SE250B4 Smart Module

Hardware Design Guide

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Technical Documentation

Contents

1. Applicability Table

Table 1: Applicability Table

Products
SE250B4-NA
SE250B4-EU

2. Introduction

Scope

This document describes electrical specifications, mechanical information, interfaces application and manufacturing information about Telit SE250B4 Smart module. With the help of this document and other application notes or user guides, users can understand Telit SE250B4 Smart module well and develop various products quickly.

Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using the Telit module.

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Product information and technical documents are accessible 24/7 on our website: https://www.telit.com

Conventions

Note: Provides advice and suggestions that may be useful when integrating the module.

Danger: This information MUST be followed, or catastrophic equipment failure or personal injury may occur.

ESD Risk: Notifies the user to take proper grounding precautions before handling the product.

Warning: Alerts the user on important steps about the module integration.

All dates are in ISO 8601 format, that is YYYY-MM-DD.

Terms and Conditions

Refer to https://www.telit.com/hardware-terms-conditions/.

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3. General Product Description

Overview

The Telit SE250B4 Smart module is a multi-mode and multi-band wireless smart module, which is based on Qualcomm QCM2290 platform. It includes baseband, memory, RF front end and required circuitry to support rich multimedia features, global location-based service, wireless connectivity, and air interface standards including GSM, WCDMA, and LTE.

With higher integration to reduce PCB surface area, time-to-market, and BOM costs, Telit SE250B4 Smart module will help drive wireless products adoption in more industry around the world.

The operating bands are different between Telit SE250B4 Smart module variants.

MANUFACTURER INFO

The manufacturer of SE250 products Family is:

Telit Communications S.p.A., via Stazione di Prosecco 5/b, 34010 Sgonico, Trieste, Italy.

Product Variants and Frequency Bands

The Telit SE250B4 Smart module is available in two variants.

- SE250B4-NA
- SE250B4-EU

SE250B4-NA	SE250B4-EU

Figure 1 SE250B4 EU/NA SKU

For details on the differences between the two variants, please refer to the next table.

Table 2 Product Variants and Frequency Bands

Configuration		SE250B4-NA	SE250B4-EU
CPU		2.0GHz	2.0GHz
Memory	RAM	2GB	2GB
	Flash	16GB	16GB
Standards & bands			
GSM	900MHz		P
	1800M Hz		P
WCDMA	B1		P
	B2		
	B4		
	B5		P
	B8		P
FDD-LTE	B1		P
	B2	P	
	B3		P
	B4	P	
	B5	P	P
	B7	P	P
	B8		P
	B12	P	
	B13	P	
	B14	P	
	B17	P	
	B20		P
	B25	P	
	B26	P	
	B28A		P
	B28B		P
	B66	P	
	B71	P	
	B38		P
	B40		P
	B41	P	P
WLAN	2.4G/5GHz; 802.11a/b/g/n/ac	P	P
BT	BT 5.0 + BR/EDR + BLE	P	P
GNSS	GPS	P	P
	GLONASS	P	P
	Galileo	P	P
	BEIDOU	P	P

Target Market

The Telit SE250B4 Smart module provides tamper-resistance, confidential, secure, and authentic end-to-end connectivity for telematics applications. The Telit SE250B4 Smart module is one of the key component among the M2M applications, such as:

- CPE (Customer Premises-based Equipment)
- POS machine
- Smart metering
- Router
- Data card
- Digital signage
- Alarm panel
- Security
- Industrial PDA.

Main Features

Table 3: Table Features

Function	Features
Application processor	Quad ARM Cortex-A53 cores up to 2.0 GHz, 64-bit Arm Cortex
Memory RAM	2 GB, 1804MHz clock (2x16 bits), LPDDR4X SDRAM
Memory Flash	16 GB (default) SE150B4-NA / SE150B4-EU External memory via SDC2 Support SD3.0 flash devices, up to128 GB
Graphics	Adreno 702; up to 845 MHz with 64-bit addressing
Operating system	Android 13 go version and above
Software upgrade	Upgrade via USB interface; support forced download
Power supply	Voltage range: 3.4V ~ 4.4V, support single-cell lithium battery power supply
Charge management	Integrated 1.44 A linear charger for single-cell lithium-ion batteries
Display support	4-lane MIPI_DSI, 1.5Gbps each; HD+(1440*720), 60fps
Camera interfaces	Supports 2 groups of 4 MIPI_CSI up to 1.5Gbps/lane and three simultaneous cams Front camera 4-lane MIPI up to 13MP Rear camera 2-lane MIPI up to 8MP Rear camera 2-lane MIPI up to 5 MP
Video applications performance	Encode: 1080p 30 fps: H264 480p 30 fps: MP4/H263 Decode: 1080p 30 fps: HEVC, H.264, VP8 Encode + Decode: 1080p 30 fps + 720p 30 fps
Audio supply	Three analog inputs that support single-ended configurations OR two data input Three outputs: earpiece, stereo headphones, and mono class-D speaker driver
Audio codec support	MP3; AAC; He-AAC v1, v2; WMA 9/Pro; Dolby AC-3, eAC-3, DTS-HD M6 and DTS-HD M8

Voice codec support	EVRC, -B, -WB; G.711; G.729A,-AB; GSM-FR,-EFR,-HR; ARM-NB,-WB; eAMR; BeAMR
USB	One USB 3.1 high-speed port One USB 2.0 compliant
UART	Supports up to 3*UART, up to 4 MHz
I2C	Supports up to 6*I2C, used to cameras, sensors, TP, and so forth
SPI	Supports up to 5*SPI, up to 50MHz. (Master only)
ADC	Supports up to 2*ADC, typical input range: 0.3~4.5V
UIM card	Dual cards dual standby; 1.8V/2.95V dual voltage adaptation
LTE features	Support 3GPP R12 CAT4 FDD and TDD Support 1.4 to 20 MHz RF bandwidth Support DL 2 x 2 MIMO FDD: Max 150Mbps (DL)/Max 50Mbps (UL) TDD: Max 100Mbps (DL)/ Max 35Mbps (UL)
UMTS features	Support 3GPP R9 DC-HSDPA/HSPA+/HSDPA/HSUPA/WCDMA Support 16-QAM, QPSK DC-HSDPA: Max 42Mbps (DL) HSUPA: Max 5.76Mbps (UL) WCDMA: Max 384Kbps (DL)/ Max 384Kbps (UL)
GSM features	R99: CSD: 9.6kbps, 14.4kbps GPRS: Support GPRS multi-slot level 33 (default 33) coding schemes: CS-1, CS-2, CS-3, CS-4 Max 85.6Kbps (UL) / Max 107Kbps (DL) EDGE: Support EDGE multi-slot level 33 (default 33) Support GMSK and 8-PSK Modulation coding DL coding schemes: CS 1-4 and MCS 1-9 UP coding schemes: CS 1-4 and MCS 1-9 Max 236.8Kbps (UL) / Max 296Kbps (DL)
WLAN features	Support SoftAP Function, 802.11 a/b/g/n Encryption: WFA WPA/WPA2 Qos: WFA WMM, WMM PS RF performance: 11b power 17 dBm, EVM≤35% 11g power 15dBm, EVM<-25dB 11n power 11dBm, EVM<-27dB Wi-Fi bands: 2.4GHz/5GHz
BT Features	Bluetooth 5.0 and earlier Specification: V2.1+EDR, 3.0+HS, V4.1 BLE Tx power levels: Class 1 & 2

Tx Output Power

Table 4 TX Output Power Power Class

Band	Power class
EGSM 900 MHz	Class 4
DCS 1800	Class 1
WCDMA/HSPA+	Class 3
LTE All Bands	Class 3

Table 5 TX Maximum Conducted Output Power (dBm)

Configuration		SE250B4-NA	SE250B4-EU
GSM	900MHz	-	34.5
	1800M Hz	-	31.5
WCDMA	B1	-	25.5
	B5	-	25.5
	B8	-	25.5
FDD-LTE	B1	-	25
	B2	25	-
	B3	-	25
	B4	25	-
	B5	25	25
	B7	25	25
	B8	-	25
	B12	25	-
	B13	25	-
	B14	25	-
	B17	24.8	-
	B20	-	25
	B25	25	-
	B26	24.8	-
	B28A	-	25
	B28B	-	25
	B66	24.8	-
	B71	25	-
	B38	-	24.5
	B40	-	25
	B41	25	24.5
WLAN	2.4GHz	19	16
	5GHz	19	13.9
BT	Bluetooth® 5.0	12	12
	Bluetooth® EDR	8.5	8.5
	Bluetooth ® LE	6	6

Note: the above values reppresent the worst conditions (modulation/operating mode) for each technology; further details are found in the confidential tune-up prodecure document.

Mechanical Specifications

Dimensions

The overall dimensions of the Telit SE250B4 Smart module family are:

- Length: 43 mm, +/- 0.15 mm tolerance
- Width: 41 mm, +/- 0.15 mm tolerance
- Thickness: 3 mm, +/- 0.25 mm tolerance

Temperature Range

Table 6 Temperature Range

Temperature range type	Temp range	Note
Operating Temperature:	-10°C / +55°C	The module is fully functional in the complete temperature range, and it fully meets the 3GPP specifications.
Extended Temperature:	-30°C ~ +75°C	Telit guarantees full functionality within this range as well. However, possibly there may be some performance deviations in this extended range related to 3GPP requirements, which means that some RF parameters may deviate from the 3GPP specification on the receiver or the maximum output power may be slightly degraded. Even so, all functionalities, such as connection to calls, SMS, USB communication, UART activation and so on, will be maintained, and the effect of such degradations will not lead to malfunctions. EU RED certified range -15°C to + 75°C
Storage Temperature	–40°C ~ +90°C	

Block Diagram

The following is the architecture block diagram.

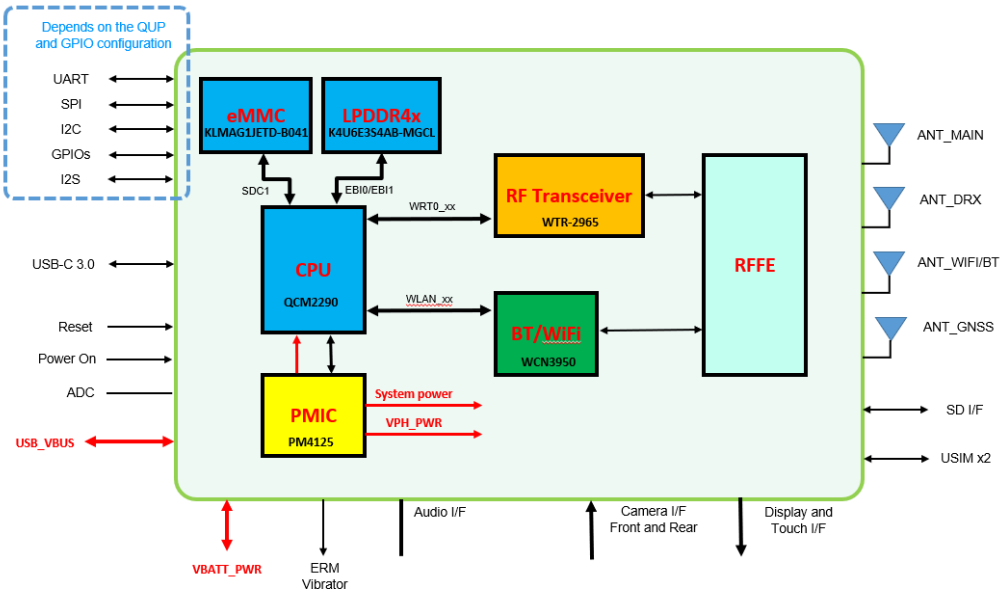


Figure 2 SE250B4 block diagram

Numbers of GPIOs, and periprheral is configurable via SW and will be eventually strictly related to the customer application.

As default settings the device supports: 2XUSB,2XSIM,2XUARTs, 1XDEBUG UART, 1X SD CARD, 33 GPIOs configured as alternate functions as follow: 8 for NFC, 3 for sensors , 1 reserved, 3 HDMI, 2 for PM8008 RST_N+ INTerrupt , 2 For CAM enable, 1 fopr SPL SHD_DW, 7 LCM (3EN+2ID+ 2BIAS) + 6 GPIO.

4. Pins Allocation

LGA Pads Layout

Top View

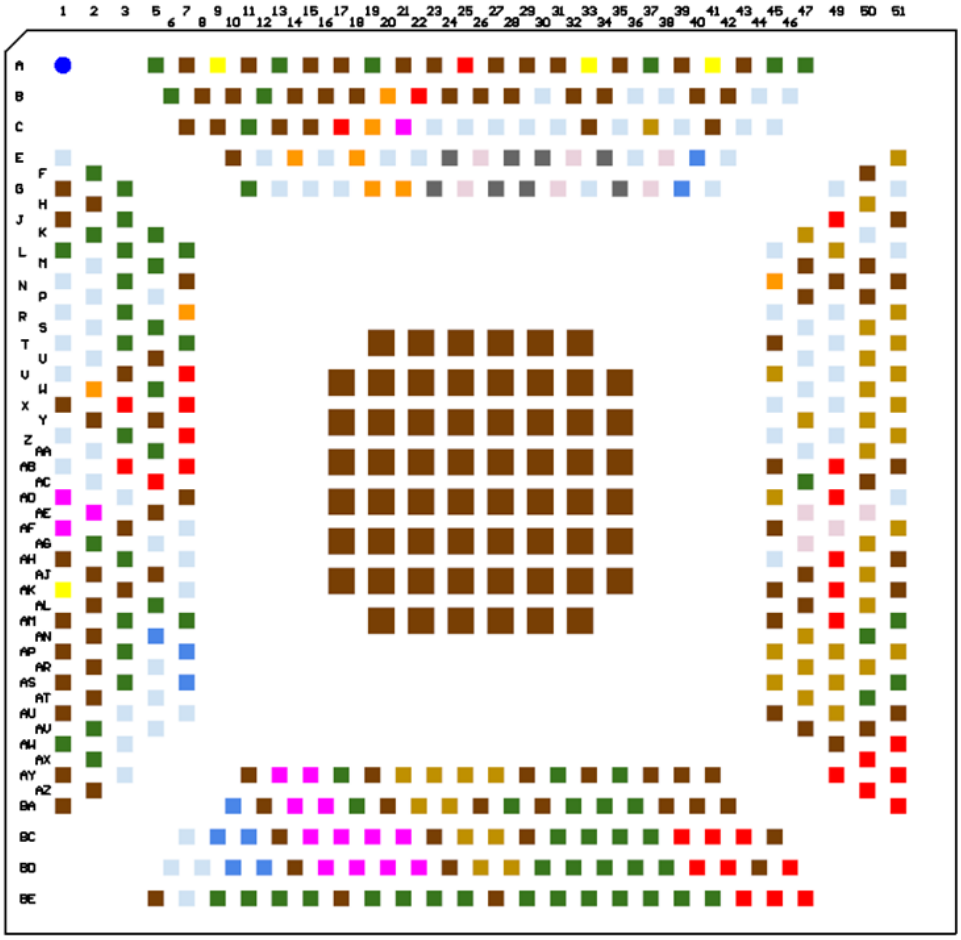


Figure 3: LGA Pads Layout

SE250B4 Pin color LEGEND					
	GND		RF		UART
	RFU		AUDIO		SENSORS
	PWR		VIDEO		MISCELLANEOUS (SIM, NFC,SDcard,Key vol,LCM, GRFC,)
	USB		GPIO		RKEY

PIN-out

USB interface

Table 7 PIN-out description

PIN	Signal	I/O	Function	DC Characteristics	Comment	Alternate Function
C21	FORCED_USB_BOOT	AI				GPIO_95
AY15	USB0_HS_SM_DM	AI/O	USB differential (-)		90Ω differential impedance with 10% tol; compliant to USB 2.0 standard	
AY13	USB0_HS_SM_DP	AI/O	USB differential (+)			
AD1, AE2, AF1	USB_VBUS_IN USB_VBUS_IN	P_IN P_IN	Charging power input and power output for OTG devices USB/adaptor insertion detection	Vmax = 6.0V Vmin = 4.0V Vnom= 5.0V	The Max output current is 500mA	
BD18	USB0_SS_RX0_M	AI/O	USB 3.1 channel 1 superspeed receive (-)		90Ω differential impedance, compliant to USB 3.1stand ard	
BC17	USB0_SS_RX0_P	AI/O	USB 3.1 channel 1 superspeed receive (+)			
BD20	USB0_SS_TX0_M	AI/O	USB 3.1 channel 1 superspeed transmit (+)			
BC19	USB0_SS_TX0_P	AI/O	USB 3.1 channel 1 superspeed transmit (-)			
BA16	USB0_SS_RX1_M	AI/O	USB 3.1 channel 2 superspeed receive (-)			

BA14	USB0_SS_RX1_P	AI/O	USB 3.1 channel 2 superspeed receive (+)			
BD22	USB0_SS_TX1_M	AI/O	USB 3.1 channel 2 superspeed transmit (+)			
BC21	USB0_SS_TX1_P	AI/O	USB 3.1 channel 2 superspeed transmit (-)			
BC15	USB_CC1	AI	USB Type-C detect 1			
BD16	USB_CC2	AI	USB Type-C detect 2			

USIM Interface

Table 8 USIM Interface

PIN	Signal	I/O	Function	DC Characteristics	Comment	
U2	UIM1_CLK	DO	(U)SIM1 card clock			GPIO_77
V1	UIM1_PRESENT	DI	(U)SIM1 card hot-plug detect	VILmax = 0.63 V VIHmin = 1.17 V	Active low. Externally pull it up to 1.8 V. If unused, keep it open.	GPIO_79
T1	UIM1_DATA	DI/O	U)SIM1 card data	VILmax = 0.2 × USIM1_VDD VIHmin = 0.7 × USIM1_VDD VOLmax = 0.4 V VOHmin = 0.8 × USIM1_VDD	Cannot be multiplexed into a generic GPIO.	GPIO_76
S2	UIM1_RESET	DO	U)SIM1 card reset	VOLmax = 0.4 V VOHmin = 0.8 × USIM1_VDD		GPIO_78
AB7	VREG_L18A_1P8	PO	USIM1_VDD	IOmax = 67 mA	Either 1.8 V or 2.95 V	

				1.8 V (U)SIM: Vmax = 1.85 V Vmin = 1.75 V 2.95 V (U)SIM: Vmax = 3.1 V Vmin = 2.8 V	(U)SIM card is supported.	
R1	UIM2_CLK	DO	(U)SIM2 card clock			GPIO_73
M2	UIM2_PRESENT	DI	(U)SIM2 card hot-plug detect	VILmax = 0.63 V VIHmin = 1.17 V	Active low. Externally pull it up to 1.8 V. If unused, keep it open.	GPIO_75
P2	UIM2_DATA	DI/O	U)SIM2 card data	VILmax = 0.2 × USIM1_VDD VIHmin = 0.7 × USIM1_VDD VOLmax = 0.4 V VOHmin = 0.8 × USIM1_VDD	Cannot be multiplexed into a generic GPIO.	GPIO_72
N1	UIM2_RESET	DO	U)SIM2 card reset	VOLmax = 0.4 V VOHmin = 0.8 × USIM1_VDD		GPIO_74
AC5	VREG_L19A_1P8	PO	USIM2_VDD	IOmax = 67 mA 1.8 V (U)SIM: Vmax = 1.85 V Vmin = 1.75 V 2.95 V (U)SIM: Vmax = 3.1 V Vmin = 2.8 V	Either 1.8 V or 2.95 V (U)SIM card is supported.	

UART Interface

Table 9 UART Interface

PIN	Signal	I/O	Function	DC Characteristics	Comment	
E34	UART_RX_N_LPI	DI	UART2 receive	VILmax = 0.63 V VIHmin = 1.17 V	1.8 V power domain.	LPI_GPIO_26
G35	UART_TX_N_LPI	DO	UART2 transmit	VOLmax = 0.45 V		LPI_GPIO_25

				VOHmin = 1.35 V	If unused, keep it open.	
E24	UART_RX_N_SE5	DI	UART1 receive	VILmax = 0.63 V VIHmin = 1.17 V		GPIO_17
G23	UART_TX_N_SE5	DO	Uart1 transmit	VOLmax = 0.45 V VOHmin = 1.35 V		GPIO_16
E28	UART_DEBUG_RX	DI	DEBUG UART RECEIVE	VILmax = 0.63 V VIHmin = 1.17 V		GPIO_13
G27	UART_DEBUG_TX	DO	DEBUG UART TRANSMIT	VOLmax = 0.45 V VOHmin = 1.35 V		GPIO_12
G29	UART_CTS_N_SE5	DI	DCE clear to send signal from DTE	VILmax = 0.63 V VIHmin = 1.17 V		GPIO_14
E30	UART_RFR_N_SE5	DO	DCE request to send signal to DTE	VOLmax = 0.45 V VOHmin = 1.35 V		GPIO_15

SDIO/SD card Interface

Table 10 SDIO/SD card interface

PIN	Signal	I/O	Function	DC characteristics	QCM2290 GPIO
C45	SDC2_CLK	DO			
B46	SDC2_CMD	DO			
C43	SDC2_DATA_0	DIO			
B44	SDC2_DATA_1	DIO			
E42	SDC2_DATA_2	DIO			
G41	SDC2_DATA_3	DIO			
K50	SD_CARD_DET_N	DI			GPIO_88
AB3	VREG_L4A_2P96	PO	SD-Card_LDO line		
X7, Z7	VREG_L21A_2P96	PO	SD-CARD_VDD	2.95 V/841 mA	

Display Interface

Table 11 Display Interface

PIN	Signal	I/O	Function	QCM2290 GPIO
AU49	MIPI_CSI0_A0_CLK_M	AI	MIPI CSI0 clock (+)	-
AT50	MIPI_CSI0_NC_CLK_P	AI	MIPI CSI0 clock (-)	-
AS49	MIPI_CSI0_C0_LN0_M	AI	MIPI CSI0 lane 0 data (-)	-
AR50	MIPI_CSI0_B0_LN0_P	AI	MIPI CSI0 lane 0 data (+)	-
AT47	MIPI_CSI0_B1_LN1_M	AI	MIPI CSI0 lane 1 data (-)	-
AS45	MIPI_CSI0_A1_LN1_P	AI	MIPI CSI0 lane 1 data (+)	-
AP45	MIPI_CSI0_A2_LN2_M	AI	MIPI CSI0 lane 2 data (-)	-
AN47	MIPI_CSI0_C1_LN2_P	AI	MIPI CSI0 lane 2 data (+)	-
AP49	MIPI_CSI0_C2_LN3_M	AI	MIPI CSI0 lane 3 data (-)	-
AR47	MIPI_CSI0_B2_LN3_P	AI	MIPI CSI0 lane 3 data (+)	-
Y50	MIPI_CSI1_A0_CLK_M	AI	MIPI CSI1 clock (-)	-
X51	MIPI_CSI1_NC_CLK_P	AI	MIPI CSI1 clock (+)	-
AA50	MIPI_CSI1_C0_LN0_M	AI	MIPI CSI1 lane 0 data (-)	-
Z51	MIPI_CSI1_B0_LN0_P	AI	MIPI CSI1 lane 0 data (+)	-
W50	MIPI_CSI1_B1_LN1_M	AI	MIPI CSI1 lane 1 data (-)	-
V51	MIPI_CSI1_A1_LN1_P	AI	MIPI CSI1 lane 1 data (+)	-
U50	MIPI_CSI1_A2_LN2_M	AI	MIPI CSI1 lane 2 data (-)	-
T51	MIPI_CSI1_C1_LN2_P	AI	MIPI CSI1 lane 2 data (+)	-
S50	MIPI_CSI1_C2_LN3_M	AI	MIPI CSI1 lane 3 data (-)	-
R51	MIPI_CSI1_B2_LN3_P	AI	MIPI CSI1 lane 3 data (+)	-
BC27	MIPI_DSI0_CLK_M	AO	LCD MIPI clock (-)	-
BC25	MIPI_DSI0_CLK_P	AO	LCD MIPI clock (+)	-
BA24	MIPI_DSI0_L0_M	AO	LCD MIPI lane 0 data (-)	-
BA22	MIPI_DSI0_L0_P	AO	LCD MIPI lane 0 data (+)	-

AY25	MIPI_DSI0_L1_M	AO	LCD MIPI lane 1 data (-)	-
AY27	MIPI_DSI0_L1_P	AO	LCD MIPI lane 1 data (+)	-
AY23	MIPI_DSI0_L2_M	AO	LCD MIPI lane 2 data (-)	-
AY21	MIPI_DSI0_L2_P	AO	LCD MIPI lane 2 data (+)	-
BD26	MIPI_DSI0_L3_M	AO	LCD MIPI lane 3 data (-)	-
BD28	MIPI_DSI0_L3_P	AO	LCD MIPI lane 3 data (+)	-
B30	LCM_RST_N	DO	LCD reset	-
B38	LCM_TE	DO	LCD tearing effect	GPIO_81
R45	LCM_BIAS_N_EN	DO	LCM bias EN (-)	GPIO_106
C39	LCM_BIAS_P_EN	DO	LCM bias EN (+)	GPIO_107
L45	LCM_ID1	DI	LCM_ID1 display	GPIO_111
G49	LCM_ID2	DI	LCM_ID2 display	GPIO_112
AW3	LCM_1P8_EN	DO	LCM supply enable	GPIO_114
AY3	LCM_2P8_EN	DO	LCM supply Enable	GPIO_113
W47	LCM_BL_EN	DO	LCM BL enable	GPIO_60
AH45	HDMI_LT8912_INT	DI	INTerrupt for MIPI DSI bridge	GPIO_28
T49	HDMI_INT	DI	Interrupt for HDMI	GPIO_34
R49	HDMI_LT8912_RST_N	DO	HDMI_Reset	GPIO_108

