

IA611 Xplained Pro Hardware User Guide

External Use

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This document describes the hardware implementation of the Knowles IA611 Xplained Pro Extension Kit (PN IA611-RDI-01). The extension kit is the IA611 Reference Design for IoT designed to be used with the Microchip SAM D21 Explained Pro MCU.

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Chapter 1: Introduction

The Knowles **IA611 Reference Design for IoT** is based on IA611 Smart Mic. The IA611 enables ultra-low power voice and event detection including voice UI supporting keywords and voice commands and acoustic event detection. To achieve low power and compact design, it is designed to be implemented with a readily available MCU board. The implementation discussed in this guide is the **IA611 Xplained Pro** development board designed to be used with the Microchip SAM D21 Explained Pro MCU.

1.1 Document Scope

The IA611 Xplained Pro Hardware User Guide explains the architecture and design of the IA611 Xplained Pro development board.

1.2 Overview

The IA611 Smart Mic is a digital top port MEMS microphone with an integrated DSP for audio processing and low power voice detection/wake.



Figure 1 The IA611 Digital Smart Microphone

The IA611 Smart Mic on the Xplained Pro Extension board will be always listening for wake words and commands. Upon detection of correct keywords, the IA611 will send an interrupt to the MCU using P5 / UART_Tx (Pin 15 TX on the Level Shifter) as IRQ, interrupt to host to signal a wake word detection. The MCU will then wake up from power saving mode and take actions according to interrupt information received.

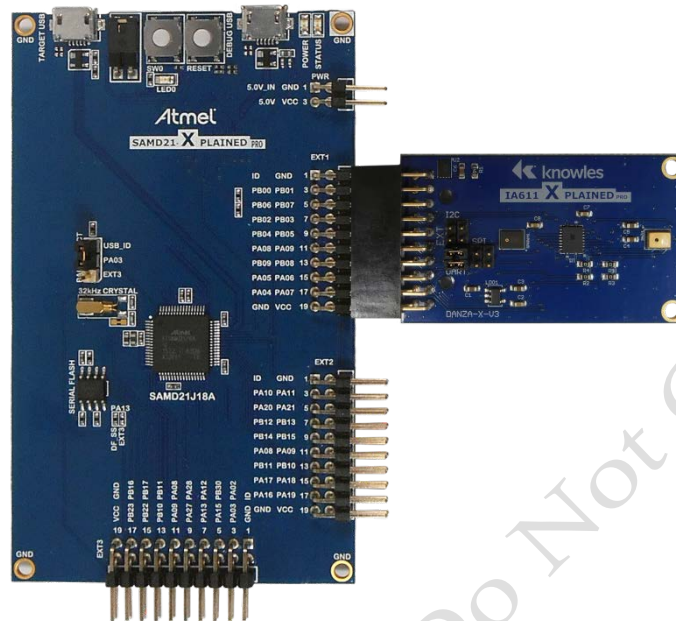


Figure 2 IA611 Xplained Pro Connected to SAM D21 Xplained Pro Development Board.

1.3 Product Overview

1.3.1 Hardware Components

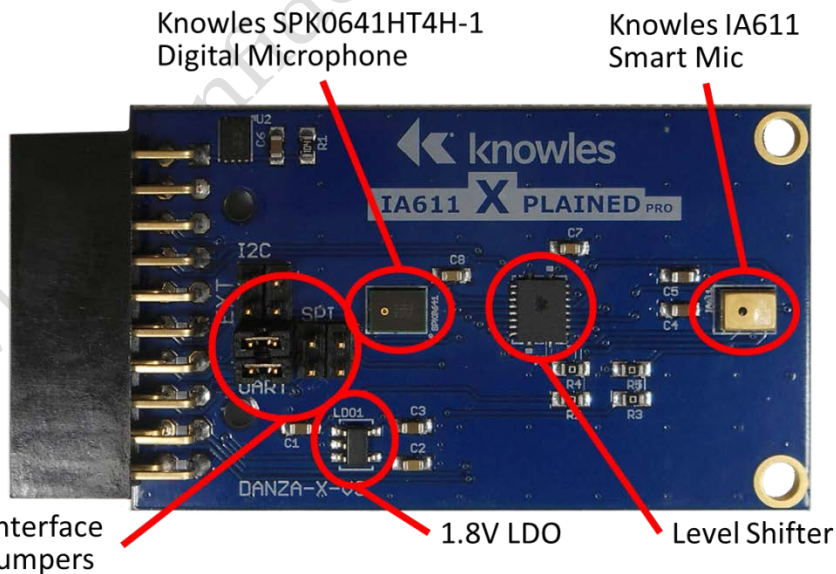


Figure 3 IA611 Xplained Pro Board

The IA611 Xplained Pro Development Board contains the following hardware:

