

EZAIRO[®] 7150 SL Hybrid Demonstrator Board User's Manual

INTRODUCTION

Purpose

This document provides detailed information for the configuration and use of the Ezairo 7150 SL hybrid demonstrator board. The hybrid demonstrator board consists of two printed circuit boards: a motherboard and daughterboard that are designed to evaluate the performance and capabilities of the Ezairo 7150 SL hybrid.

The Ezairo 7150 SL hybrid is a System-in-Package (SiP) that includes the following:

- ON Semiconductor Ezairo 7100 Digital Signal Processor (DSP)
- Nordic Semiconductor nRF51822 2.4 GHz Radio IC
- ON Semiconductor 2 Mb EEPROM (EA2M) for audiology

Conventions

The following conventions are used in this manual to signify particular types of information:

- Component and pin names, as well as file and path names are in a `monospace` font
- Variable path names (where you fill in suitable information) and characters that you type are in a **bold monospace** font
- Default jumper configurations and items you see on the screen are in a **bold** typeface.

Manual Organization

The Ezairo 7150 SL Hybrid Demonstrator Board User's Guide contains the following chapters and appendices:

- *Introduction*, describes the purpose and organization of this manual, the intended audience, and provides a list of recommended reading for more information.
- *Overview*, provides an overview of the hybrid demonstrator board for Ezairo 7150 SL.
- *Getting Started*, explains how to use the hybrid demonstrator board, and introduces the setup using the Ezairo Sound Designer Software Application.
- *Hybrid Demonstrator Board*, provides the details of the hybrid demonstrator board. The chapter is divided into the following topics:
 - ♦ The setup



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- ♦ The design
- ♦ Power supply
- ♦ Digital input/output
- ♦ I²C
- ♦ CS44
- ♦ Audio interfaces
- ♦ Board configuration
- *Appendix A: Connectors*, provides a complete list of the connectors and jumpers on the hybrid demonstrator board
- *Appendix B: Motherboard Schematics*, contains the motherboard schematics for the hybrid demonstrator board
- *Appendix C: Daughterboard Schematics*, contains the daughterboard schematics for the hybrid demonstrator board

Further Reading

For more information, refer to the following documents:

- Promira™ Serial Platform Quick Start Guide, available at totalphase.com
- Communication Accelerator Adaptor Manual, which is installed with the Communication Accelerator Adaptor (CAA) software
- Ezairo 7150 SL Datasheet
- EA2M Datasheet (available at www.onsemi.com)
- Ezairo Sound Designer Software User Manual

OVERVIEW

Introduction

The Ezairo 7150 SL hybrid demonstrator board consists of a motherboard and daughterboard used for evaluating the Ezairo 7150 SL hybrid. The motherboard provides access to all input and output connections via 0.1" standard headers. One 6-pin DIN socket (J2) is available on the motherboard to connect to the a programming interface that provides communication to the board from a host PC. For more information about the the programming interface you are using, see the respective user manual.

The daughterboard connects the Ezairo SL chip to the motherboard, and can be powered independently of the motherboard. The daughterboard was designed for evaluating Ezairo 7150 SL as a smaller form factor, and it is used for key measurements such as power consumption.

Hybrid Demonstrator Board Features

The hybrid demonstrator board offers unique advantages, enabling developers to evaluate the performance and capabilities of the Ezairo 7150 SL hybrid in addition to developing, demonstrating and debugging applications.

NOTE: The motherboard is required for programming the Ezairo 7150 SL chip and requires the daughterboard. The daughterboard can be used by itself.

The motherboard includes:

- Support for manually powering RFVDD, VDDO2, and VDDO3 when the appropriate resistors on the daughterboard are removed
- Support for various VBAT powering options
- Two buttons for application usage purposes
- Standard audio connectors (0.1" headers)
- Access to all Ezairo 7150 SL digital input/output signals via standard 0.1" headers
- Provision for adding a CS44 connector

GETTING STARTED

Introduction

This chapter is about setting up the hybrid demonstrator board for use. You have to provide it with power and connect it to your computer. If you want to program the nRF51822 radio IC and the Ezairo 7100 on the board, you need some software development tools. Finally, if you would like to evaluate the volume control, this chapter describes connecting to the audio input/output.

You need a programming box to connect the hybrid demonstrator board to a computer. Supported programmers are:

- Promira Serial Interface from Total Phase, Inc., driver version 1.3.6
- Communication Accelerator Adaptor (CAA), driver version 1.3

- HI-PRO, driver version 2.0.0.4
- DSP Programmer Version 3
- NOAHlink
- BlueGiga (Pre Suite only)

Powering the Ezairo 7150 SL Motherboard

1. Connect the programmer to the header J2 on the motherboard.
2. Short the header VBAT-I.
3. Short the top row (pins 1 and 2) of PSU-SEL. This will cause the system to be powered by a battery connected to J3. Additional powering options are noted in “Selecting the Power Supply” section.
4. Switch SW3 to **ON**.

Selecting the Power Supply

To change the power supply for Ezairo 7150 SL, a different row of the header, **PSU-SEL** must be shorted.

