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ADuC7023 Evaluation Board User Guide
MicroConverter ADuC7023 Development System

FEATURES

2-layer printed circuit board (PCB), 4 inch × 5 inch form factor
USB power supply regulated to 3.3 V on board
USB-to-I²C programming interface on board
20-pin standard JTAG connector for programming/ debugging
Demonstration circuit
32.768 kHz watch crystal to drive the PLL clock
ADR291 2.5 V external reference chip
Reset/download/IRQ0 push buttons
Power indicator/general-purpose LEDs
Access to all ADC inputs and DAC outputs from external header; all device ports are routed to external header pins
Surface-mount and through-hole, general-purpose prototype area
The full evaluation kit also includes:
mIDAS-Link JTAG programming POD
CD containing evaluation software, including user manuals, data sheets, example code, I2CWSD, and evaluation compilers
USB cable

GENERAL DESCRIPTION

This user guide refers to the ADuC7023 evaluation boards provided in the EVAL-ADuC7023QSPZ (32-lead LFCSP device based) and the EVAL-ADuC7023QSPZ1 (40-lead LFCSP device based) kits. These evaluation boards allow for the evaluation of the MicroConverter® ADuC7023. The ADuC7023 contains an ARM7TDMI core, 64 kB of Flash, 8 kB of SRAM, a 12-bit, 1 MSPS SAR analog-to-digital converter (ADC), and 4 × 12-bit voltage digital-to-analog converters (DACs), plus many other features.

These evaluation boards allow users to program the ADuC7023 via the JTAG or the I²C interfaces. Users may also debug their source code through the JTAG interface.

In this user guide, all references to the physical orientation of components on the boards are made with respect to a component-side view of the board with the prototype area appearing in the bottom of the board.

The boards are laid out to minimize coupling between the analog and digital sections of the board. To this end, the ground plane is split with the analog section on the left side and a digital plane on the right side of the board. The regulated 3.3 V power supply is routed directly to the digital section and is filtered before being routed into the analog section of the board.

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REVISION HISTORY

7/10—Revision 0: Initial Version

EVALUATION BOARD FEATURES

POWER SUPPLY

Both boards can be directly powered via the mini-USB connector, J1. Alternatively, an external 12 V to 5 V power supply can be connected to the 2-pin header, J7, which is labeled POWER. The pin beside the mini-USB connector is the power pin.

I²C PROGRAMMING INTERFACE

The ADuC7023 is connected to the USB connector via the I²C-to-USB transceiver chip referenced as U5 on the PCB. The interface allows direct connection to the PC via the USB port.

Connect the evaluation board to the PC via the USB port using the mini-USB lead included in the evaluation package.

Prompts appear to install drivers for the new hardware, which includes the following: Serial Converter A, Serial Converter B, and the serial ports. The D2XX direct drivers can be found on the FTDI website. These drivers are also included on the CD with the evaluation kit.

Complete the following steps to install the drivers for the FT2232H device on the evaluation board and to download a hex file to the ADuC7023 internal flash via the I2CWSD application provided with the evaluation software.

1. Select **Install the software automatically (Recommended)** and Click **Next >** to complete the install (see Figure 1).

Figure 1. Found New Hardware Wizard Dialog Box

2. To connect to the Microcontroller, open the I2CWSD application from the Windows® Start menu (see Figure 2). This may also be downloaded from the ADuC7023 product page on the Analog Devices, Inc., website. This I2CWSD is different from the generic I2CWSD application that interfaces to the USB-I2C/LIN-CONVZ dongle.

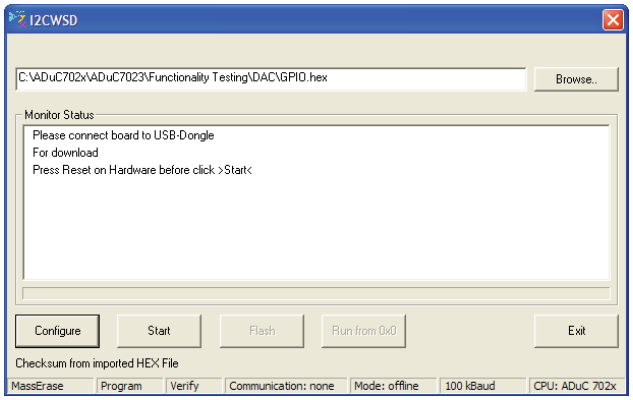

Figure 2. I2CWSD Dialog Box

3. Click **Configure** and select the settings shown in Figure 3.

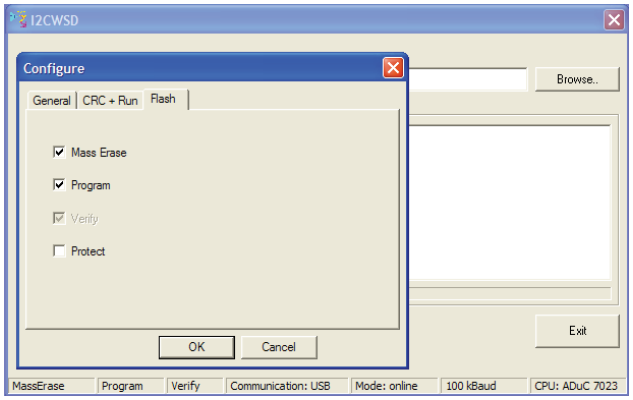

Figure 3. I2CWSD Configure Options

4. Select the hex files location by clicking **Browse..** and reset the evaluation board. This is done by holding down the $\overline{\text{SERIAL DOWNLOAD}}$ button (S2), toggling the $\overline{\text{RESET}}$ button (S3), and releasing the $\overline{\text{SERIAL DOWNLOAD}}$ switch, which then resets the board (see Figure 4).

