AN13804

SLN-VIZNLC-IOT Power Consumption Features

Rev. 0 — 24 March 2023 Application note

Document information

Information	Content
Keywords	SLN-VIZNLC-IOT, RT106F, Smart Lock, Smart Access
Abstract	This application note provides the NXP MCU-based SLN-VIZNLC-IOT power consumption features

1 Introduction

This application note provides the NXP MCU-based SLN-VIZNLC-IOT solutions with fully integrated, self-contained software and hardware. This feature includes the i.MX RT106F and pre-integrated machine-learning face-recognition algorithms that are provided in the NXP i.MX RT runtime library, as well as all required drivers for peripherals, such as camera, Liquid-Crystal Display (LCD), and memory.

This application note also provides power consumption details when running NXP demonstration software on SLN-VIZNLC-IOT hardware.

The typical current consumption data splits the system into eight major contributors:

- LPC845, including PIR section
- i.MXRT106F
- Synchronous Dynamic Random Access Memory (SDRAM)
- Quad Serial Peripheral Interface (QSPI) flash
- Camera
- LCD
- Bluetooth Low Energy (BLE)
- Additional contributors include Infrared (IR) and white LEDs, an audio section, an Input/Output (I/O) expander, a power section, and more

For more details, see Figure 1.

Summary:

- The Low-power mode is only supplied for Passive Infrared (PIR) sensor and LPC845. The LPC845 is set in Deep power-down mode. The average current drawn from the 5 V supply is typically 220 µA. The main contributors are as follows:
  - PIR sensor - 20 µA
  - LPC845 < 1 µA
  - Low-Dropout (LDO) quiescent current - 200 µA, for more details on LDO, see Table 2
- In Normal mode, PIR sensor detects the live body, wake-up LPC845, and then LPC845 controls the power-on of the RT106F system and peripheral interfaces such as camera, LCD, BLE, Wi-Fi, and Audio. The average current drawn from the 5 V supply is typically 303 mA, equivalent to an average of 1.525 W. In that configuration, the main contributors are as follows:
  - i.MX RT106F - 90 mA
  - SDRAM - 15.75 mA
  - QSPI Flash -12 mA
  - LCD - 113.5 mA
  - Camera - 55.8 mA
  - BLE 1.9 - mA

  While the other combined current consumption is use 8.5 mA.

Figure 1. MCU SLN-VIZNLC-IOT

2 SLN-VIZNLC-IOT hardware description

Figure 2 shows the hardware block diagram of MCU SLN-VIZNLC-IOT.