Table 1. EZAIRO 7150 SL MOTHERBOARD POWERING CONFIGURATION OPTIONS

Pin Numbers	Power Supply	Additional Connections
1 and 2	Battery	A battery must be placed in the battery clip J3
5 and 6	Programmer	Programmer must be connected
7 and 8	External Power Supply	An external power supply must be connected to EXT-PSU (positive polarity is marked by the '+' sign)

HYBRID DEMONSTRATOR BOARD

Demonstrator Board Setup

This section is an overview of how to configure the hybrid demonstrator board. Figure 1 represents an overview of the

board setup. Communication to the Ezairo 7150 SL hybrid requires both a daughterboard and a motherboard.

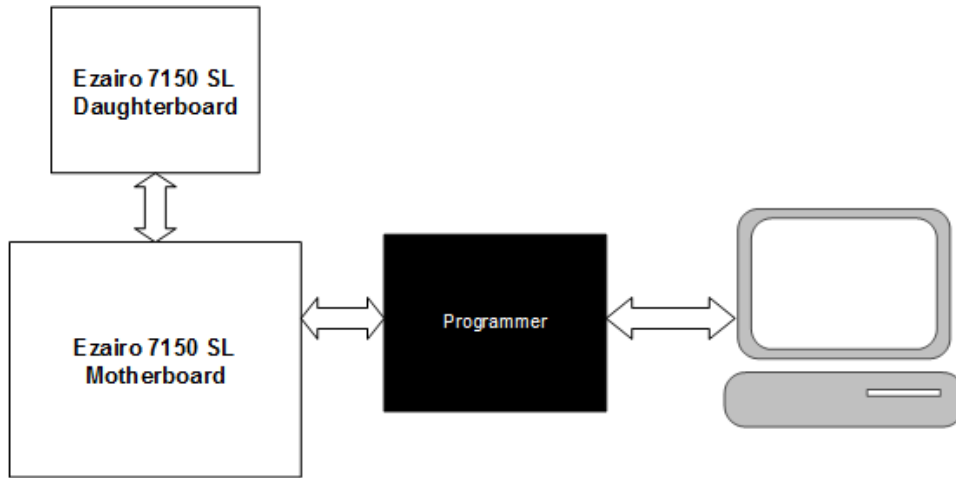


Figure 1. Hybrid Demonstrator Board Setup

The Ezairo 7150 SL hybrid is packaged in a 49-pin ball grid array (BGA) package that is used on the hybrid demonstrator board.

The Ezairo 7150 SL hybrid demonstrator board can be powered from different sources via the motherboard:

1. A programmer (see “Introduction” section for a list of supported programmers).
2. An external power source.
3. A hearing aid battery.

Development Board Design

The following sections detail the various sub-circuits of the Ezairo 7150 SL hybrid demonstrator board; both boards are outlined. The block diagram in Figure 2 shows the locations of the various circuit sections for the motherboard.

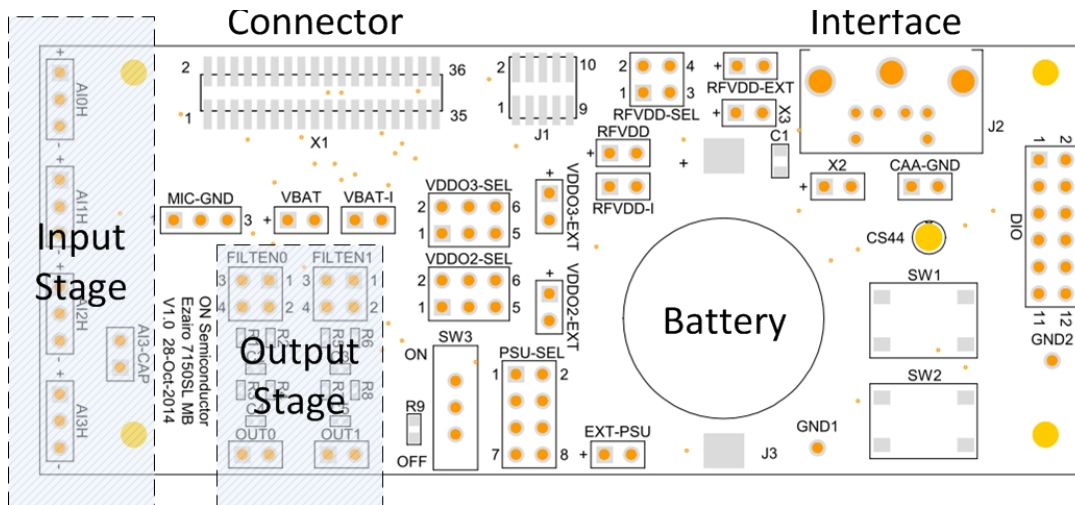


Figure 2. Motherboard Circuit Location Block Diagram

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A block diagram showing all of the daughterboard circuit sections is shown in Figure 3.