TP Interface

Table 12 TP Interface

PIN	Signal	I/O	Function	DC Characteristic	Comment	QCM2290 GPIO
E32	TS_I2C_SCL	DO	TP I2C clock		Need to be pulled up to 1.8 V externally. Can be used for other I2C devices.	GPIO_7
G31	TS_I2C_SDA	DO	TP I2C data			GPIO_6
C31	TS_INT_N	DI	TP interrupt	VILmax = 0.63 V VIHmin = 1.17 V	1.8 V power domain.	GPIO_80
C35	TS_RESET_N	DO	TP reset	VOLmax = 0.45 V VOHmin = 1.35 V	1.8 V power domain. Active low.	GPIO_71
G51	TS_3P0_EN	DI	TP Enable			GPIO_37

Camera Interface

Table 13 Camera Interface

PIN	Signal	I/O	Function	QCM2290 GPIO
AJ50	CAM_MCLK0	DO	Master clock of camera 0	GPIO_20
L49	CAM0_PWDN	DO	Power down of camera 0	GPIO_97
AF51	CAM0_RST_N	DO	Reset of camera 0	GPIO_18
AG50	CAM_MCLK1	DO	Master clock of camera 1	GPIO_21
AD45	CAM1_PWDN	DO	Power down of camera 1	GPIO_36
Y47	CAM1_RST_N	DO	Power down of camera 1	GPIO_19
AL50	CAM_MCLK2	DO	Master clock of camera 2	GPIO_27
C37	CAM2_PWDN	DO	Power down of camera 2	GPIO_104
V45	CAM2_RST_N	DO	Power down of camera 2	GPIO_24
AG47	CAM_CCI_I2C_SCL0	DO	I2C clock of camera 0	GPIO_23
AE47	CAM_CCI_I2C_SDA0	DIO	I2C data of camera 0	GPIO_22
AE50	CAM_CCI_I2C_SCL1	DO	I2C clock of camera 1	GPIO_30
AF49	CAM_CCI_I2C_SDA1	DIO	I2C data of camera 1	GPIO_29
J49	CAM_AF_VDD_EN	DO		GPIO_38
K47	CAM_1P2_EN	DO		GPIO_58
H50	CAM_1P8_EN	DO		GPIO_39
E51	CAM_2P8_EN	DO		GPIO_42

Keypad Interface

Table 14 Keypad interface

PIN	Signal	I/O	Function	QCM2290 GPIO
AB1	KEY_PWR_ON_N	DI	Turn on/off the module	
Z1	KEY_PM_RESIN_N	DI	Reset the module	
E36	KEY_VOL_DOWN_N	DI	Volume down	GPIO_103
B36	KEY_VOL_UP_N	DI	Volume up	GPIO_96

Sensor Interface

Table 15 Sensor interface

PIN	Signal	I/O	Function	Comment

V49	SNSR_ACCL_INT	DI	Inerrupt for ACC sensor	GPIO_32
X49	SNSR_GYRO_INT	DI	Interrupt for gyro sensor	GPIO_33
AD51	SNSR_ALPS_INT_N	DI	Interrupt for Lux/proximity sensor	GPIO_35
E38	SNSR_I2C_SCL	DO	I2C clock for external sensors	GPIO_110
G37	SNSR_I2C_SDA	DIO	I2C data for external sensors	GPIO_109
E26	APPS_I2C_SDA	DIO	For PM8008/MIPI DSI bridge IC/NFC/LCD BIAS IC/Backlight driver IC	GPIO_4
G25	APPS_I2C_SCL	DO		GPIO_5

RF Interface

Table 16 RF interface

PIN	Signal	I/O	Function	Comment
A41	ANT_TRX	AIO	Main antenna interface	
A33	ANT_DRX	AI	Diversity antenna interface	
A9	ANT_GPS	AI	GNSS antenna interface	
AK1	ANT_WIFI	AIO	Wi-Fi/Bluetooth antenna interface	

Audio Interface

Table 17 Audio Interface

PIN	Signal	I/O	Function	Comment
BC9	CDC_MIC_BIAS1	AO	Bias voltage 1 output for microphone	Vomin = 1.6 V Vnom=1.8V Vomax = 2.85 V I=3mA
BD10	CDC_MIC_BIAS2	AO	Bias voltage 2 output for microphone	
BA10	CDC_MIC_BIAS3	AO	Bias voltage 3 output for microphone	
BD8	CDC_IN1_M	AI	Microphone input for channel 1 (-)	
BC7	CDC_IN1_P	AI	Microphone input for channel 1 (+)	
AV5	CDC_IN2_M	AI	Microphone input for channel 2 (-)	
AU7	CDC_IN2_P	AI	Microphone input for channel 2 (+)	
AT5	CDC_IN3_M	AI	Microphone input for channel 3 (-)	

AR5	CDC_IN3_P	AI	Microphone input for channel 3 (+)	
BC11	CDC_EAR_M	AO	Earpiece output (-)	The typical output voltage is 2 Vrms.
BD12	CDC_EAR_P	AO	Earpiece output (+)	
AS7	CDC_HPH_REF	GND	Headphone reference Ground	
AP7	CDC_HPH_L	AO	Headphone left channeloutput	
AN5	CDC_HPH_R	AO	Headphone right channel output	
AU3	CDC_HS_DET	AI	Headset hot-plug detect	
BD6	CDC_AUX_P	AO	Audio line differential output (+)	
BE5	CDC_AUX_M	AO	Audio line differential output (-)	
E40	AUD_DMIC_CLK_1	DO	Clock for digital mic	GPIO_98 (QCM2290)
G39	AUD_DMIC_DATA_1	DI	data for digital mic	GPIO_99 (QCM2290)
G21	AUD_SPK_AMP_SHDN_N	DO	SHDN for audio amp	

Battery Charger

Table 18 Battery Charge

PIN	Signal	I/O	Function	QCM2290 GPIO
AD3	BATT_ID	AI	Battery type detect	PM_GPIO_07
AG5	BATT_THERM	AI	Battery temperature detect	
AH7	BATT_CONN_VSNS_P	AI	Battery voltage detect (+)	
AK7	BATT_CONN_VSNS_M	AI	Battery voltage detect (-)	

MIX Functions

Table 19 Mix Function

PIN	Signal	I/O	Function	Comment	QCM2290 GPIO
AA2	CBL_PWR_N	DO		Initiate power-on when grounded	
P5	VIB_DRIVER	PO	Vibration motor driveroutput control		

U47	PM8008_RST_N	DIO	Reset for PM8008		GPIO_26
S47	PM8008_INT_N	DIO	Interrupt for PM8008		GPIO_25
G17	VCOIN	PIO	Power supply for RTC		
Z49	GRFC_10	DIO	Generic RF controller		GPIO_47
Z45	GRFC_12	DIO	Generic RF controller		GPIO_49
X45	GRFC_15	DIO	Generic RF controller		GPIO_52
AF7	PM_AMUX_2	ADC	General-purpose ADC interface		
A5	PM_AMUX_3	ADC	General-purpose ADC interface		
E1	EXT_GPS_LNA_EN0	DO	GNSS LNA enable control		GPIO_63

GPIO

Table 20 GPIO

PIN	Signal	I/O	Function	Comment
B20	PM_GPIO3	DIO	General-purpose input/output	
C19	PM_GPIO4			
G19	PM_GPIO8			
E18	PM_GPIO1			
R7	PM_GPIO5			
E14	PM_GPIO6			

NFC/SPI

Table 21 NFC/SPI

PIN	Signal	I/O	Function	QCM2290 GPIO
C23	NFC_SPI_MISO	DI	NFC/SPI_MISO	GPIO_0
B22	NFC_SPI_MOSI	DO	NFC/SPI_MOSI	GPIO_1
C29	NFC_SPI_CLK	DO	NFC/SPI_CLK	GPIO_2
N45	NFC_SPI_CS_N	DO	NFC/SPI_RESET	GPIO_3
C25	NFC_EN	DO	NFC_EN	GPIO_69
E22	NFC_INT_N	DI	NFC_INTERRUPT	GPIO_70
L51	NFC_DWL_REQ	DI	reserved NFC chip_SN100UUK connection	GPIO_31

C27	NFC_CLKREQ	DI	reserved NFC chip_SN100UUK connection	GPIO_86
A25	NFC_RFCLK3	DO	reserved NFC chip_SN100UUK connection	

LED

Table 22 LED

PIN	Signal	I/O	Function	QCM2290 GPIO
AC2	LED_CHG_SINK	DO	Indicate the module's charging status	PM_GPIO_02
E20	LCM_WLED_PWM	DO	PWM output	
E16	LED_FLASH	DO	Flash/torch driver output	
G15	LED_FLASH	DO	Flash/torch driver output	
G13	LED_GREEN	AI	PM4125 battery charger	
E12	LED_RED	AI	PM4125 battery charger	

Power

Table 23 Power

PIN	Signal	I/O	Function	Comment
BC39, BC43, BD40, BE43, BE45	VPH_PWR	PO	3.8V up 1A of continuous power output supported	The SE250B4 can support up 3.8W, we do not recommend to exceed these limits
AW51, AX50, AY49, AY51, AZ50, BA51, BC41, BD42	VPH_PA	PI	Power supply for the module	It can adsorb up to 3 A. To consider the input current up to 3A, it is not able to separate with VPH_PA when device designed with battery. Please consider adding TVS for protection.

BE47,	VBAT	PI	Power supply for BB	Can be routed in pair to VPH_PA or separately depends on customer application needes
AB49. AH49	VREG_L15A_1P8	PO	1.8 V output	Vnom = 1.8 V IOmax = 200 mA
AD49	VREG_L17A_3P0	PO	3.0 V output	Vnom = 3.0 V IOmax = 192 mA
AM49	VREG_L20A_2P96	PO	2.96 V output	Vnom = 2.96 V IOmax = 500 mA internal eMMC used. internal used for RF function
X3	VREG_S4A_2P04	PO	2.04V	Vnom = 2.04 V IOmax = 600 mA Internal PMIC LDOs input Reserved for external LDOs input on camera power supply on EVB(TLB2).
C17	VREG_S3A_1P352	PO	Vout=1.352V	Vout=1.352V up 600mA, Internal PMIC LDOs input input voltage of PM8008 on camera power supply in QTI reference design.

GND

Table 24 GND

PIN	Signal	Function	Comment
A11, A15, A17, A21, A23, A27, A29 A31, A35, A39, A43, A7, AA5, AA47, AB45, AB51, AC50, AD7, AE5, AF3, AF45, AG2, AH1, AH51, AJ2, AJ47, AJ5, AK3, AK45, AK51, AL2, AL47, AM1, AM45, AN2, AN50, AP1, AP51, AR2, AS1, AT2, AU1, AU45, AU51, AV47, AV50, AW49, AY1, AY11, AY17, AY19, AY29, AY33, AY37, AY39, AY41, AZ2, B10, B14,, B16, B18, B24, B26, B28, B32, B34, B40, B42, B8, BA1, BA12, BA20, BA26, BA30, BA38, A40, BA42, BC13, BC23, BC29, BC37,BC45, BD14, BD24, BD38, BE39, BE41, D44, , BE11, BE17, BE21,BE27, BE7, C13, C15, C33, C41, C7, C9, E10, F50, G1, H2, J1, J51, M47, M50, N49, N51, N7, P47, P50, R3,T45, U5, V3, X1, Y2, Y5	GND		
1,2,3,4,5,6,7,8,9,10 11,12,13,14,15,16,17,18,19,20 21,22,23,24,25,26,27,28,29,30 31,32,33,34,35,36,37,38,38,39,40 41,42,43,44,45,46,47,48,49,50 51,52,53,54,5,56,57,58,59,60	GND (thermal dissipation)		

RFU

Table 25 RFU

PIN	Signal	Function	Comment
A13,A19, A37, A45, A47, AC47, AH3, AK49, AL5, AM3, AM51, AM7, AP3, AS3, AS51, AV2, AW1, AX2, AY31, AY35, B6, B12, BA18, BA28, BA32, BA34, BA36, BC31, BC33, BC35, BD30, BD32, BD34, BD36, BE13, BE15, BE19, BE23, BE25, BE29, BE31, BE33, BE35, BE37, BE9, C11, F2, G3, G11, J3, K2, K5, L1, L3, L7, M5, N3, S5, T3, T7,V7, W2,W5, Z3	RFU		

Note: Reserved Pin's must not be connected.

PIN Description

Table 26 Pin-type description

Symbol	Description
PI	Power input
PO	Power output
AI	Analog input
AO	Analog output
DIO	Digital input output
DI	Digital input

5. Power Supply

The power supply circuitry and board layout are a very important part in the full product design and they strongly reflect on the product overall performances, hence read carefully the requirements and the guidelines that will follow for a proper design.

To ensure high power transmission, we recommend to use a power supply that supports up to 3A.

Power Supply Requirements

Table 27: Power Supply Requirements

Power Supply	Value
Nominal Supply Voltage	3.8V
Operating Voltage Range	3.40 V ÷ 4.40 V
Extended Voltage Range	3.00 V ÷ 4.75 V

Note: The Extreme Operating Voltage Range MUST never be exceeded.

If the power supply is not properly designed, it can cause a large voltage drop.

The hardware shutdown voltage of the module is 3.0V. If the voltage drops below 3.0V, the module hardware will be shut down.

Power Consumption

Table 28: Power Consumption

Parameter	Conditions	Min	Typical	Max	Unit
Leakage current	Off mode	-	70.52	-	uA
Flight mode	Flight mode	-	4.29	-	mA
Standby GSM/GPRS	BS-PA-MFRMS=9	-	4.79	-	mA
	BS-PA-MFRMS=5	-	4.99	-	mA
	BS-PA-MFRMS=2	-	5.61	-	mA
Standby WCDMA	2.56sec, DRX=8	-	4.78	-	mA
Standby LTE FDD	2.56sec, DRX=8	-	4.87	-	mA
Standby LTE TDD	1.28s, DRX=7	-	5.15	-	mA
Voice Call 2G	EGSM900 PCL= 5@ 31.97dB Channel=62	-	225.95	-	mA
	EGSM1800 PCL= 0@ 28.95dB Cannel=698	-	174.48	-	mA
Voice Call 3G	B1 power@ 21dB Channel=10700	-	503.22	-	mA
	B8 power@ 21dB, Channel=3012	-	398.27	-	mA
Data Call LTE	FDD B1 power@ 22dB BW=10MHZ	-	574.98	-	mA

	Ch=18300				
	FDD B3 power@ 22dB BW=10MHZ Ch=19575	-	617.28	-	mA
	FDD B5 power@ 22dB BW=10MHZ Ch=20525	-	474.04	-	mA
	FDD B8 power@ 22dB BW=10MHZ Ch=21625	-	480.97	-	mA
	TDD B38 power@ 23dB BW=10MHZ Ch=37800	-	292.15	-	mA
	TDD B40 power@ 23dB BW=10MHZ Ch=38700	-	317.51	-	mA
	TDD B41 power@ 23dB BW=10MHZ Ch=40740	-	270.86	-	mA
Peak Current	-	-	1156.63	-	mA

SPECIAL CASES ON FLIGHT MODE	
TEST CASE	Current mA
Flight mode on with WiFi re-enabled	5.98
Flight mode on with BT re-enabled	5.90
Flight mode on with WiFi/BT re-enabled	7.42

Note:

Leakage current: The current supplied by VBAT during shutdown.
Flight mode: The Flight mode powers off the backlight and display.

6. GPS Performance

Table 29 SE250B4-EU GPS Performances

GPS	C/N0	Tracking sensitivity	Recapture sensitivity	Cold start capture sensitivity	Cold start TTFF	Hot start TTFF
Level	TBD	TBD	TBD	TBD	TBD	TBD
GPS	TBD	TBD	TBD	TBD	TBD	TBD
GPS+ GLONASS	TBD	TBD	TBD	TBD	TBD	TBD

Table 30 SE250B4-NA GPS Performances

GPS	C/N0	Tracking sensitivity	Recapture sensitivity	Cold start capture sensitivity	Cold start TTFF	Hot start TTFF
Level	TBD	TBD	TBD	TBD	TBD	TBD
GPS	TBD	TBD	TBD	TBD	TBD	TBD
GPS+ GLONASS	TBD	TBD	TBD	TBD	TBD	TBD

General Design Rules

The principal guidelines for the Power Supply Design embrace three different design steps:

- Electrical design
- Thermal design
- PCB layout

7. Electrical Design Guidelines

The electrical design of the power supply strongly depends on a drained power source. The electrical design guidelines categories are:

- +5V input (typically PC internal regulator output)
- +12V input (typically automotive)
- Battery

LDO Power Supply Guidelines

The power supply range of the module is between 3.5-4.4V, and the recommended value is 3.8V. The power supply performance, such as load capacity, voltage ripple etc directly influences the module's performance and stability. Under worst conditions, the transient peak current of the module may surge up 3A.

During the higher peak of current absorption the voltage may drop down from nominal voltage. If the power supply network is not properly designed it might happen that, during these peak current absorption periods, the Voltage drops below 3.4V, causing the automatic switch down of the module, please refer to the figure below for a graphic representation of the electric phenomenon.

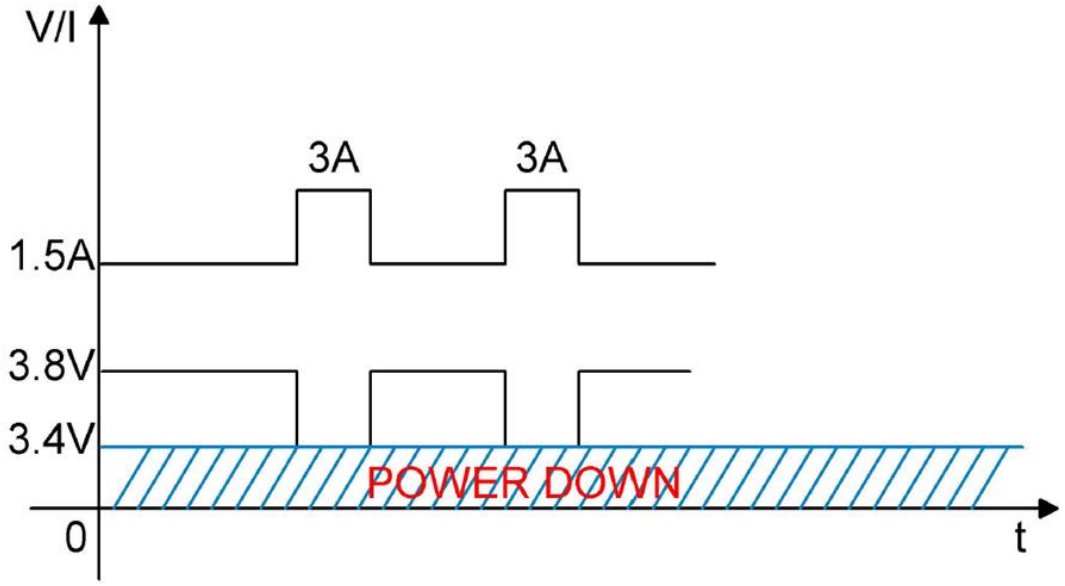


Figure 4: Power Down Voltage Seguence

Voltage drops can be reduced using a bypass capacitor of about 100 µF with low ESR (<0.7) + a multi-layer ceramic chip capacitor array composed at least from three ceramic capacitors with 100 nF, 33 pF and 4.7 µF respectively placed as close as possible to VBAT pins. Additionally use a 4.7 µF capacitor in parallel to reduce the voltage ripple to minimum.

The block diagrams for recommended capacitor bank is shown on figure below.

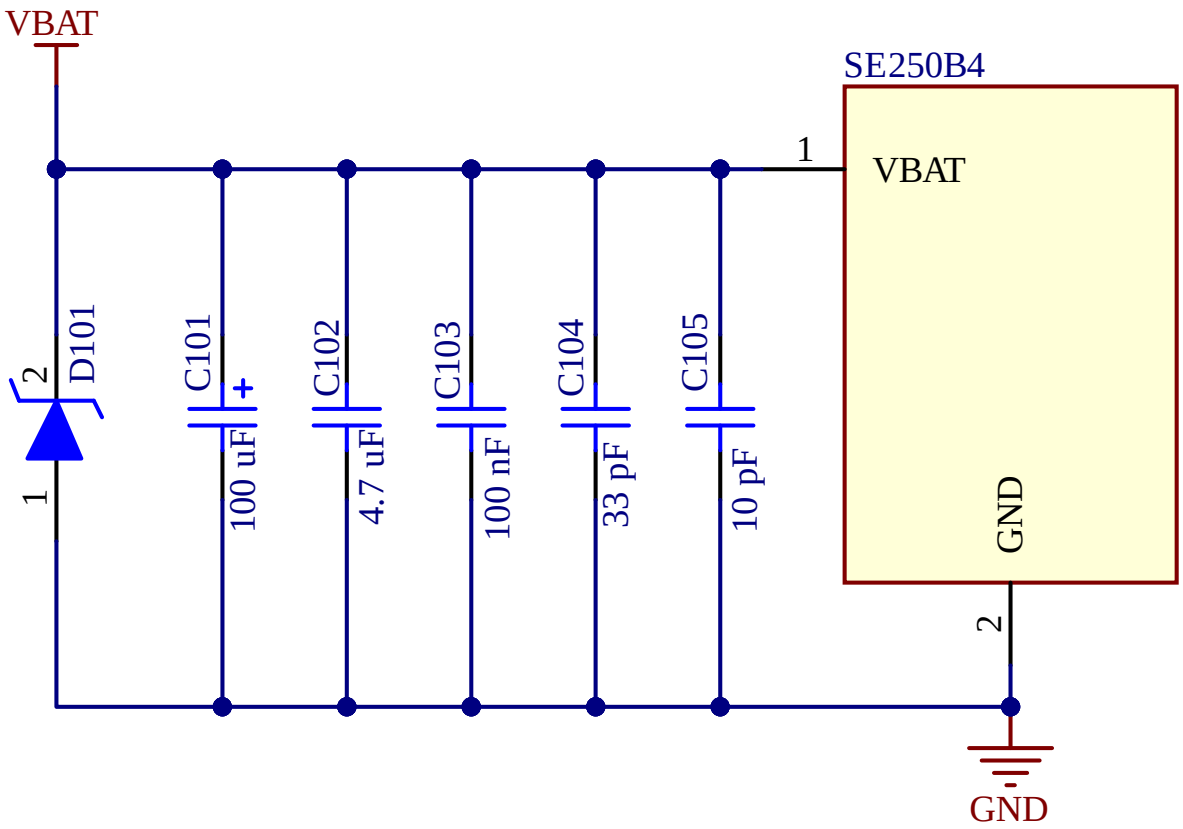


Figure 5 Reference design for power supply

Reference Design for Power Supply

As already mentioned the design of the power supply network is very important as the performance of the module largely depends on power supply source. The supply source should be able to provide at least 3A of current @3.8V.

To obtain 3.8V , different design techniques can be used depending on the difference between the input voltage and the output voltage required and depending on the application including or not a battery.

For non-battery powered applications, if the DC input voltage is +5V then a power efficiency optimization is not strictly required. In this case we can consider using an high-current-low dropout regulator as for example the MIC3932.

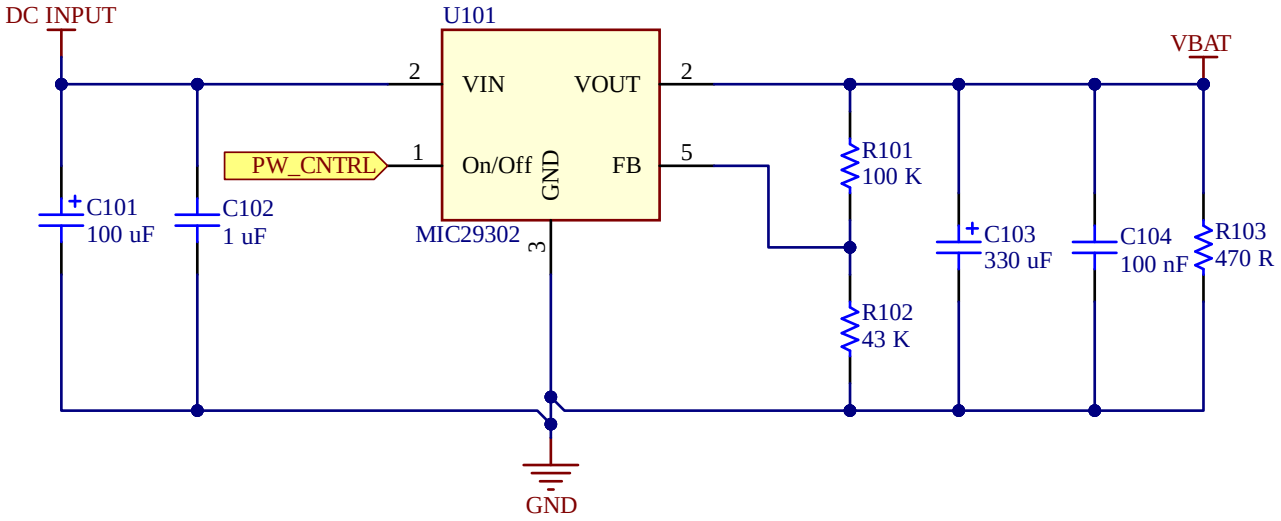


Figure 6 Reference design for non-battery solutions

Note:

To ensure proper behavior of the regulator under minimal load, an extra minimum load is required. The Telit SE250B4 Smart module in sleep mode and power off has a trifling current adsorption.

For minimum load details please refer to MIC29302 specifications.

For battery powered devices, having a high efficiency conversion becomes crucial, so in this case we recommend using a buck converter.

In out EVB that is meant to be used also on battery applications, we used the SY80003DQD buck converter

The SY8009 is capable to provide up 2A output current @ 3.8V in the configuration below.