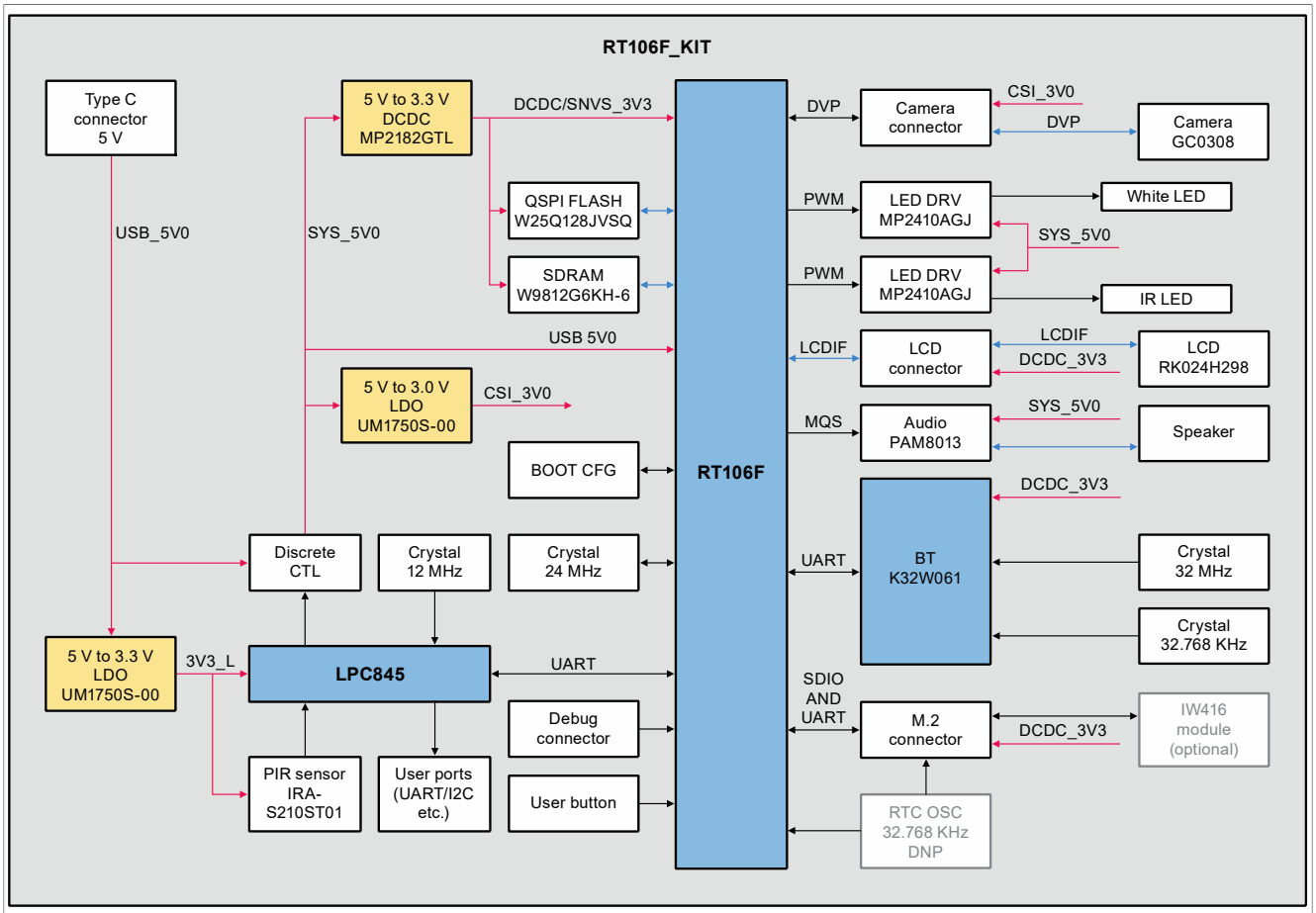

Figure 2. MCU SLN-VIZNLC-IOT hardware block diagram

3 Power supply section

The platform is supplied with a +5 V DC input via a USB-Type C connector `J1`. For more details on power supplies, see Table 1.

`USB_5V` is down-converted to 3.3 V to power-on the LPC845 and PIR sensor; when the PIR sensor detects a live body, it wakes up the LPC845. The LPC845 controls the power-on of `SYS_5V0`, and `SYS_5V0` is down-converted to 3.3 V using a DC-to-DC buck converter and to 3.0 V using a low drop-out linear regulator.

Table 1. Power supplies of main components

Main component	Description	Supply voltage	Note
LPC845	Low-power MCU	+3.3 V	-
IRA-S210ST01	PIR + signal conditioning	+3.3 V	Motion detection Can be used as a wake-up source
iMXRT106F	MCU	+3.3 V	Supply to the embedded DC-to-DC converter, to the peripherals, and so on
		+5 V	Supply to the USB interface
W25Q128JVSIQ	SPI Flash	+3.3 V	-
W9812G6KH-6I	SDRAM	+3.3 V	-

Table 1. Power supplies of main components...*continued*

Main component	Description	Supply voltage	Note
GC03-0CCM-D1	Camera	+3.0 V	-
RK024HH298	LCD	+3.3 V	-
EAR00385	1XK M.2 Module	+3.3 V	Not enabled in this test
PAM8013	Audio amplifier	+5 V	-

4 Current consumption test setup

Figure 3 shows the details on how power consumption is measured.

