NXP Semiconductors

Technical Note

Document Number:
SLN-LOCAL-IOT-POWER-CONSUMPTION

Rev. 1.0, 09/2019

MCU Local Voice Solution Technical Note

Contents

1. Introduction 3
2. SLN-LOCAL-IOT hardware description 4
3. Power Supply section 4
4. Current consumption test setup 5
5. Current consumption data 6
   5.1. iMXRT106L + Hyperflash + Microphones 7
   5.2. Class-D amplifier section 8
6. Annex – HW & SW versions 9
7. Annex – HW modifications for current consumption measurements 9

DOCUMENT DETAILS 11
   3.1. Revision History 11
   3.2. References 11
   3.3. Definitions 11
   3.4. Acronyms & Abbreviations 11

© 2019

NXP B.V.

1. Introduction

NXP SLN-LOCAL-IOT development kit is a comprehensive, secure and cost optimized voice control solution with a widely adopted development environment that enables customers to quickly get to market with a production ready end-to-end software application.

SLN-LOCAL-IOT embeds all the components required to produce a local voice commands solution. It is based on the i.MXRT106L microcontroller powered by an ARM® Cortex®-M7 core.

The present note provides power consumption figures when running NXP demonstration software (local_commands_demo) on SLN-LOCAL-IOT hardware. The note highlights typical current consumption data splitting the system into 2 major contributors:

1. iMXRT106L + hyperflash memory + microphones
2. TFA9894D Class-D audio amplifier with its DC to DC converter.

In summary:

- When the platform is waiting for “Hey NXP” local wake word, the average current drawn from the +5V supply is typically 142mA. This is equivalent to an **average of 0.71W**.
- The peak current consumption is observed when the device answers to a local command. The peak is always very brief. The highest peak current was observed at 466mA. Which is equivalent to a **peak power of 2.3W**.

2. SLN-LOCAL-IOT hardware description

Figure 1 details SLN-LOCAL-IOT hardware architecture.