- IA611 Digital Top Port Microphone with integrated DSP
- Level Shifter to shift digital signals from the SAMD21 at 3.3V to 1.8V for the IA611 microphone.
- Knowles SPK0641HT4H-1 Digital Microphone
- 1.8V LDO to power the level shifter, IA611 and SPK0641HT4H-1 microphones
- Interface jumpers (2mm) to select desired interface SPI, I2C or UART (default)

1.3.2 Jumper Settings

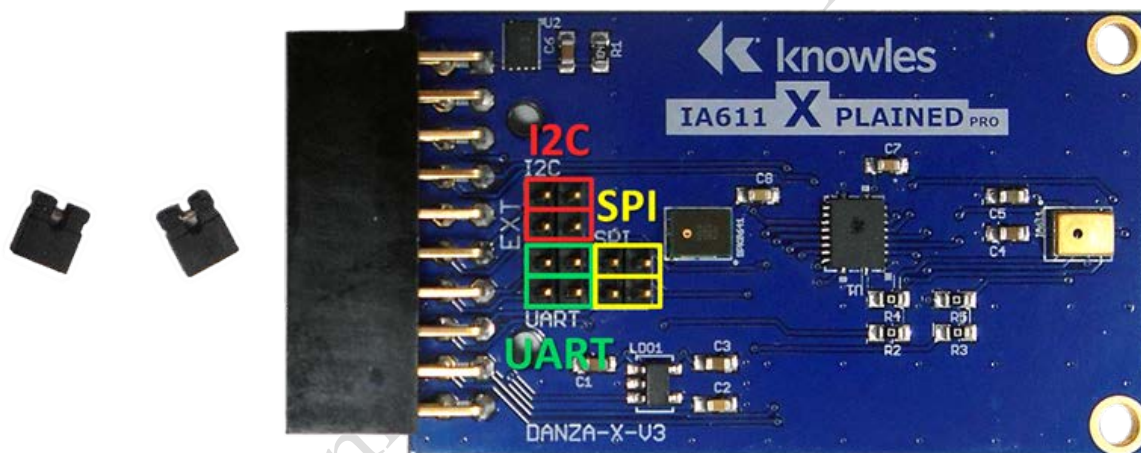


Figure 4 Jumper Settings for Interfaces

The IA611 Xplained Pro Development Board contains three sets of jumpers to allow changing of the interface used to send commands and control the IA611.

Figure 4 shows the location of the jumpers for each of the interfaces. The default interface is UART and shown in green. The SPI interface can be configured by placing the jumpers on the SPI block shown in yellow. For I2C interface, the jumpers may be moved to the I2C block shown in red.

Only one interface can be selected at a time. Only 2 jumpers can be placed at a time on the blocks and should be paired together on the same interface.

Chapter 2: IA611 Xplained Pro Hardware

The IA611 Xplained Pro development board is part of the Knowles IA611 Reference Design for IoT platform of products that connect the IA61x series of Digital Smart Microphones to low cost microcontrollers for basic voice wake or voice command applications.