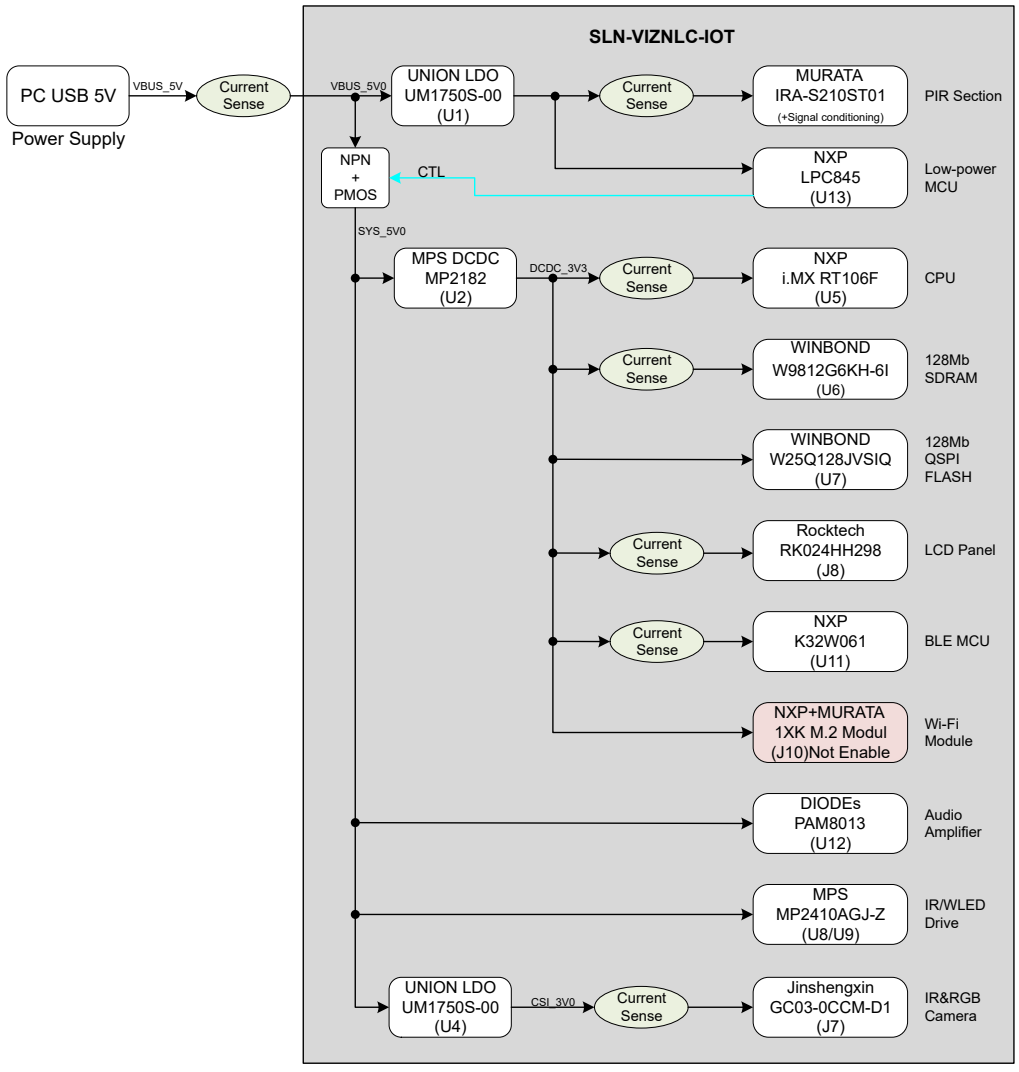

Figure 3. Current sensing on SLN-VIZN-IOT

Note: *The hardware must be modified to get the current measurements, see Section 6.*