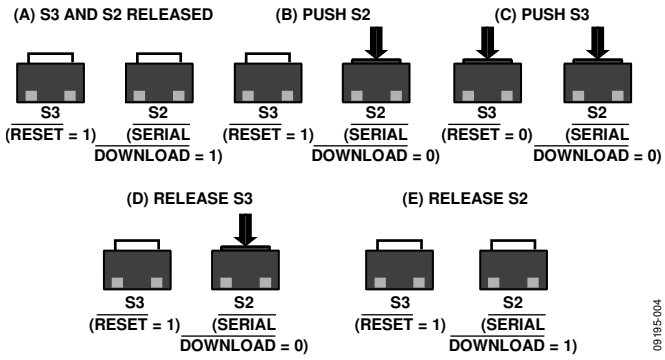

Figure 4. Download Mode Entry Sequence

5. Click **Start** in the I2CWSD dialog box to connect the I2CWSD download software with the ADuC7023 bootloader (see Figure 5).

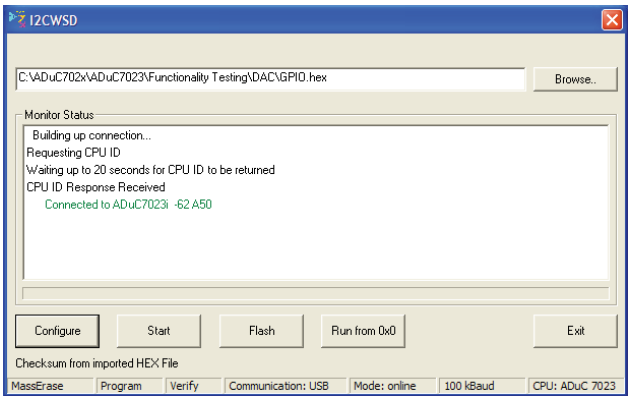

Figure 5. I2CWSD Application Showing a Valid ADuC7023 ID String Response

EMULATION INTERFACE

Nonintrusive emulation and download are possible on the ADuC7023 via JTAG by connecting a JTAG emulator to the J4 connector.

USING P0.4 AND P0.5 AS I²C PINS

The ADuC7023 evaluation boards use an I²C-to-USB transceiver chip, the FT2232H, that allows the ADuC7023 to be programmed directly over the USB interface without any need of an external dongle. However, the FT2232H does drive the P0.4/P0.5 pins of the ADuC7023 by default. To isolate these pins from the FT2232H, run the **Reset_Ft2232h_Io.exe** utility, which can be downloaded from the ADuC7023 product page on the Analog Devices website.

This utility configures the P0.4/P0.5 connection to the FT2232H as input pins, which stops the FT2232H from driving these pins.

Execute this utility if the P0.4/P0.5 pins are intended for any use other than interfacing with the PC via the USB transceiver.

Run the executable from the **Command** window, as shown in Figure 6.

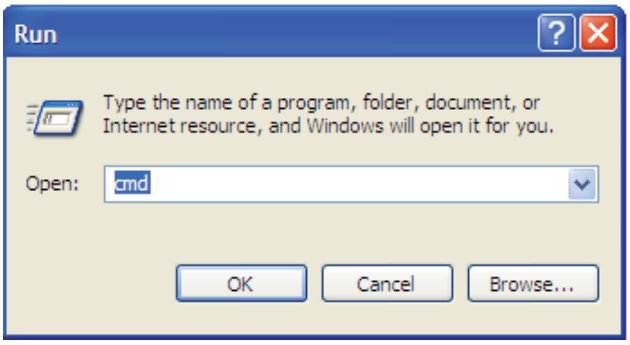

Figure 6. How to Open a Command Window

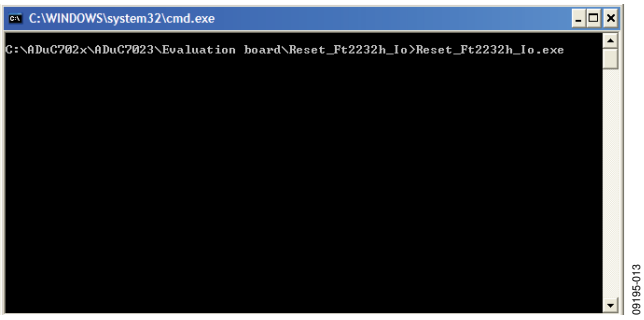

Figure 7. Command to Enter to Run Reset_Ft2232h_Io.exe

Go to the directory where the **Reset_Ft2232h_Io.exe** utility is copied on the PC (see Figure 7 and Figure 8).

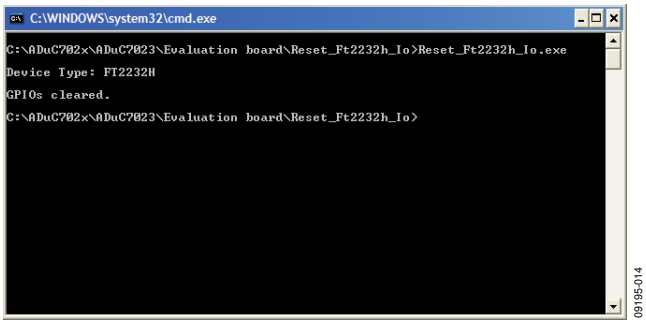

Figure 8. Expected Text after Running Reset_Ft2232h_Io.exe

CRYSTAL CIRCUIT

The board is fitted with a 32.768 kHz crystal, from which the on-chip PLL circuit can generate a 41.78 MHz clock.

EXTERNAL REFERENCE (ADR291E)

The external 2.5 V reference chip, U2, is provided on the evaluation board to demonstrate the external reference option of the ADuC7023.

RESET/DOWNLOAD/IRQ1 PUSH-BUTTONS

A reset push button is provided to allow users to reset the part manually. When pressed, the $\overline{\text{RST}}$ pin of the ADuC7023 is pulled to DGND. Because the $\overline{\text{RST}}$ pin on the ADuC7023 is Schmidt-triggered internally, there is no need to use an external Schmidt trigger on this pin.

When pressed, the IRQ1 push-button switch drives the P1.1 pin high. This can be used to initiate an External Interrupt 1.

On the evaluation board, serial download mode can be easily initiated by holding down the **SERIAL DOWNLOAD** push button (S2) while pressing and releasing the **RESET** button (S3), as shown in the I²C Programming Interface section. Also, ensure that Flash Address 0x80014 contains 0xFFFFFFFF.