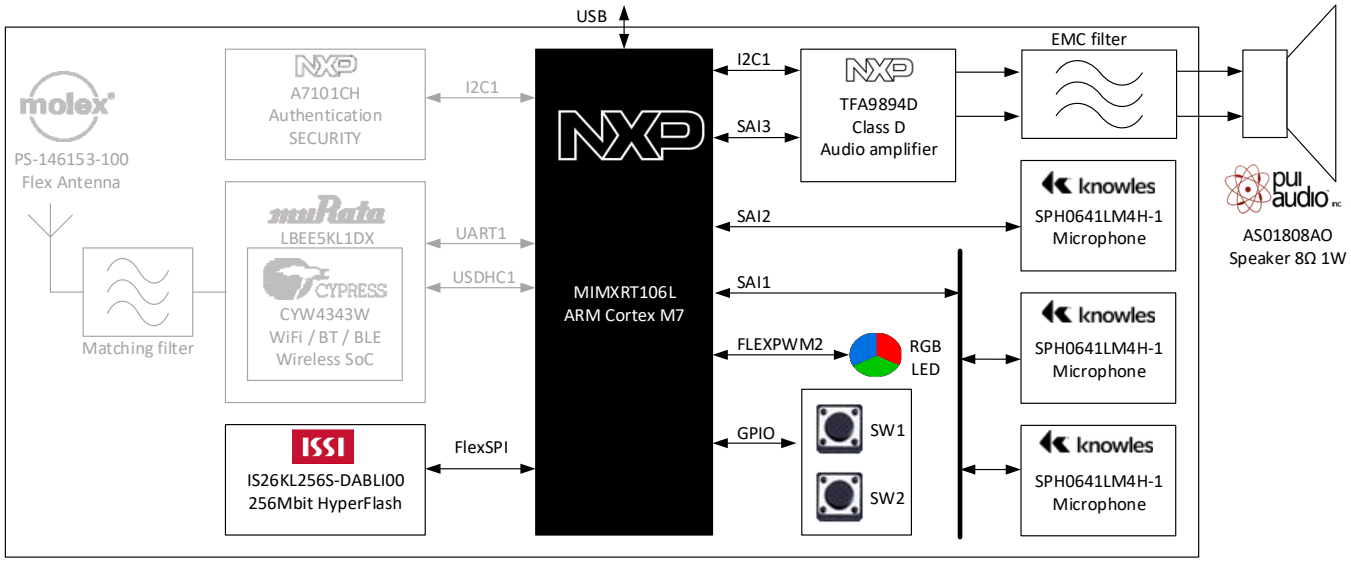

Figure 1. MCU Local Voice hardware block diagram

Note: greyed components are not used in this solution. Although they are present on this HW, their functionality is not used for voice local commands.

3. Power Supply section

The platform is supplied with a +5V DC input, typically delivered via an USB type C connector.
To power the various sections of the platform the +5V is down-converted to +3.3V using a DCDC buck converter and to +1.8V using a Low Drop Out Linear regulator.

Main component	Description	Supply voltage	Note
iMXRT106L	MCU	+3.3V	Supply to the embedded DCDC converter, to the peripherals, etc…
		+5V	Supply to the USB interface
LBEEKL1DX	WLAN module	+3.3V	Not enabled in this test
IS26KL256S	Hyperflash memory	+3.3V	
A7101CH	Authentication	+3.3V	Not enabled in this test
SPH0641LM4H	PDM microphone	+3.3V	
TFA9894D	Audio amplifier	+5V	Supply to DCDC boost converter and class-D amplifier
		+3.3V	Supply for the digital interface to iMXRT
		+1.8V	Supply for the audio DSP

Table 1. Power supplies of the main components.

4. Current consumption test setup

The diagram below details how the 2 power consumption contributors are measured.