Note: *The current contributions are measured using Keysight DSO9254A (Oscilloscope) together with the associated current probe N2820A+N2824A and Fluke 17 B+ (Multimeter).*

5 Current consumption data

Two application scenes were evaluated:

1. Low-power mode: PIR sensor and its signal conditioning circuit are supplied, but the PIR sensor does not detect the live body. The LPC845 runs in Deep power-down mode, its functional pins are set in 3-state except for the `WAKEUP` pin.
2. Normal mode: PIR sensor detects live body and wake-up LPC845, LPC845 controls the power-on of the whole system.

5.1 Summary

Table 2 shows the current consumption from the +5 V supply, the +3.3 V line (after LDO or DC-to-DC buck regulator), or the 3.0 V line (after LDO).

Table 2. Current consumption

Operating mode	Section	On +5 V supply		On +3.3 V supply		On +3.0 V supply	
		Average current (mA)	Average Power (mW)	Average current (mA)	Average power (mW)	Average current (mA)	Average Power (mW)
Low-power mode	LDO (U1)	0.19[1]	0.95[1]	0.009[1]	N/A[1]	N/A	N/A
	LPC845	0.001[1]	0.099[1]	0.001[1]	N/A[1]	N/A	N/A
	PIR Sensor	0.02[2]	1.0	0.02[2]	0.066	-	-
	Total	0.22[2]	1.1	0.03[2]	0.099	N/A	N/A
Normal mode	LPC845	5.48[1]	27.4[1]	5.48[1]	18.1[1]	N/A	N/A
	PIR Sensor	0.02[1]	0.1[1]	0.02[2]	0.07	N/A	N/A
	i.MXRT106F	90[1]	450[1]	120[2]	396	N/A	N/A
	SDRAM	15.75[1]	78.75[1]	21[2]	69.3	N/A	N/A
	QSPI FLASH	12[1]	60[1]	16[2]	52.8[1]	-	-
	RGB Camera	27.2[1]	136[1]	n.a	n.a	27.2[2]	81.6
	IR Camera	28.6[1]	143[1]	n.a	n.a	28.6[2]	85.8
	LCD Interface	5.49[1]	27.5[1]	7.32[2]	24.2	N/A	N/A
	LCD backlight	108[1]	540[1]	144[2]	475.2	N/A	N/A
	BLE	1.93[1]	9.67[1]	2.58[2]	8.5	N/A	N/A
	Others[3]	8.5[1]	42.6[1]	N/A	N/A	N/A	N/A
	Total	303[2]	1515	311[1]	1026[1]	55.8[1]	167[1]

[1] Estimated currents either based on the datasheets or calculation, assuming that the DC-to-DC buck regulator has a power efficiency of 88 % at 300 mA
[2] Actual test data
[3] The power consumption is smaller in the Low-power mode while using a new LDO with ultra-low quiescent current.

Note: *LPC845 current is about 1 µA in Deep power-down mode and about 5.4 mA when active.*

Note: *Decrease MCU frequency to 528 MHz or even lower would allow significantly reduce the total power consumption. The impact on the inference time (not reported in this document) must be evaluated.*

5.2 PIR signal conditioning circuit and LPC845

Figure 4 shows the +3.3 V current consumption of PIR+LPC845 – running all software.