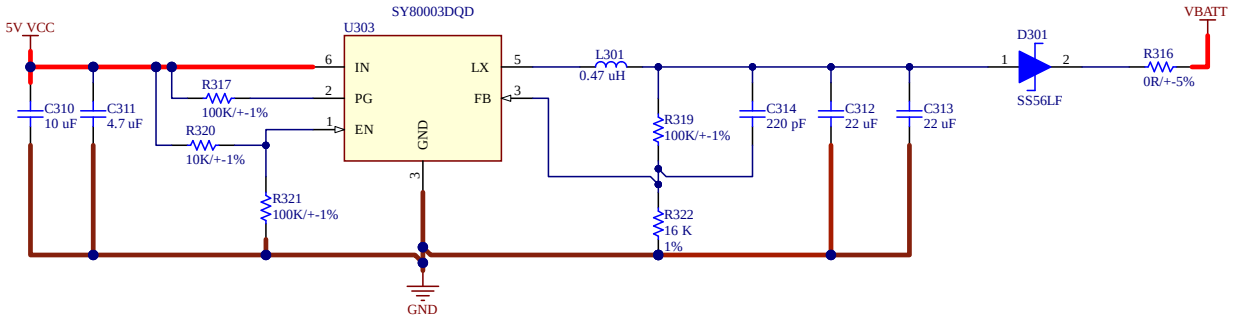


Figure 7 STEP-DOWN DC-DC power supply reference circuit

Thermal Design Guidelines

The thermal design for the power supply heat sink must be performed taking into account the following specifications:

- Average current consumption during RF transmission at maximum power level as shown in Telit SE250B4 Smart module current consumption.
- Average current consumption during Class10 GPRS transmission at maximum power level as shown in Telit SE250B4 Smart module current consumption.
- Average GPS current consumption during GPS tracking (LTE @ idle): mA (TBD mA).

RTC Bypass Out

When the module is powered down and there is no power supply on VBAT the module can keep the RTC (real time clock) if an external coin cell is connected to the module VCOIN pad. If RTC support is needed when VBAT is removed, then a qualified coin cell or keep-alive capacitor needs to be connected to the VCOIN PIN. When VBAT is present and valid, coin cell charging is enabled through software control and powered from VBAT.

- If the RTC fails in keeping the time, the module can synchronize the RTC clock time , aligning with the clock of the network cell, after power on.
- Refer to VCOIN characteristics for RTC hardware parameters.
- The voltage value range for VCOIN power supply is between 2.0-3.25V and the typical value is 3.0V. In these conditions the average current consumption is about 5ua when VBAT is disconnected and RTC is supplied directly from VCOIN only.
- RTC error is 50ppm when the module is powered by VBAT; RTC error is 200 ppm when the module is powered by VCOIN and modem is OFF.
- When a rechargeable coin battery is connected externally, the ESR of the coin battery shall be less than 2KΩ. We suggest using Seiko's ms621fe fl11e battery.
- If the VCOIN PIN is connected to a large capacitance externally, the recommended capacitance value is 100uF with low ESR, which can keep the real-time clock for about 45 seconds.

The following is the circuit diagram:

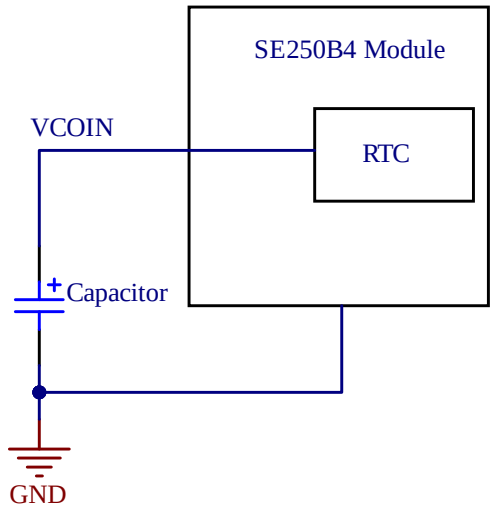


Figure 8 Keep Alive Capacitor

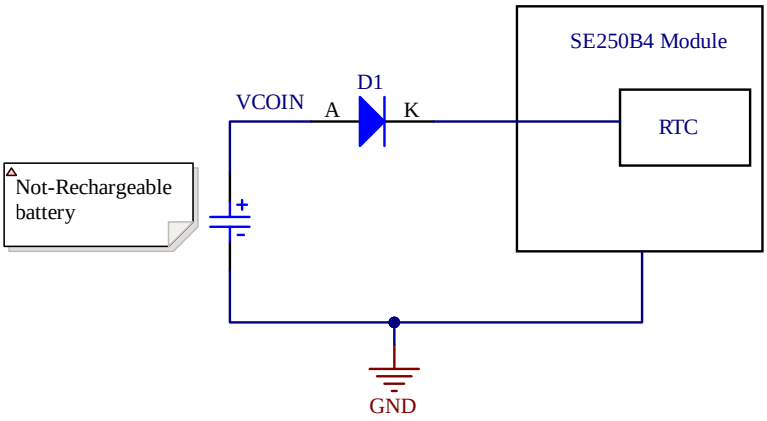


Figure 9 No-rechargeable Battery

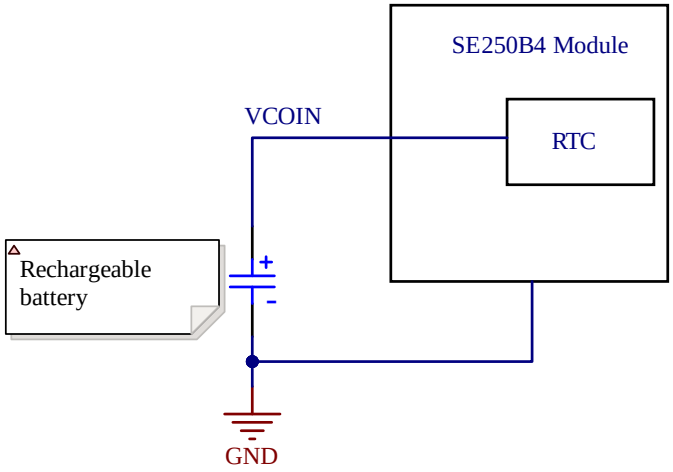


Figure 10 Rechargeable battery

VRTC typical voltage is 3.0V, and the current consumption is about 7.5uA when VBAT is not present.

Table 31 VCOIN

Parameter	Description	Min	Type	Max	Unit
VCOIN-IN	VCOIN input voltage	2.0	3.0	3.25	V
ICOIN-IN	VCOIN current consumption	-	7.5	-	µA
VCOIN-OUT	VCOIN output voltage	2.5	3.1	3.2	V
ICOIN-OUT	VCOIN output current	-	-	2	mA

Note:

If the VBAT supply connected to the module is never removed, or the RTC is not required, then the VCOIN PIN can be left floating. The software needs to be configured to turn off the VCOIN charge and discharge function.

Battery Charge

The Telit SE250B4 Smart module supports battery charging. The embedded IC supports trickle charging, constant current charging and constand voltage charging modes with optimized procedure and thresholds for Li-ion batteries.

The charging process can be divided in three steps depending on the battery voltage

- Trickle charging: this happens when the battery voltage is below 2.1V, then a constant charging current of 90mA is applied to the battery. In the range between 2.1 and 3.4V the current is set up to 400mA as maximum value.
- Constant current mode (CC mode) happens when the battery voltage is between 3.2V and 4.2V, in this case the maximum charging current is 1.85A when an adapter is used and 450mA for USB charging.
- Constant voltage mode (CV mode) starts when the battery voltage reaches the final value 4.35V the system will switch to CV mode and the charging current will decrease gradually and will stop when the charging level will reach 100%.
- Battery charging is controlled by a PMIC state-machine. The first step in the automated charging process determines if trickle charging is needed. Charging a severely depleted battery must begin with trickle charging to limit the current inflow, avoid pulling VDD down, and protect the battery from more charging current than it can handle. Once a minimum battery voltage is established using trickle charging, constant-current charging is enabled to charge the battery quickly – this mode is sometimes called fast charging. Once the battery approaches its target voltage, the charge is completed using constant-voltage charging.
- The following is the charge control diagram:

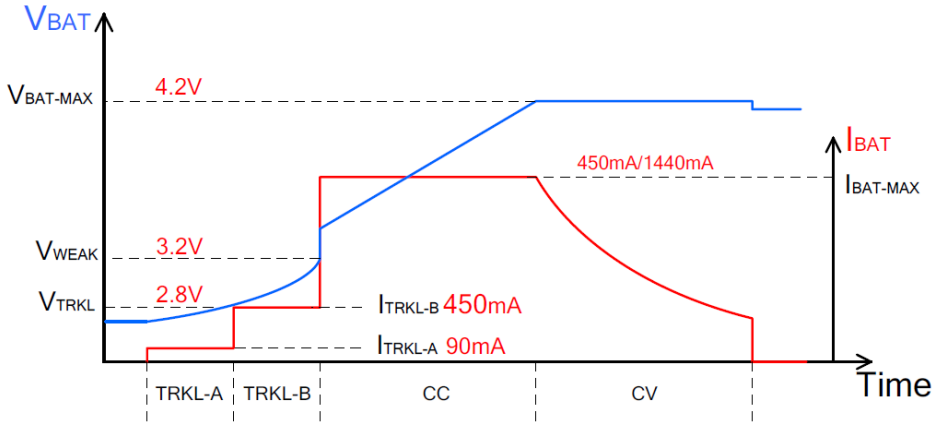


Figure 11 Voltage/Current charging measurements

Table 32: Voltage/Current charging measurements

Parameter	Comments	Min	Type	Max	Units
ITRKL-A	Trickle-A Charging current	TBD	TBD	TBD	TBD
ITRKL-B	Trickle-B Charging current	TBD	TBD	TBD	TBD
VTRKL	Trickle-B threshold voltage range Programmable, 15.62 mV steps	TBD	TBD	TBD	TBD
VWEAK	Weak battery threshold range Programmable, 18.75 mV steps	TBD	TBD	TBD	TBD
VBAT_MAX	Maximum battery voltage Programmable, 25 mV steps	TBD	TBD	TBD	TBD
IBAT_MAX	Fast charging current range Programmable, 90mA steps	TBD	TBD	TBD	TBD

Battery charger PADS

Table 33 Battery Charger PADS

PIN	Signal	I/O	Function	Comment
AD3	BATT_ID	AI	Battery type detect	Internally pulled down with a 100 kΩ resistor. If unused, keep it open.
AG5	BATT_THERM	AI	Battery temperature detect	Internal pull up by default. Supports 47 kΩ NTC thermistor bydefault. If unused, connect it to GND with a 47 kΩ resistor.
AH7	BATT_CONN_VSNS_P	AI	Battery voltage detect (+)	Cannot be kept open.
AK7	BATT_CONN_VSNS_M	AI	Battery voltage detect (-)	

The module supports battery temperature detection, under the condition that the battery integrates a thermistor (47 KΩ 1% NTC thermistor with a B-constant of 4050 K by default) and the thermistor is connected to BATT_THERM pin. If the BAT_THERM pin is not connected, there will be malfunctions such as battery charging failure, battery level display error etc. The battery charge temperature range varies with different types of batteries.

A reference design for the battery charging circuit is shown below:

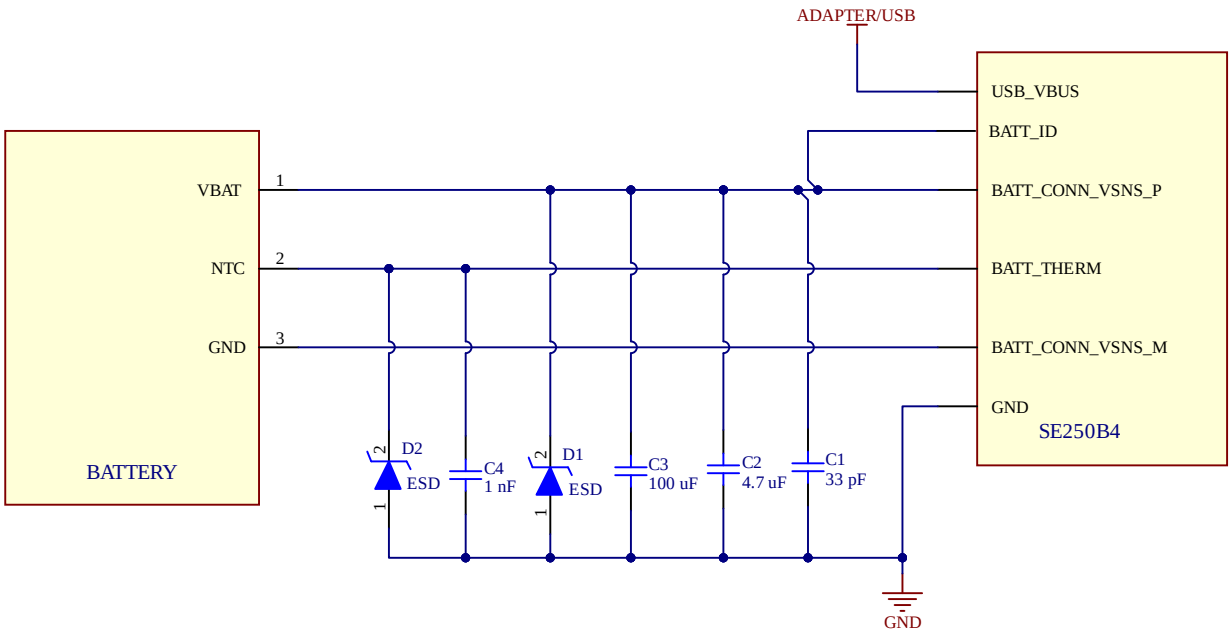


Figure 12 Battery charging circuit

Mobile devices such as mobile phones or handheld POS systems are powered by batteries. For different batteries, you should modify the charging and discharging curve correspondingly to actieve the best performance.

If the thermistor is not available in the battery, or an adapter is used to power the module, you need to connect the BAT_THERM pad to GND via a 47 KΩ resistor otherwise the system may mistakenly judge that the battery temperature is abnormal and therefore cause battery charging failure.

BATT_CONN_VSNS_P and BAT_CONN_VSNS_N ,must be connected otherwise exceptions in voltage detection will be caused, with associated problems of turn on/off and battery charging/discharging.

VBAT_THERM is used for battery-temperature monitoring (BTM) and battery-presence detection (BPD).

If BAT_THERM is not used, it must be grounded, and the software battery temperature feature must be disabled. If an external charger is used, then BAT_THERM pin must be grounded.

A 10K (B-Constant = 3380K± 1%) or 47 K(B-Constant = 4050 K) NTC resistor should be integrated inside the battery, and the cold / hot comparator threshold setting should be 70% / 35%. The allowable charging temperature range is -2 ° C to 52 ° C, with an accuracy of ± 2 ° C. If there is no NTC resistor inside the battery, choose R_S3 and R_S1 with the same value to keep the battery-temperature monitoring 25 ° C all the time.

The following is the circuit diagram:

VBAT_SNS is used for battery voltage sensing, the typical input range is 3.0V~4.75V.

VBAT_SNS PIN cannot beleft floating. It shall be connected to the battery positive PIN when the lithium battery is used for module power supply. It shall be connected to the module VBAT_BB, when powered from a LDO or DCDC.

Table 34 NTC

Battery inside NTC value	R_S1	R_S2	R_S3
10K (B-Constant = 3380K±1%)	15K, 1%	3.3K, 1%	NC
47K (B-Constant = 4050K)	100K, 1%	39K, 1%	NC
None	100K, 1%	NC	100K, 1%

Charging LED

The Telit SE250B4 Smart module supports a charging LED indicator.

Table 35 Charging LED

PIN name	PIN number	I/O	Description
CHG_RED_LED	197	PO	charging indicator

The following is the circuit diagram:

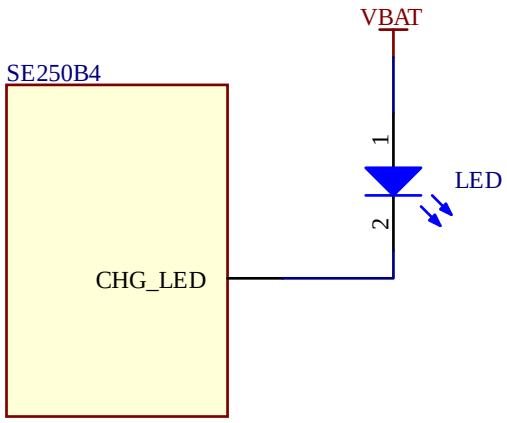


Figure 13 LED Reference Circuit

Note:

While charging, the CHG_LED_SINK pin controls the LED indicator. If the LBC is not active, then the CHG_LED_SINK pin cannot control the LED indicator. (CHARGE_SEL is grounded).

Power On

You can power on the Telit SE250B4 Smart module by holding down the PWRKEY PIN for more than 2 seconds then release it. This PIN is already pulled up to 1.8V internally, so external pull up is not needed.

Table 36 Power ON voltage Levels

Parameters	Description	Min	Type	Max	Unit
VIH	High-level input voltage	1.4	-	-	V
VIL	Low-level input voltage	-	-	0.6	V

The power circuitry can be designed by using a Push button or an open collector with a single transistor, please refer to diagrams below for more details:

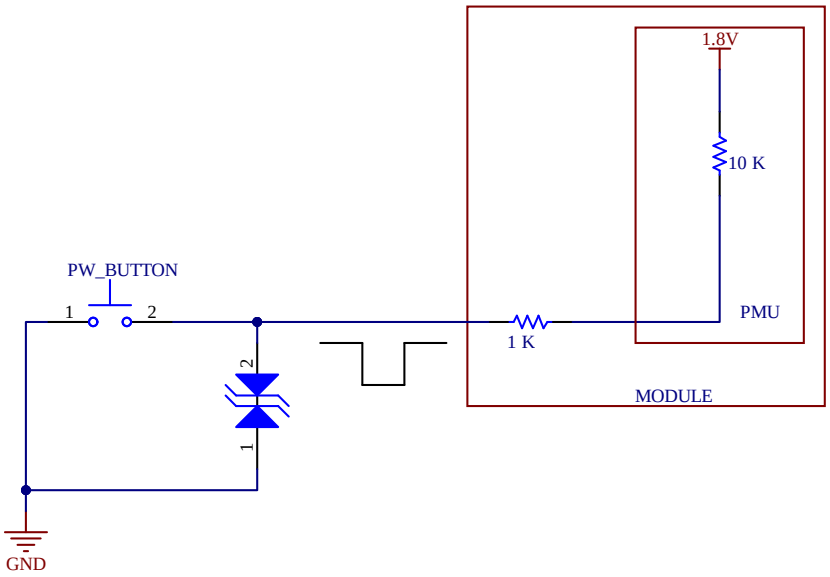


Figure 14 Power on/off using the power button

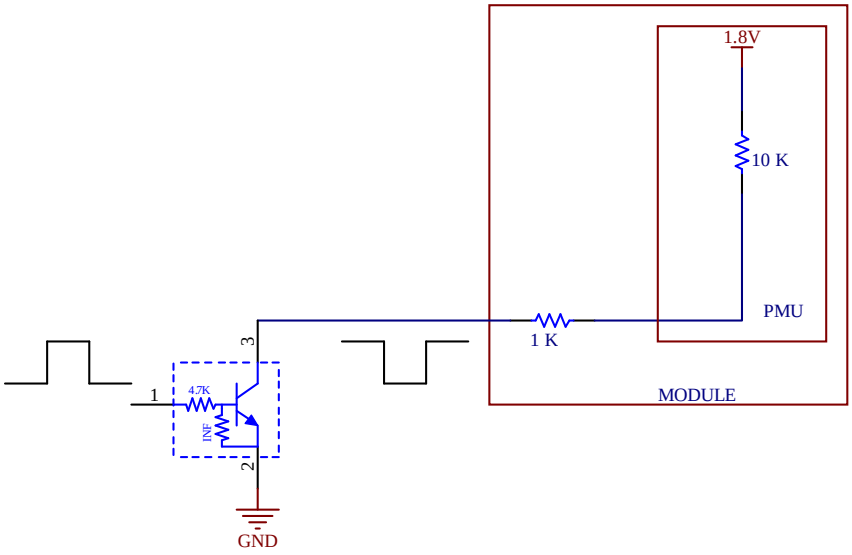


Figure 15 Power On/Off using the transistor

Power-On Sequence

The following is the power on sequence diagram:

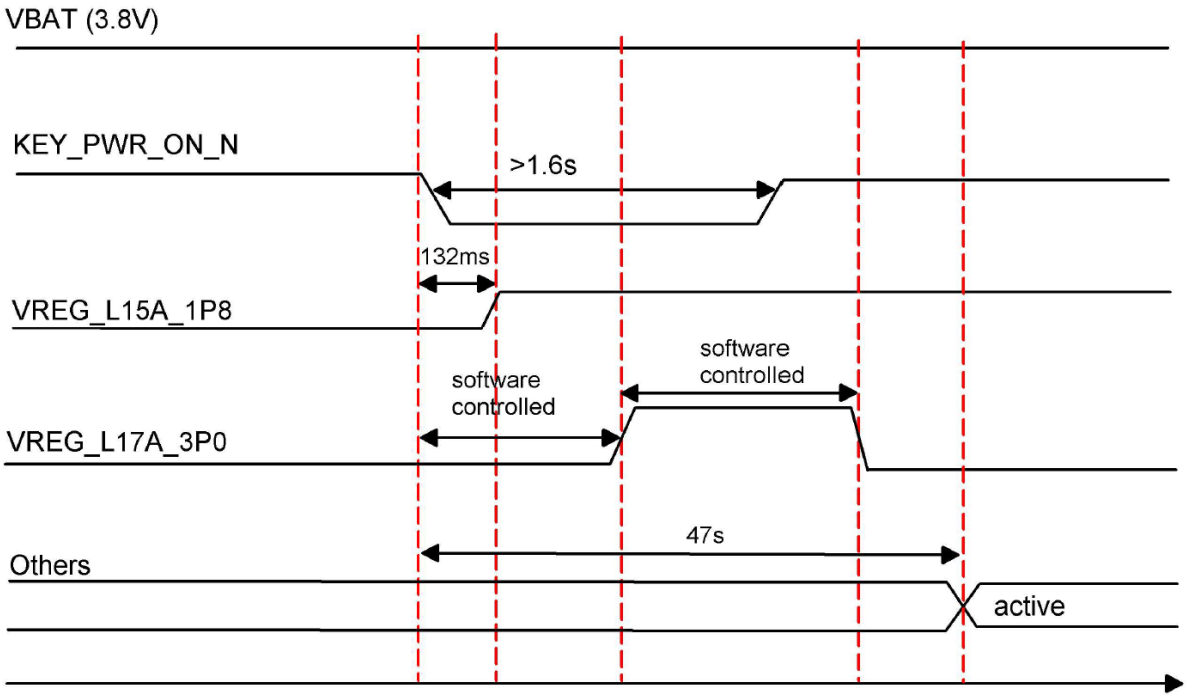


Figure 16 Turn-on Timing

Note:

1 When the module is turned on for the first time the power on sequence may be different from the shown above.

2 Make sure VBAT is stable @3V8 for at least 50ms before pulling down KEY_PWR_ON, it doesn't need to be kept pulled down during this time.

Power Off

Users can turn off Telit SE250B4 Smart module by pulling down the KEY_PWR_ON PIN for more than 1 second. After the module detects that the KEY_PWR_ON is low level, a prompt window will pop up on the screen to confirm whether to execute the shutdown action.

Module can also be forced to shut down by pulling down KEY_PWR_ON for more than 8 seconds.

Please refers to the diagram below:

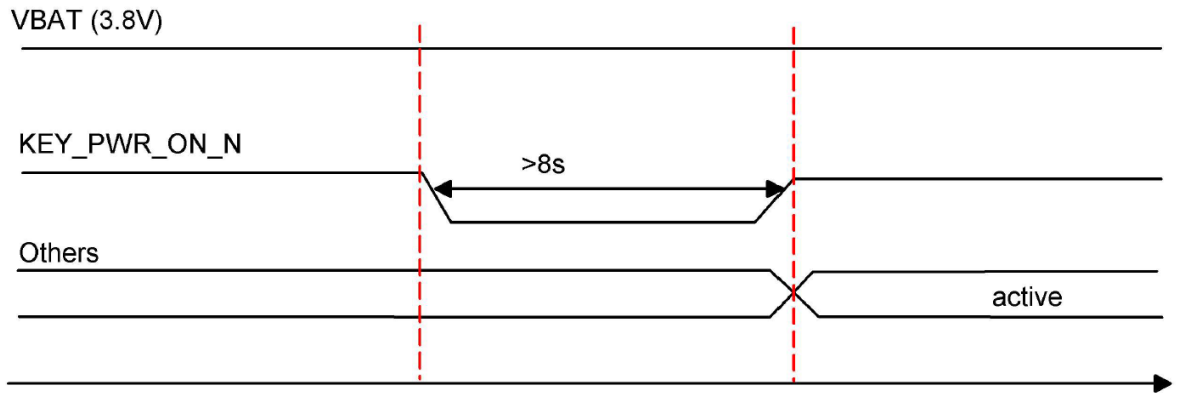


Figure 17 Forced Turn-off Timing

Note:

1. The VBAT power supply circuit of the module can be cut off in the customer's hardware design.
2. It is recommended to add a low-cost MCU, which can control the KEY_PWR_ON_N to power on and power off the module, as well as the hardware watchdog to protect the normal operation.
3. Do not directly cut off the power supply VBAT of the module while it is in operation, otherwise the internal flash of the module may be corrupted. It is strongly recommended to shut down the module through KEY_PWR_ON_N or AT command before disconnecting the power supply VBAT of the module.

Unconditional Restart

Users can turn off Telit SE250B4 Smart module by pulling down the KEY_PM_RESIN_N PIN for more than 200ms. After the module detects that the KEY_PM_RESIN_N is low level, the device will perform an unconditional restart.

Communication Ports

USB Interface

The module provides USB interfaces which comply with both USB 3.1 and USB 2.0 specifications and supports the modules below:

- superspeed (5Gbps)
- high-speed (480 Mbps)
- full speed (12Mbps)

The USB interface also supports USB OTG and can be used for AT commands and data transmission, Software debugging and Firmware upgrading.

The module only support USB Type-C connector, the USB iunterface has one USB 2.0 compliant high-speed differential channel (USB_DP, USB_DM) and one USB 3.1 compliant superspeed differential channel (USB_SS1_RX_P/M, USB_SS1_TX_P/M) and USB_SS2_TX_/M).

