EV-ProMW1001ARDZ User Guide

UG-1552

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EV-ProMW1001ARDZ Getting Started Guide

FEATURES

Full featured MeasureWare development kit
Control and analysis with MeasureWare Lab
Rapid configuration with MeasureWare Designer
Firmware development jumpstart enabled with API available in Mbed®
Multiplatform compatibility with Arduino R3 pin compatibility
Interfaces with MeasureWare sensor board library

DEVELOPMENT KIT CONTENTS

EV-ProMW1001ARDZ

EQUIPMENT NEEDED

PC running Windows® 7 or newer
ST Nucleo development board (ST NUCLEO-F411RE)

GENERAL DESCRIPTION

The EV-ProMW1001ARDZ development kit provides the flexibility and versatility to expand, refine, and enhance customer developed prototypes over time. The EV-ProMW1001ARDZ features the ADMW1001, a flexible hardware module that seamlessly connects to a range of both analog and digital compensated and uncompensated sensors. The EV-ProMW1001ARDZ features an Arduino-compatible header that allows the board to interface to a wide range of processor development boards. In conjunction with the MeasureWare® ecosystem, the ADMW1001 can be configured and optimized for sensor types selected to meet the accuracy and measurement times required.

Using the MeasureWare ecosystem and the MeasureWare Designer™ online tool, a new design can be defined using the tools of the ecosystem. These tools give an optimized recommended configuration for the associated hardware, in this case, the ADMW1001, which is in the form of a design pack. This design pack can then be used directly with the EV-ProMW1001ARDZ development kit to implement the defined measurement.

For further details on the ADMW1001, see the ADMW1001 data sheet. Use the ADMW1001 data sheet in conjunction with this user guide when using the EV-ProMW1001ARDZ.

EV-ProMW1001ARDZ PHOTOGRAPH

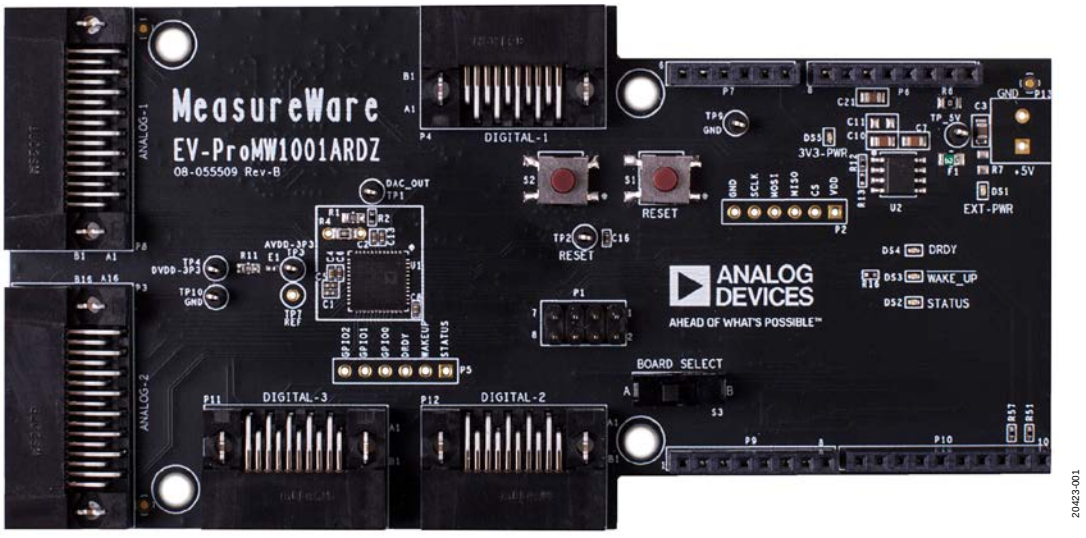

Figure 1.

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REVISION HISTORY

7/2019—Revision 0: Initial Version

EV-ProMW1001ARDZ QUICK START

To prepare to capture data, take the following steps:

1. Install the MeasureWare Lab as outlined in the Software Installation section.
2. Connect the ST-NUCLEO-F411RE to the EV-ProMW1001ARDZ using the Arduino headers. The ST-NUCLEO-F411RE connects to the PC via the USB cable provided. Ensure Switch S3 is in Position A.

RUNNING MEASUREWARE LAB

Use the following procedure to ensure communications between the EV-ProMW1001ARDZ development kit and the MeasureWare Lab software installed on the PC.

1. Double click the **MeasureWareLab.exe** file.
2. Log in to the MeasureWare account when prompted (see Figure 5).
3. Choose which configuration to load. The MeasureWare Designer can generate new configurations (see Figure 8).
4. An on screen image shows the correct ports to connect the sensor boards to, as defined in the configuration file (see Figure 9). After the boards are connected correctly, click **Proceed**.
5. The sensor measurement is streamed to the measurement windows (see Figure 10).

