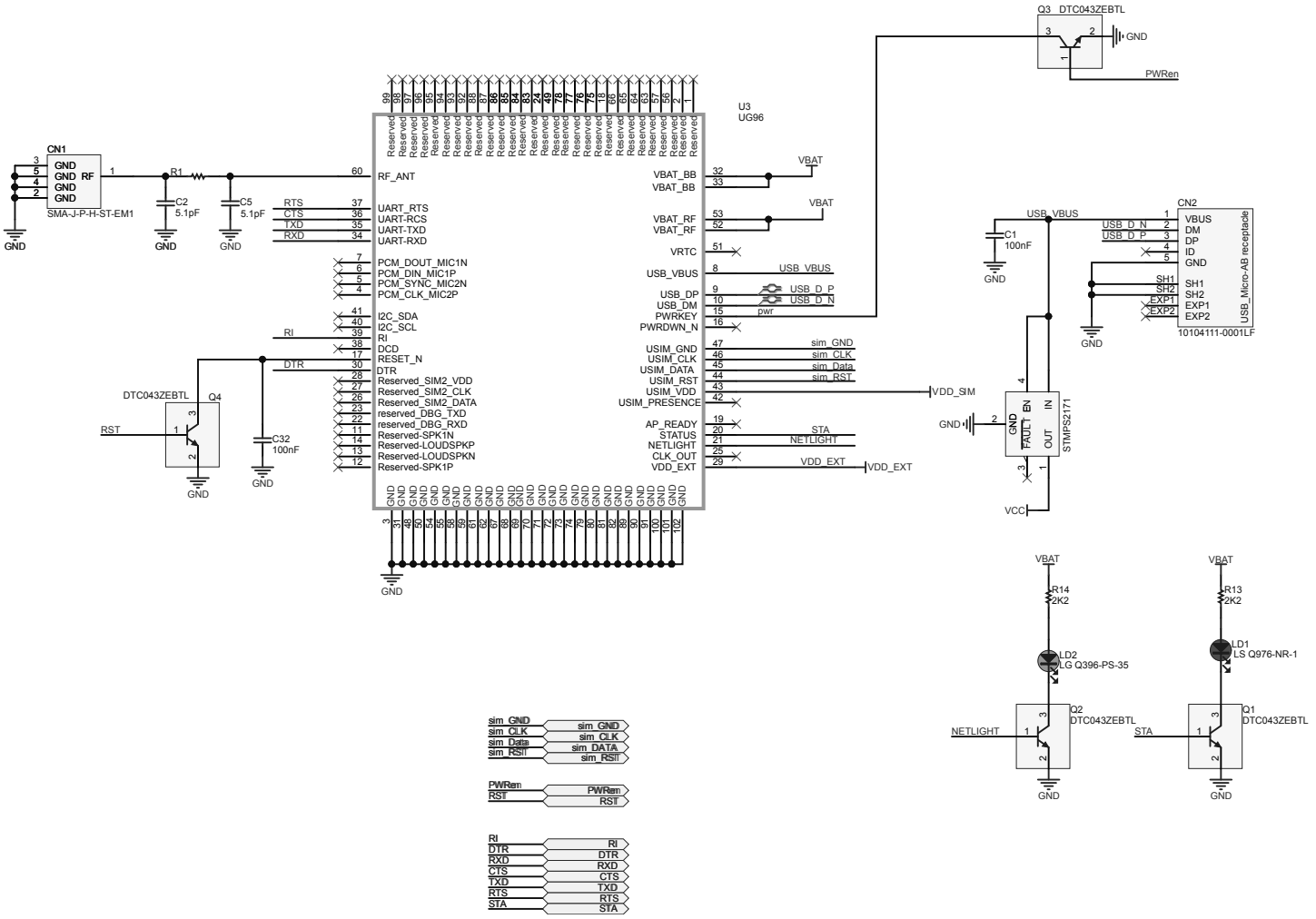


Figure 5. STEVAL-STMODLTE circuit schematic (2 of 4)