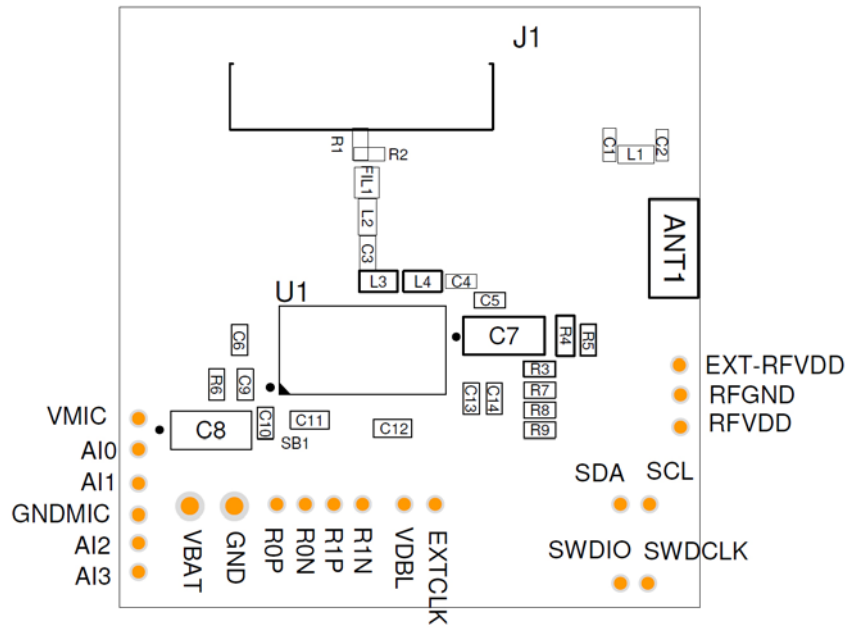


Figure 3. Daughterboard Circuit Location Block Diagram

The motherboard connects directly to the daughterboard via a 36-pin header (X1). This is shown in Figure 4.

For development purposes, we recommend using the following off-the-shelf SMA antenna:

- ANT-2.4-CW-RAH-SMA-ND from Linx Technologies

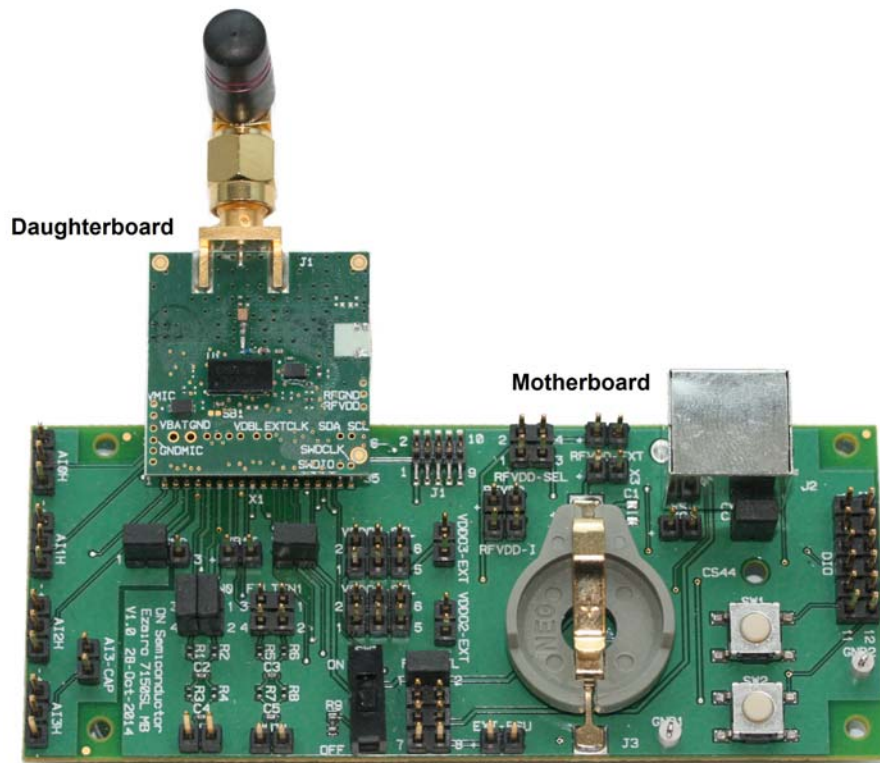


Figure 4. Motherboard/Daughterboard Connection

Here are the steps to setting up your product device for use with the Ezairo Sound Designer software:

NOTE: If you are programming the device with your own firmware, please refer to the documentation provided within the Ezairo 7100 Evaluation & Development Kit.

1. Connect the product to your programmer and to your computer, as follows:
 - ◆ Connect your input source to the negative and center pins of the 3-pin AI1H header.
 - ◆ Connect your recording or listening equipment to the output, which is labelled OUT0. You might require an external amplifier to drive headphones from the output.
 - ◆ You can use SW1 and SW2 (found on the evaluation board) to adjust the volume.
 - ◆ The maximum input signal range is approximately 2 Vpp (volts peak-to-peak).
2. Power on the board by setting SW3 to ON.
3. Next, start Sound Designer software by double-clicking on the SD/sounddesigner.exe shortcut, which you will find wherever you installed the Sound Designer software files.
4. Choose a workspace as shown in Figure 1 on page 8. If you do not have a workspace directory available, click Browse and the software allows you to create one. If you click Browse and select a pre-existing directory for your workspace, make sure it is empty. For this example, check Import Sample Workspace, and select E7150SL from the drop-down list. Click OK.
5. Open the console window by clicking the Show console icon. The console window displays error and status messages accumulated in this session. We recommend having the console viewable at all times while using Sound Designer software, to get immediate status information.
6. Click on Control Panel and then, for this example, double-click the Ezairo7150SL.param sample parameter file to open the demo product library. See Section 2.1.5, “The SETTINGS Window” on page 11 for more information.
7. To connect to the device, go to the SETTINGS window. Select the correct Programmer, and Port if applicable. If you also select Verify NVM Writes, the software burns the settings to the device’s Non-Volatile Memory and then immediately reads back the settings to confirm that the values burned to the device match what is being read out of the device. This option requires additional programming time. Next, click on Detect. A successful detection will populate the device information in the Device Info box.
8. Use the back button—the arrow in the top left corner—to return to the Control Panel.
9. To configure the device for the selected product, click Programmer > Connect. If the connection succeeds, the Connection status symbol appears to the right of the File Name. You can hover over this symbol to view the programmer name and the firmware ID of the device. The connected device must now be configured before you can read, burn or write parameters in Control Panel. Click Programmer > Configure to do this.
10. Now you are ready to begin. See Chapter 3, “Modeler” on page 15 of the Ezairo Sound Designer Software User Manual for your next steps in the process of developing a product with Sound Designer software.