POWER INDICATOR/GENERAL-PURPOSE LEDS

A power LED (D5) is used to indicate that a sufficient supply is available on the board. A general-purpose LED (D2) is directly connected to VDDIO and connected to P0.7 of the ADuC7023 through R18. When P0.7 is cleared, the LED turns on. When P0.7 is set, the LED turns off.

ANALOG I/O CONNECTIONS

All analog I/O connections are connected to Header J3.

ADC0 and ADC1 are buffered using an AD8606 to evaluate single-ended and pseudo differential mode. A potentiometer can be connected to ADC0 buffered.

ADC3 and ADC2 can be buffered with a single-ended-to-differential op amp on board, with the AD8132 used to evaluate the ADC in differential mode.

DAC1 can be used to control the brightness of the green LED, D1, when connected via the S1 switch.

GENERAL-PURPOSE PROTOTYPE AREA

General-purpose prototype areas are provided at the bottom of the evaluation board for adding external components as required in the application. As can be seen from the layout, AVDD, AGND, VDDIO, and DGND tracks are provided in this prototype area (see the Evaluation Board, Schematics and Artwork section).

DIP SWITCH LINK OPTIONS

Table 1.

Option	Function	Use
S1-1 VREF	Connects V_{OUT} of the ADR291E to the V_{REF} pin.	Slide S1-1 to the on position to connect V_{OUT} of the ADR291E to V_{REF}. Slide S1-1 to the off position to disconnect V_{OUT} of the ADR291E from V_{REF}.
S1-2 VOCM	Connects V_{OUT} of the ADR291E to VOCM.	Slide S1-2 to the on position to connect V_{OUT} of the ADR291E to VOCM. Slide S1-2 to the off position to disconnect V_{OUT} of the ADR291E from VOCM.
S1-3 POT	Connects POT output to the noninverting input of U4-A, the input buffer for ADC0.	Slide S1-3 to the on position to connect POT to ADC0. Slide S1-3 to the off position to disconnect POT from ADC0.
S1-4 ADC3	Connects ADC3, J3 (Pin 8), to B_ADC3.	Slide S1-4 to the on position to connect ADC3, J3 (Pin 8), to B_ADC3. Slide S1-4 to the off position to disconnect ADC3, J3 (Pin 8), from B_ADC3.
S1-5 ADC3	Connects V+ output of the differential amplifier, U3, to the ADC3 input.	Slide S1-5 to the on position to connect the V+ output of the AD8132 differential amplifier to ADC3. Slide S1-5 to the off position to disconnect the V+ output of the AD8132 differential amplifier from ADC3.
S1-6 ADC2	Connects V– output of the differential amplifier, U3, to the ADC2 input.	Slide S1-6 to the on position to connect the V– output of the AD8132 differential amplifier to ADC2. Slide S1-6 to the off position to disconnect the V– output of the AD8132 differential amplifier to ADC2.
S1-7 ADC2	Not used	Not used.
S1-8 DAC1	Connects DAC1 to D1 for the LED demonstration circuit.	Slide S1-8 to the on position to connect DAC1 to D1. Slide S1-8 to the off position to disconnect DAC1 from D1.

EXTERNAL CONNECTORS

ANALOG I/O CONNECTOR, J3

The analog I/O connector, J3, provides external connections for all ADC inputs, reference inputs, and DAC outputs. The pinout of the connector is shown in Table 2.

Both evaluation board versions have the same pinout.

Table 2. Pin Functions for Analog I/O Connector, J3

Pin Number	Pin Function
J3-1	AVDD
J3-2	AGND
J3-3	VREF
J3-4	AGND
J3-5	POT
J3-6	ADC1
J3-7	ADC2
J3-8	ADC3
J3-9	AVDD
J3-10	AGND
J3-11	AGND
J3-12	AGND
J3-13	DIFF
J3-14	V0CM
J3-15	DAC0
J3-16	DAC1
J3-17	DAC2
J3-18	DAC3
J3-19	AGND
J3-20	AGND

EMULATION CONNECTOR, J4

Connector J4 provides a connection of the evaluation board to the PC via a JTAG emulator.

MINI-USB INTERFACE CONNECTOR, J1

Connector J1 provides power and a simple connection of the evaluation board to the PC via a USB cable provided with the ADuC7023 development system.

DIGITAL I/O CONNECTOR, J2

The digital I/O connector, J2, provides external connections for all GPIOs. The pinout of the connector is shown in Table 3 and Table 4 for the 32-pin and 40-pin boards, with details of the pin functions.

I²C CONNECTOR, J9

Connector J9 provides duplicate external connections from the digital I/O. Table 5 provides further details.

Table 3. Pin Functions for the Digital I/O Connector, J2, on the 32-Pin Evaluation Board

Pin No.	Pin Function
J2-1	DGND
J2-2	P0.0
J2-3	P0.1
J2-4	P0.2
J2-5	P0.3
J2-6	P0.4
J2-7	P0.5
J2-8	P0.6
J2-9	P0.7
J2-10	P1.0
J2-11	P1.1
J2-12	P1.2
J2-13	P1.3
J2-14	VDDIO

Table 4. Pin Functions for the Digital I/O Connector, J2, on the 40-Pin Evaluation Board

Pin No.	Pin Function
J2-1	DGND
J2-2	P0.0
J2-3	P0.1
J2-4	P0.2
J2-5	P0.3
J2-6	P0.4
J2-7	P0.5
J2-8	P0.6
J2-9	P0.7
J2-10	P1.0
J2-11	P1.1
J2-12	P1.2
J2-13	P1.3
J2-14	P2.4
J2-15	P1.4
J2-16	P1.5
J2-17	P1.6
J2-18	P1.7
J2-19	P2.0
J2-20	P2.2
J2-21	P2.3
J2-22	VDDIO