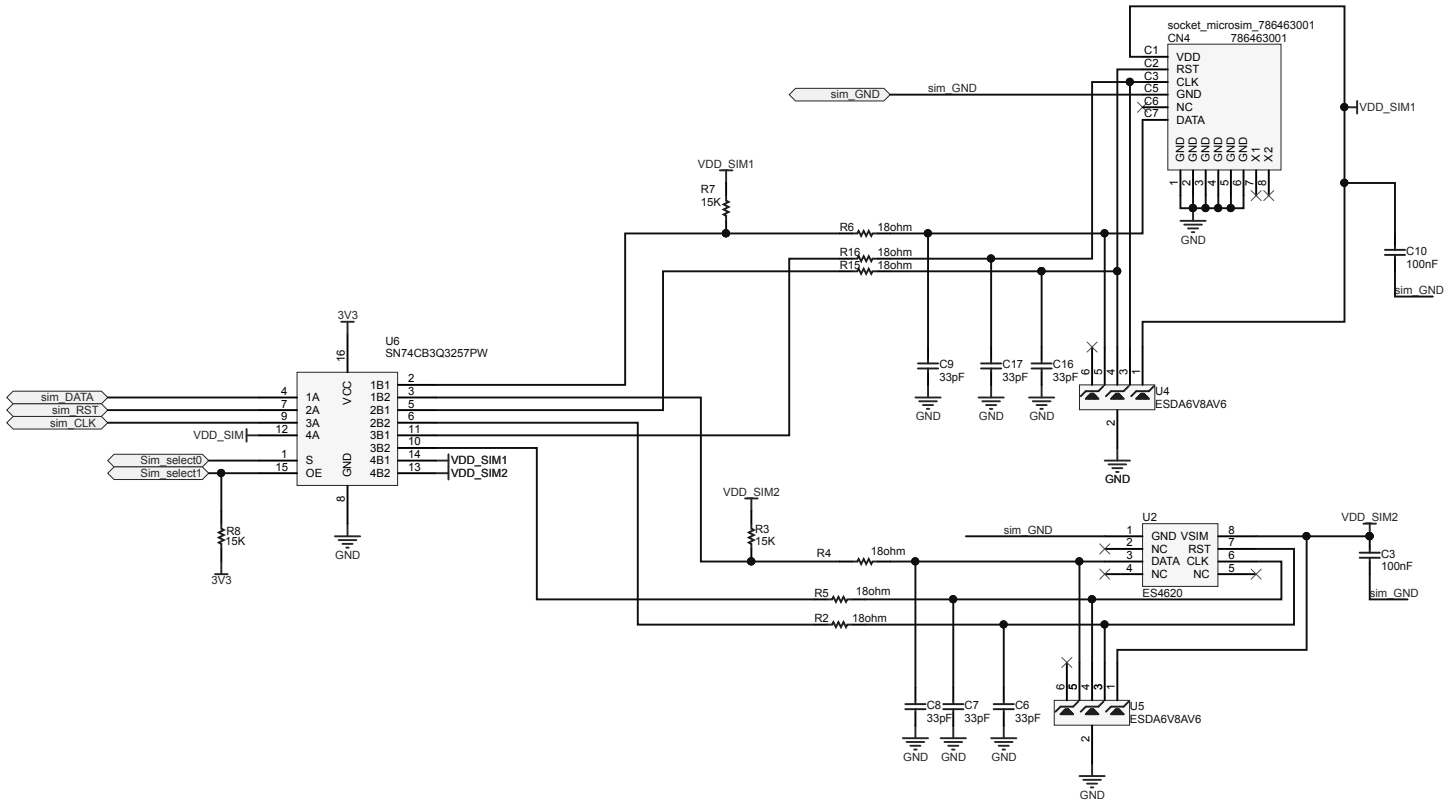


Figure 6. STEVAL-STMODLTE circuit schematic (3 of 4)