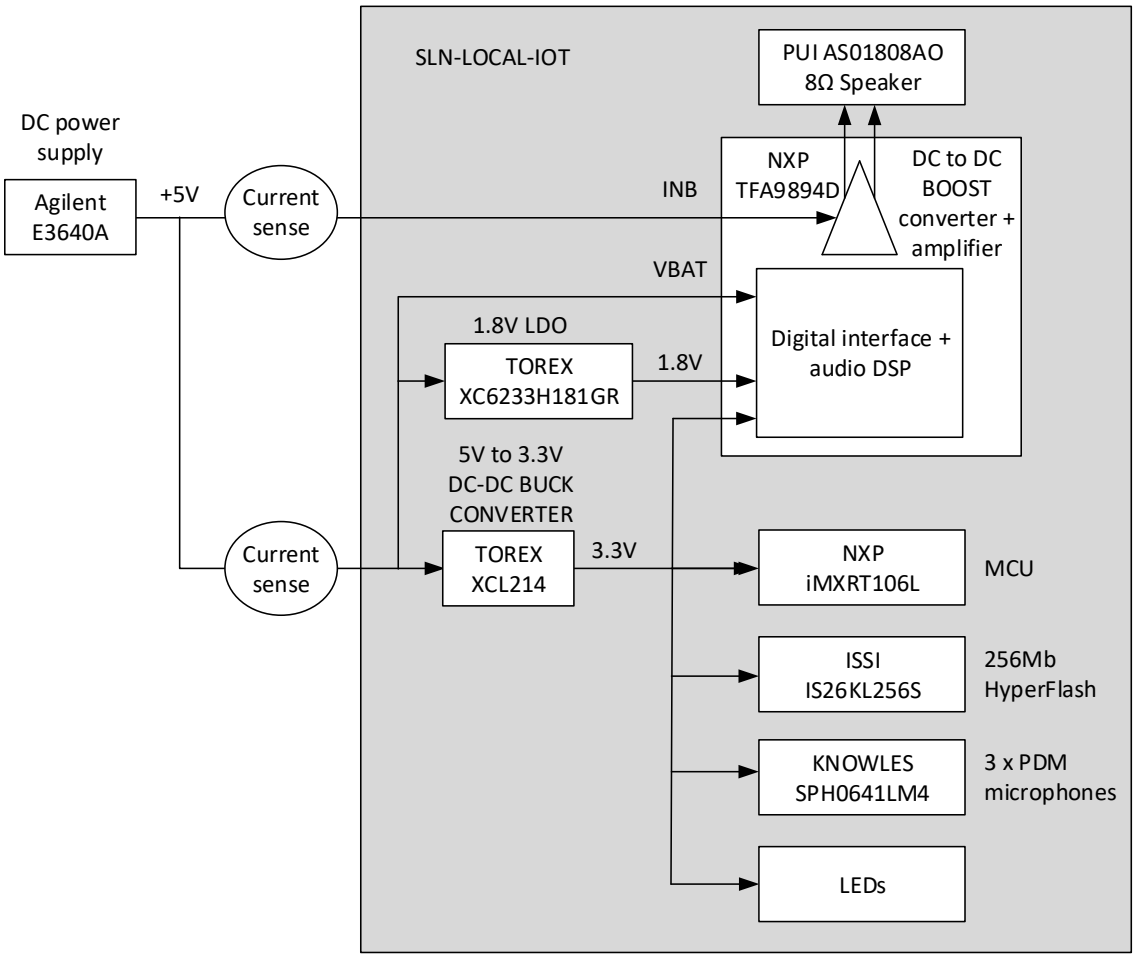

Figure 2. Current Sensing on SLN-LOCAL-IOT

Notes:

- The HW needs to be modified to allow the current measurements. Cf. Annex – HW modifications for current consumption measurements).
- The current contributions are measured using Keysight CX332A (Device Current Waveform Analyzer) together with the associated current probe CX1101A.

PCB	Description	Version
SPF-SOL0001	iMXRT106L connected module	C2
SPF-SOL0002	Voice control board	C

Table 2. HW revision

Application	Version
Local_commands_demo	Alpha 0.3

Table 3. SW revision

5. Current consumption data

In the following measurement results, 2 situations were evaluated:

a. Waiting for “hey NXP” wake word,
b. Answering to the command with an audio output volume set to the maximum.

The table shows the current consumption from the +5V supply.

		On +5V supply	
Operating mode	section	Average current (mA)	Maximum current (mA)
Waiting for “hey NXP” wake word	iMXRT106L + Hyperflash + microphones	141.6	209.5
	Class-D audio amplifier	0.2	-
Answering to the command with max audio output volume	iMXRT106L + Hyperflash + microphones	141.6	209.5
	Class-D audio amplifier saying “sorry…”	47.7	256.3

Table 4. Current consumption figures

Note:
The current delivered by the audio amplifier depends on the output volume but also on the audio content, the more stressful captured sample corresponds to the sentence “sorry…”.

5.1. iMXRT106L + Hyperflash + Microphones

Figure 3. +5V Current consumption of iMXRT106L + Hyperflash + Microphones – Waiting for "hey NXP" wake word - large time window.

Figure 4. +5V Current consumption of iMXRT106L + Hyperflash + Microphones – Waiting for "hey NXP" wake word – zoom.

5.2. Class-D amplifier section

Remark: the current consumption is measured on the +5V supply to TFA9894D INB pins. The current measurements highlight the behavior of the section driving the speaker.