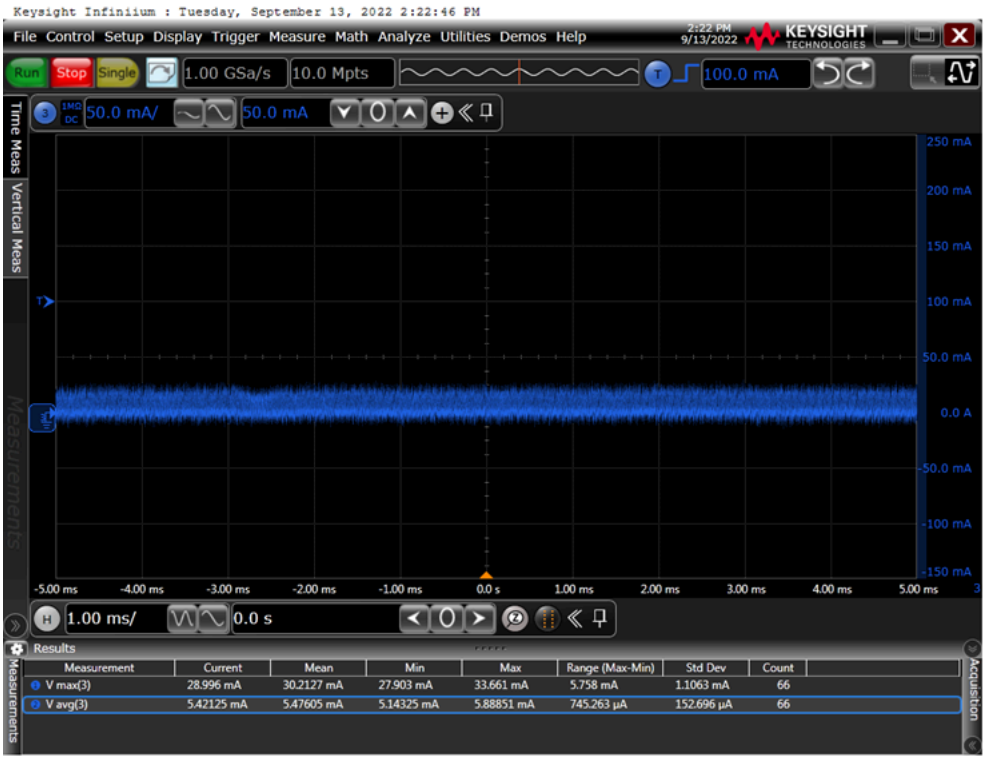

Figure 4. +3.3 V current consumption of PIR+LPC845 – running all software

5.3 i.MX RT106F

Figure 5 shows the +3.3 V current consumption of i.MXRT106F – running all software.