Basic HW Block Diagram

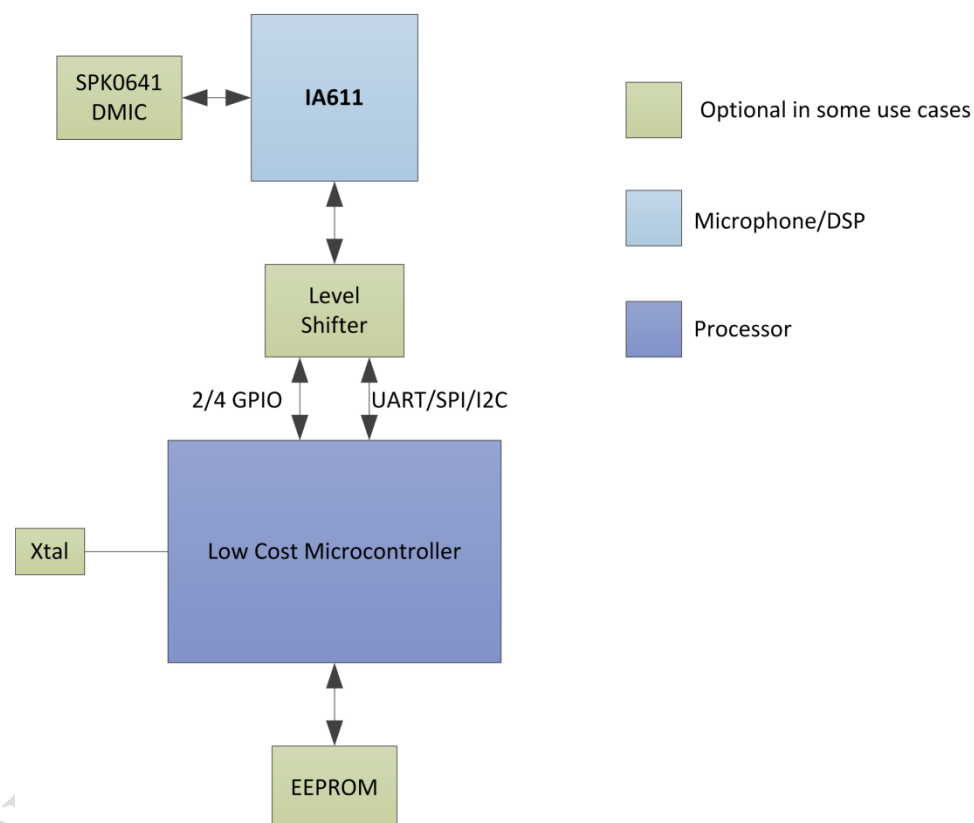


Figure 5 Basic Hardware Architecture for IA611 Reference Design for IoT Platform

2.1 IA611 HW Connection

The IA611 Xplained Pro development board is connected to the SAM D21 development board through the EXT connector.

The IA611 Xplained Pro board uses a UART for the communication to the DSP integrated inside the microphone. The UART connects the IA611 to the SAM D21. The baud rate for the microphone is initially set to 115200 bps but is changed after

initialization to increase the speed of software download. For more information, see the IA611 Xplained Pro Software User Guide for details.

There are 4 GPIO signals in addition to the two UART signals that also connect to the IA611 through the level shifter. The GPIOs can be used for signaling from the microphone to the MCU.

Since the IA611 only operates at 1.8V, the IA611 Xplained Pro board contains a 1.8V LDO to generate the necessary voltage for the microphones and the level shifter.

A second digital microphone (SPK0641HT4H) is connected directly to the IA611 microphone for use in a multi-microphone configuration. This could be useful in applications where beam forming or noise cancellation may improve performance of the solution. The SPK0641HT4H can be disconnected from the IA611 through two zero ohm resistors should all 4 GPIO signals be needed in the desired application.

Three sets of jumpers are installed on the board to allow the user to change the desired interface. The default setting for the board is to use the UART. To switch to SPI, the jumpers can be moved from the UART block to the SPI block. This block is just to the right of the UART block. To use I2C, the jumpers can be moved to the I2C block located directly above the UART block. Please see the software examples for each interface to see the correct connections to the SAMD21.