Table 5. Pin Functions for Analog I/O Connector, J9

Pin No.	Pin Function
J9-1	DGND
J9-2	P0.5
J9-3	P0.4
J9-4	VDDIO

EVALUATION BOARD, SCHEMATICS AND ARTWORK

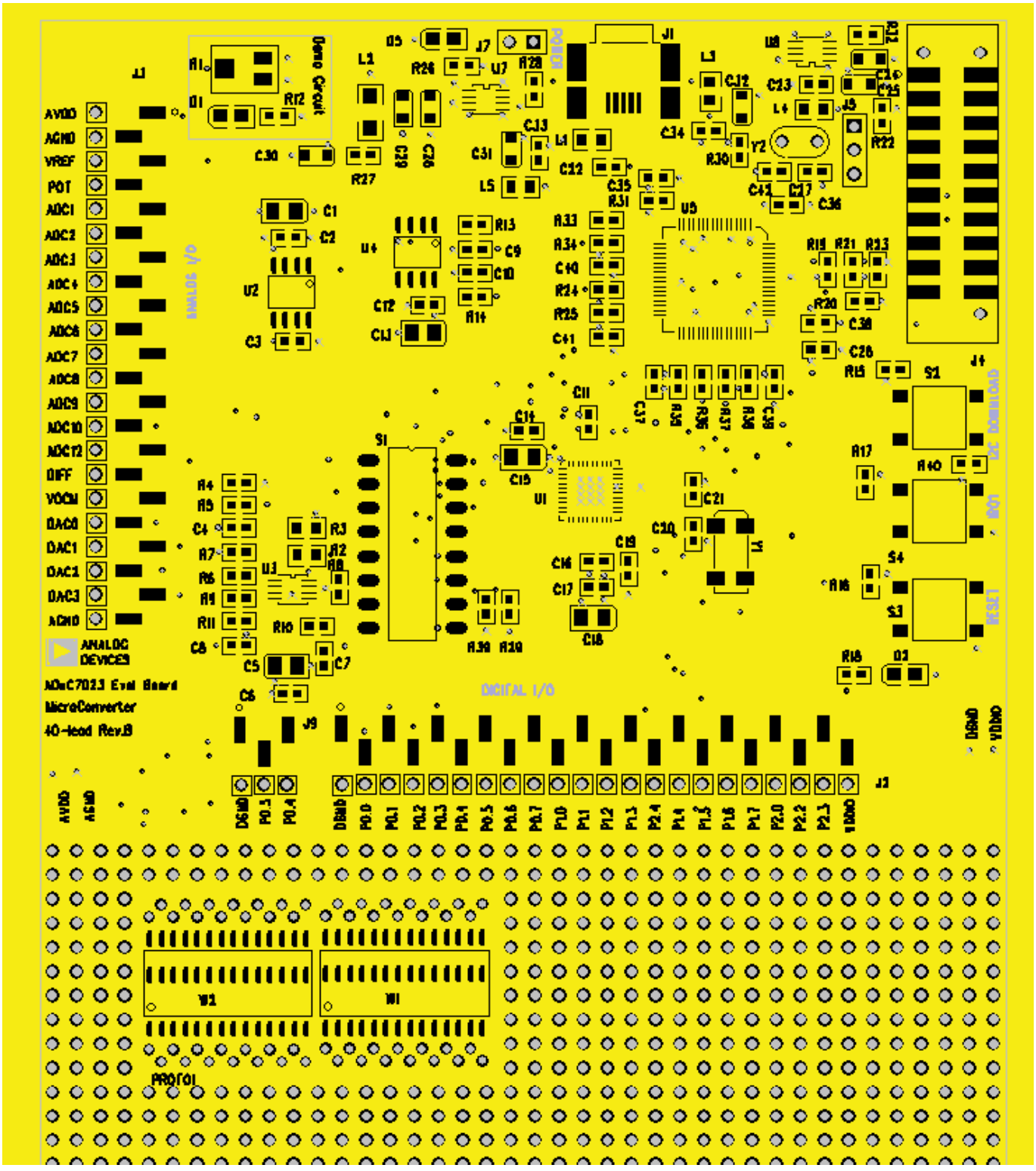