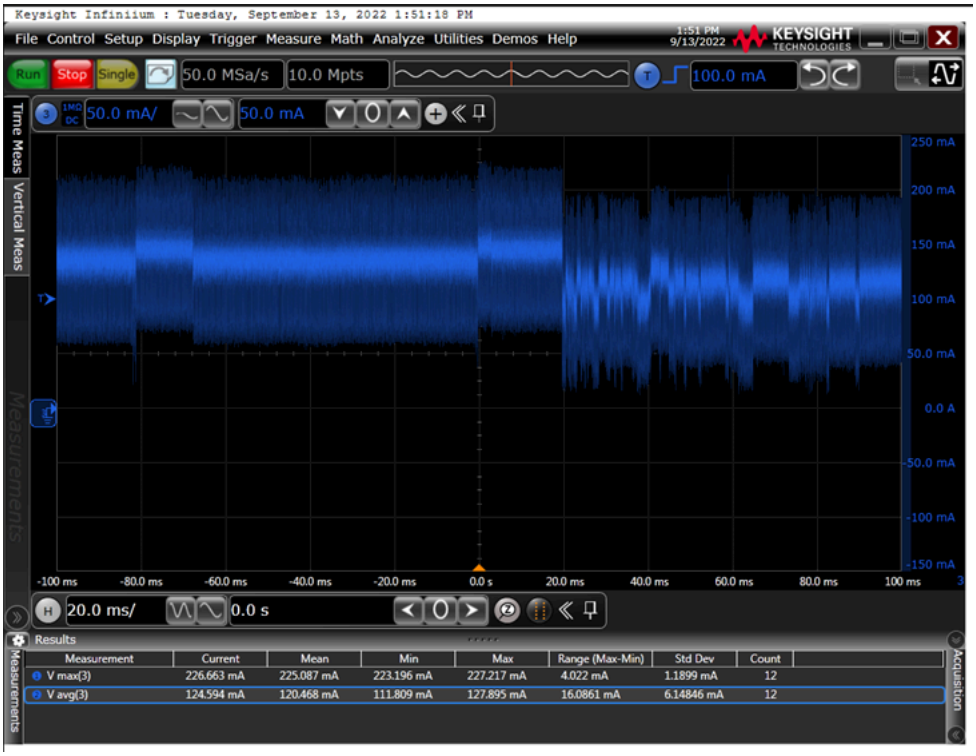

Figure 5. +3.3 V current consumption of i.MXRT106F – running all software

5.4 SDRAM

Figure 6 shows the +3.3 V current consumption of SDRAM – running all software.

Figure 6. +3.3 V current consumption of SDRAM – running all software

5.5 SLN-VIZN-IOT kit

Figure 7 shows the +5 V current consumption of SLN-VIZN-IOT kit – running all software.

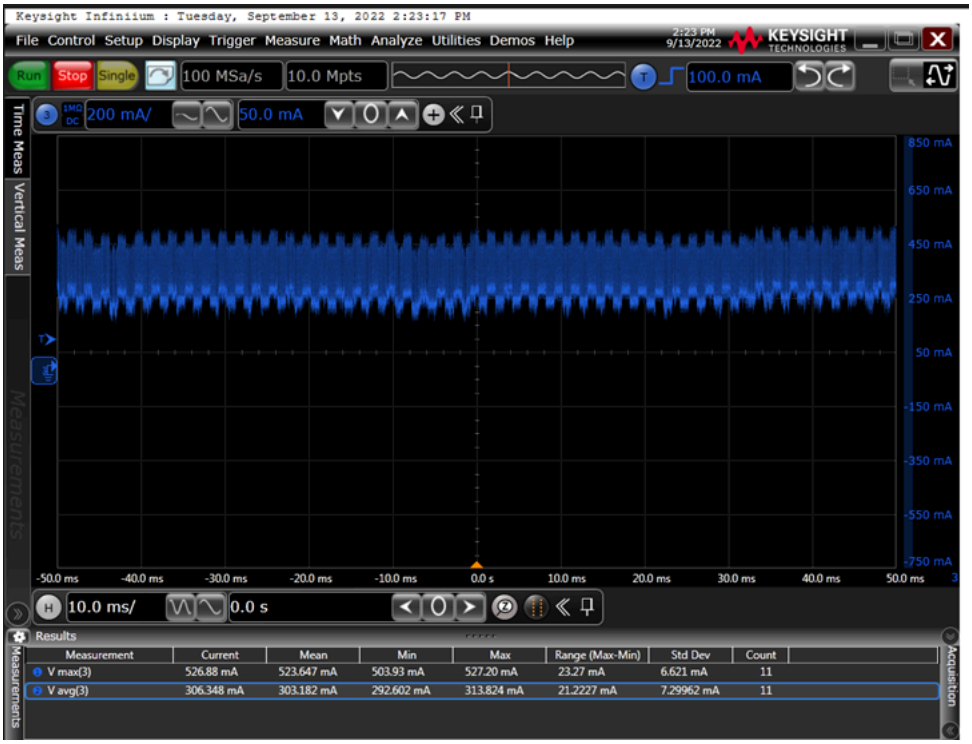

Figure 7. +5 V current consumption of SLN-VIZN-IOT kit – running all software

6 Hardware modifications for current consumption measurements

Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, and Figure 13 shows the changes made to the reference schematic to enable the current measurements.