EVALUATION BOARD HARDWARE

DEVICE DESCRIPTION

The EV-ProMW1001ARDZ development kit uses the ADMW1001 hardware platform. The ADMW1001 is a flexible and versatile module that directly connects to a range of both compensated and uncompensated temperature, weight, humidity, and accelerometer sensors. The module has all the building blocks to excite, measure, and correct the sensor and to generate an output in sensor related units, such as °C, °F, or Kg. In conjunction with the MeasureWare Designer, the ADMW1001 can be configured and optimized for the sensor types selected to meet the accuracy and measurement times required. The ADMW1001 directly supports uncompensated J-type, K-type, and T-type thermocouples, PT100 (platinum resistance temperature detectors (RTDs), 100 Ω at 0°C) and PT000 (platinum RTDs,1000 Ω at 0°C) 2-wire, 3-wire, and 4-wire RTDs. The correction for the temperature sensors is embedded in the ADMW1001. The EV-ProMW1001ARDZ also allows the user to connect custom sensors. Along with other types of RTDs and thermocouples, the module can interface to 4-wire and 6-wire bridges, such as pressure or strain transducers. The correction for the custom sensors can be written to the ADMW1001 so that the module then performs measurement and correction.

The EV-ProMW1001ARDZ has two analog measurement inputs that connect to sensor boards for temperature, pressure, load, and strain.

The ADMW1001 includes three digital input channels that can be configured as I^2C or serial peripheral interface (SPI). The device can support two I^2C sensors and one SPI sensor on any of the digital channels. The digital channels can be used for accelerometer, pressure, humidity, temperature, and carbon dioxide (CO_2) measurements. The ADMW1001 measures these sensors and generates an output in sensor related units.

When the device is first connected to the MeasureWare Lab, this program loads the ADMW1001 with the most recent version of the device firmware to ensure that the largest feature set and sensors library is available.

HARDWARE CONNECTOR DESCRIPTION

Table 1 outlines a description of the connectors on the EV-ProMW1001ARDZ. The EV-ProMW1001ARDZ development board also must be connected to a host processor. By default, this host processor is the ST-NUCLEO-F411RE when interfacing to the MeasureWare Lab. Place the **BOARD SELECT** switch in Position A.

SERIAL INTERFACE

The EV-ProMW1001ARDZ connects via the Arduino headers to the host processor ST-NUCLEO-F411RE. The SPI is used for communication between the two boards. There are four primary input signals: $\overline{CS}$, $\overline{SCLK}$, DOUT, and DIN, and one output from the ADC (DOUT/$\overline{RDY}$). The host processor board connects to the PC via the USB port, where the board is displayed as a virtual COM port.

The digital interface is compatible with a 3.3 V to 5 V logic. The host to the ADMW1001 logic level is set using the IOREF pin (Pin 2) on Connector P6, which powers the device input side of the digital level translator.

HOST PROCESSOR

To get the EV-ProMW1001ARDZ to communicate with the PC, a host processor is required. The default device used for the host processor for MeasureWare Lab is the ST-NUCLEO-F411RE.

For firmware development using the custom application program interface (API) in Mbed, the user has the option to select over 100 development boards.

POWER SUPPLIES

The EV-ProMW1001ARDZ is powered directly from the host processor development board through the Arduino connector. The 5 V pin on the Arduino Connector P6 is used to power the ADP7104-3.3 precision low dropout (LDO) regulator. This LDO is used to power the AVDD pin and both IOVDD pins on the ADMW1001.

CONNECTORS AND SOCKETS

Table 1 details the connectors and sockets, and Table 2 details the test points.

Table 1. Connector and Socket Details

Connector/Socket	Name
P8	Analog Sensor 1
P3	Analog Sensor 2
P4	Digital Sensor 1
P12	Digital Sensor 2
P11	Digital Sensor 3
P6	Arduino header for stackable shield
P7	Arduino header for stackable shield
P9	Arduino header for stackable shield
P10	Arduino header for stackable shield
P13	External power connector (not inserted)
P2	SPI breakout port
P5	Digital signal breakout port
S1	Reset
S2	Not applicable
S3	Board select (Default Position A)

Table 2. Test Point Details

Connector	Name
TP1	RSENSE bias
TP2	UCM_RESETN
TP3	AVDD
TP4	DVDD
TP5	RSENSE+
TP6	RSENSE–
TP7	INT_REF (ADMW1001 1.2 V reference)
TP9	AGND
TP10	AGND

REFERENCE RESISTOR

To maximize measurement accuracy, the ADMW1001 allows users to input the values of the reference resistor used for ratiometric measurement and also the voltage reference value. By default, the EV-ProMW1001ARDZ has a 0.01% tolerance reference resistor with 2 ppm/°C temperature drift.

The ADMW1001 has test points, TP5 and TP6, for measurement of the reference resistor, R4, see Figure 14. This value can be added to the API configuration file or manually added to Register 0x54. The format is 32-bit floating point.