Figure 9. EVAL-ADuC7023QSPZ1, 40-Lead LFCSP Evaluation Board Artwork

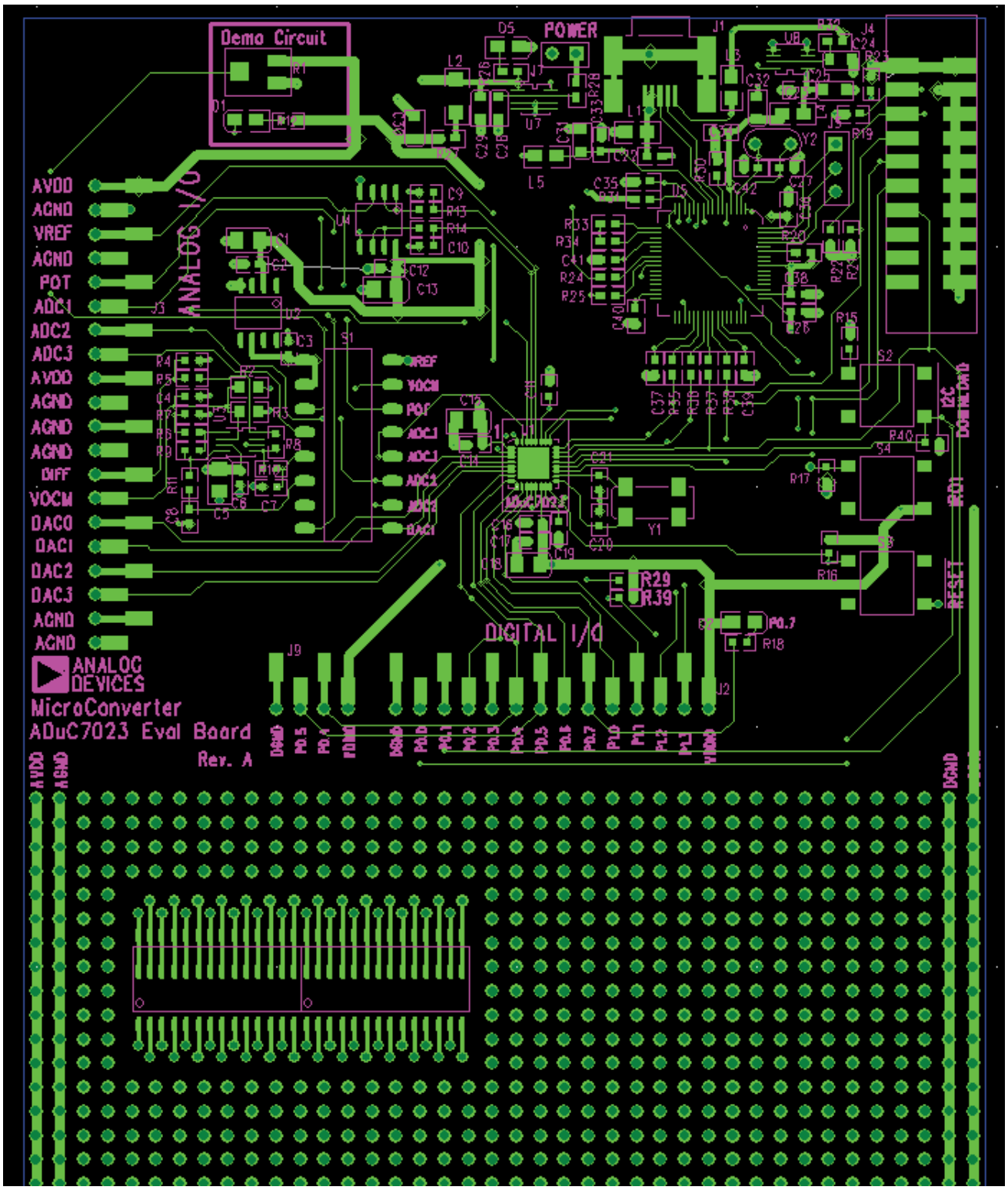

Figure 10. EVAL-ADuC7023QSPZ, 32-Lead LFCSP Evaluation Board Artwork

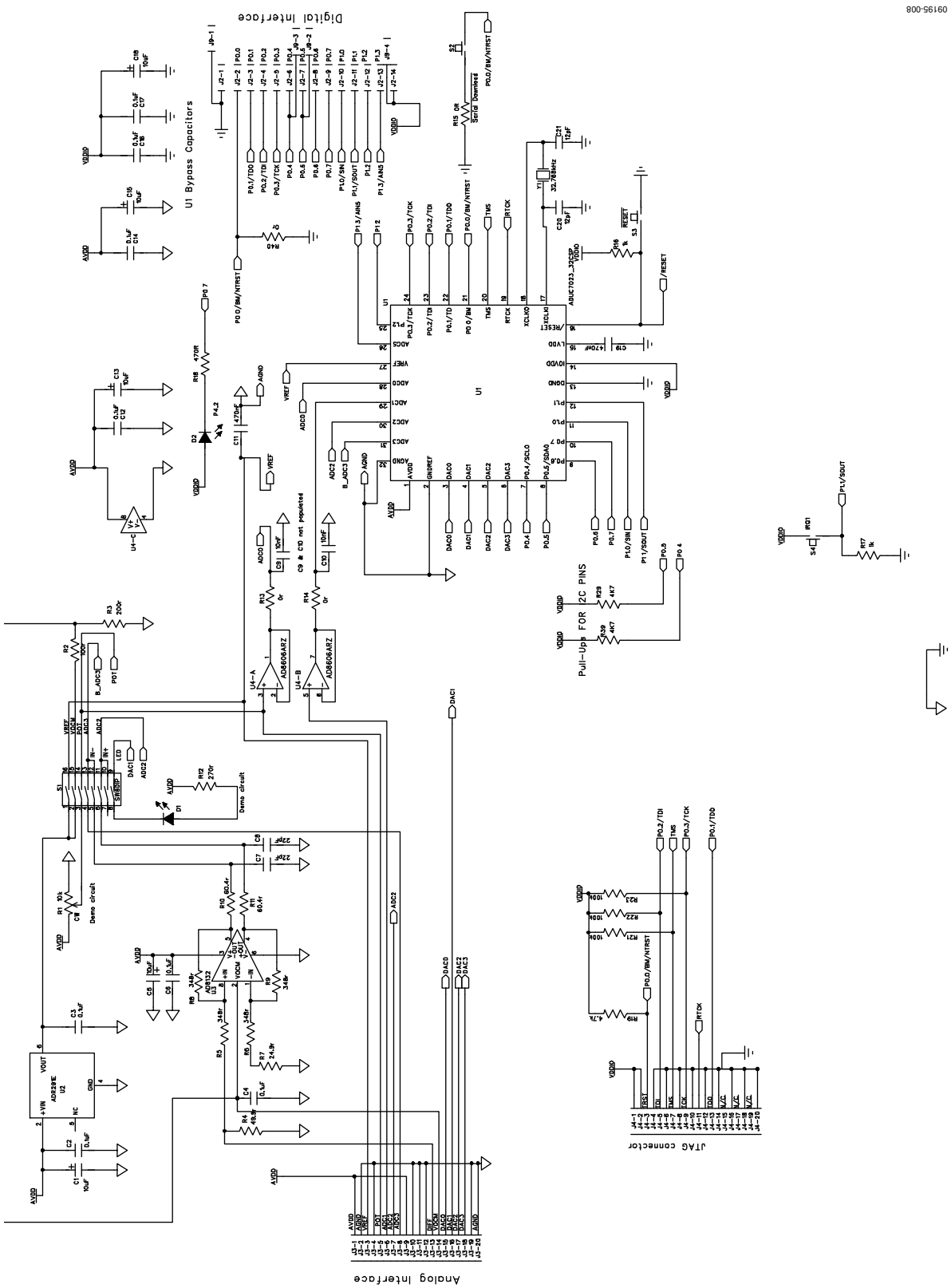

