AN-904
APPLICATION NOTE

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ADuC7028 Evaluation Board Reference Guide
MicroConverter® ADuC7028 Development System

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EVALUATION BOARD OVERVIEW

The ADuC7028 evaluation board has the following features:

- 2-layer PCB (4 in × 5 in form factor).
- 9 V power supply regulated to 3.3 V on board.
- 4-pin UART header to connect to RS-232 interface cable.
- 20-pin standard JTAG connector.
- 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 output from external header. All device ports are brought out to external header pins.
- Surface-mount and through-hole general-purpose prototype area.

CONSIDERATIONS

- This application note refers to the MicroConverter ADuC7028 evaluation board.
- All references in this application note to the physical orientation of components on the board are made with respect to a component-side view of the board with the prototype area appearing in the bottom of the board.
- The board is 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.

EVALUATION BOARD FEATURES

POWER SUPPLY

The user should connect the 9 V power supply via the 2.1 mm input power socket (J5). The input connector is configured as a center negative, that is, with GND on the center pin and +9 V on the outer shield.

The 9 V supply is regulated via the Linear Voltage Regulator U5. The 3.3 V regulator output is used to drive the digital side of the board directly. The 3.3 V supply is also filtered and then used to supply the analog side of the board.

When on, the LED (D3) indicates that a valid 3.3 V supply is driven from the regulator circuit. All active components are decoupled with 0.1 µF at device supply pins to ground.

RS-232 INTERFACE

The ADuC7028 (U1) P1.1 and P1.0 lines are connected to the RS232 interface cable via Connector J1. The interface cable generates the required level shifting to allow direct connection to a PC serial port. Ensure that the cable supplied is connected to the board correctly, that is, DVDD is connected to DVDD and DGND is connected to DGND.

EMULATION INTERFACE

Nonintrusive emulation and download are possible on the ADuC7028 via JTAG by connecting a JTAG emulator to the J4 connector.

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 (ADR291)

The external 2.5 V Reference Chip U2 has two functions. It is provided on the evaluation board to demonstrate the external reference option of the ADuC7028, but its main purpose is to generate the VOCM voltage of the differential amplifier if required.

RESET/DOWNLOAD/IRQ0 PUSH BUTTONS

A reset push button is provided to allow the user to reset the part manually. When pressed, the reset pin of the ADuC7028 is pulled to DGND. Because the $\overline{\text{RST}}$ pin on the ADuC7028 is Schmidt-triggered internally, there is no need to use an external Schmidt trigger on this pin.

When pressed, the IRQ0 push button switch drives P0.4/IRQ0 high. This can be used to initiate an external interrupt 0.

To enter serial download mode, the user must pull the P0.0/BM pin low while reset is toggled. 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 Figure 1.

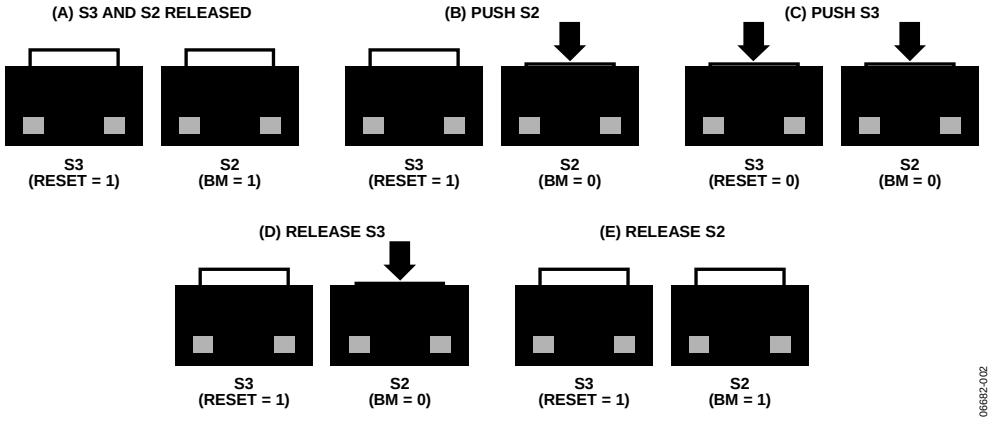

Figure 1. Entering Serial Download Mode on the Evaluation Board

POWER INDICATOR/GENERAL PURPOSE LEDS

A power LED (D3) is used to indicate that a sufficient supply is available on the board. A general-purpose LED (D2) is directly connected to P4.2 of the ADuC7028. When P4.2 is cleared, the LED is turned on and when P4.2 is set, the LED is turned off.