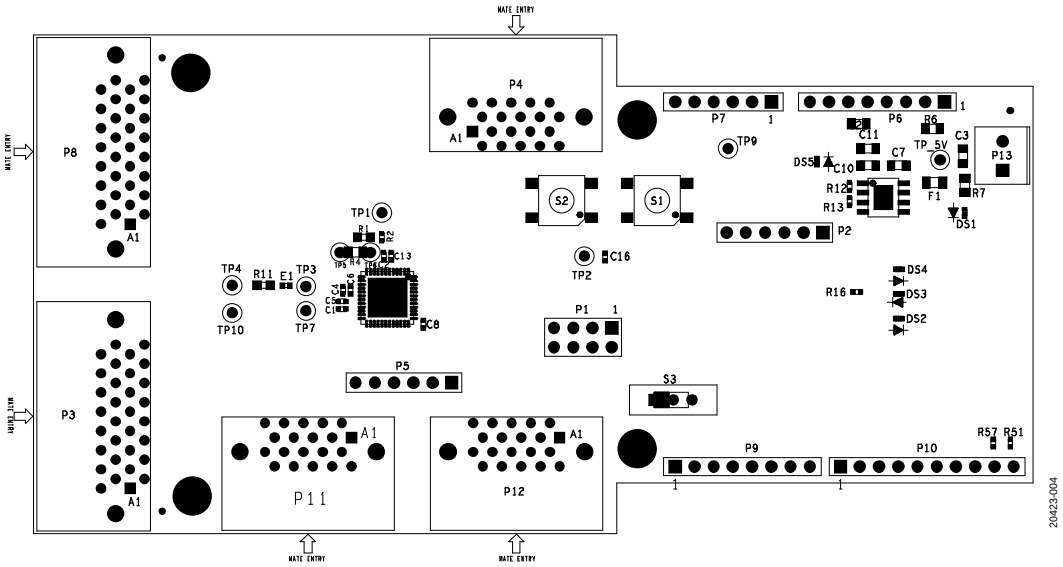

Figure 2. EV-ProMW1001ARDZ Board Overview

EVALUATION BOARD SOFTWARE

SOFTWARE INSTALLATION

The EV-ProMW1001ARDZ comes with a suite of tools in the MeasureWare Knowledge Center, including a graphical user interface from Analog Devices, Inc., known as MeasureWare Lab. MeasureWare Lab can be used to update, configure, and interface to the ADMW1001 through the host microcontroller. After a configuration is uploaded to the board, the device begins the defined sequence and starts plotting data to the default screens in the MeasureWare Lab.

This software can be installed from the executable supplied available on the MeasureWare Lab webpage.

Double click the **MeasureWareLab.exe** file, and then follow the on screen instructions to install this file on the PC.

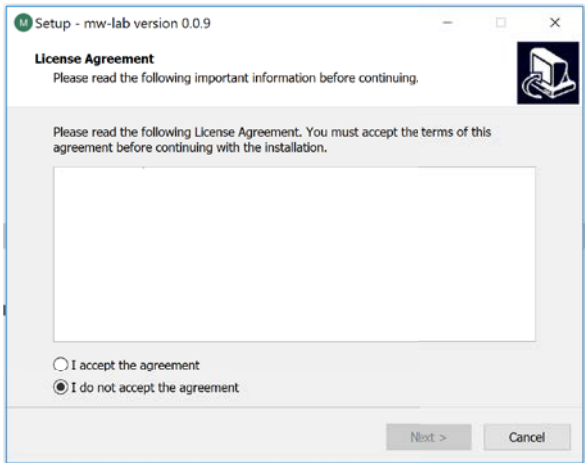

Figure 3. MeasureWare Lab Installation

Follow the on screen instructions to install the ST Nucleo driver pack. This driver pack ensures that the USB on the PC is able to communicate with the host microcontroller through a USB to universal asynchronous receiver/transmitter (UART) converter.

Following installation of the software, execute the software program by navigating to **Start** > **Programs** > **Analog Devices** > **MeasureWare_Lab**.

MeasureWare Designer: Device Configuration

When ordering the EV-ProMW1001ARDZ through the MeasureWare Designer, users must select measurement types and provide three measurement requirements: range, accuracy, and sampling speed. Based on the user selection, a recommended sensor list is generated for the user. After the design is complete, a configuration file is generated. This configuration file contains all register settings to configure the ADMW1001 to interface and sample the selected sensor boards. Upon startup of the MeasureWare Lab, the user can select the appropriate configuration file from the list of configurations generated in the MeasureWare account of the user.

MEASUREWARE LAB

MeasureWare Lab is an online graphical user interface (GUI) used to link an online MeasureWare account to MeasureWare hardware. Configuration files generated in the MeasureWare Designer can upload to the evaluation kits. Data generated by the kit can be live streamed to one of the data graphing windows or stored in the online database. MeasureWare Lab is the quickest way to get up and running with the EV-ProMW1001ARDZ kit.

Connecting the EV-ProMW1001ARDZ

First, ensure that the host microcontroller with the EV-ProMW1001ARDZ shield is connected to the PC and that the S3 switch on the EV-ProMW1001ARDZ is in Position A. When connected, the GUI acknowledges this, and the user can press the **Next** button to proceed (see Figure 4).

Figure 4. Connect Hardware to Host PC

After the MeasureWare Lab has confirmed that the hardware is connected to the PC, the user proceeds to the MeasureWare account log in page (see Figure 5). The log in details are the log in details created to access the MeasureWare Designer. If, for some reason, the user does not have an account, proceed to the MeasureWare Designer page to create an account and to generate a configuration file.