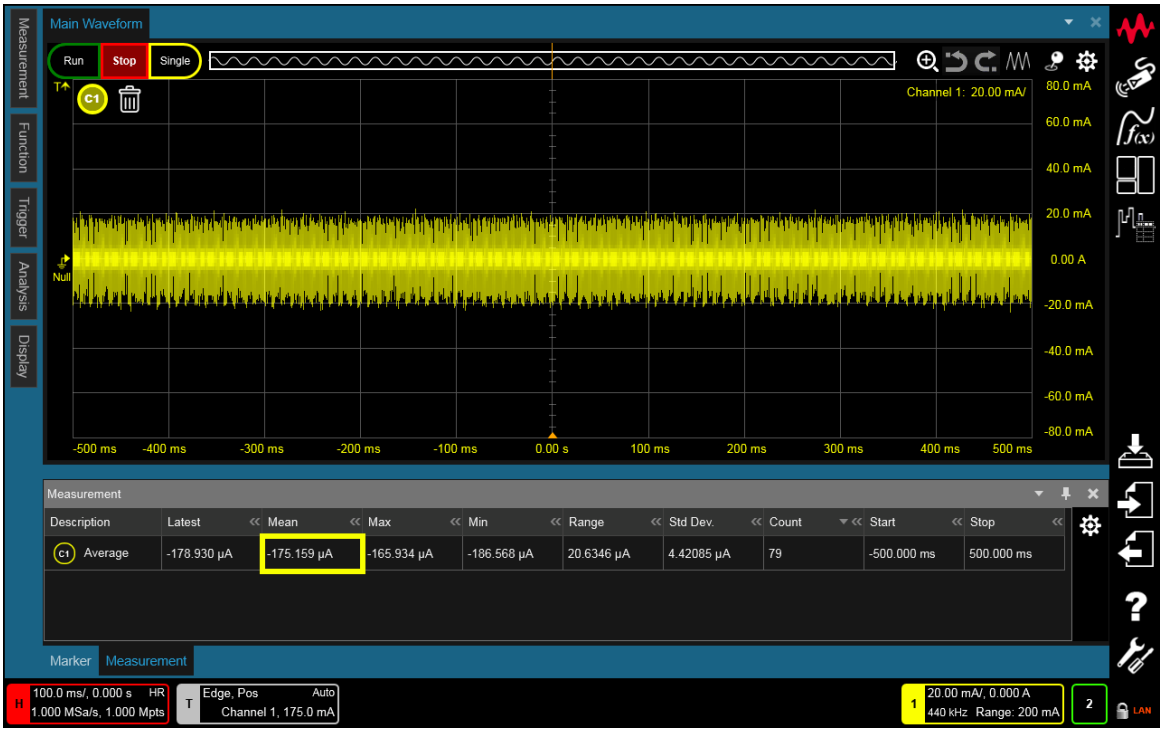

Figure 5. +5V Current consumption of Class-D audio amplifier – waiting for "hey NXP" wake word.

Figure 6. +5V Current consumption of Class-D audio amplifier – Saying "Sorry…", with max volume, zoom on the current peak.

6. Annex – HW & SW versions

PCB	Description	Version
SPF-SOL0001	iMXRT106L connected module	C2
SPF-SOL0002	Voice Control Board	C

Table 5. HW revision.

Application	Version
Local_commands_demo	Alpha 0.3

Table 6. SW revision.