If Type-C is plugged in with the external device is detected by USB_CC1 and the data will be transmitted through USB_SS1, when is plugged in the other side up, the external device is detected by USB_CC2 and the data will be transmitted through USB_SS2. The following table shows the pin definition of USB interface:

Table 37 Communication PORTS

PIN	Signal	I/O	Function	Comment
C21	FORCED_USB_BOOT	AI		
AY15	USB0_HS_SM_DM	AI/O	USB differential (-)	90Ω differential impedance with 10% tol; compliant to USB 2.0 standard
AY13	USB0_HS_SM_DP	AI/O	USB differential (+)	
AD1, AE2, AF1	USB_VBUS_IN USB_VBUS_IN	P_IN P_IN	Charging power input and power output for OTG devices USB/adaptor insertion detection	The Max output current is 500mA
BD18	USB0_SS_RX0_M	AI/O	USB 3.1 channel 1 superspeed receive (-)	
BC17	USB0_SS_RX0_P	AI/O	USB 3.1 channel 1 superspeed receive (+)	
BD20	USB0_SS_TX0_M	AI/O	USB 3.1 channel 1 superspeed transmit (+)	

BC19	USB0_SS_TX0_P	AI/O	USB 3.1 channel 1 superspeed transmit (-)	90Ω differential impedance, compliant to USB 3.1stand ard
BA16	USB0_SS_RX1_M	AI/O	USB 3.1 channel 2 superspeed receive (-)	
BA14	USB0_SS_RX1_P	AI/O	USB 3.1 channel 2 superspeed receive (+)	
BD22	USB0_SS_TX1_M	AI/O	USB 3.1 channel 2 superspeed transmit (+)	
BC21	USB0_SS_TX1_P	AI/O	USB 3.1 channel 2 superspeed transmit (-)	
BC15	USB_CC1	AI	USB Type-C detect 1	
BD16	USB_CC2	AI	USB Type-C detect 2	

A basic connection Scheme is on shown on the figure below:

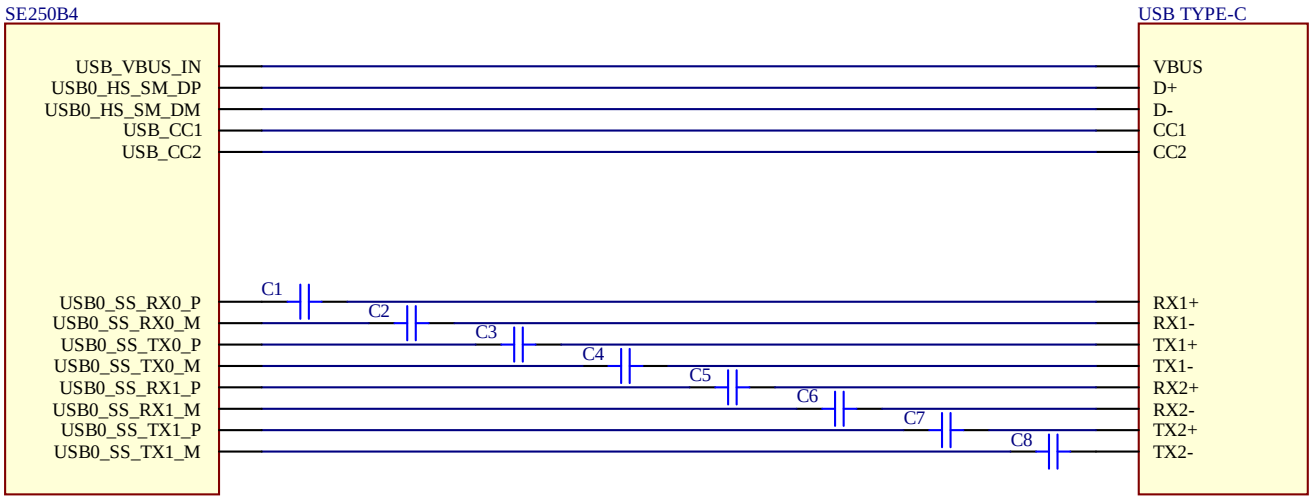


Figure 18 USB connector

To ensure USB performance, comply wih the following rules when designing the USB interface:

- Route USB signal traces as differential pairs with total grounding, the differential impedance of each differential paid should be controlled to 90 Ω ± 10%
- Keep the ESD protection components as close as possible to the USB connector. Be careful to the influence of junction capacitance of ESD protection component on USB lines. Typically, the capacitance value should be less than 2 pF for USB 2.0 and less than 0.5 pF for USB 3.1

- Do not route signals traces under crystals, oscillators, magnetic devices, or RF signal traces. Route the USB differential traces in the inner layer with ground on all four sides of the USB track (TOP, BOTTOM, and shield left and right with VIA grounding) → this means that a stack up with at least 4 layers should be used.
- Make sure the intra-pair length difference doesn't exceed 2mm, for USB 2.0 and 0.7mm for USB3.1 (TX and RX)
- The spacing between USB signals and all other signals should be at least 4 times the trace width, while the signals between Rx and Tx should be at least 3 times compared to the trace width.
- For USB 3.1 we recommend performing some signals integrity simulation after design, the quality of transmitted and received signals, can be affected by cable or numbers of vias that could provide a parasitic not negligible effect, in this case the simulation will help to better tune the design in order to keep good performances.
- If there are test points, place them on the trace to keep branches as short as possible.
- If USB connector is used as the charger input, USB_VBUS node must be routed to the module using extremely wide traces or sub planes.

Table 38 UDB lines length inside the module

Pin Number	Signal	Length (mm)	Length Difference |DP-DM|
AY15	USB0_HS_SM_DM	22.939	0.024
AY13	USB0_HS_SM_DP	22.915	
BD18	USB0_SS_RX0_M	25.38	0.009
BC17	USB0_SS_RX0_P	25.371	
BA16	USB0_SS_RX1_M	25.278	0.013
BA14	USB0_SS_RX1_P	25.291	
BD20	USB0_SS_TX0_M	17.415	0.066
BC19	USB0_SS_TX0_P	17.481	
BD22	USB0_SS_TX1_M	16.148	0.389
BC21	USB0_SS_TX1_P	15.759	

Forced USB BOOT

FORCED_USB_BOOT is the emergency download interface. If FORCED_USB_BOOT is pulled up to VREG_L15A_1P8, the module enters emergency download mode. Used when the product does not start properly. To facilitate the subsequent software upgrades and debugging, you must reserve the test points

The following is the circuit diagram:

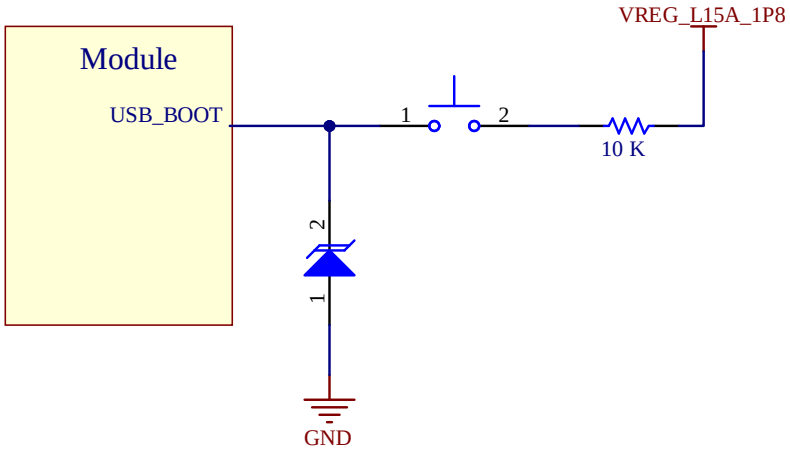


Figure 19 Forced download circuit

Table 39 Forced USB

PIN name	PIN	I/O	Description	Note
Forced_USB_BOOT	C21	I	USB forced download signal, short-circuit to LDO5_1V8 at power-on to enter forced download mode.	Reserved test point
VREG_L15A_1P8	AB49. AH49	PO	1.8V LDO output	

Uart Interfaces

The module provides three UART interfaces:

- UART0 : (debug UART): two wires UART interface, use for debugging by default
- UART1: four-wire UART interface with RTS/CTS HW flow control
- UART2: two wire UART interface.

Table 40 UART PADS

PIN	Signal	I/O	Function	DC Characteristics	Comment
E34	UART_RX_N_LPI	DI	UART2 receive	VILmax = 0.63 V VIHmin = 1.17 V	1.8 V power domain. If unused, keep it open.
G35	UART_TX_N_LPI	DO	UART2 transmit	VOLmax = 0.45 V VOHmin = 1.35 V	
E24	UART_RX_N_SE5	DI	UART1 receive	VILmax = 0.63 V VIHmin = 1.17 V	
G23	UART_TX_N_SE5	DO	Uart1 transmit	VOLmax = 0.45 V VOHmin = 1.35 V	
E28	UART_DEBUG_RX	DI	DEBUG UART RECEIVE	VILmax = 0.63 V VIHmin = 1.17 V	
G27	UART_DEBUG_TX	DO	DEBUG UART TRANSMIT	VOLmax = 0.45 V VOHmin = 1.35 V	

G29	UART_CTS_N_SE5	DI	DCE clear to send signal from DTE	VILmax = 0.63 V VIHmin = 1.17 V	
E30	UART_RTS_N_SE5	DO	DCE request to send signal to DTE	VOLmax = 0.45 V VOHmin = 1.35 V	

The Telit SE250B4 Smart module provides several sets of GPIOs which are available as BLSP (BAM-enabled low-speed peripheral) interfaces that can be configured to support various interface combinations. The operation voltage is 1.8V

UART: Support 3*UART; up to 4 Mbps

SPI: Supports 5*SPI; master-only mode; up to 50 MHz.

I2C: Support 6*I2C; master-only mode; up to 3.4 MHz, 2.2Kohm pull-up resistors are needed externally.

The serial port level of the Telit SE250B4 Smart module UART port is 1.8V. To communicate with the 3.3V serial port level, a level conversion chip must be added between the conversion chip and the module. It is recommended to use TI's TXS0104EPWR

The following is the circuit diagram:

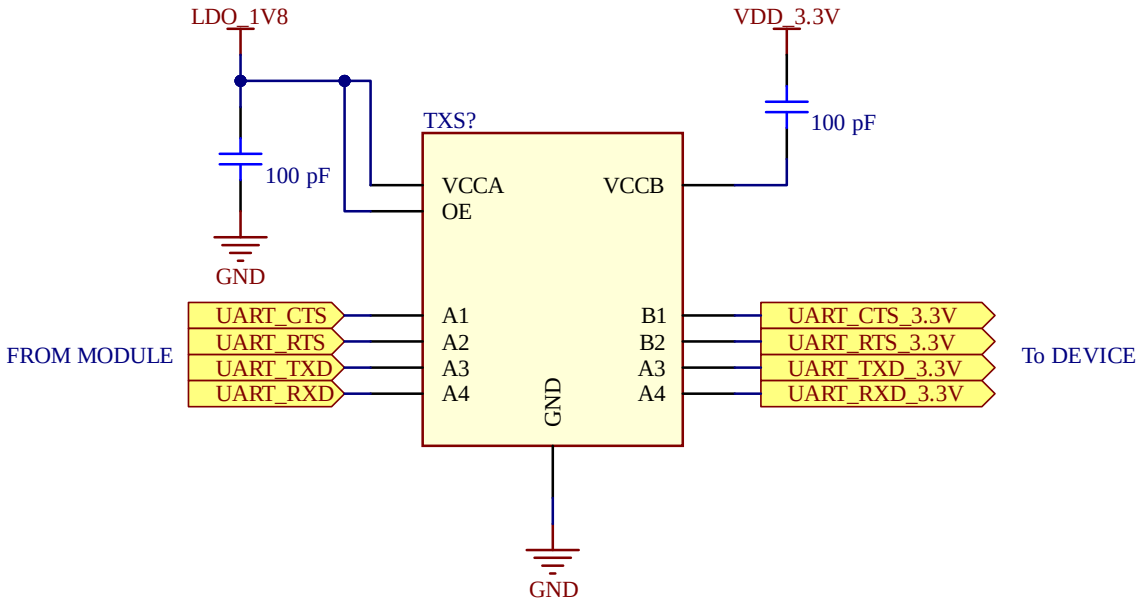


Figure 20 Reference Circuit with Level Translator Chip for UART0

The figure below represent an example of connection between the module and a PC. Using a RS-232 level translator chip between the module and PC COM PORT is required to grand a proper level for signals.

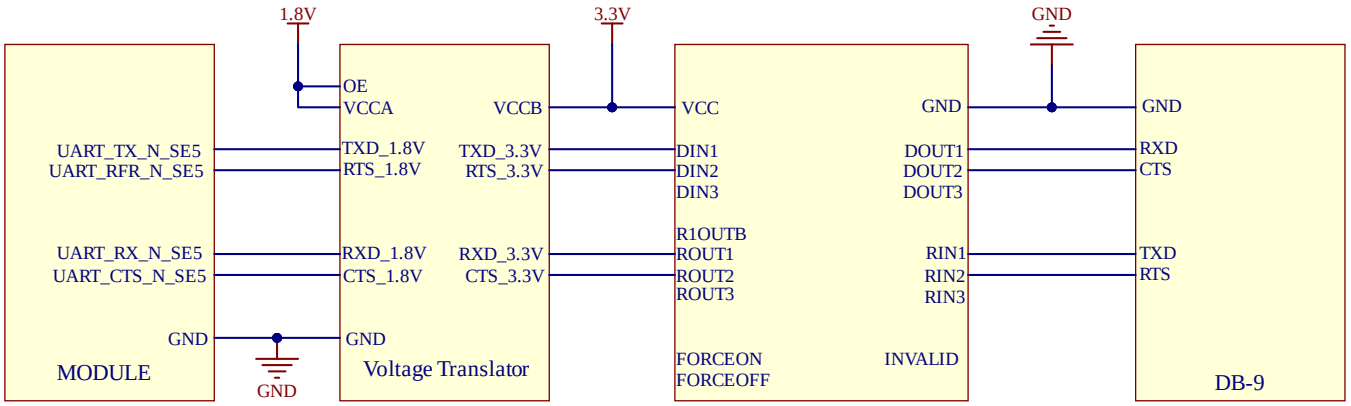


Figure 21 RS-232 Level Match Circuit for UART0

Note: UART_LPI and UAR_DEBUG are similar to UART. Please refer to the same reference design.

UIM Interface

The Telit SE250B4 Smart module provides provides two U(SIM) interfaces that meet the ETSI and IMT-2000 requirements. Dual SIM Dual Standby is supported by default. Either cards support 1.8V or 2.95V and are powered by an internal power supply of the module

Table 41 USIM PADS

PIN	Signal	I/O	Function	Comment
U2	UIM1_CLK	DO	(U)SIM1 card clock	
V1	UIM1_PRESENT	DI	(U)SIM1 card hot-plug detect	Active low. Externally pull it up to 1.8 V. If unused, keep it open.
T1	UIM1_DATA	DI/O	U)SIM1 card data	Cannot be multiplexed into a generic GPIO.
S2	UIM1_RESET	DO	U)SIM1 card reset	
AB7	VREG_L18A_1P8	PO	USIM1_VDD	Either 1.8 V or 2.95 V (U)SIM card is supported.
R1	UIM2_CLK	DO	(U)SIM2 card clock	
M2	UIM2_PRESENT	DI	(U)SIM2 card hot-plug detect	Active low. Externally pull it up to 1.8 V. If unused, keep it open.
P2	UIM2_DATA	DI/O	U)SIM2 card data	Cannot be multiplexed into a generic GPIO.
N1	UIM2_RESET	DO	U)SIM2 card reset	
AC5	VREG_L19A_1P8	PO	USIM2_VDD	Either 1.8 V or 2.95 V

				(U)SIM card is supported.

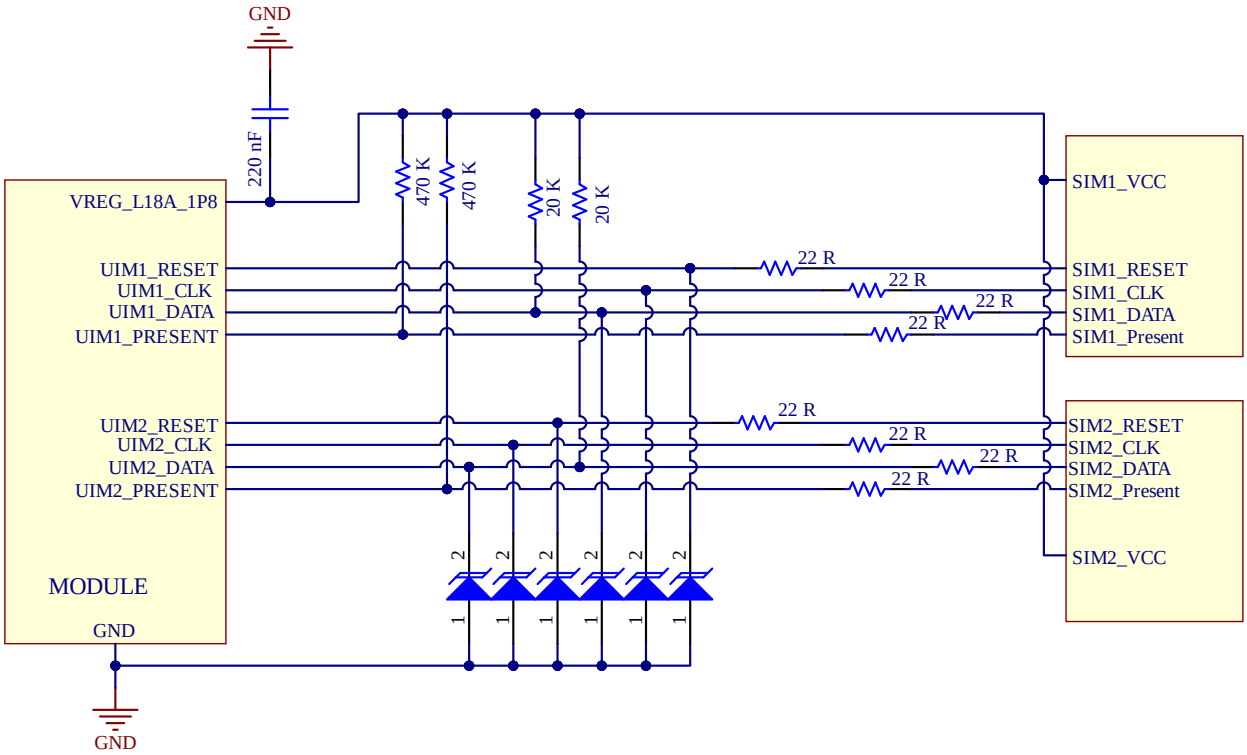


Figure 22 Reference Circuit for (U)SIM Interface with a 6-pin (U)SIM Card Connector

Note: UIM_DATA lines need to be pulled up to VREG_L18A_1P8 voltage trough a 20K resistor.

UIM1/2_Present need to be pulled up to VREG_L18A_1P8 through a 470K resistor.

On VREG_L18A_1P8 please add a ceramic 220nF bypass capacitor on VREG_L18A_1P8 to reduce interference.

To optimize performance and ensure reliability on your design please considering follow the criteria below:

- Place the (U)SIM card connector as close as possible to the module in your application board to keep the trace as short as possible (max 200mm)
- Keep the (U)SIM card signals away from RF and power supply traces to reduce interference.
- Place a bypass capacitor close the VREG_L18A_1P8 Pad on SE250B4 and if necessary, another bypass capacitor close to the SIM_VCC pad. Consider a capacitance value of 220nf (it will act as a high pass for frequency 1MHz (~724 KHz))
- UIM-DATA, UIM-CLK and USIM-RESET are most critical lines and need to accuracy during routing process. UIM-DATA and UIM-CL can suffer of cross-talking if not properly GND shielding. An interference on the UIM-RESET line might cause the SIM malfunctioning, so we recommend to shielding with GND as better as possible.

- Add a TVS array for ensuring ESD protection on all lines and pay attention that parasitic capacitance don't exceed 10pF.Moreover 22Ω series resistor can be used to suppress EMI such spurious transmission.
- At least, 4-layer through-hole PCB should be chosen for good impedance control and signal shielding.

SD CARD Interface

SD Card interface of the module supports SD 3.0 protocol. The pin definition of SD card is shown below.

Table 42 SD CARD PADS

PIN	Signal	I/O	Function	Comment
C45	SDC2_CLK	DO	SD card clock	50 Ω characteristic impedance.
B46	SDC2_CMD	DO	SD card command	
C43	SDC2_DATA_0	DIO	SDIO data bit 0	
B44	SDC2_DATA_1	DIO	SDIO data bit 1	
E42	SDC2_DATA_2	DIO	SDIO data bit 2	
G41	SDC2_DATA_3	DIO	SDIO data bit 3	
K50	SD_CARD_DET_N	DI	SD card hot-plug detect	Active low.
AB3	VREG_L4A_2P96	PO	1.8/2.95 V output power for SD card pull-up circuits	
X7, Z7	VREG_L21A_2P96	PO	SD card power supply	

Our EVK includes a MICRO SD connector.

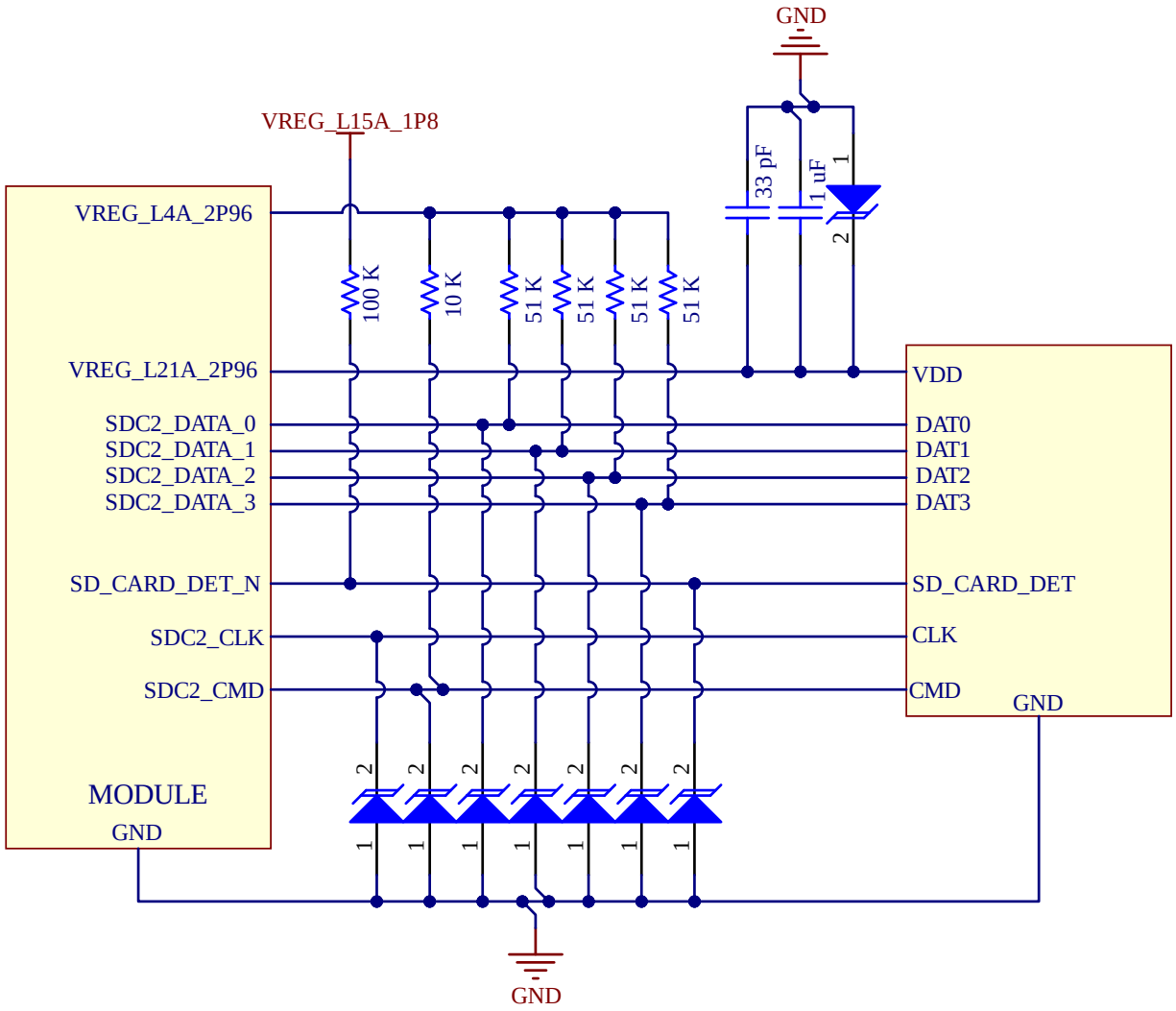


Figure 23 Reference Circuit for the SD Card Interface

VREG_L21A_2P96 is the power supply for SD card and provide up 841mA of output current. For this reason we recommend a trace width of at least 0.8/1mm on the PCB. Considering adding capacitors of 33 pF and 1uF in parallel to improve the current stability.

SDC2_DATA0,SDC2_DATA1,SCD2_DATA2,SDC2_DATA3, SDC2_CLK,SCD2_CMD are high speed signals and requires a characteristic impedance trace of 50Ω ± 10% ,please be careful to not crossing with any other line and shield properly. SDC2_CLK need to be shielded separately.

We recommend using an inner layer on the PCB and keep the data signal of the same length.

Table 43 SD signal length inside the module

PIN	Signal	Length (mm)
C45	SDC2_CLK	3.6
B46	SDC2_CMD	15.864
C43	SDC2_DATA_0	15.518
B44	SDC2_DATA_1	15.626
E42	SDC2_DATA_2	16.02
G41	SDC2_DATA_3	15.523

General Purpose I/O

The Telit SE250B4 Smart module has different GPIOs that can be configured depending on customer application.

In the default configuration the Smart Module comes with few GPIO since a lot of signals are already dedicated to other functions as explained on the PINOUT section.

However it's possible for the customer to configure different GPIO's in relation to their HW and SW needs.