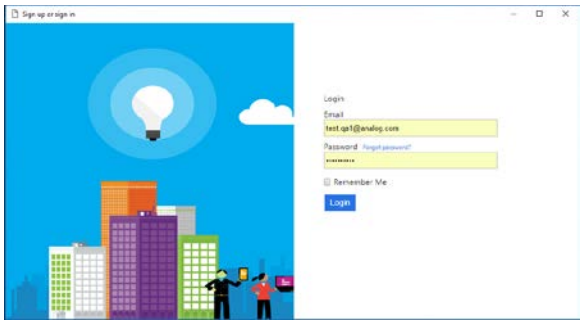

Figure 5. MeasureWare Account Log In

After login, MeasureWare Lab confirms that hardware is connected. When MeasureWare Lab has recognized the EV-ProMW1001ARDZ, a firmware recognition takes place to verify that the version of the firmware is the most recent to allow access to the latest sensor library. A popup window, as seen in Figure 6, appears if new firmware is available. Click **Download** and wait for the download phase to complete. Do not disconnect the board until the download process is finished (see Figure 7).

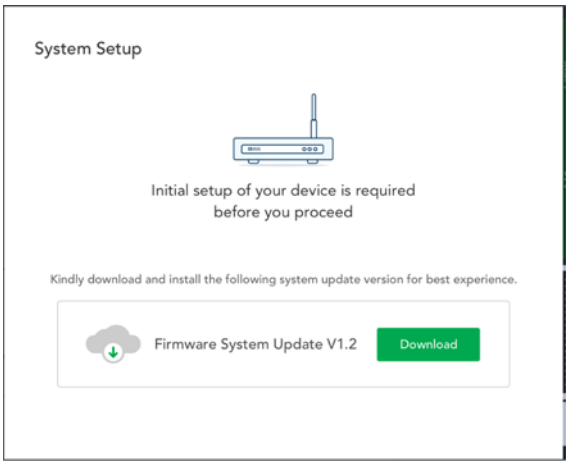

Figure 6. Firmware Update Pop Up

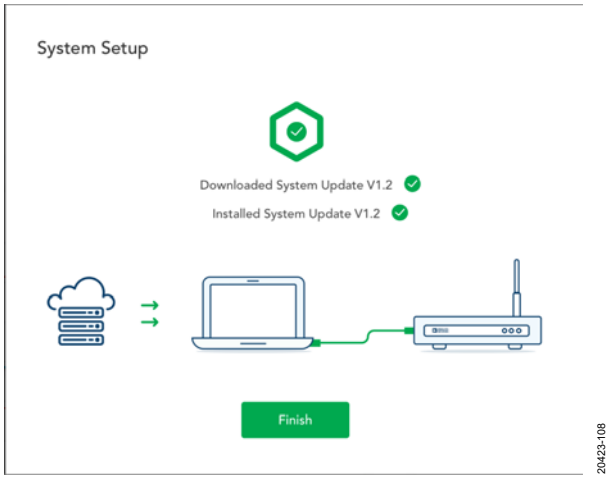

Figure 7. Firmware Update Complete

Once logged into the MeasureWare Lab account, the user selects a design from the design list (see Figure 8). The design list contains all the user designs generated in the MeasureWare Designer. Users can also choose to upload a configuration file. However, this is not recommended for most users.

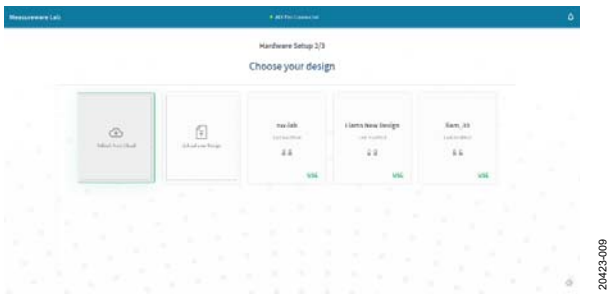

Figure 8. Design Selection

When the design is loaded, the configuration diagram in Figure 9 displays showing which sensor boards are required and which ports these sensor boards must be connected to. The software confirms if the sensor boards are connected correctly, and if so, the user is prompted to continue to the measurement dashboard.

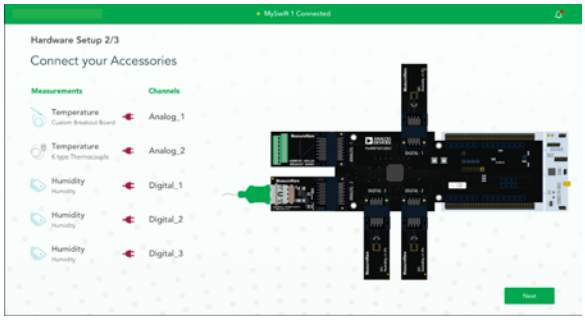

Figure 9. Sensor Board Connection

Sampling Data

Because the hardware and firmware are now configured, the user clicks the **Proceed** button, and the sampling dashboard displays. Within this dashboard, users can edit the graph window using the graph tools.

