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Freescale Semiconductor, Inc.
User's Guide

Document Number: FRDMKW40ZUG
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FRDM-KW40Z Freescale Freedom Development Board
User's Guide

1 Introduction

This guide describes the hardware for the FRDM-KW40Z Freescale Freedom development board. The FRDM-KW40Z Freedom development board is a small, low-power, and cost-effective evaluation and development board for application prototyping and demonstration of the MKW40Z SoC family of devices. These evaluation boards offer easy-to-use mass-storage-device mode flash programmer, a virtual serial port, and standard programming and run-control capabilities.

The MKW40Z SoC is an ultra-low-power, highly integrated single-chip device that enables Bluetooth Low Energy (BLE) and/or IEEE® Std. 802.15.4/RF connectivity for portable, ultra-low-power embedded systems.
The MKW40Z SoC family integrates a radio transceiver operating in the 2.36 GHz to 2.48 GHz range (supporting a range of FSK/GFSK and O-QPSK modulations), ARM® Cortex®-M0+ CPU, 160 KB flash memory and 20 KB SRAM, BLE Link Layer hardware, 802.15.4 packet processor hardware, and peripherals optimized to meet the requirements of the target applications.

1.1 Audience

This guide is intended for system designers.

Contents

2 Safety information

2.1 FCC guidelines

This equipment is to be used by developers for evaluation purposes only, and must not be incorporated into any other device or system. This device must not be sold to the general public. Integrators are responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

The FCC approval of this device only covers the original configuration of this device (as supplied). Any modifications to this product (including changes shown in this guide) may violate the rules of the Federal Communications Commission and Industry Canada and make the operation of the product unlawful.

2.1.1 Labeling

The FCC labels are located on the back of the board.

2.1.2 Operating conditions

The device must comply with part 15 of the FCC rules. Operation is subject to these two conditions:

- This device must not cause harmful interference.
- This device must accept any interference received, including interference that can cause undesired operation.

2.1.3 Exposure limits

The device must comply with FCC radiation exposure limits set forth for an uncontrolled environment. Install the antenna(s) used by the device to provide a separation distance of at least 8 inches (20 cm) from all persons.

2.1.4 Antenna restrictions

An intentional radiator must be designed to ensure that no antenna (other than that furnished by the responsible party) is used with the device. Using a permanently attached antenna or an antenna that uses a unique coupling to the intentional radiator is considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but using a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221 of the IEEE 802.15.4 Standard. This requirement does not apply to intentional radiators that must be professionally installed (such as perimeter protection systems and field disturbance sensors) or to other intentional radiators which must be measured at the installation site (in accordance with Section 15.31(d)). The installer is responsible for ensuring that a proper antenna is employed (to not exceed the limits in this Part).

2.2 Regulatory approval for Canada (IC RSS 210)

This equipment complies with Industry Canada license-exempt RSS standard(s). Operation is subject to these two conditions:

1. This board must not cause interference.
2. This board must accept any interference, including interference that may cause undesired operation of the device.

2.2.1 26 PART 5—Appendix

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

2.3 Electrostatic discharge considerations

Although the damage from electrostatic discharge (ESD) is much less common on these devices when compared to the early CMOS circuits, use standard handling precautions to avoid exposure to static discharge. Qualification tests are performed to ensure that these devices can withstand exposure to reasonable levels of static without suffering any permanent damage.

All ESD testing must conform to the JESD22 Stress Test Qualification for Commercial Grade Integrated Circuits. During the device qualification, ESD stresses were performed for the Human Body Model (HBM), the Machine Model (MM), and the Charge Device Model (CDM).

All latch-up test testing must conform to the JESD78 IC Latch-Up Test.

When operating or handling the development boards or components, Freescale strongly recommends using at least grounding wrist straps, plus any (or all) of these ESD dissipation methods:

- Flexible fabric, solid fixed size, or disposable ESD wrist straps.
- Static control workstations, static control monitors and table or floor static control systems.
- Static control packaging and transportation materials and environmental systems.

2.4 Disposal instructions

This product may be subject to special disposal requirements. For product disposal instructions, see freescale.com/productdisposal.

3 FRDM-KW40Z overview and description

3.1 Introduction

The FRDM-KW40Z development board is an evaluation environment supporting Freescale MKW40Z SoC transceiver.

The MKW40Z SoC integrates a radio transceiver operating in the 2.36 GHz to 2.48 GHz range (supporting a range of FSK/GFSK and O-QPSK modulations) and an ARM Cortex-M0+ MCU into a single package.

Freescale supports the MKW40Z SoC with tools and software that include hardware evaluation and development boards, software development IDE, applications, drivers, custom PHY usable with IEEE Std. 802.15.4 compatible MAC, BLE Link Layer, and enables the usage of the Bluetooth Low Energy protocol in the MBAN frequency range for proprietary applications.

The FRDM-KW40Z development board consists of the MKW40Z device with 32 MHz reference oscillator crystal, RF circuitry (including antenna), 2-Mbit external serial flash, and supporting circuitry in the popular Freedom form. The board is a standalone PCB and supports application development with Freescale IEEE Std. 802.15.4 protocol stacks.

3.2 Board features

3.2.1 FRDM-KW40Z board

The FRDM-KW40Z development board is based on Freescale Freedom development platform. It is the most diverse reference design containing the MKW40Z device and all necessary I/O connections for use as a standalone board, or connected to an application. You can also connect it to the Freedom development platform.

Figure 1 shows the FRDM-KW40Z development board. A similar board (not shown) uses the MKW40Z device.

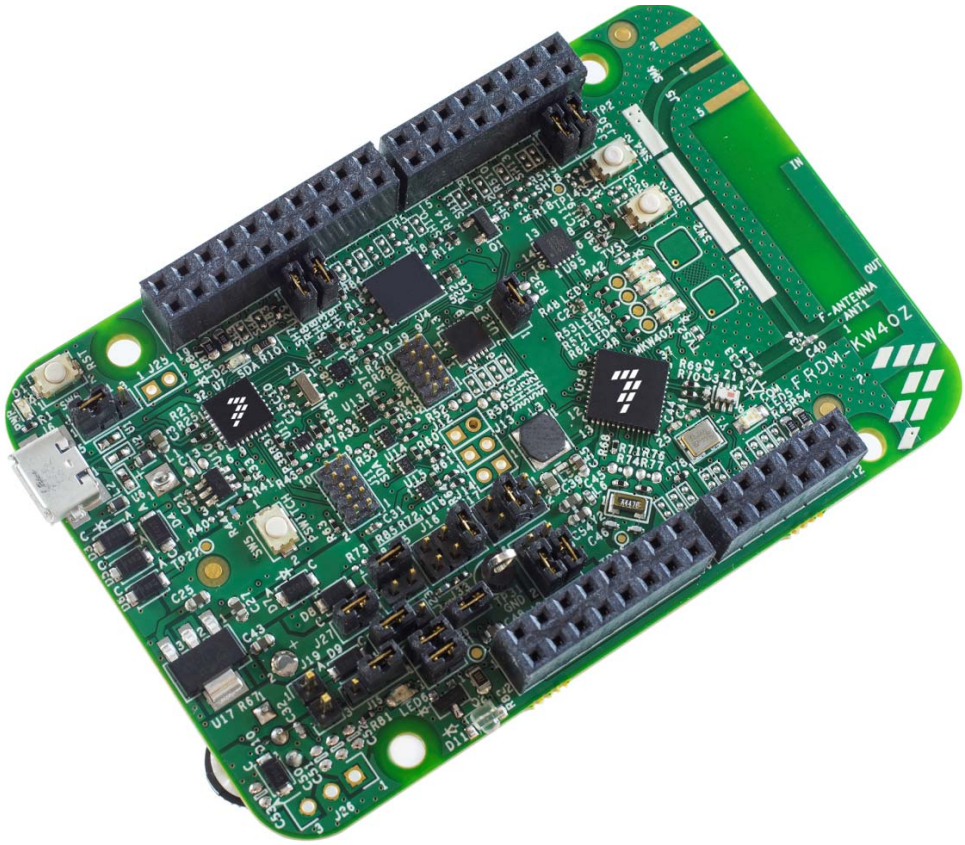

Figure 1. FRDM-KW40Z Freedom development board

The FRDM-KW40Z development board has these features:

- Freescale ultra-low-power MKW40Z SoC BLE/IEEE Std. 802.15.4 platform.
- IEEE Std. 802.15.4, 2006-compliant transceiver supporting 250 kbps O-QPSK data in 5.0 MHz channels, and full spread-spectrum encoding and decoding.
- Fully compliant Bluetooth v4.1 Low Energy (BLE).
- IEEE 802.15.4-compliant wireless node.
- Reference design area with small-footprint, low-cost RF node.
  - Differential input/output port used with external balun for single-port operation.
  - Low count of external components.
  - Programmable output power from -20 dBm to +5 dBm at the SMA connector, no harmonic trap, with DC/DC Bypass and Buck modes of operation.
  - Receiver sensitivity is -102 dBm, typical (@1 % PER for 20-byte payload packet) for 802.15.4 applications, at the SMA connector.
  - Receiver sensitivity is -91 dBm (for BLE applications).
- Integrated PCB inverted F-type antenna and SMA RF port.
- Selectable power sources.
- DC-DC converter with Buck, Boost, and Bypass operation modes.

- 32 MHz reference oscillator.
- 32 kHz reference oscillator.
- 2.4 GHz frequency operation (ISM and MBAN).
- External serial flash memory for Over-the-Air Programming (OTAP) support.
- Integrated Open-Standard Serial and Debug Adapter (OpenSDA).
- Cortex 10-pin (0.05″) SWD debug port for target MCU.
- Cortex 10-pin (0.05″) JTAG port for OpenSDA updates.
- Four red LED indicators.
- One blue LED indicator.
- Two push-button switches.
- Two TSI buttons.

This figure shows the main board features and Input/Output headers for the Freescale FRDM-KW40Z board:

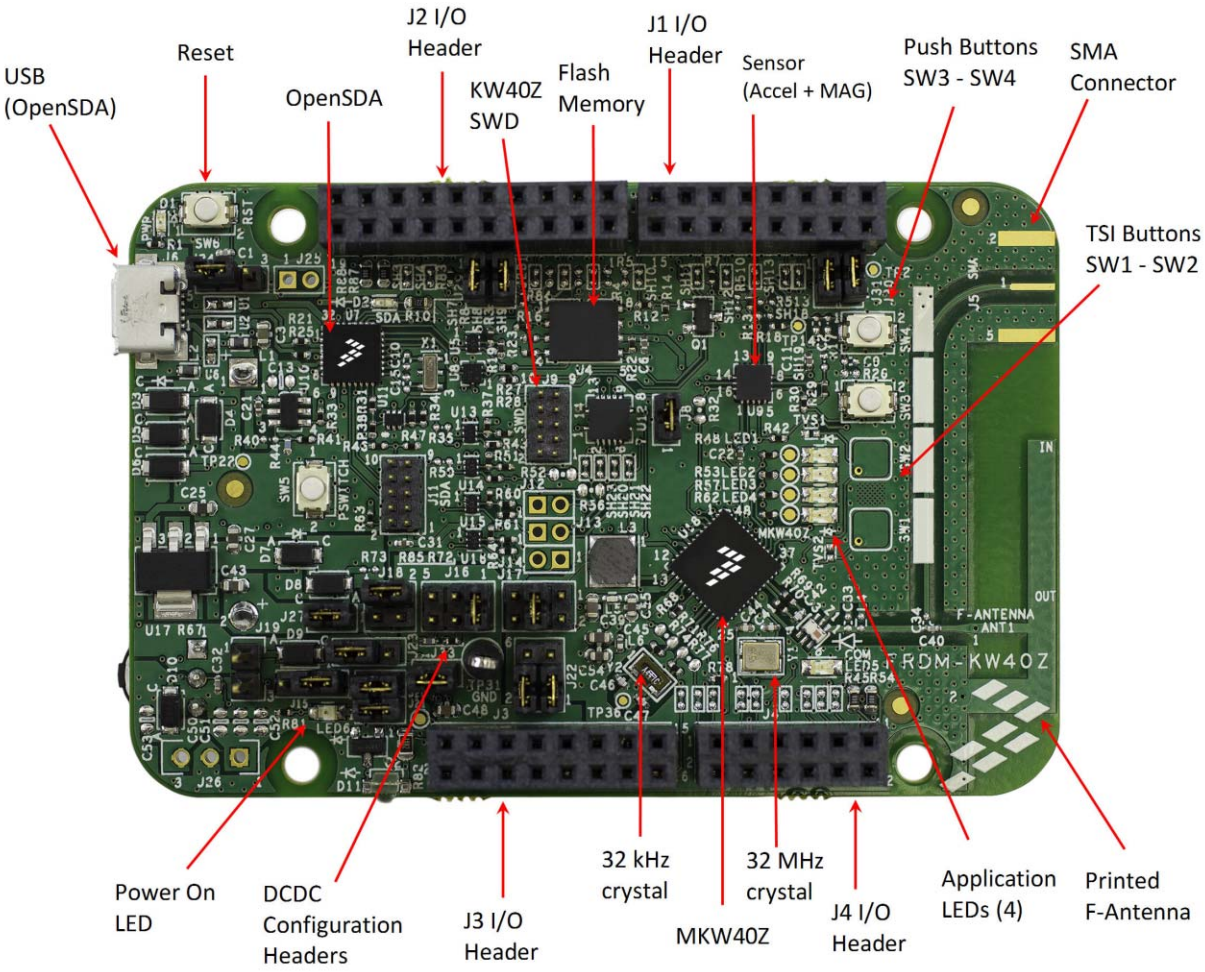

Figure 2. FRDM-KW40Z component placement

3.3 Serial and Debug Adapter

The FRDM-KW40Z development board includes OpenSDA v2.1-a serial and debug adapter circuit that includes an open-source hardware design, an open-source bootloader, and debug interface software. It bridges serial and debug communications between a USB host and an embedded target processor as shown in Figure 3. The hardware circuit is based on a Freescale Kinetis K20 family microcontroller (MCU) with 128 KB of embedded flash and an integrated USB controller. OpenSDAv2.1 comes preloaded with the CMSIS-DAP bootloader - an open-source mass storage device (MSD) bootloader and the CMSIS-DAP Interface firmware (aka mbed interface), which provides a MSD flash programming interface, a virtual serial port interface, and a CMSIS-DAP debug protocol interface.

For more information on the OpenSDAv2.1 software, see mbed.org and https://github.com/mbedmicro/CMSIS-DAP.

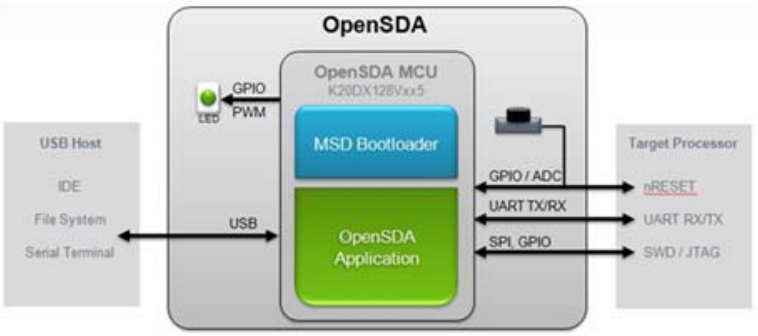

Figure 3. OpenSDAv2.1 high-level block diagram

OpenSDAv2.1 is managed by a Kinetis K20 MCU built on the ARM Cortex-M4 core. The OpenSDAv2.1 circuit includes a status LED (D2) and a pushbutton (SW6). The pushbutton asserts the Reset signal to the MKW40Z target MCU. It can also be used to place the OpenSDAv2.1 circuit into bootloader mode. UART and GPIO signals provide an interface to either the SWD debug port or the K20. The OpenSDAv2.1 circuit receives power when the USB connector J6 is plugged into a USB host.