Figure 11. EVAL-ADuC7023QSPZ, 32-LFCSP Evaluation Board Schematic, Page1

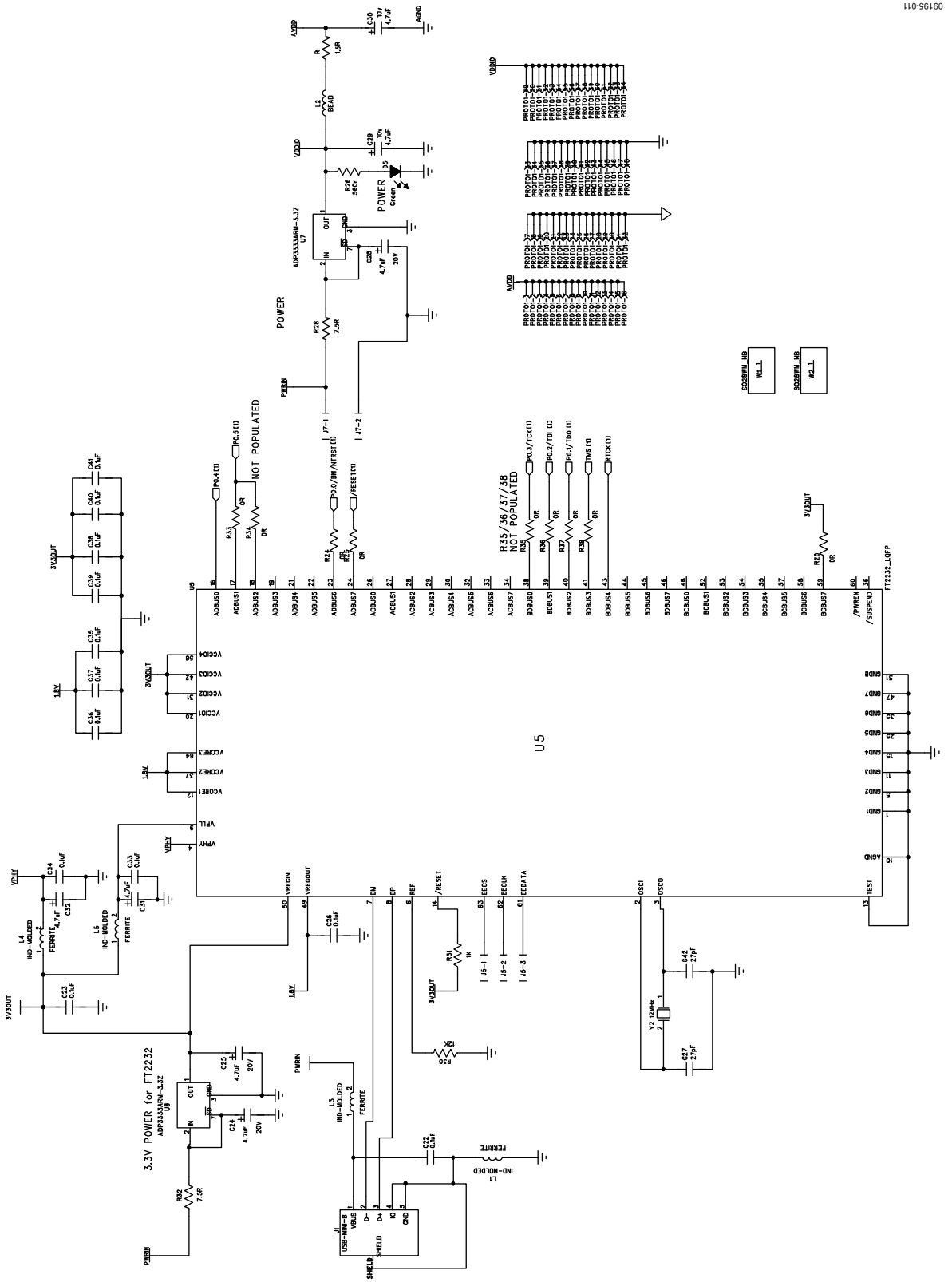

Figure 12. EVAL-ADuC7023QSPZ, 32-LFCSP Evaluation Board Schematic, Page2

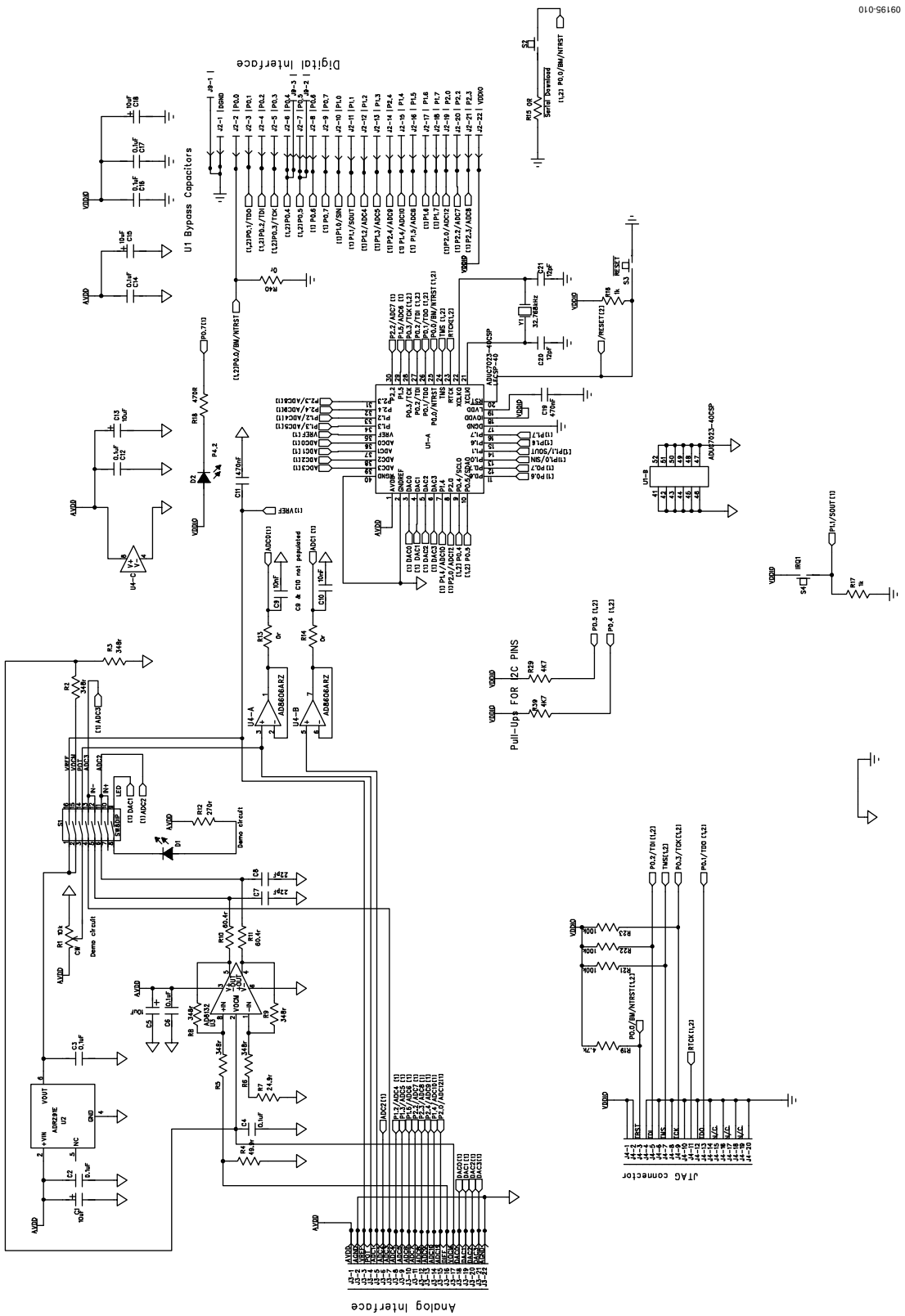