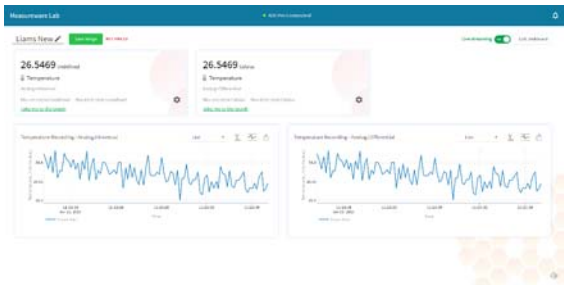

Figure 10. Data Acquisition

ADMW1001 API

The ADMW1001 API is a cross platform API generated in C++ and available in Mbed. The API allows rapid prototyping development with the EV-ProMW1001ARDZ or with custom developed printed circuit boards (PCBs).

When a user creates a configuration in MeasureWare Designer, a header file is also generated. This header file can be imported into the sample API project in Mbed. By default, the header file is named **config.h**.

For rapid development using the API, users must only include the design file in the project before compiling. After the project is compiled and the generated binary file is loaded to the host processor, the ADMW1001 starts sampling in the manor specified in the configuration file. Samples are made available through the serial port and can be viewed in any terminal applications, such as RealTerm or PuTTY.

The source code can also be cloned from the repository and imported into any C/C++ integrated development environment (IDE). Visit the Knowledge Center for links to the repository.

Mbed Compiler

The Mbed compiler is a free online IDE for rapid development of code for ARM® code processors, with over 100 ARM code development boards available in the library.

Within the Knowledge Center, there is a link to the Mbed compiler. If a user does not have an account, the user is required to register for free to make use of the online resources. After registration, a user can import the API source code by clicking the **Import** button and pasting the host code URL, located on the MeasureWare landing page.

The user can import the configuration file into the project. After the configuration file is included, the user can click compile, which downloads a hex file that can be copied to the device. For example, in the case of the ST NUCLEO-F411RE, the hex file can be dragged and dropped to the board, similar to a file being copied to a USB removable drive. After the code is loaded to the host processor, reset the host board. The configuration loads automatically to the ADMW1001, and the data starts streaming to the host PC through the virtual COM port. The default UART settings are 1: stop, 0: parity, and 115200: baud.

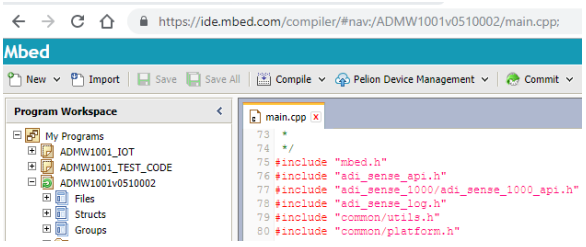

Figure 11. Mbed Compiler

MBED CHANGING HOST BOARD

To select a host board, click on the development board name in the top right corner of the compiler. Here, a user can select from previously used boards or add a new hardware board. See Figure 12 for platform selection.

Figure 12. Platform Selection

After a new platform is selected, the user must only open the **platform.h** file in the example project and add the selected board to the definition. See Figure 13 for an example of multiple platform definitions. Ensure that the pin definitions for the given board align with the pin configuration of the EV-ProMW1001ARDZ. See the Evaluation Board Schematics section for details on the pin configuration.