Power Supply

The Evaluation and Development Platform can be powered using the motherboard and daughterboard connected together, or by using the daughterboard alone. The main power supply pin for Ezairo 7150 SL is VBAT. When using the motherboard with the daughterboard, the Ezairo 7150 SL hybrid can be powered in the following ways:

- Via the programming interface, connected by the 6-pin DIN header which accesses connector J2.
- Via an external supply connected to the EXT-PSU header
- Via a hearing aid battery (size 312, 13 or 675) inserted into the 16 mm battery holder (J3) located on the motherboard

The VBAT-I header located on the motherboard is provided for measuring the current consumption of Ezairo

7150 SL. For normal operation, short the VBAT-I header. When using an external supply, ensure the Ezairo 7150 SL recommended voltage level is not exceeded; refer to Table 2 for minimum and maximum voltages.

Table 2. VBAT MINIMUM AND MAXIMUM VOLTAGES

Minimum (V)	Maximum (V)
1.05	2.00

The PSU-SEL switch allows you to select between any of the powering options noted above by connecting a two-pin jumper. This is described in more detail in Table 3. Note that any pins that are not specified as being shorted are intended to be left open.

Table 3. POWER SUPPLY SELECTION

Power Source	PSU-SEL	Additional Connections
Programmer	Short Pin 5 and 6	Adaptor must be connected
Battery	Short Pin 1 and 2	A battery must be placed in the battery clip J3
External Supply	Short Pin 7 and 8	An external power supply must be connected to EXT-PSU (positive polarity is marked by the '+' sign)

When using the daughterboard standalone, you must use external power via the VBAT and GND pins shown in Figure 3.

Ezairo 7150 SL provides access to 10 digital I/Os that are mapped into two power domains: VDDO1 and VDDO3.

The headers VDDO2-SEL and VDDO3-SEL (refer to Table 4) configure the I/O voltages for each of these power domains to either VBAT, VDBL (a regulated supply from

Ezairo 7100), or an external supply. The VDDO1 I/O voltage is internally connected within the hybrid to VDBL and is used to power the EA2M that is inside the hybrid. The VDDO2 I/O voltage powers the I/O signals connected between Ezairo 7100 and nRF51822 inside the hybrid. The VDDO3 I/O voltage is used by Ezairo 7150 SL for its debug port interface reset pin.

Table 4. I/O VOLTAGE CONFIGURATIONS

Header	VDBL	VBAT	External Supply
VDDO2-SEL	Short Pins 1 to 2	Short Pins 3 to 4	Short Pins 5 to 6
VDDO3-SEL	Short Pins 1 to 2	Short Pins 3 to 4	Short Pins 5 to 6

Digital Input/Output (DIO)

The motherboard provides access to all of the DIOs exposed on the Ezairo 7150 SL hybrid on the DIO header. The header also provides two DGND pins for prototyping purposes, as well as two buttons tied to DIO24 and DIO29.

The logic levels of the digital inputs/outputs are dependent on the I/O bank that they are on. DIO5 to DIO9 are powered by VDDO1 (connected to VDBL inside the hybrid); DIO20 to DIO29 are powered by VDDO3 (the powering of this bank is configurable).

The DIO signal lines from Ezairo 7150 SL provide access to a wide variety of interfaces, including:

- GPIO (controlled by the CFX DSP or controlled by the Arm[®] Cortex[®]-M3 processor)
- SPI (x2)
- I²C
- UART
- LSAD inputs (x6)
- Output Clocks
- Other digital inputs and outputs

The motherboard provides access to any of the DIOs or their multiplexed signals via the DIO header.

The digital I/O signals on Ezairo 7100 are multiplexed with several interfaces.

I²C

The Promira Serial Platform, CAA, or HI-PRO is used to communicate with Ezairo 7150 SL using an I²C communication protocol. The 6-pin DIN header (J2) on the motherboard connects Ezairo 7150 SL to the programmer.

The I²C connection carries I²C bus signals, as well as power, ground, and the VDDO3 signal. Table 5 shows the pin number and associated signal of the J2 connector.