ANALOG I/O CONNECTIONS

All analog I/O connections are brought out on Header J3.

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

ADC3 and ADC4 can be buffered with a single-ended-to-differential op amp on-board, with the AD8132 used to evaluate the ADC in fully differential mode.

ADC2, ADC5, ADC6 and ADC7 are not buffered. Be sure to follow the ADuC7028 data sheet recommendations when connecting signals to these inputs.

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 user's application. As can be seen from the layout in Figure 3, AV_{DD}, AGND, V_{DDIO}, and DGND tracks are provided in this prototype area.

DIP SWITCH LINK OPTIONS

S1-1 VREF

Function

Connects the output of the 2.5 V external reference (ADR291) to the V_{REF} pin (Pin B5) of the ADuC7028.

Use

Slide S1-1 to the on position to connect the external reference to the ADuC7028.

Slide S1-1 to the off position to use the internal 2.5 V reference or a different external reference on the V_{REF} pin of Header J3.

S1-2 V_{OCM}

Function

Connects 1.67 V to the V_{OCM} pin of the AD8132. No extra dc voltage is required on the board to use the ADC in differential mode.

Use

Slide S1-2 to the on position to connect V_{OCM} of the differential amplifier to the 1.67 V divided output of the ADR291 reference.

Slide S1-2 to the off position to use a different voltage for V_{OCM} by connecting a dc voltage to the V_{OCM} pin of Header J3. Note that the V_{OCM} value is dependent on the reference value, as shown in Table 1.

Table 1. V_{OCM} Range

V_{REF}	V_{OCM} Minimum	V_{OCM} Maximum
2.5 V	1.25 V	2.05 V
2.048 V	1.024 V	2.276 V
1.25 V	0.75 V	2.55 V

S1-3 POT

Function

Connects the potentiometer output to ADC0. This input is buffered by an AD8606. This is for demonstration purposes.

Use

Slide S1-3 to the on position to connect the potentiometer to the op amp of the ADC0 input channel.

Slide S1-3 to the off position to use the ADC0 input on Header J3.

S1-4 ADC3

Function

Brings out ADC3 (Pin A1) on Header J3.

Use

Slide S1-6 to the on position to connect ADC3 of Header J3 directly to the ADC3 pin (Pin A1) of the ADuC7028.

Slide S1-6 to the off position to disconnect ADC3 of Header J3 from the ADC3 pin (Pin A1) of the ADuC7028.

S1-5 VIN–

Function

Connects the –OUT pin of the single-ended-to-differential op amp (AD8132) to ADC3. S1-5 and S1-6 must be used together. When S1-5 VIN– is in the on position, S1-6 VIN+ must also be in the on position to use the differential op amp on Channel ADC3 and Channel ADC4.

Use

Slide S1-5 to the on position to connect –OUT of the AD8132 to ADC3.

Slide S1-5 to the off position to use ADC3 without the AD8132.

S1-6 VIN+

Function

Connects the +OUT pin of the single-ended to differential op amp (AD8132) to ADC4. When S1-6 VIN+ is in the on position, S1-5 VIN– must also be in the on position to use the differential op amp on Channel ADC3 and Channel ADC4.

Use

Slide S1-6 to the on position to connect +OUT of AD8132 to ADC4.

Slide S1-6 to the off position to use ADC4 without the AD8132.

S1-7 ADC4

Function

Brings out ADC4 (Pin B1) on Header J3.

Use

Slide S1-7 to the on position to connect ADC4 of Header J3 directly to the ADC4 pin (Pin B1) of the ADuC7028.

Slide S1-7 to the off position to disconnect ADC4 of Header J3 from the ADC4 pin (Pin B1) of the ADuC7028.

S1-8 LED

Function

Connects the DAC1 output to the green LED of the demo circuit, D1.

Use

Slide S1-8 to the on position to connect the DAC1 output to D1.

Slide S1-8 to the off position to use the DAC1 output on Header J3.

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.

POWER SUPPLY CONNECTOR J5

Connector J5 allows for connection between the evaluation board and the 9 V power supply provided in the ADuC7028 development system.

EMULATION CONNECTOR J4

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

SERIAL INTERFACE CONNECTOR J1

Connector J1 provides a simple connection of the evaluation board to the PC via a serial port cable provided with the ADuC7028 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, with details of the pin functions.