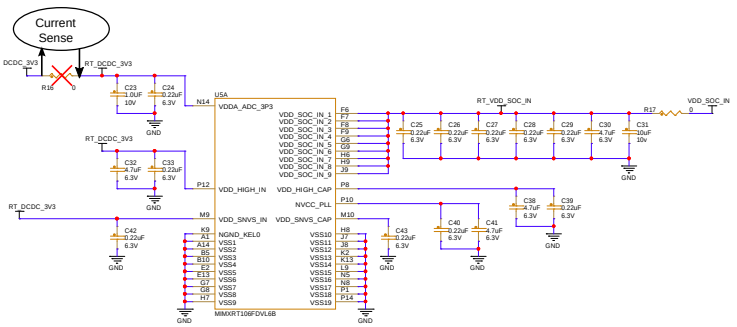

Figure 8. i.MXRT106F section, modification to measure current

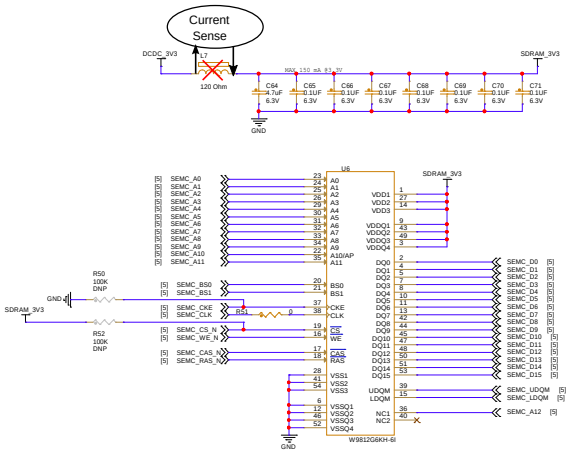

Figure 9. SDRAM section, modification to measure current

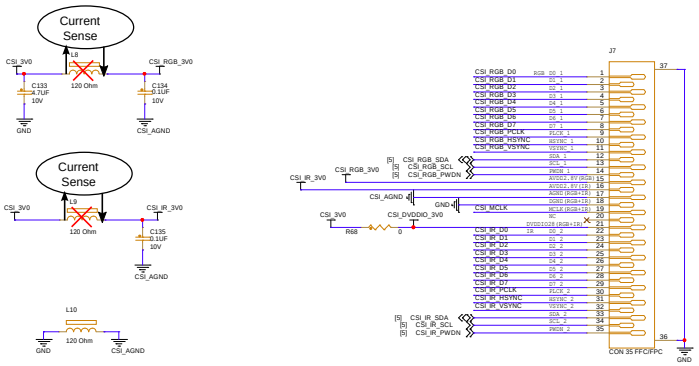

Figure 10. Camera section, modification to measure current

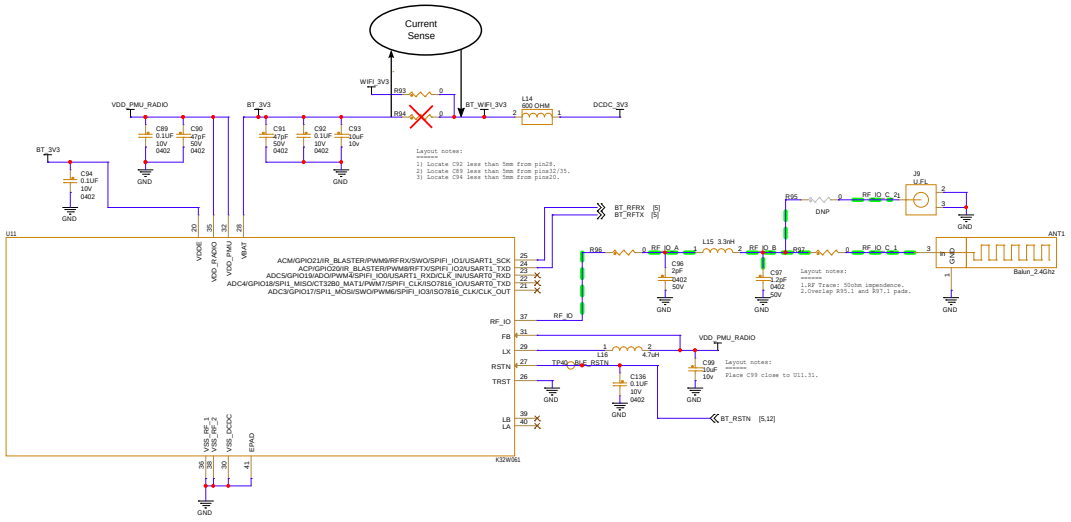

Figure 11. BLE section, modification to measure current

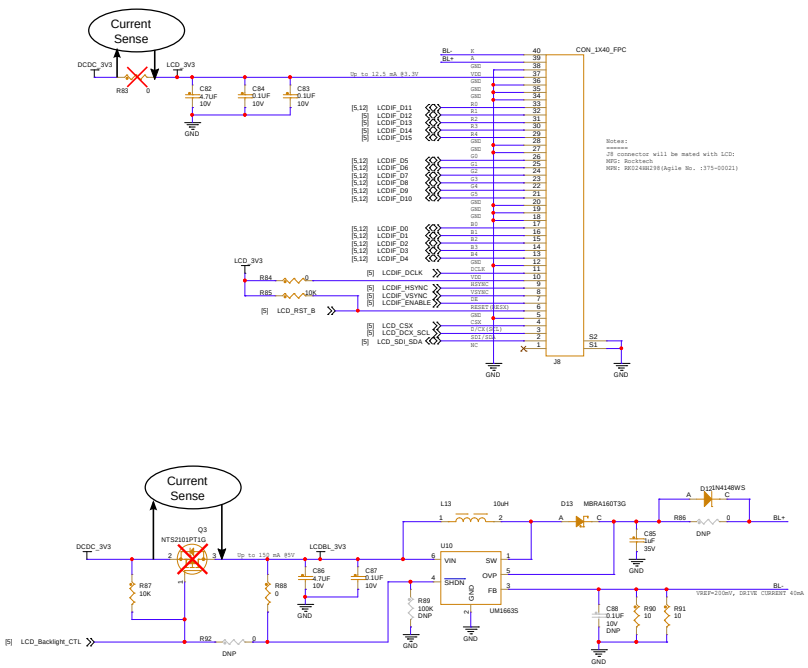

Figure 12. LCD section, modification to measure current

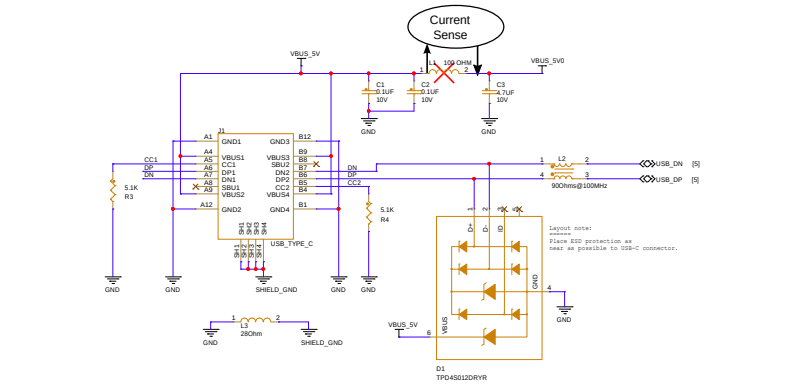

Figure 13. Whole board, modification to measure current

Note: *Modify the (Universal Serial Bus) USB cable and keep the multimeter or probes in series to the power line of the USB cable. It is easy to measure the current of the whole board.*

7 References

- NXP EdgeReady MCU-Based Solution for Face Recognition with Liveness Detection

8 Revision history

Table 3 summarizes the changes done to this document since the initial release.

Table 3. Revision history

Revision number	Date	Substantive changes
0	24 March 2023	Initial release

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