Chapter 3: Schematic

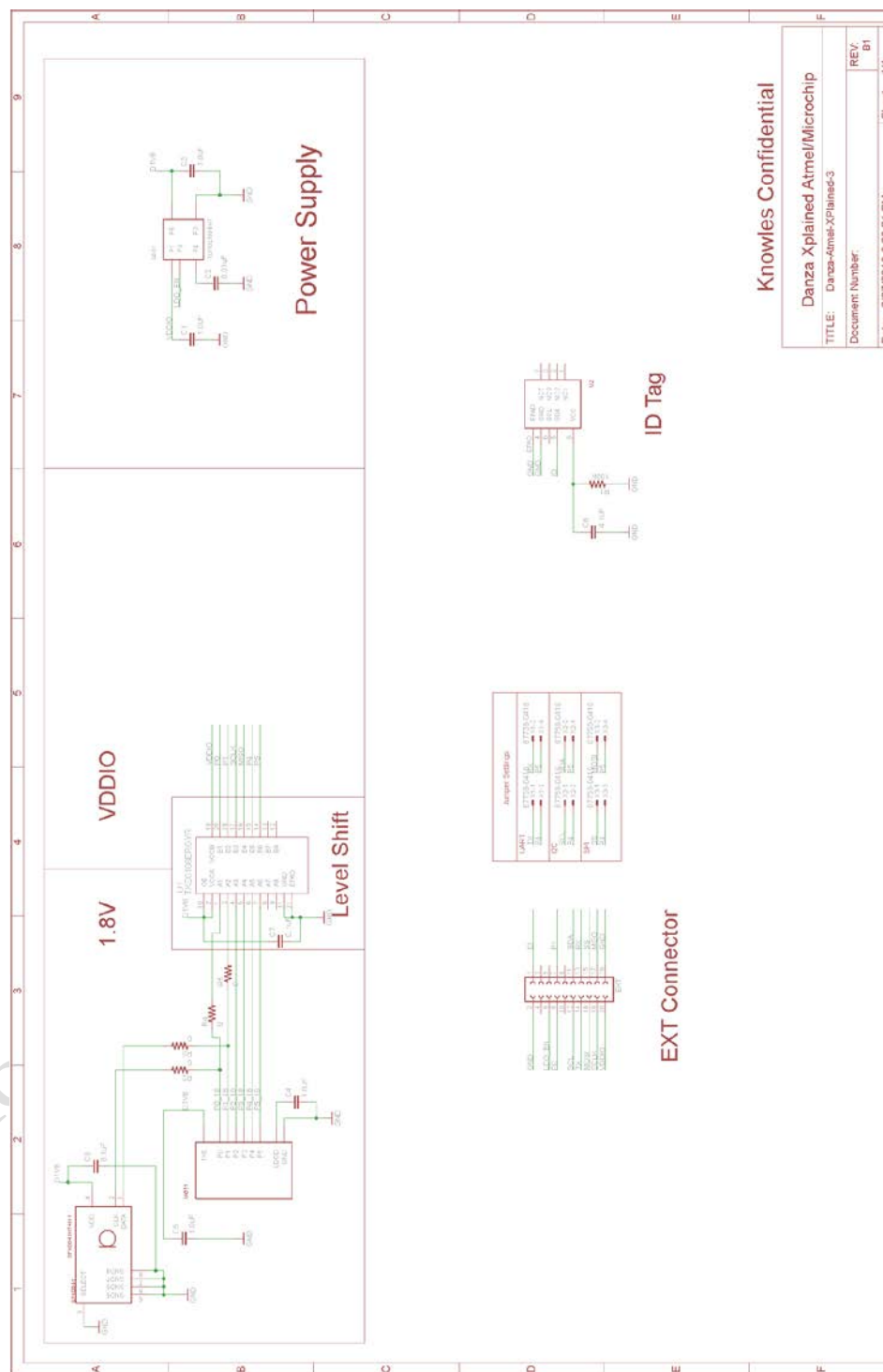


Figure 6 Schematic of the Knowles IA611 Xplained Pro Board

3.1 Bill of Materials

| Part | Value | Device | Manufacturer Part Number |
|---------|---------------------------|---------------------------|--------------------------|
| C1 | 1.0uF | C-EUC0603 | CL10B105KA8NFNC |
| C2 | 0.01uF | C-EUC0603 | CL10B103KO8NNNC |
| C3 | 1.0uF | C-EUC0603 | CL10B105KA8NFNC |
| C4 | 1.0uF | C-EUC0603 | CL10B105KA8NFNC |
| C5 | 1.0uF | C-EUC0603 | CL21B105KA8NFNC |
| C6 | 4.7uF | C-EUC0603 | CL10B475KQ8NQNC |
| C7 | 0.1uF | C-EUC0603 | CL21B104KACNNNC |
| C8 | 0.1uF | C-EUC0603 | CL21B104KACNNNC |
| EXT | | FE10-2W | |
| LDO1 | TLV70218DBVT | TLV70218DBVT | |
| R1 | 100K | R-US_R0603 | RC0603JR-07100KL |
| R2 | 0 | R-US_R0603 | |
| R3 | 0 | R-US_R0603 | |
| R4 | 0 | R-US_R0603 | |
| R5 | 0 | R-US_R0603 | |
| SPK0641 | SPK0641HT4H-1 | SPK0641HT4H-1 | |
| IA611 | SHAPIRO2_SPKSHAPIRO_SPK_2 | SHAPIRO2_SPKSHAPIRO_SPK_2 | |
| U1 | TXS0108ERGYR | TXS0108ERGYR | TXS0108ERGYR |
| U2 | ATSHA204A-MAHCZ-T | ATSHA204A-MAHCZ-T | |

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Revision History

The following lists the changes made since the previous version of this document.

| Version | Revision Date | Author(s) | Comments |
|---------|---------------|---------------|---|
| 1.0 | 1/26/2018 | Popper/Cawley | Release |
| 1.0.1 | 2/20/2018 | Cawley | Update DMIC and graphics. |
| 1.02 | 3/27/2018 | Popper | Updated Schematic and DMIC |
| 2.0 | 4/6/2018 | Popper | Release for V3 hardware adding support for I2C and SPI. |



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