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

Pin Number	Pin Function
J3-1	AV_{DD}
J3-2	AGND
J3-3	V_{REF}
J3-4	DAC_{REF}
J3-5	ADC0
J3-6	ADC1
J3-7	ADC2
J3-8	ADC3
J3-9	ADC4
J3-10	ADC5
J3-11	ADC6
J3-12	ADC7
J3-13	V_{DIFF}
J3-14	V_{OCM}
J3-15	DAC0
J3-16	DAC1
J3-17	DAC2
J3-18	DAC3
J3-19	ADC_{NEG}
J3-20	AGND

Table 3. Pin Functions for Digital I/O Connector J2

Pin No.	Pin Function
J2-1	DGND
J2-2	P4.5 PLAO[13]
J2-3	P4.4 PLAO[12]
J2-4	P4.3 PLAO[11]
J2-5	P4.2 PLAO[10]
J2-6	P1.0 T1/SPM0/PLAI[0]
J2-7	P1.1 SPM1/PLAI[1]
J2-8	P1.2 SPM2/PLAI[2]
J2-9	P1.3 CTS/SDA1/PLAI[3]
J2-10	P1.4 IRQ2/RI/CLK/PLAI[4]
J2-11	P1.5 IRQ3/SPM5/PLAI[5]
J2-12	P4.1 PLAO[9]
J2-13	P4.0 PLAO[8]
J2-14	P1.6 SPM6/PLAI[6]
J2-15	P1.7 SPM7/PLAO[0]
J2-16	P3.7 PWM_{SYNC}/PLAI[15]
J2-17	P3.6 PWM_{TRIP}/PLAI[14]
J2-18	P0.7 ECLK/XCLK/SPM8/PLAO[4]
J2-19	P2.0 $\overline{CONV}_{START}$/SPM9/PLAO[5]
J2-20	P0.5 IRQ1/ADC_{BUSY}/PLAO[2]
J2-21	P0.4 IRQ0/PWM_{TRIP}/PLAO[1]
J2-22	P3.5 $PWM2_L$/PLAI[13]
J2-23	P3.4 $PWM2_H$/PLAI[12]
J2-24	P0.3 TRST/ADC_{BUSY}
J2-25	P3.3 $PWM1_L$/PLAI[11]
J2-26	P3.2 $PWM1_H$/PLAI[10]
J2-27	P3.1 $PWM0_L$/PLAI[9]
J2-28	P3.0 $PWM0_H$/PLAI[8]
J2-29	P0.6 T1/MRST/PLAO[3]
J2-30	P0.0 CMP_{OUT}/PLAI[7]/BM
J2-31	P4.7 PLAO[15]
J2-32	P4.6 PLAO[14]
J2-33	DGND
J2-34	DGND

POTENTIOMETER DEMONSTRATION CIRCUIT

Using the sample code in pot.c located in the code example folder, the variation in the potentiometer resistance can be seen on the output LED.

Note that the internal and external reference are 2.5 V, which gives an ADC input range of 0 V to 2.5 V in single-ended mode. The potentiometer can give a voltage between 0 V and AV_{DD} = 3.3 V.