Figure 13. EVAL-ADuC7023QSPZ1, 40-LFCSP Evaluation Board Schematic, Page1

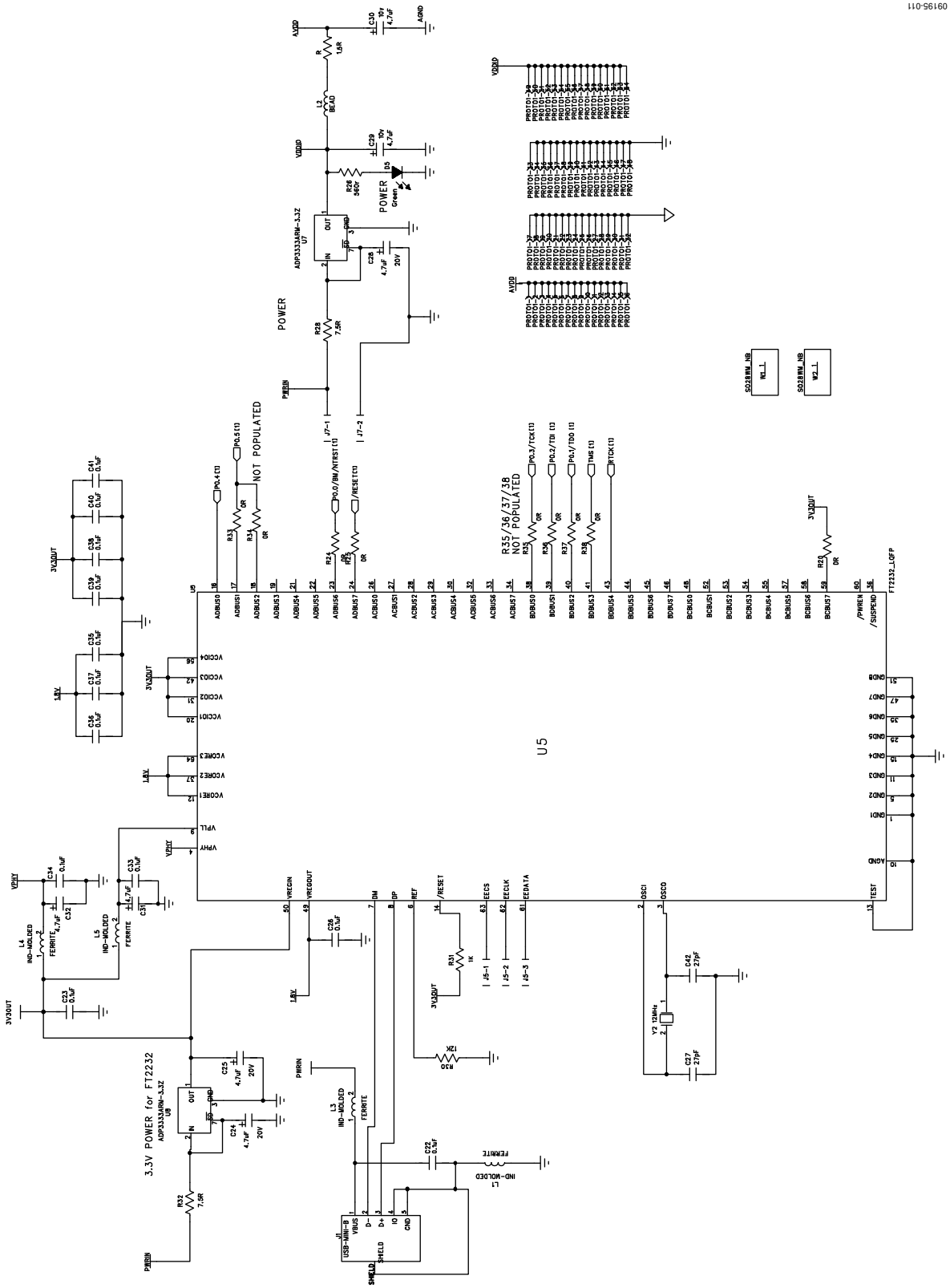

Figure 14. EVAL-ADuC7023QSPZ1, 40-LFCSP Evaluation Board Schematic, Page2

ORDERING INFORMATION

BILL OF MATERIALS

Table 6.