Table 44 GPIOs table

PIN	Signal	I/O	Function	Comment
B20	PM_GPIO3	DIO	General-purpose input/output	
C19	PM_GPIO4			
G19	PM_GPIO8			
E18	PM_GPIO1			
R7	PM_GPIO5			
E14	PM_GPIO6			

I2C Interface

The Telit SE250B4 provides four I2C interfaces. All I2C interfaces are open drain signals and therefore must be pulled up externally. The reference power domain is 1.8V. The sensor I2C interface only supports sensors for ADSP architecture. CAM0 I2C and CAM1 I2C signals are controlled by the Kernel code and support connection to radio-output related devices.

Table 45 I2S Interface

PIN	Signal	I/O	Function	Comment
E32	TS_I2C_SCL	DO	TP I2C clock	Need to be pulled up to 1.8 V externally. Can be used for other I2C devices.
G31	TS_I2C_SDA	DO	TP I2C data	
AG47	CAM_CCI_I2C_SCL0	DO	I2C clock of camera 0	Can only be used for camera I2C devices.
AE47	CAM_CCI_I2C_SDA0	DIO	I2C data of camera 0	
AE50	CAM_CCI_I2C_SCL1	DO	I2C clock of camera 1	
AF49	CAM_CCI_I2C_SDA1	DIO	I2C data of camera 1	
E38	SNSR_I2C_SCL	DO	I2C clock for external sensors	Can only be used to for sensors.
G37	SNSR_I2C_SDA	DIO	I2C data for external sensors	

ADC Converter

The Telit SE250B4 supports TWO Analog-to-Digital Converter (ADC) interface. The ADC interface supports resolution up to 15 bits. The pin definition is shown below.

Table 46 ADC converter

PIN	Signal	I/O	Function
AF7	PM_AMUX_2	ADC	General-purpose ADC interface
A5	PM_AMUX_3	ADC	General-purpose ADC interface

Table 47 ADC Performances

Parameter	Comments	Min	Type	Max	Unit
Input voltage range	Programmable	0.1	-	1.7	V
		0.3	-	4.5	
Resolution		-	15	-	bits
Analog input bandwidth		-	100	-	kHz
Sample rate	XO/8	-	2.4	-	MHz
INL	15-bit output	-8	-	8	LSB
DNL	15-bit output	-4	-	4	LSB
Offset error	Relative to full-scale	-1	-	1	%
Gain error	Relative to full-scale	-1	-	1	%

Note: Ensure to use a resistor divider before connecting to the ADC. This prevents the ADC from damaging the module due to high power supply.

Vibrator

The Telit SE250B4 Smart module supports silent incoming-call alarms with a vibration motor driver. The vibration driver is a programmable voltage output that is referenced to VBAT; when off, its output voltage is VBAT. The motor is connected between VBAT and the VIB_DRIVER. The programmable motor voltage ranges from 1.2 to 3.1 V in 100 mV steps.

Table 48 Vibrator

PIN	Signal	I/O	Function
P5	VIB_DRIVER	PO	Vibration motor driver output control

The following is the circuit diagram:

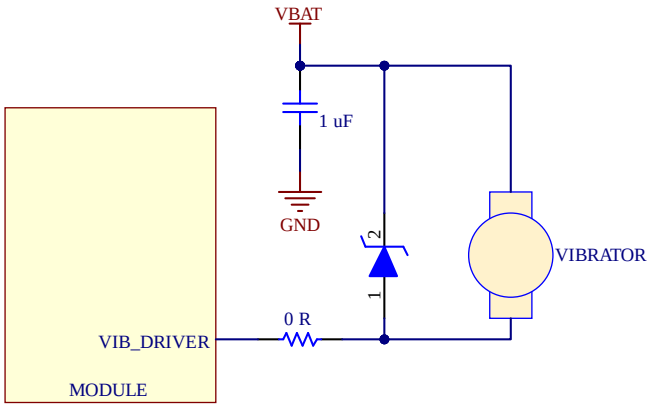


Figure 24 Reference Circuit for Motor Connection

When the motor stops working and the VIB_DRIER is disconnected, the redundant electricity on the motor can be discharged from the circuit loop formed by diodes, thus avoiding components damage.

LCM Interface

The module provides one LCM interface, which complies to MIPI DSI standard. The interface supports high-speed differential data transmission and support HD+ display (1680 x 720 @60 fps). The pin definition of the LCM interface is shown below

Table 49 LCM Interface

PIN	Signal	I/O	Function
BC27	MIPI_DSI0_CLK_M	AO	LCD MIPI clock (-)
BC25	MIPI_DSI0_CLK_P	AO	LCD MIPI clock (+)
BA24	MIPI_DSI0_L0_M	AO	LCD MIPI lane 0 data (-)
BA22	MIPI_DSI0_L0_P	AO	LCD MIPI lane 0 data (+)
AY25	MIPI_DSI0_L1_M	AO	LCD MIPI lane 1 data (-)
AY27	MIPI_DSI0_L1_P	AO	LCD MIPI lane 1 data (+)
AY23	MIPI_DSI0_L2_M	AO	LCD MIPI lane 2 data (-)
AY21	MIPI_DSI0_L2_P	AO	LCD MIPI lane 2 data (+)
BD26	MIPI_DSI0_L3_M	AO	LCD MIPI lane 3 data (-)
BD28	MIPI_DSI0_L3_P	AO	LCD MIPI lane 3 data (+)
B30	LCM_RST_N	DO	LCD reset
B38	LCM_TE	DO	LCD tearing effect
R45	LCM_BIAS_N_EN	DO	LCM bias EN (-)
C39	LCM_BIAS_P_EN	DO	LCM bias EN (+)
L45	LCM_ID1	DI	LCM_ID1 display
G49	LCM_ID2	DI	LCM_ID2 display
W47	LCM_BL_EN	DO	LCM BL enable
E20	LCM_WLED_PWM	DO	PWM output

The reference schematic for LCM includes also Backlight driver reference design and IC BOOST reference design.

The design is in vectorial form so the customer can easily zoom in to better see the details.

Both Backlight driver and IC boost contain IC address for reference and are supplied directly from the SE250B4.

This may be considered as reference for general LCM driver and reflects the design of our EVB in which we have a socket for the LCM.

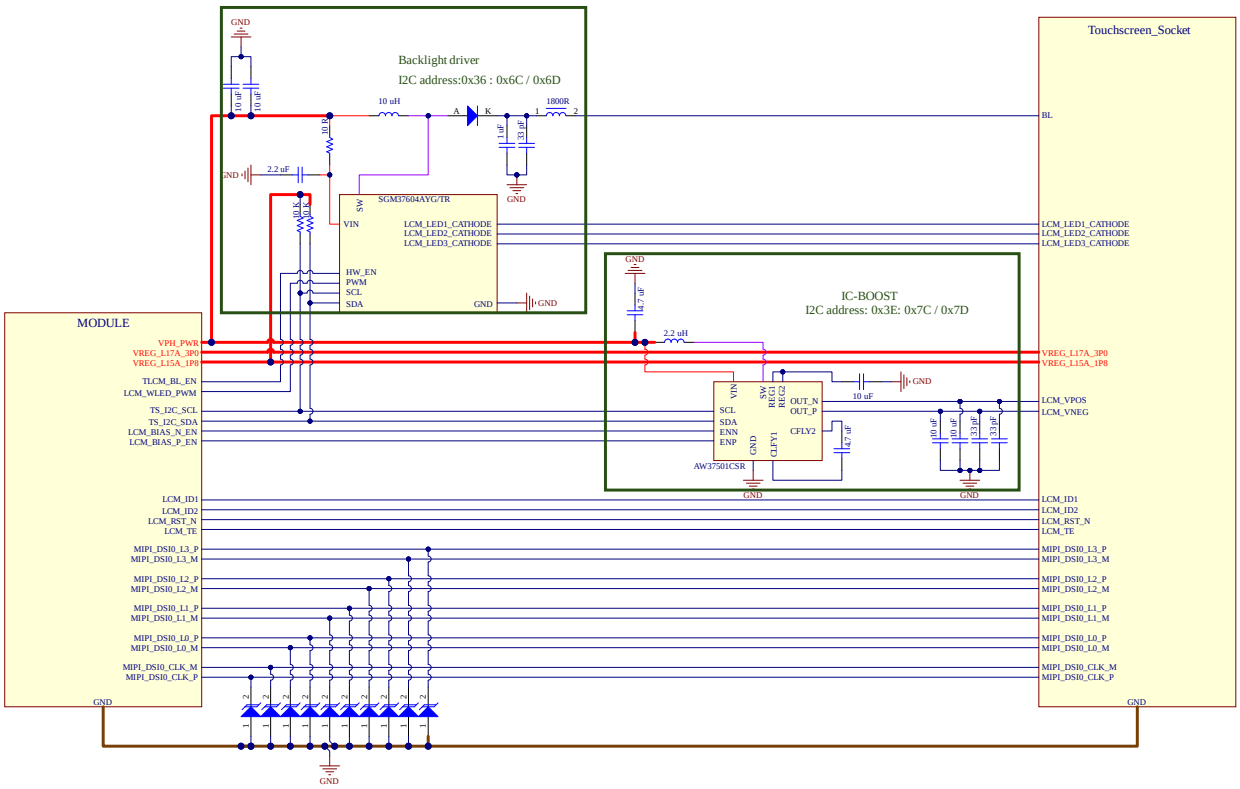


Figure 25 Reference Circuit Design for LCM Interface

LED Flash Interface

The Telit SE250B4 supports one flash LED driver with maximum output power up 1 A.

The Flash current is programmable in step of 12.5mA (max 1.A) or 5mA (max 640mA)

Table 50 LED Flash interface

PIN	Signal	I/O	Function
E16	LED_FLASH	DO	Flash/torch driver output
G15	LED_FLASH	DO	Flash/torch driver output

Touch Panel Interface

The Telit SE250B4 provides one I2C interface for the connector to a Touch Panel (TP) and also provides the corresponding power supply and interrupt pins. The definition of TP interface is shown in the table and reference schematic below.

Table 51 Touch panel Interface

PIN	Signal	I/O	Function	Comment
E32	TS_I2C_SCL	DO	TP I2C clock	Need to be pulled up to 1.8 V externally. Can be used for other
G31	TS_I2C_SDA	DO	TP I2C data	

				I2C devices.
C31	TS_INT_N	DI	TP interrupt	1.8 V power domain.
C35	TS_RESET_N	DO	TP reset	1.8 V power domain. Active low.
G51	TS_3P0_EN	DI	TP Enable	

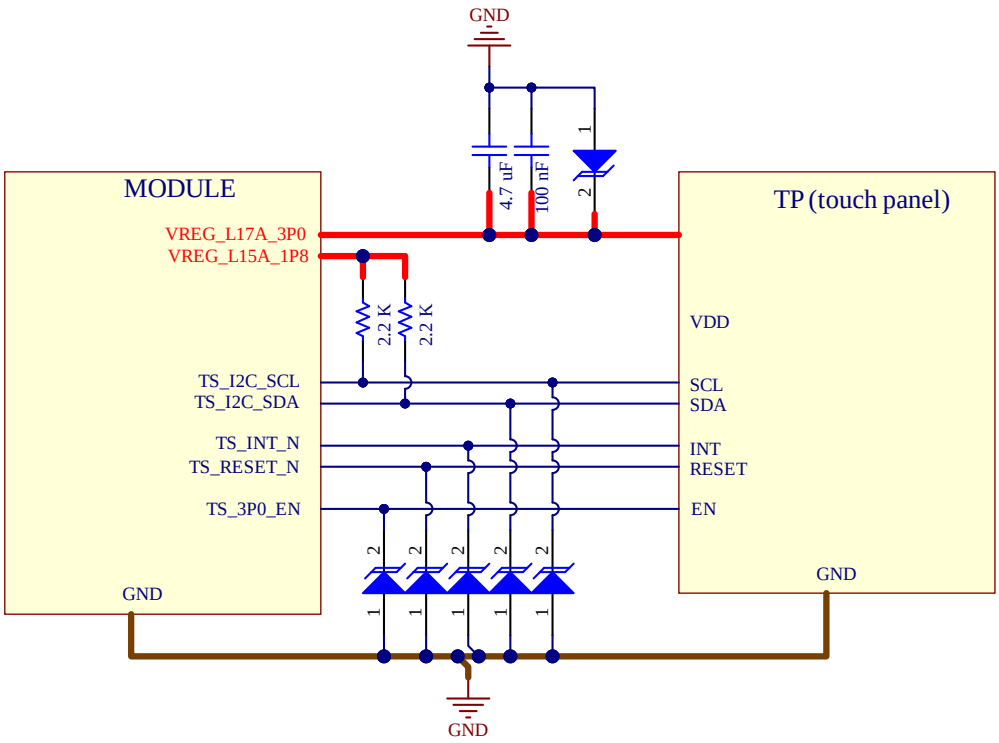


Figure 26 Reference Circuit Design for the Touch Panel Interface

Camera Interface

Based on MIPI CSI standard, the module supports two cameras (4-lane+4-lane) or three cameras (4lane+2lane+1lane), and the maximum resolution is 35MPx. The video and photo quality are determined by various factors such as camera sensors and camera lens specifications. The pad list of cameras is shown below, our reference design will take into consideration two cameras respectively of 13 and 5 MPx and a front camera of 2MPx. The cameras can be used also simultaneously.

Table 52 Camera Interface

PIN	Signal	I/O	Function
AJ50	CAM_MCLK0	DO	Master clock of camera 0
L49	CAM0_PWDN	DO	Power down of camera 0
AF51	CAM0_RST_N	DO	Reset of camera 0
AG50	CAM_MCLK1	DO	Master clock of camera 1
AD45	CAM1_PWDN	DO	Power down of camera 1
Y47	CAM1_RST_N	DO	Power down of camera 1

AL50	CAM_MCLK2	DO	Master clock of camera 2
C37	CAM2_PWDN	DO	Power down of camera 2
V45	CAM2_RST_N	DO	Power down of camera 2
AG47	CAM_CCI_I2C_SCL0	DO	I2C clock of camera 0
AE47	CAM_CCI_I2C_SDA0	DIO	I2C data of camera 0
AE50	CAM_CCI_I2C_SCL1	DO	I2C clock of camera 1
AF49	CAM_CCI_I2C_SDA1	DIO	I2C data of camera 1
J49	CAM_AF_VDD_EN	DO	
K47	CAM_1P2_EN	DO	
H50	CAM_1P8_EN	DO	
E51	CAM_2P8_EN	DO	
AU49	MIPI_CSI0_A0_CLK_M	AI	MIPI CSI0 clock (+)
AT50	MIPI_CSI0_NC_CLK_P	AI	MIPI CSI0 clock (-)
AS49	MIPI_CSI0_C0_LN0_M	AI	MIPI CSI0 lane 0 data (-)
AR50	MIPI_CSI0_B0_LN0_P	AI	MIPI CSI0 lane 0 data (+)
AT47	MIPI_CSI0_B1_LN1_M	AI	MIPI CSI0 lane 1 data (-)
AS45	MIPI_CSI0_A1_LN1_P	AI	MIPI CSI0 lane 1 data (+)
AP45	MIPI_CSI0_A2_LN2_M	AI	MIPI CSI0 lane 2 data (-)
AN47	MIPI_CSI0_C1_LN2_P	AI	MIPI CSI0 lane 2 data (+)
AP49	MIPI_CSI0_C2_LN3_M	AI	MIPI CSI0 lane 3 data (-)
AR47	MIPI_CSI0_B2_LN3_P	AI	MIPI CSI0 lane 3 data (+)
Y50	MIPI_CSI1_A0_CLK_M	AI	MIPI CSI1 clock (-)
X51	MIPI_CSI1_NC_CLK_P	AI	MIPI CSI1 clock (+)
AA50	MIPI_CSI1_C0_LN0_M	AI	MIPI CSI1 lane 0 data (-)
Z51	MIPI_CSI1_B0_LN0_P	AI	MIPI CSI1 lane 0 data (+)
W50	MIPI_CSI1_B1_LN1_M	AI	MIPI CSI1 lane 1 data (-)
V51	MIPI_CSI1_A1_LN1_P	AI	MIPI CSI1 lane 1 data (+)
U50	MIPI_CSI1_A2_LN2_M	AI	MIPI CSI1 lane 2 data (-)
T51	MIPI_CSI1_C1_LN2_P	AI	MIPI CSI1 lane 2 data (+)
S50	MIPI_CSI1_C2_LN3_M	AI	MIPI CSI1 lane 3 data (-)
R51	MIPI_CSI1_B2_LN3_P	AI	MIPI CSI1 lane 3 data (+)

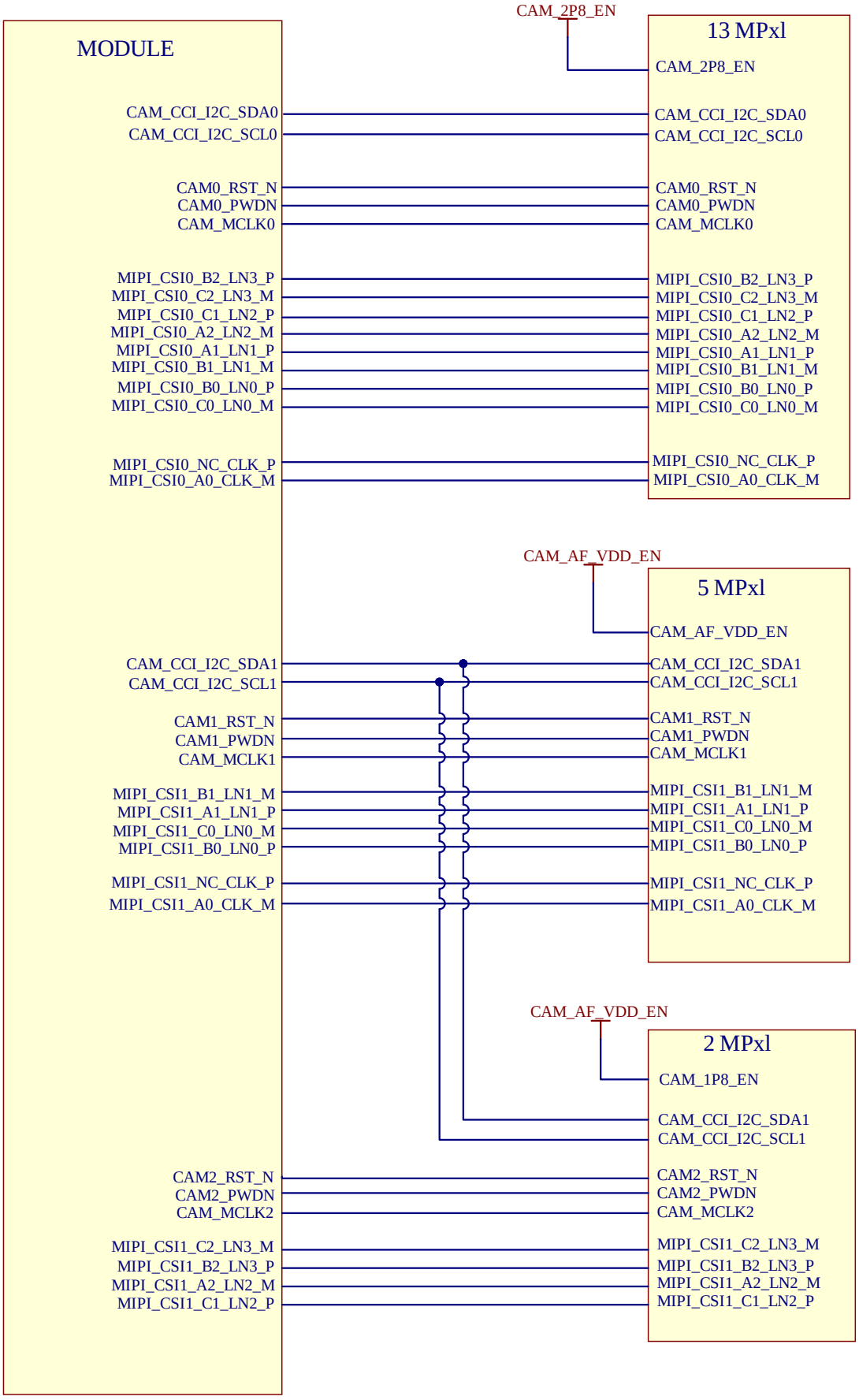


Figure 27 Reference Circuit Design for 3-Camera Applications

MIPI Design Consideration

Special attention is required on the pin definition on LCM and camera connections.

Since MIPI lines are high-speed differential signal lines for both DSI and CSI. Please consider that DSI support maximum speed up 1.5 Gbps and CSI a data rate up to 2.5 Gbps.

The differential impedence should be controllet to 100Ω±10%.

Additionally, it's recommended to route those traces in the PCB inner layers, and avoid cross-talking with other "power" , "high speed", or RF lines.

In general to keep signal integrity the total length of MIPI traces should not exceed 240mm, and differential length should not exceed 0.7mm.

It's recommended to select a low-capacitance TVS for ESD protection on application board and to not exceed a total parassitic capacitance of 1pF.

The following table reports the MIPI trace length inside the module

Table 53 MIPI lines length inside the module

PIN	Signal	Length (mm)	Lengt Difference |P-N|
BC27	MIPI_DSI0_CLK_M		
BC25	MIPI_DSI0_CLK_P		
BA24	MIPI_DSI0_L0_M		
BA22	MIPI_DSI0_L0_P		
AY25	MIPI_DSI0_L1_M		
AY27	MIPI_DSI0_L1_P		
AY23	MIPI_DSI0_L2_M		
AY21	MIPI_DSI0_L2_P		
BD26	MIPI_DSI0_L3_M		
BD28	MIPI_DSI0_L3_P		
AU49	MIPI_CSI0_A0_CLK_M	22.271	0.302
AT50	MIPI_CSI0_NC_CLK_P	21.969	
AS49	MIPI_CSI0_C0_LN0_M	22.369	0.081
AR50	MIPI_CSI0_B0_LN0_P	22.288	
AT47	MIPI_CSI0_B1_LN1_M	21.902	0.54
AS45	MIPI_CSI0_A1_LN1_P	22.442	
AP45	MIPI_CSI0_A2_LN2_M	22.084	0.021
AN47	MIPI_CSI0_C1_LN2_P	22.063	
AP49	MIPI_CSI0_C2_LN3_M	22.313	0.027
AR47	MIPI_CSI0_B2_LN3_P	22.286	
Y50	MIPI_CSI1_A0_CLK_M	13.775	0.022
X51	MIPI_CSI1_NC_CLK_P	13.753	
AA50	MIPI_CSI1_C0_LN0_M	13.456	0.08
Z51	MIPI_CSI1_B0_LN0_P	13.536	
W50	MIPI_CSI1_B1_LN1_M	13.579	0.023
V51	MIPI_CSI1_A1_LN1_P	13.556	
U50	MIPI_CSI1_A2_LN2_M	13.427	0.121
T51	MIPI_CSI1_C1_LN2_P	13.548	
S50	MIPI_CSI1_C2_LN3_M	13.553	0.004

R51	MIPI_CSI1_B2_LN3_P	13.549	

Sensor Interface

The module supports communication with sensors via I2C interfaces, and it supports ALS/PS,BDS, accelerometer, gyroscope etc, our EVK already include some sensors but the module has also two general purpose pads that can be used for external sensor applications.

Table 54 Sensor Interface PADS

PIN	Signal	I/O	Function	Comment
V49	SNSR_ACCL_INT	DI	Inerrupt for ACC sensor	GPIO_32
X49	SNSR_GYRO_INT	DI	Interrupt for gyro sensor	GPIO_33
AD51	SNSR_ALPS_INT_N	DI	Interrupt for Lux/proximity sensor	GPIO_35
E38	SNSR_I2C_SCL	DO	I2C clock for external sensors	GPIO_110
G37	SNSR_I2C_SDA	DIO	I2C data for external sensors	GPIO_109
E26	APPS_I2C_SDA	DIO	For PM8008/MIPI DSI bridge IC/NFC/LCD BIAS IC/Backlight driver IC	GPIO_4
G25	APPS_I2C_SCL	DO		GPIO_5

Audio Interface

The Telit SE250B4 provides three analog input channels and three analog output channels. The following table shows the pin definition

Table 55 Audio Interface

PIN	Signal	I/O	Function	Comment
BC9	CDC_MIC_BIAS1	AO	Bias voltage 1 output for microphone	Vomin = 1.6 V Vnom=1.8V Vomax = 2.85 V I=3mA
BD10	CDC_MIC_BIAS2	AO	Bias voltage 2 output for microphone	
BA10	CDC_MIC_BIAS3	AO	Bias voltage 3 output for microphone	
BD8	CDC_IN1_M	AI	Microphone input for channel 1 (-)	
BC7	CDC_IN1_P	AI	Microphone input for channel 1 (+)	
AV5	CDC_IN2_M	AI	Microphone input for channel 2 (-)	
AU7	CDC_IN2_P	AI	Microphone input for channel 2 (+)	
AT5	CDC_IN3_M	AI	Microphone input for channel 3 (-)	
AR5	CDC_IN3_P	AI	Microphone input for channel 3 (+)	

BC11	CDC_EAR_M	AO	Earpiece output (-)	The typical output voltage is 2 Vrms.
BD12	CDC_EAR_P	AO	Earpiece output (+)	
AS7	CDC_HPH_REF	GND	Headphone reference Ground	
AP7	CDC_HPH_L	AO	Headphone left channeloutput	
AN5	CDC_HPH_R	AO	Headphone right channel output	
AU3	CDC_HS_DET	AI	Headset hot-plug detect	
BD6	CDC_AUX_P	AO	Audio line differential output (+)	
BE5	CDC_AUX_M	AO	Audio line differential output (-)	
E40	AUD_DMIC_CLK_1	DO	Clock for digital mic	GPIO_98 (QCM2290)
G39	AUD_DMIC_DATA_1	DI	data for digital mic	GPIO_99 (QCM2290)
G21	AUD_SPK_AMP_SHDN_N	DO	SHDN for audio amp	

EMC MIC

- The module offers three audio input channels.
- The output voltage range of MIC_BIAS1 is programmable between 1.6V and 2.85V and the maximum output current is 3 mA. MIC_BIAS3 supports 1.8V pull-up output only and is not programmable.
- The earpiece interface uses differential output.
- The lineout interface uses differential output, lineout is used as audio PA input.
- The headphone interface feature stereo left and right channel output and supports headphone insertion detection.