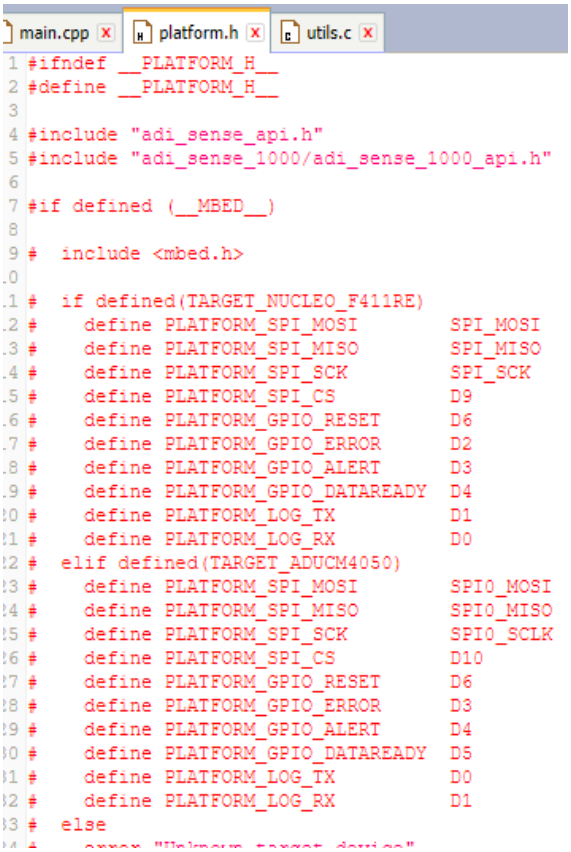

Figure 13. Platform Definitions

EVALUATION BOARD SCHEMATICS

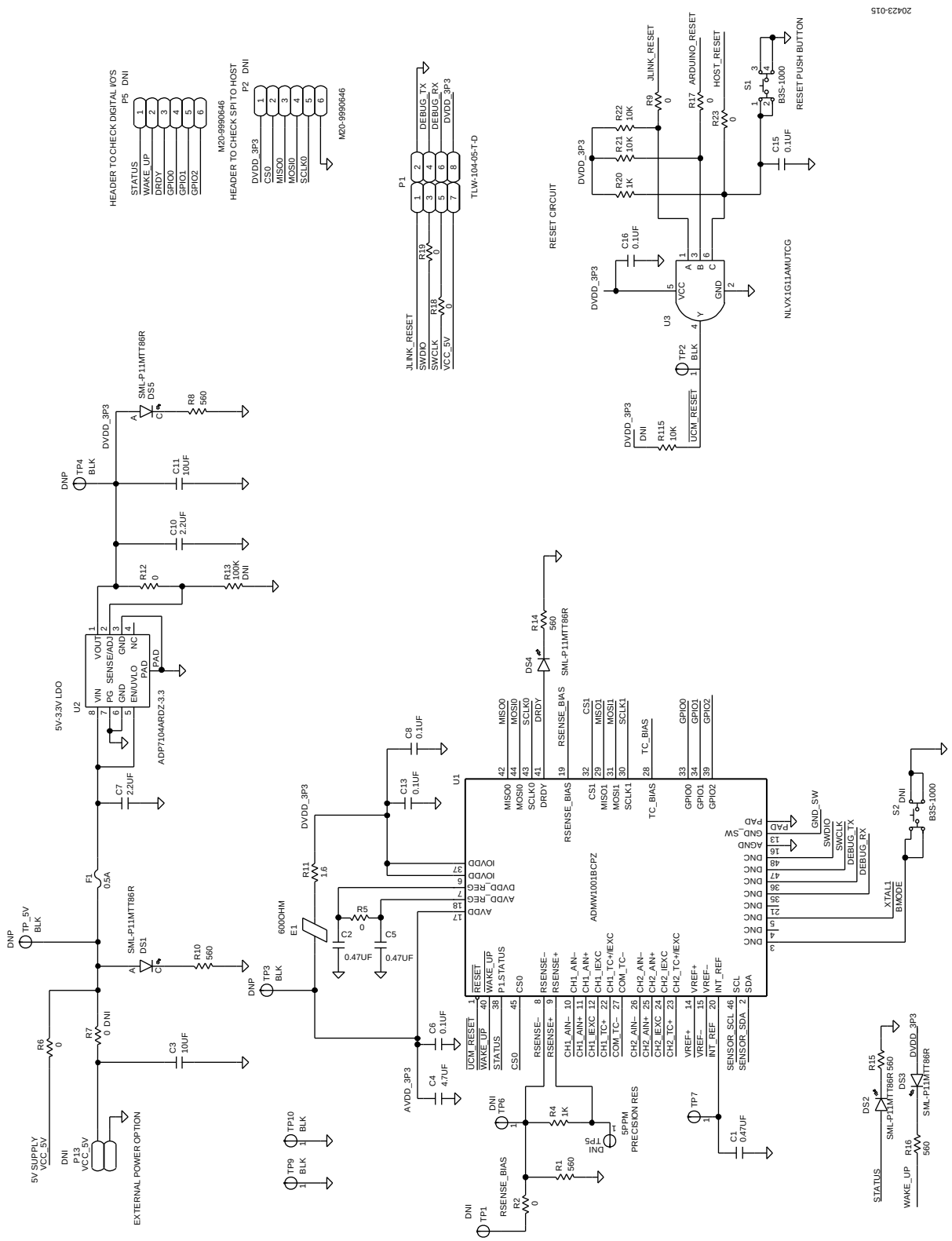

Figure 14. ADMW1001 Configuration and Power