3.3.1 Virtual serial port

A serial port connection is available between the OpenSDAv2.1 MCU and pins PTC6 and PTC7 of the MKW40Z.

NOTE

To enable the Virtual COM, Debug, and MSD features, mbed drivers must be installed. Download the drivers at https://developer.mbed.org/handbook/Windows-serial-configuration.

4 FRDM-KW40Z development board

4.1 FRDM-KW40Z board overview

The FRDM-KW40Z board is an evaluation board based on Freescale MKW40Z transceiver, and it provides a platform to evaluate the MKW40Z SoC device and to develop software and applications. The core device is accompanied by a 32 MHz reference oscillator crystal, RF circuitry (including antenna), and supporting circuitry.

The FRDM-KW40Z board is intended as the core PCB for MKW40Z device evaluation and application development, and can be used in the following modes:

- Simple standalone evaluation platform.
- Daughter card for other Freedom development platform boards.
- Mother card for application-specific daughter cards, such as a shield card.

4.1.1 PCB features

The FRDM-KW40Z board has these features:

- The Freescale Freedom development board form factor.
- Four-layer, metal, 0.062 inches thick FR4 board.
- LGA footprint and power supply (DC-DC converter).
- DC-DC converter with Buck, Boost, and Bypass operation modes.
- Printed-metal F-Antenna or SMA connector (for conducted measurements).
- 32 MHz reference oscillator crystal.
- 32.768 kHz crystal provided for optional timing oscillator.
- Standard Freedom daughter card mounting interface (shield).
- External serial flash memory for OTAP support.
- Combo sensor—six-axis sensor with integrated linear accelerometer and magnetometer.

4.1.2 Form factor

Figure 4 shows the FRDM-KW40Z board with the location of the I/O headers. This list provides the details:

- J1, J2, J3, and J4:
  - Headers have standard 0.1 in/2.54 mm pin spacing.
  - J2 is 20-pin.
  - J1 and J3 are 16-pin.
  - J4 is 12-pin.
  - All pin headers mounted on the top side of the FRDM-KW40Z board are intended for plugging into matching receptacles on the Freedom platform development board.

- J16, J17, J18, and J22:
  - Headers have standard 0.787 in./2.00 mm pin spacing.
  - J18 is a 2 × 2 pin.
  - J16, J17, and J22 are 2 × 3 pins.
  - Pin headers mounted on the top side of the FRDM-KW40Z are intended to select between power configurations, Bypass, Buck, and Boost.

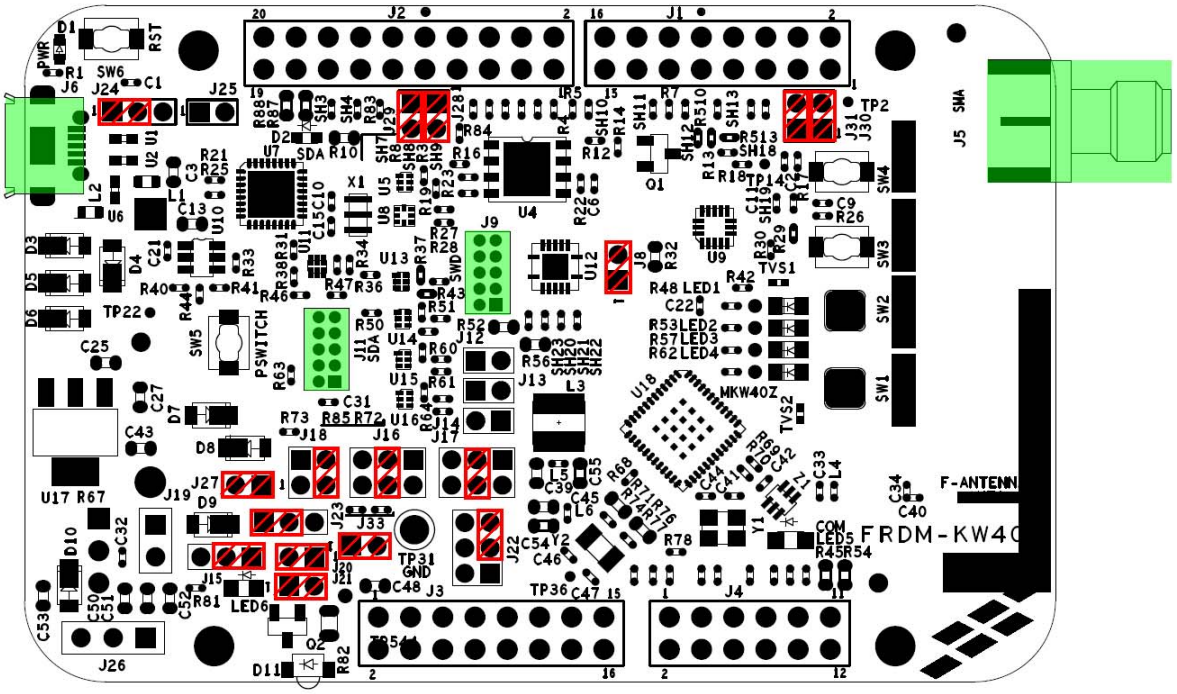

Figure 4. FRDM-KW40Z board with I/O headers locations

This figure shows the footprint of the FRDM-KW40Z board with the board dimensions:

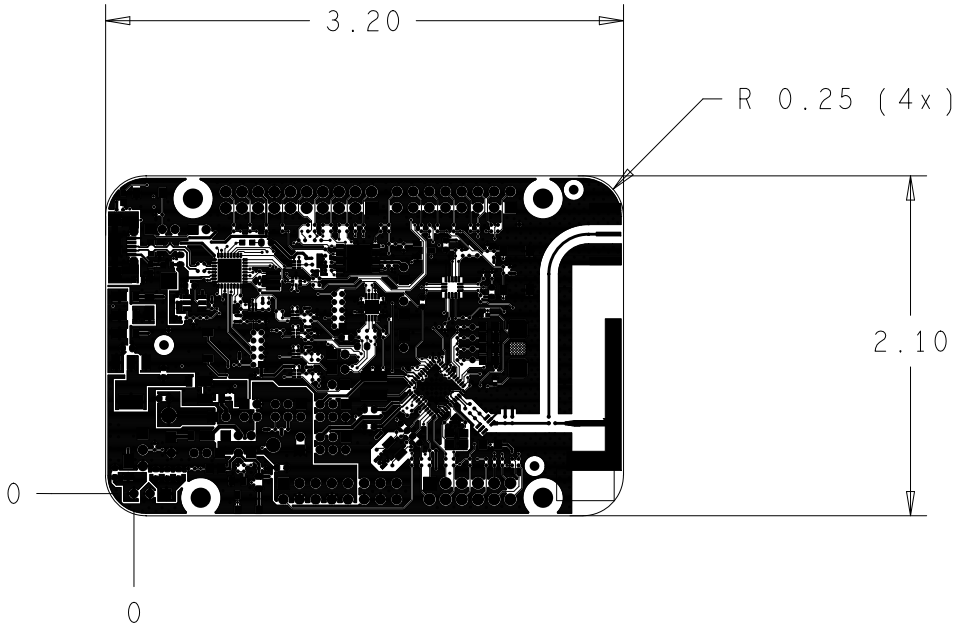

Figure 5. FRDM-KW40Z board dimensions

4.1.3 Board level specifications

Table 1. FRDM-KW40Z board specifications

Parameter	Min	Typ	Max	Units	Notes/Conditions
General					
Size (PCB: X, Y)	—	—	81.2 × 53.3 3.20 × 2.10	mm inches	—
Layer build (PCB)	—	1.57 0.062	—	mm inches	Four-layer
Dielectric material (PCB)	—	—	—	—	FR4
Power					
Current consumption	—	—	—	mA	See the data sheet
Temperature					
Operating temperature (see note)	-40	+25	+70	°C	Operating temperature is limited to +70 °C due to switches. Basic circuit handles a maximum temperature of +85 °C.
Storage temperature	-30	+25	+70	°C	—
RF 802.15.4 frequency range	2405	—	2480	MHz	All 16 channels in the 2450 MHz band
RF BLE frequency range	2400	—	2480	MHz	All 40 channels in the 2450 MHz band