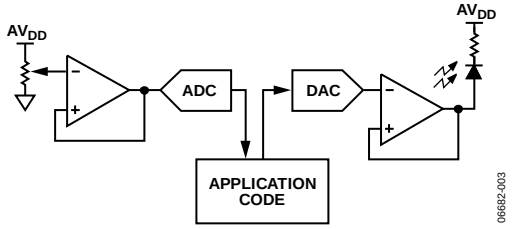

Figure 2. Circuit Diagram of the RTD Circuit

SCHEMATIC AND ARTWORK

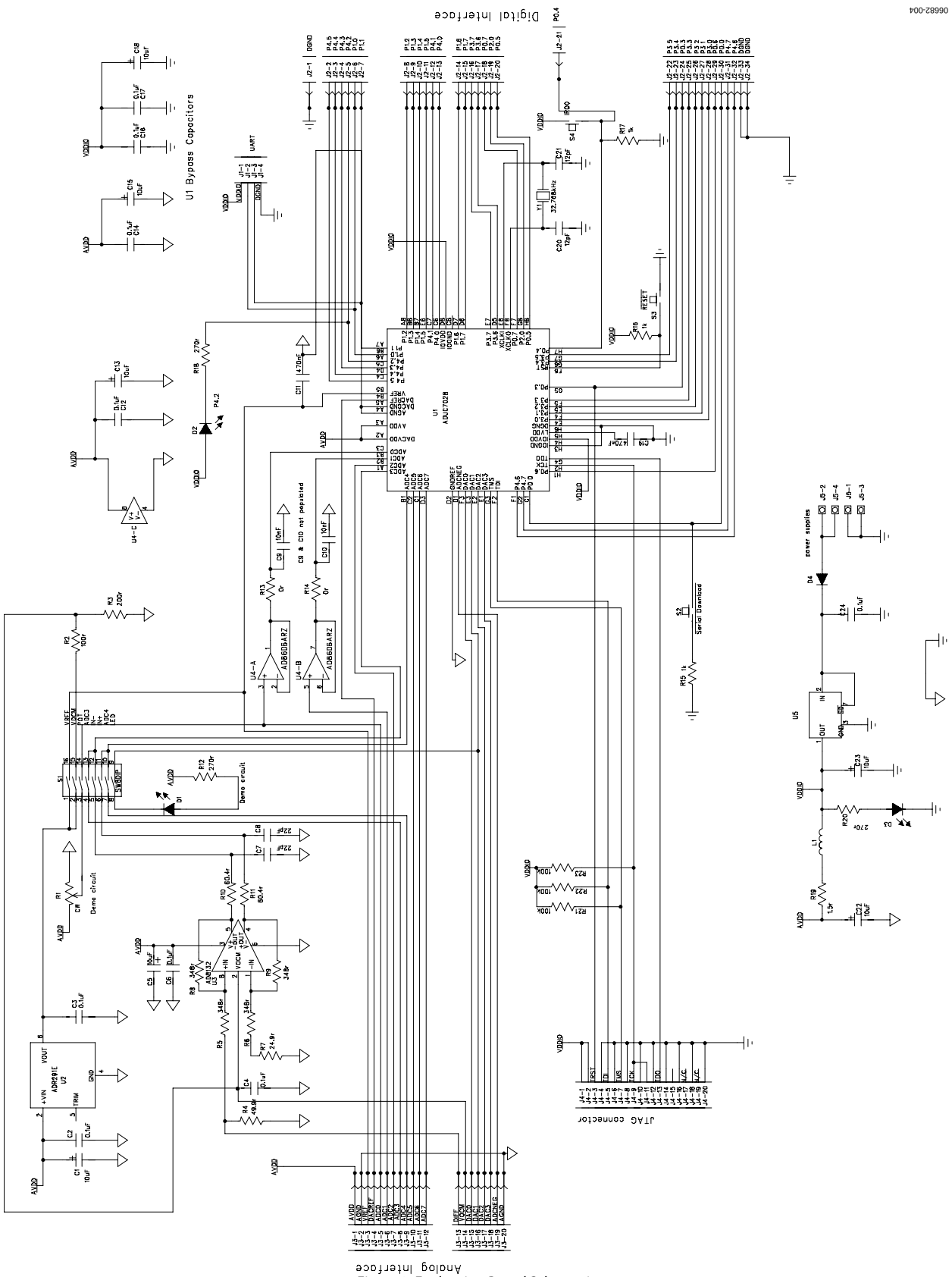

Figure 3. Evaluation Board Schematic

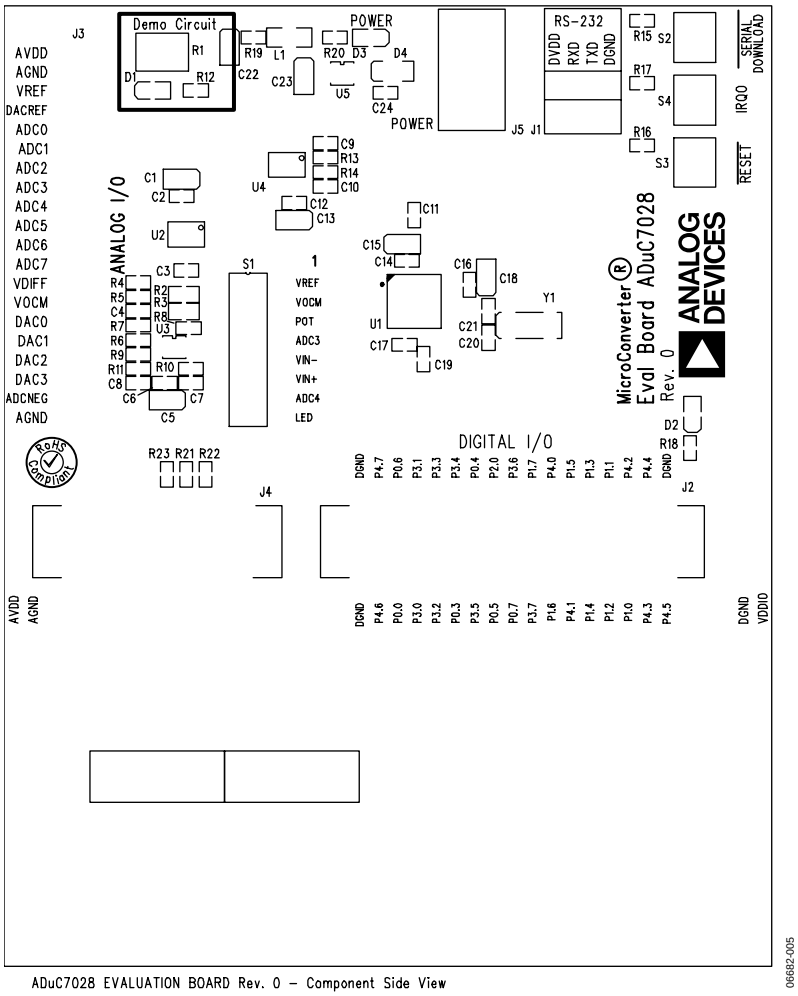

Figure 4. Evaluation Board Silkscreen

ADuC7028 EVALUATION BOARD PARTS LIST

Table 4.

Qty	Component	Description	Order No.	Supplier
1	EVAL-ADuC7028QS QuickStart PCB	Two-sided surface-mount PCB-1		
4	PCB Stand-off	Stand-off, stick-on mounting feet	1165061	Farnell
1	U1	MicroConverter	ADuC7028	Analog Devices
1	U2	Band gap reference	ADR291ERZ	Analog Devices
1	U3	Differential op amp	AD8132ARMZ	Analog Devices
1	U4	Dual op amp, (8-lead SOIC)	AD8606ARZ	Analog Devices
1	U5	Fixed 3.3 V linear voltage regulator	ADP3333ARM3.3	Analog Devices
1	Y1	32.768 kHz watch crystal	FEC 9713220	Farnell
1	S1	SW/8-way DIP switch	FEC 9479112	Farnell
3	S2, S3, S4	PCB-mounted push-button switch	FEC 177807	Farnell
3	D1, D2, D3	1.8 mm miniature LED	FEC 8530220	Fairchild Semiconductor
1	D4	PRLL4002 diode	BAV103TPMSCT-ND	Digikey
7	C1, C5, C13, C15, C18, C22, C23	10 µF surface-mount tantalum capacitor, Taj-B case	FEC 1135105	Farnell
2	C9, C10	10 nF surface-mount ceramic capacitor, case 0603	FEC 3019561	Farnell
9	C2, C3, C4, C6, C12, C14, C16, C17, C24	0.1 µF surface-mount ceramic capacitor, 0603 case	FEC 9406204	Farnell
2	C7, C8	22 pF surface-mount ceramic capacitor, 0603 case	FEC 722005	Farnell