Table 5. DIN CONNECTOR (J2) PIN-OUT ON THE MOTHERBOARD

Pin Number	J2 Pin Connector
1	Supply Voltage from programmer
2	System Ground
3	SCL (I ² C Clock)
4	SDA (I ² C data)
5	VDDO3 (Sense Voltage)
6	No Connect

CS44

The motherboard provides a non-populated footprint for a CS44 connector through the VBAT-TP, GND-TP, SCL-TP, and SDA-TP pads.

Audio Interfaces

Input Stage

The audio input interface consists of the following connectors (standard 0.1" headers) located on the motherboard:

- AI0H
- AI1H
- AI2H
- AI3H

The input ground reference for the above input connectors is normally referenced internally to GND_MIC. The board provides two headers to change the input ground reference to either GND_MIC or to GNDA. Header MICGND configures the input ground reference.

For electrical testing of Ezairo 7150 SL, we recommend configuring the input ground to GNDA when the test equipment provides a single ended (unbalanced) output for

supplying the audio input signal. For test equipment that provides differential outputs (balanced), you can connect the input ground to GND_MIC. We recommend performing electro-acoustic testing (microphone and receiver attached to the PCB) with the input ground connected to GND_MIC.

Output Stage

There are two digital outputs (RCVR0, RCVR1) provided on the motherboard. The audio output interface consists of the following connectors located on the motherboard:

- Standard 0.1" headers: FILTEN0, FILTEN1, OUT0 and OUT1
- Two RC filter networks for use with the direct digital outputs when running electrical measurements

Outputs for the direct digital outputs are available on headers FILTEN0 and FILTEN1. Separate RC filter networks are provided to attenuate out-of-band noise from the direct digital outputs when connected to high impedance audio measurement equipment. The on-board RC filters are enabled by the FILTEN0 and FILTEN1 headers as described in Table 6.

Table 6. ON-BOARD RC FILTER CONFIGURATION

Function	FILTEN0	FILTEN1
Disabled	Open pins 1 to 2 Open pins 3 to 4	Open pins 1 to 2 Open pins 3 to 4
Enabled	Short pins 1 to 2 Short pins 3 to 4	Short pins 1 to 2 Short pins 3 to 4

To connect receivers or loud speakers (without the RC filter) use headers FILTEN0 and FILTEN1 pins 1 and 3.

Board Configurations

The following section describes the configuration required for powering the different evaluation board setups.

Motherboard and Daughterboard

If you are using both the motherboard and daughterboard, the following subsections describe how to configure them for power.

Daughterboard Configuration:

To identify the headers on the daughterboard, see Figure 3.

NOTE: Remove solder bridges SB1 and SB2 if they are shorted.

The rest of the configurations depend on the power supply input(s) that you choose. See Table 7.

Table 7. POWER CONFIGURATION OPTIONS FOR THE DAUGHTERBOARD WHEN USED WITH THE MOTHERBOARD

Power Supply Input	Source		
	VDBL	Motherboard Configuration	Other
RFVDD	Populate R4 on the daughterboard with an 11.8 Ω resistor and remove R5. (Default)	Remove R4 and R5 on the daughterboard	<i>External Supply:</i> Populate R5 on the daughterboard with an 11.8 Ω resistor and remove R4.
VDDO2	Populate R8 on the daughterboard with a 0 Ω resistor and remove R9. (Default)	Remove R8 and R9 on the daughterboard	<i>VBAT:</i> Populate R9 on the daughterboard with a 0 Ω resistor and remove R8.
VDDO3	Populate R7 on the daughterboard with a 0 Ω resistor and remove R3	Remove R3 and R7 on the daughterboard	<i>VBAT:</i> Populate R3 on the daughterboard with a 0 Ω resistor and remove R5. (Default)

Motherboard Configuration:

To identify the headers on the motherboard, see Figure 8 on page 16. Do the following:

- Add a jumper to the PSU–SEL header to indicate the powering method for Ezairo 7150 SL
- Connect a jumper or ammeter to the VBAT–I header
- Set SW3 to ON to power the system

WARNING: Do not use a multimeter to measure current on the motherboard because the impedance is unsuitable and results in a non-functioning circuit.

The rest of the configurations depend on the resistors that are populated on the daughterboard:

- The RFVDD–SEL header can only be configured with a jumper if the R4 and R5 resistors on the daughterboard are not populated

- The VDDO2–SEL header can only be configured with a jumper if the R8 and R9 resistors on the daughterboard are not populated
- The VDDO3–SEL header can only be configured with a jumper if the R3 and R7 resistors on the daughterboard are not populated

Daughterboard Only

To identify the headers on the daughterboard, see Figure 3. For all configurations:

- Short the SB1 and SB2 solder bridges on the daughterboard
- Connect an external power source to the VBAT/GND pins to power the system

The rest of the configurations depend on the power supply input(s) that you choose. See Table 8.