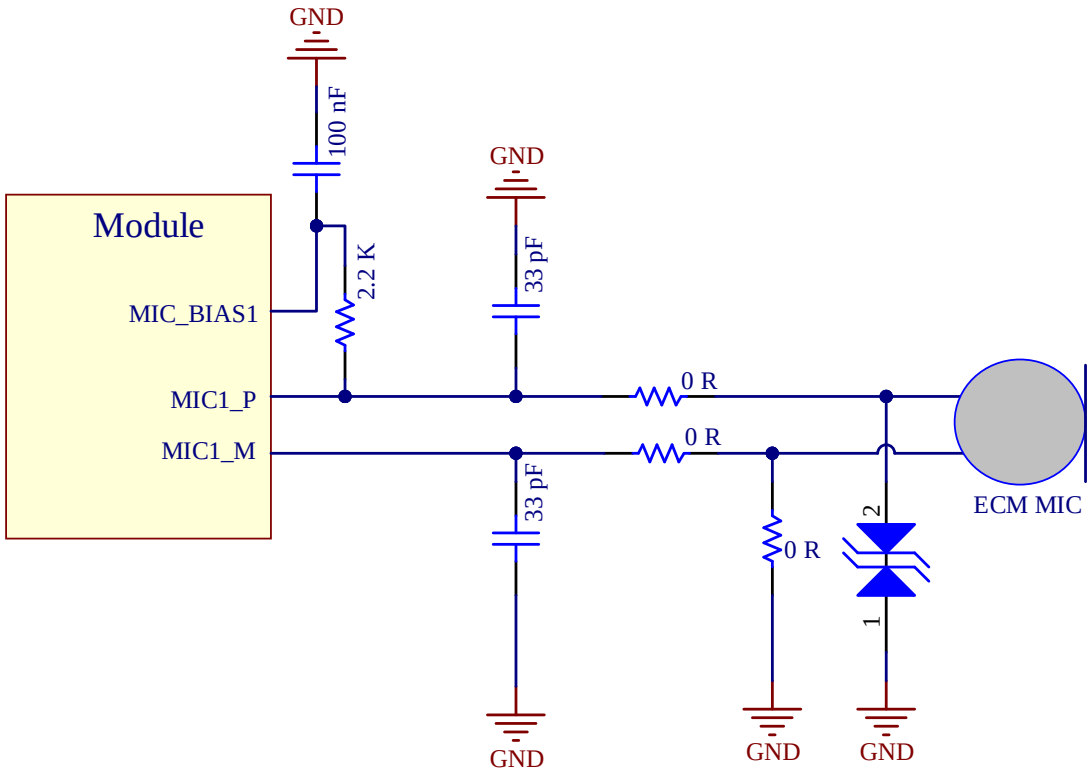


Figure 28 Reference Circuit Design for ECM Microphone Interface

- The characteristics of audio signal are obviously affected by the microphone gain.

On the tables below you can find some reference measurements depending on the selected gain value.

Table 56 Microphone amplifier gain = 0 dB (minimum gain)

Parameter	Test conditions	Min	Typical	Max	Units
Input referred noise	Single-ended, A-weighted, capless	-	18.5	25.1	µVrms
Signal-to-noise ratio	Single-ended, A-weighted, capless	92	94	-	dB
THD+N ratio, Analog input = -1 dBV	f = 1.02 kHz; single-ended input; 200 Hz to 20 kHz bandwidth; capless	-	-83	-70	dB

Table 57 Microphone amplifier gain = 6 dB

Parameter	Test conditions	Min	Typical	Max	Units
Input referred noise	Single-ended, A-weighted, capless	-	10	13	µVrms
Signal-to-noise ratio	Single-ended, A-weighted, capless	91	94	-	dB
THD+N ratio Analog input = -1 dBV	f = 1.02 kHz; single-ended input; 200 Hz to 20 kHz bandwidth; capless	-	-82.5	-70	dB

Table 58 Microphone amplifier gain = 24 dB (maximum gain)

Parameter	Test conditions	Min	Typical	Max	Units
Input referred noise	Single-ended, A-weighted, capless	-	2.6	4.2	µVrms
Signal-to-noise ratio	Single-ended, A-weighted, capless	84	87.5	-	dB
THD+N ratio Analog input = -1 dBV	f = 1.02 kHz; single-ended input; 200 Hz to 20 kHz bandwidth; capless	-	-82	-60	dB

The table below shows the general characteristics of microphone.

Table 59 General Microphone Specifications

Parameter	Test conditions	Min	Typical	Max	Units
Full-scale input voltage	Single-ended 1 kHz input. Input signal level required to get 0 dBFS digital output	-0.5	0	0.5	dBV
Input impedance	Capless input Input disabled	1	-	-	MΩ
		3	-	-	MΩ
Input capacitance	Capless input	-	-	15	pF

Table 60 Microphone Bias Output Performance Specifications

Parameter	Test conditions	Min	Typical	Max	Units
Output voltage	No load	1.60	-	2.85	V
Output voltage accuracy	No load	-3.00	0.00	3.00	%
Output current	2 microphone loads of 1.0 to 1.5 mA each	2.0	3.0	-	mA
Output switch to ground	On resistance	-	-	20	Ω
	Sink current	2.0	-	-	mA
Output noise	0.1 µF bypass	0.0	2.0	4.0	µVrms
PSRR - Power supply rejection ratio 100 mVpp applied to PMIC Vbatt input	at 20 Hz	90	-	-	dB
	at 200 Hz to 1 kHz	90	-	-	dB
	at 5 kHz	90	-	-	dB
	at 10 kHz	90	-	-	dB
	at 20 kHz	85	-	-	dB
Output capacitor value	External bypass mode	0.1	0.1	0.5	µF
	No external bypass mode	-	-	270	pF

MEMS MIC

For Digital microphone please consider the reference design and the table below.

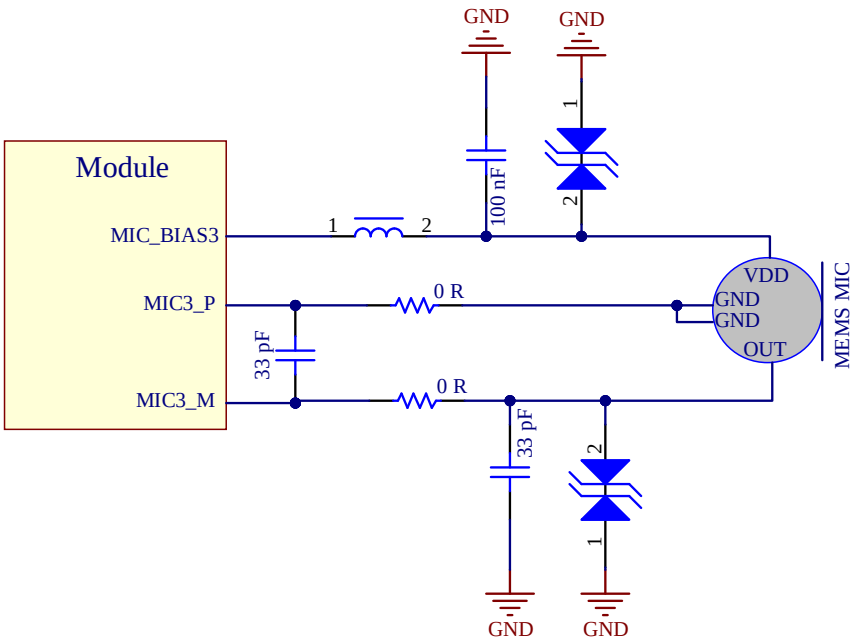


Figure 29 Reference Circuit Design for MEMS Microphone Interface

Table 61 Digital Microphone Input Performance

Parameter	Test conditions	Min	Typical	Max	Units
Sensitivity	@1kHz (0dB=1V/Pa)	-27	-26	-25	dBFS
Signal-to-noise ratio	94dBSPL@1kHz, A-weighted Bandwidth 20KHz	-	65	-	dB FS(A)
Maximum Acoustic Input	THD<10% @1kH		122		dB SPL
Current consumption	VDD=1.8V, fclock =2.4MHz	390	560	730	uA
Power supply rejection ratio	200 mVPP sinewave @ 1kHz		64		dB FS/V

Earpiece

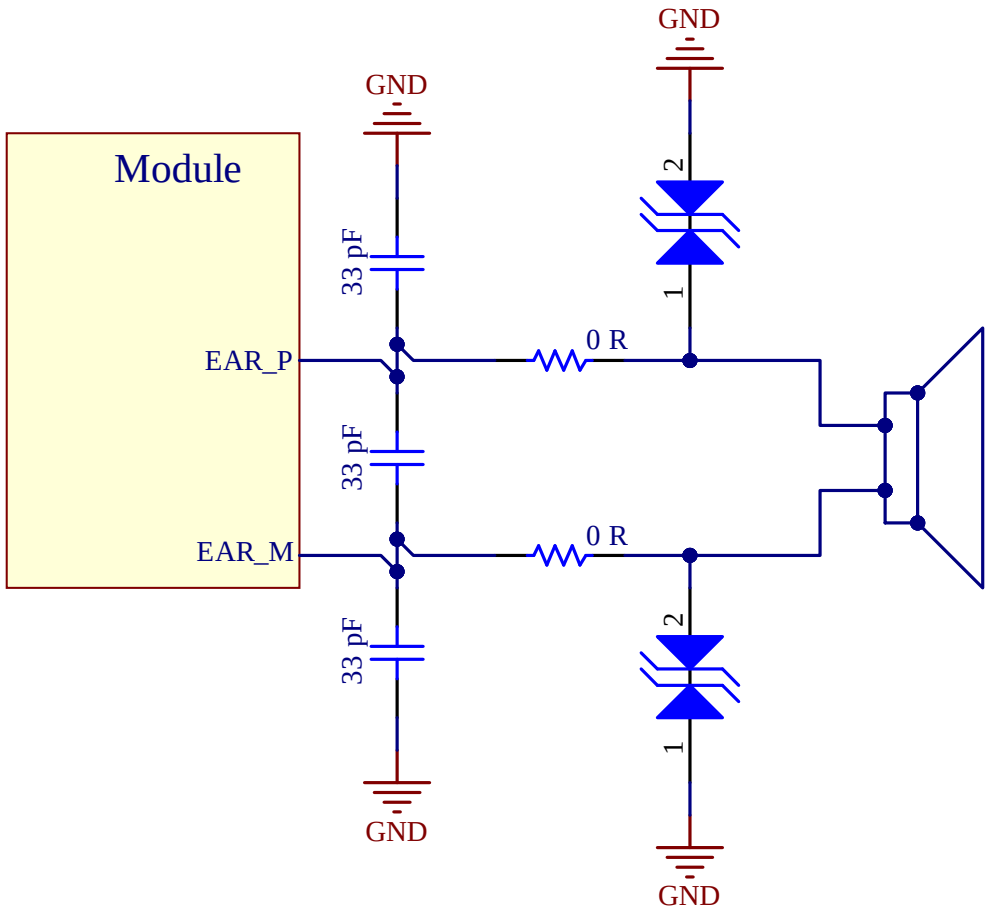


Figure 30 Reference Circuit Design for Earpiece Interface

Table 62 Earpiece output performances

Parameter	Test conditions	Min	Typical	Max	Units
Output power	32 Ω load f = 1.02 kHz, 6 dB gain THD+N < 1%	120	124.5	-	mW
	16 Ω load f = 1.02 kHz, 6 dB gain THD+N < 1%	235	243	-	mW
	10.67 Ω load f = 1.02 kHz, 6 dB gain THD+N < 1%	310	320		mW
Full-scale output	6 dB gain mode f = 1.02 kHz	1.8	2	2.1	Vrms
Voltage	1.5 dB gain mode f = 1.02 kHz	1	1.2	1.3	Vrms
Output load		10.7	32	50000	Ω
Disabled output impedance	Measured externally, amplifier disabled	1	-	-	MΩ

Headset

The Telit SE250B4 Smart module supports Stereo class-AB headphone with 16 Ω, 32 Ω impedance and up to 50 KΩ loads.

Its typical output power at 1.02 KHz and THD + N ≤ 1% is:

- 21.5 Mw with 16 Ω loads, 0 dBFS and -4.5 dB gain
- 30.8 Mw with 32 Ω loads, 0 dBFS and 0 dB gain

A 100KΩ pull-down resistor is integrated at HPH_L PIN, which could be used for mechanical insertion or removal detection through HS_DET PIN.

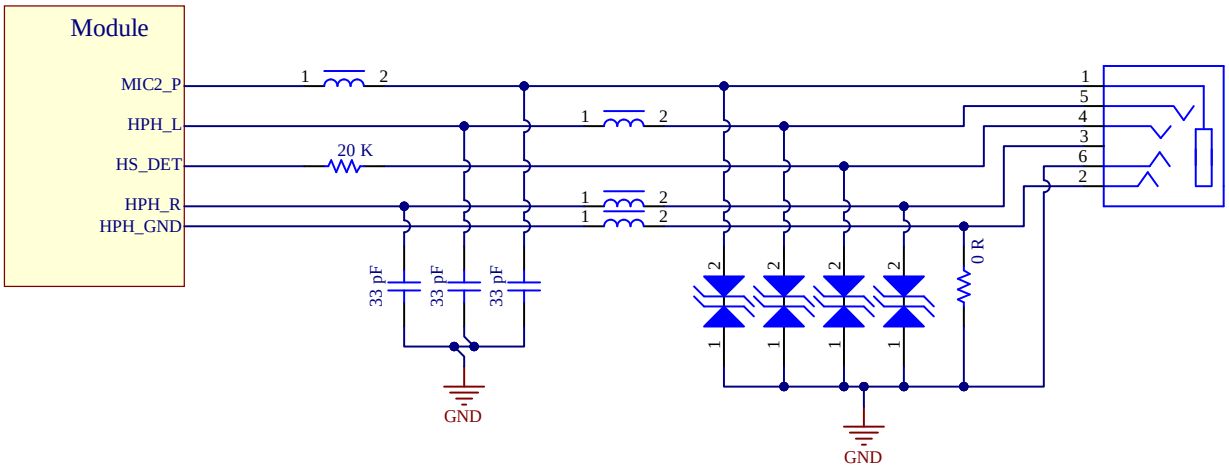


Figure 31 Reference Circuit Design for Headset Interface

Table 63 Headset performances

Parameter	Test conditions	Min	Typical	Max	Units
Output power	16 Ω load f = 1.02 kHz, 0 dB FS; VDD_CP* = 1.9 V	15.6	21.5	25.5	mW
	32 Ω load f = 1.02 kHz, 0 dB FS; VDD_CP* = 1.9 V	27.0	30.8	32.0	mW
Full-scale output Voltage	16 Ω load f = 1.02 kHz, 0 dB FS; VDD_CP* = 1.9V	0.50	0.59	0.64	Vrms
	32 Ω load f = 1.02 kHz, 0 dB FS; VDD_CP* = 1.9V	0.96	0.99	1.00	Vrms
Ouput Load	0 dBV maximum output	26	32	50000	Ω
	-4.5 dBV maximum output	13	16	50000	Ω
Disabled Output	Measured externally, with amplifier disabled	1.0	-	-	MΩ

Speaker

The Telit SE250B4 Smart module includes one Class-D mono differential loud speaker driver that supports 4 Ω and 8 Ω loads. Integrated boost circuit (max output voltage 5.5V is inside the module.

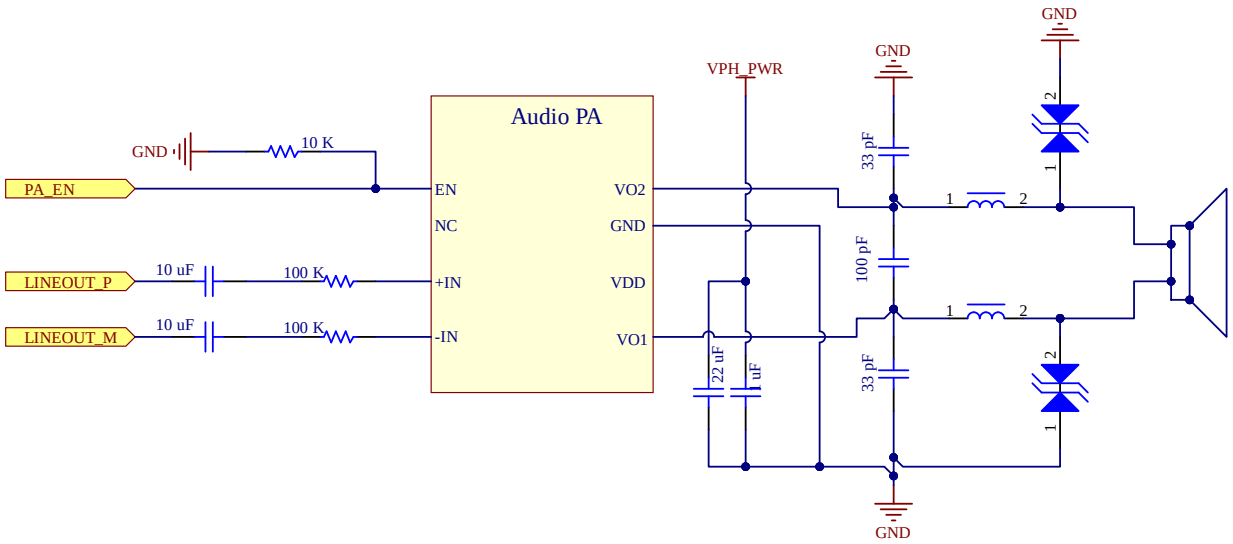


Figure 32 Reference Circuit Design for Lineout Interface

Table 64 Speaker Output Performance

Parameter	Test conditions	Min	Typical	Max	Units
Output power (Pout) (f = 1 kHz, gain = 12 dB, THD+N ≤ 1%)	15 µH + 8 Ω + 15 µH Vdd = 5 V	1200	1500	-	mW
	15 µH + 4 Ω + 15 µH Vdd = 5 V	1500	2000	-	mW
THD+N (1 kHz)	1.5 W Pout VDD_SPKR = 5.5 V	-	-86.5	-80	dB
	1.2 W Pout VDD_SPKR = 5 V	-	-86	-80	dB
Efficiency Vdd = 5V)	Pout = 1 W 115 µH + 8 + 15 µH	73	81	-	%
	Pout = 2 W 15 µH + 4 + 15 µH	61	72	-	%
Output impedance	Disabled	25	-	-	kΩ
Shutdown current		-	0.1	1	µA
Turn on time		-	0.2	10	ms

Audio Signal Design Considerations

It is recommended to use EMC microphone with dual build in shunt capacitors (e.g. 10pF and 33pF) to filter RF interference, thus TDD noise..

Without this capacitor the TDD noise could be heard during voice calls, please note that the resonant frequency point of a capacitor largely depends on its material and manufacturing technique. Therefore, you should consult the capacitor vendors to choose the most suitable capacitor to filter out the high-frequency noises.

The severity of RF interference in the voice channel during during GSM transmitting largely depends on the application design. In some cases, EGSM900 TDD noise is more relevant, while in other cases the DCS1800 TDD is stronger. Therefore you need to select the more suitable capacitor according to the test results. Sometimes, depending also from the routing techniques adopted in your application, on material, or numbers of layers used in your stackup the capacitor might be not required.

In order to decrease radio or other signal interference, place RF antennas as far as possible from your audio interfaces and audio traces.

Power lines can act as a channel for RF interferences and then intermodulate noise on audio traces, the differential audio should be able to reject the common mode noise but it's a good practice to keep also power lines as far as possible from audio traces.

Obviously route the differential audio traces accordingly to the differential layout route.

8. Cellular RF Connections

Antenna Requirements

The Telit SE250B4 Smart module provides four antenna interfaces for cellular (main and diversity), one for WiFi/BT and another one for GPS antenna.

The characteristic impedance of all antenna ports iside the module and in our EVK is controlled to 50Ω. impedance

Table 65 Pin Definition for antenna connections

PIN	Signal	I/O	Function	Comment
A41	ANT_TRX	AIO	Main antenna interface	50Ω.
A33	ANT_DRX	AI	Diversity antenna interface	

Operating frequencies for Cellular Part.

Table 66 SE250B4-EU operating frequencies

3GPP Bands	Downlink	Uplink	Unit
EGSM900 (B8)	925–960	880–915	MHz
DCS1800 (B3)	1805–1880	1710–1785	MHz
WCDMA B1	2110–2170	1920–1980	MHz
WCDMA B5	869 - 894	824 - 849	MHz
WCDMA B8	925–960	880–915	MHz
EV-DO/CDMA BC0	869–894	824–849	MHz
LTE-FDD B1	2110–2170	1920–1980	MHz
LTE-FDD B3	1805–1880	1710–1785	MHz
LTE-FDD B5	869–894	824–849	MHz
LTE-FDD B7	2620 – 2690	2500 – 2570	MHz
LTE-FDD B8	925–960	880–915	MHz
LTE-FDD B20	791 – 821	832 – 862	MHz
LTE-FDD B28	758 – 803	703 – 748	MHz
LTE-TDD B38	2570 – 2620	2570 – 2620	MHz
LTE-TDD B40	2300 – 2400	2300 – 2400	MHz
LTE-TDD B40	2496 – 2690	2496 – 2690	MHz

Table 67 SE250B4-Na Operating frequencies

3GPP Bands	Downlink	Uplink	Unit
LTE-FDD B2	1930 - 1990	1850 - 1910	MHz
LTE-FDD B4	2110 - 2155	1710 - 1755	MHz
LTE-FDD B5	869 - 894	824 - 849	MHz
LTE-FDD B7	2620 - 2690	2500 - 2570	MHz
LTE-FDD B12	729 - 746	699 - 716	MHz
LTE-FDD B13	746 - 756	777 - 787	MHz
LTE-FDD B17	734 – 746	704 – 716	MHz
LTE-FDD B25	1930 - 1995	1850 - 1915	MHz

LTE-FDD B26	859 - 894	814 - 849	MHz
LTE-FDD B66	2110 – 2200	1710 – 1780	MHz
LTE-FDD B71	617 – 652	663 – 698	MHz
LTE-TDD B41	2496 – 2690	2496 – 2690	MHz

Reference Design for Cellular Part

A reference circuit design for the main and Rx-diversity antenna interface is shown below. In your application board, please consider reserving a π–type matching circuit for each antenna to achieve better RF performances, and place matching components as close as possible to the antenna feeding point. Components must be chosen with RF measurements on the final device, so at the first stage of the design you can consider 0Ω series resistor and not mount shunt capacitors/inductors. After measurement adjust the component values for best antenna matching.

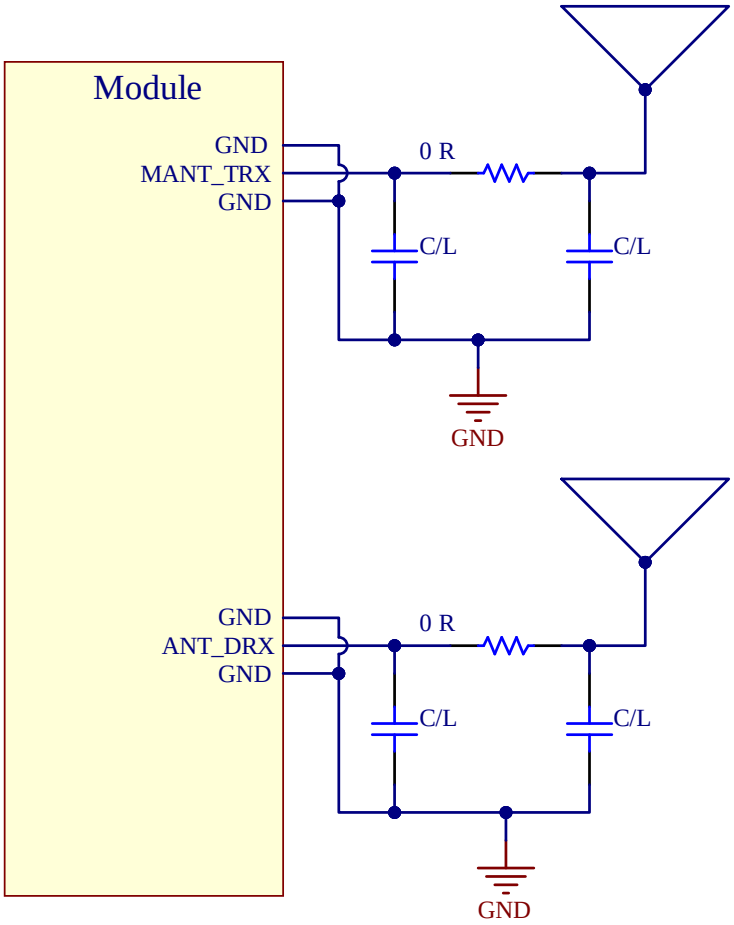


Figure 33 Recommended RF connection circuit for cellular part

Operating Frequencies for Wi-Fi/BT Part

The following tables show the pin definition and frequency specification fot the W-iFi/BT antenna interface.

Table 68 Wi-Fi/Bluetooth Pin Definition

PIN	Signal	I/O	Function	Comment
AK1	ANT_WIFI	AIO	Wi-Fi/Bluetooth antenna interface	50W.

Table 69 Wi-Fi/Bluetooth Frequencies

Type	Frequency	Unit
Wi-Fi (2.4 GHz)	2402–2482	MHz
Wi-Fi (5 GHz)	5180–5825	MHz
Bluetooth 5.0	2402–2480	MHz

Reference Design for Wi-Fi/BT part.