Table 1. FRDM-KW40Z board specifications (continued)

Parameter	Min	Typ	Max	Units	Notes/Conditions
RF ISM and MBAN frequency range	2360	—	2483	MHz	—
RF receiver					
Saturation (maximum input level)	—	+0	—	dBm	See the data sheet
Sensitivity for 1 % packet error rate (PER) (+25 °C) 802.15.4	—	-102	—	dBm	See the data sheet
Sensitivity for 1 % packet error rate (PER) (+25 °C) BLE	—	-91	—	dBm	See the data sheet
RF transmitter					
RF power output	-20	—	+5	dBm	Programmable in steps. At the antenna feed with no harmonic trap.[1]
2nd harmonic	—	≤50	≤40	dBm	See the data sheet
3rd harmonic	—	≤50	≤40	dBm	See the data sheet
Regulatory approval					
FCC	—	—	—	—	Product is approved according to the FCC part 15 Standard.
CE (ETSI)	—	—	—	—	Product is approved according to the EN 300 328 V1.7.1 (2006-10) Standard.
CE (EMC)	—	—	—	—	Product is approved according to the EN 301 489-1 V1.6.1 (2005-09) and EN 301 489-17 V1.2.1 (2002-08) s=Standards.
Safety					
UL	—	—	—	—	Product is approved according to the IEC 60950-1 and EN 60950-1, First Edition Standards.
Environment					
RoHS	—	—	—	—	Product complies with the EU Directive 2002/95/EC of 27 January 2003.
WEEE	—	—	—	—	Product complies with the EU Directive 2002/95/EC of 27 January 2003.

1 Harmonic trap will add 1-2 dB of loss

4.2 Functional description

The FRDM-KW40Z board is built around Freescale MKW40Z SoC in a 48-pin LGA package. It features an IEEE Std. 802.15.4 and BLE 2.4 GHz radio frequency transceiver and a Kinetis family ultra-low-power, mixed-signal ARM Cortex-M0+ MCU in a single package. This board is intended as a simple evaluation platform and as a building block for application development. The four-layer board provides the MKW40Z SoC with its required RF circuitry, 32 MHz reference oscillator crystal, and power supply with a DC-DC converter including Bypass, Buck, and Boost modes. The layout for this base-level functionality can be used as a reference layout for your target board. This figure shows a simple functional block diagram:

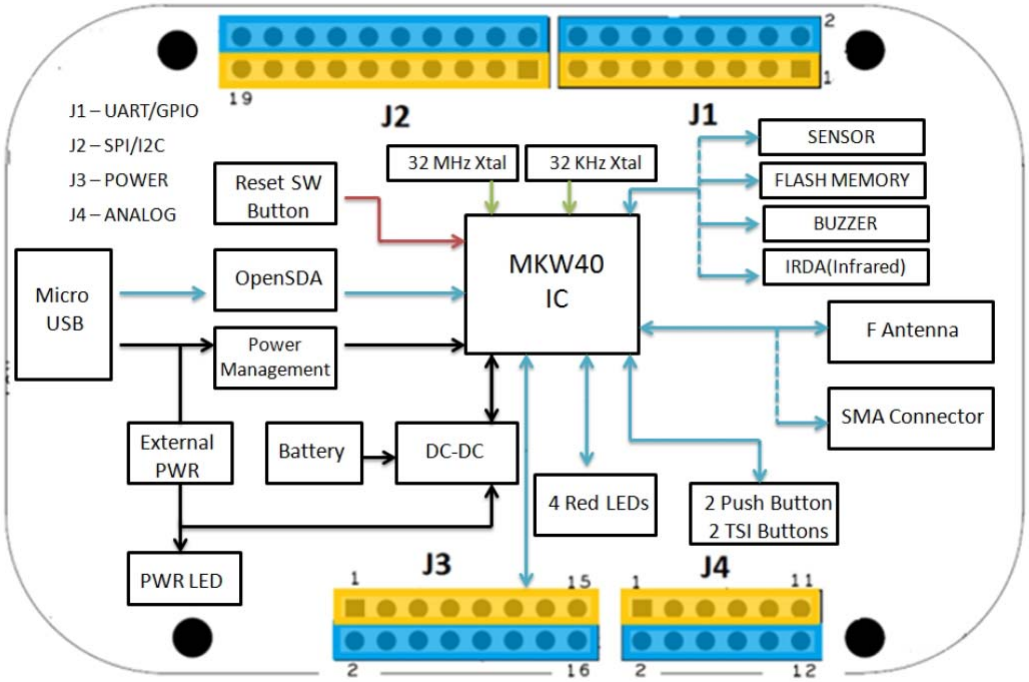

Figure 6. FRDM-KW40Z board functional block diagram

4.2.1 RF performance and considerations

The FRDM-KW40Z board's integrated transceiver includes a 1 mW nominal output power PA with internal Voltage-Controlled Oscillator (VCO), integrated transmit/receive switch, on-board power supply regulation, and full spread-spectrum encoding and decoding. The main specifications of the MKW40Z SoC are:

- Nominal output power is set to 0 dBm.
- Programmable output power ranges from -20 dBm to +5 dBm at the SMA (no harmonic trap).
- Typical sensitivity is -102 dBm (@1 % PER for 25 °C) at the SMA (802.15.4).
- Typical sensitivity is -91 dBm (@1 % PER for 25 °C) at the SMA (BLE).
- Frequency ranges from 2360 to 2480 MHz.
- Differential bidirectional RF input/output port with integrated transmit/receive switch.
- "F" printed-metal antenna for a small-footprint, low-cost design.
- Minimum number of RF marching components and external 50:100 balun.

The external 50 (balanced):100 (unbalanced) balun connects a single-ended 50-Ohm port to the differential RF port of the MKW40Z SoC transceiver. The layout has a provision for out-of-band signal suppression (components L4 and C33), if required. The following figure shows the typical topology of the RF circuitry. The RF connector J5 is provided for conducted measurement purposes, and it is used as DNP.

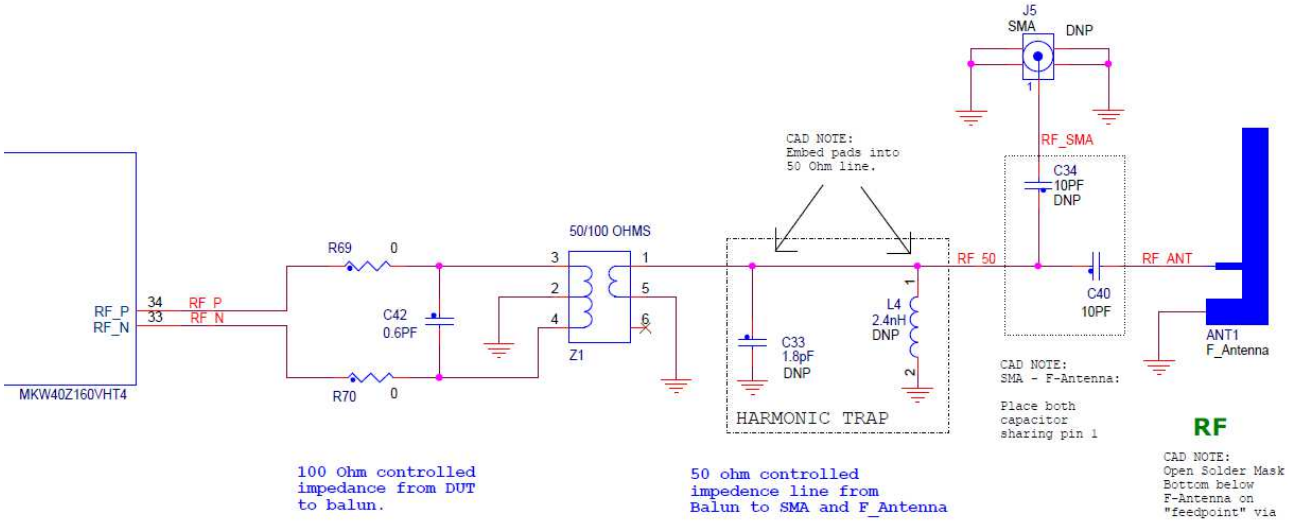

Figure 7. FRDM-KW40Z board's RF circuitry

4.2.2 Clocks

The FRDM-KW40Z board provides two clocks:

- 32 MHz Reference Oscillator—Figure 8 shows the 32 MHz external crystal Y1. This mounted crystal meets the specifications outlined in *Reference Oscillator Crystal Requirements for the MC1320x, MC1321x, MC1322x, and MC1323x IEEE 802.15.4 Devices* (document AN3251). The IEEE Std. 802.15.4 requires the frequency to be accurate to less than ±40 ppm.
  - Capacitors C41 and C42 provide the bulk of the crystal load capacitance. At 25 °C, the frequency must be accurate to ±10 ppm (or less) to enable temperature variation.
  - To measure the 32 MHz oscillator frequency, program the CLKOUT (PTB0) signal to provide buffered output clock signal.
- Optional 32.768 kHz Crystal Oscillator—a secondary 32.768 kHz crystal Y2 is provided (see Figure 9). Use this oscillator for a low-power accurate time base.
  - The module provides the Y2 crystal and its load capacitors C46 and C47.
  - Load capacitors C46 and C47 provide the entire crystal load capacitance; there is no on-board trim capacitance.
  - The 32 kHz oscillator components are supplied, but not enabled. The 0 Ohm resistors R71 and R76 disable the 32 kHz oscillator.

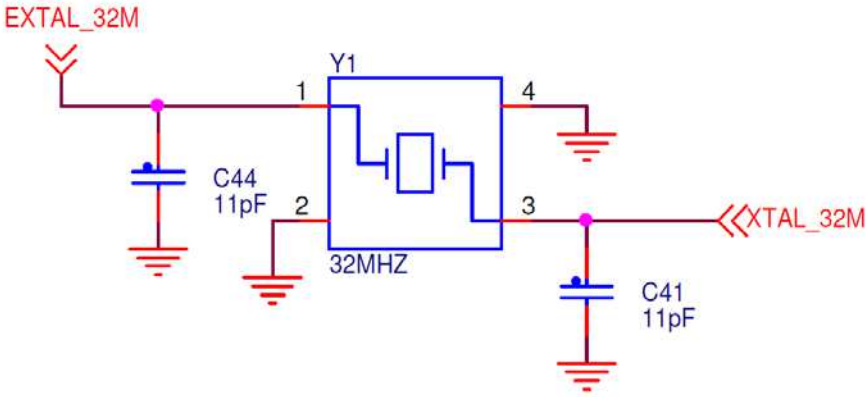

Figure 8. FRDM-KW40Z board's 32 MHz reference oscillator circuit

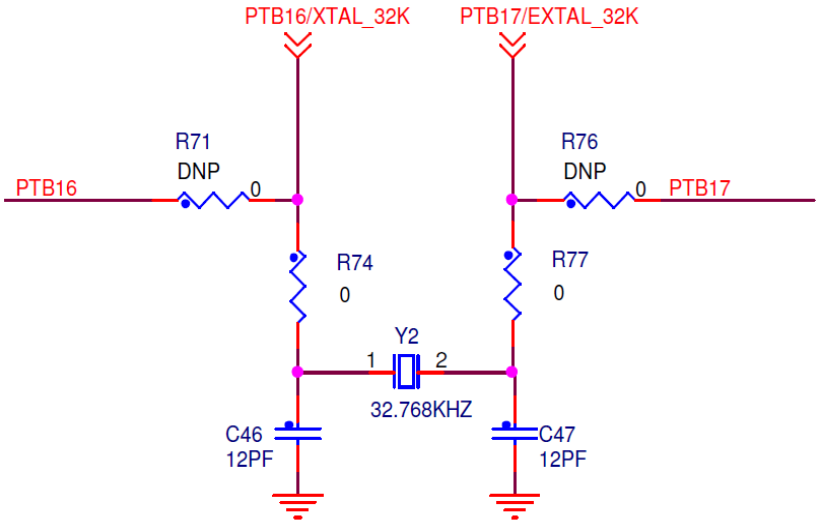

Figure 9. FRDM-KW40Z board's optional 32.768 kHz oscillator circuit

4.2.3 Power management

There are several different ways to power and measure current on the FRDM-KW40Z board. The FRDM-KW40Z power-management circuit is shown in this figure:

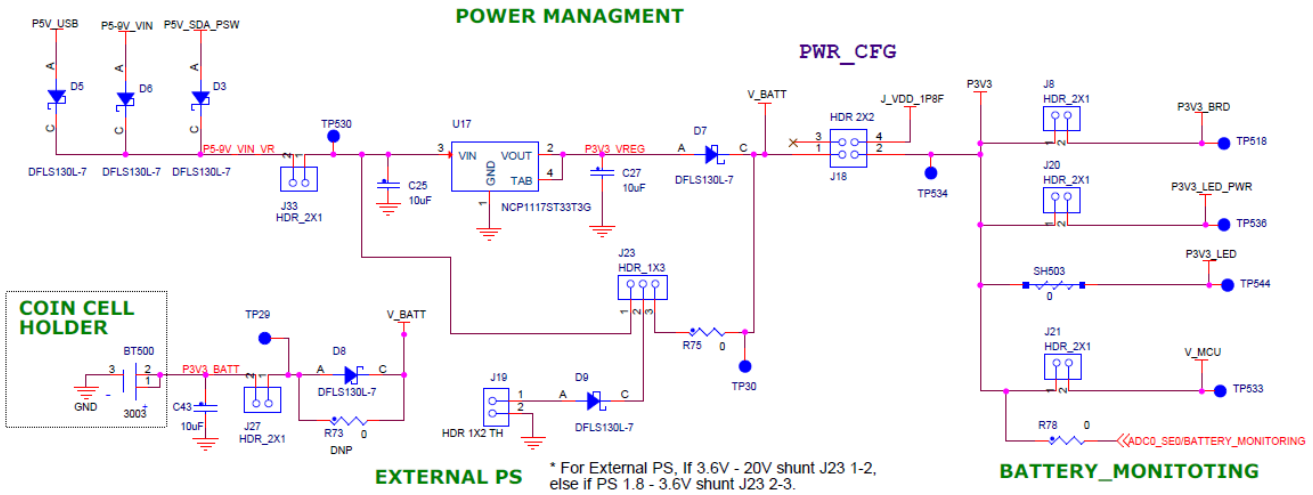

Figure 10. FRDM-KW40Z board's power-management circuit

Power the FRDM-KW40Z in several ways:

- Power the board through the micro USB type B connector (J6), which provides P5V_USB to LDO 3V3 (U17).
- Power the board through the Freedom development board headers, which provide either P3.3V or P5-9V_VIN on header J3 pin-16 to LDO 3V3 (U17).
- Power the board from an external battery (Coincell – BT500).
- Power the board from an external DC supply in these ways:
  - Connect an adapter that can supply 1.8 to 3.6 VDC to J19 pins 1 using the selector J23 pin 2-3.
  - Connect an unregulated external supply (of up to 5.5 VDC) to J19 pin 1 and the GND pin to use the onboard 3.3 V LDO regulator (using the selector J23 pin 1-2).

The 2-pin 1×2 headers J8, J20, and J21 can supply current to various board components and measure the current (if desired). Green LED marked as LED6 is available as a power indicator.

Power headers can supply either the LED, MCU, or peripheral circuits. Measure the current by inserting a current meter in place of a designated jumper. Connection configurations are described in Table 2.