Table 8. POWER CONFIGURATION OPTIONS FOR THE DAUGHTERBOARD WHEN USED ALONE

Power Supply Input	Source		
	VDBL	EXT–RFVDD (External)	VBAT
RFVDD	Populate R4 with an 11.8 Ω resistor and remove R5. (Default)	Populate R5 with an 11.8 Ω resistor and remove R4.	N/A
VDDO2	Populate R8 with a 0 Ω resistor and remove R9. (Default)	N/A	Populate R9 with a 0 Ω resistor and remove R8.
VDDO3	Populate R7 with a 0 Ω resistor and remove R3.	N/A	Populate R3 with a 0 Ω resistor and remove R7. (Default)

APPENDIX A – CONNECTORS

Overview

This appendix contains a listing of all connectors on the hybrid demonstrator boards. It is divided into the following sections:

- Jumpers: a complete listing and description of all jumpers and possible configurations
- Headers: a complete listing and description of all headers
- Switches: a complete listing and description of all switches and possible configurations
- Connectors: a complete listing and description of all connectors

Jumpers

Table 9. MOTHERBOARD JUMPER DESCRIPTIONS

Designator	Description
RFVDD–SEL	RFVDD (nRF51822 supply) voltage selection
RVDD–I	RFVDD supply current header and power enable
CAA–GND	Disconnects the I ² C programmer ground from the system ground
VDDO2–SEL	Ezairo 7150 SL VDDO2 voltage selection
VDDO3–SEL	Ezairo 7150 SL VDDO3 voltage selection
VBAT–I	Ezairo 7150 SL VBAT current header and power enable
PSU–SEL	Ezairo 7150 SL VBAT voltage selection
MICGND	Input ground connection to AGND or GNDMIC
FILTEN0	Enable OD0 on-board RC output filter
FILTEN1	Enable OD1 on-board RC output filter
X2	Header for connecting VDDO3 to the CAA VSENSE signal

Headers

Table 10. MOTHERBOARD HEADER DESCRIPTIONS

Designator	Description
RFVDD	RFVDD measurement header
RFVDD–EXT	External power supply header for RFVDD
VDDO2–EXT	External power supply header for VDDO2
VDDO3–EXT	External power supply header for VDDO3
DIO	DIO signals for DIOs: 5, 6, 8, 9, 20, 21, 22, 23, 24, and 29
EXT–PSU	External power supply header for VBAT
X3	Header for optional battery capacitor
VBAT	VBAT measurement header
AI0	AI0 input header
AI1	AI1 input header
AI2	AI2 input header
AI3	AI3 input header
OUT0	OD0 filtered output
OUT1	OD1 filtered output
FILTEN0	OD0 header, non-filtered output at pins 1 and 3
FILTEN1	OD0 header, non-filtered output at pins 1 and 3

Switches

Table 11. SWITCH DESCRIPTIONS

Designator	Description	Board
PSU-SEL	Main power switch select	Motherboard
SW1	Momentary push-button switch for selected DIO	Motherboard
SW2	Momentary push-button select for selected DIO	Motherboard
SW3	Main power (VBAT) ON/OFF switch	Motherboard

Connectors

Table 12. MOTHERBOARD CONNECTOR DESCRIPTIONS

Designator	Description
J1	Reserved for ON Semiconductor internal use
J2	6-pin DIN connector to any I ² C programmer, such as Promira, or HI-PRO, or other Ezairo 7100 development board
X1	Connector header for the daughterboard

Table 13. DAUGHTERBOARD CONNECTOR DESCRIPTIONS

Designator	Description
X1	Connector header for the motherboard

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APPENDIX B – MOTHERBOARD SCHEMATICS

Overview

This appendix contains all schematics for the hybrid demonstrator board motherboard:

- Daughterboard Connector
- Communication Interfaces, Main PSU
- Input/Output Connector