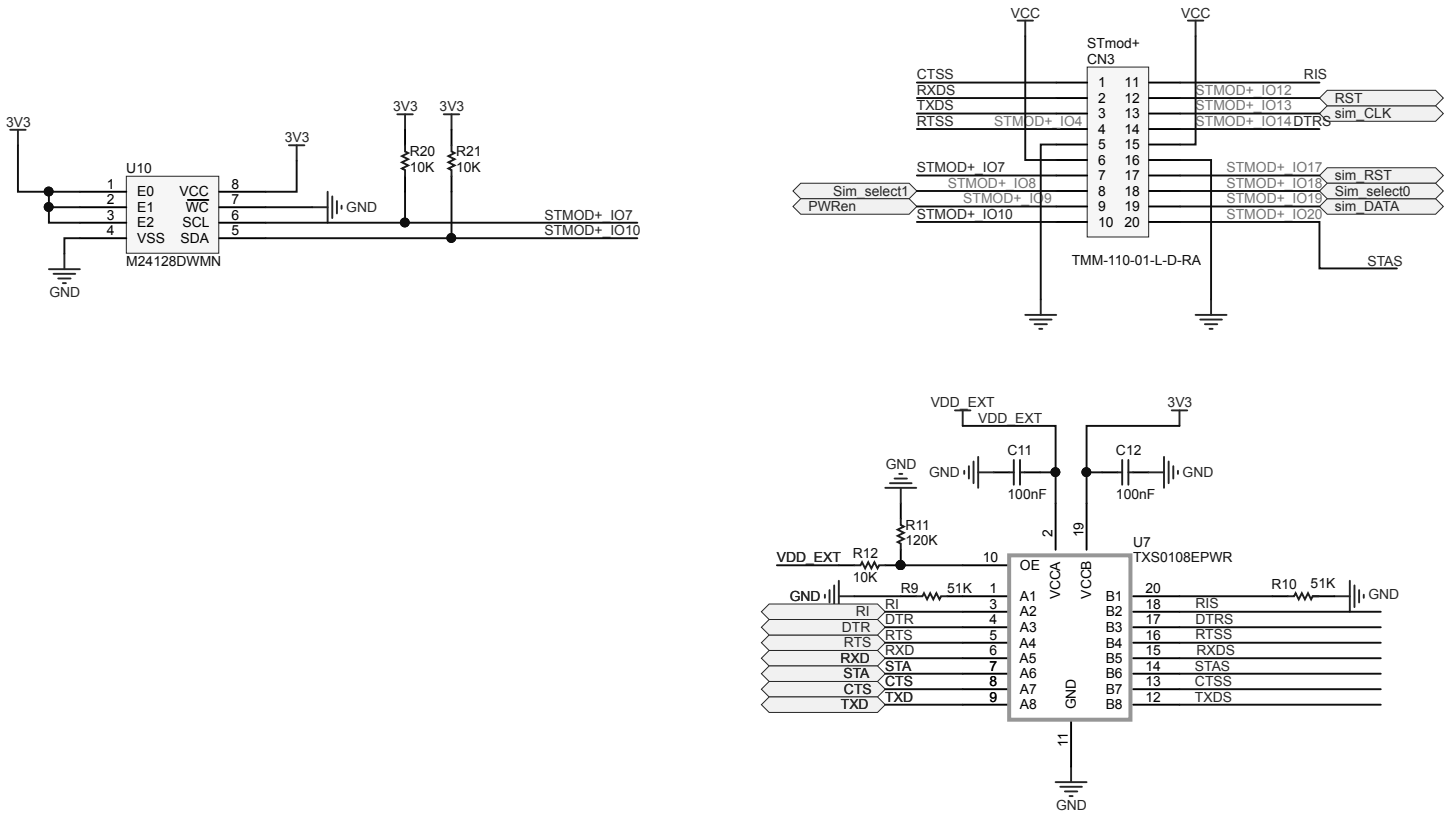
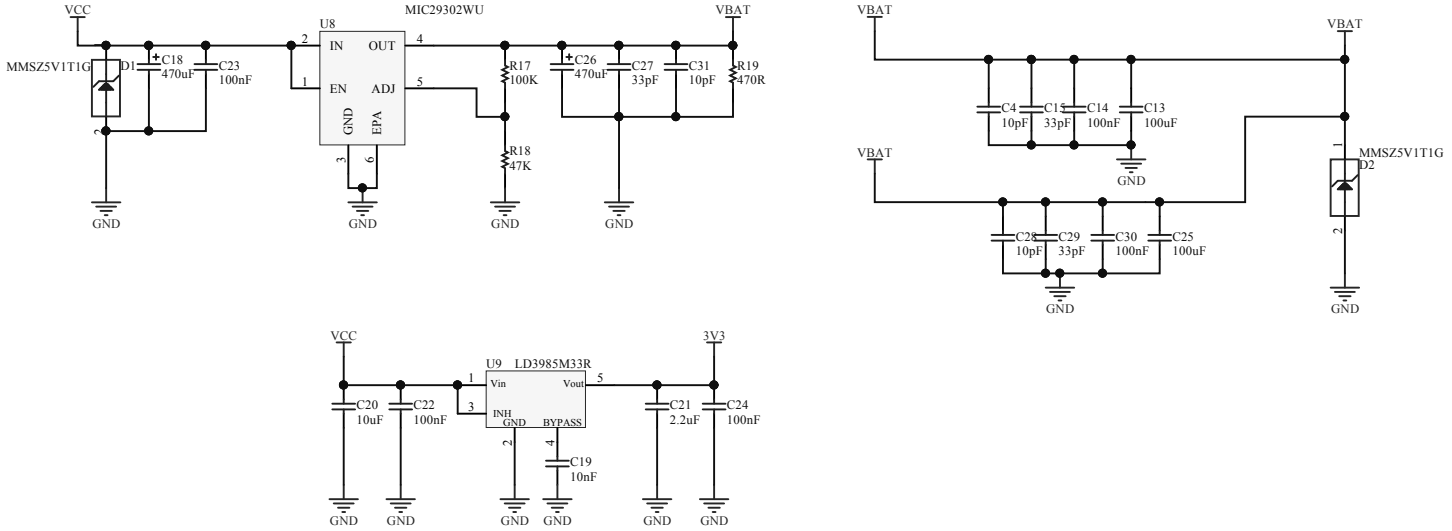


Figure 7. STEVAL-STMODLTE circuit schematic (4 of 4)



9 Regulatory information

Formal Notice Required by the U.S. Federal Communications Commission

FCC NOTICE

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.

Changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment.

Formal Product Notice Required by Industry Canada

Innovation, Science and Economic Development Canada Compliance

This device complies with Innovation, Science and Economic Development RSS standards. 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. Changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment.

Conformité à Innovation, Sciences et Développement Économique Canada

Cet appareil est conforme aux normes RSS d'Innovation, Science et Développement économique. L'utilisation est soumise aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférences nuisibles, et (2) cet appareil doit accepter de recevoir tous les types d’interférence, y comprises les interférences susceptibles d'entraîner un fonctionnement indésirable. Les changements ou les modifications non expressément approuvés par le fabricant pourraient annuler le permis d'utiliser l'équipement.

Revision history

Table 4. **Document revision history**

Date	Revision	Changes
01-Dec-2020	1	Initial release.

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