Table 2. Power distribution headers

Supply designation	Header pins	Description
P3V3_BRD J8	1-2	Supply voltage to board peripherals • Normally jumpered • Jumper used to enable sensor, external flash memory, and buzzer on board • Leave open for lowest power • Usage—measure the current or breakout for current consumption
P3V3_LED_PWR J20	1-2	Supply voltage to power LED • Normally jumpered • Jumper used to enable green power LED on board • Leave open for lowest power • Usage—measure the LED current
V_MCU J21	1-2	Supply voltage to MKW40Z SoC • Normally jumpered • Powers the MKW40Z SoC and transceiver • Usage—measure or supply the MCU and radio current

The DC-DC power configuration headers provide the DC-DC modes, and can be easily modified for the desired mode. The connection configurations are described in Table 3:

Table 3. DC-DC power distribution headers

DC-DC mode	Reference designator and header pins	Description
Bypass	J18 1-2 J16 1-2 J17 3-4 J22 1-3, 2-4	Supply voltage to power Bypass mode • Normally jumpered as primary mode • Power level range 1.8 V–3.6 V
Buck	J18 2-4 J16 5-6 J17 3-4 J22 3-5	Supply voltage to power Buck mode • Alternative configuration, related to Coin cell option • Power level range 1.8 V–4.2 V • DC-DC converter requires at least 2.1 V to start; the supply can drop to 1.8 V after the DC-DC converter settles
Buck Auto-Start	J18 2-4 J16 3-4 J17 3-4 J22 3-5	Supply voltage to power Buck Auto-Start mode • Alternative configuration, related to Coin cell option • Power level range 1.8 V–4.2 V • DC-DC converter requires at least 2.1 V to start; the supply can drop to 1.8 V after the DC-DC converter settles
Boost	J18 2-4 J16 3-4 J17 1-2, 5-6 J22 3-5	Supply voltage to power Boost mode • Alternative configuration, related to single battery option • Power level range 0.9 V–1.8 V

NOTE

When configuring the Buck mode, SWD connector does not support J-Link Lite. J-Link BASE is required. It is due to the 1.8 V operating mode.

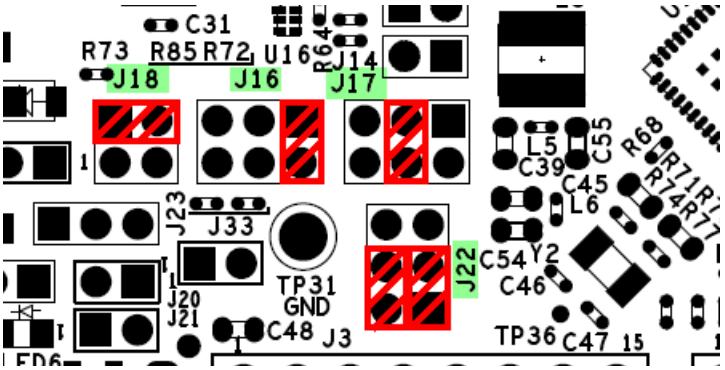

Figure 11. Bypass headers

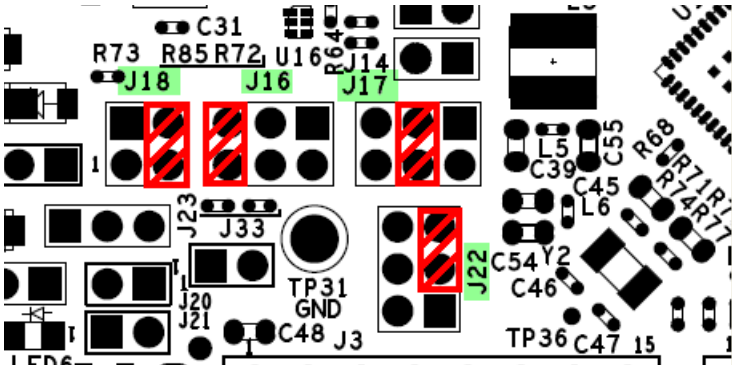

Figure 12. Buck headers

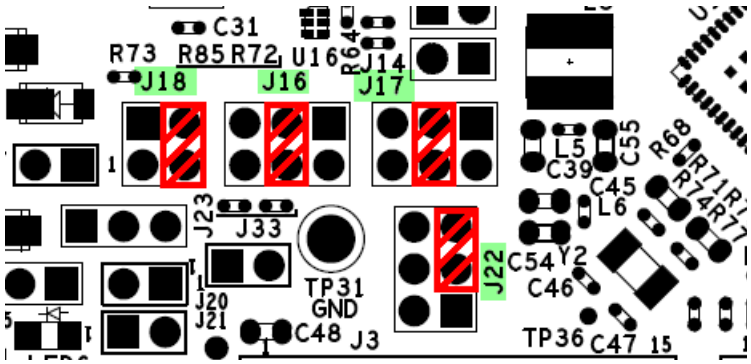

Figure 13. Buck Auto-Start headers

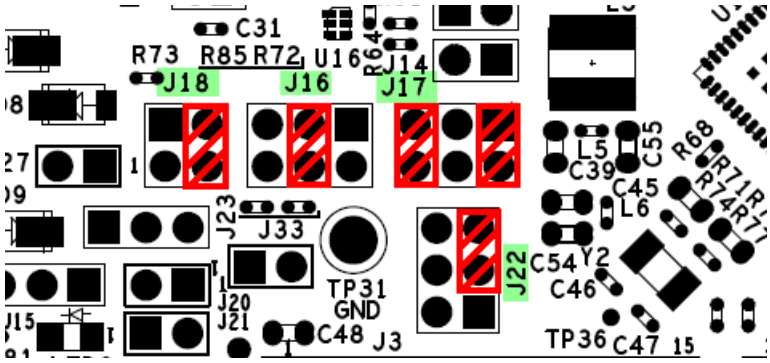

Figure 14. Boost headers

4.2.4 FRDM-KW40Z board peripheral functions

The FRDM-KW40Z development board includes the Freedom development board headers to interface with the general-purpose functions, and to assist in the implementation of target applications.
The FRDM-KW40Z board has alternate port functions routed to those interface headers where you can use the off-board Freedom development platform peripherals.

4.2.4.1 Serial flash memory (SPI interface)

Component U4 is the AT45DB021E 2-Mbit (256 KB) serial flash memory with SPI interface. Use the memory for Over-the-Air Programming (OTAP) for storing the non-volatile system data or parameters. The figure below shows the memory circuit.

- Memory power supply is P3V3_BRD.
- Discrete pullup resistors for the SPI port are included.
- You can share the SPI with other peripherals using the J2 SPI connectors. The normal SPI_SS and the second chip-select must not be active at the same time.
- The SPI Write Protect and Reset have a discrete pullup resistor.

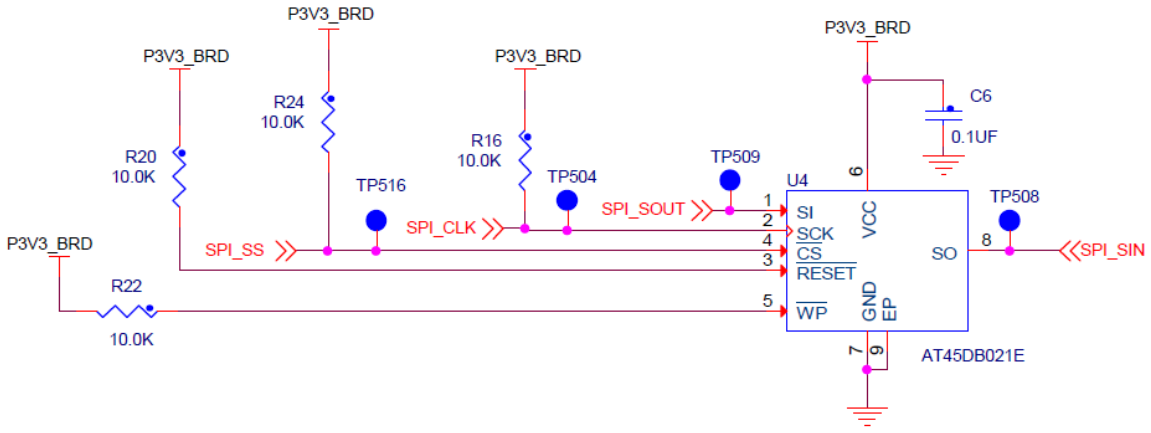

Figure 15. AT45DB021E 2-Mbit (256 KB) serial flash memory circuit

4.2.4.2 Combo sensor (I^2C interface)

Component U9 is Freescale FXOS8700CQ sensor, a six-axis sensor with integrated linear accelerometer and magnetometer, very low power consumption, and selectable I^2C. Figure 16 shows the sensor circuit.