2	C11, C19	470 nF surface-mount ceramic capacitor, 0603 case	FEC 3188851	Farnell
2	C20, C21	12 pF surface-mount ceramic capacitor, 0603 case	FEC 721979	Farnell
1	R1	10 kΩ potentiometer, 0.25 W, 4 series, 4 mm square, sealed, 20% tolerance	TS53YJ	Vishay
1	R2	100 Ω surface-mount resistor, 0603 case	FEC 9332375	Farnell
1	R3	200 Ω surface-mount resistor, 0603 case	FEC 9332758	Farnell
1	R4	49.9 Ω surface-mount resistor, 0805 case	FEC 1170658	Farnell
4	R5, R6, R8, R9	348 Ω surface-mount resistor, 0603 case	FEC 1170742	Farnell
1	R7	24.9 Ω surface-mount resistor, 0805 case	FEC 1170628	Farnell
2	R10, R11	60.4 Ω surface-mount resistor, 0805 case	FEC 1170666	Farnell
3	R12, R18 R20	270 Ω surface-mount resistor, 0603 case	FEC 9330917	Farnell
2	R13, R14	0 Ω surface-mount resistor, 0603 case	FEC 9331662	Farnell
3	R15, R16, R17	1 kΩ surface mount resistor, 0603 case	FEC 9330380	Farnell
1	R19	1.5 Ω surface-mount resistor, 0603 case	FEC 9331832	Farnell
3	R21, R22, R23	100 kΩ surface-mount resistor, 0603 case	FEC 177807	Farnell
1	L1	Ferrite bead surface-mount inductor, 1206 case	FEC 9526862	Farnell
1	J1	4-pin, 90° single row header	TSM-104-02-T-SH	Samtec
1	J2	34-pin straight single row header	TSM-117-01-T-DV	Samtec
1	J3	20-pin straight single row header	TSM-120-01-T-SV	Samtec
1	J4	20-pin connector	HTST-110-01-L-DV	Samtec
1	J5	PCB-mounted power socket (2 mm pin diameter)	KLDX-SMT2-0202-A	Kycon

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EVAL-ADUC7028QSZ