A reference circuit design for Wi-Fi/Bluetooth antenna interface is shown below. Please consider adding the placeholder for these components in your PCB application board. Initially leave not mounted the reactive components C/L and use a default series resistor of 0Ω. After RF measurement, adjust the components values to obtain the best matching to 50Ω

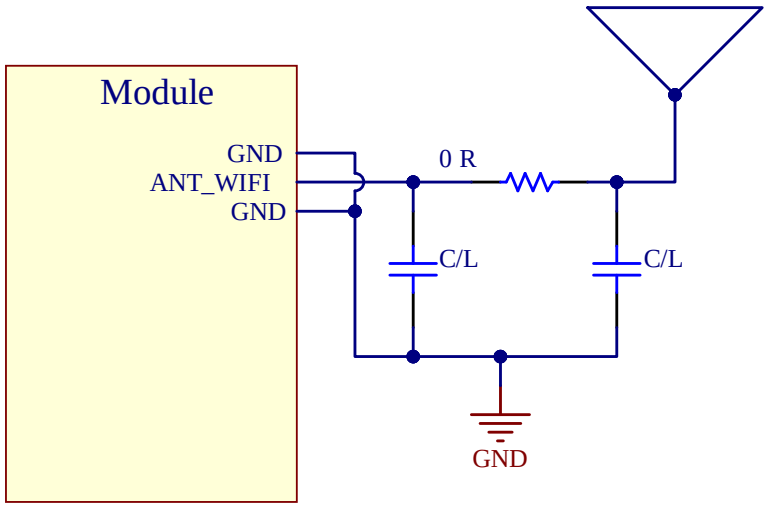


Figure 34 Recommended RF connection circuit for WiFi/BT part

For antenna specification please refer to the table below.

Table 70 Antenna specification for WiFi/BT

Item	*Value*
Impedance (ohm)	50
VSWR (linear)	< 2 (Typical)

Please consider that in general after the tuning the performance of WiFi should be as reported in the tables below.

Table 71 SE250B4 standard Wifi Performances @2.4GHz

Item	802.11B (11M)	802.11G (54M)	802.11N(MCS7)	Unit
TX Output power	17	15	12.5	dBm
EVM	<20%	<-25dB	<-27dB	
RX sensitivity	-88	-73.5	-71	dBm

Table 72 SE250B4 standard Wifi Performances @5 GHz

Item	802.11G (54M)	802.11N(MCS7)	Unit
TX Output power	15	11	dBm
EVM	<-25	<-27	dB
RX sensitivity	-73.5	-71	dBm

Table 73 SE250B4 standard BT performances

Item	DH5	2DH5	3DH5	Unit
TX Output power	9	7	7	dBm
RX sensitivity	-90	-80	-80	dBm

GNSS Antenna Interface

The following tables show he pin definition and frequency specification for GNSS antenna interface.

Table 74 GNSS Pin definition.

PIN	Signal	I/O	Function	Comment
A9	ANT_GPS	AI	GNSS antenna interface	50Ω.

Table 75 GNSS Antenna Interface

Type	Frequency	Unit
GPS L1	1575.42 ±1.023	MHz
GLONASS L1	1597.5–1605.8	MHz
BDS B1I	1561.098 ±2.046	MHz
Galileo E1	1575.42 ±2.046	MHz

Reference Design for GNSS part

GNSS antenna interface supports both active and ceramic/passive antennas.

Then we have two distinct reference design depending on which antenna type the customer wants in his application board.

The reference design for passive antenna is the same that we had for cellular and Wi-Fi part, we recommend adding the same p-type matching circuit network if you need to tune the characteristic impedance of the board.

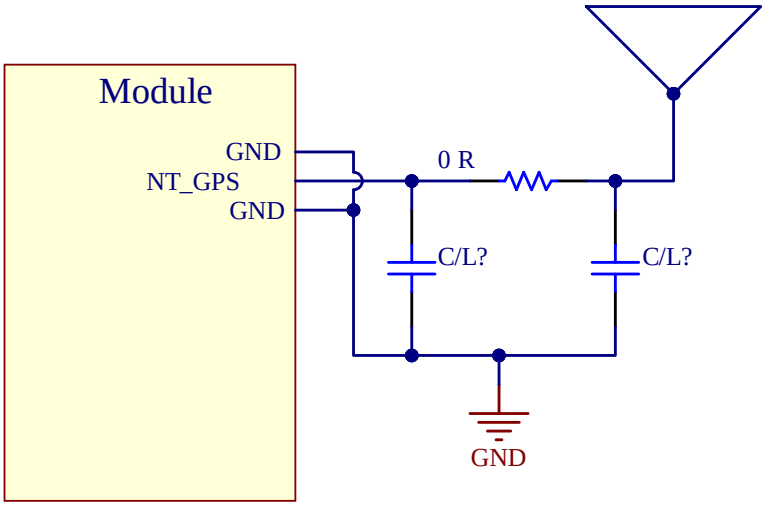


Figure 35 Recommended RF connection circuit for GNSS part.

For active antennas we need to also bring the power supply for the LNA integrated inside the antenna. Then we need to add just some other components, and basically a DC feed and DC block components to avoid the dispersion of received signals through the supply path.

For Antenna requirement specification please refer to the table below

Table 76 GNSS Antenna specifications

Item	Value
Frequency range	1565 - 1607MHz
Polarization	RHCP or linear VSWR: < 2 (Typical)
Passive antenna gain	> 0dBi
Active antenna gain	> -2dBi
Active antenna noise figure	< 1.5dB
Active antenna embedded LNA gain	20dB (Typical)
Active antenna total gain	> 18dBi (Typical)

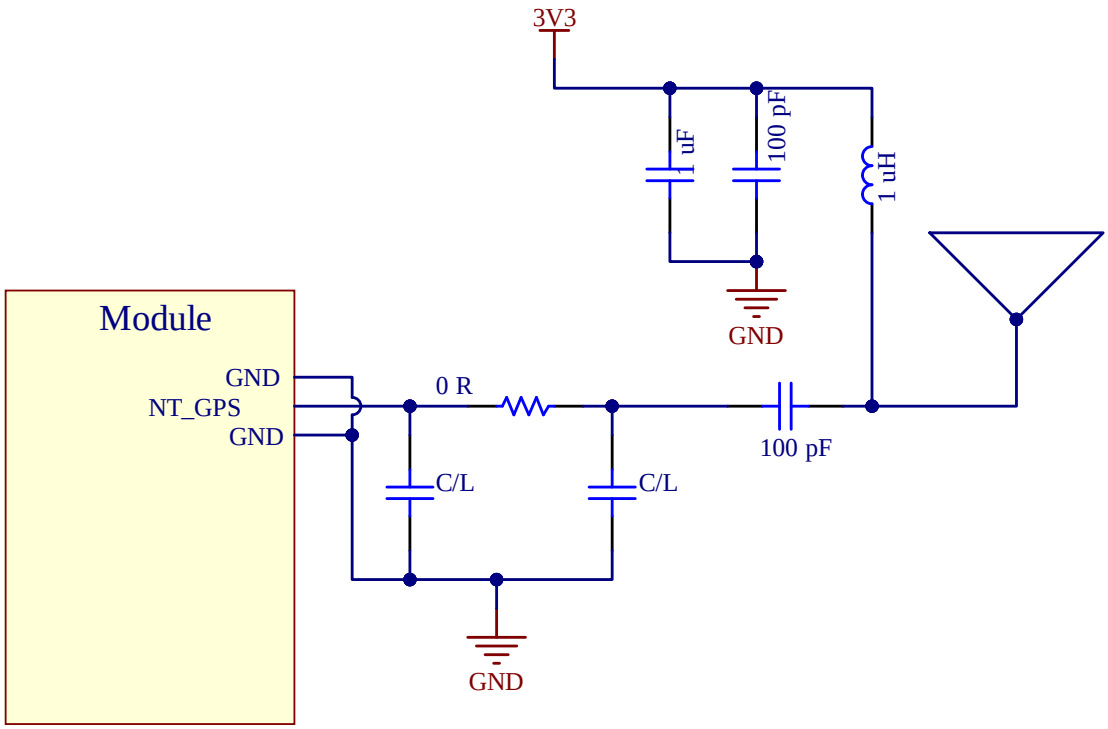


Figure 36 Recommended connection circuit for GNSS active antenna.

Note: We recommend using passive antennas. Active antennas can increase the signal, but an excessive gain can blind the receiver. Please make sure to follow the RF routing guideline for RF track routing.

PCB RF Design Guidelines

To ensure good RF performance, users should meet the following requirements:

- At least, 4-layer through-hole PCB should be chosen for good impedance control and signal shielding.
- Keep the RF traces at 50Ω.
- Maintain a complete and continuous reference ground plane from module antenna PAD to the RF connector.
- The RF traces should be away from any other noisy traces.
- Keep the RF traces as short as possible.
- Locate Telit SE250B4 Smart module in the center of PCB, rather than in the corner.
- Digital devices and traces should not be placed near sensitive signals like RF and clock.
- Keep SPKR and MIC away from sensitive RF lines.
- RF connectors should be placed close to the module's antenna PAD.
- Antenna matching circuit should be placed close to the antenna.
- If using a coaxial RF cable to connect the antenna, please avoid spanning over UIM cards, power circuits and high-speed digital circuits to minimize the impact on each other.

The characteristic impedance of RF signals should be controlled at 50 Ohm. In general, the impedance of RF signal is determined by the Permittivity (ER) of PCB material, line width (W), ground clearance (S), height of reference ground plane (H) and other factors.

Microstrip line and coplanar waveguide are usually used to control the characteristic

impedance of RF wiring. The following illustrations show the structure design of microstrip line and coplanar waveguide.

The following is the structure diagram:

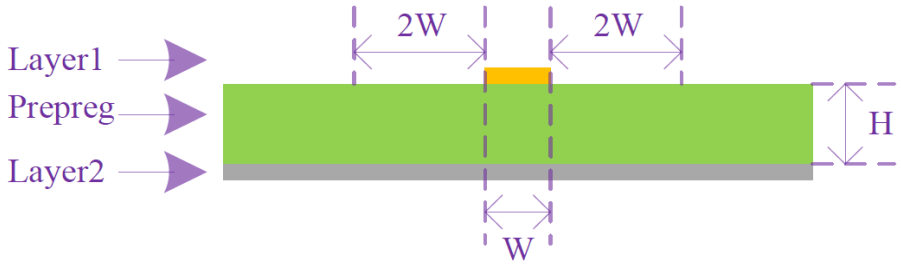


Figure 37 Two Layers PCB microstrip structure

Table 77 Impedance control of microstrip line structure

Item	Value	
PCB thickness	1mm	1.6mm
Permittivity (ER)	4.2	4.2
Line thickness	0.035mm	0.035mm
Layer	Layer1	Layer1
Reference plane	Layer2	Layer2
Target impedance	50 ohm	50 ohm
Expected linewidth W	1.7mm (67 mil)	3mm (118 mil)

The following is the structure diagram:

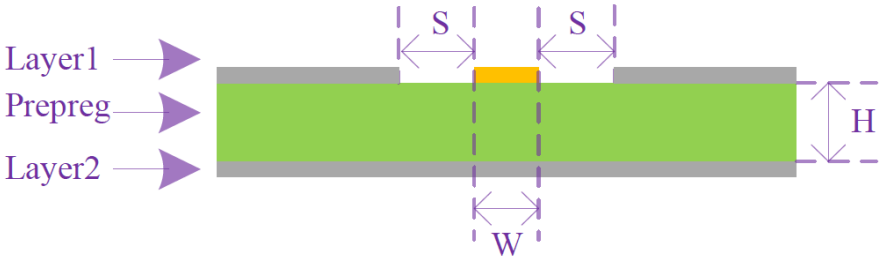


Figure 38 Two-layer PCB coplanar waveguide structure

Table 78 : Impedance control of coplanar waveguide structure

Item	Value	
PCB thickness	1mm	1.6mm
Permittivity (ER)	4.2	4.2
Line thickness	0.035mm	0.035mm
Layer	Layer 1	Layer 1
Reference plane	Layer2	Layer2
Target impedance	50 ohm	50 ohm
Expected gap to ground S	0.65mm (25.6 mil)	0.65mm (25.6 mil)
Expected linewidth W	0.2mm (7.8 mil)	0.15mm (5.9 mil)

The following is the structure diagram:

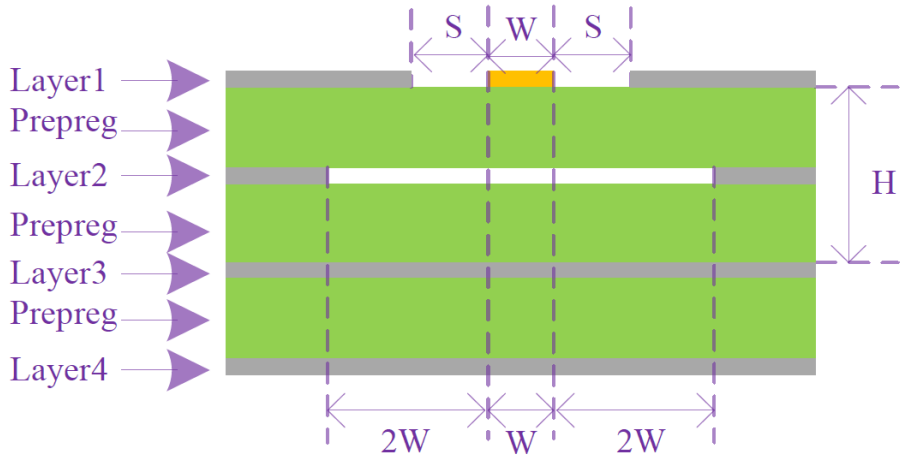


Figure 39 Four-layer PCB coplanar waveguide structure 1#

Four-layer PCB coplanar waveguide structure 2# is shown in following figure. The fourth layer is reference layer.

The following is the structure diagram:

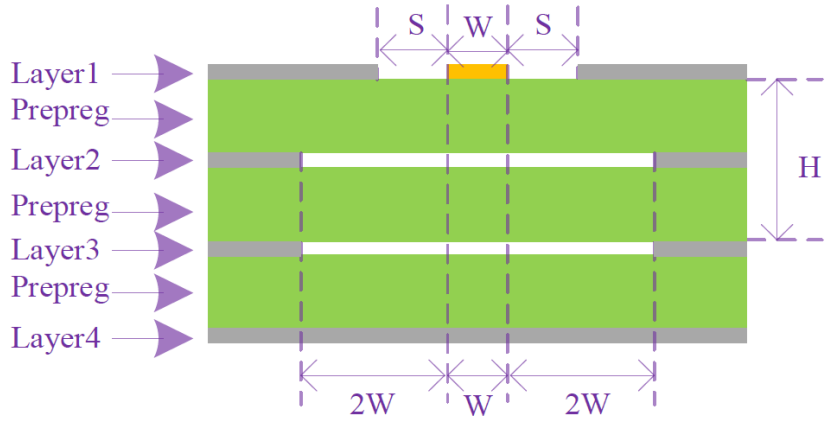


Figure 40 Four-layer PCB coplanar waveguide structure 2#

9. RECOMMENDED PERIPHERALS LIST

Warning: The components listed in the recommended peripherals list are for information purpose only. For more information, see Terms of Use.

Camera

Table 79 Camera Peripheral List

Items	Part Number	Vendor	Resolution
1	BF2257	BYD	2M
2	GC02M1	GalaxyCore Shanghai Limited Corporation	2M
3	HI-556	SK hynix	5M
4	GC5035	GalaxyCore Shanghai Limited Corporation	5M
5	S5K5E9	Samsung Electronics Co., Ltd	5M
6	S5K4H7	Samsung Electronics Co., Ltd	8M
7	Hi-846	SK hynix	8M
8	OV08A	OmniVision Technologies(ShangHai) Co., Ltd.	8M
9	S5K3L6	Samsung	13M
10	HI-1336	SK hynix	13M
11	OV13B10	OmniVision Technologies(ShangHai) Co., Ltd.	13M

LCD Driver

Table 80 LCD Driver Peripheral List

Item	Part Number	Vendor	Resolution
1	FL7703N-G5-DP	Sitronix	HD+ (EVB design)
2	ST7701SN	Sitronix	FWVGA
3	9503CV	GALAXYCORE	FWVGA
4	9702C	GALAXYCORE	HD
5	JD9365DA-H3	FITI	HD
6	JD9161Z	FITI	FWVGA
7	JD9161S	FITI	FWVGA

Accelerometer & Gyroscope

Table 81 Accelerometer and Gyroscope Peripheral List

Item	Part Number	Vendor	Accelerometer	Gyroscope
1	ICM-42670-N	TDK	√	√
2	BMI320	Bosch	√	
3	SH3001-A	SENODIA	√	√

E-Compass

Table 82 E-Compass Peripheral List

Item	Part Number	Vendor
1	QMC6308	QST
2	MMC5603NJ	MEMSIC

Proximity and Ambient

Table 83 Proximity & Ambient Light Peripheral List

Number	Part Number	Vendor	Proximity	Ambient Light
1	MN78911DKDN	EMINENT	√	√
2	STK33562	SENSORTEK	√	√
2	JSA-1233	SOLTEAM	√	√
3	APM-16D24-U6E-DF8/TR8	EVERLIGHT	√	√
4	LTR-569ALS-02	LITEON	√	√

Pressure

Table 84 Pressure Peripheral List

Number	Part Number	Vendor
1	ICP-10111	TDK-INVENSENSE
2	BMP580	Bosch
3	SPL07-003	Goretek
4	ICP-20100	TDK-INVENSENSE

10. Mechanical Design

The following is the Top and bottom view of Telit SE250B4 Smart module.

Drawing

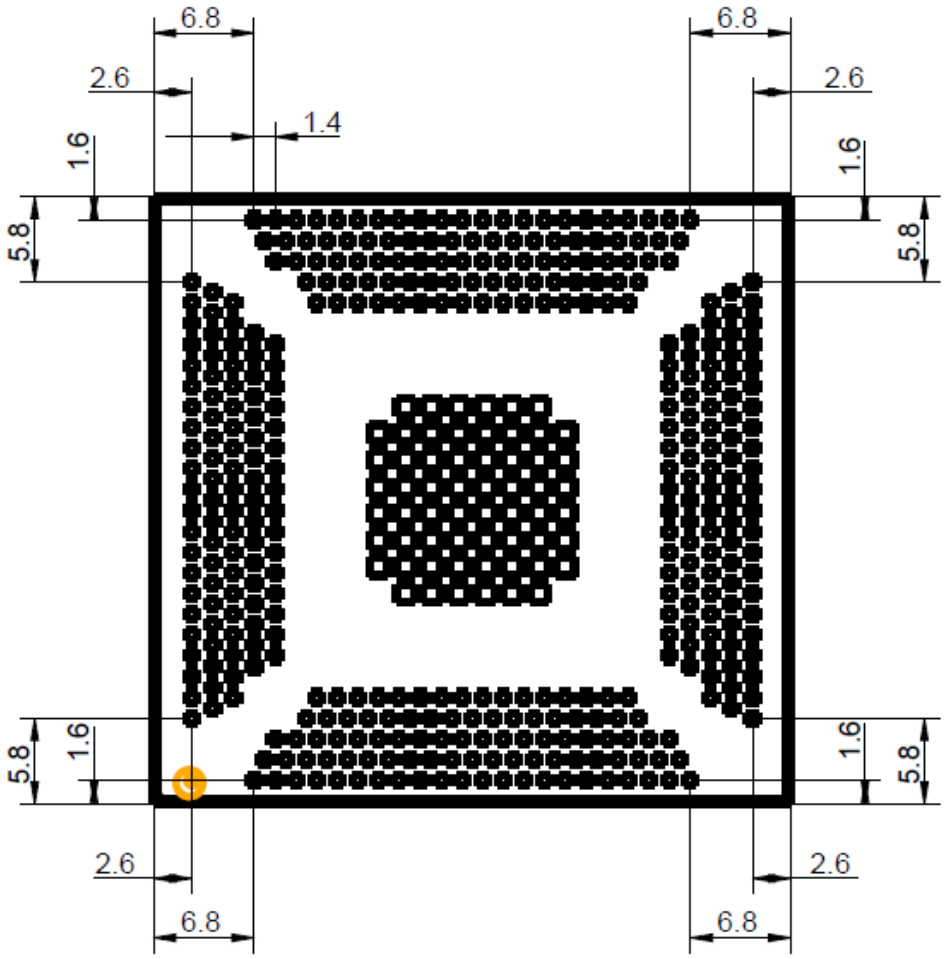


Figure 41 SE250B4 mechanical drawing (bottom view).

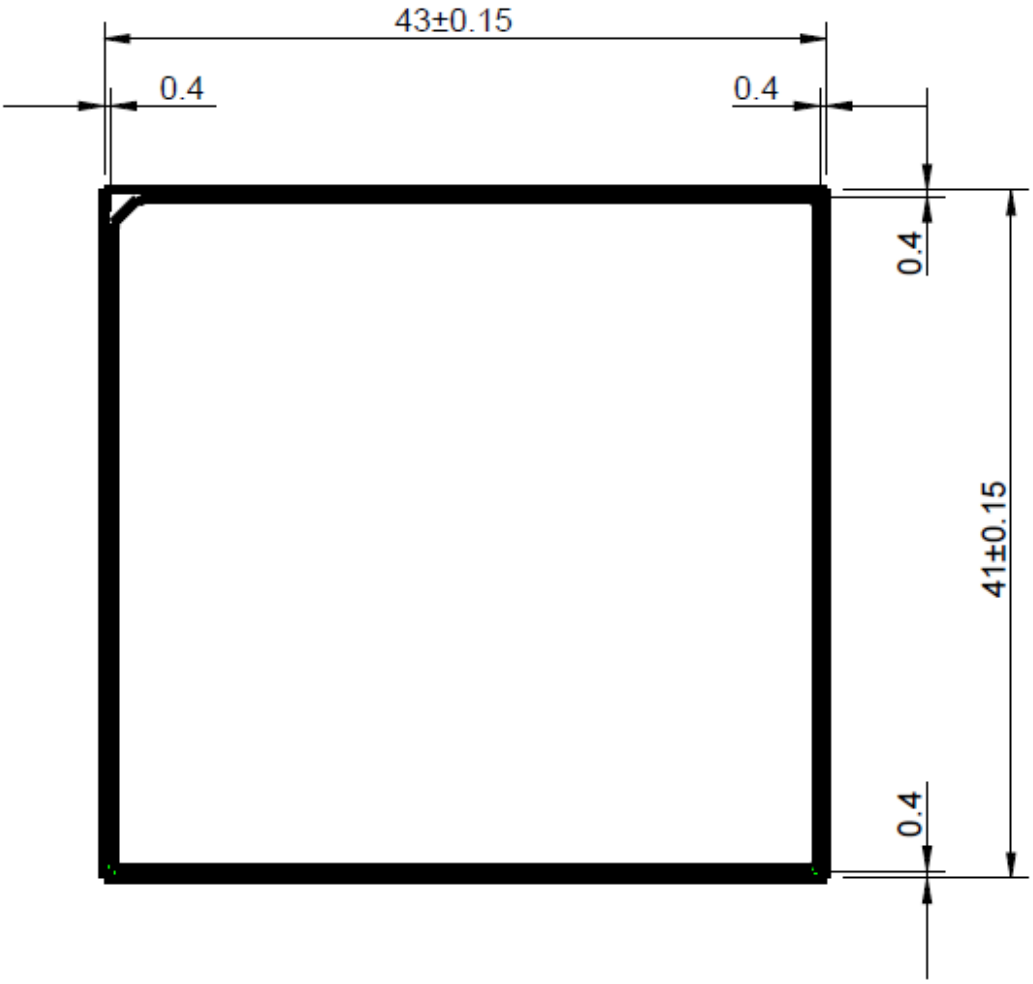


Figure 42 SE250B4 mechanical drawing (top view).

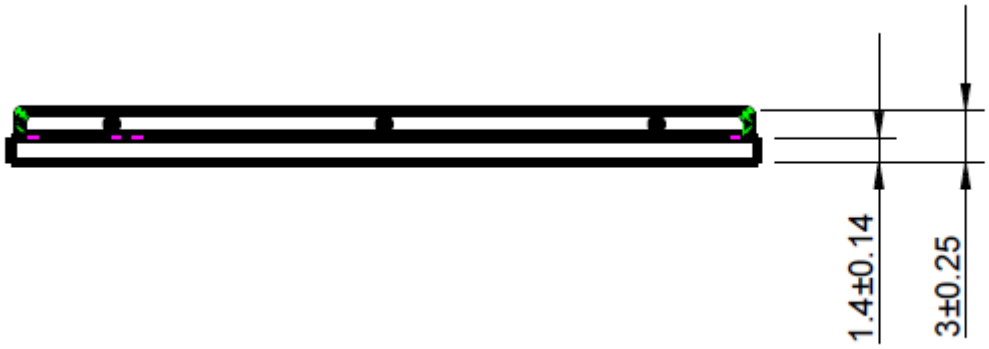


Figure 43 SE250B4 mechanical drawing (side view).

11. APPLICATION PCB Design

Footprint

The following is the footprint diagram:

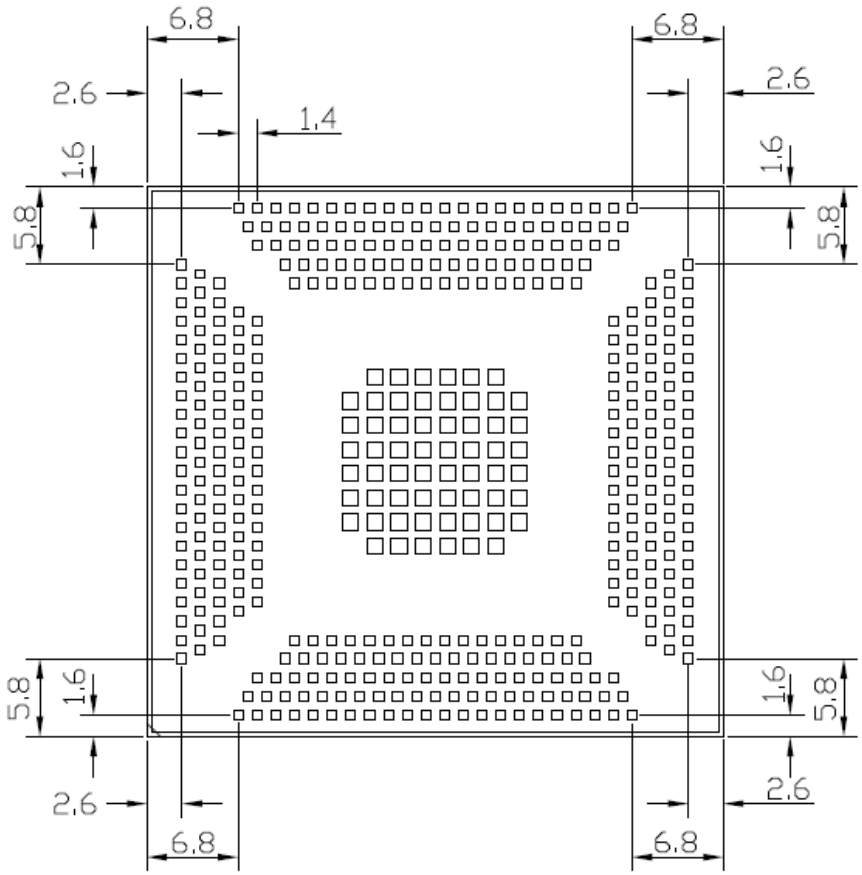


Figure 44 Footprint of the Telit SE250B4 Smart module

Solder reflows

The following is the SMT reflow of the Telit SE250B4 Smart module.