- The sensor power supply is P3V3_BRD.
- Discrete pullup resistors for the I^2C port are provided.
- There is one interruption signal.
- The I^2C can be shared with other peripherals through the J4 pin 10 and pin 12 (I^2C1 connectors).

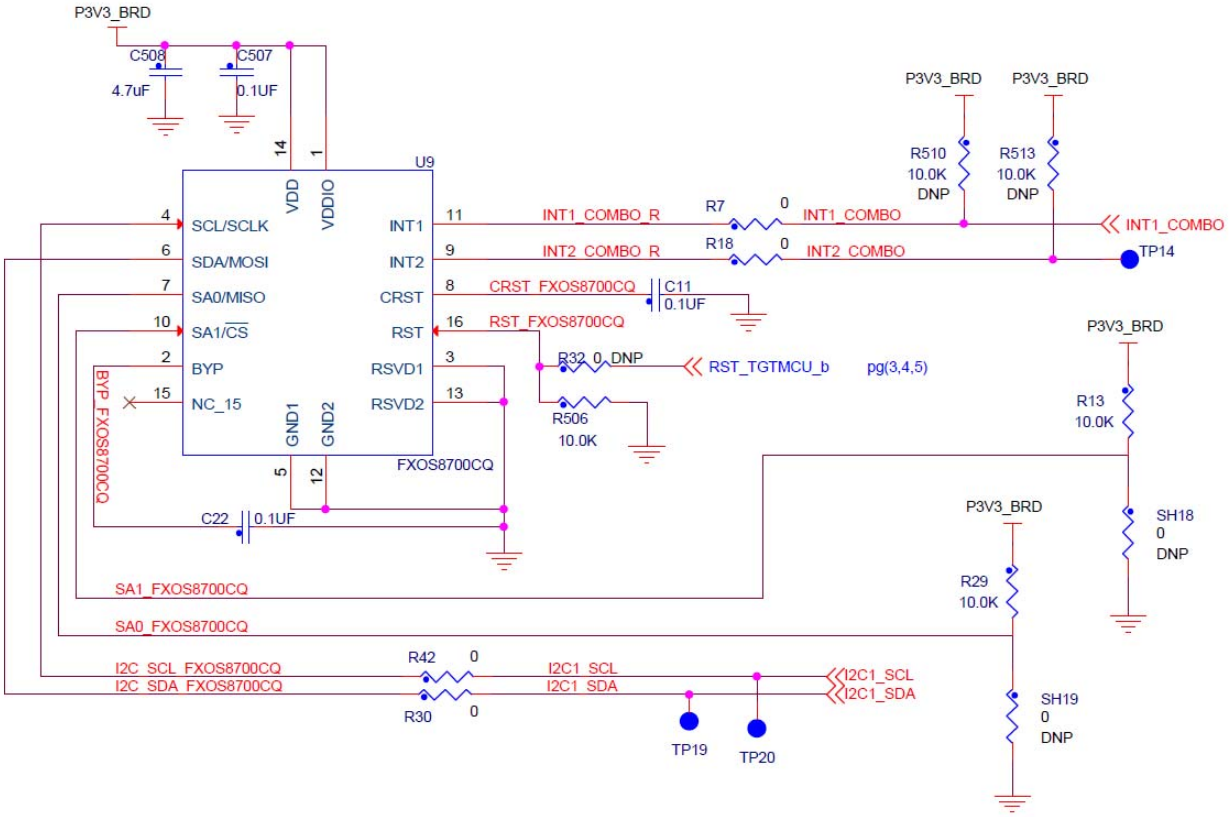

Figure 16. FXOS8700CQ combo sensor circuit

4.2.4.3 Buzzer

Component BZ500 is is a piezoelectric transducer (MPN: AST1109MLTRQ). Use the buzzer for sound applications. Figure 17 shows the buzzer circuit. PWM signal is required to enable the buzzer.

- The buzzer power supply is P3V3_BRD.
- The resonant frequency is 4.0 kHz.
- Buzzer is driven by Q1 and MCU output PTB3 signal.
- The driven signal can be shared with other peripherals through the J1 pin 16.

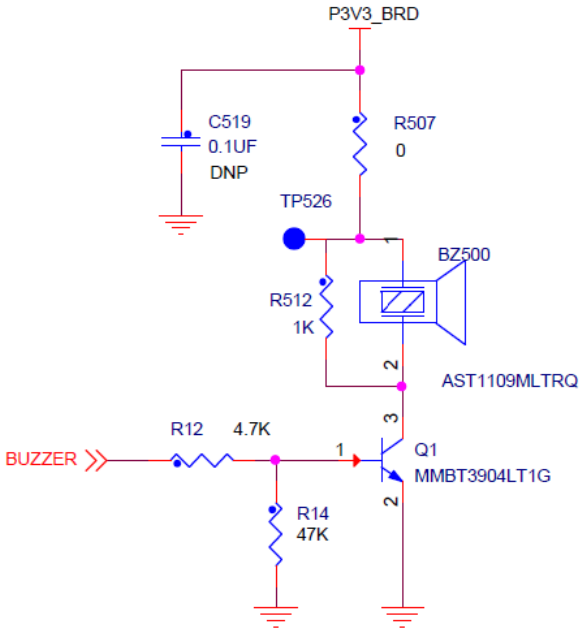

Figure 17. Buzzer circuit

4.2.4.4 Potentiometer (ADC interface)

Use the 5 kΩ potentiometer (R67) for ADC verification and applications. Figure 18 shows the potentiometer circuit.

- The POT power supply can be either the P3V3 or V_BATT for the input source.
- A single-turn potentiometer is provided.
- Signal is routed through ADC0_SE.
- The ADC trace can be shared with other peripherals through the J4 pin 3.

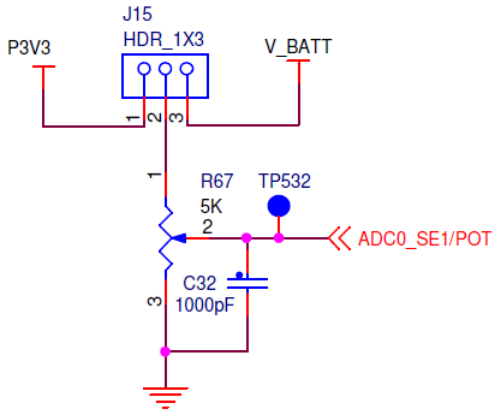

Figure 18. Potentiometer circuit

NOTE

To measure the POT value, program the ADC in differential mode. The V_BATT is taken as the differential input.

4.2.4.5 IR transmitter (CMT interface)

An infrared transmitter or blaster is provided to control the IR. Figure 19 shows the IR circuit.

- The IR power supply is P3V3_LED.
- The IR has a range of approximately 10 meters.
- The current draw is approximately 100 mA when active.
- When using the blaster as an application, assure the proper orientation.

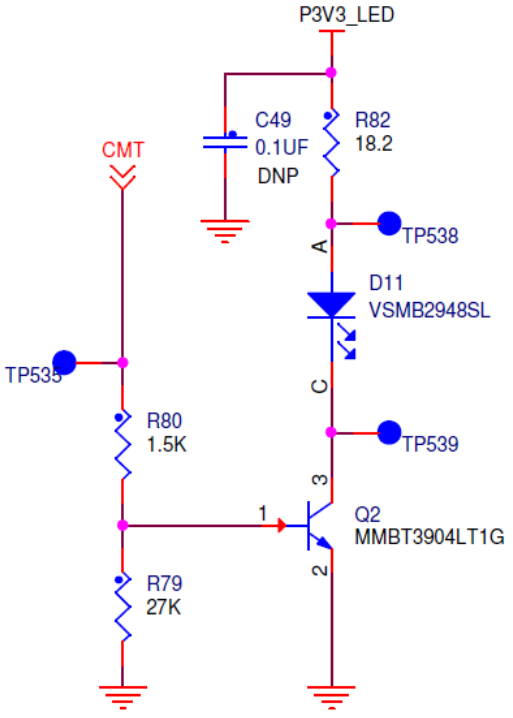

Figure 19. IR transmitter circuit

4.2.4.6 Interface connectors J1, J2, J3, and J4

The four connectors (J1, J2, J3, and J4) are 100-mil pin headers mounted on the front (component side), supporting the standard Freedom connector.