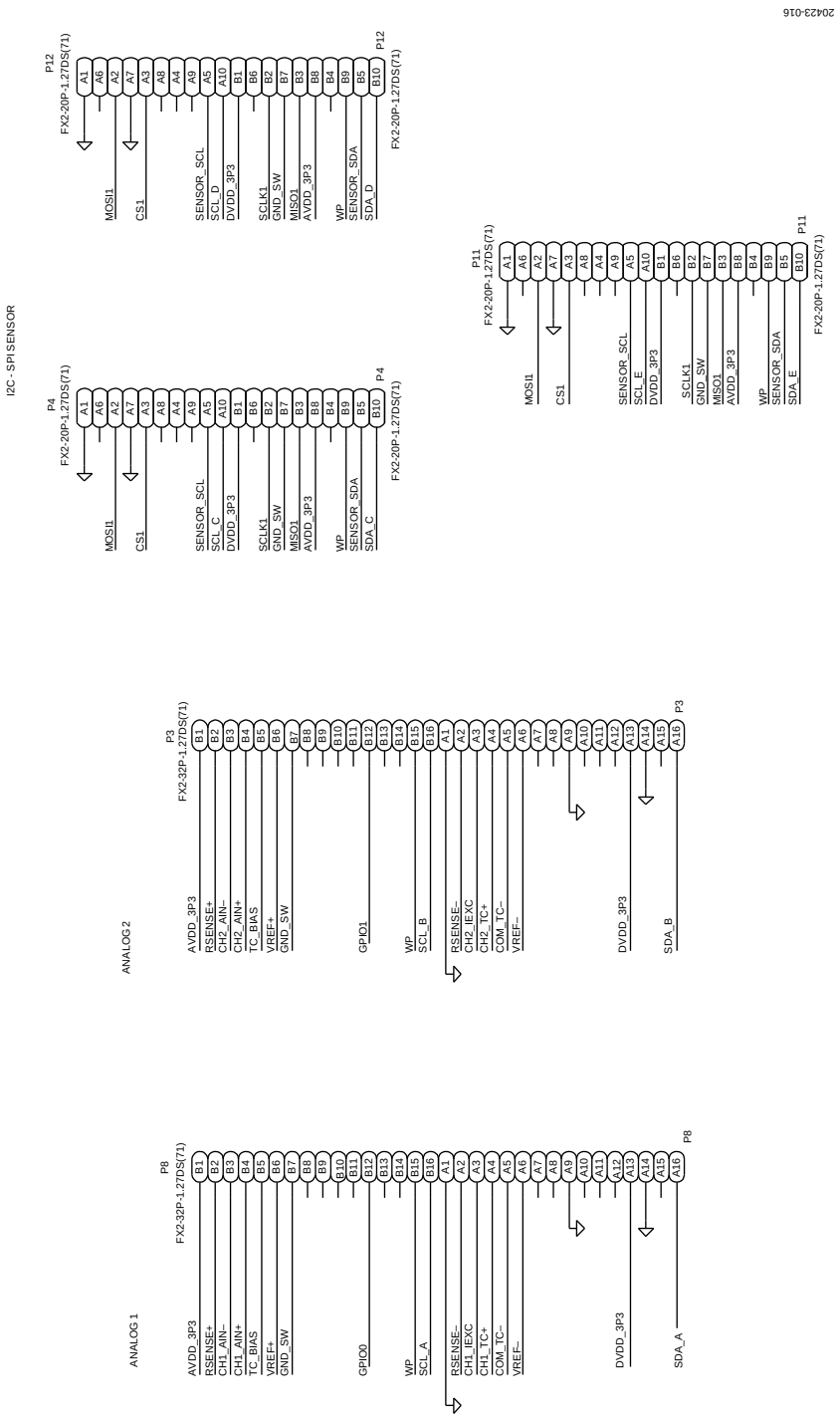

Figure 15. Analog and Digital Connectors

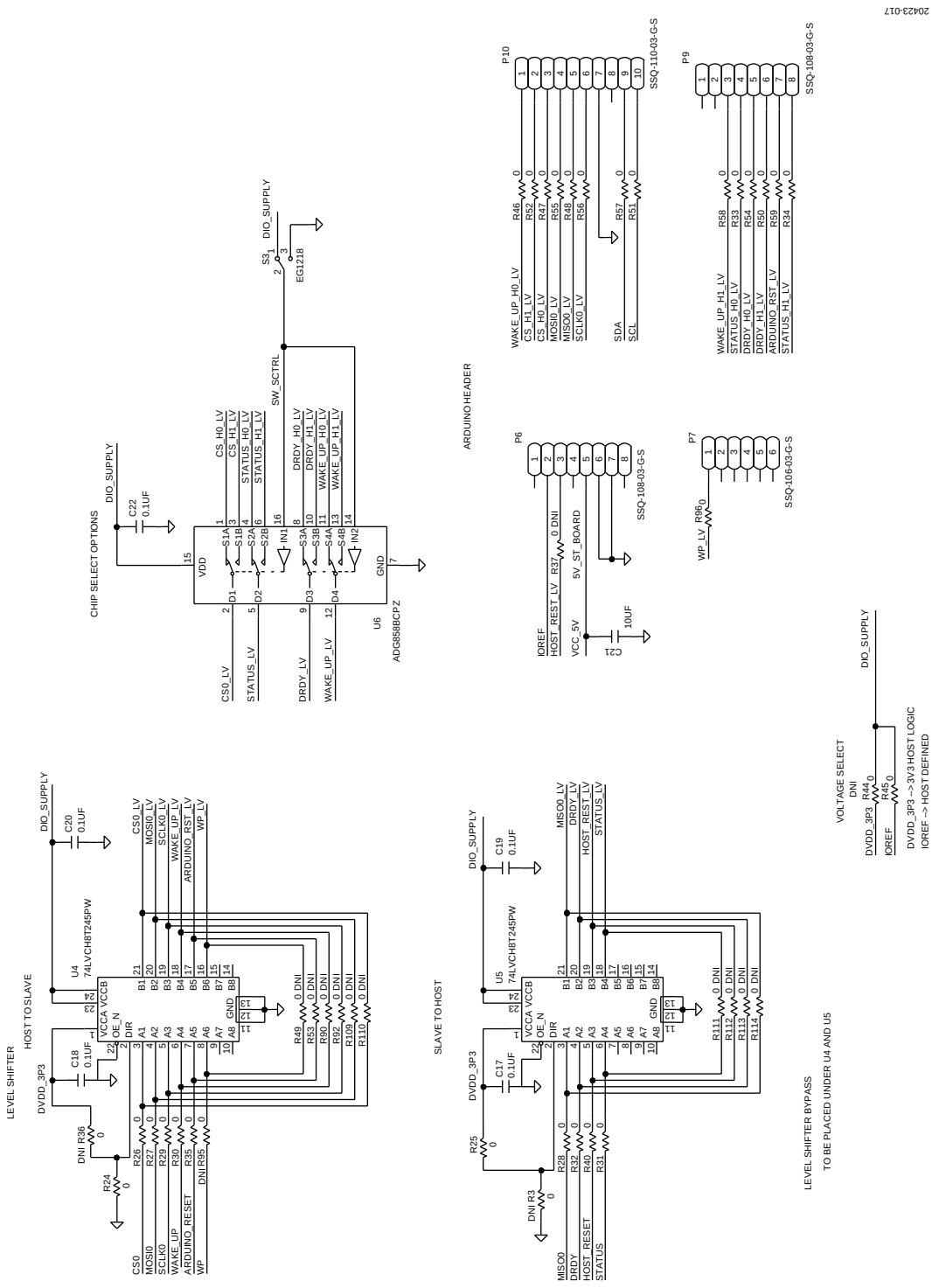

Figure 16. Level Translators and Arduino Headers

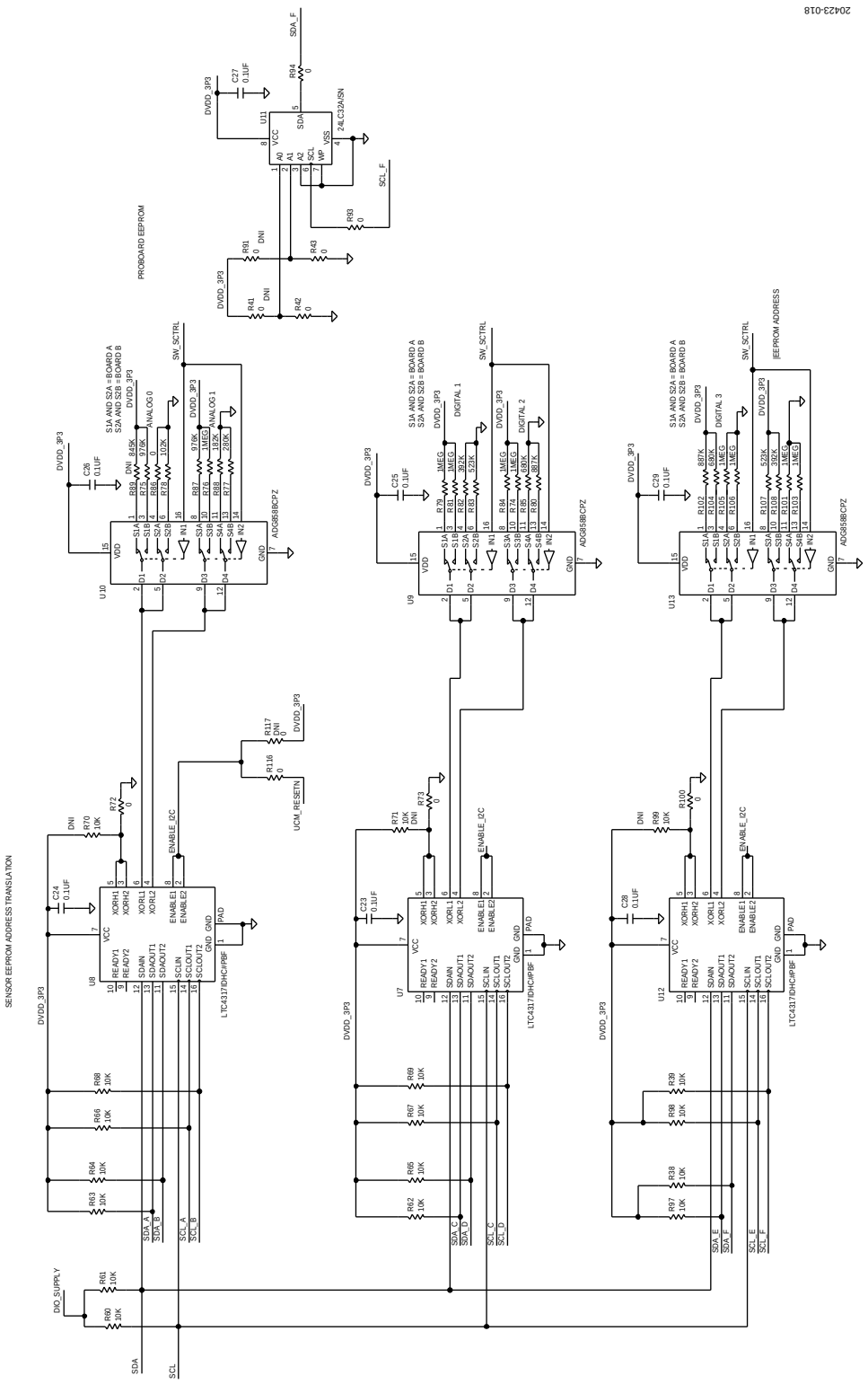

Figure 17. Electronically Erasable Programmable Read Only Memory (EEPROM) Translators and EEPROM

NOTES

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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