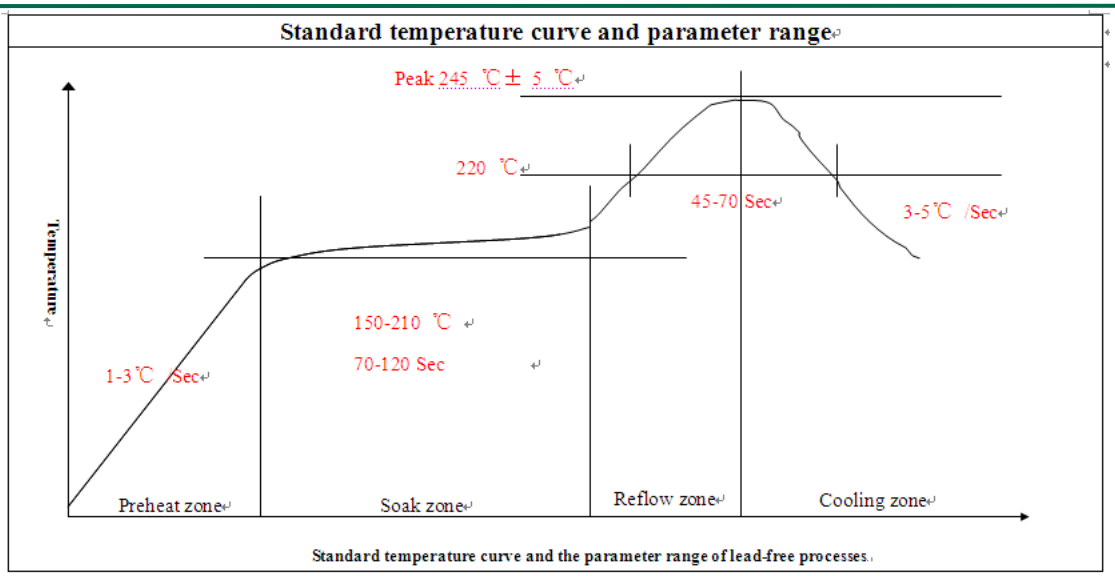


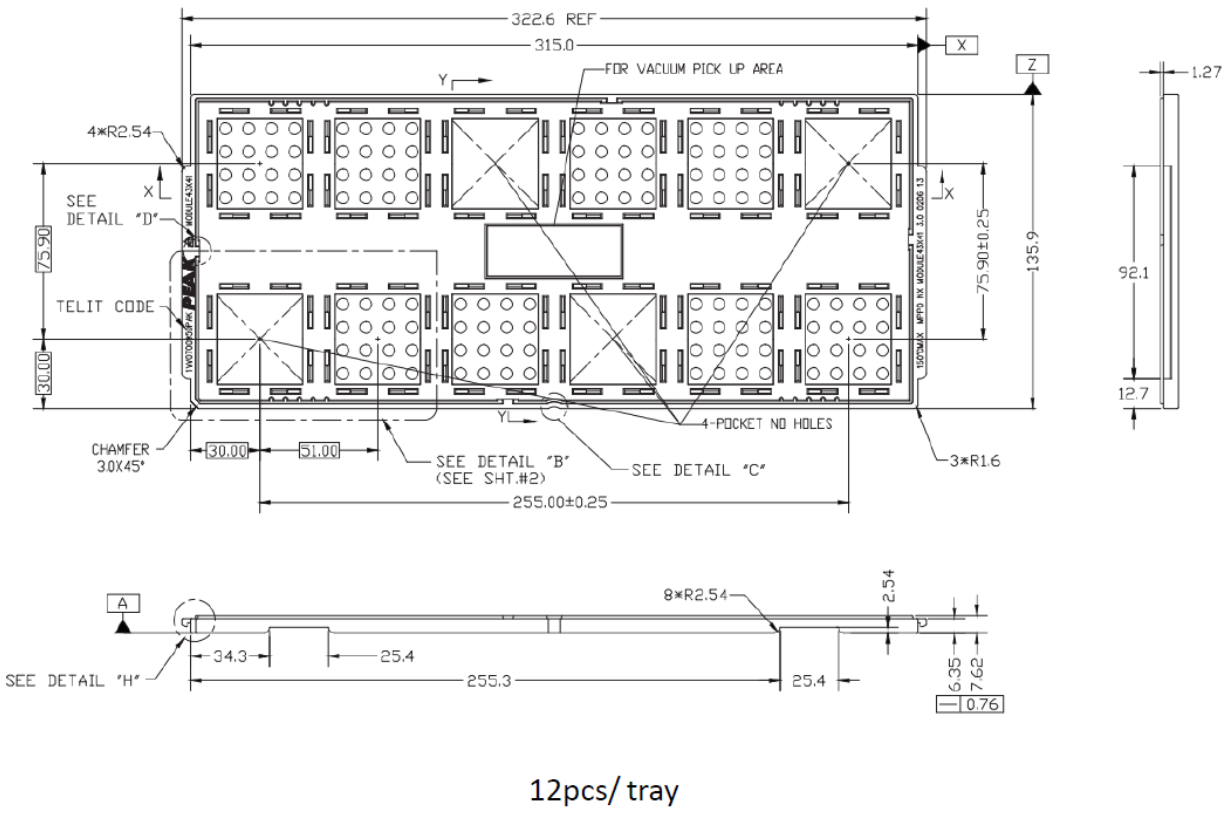
Figure 45 SMT reflow of the Telit SE250B4 Smart module

12. PACKAGING

Tray

Telit SE250B4 Smart module supports tray packaging.

The following is the packaging process:



12pcs/ tray

Figure 46 Tray

Table 85 Tray dimensions

Length (mm)	Width (mm)	Units per tray
322.6	135.9	12

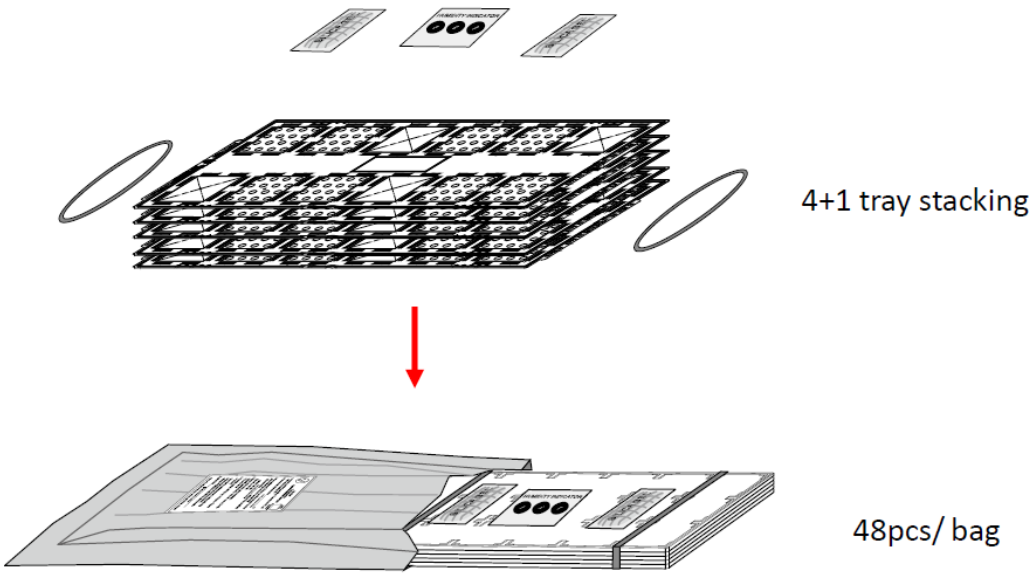


Figure 47 Tray Packaging

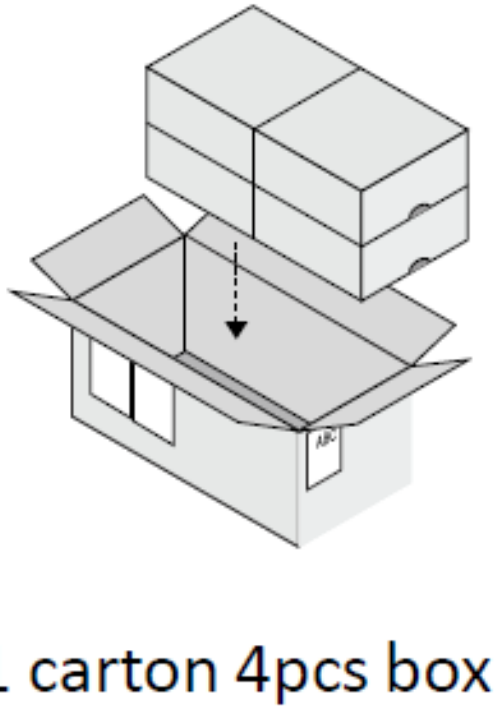


Figure 48 multi-packaging

Moisture Sensitivity

Telit SE250B4 Smart module is susceptible to damage induced by absorbed moisture and high temperature. A package's moisture-sensitivity level (MSL) indicates its ability to withstand exposure after it is removed from its shipment bag, while it is on the factory floor awaiting PCB installation. A low MSL rating is better than a high rating; a low MSL device can be exposed on the factory floor longer than a high MSL device.

MSL Rating Summary

Table 86 MSL rating summary

MSL	Out-of-bag floor life	Comments
1	Unlimited	≤+30°C/85% RH
2	1 year	≤+30°C/60% RH
2a	4 weeks	≤+30°C/60% RH
3	168 hours	≤+30°C/60% RH
4	72 hours	≤+30°C/60% RH; SE250B4x rating
5	48 hours	≤+30°C/60% RH
5a	24 hours	≤+30°C/60% RH
6	Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label.	≤+30°C/60% RH

The MSM8909 device samples are currently classified as MSL4 at 255 (+5, -0)°C, following the latest IPC/JEDEC J-STD-020 standard revision for moisture-sensitivity qualification This qualification temperature (255°C) should not be confused with the peak temperature within the recommended solder reflow profile.

Baking Requirements

It is necessary to bake modules if the prescribed time limit has been exceeded. The baking conditions are specified in the table mentioned below Note that if baking is required, devices must be transferred into trays that can be baked to at least 125°C.

Table 87 Banking requirements

Baking conditions options	Duration
40°C±5°C, <5% RH	192 hours
120°C±5°C, <5% RH	4 hours

13. CONFORMITY ASSESSMENT ISSUES

Approvals Summary

Table 88 EMEA Approvals summary

Region	EMEA	
Country & Type Approval	EU RED	UK UKCA
SE250B4-EU	●	●

Table 89 Americas Approvals summary

Region	Americas		
Country & Type Approval	US FCC	CA ISED	BR ANATEL
SE250B4-NA	●	●	-

●	The equipment is compliant
●	Type approval is in progress
-	The equipment is not compliant

EMEA Approvals

EU RED

EU Declaration of Conformity

In accordance with the above Approval Compliance Summary table, where applicable (green ball), hereby, Telit Cinterion declares that the equipment is in compliance with the Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: https://www.telit.com/red

Text of 2014/53/EU Directive (RED) requirements can be found here:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0053

RED Antennas

This radio transmitter has been approved under RED to operate with the antenna types listed below with the maximum permissible gain indicated. The usage of a different antenna in the final hosting device may need a new assessment of host conformity to RED.

Table 90 RED Antenna used for testing

Model	Antenna Type
SE250B4-EU	**2G/3G/4G:** Model: ZTX S50, Type: Monopole with SMA connector, 50ohm impedence **WiFi/Bluetooth® :** Model: ZTX TG2, Type: Monopole with SMA connector, 50ohm impedence

Table 91 Licensed 2G/3G/4G Max antenna gain for RED

Licensed 2G/3G/4G Max Gain for RED (dBi)	
Band	SE250B4-EU
GSM 900	1.54
DCS 1800	2.06
WCDMA B1	2.2
WCDMA B8	2.31
LTE FDD 1	2.2
LTE FDD 3	2.06
LTE FDD 7	3.12
LTE FDD 8	1.54
LTE FDD 20	1.93
LTE FDD 28	1.81
LTE TDD 38	2.76
LTE TDD 40	2.76

Table 92 Unlicensed 2.5G/5G Max Gain for RED (dBi)

Unlicensed 2.5G/5G Max Gain for RED (dBi)		
Band	Sub-band	SE250B4-EU
2.4G	2.400~2483.5MHz	3.757
5G	5150~5250MHz	2.475
	5250~5350MHz	1.879
	5470~5725MHz	2.122
	5725~5850MHz	1.672

Americas Approvals

USA FCC

FCC Certificates

The FCC Grants can be found here: https://www.fcc.gov/oet/ea/fccid

Applicable FCC and ISED Rules/Liste des Règles FCC et ISDE Applicables

Applicable FCC Rules

Table 93 List of applicable FCC rules

Model *Modèle*	Applicable FCC Rules
SE250B4-NA	47 CFR Part 2, 22, 24, 27, 90 Part 15.247, 15.407

FCC Regulatory Notices

This module is intended for OEM integrators only. Per FCC KDB 996369 D03 OEM Manual, the following conditions must be strictly followed when using this certified module.

Modification statement

Telit has not approved any changes or modifications to this device by the user.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Interference statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

RF exposure considerations

This equipment complies with FCC mobile radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.

5G Operation restriction

Operations in the 5.15-5.25GHz band are restricted to indoor usage only. This device meets all the other requirements specified in Part 15E, Section 15.407 of the FCC Rules.

FCC Class B digital device notice

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 taking one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into 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.

Information for the OEMs and Integrators

1. This device is intended for OEM integrators only.
2. Please see the full Grant of Equipment document for other restrictions

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment.

The final host product must comply with the requirements specified in §15.203, §15.204(b) and §15.204(c).

Manual Information to the End User

The OEM integrator should be aware not to provide information to the end user on how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warming as shown in this manual

Information on test modes and additional testing requirement

The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) or being used in a portable condition will need a separate reassessment through a class II permissive change application or new certification.

If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093.

Limited module procedures

Not applicable.

Trace antenna designs

Please, refer to Section 8 of this document for antenna connector trace layout design and to the Gerber files attached to this document. Note that only the unique antenna connectors as indicated in this manual can be used for all transmitter ports.

Any deviation(s) from the defined parameters of the trace layout to antenna connector(s), as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Unique antenna connector

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only authorized by the FCC for the specific rule parts (for example, FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.

As long as all conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

EMI Considerations

Please follow the guidance provided for host manufacturers in KDB publications 996369 D02 and D04.

How to make changes

Only Grantees are permitted to make permissive changes. Please contact us should the host integrator expect the module to be used differently than as granted:

Grantee code: RI7
Grantee name: Telit Communications S.p.A.
Mailing address: Viale Stazione di Prosecco 5/b, 34010 Sgonico – Trieste, Italy
Website: https://www.telit.com/
Support contact: TS-EMEA@telit.com

FCC Antenna info

This radio transmitter has been approved by FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antennas of the same type with equal or lower gain may also be used with this module. Antennas having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device. The antenna must be installed such that 20 cm can be maintained between the antenna and users.

This radio module is sold without a specific antenna. Detailed electrical characteristics of the usable antenna are shown in Chapter 8.

For all transmitters (licensed and unlicensed), the final host product must comply with the requirements specified in §15.203, §15.204(b) and §15.204(c). As such, the host product must use a permanently attached antenna or an antenna that uses a unique coupling. The OEM integrator is responsible for using a unique external antenna connector in the host product, which must be selected from the types listed below.

List of unique antenna connectors

RP-SMA

Table 94 FCC Antenna used for testing

Model	Antenna Type
SE250B4-NA	**4G:** Model: ZTX S50, Type: Monopole with SMA connector, 50ohm impedence **WiFi/Bluetooth® :** Model: ZTX TG2, Type: Monopole with RP SMA connector, 50ohm impedence

Table 95 Licensed 4G Max Gain for FCC (dBi)

Licensed 4G Max Gain for FCC (dBi)	
Band	SE250B4-NA
LTE FDD 2	2.16
LTE FDD 4	2.06
LTE FDD 5	2.31
LTE FDD 7	3.12
LTE FDD 12	1.47
LTE FDD 13	1.29
LTE FDD 14	1.47

LTE FDD 17	1.47
LTE FDD 25	2.16
LTE FDD 26	2.31
LTE FDD 66	2.06
LTE FDD 71	1.58
LTE TDD 41	2.83

Table 96 Unlicensed 2.5G/5G Max Gain for FCC (dBi)

Unlicensed 2.5G/5G Max Gain for FCC (dBi)		
Band	Sub-band	SE250B4-NA
2.4G	2.400~2483.5MHz	3.757
5G	5150~5250MHz	2.475
	5250~5350MHz	1.879
	5470~5725MHz	2.122
	5725~5850MHz	1.672

The host product is required to include an antenna which complies with the requirements specified within these integration instructions.

FCC Labelling Requirements for the Host Device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the FCC ID of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as in the below table.

The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Table 97: Host device FCC Label

Model	FCC ID
SE250B4-NA	Contains FCC ID: RI7SE250B4

Canada ISED

ISED Database

The product ISED certified can be found here:

Le certificat ISDE est disponible ici:

https://sms-sgs.ic.gc.ca/equipmentSearch/searchRadioEquipments?execution=e1s1&lang=en

Applicable ISED Rules / Liste des Règles ISDE Applicables

Table 98 Applicable ISED rules / *Règles ISDE applicables*

Model *Modèle*	Applicable ISED Rules *Règles ISDE applicables*
SE250B4-NA	RSS-130 Issue 2, RSS-132 Issue 4, RSS-133 Issue 6, RSS-139 Issue 4, RSS-140 Issue 1, RSS-199 Issue 4; RSS-247 Issue 3, RSS-Gen Issue 5, RSS-102 Issue 5

ISED Regulatory notices / Avis réglementaires de ISDE

Modification statement / *Déclaration de modification*

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Telit n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

Interference statement / *Déclaration d'interférence*

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Wireless notice / *Wireless avis*

This device complies with ISED radiation exposure limits set forth for an uncontrolled environment and meets the RSS-102 of the ISED radio frequency (RF) Exposure rules. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body.

Le présent appareil est conforme à l'exposition aux radiations ISDE définies pour un environnement non contrôlé et répond aux directives d'exposition de RSS-102 de la

fréquence radio (RF) ISED règles d'exposition. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur. L'antenne doit être installée de façon à garder une distance minimale de 20 centimètres entre la source de rayonnements et votre corps.

Caution / *Avertissement* :

(i) the device for operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

(ii) for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit; (detachable antenna only)

(iii) for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be such that the equipment still complies with the e.i.r.p. limits as appropriate; (detachable antenna only)

(iv) where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth in section 6.2.2.3 shall be clearly indicated.

Le guide d'utilisation des dispositifs pour réseaux locaux doit inclure des instructions précises sur les restrictions susmentionnées, notamment :

(i) les dispositifs fonctionnant dans la bande 5150-5250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux;

(ii) pour les dispositifs munis d'antennes amovibles, le gain maximal d'antenne permis pour les dispositifs utilisant les bandes de 5 250 à 5 350 MHz et de 5 470 à 5 725 MHz doit être conforme à la limite de la p.i.r.e; (detachable antenna only)

(iii) pour les dispositifs munis d'antennes amovibles, le gain maximal d'antenne permis (pour les dispositifs utilisant la bande de 5 725 à 5 850 MHz) doit être conforme à la limite de la p.i.r.e. spécifiée, selon le cas; (detachable antenna only)

(iv) lorsqu'il y a lieu, les types d'antennes (s'il y en a plusieurs), les numéros de modèle de l'antenne et les pires angles d'inclinaison nécessaires pour rester conforme à l'exigence de la p.i.r.e. applicable au masque d'élévation, énoncée à la section 6.2.2.3, doivent être clairement indiqués

Information for the OEMs and Integrators / *Informations pour les OEM et les intégrateurs*

This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed and operated with greater than 20cm between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1) L'antenne doit être installé et exploité avec plus de 20 cm entre l'antenne et les utilisateurs, et (if EUT is portable device, please delete this item)

2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

IMPORTANT NOTE / *NOTE IMPORTANTE:*

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

ISED Antenna info / *Informations sur l'antenne d'ISDE*

This radio transmitter has been approved by ISED to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device. This transmitter module is authorized only for use in device where the antenna may be installed and operated with greater than 20cm between the antenna and users.

Le présent émetteur radio a été approuvé par ISDE pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur. Ce module émetteur est autorisé uniquement pour

une utilisation dans un appareil où l'antenne peut être installée et utilisée à plus de 20 cm entre l'antenne et les utilisateurs.

This radio module is sold without a specific antenna. Detailed electrical characteristics of the usable antenna are shown in Chapter 8.

Ce module radio est vendu sans antenne spécifique. Les caractéristiques électriques détaillées de l'antenne utilisable sont présentées au chapitre 8.

Table 99 ISED Antenna used for testing

Model *Modèle*	Antenna Type *Type d'Antenne*
SE250B4-NA	**4G:** Model: ZTX S50, Type: Monopole with SMA connector, 50ohm impedence **WiFi/Bluetooth® :** Model: ZTX TG2, Type: Monopole with RP SMA connector, 50ohm impedence

Table 100 2G/3G/4G Max Gain for ISED (dBi) / *2G/3G/4G Gain maximum pour ISDE (dBi)*

Licensed 4G Max Gain for ISED (dBi) *4G Gain maximum pour ISDE (dBi)*	
Band	SE250B4-NA
LTE FDD 2	2.16
LTE FDD 4	2.06
LTE FDD 5	2.31
LTE FDD 7	3.12
LTE FDD 12	1.47
LTE FDD 13	1.29
LTE FDD 14	1.47
LTE FDD 17	1.47
LTE FDD 25	2.16
LTE FDD 66	2.06
LTE FDD 71	1.58
LTE TDD 41	2.83

Table 101 Unlicensed 2.5G/5G Max Gain for ISED (dBi) / *Sans licence 2.5G/5G Gain maximum pour ISDE (dBi)*

Unlicensed 2.5G/5G Max Gain for ISED (dBi) *Sans licence 2.5G/5G Gain maximum pour ISDE (dBi)*		
Band	Sub-band	SE250B4-NA
2.4G	2.400~2483.5MHz	3.757
5G	5150~5250MHz	2.475
	5250~5350MHz	1.879
	5470~5725MHz	2.122
	5725~5850MHz	1.672

ISED Label and compliance information / *ISDE Étiquette et informations de conformité*

The host product shall be properly labelled to identify the modules within the host product.

The ISED certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the ISED certification number for the module, preceded by the word "contains" or similar wording expressing the same meaning, as follows:

Contains IC: XXXXXX-YYYYYYYYYY

In this case, XXXXXX-YYYYYYYYYY is the module's certification number.

Le produit hôte devra être correctement étiqueté, de façon à permettre l'identification des modules qui s'y trouvent.

L'étiquette d'homologation d'un module d'ISDE devra être apposée sur le produit hôte à un endroit bien en vue, en tout temps. En l'absence d'étiquette, le produit hôte doit porter une étiquette sur laquelle figure le numéro d'homologation du module d'ISDE, précédé du mot « contient », ou d'une formulation similaire allant dans le même sens et qui va comme suit :

Contient IC : XXXXXX-YYYYYYYYYY

Dans ce cas, XXXXXX-YYYYYYYYYY est le numéro d'homologation du module.

Table 102: Host device ISED Label / *Étiquette ISED du périphérique hôte*

Model / *Modèle*	IC ID
SE250B4-NA	Contains IC: 5131A- SE250B4 *Contient des IC: 5131A-SE250B4*

RoHS and REACH info

RoHS info

Any requests on information related to RoHS certifications can be addressed to *Chemical.Certifications@telit.com.*

REACH info

Any requests on information related to REACH certifications can be addressed to *Chemical.Certifications@telit.com.*

14. Acronyms and Abbreviations

Table 103: Acronyms and Abbreviations

Acronym	Definition
TTSC	Telit Technical Support Centre
USB	Universal Serial Bus
HS	High Speed
DTE	Data Terminal Equipment
UMTS	Universal Mobile Telecommunication System
WCDMA	Wideband Code Division Multiple Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
UART	Universal Asynchronous Receiver Transmitter
HSIC	High Speed Inter Chip
SIM	Subscriber Identification Module
SPI	Serial Peripheral Interface
ADC	Analog – Digital Converter
DAC	Digital – Analog Converter
I/O	Input Output
GPIO	General Purpose Input Output
CMOS	Complementary Metal – Oxide Semiconductor
MOSI	Master Output – Slave Input
MISO	Master Input – Slave Output
CLK	Clock
MRDY	Master Ready
SRDY	Slave Ready
CS	Chip Select
RTC	Real Time Clock
PCB	Printed Circuit Board
ESR	Equivalent Series Resistance
VSWR	Voltage Standing Wave Radio
VNA	Vector Network Analyzer

15. Related Documents

Refer to https://dz.telit.com/ for current documentation and downloads.

Table 104: Related Documents

S.no	Book Code	Document Title
1	1VV0301822	SE250B4 Smart EVB User Guide
2	1VV0301823	SE250B4 SDK User Guide

16. Document History

Table 105: Document History

Revision	Date	Changes
0	2023-05-23	Template Update
1	2023-05-15	First issue
2	2023-08-07	Release to Downloadzone
3	2024-02-07	Added Current Consumption table (table 27), added conformity assessment section