Name	Value[1]	Part Description	Manufacturer[1]	Part No.[1]
C1, C5, C13, C15, C18	10 µF	10 V SMD tantalum capacitors	AVX	FEC 197-130
C2 to C4, C6, C12, C14, C16, C17, C22, C23, C26, C33 to C41	0.1 µF	Multilayer ceramic capacitors, 0603, 25 V	AVX	FEC 317-287
C7, C8	22 pF	Multilayer ceramic capacitors, 0603, 50 V	Phycomp (Yageo)	FEC 722-005
C9, C10	10 nF	Multilayer ceramic capacitors, 0603, 25 V	Phycomp (Yageo)	FEC 301-9561
C11, C19	470 nF	Multilayer ceramic capacitors, 0603, 16 V	Phycomp (Yageo)	FEC 318-8851
C20, C21	12 pF	Multilayer ceramic capacitors, 0603, 50 V	Phycomp (Yageo)	FEC 721-979
C24, C25, C28 to C32	4.7 µF	Capacitors, Case A, 16 V	AVX	FEC 197269
C27, C42	27 pF	Capacitors, 0603, 50 V	Phycomp (Yageo)	FEC 722017
D1, D2, D5	N/A	Green SMD LEDs	Avago Technologies	FEC 4134436
J1	N/A	USB mini-B connector (USB-OTG)	Molex	FEC 9786490
J2	N/A	SIP-14P_SMD, surface-mount terminal strip	Samtec (Sable Electronics)	TSM-114-01-T-SV
J3	N/A	SIP-20P_SMD, surface-mount terminal strip	Samtec (Sable Electronics)	TSM-120-01-T-SV
J4	N/A	20-pin (2 × 10) SMT shrouded header	Samtec	HTST-110-01-L-DV
J7	N/A	Not populated	N/A	N/A
J9	N/A	4-pin inline header; 100 mil centers	Samtec (Sable Electronics)	TSM-104-01-T-SV
L1, L3 to L5	N/A	Ferrite beads, 2012 case	TDK	FEC 1301672
L2	600 Ω	Inductor, SMD	Murata Manufacturing Co.	FEC 9526862
R1	10 kΩ	Trimmer, SMD	Vishay Sfernice	FEC 1141485
R2	100 Ω	SMD resistor, 0805	Multicomp	FEC 933-2375
R3	200 Ω	SMD resistor, 0805	Multicomp	FEC 9332758
R4	49.9 Ω	SMD resistor, 0603, 1%	Yageo	Digi-Key 311-49.9HRCT-ND
R5, R6, R8, R9	348 Ω	SMD resistors, 0603, 1%	Yageo	Digi-Key 311-348HRCT-ND
R7	24.9 Ω	SMD resistor, 0603, 1%	Yageo	Digi-Key 311-24.9HRCT-ND
R10, R11	60.4 Ω	SMD resistors, 0603, 1%	Yageo	Digi-Key 311-60.4HRCT-ND
R12	270 Ω	SMD resistor, 0603, 1%	Multicomp	FEC 9330917
R13, R14, R15, R20, R24, R25, R33 to R38, R40	0 Ω	SMD resistors, 0603	Multicomp	FEC 9331662
R16, R17, R31	1 kΩ	SMD resistors, 0603, 1%	Multicomp	FEC 9330380
R18	470 Ω	SMD resistor, 0603, 1%	Vishay Draloric	FEC 1469815
R19	4.7 kΩ	SMD resistor, 0603, RC21	Phycomp (Yageo)	FEC 9233466
R21 to R23	100 kΩ	SMD resistors, 0603, 1%	Multicomp	FEC 9330402
R26	560 Ω	Resistor, 0603, 1%	Multicomp	FEC 9331344
R27	1.5 Ω	Resistor, 0603, 5%	Multicomp	FEC 9331832
R28, R32	7.5 Ω	Resistor, 0603, 1%, 50 ppm	Phycomp (Yageo)	FEC 1527233
R29, R39	4.7 kΩ	SMD resistor, RC21, 0603	Phycomp (Yageo)	FEC 9233466
R30	12 kΩ	Resistor, RC21, 0603	Phycomp (Yageo)	FEC 9233512
S1		8-position switch (sealed), SMD	Grayhill, Inc.	Digi-Key GH7242-ND
S2 to S4	N/A	Switch SMD, SPNO	OMRON Corporation	FEC 177807

Name	Value[1]	Part Description	Manufacturer[1]	Part No.[1]
U1	N/A	Precision analog microcontroller, 12-bit analog I/O, ARM7TDMI MCU		ADuC7023
U2	N/A	Low noise micropower precision voltage reference (2.5 V)	Analog Devices, Inc.	ADR291ERZ
U3	N/A	Low cost, high speed differential amplifier	Analog Devices, Inc.	AD8132ARMZ
U4	N/A	Precision, low noise, CMOS, rail-to-rail, input/output operational amplifier (dual)	Analog Devices, Inc.	AD8606ARZ
U5	N/A	Dual high speed USB to multipurpose UART/FIFO IC	FTDI	FT2232HL
U7, U8	N/A	High accuracy ultralow I_Q, 300 mA, anyCAP® low dropout regulator	Analog Devices, Inc.	ADP3333ARM-3.3Z
Y1	32.768 kHz	SMD crystal	IQD Frequency Products	FEC 9713220
Y2	12 MHz	Crystal, 16 pF through hole	ABRACON	FEC 7942060

[1] N/A is not applicable.

RELATED LINKS

Resource	Description
ADuC7023	Product Page, Precision Analog Microcontroller, 12-Bit Analog I/O, ARM7TDMI MCU
EVAL-ADuC7023QSPZ	32-Lead LFCSP ADuC7032 Evaluation Board
EVAL-ADuC7023QSPZ1	40-Lead LFCSP ADuC7032 Evaluation Board
ADR291	Product Page, Low Noise Micropower Precision Voltage Reference (2.5 V)
AD8606	Product Page, Precision, Low Noise, CMOS, Rail-To-Rail, Input/Output Operational Amplifier (Dual)
AD8132	Product Page, Low Cost, High Speed Differential Amplifier

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.

UG09195-0-7/10(0)

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