7. Annex – HW modifications for current consumption measurements

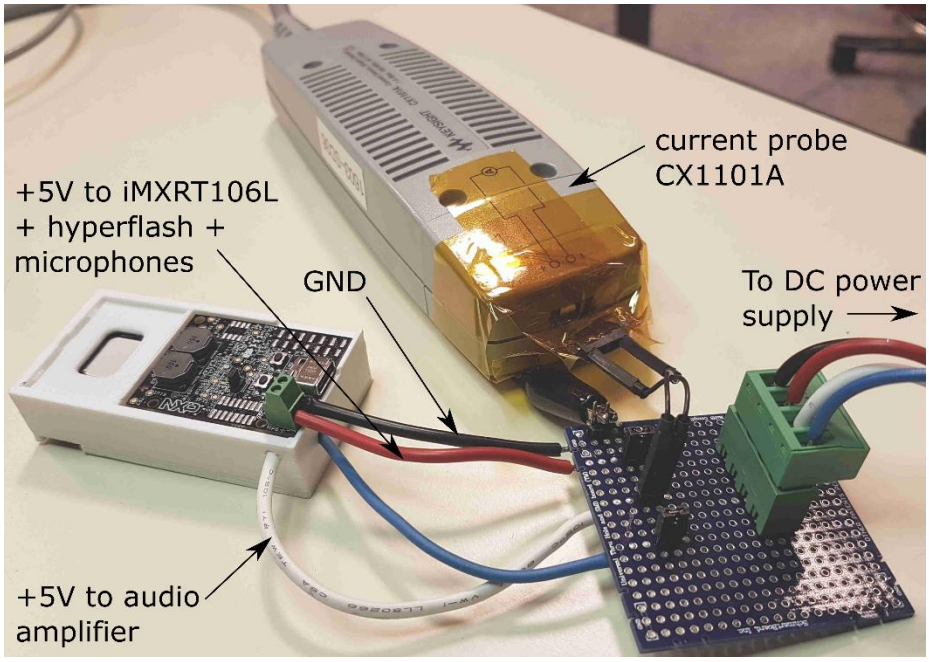

Figure 7. Test setup.

The following snapshots illustrate the changes made to the reference schematic to enable the current measurements. Note that to measure the current flowing into the audio amplifier section, the PCB needs a physical cut.

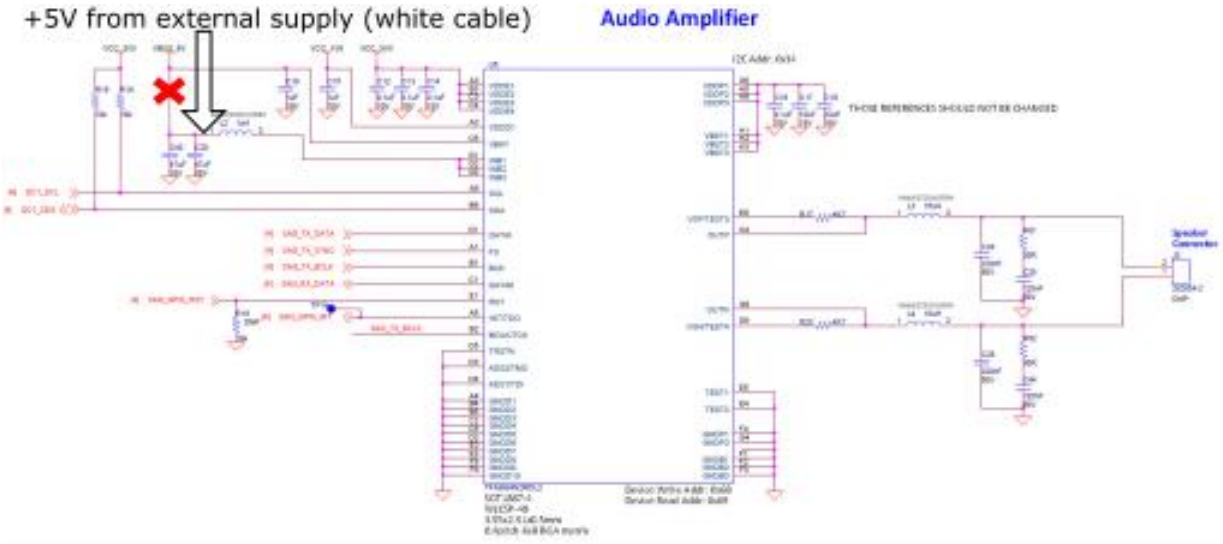

Figure 8. Audio amplifier section, modification to measure the current.