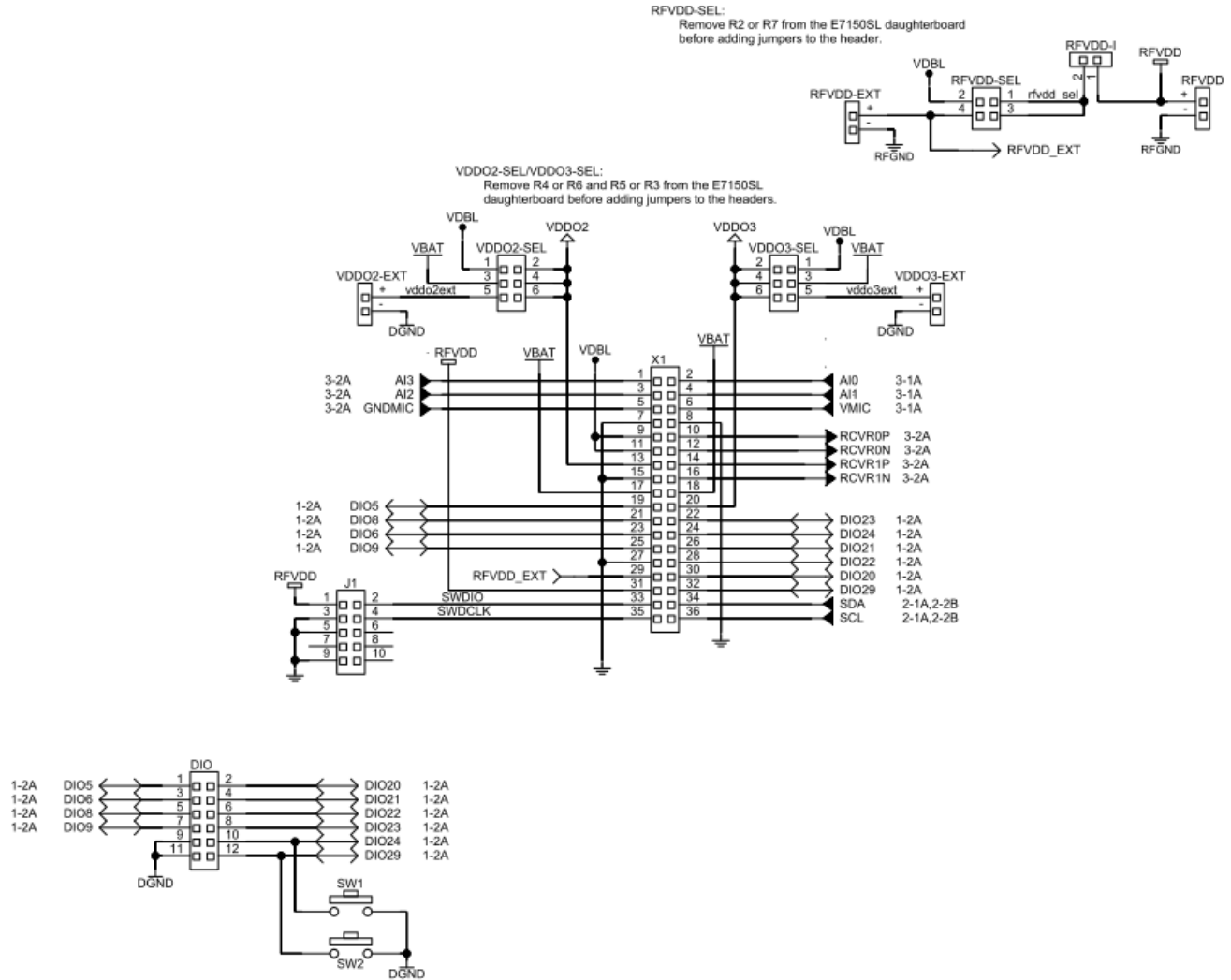


Figure 5. Motherboard: Daughterboard Connector

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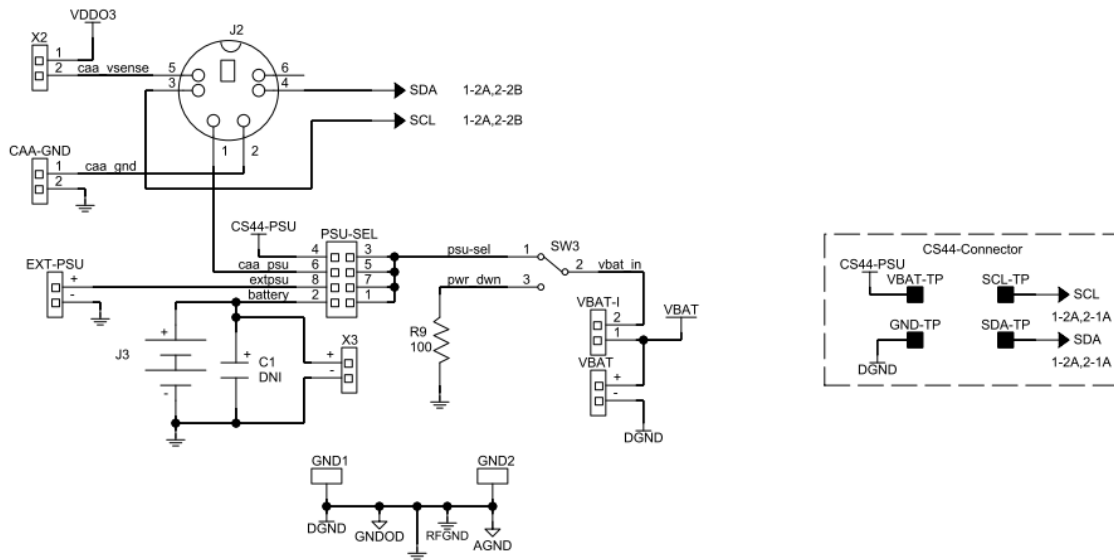