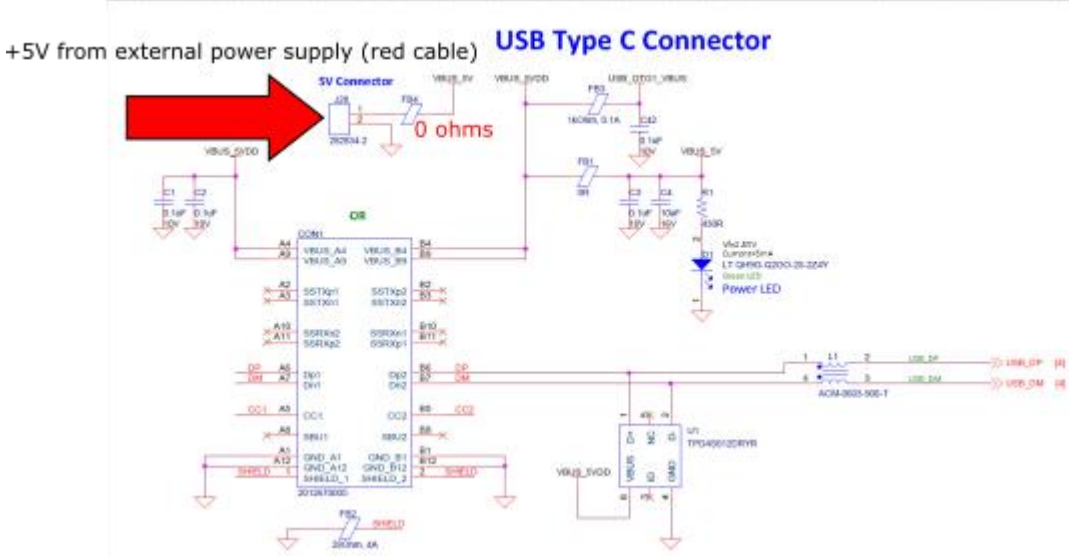

Figure 9. iMXRT + hyperflash + microphones section, modification to measure the current.

DOCUMENT DETAILS

3.1. Revision History

Date	Version	Details of change	Author	Reviewers
17-09-2019	Draft 1.0	Initial version based on local_commands_demo alpha 0.3	Jerome BRILLANT	

3.2. References

Document/Link	Remark
SPF_SOL0001_C2	Connected module schematic
SPF_SOL0002_C	Voice control board schematic

3.3. Definitions

Term	Definition

3.4. Acronyms & Abbreviations

Term	Definition

How to Reach Us:

Home Page:
www.nxp.com

Web Support:
www.nxp.com/support

Information in this document is provided solely to enable system and software implementers to use NXP products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits based on the information in this document. NXP reserves the right to make changes without further notice to any products herein.

NXP makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does NXP assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. “Typical” parameters that may be provided in NXP data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including “typicals,” must be validated for each customer application by customer’s technical experts. NXP does not convey any license under its patent rights nor the rights of others. NXP sells products pursuant to standard terms and conditions of sale, which can be found at the following address: www.nxp.com/SalesTermsandConditions.

NXP, the NXP logo, NXP SECURE CONNECTIONS FOR A SMARTER WORLD, Freescale, the Freescale logo are trademarks of NXP B.V. All other product or service names are the property of their respective owners. Arm, AMBA, Arm Powered, Artisan, Cortex, Jazelle, Keil, SecurCore, Thumb, TrustZone, and µVision are registered trademarks of Arm Limited (or its subsidiaries) in the EU and/or elsewhere. Arm7, Arm9, Arm11, big.LITTLE, CoreLink, CoreSight, DesignStart, Mali, Mbed, NEON, POP, Sensinode, Socrates, ULINK and Versatile are trademarks of Arm Limited (or its subsidiaries) in the EU and/or elsewhere. All rights reserved.

© 2018 NXP B.V.

Document Number: SLN-LOCAL-IOT-POWER-CONSUMPTION
Rev. 1.0
09/2019