Figure 6. Motherboard: Communication Interfaces, Main PSU

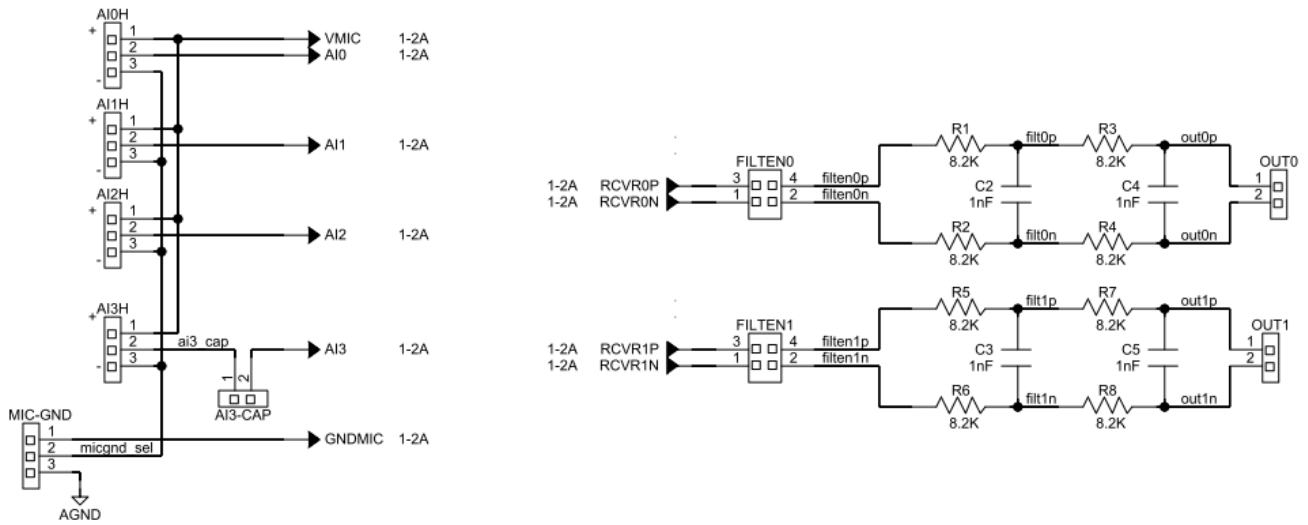


Figure 7. Motherboard: Input/Output Connectors

APPENDIX C – DAUGHTERBOARD SCHEMATIC

Overview

This appendix contains the schematic for the hybrid demonstrator board single-ended antenna version of the daughterboard.

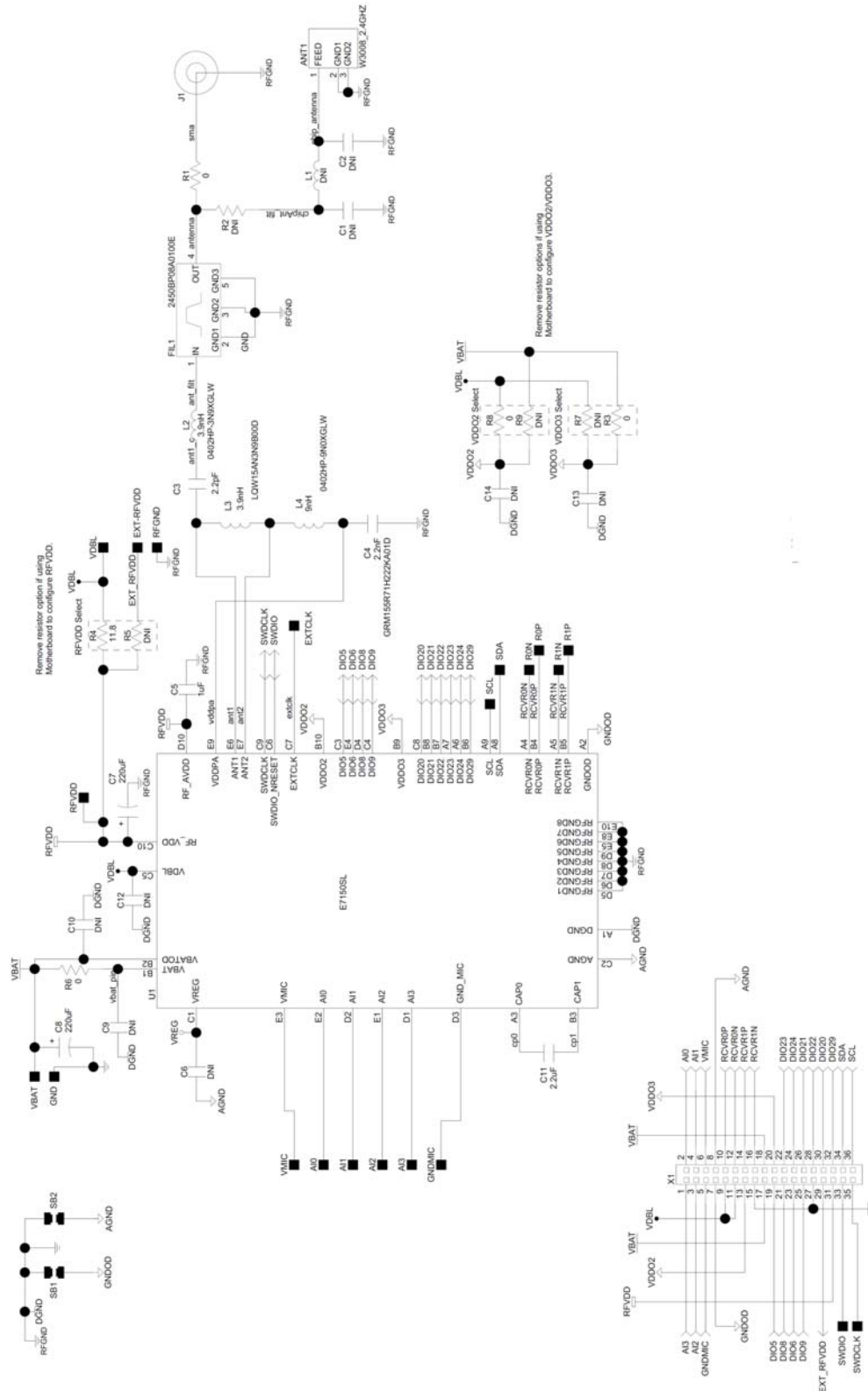



Figure 8. Daughterboard: Ezairo 7150 SL, Motherboard Connector

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