- P3V3, P5V_USB, and P5-9V_VIN provide the supply voltage for the headers connector.
  - The I/O power supply for the FRDM-KW40Z board and the power supply for the MKW40Z SoC must use the same voltage to avoid potential damage.

The pin definitions for the headers are shown in Table 4 and Table 5, respectively.

Table 4. J1 and J2 connectors

Header pin no.	J1	Description	Header pin no.	J2	Description
	MKW40Z pin name			MKW40Z pin name	
1	NC	NC	1	NC	NC
2	UART0_RX_TGTMCU	PTC6 (D0/Rx/int)	2	SWD_DIO_TGTMCU	PTA0 (D8/Int)
3	NC	NC	3	NC	NC
4	UART0_TX_TGTMCU	PTC7 (D1/Tx/int)	4	KW40_SWD_CLK	PTA1 (D9/Int)
5	NC	NC	5	NC	NC
6	ELEC_IN1	PTA16 (D2/int)	6	SPI_SS	PTC19 (D10/SPI_SS)
7	NC	NC	7	NC	NC
8	ELEC_IN2	PTA17 (D3/PWM/int)	8	SPI_SIN	PTC18 (D11/MOSI)
9	NC	NC	9	NC	NC
10	SW4	PTA19 (D4/int)	10	SPI_SOUT	PTC17 (D12/MISO)
11	NC	NC	11	NC	NC
12	SW3	PTA18 (D5/PWM/int)	12	SPI_CLK	PTC16 (D13/SCK)
13	NC	NC	13	NC	NC
14	INT1_COMBO	PTB2 (D6/PWM/Int)	14	GND	VSS (GND) board ground
15	NC	NC	15	NC	NC
16	BUZZER	PTB3 (D7/CMP/int)	16	P3V3	VREF
—	—	—	17	NC	NC
—	—	—	18	PTC1	PTC1 (D14/Ana/Int)
—	—	—	19	NC	NC
—	—	—	20	PTC0	PTC0 (D15/Ana/Int)

Table 5. J3 and J4 connectors

Header pin no.	J3	Description
	MKW40Z pin name	
1	NC	NC
2	PTC4	EXTRG_IN
3	NC	NC
4	P3V3	IO_REF
5	NC	NC
6	RST_TGTMCU_b	RESET
7	NC	NC
8	P3V3	V_OUT
9	NC	NC
10	P5V_USB	5V
11	NC	NC
12	GND	GND
13	NC	NC
14	GND	GND
15	NC	NC
16	P5-9V_VIN	Unregulated Voltage

Header pin no.	J4	Description
	MKW40Z pin name	
1	ADC_SE0/BATTERY_ MONITORING	ADC0_SE0
2	PTB17	PTB17/XTAL32k/I2C_SDA
3	ADC0_SE1/POT	ADC0_DM0/CMPO_IN1
4	PTB16	PTB16/EXTAL32k/I2C_SCL
5	NC	NC
6	CMT	PTB1/TSI_CH15/CMT_IRO
7	NC	NC
8	PTC5	PTC5/TSI_CH1
9	COM	PTB0/CLKOUT
10	I2C1_SDA	PTC3/I2C1_SDA
11	PTB18	PTB18/CMP0_IN2
12	I2C1_SCL	PTC2/I2C1_SCL
—	—	—
—	—	—
—	—	—
—	—	—

4.3 Schematic, board layout, and bill of materials

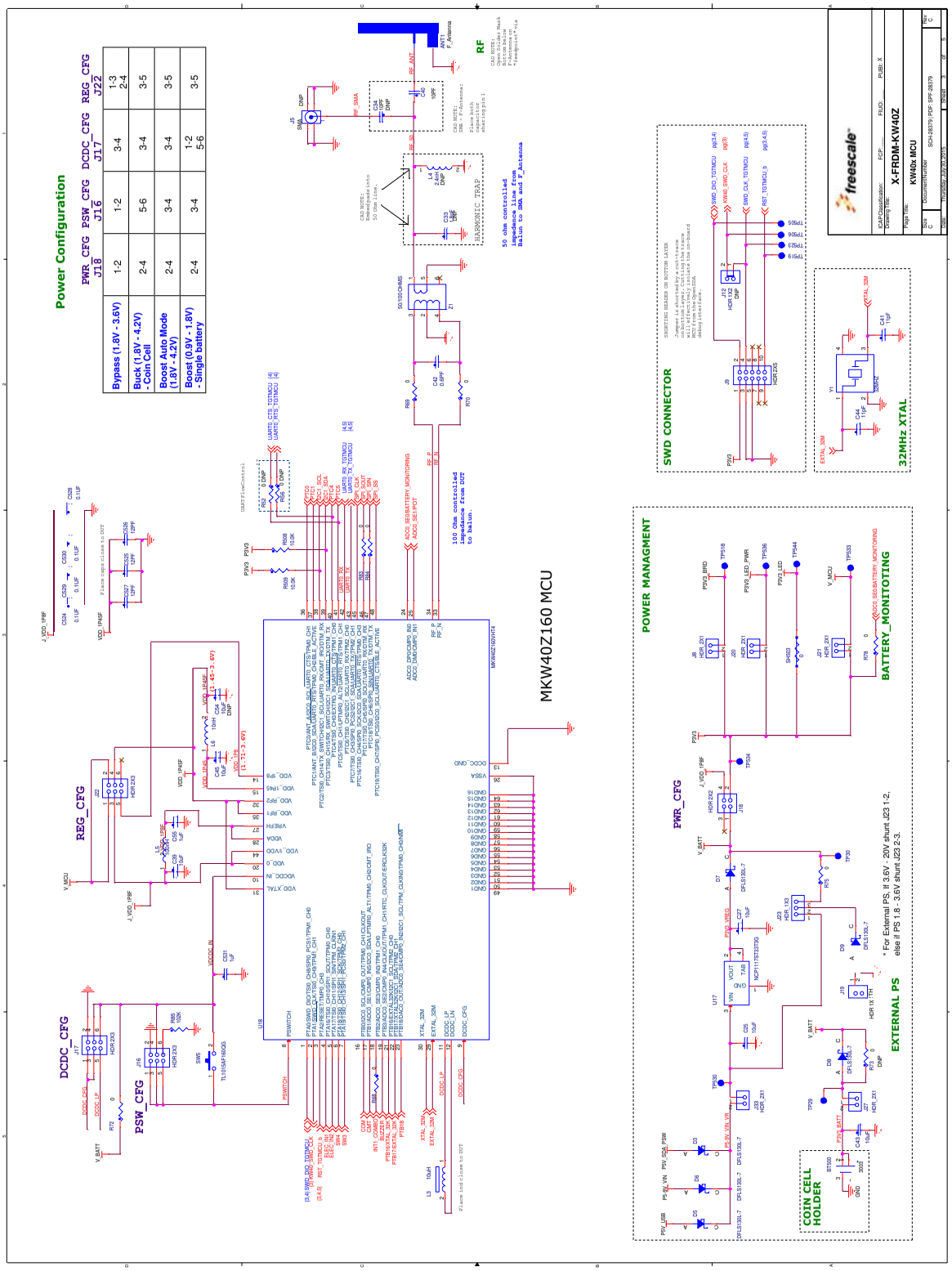

Figure 20. FRDM-KW40Z board schematic rev. C (sheet 1 of 3)

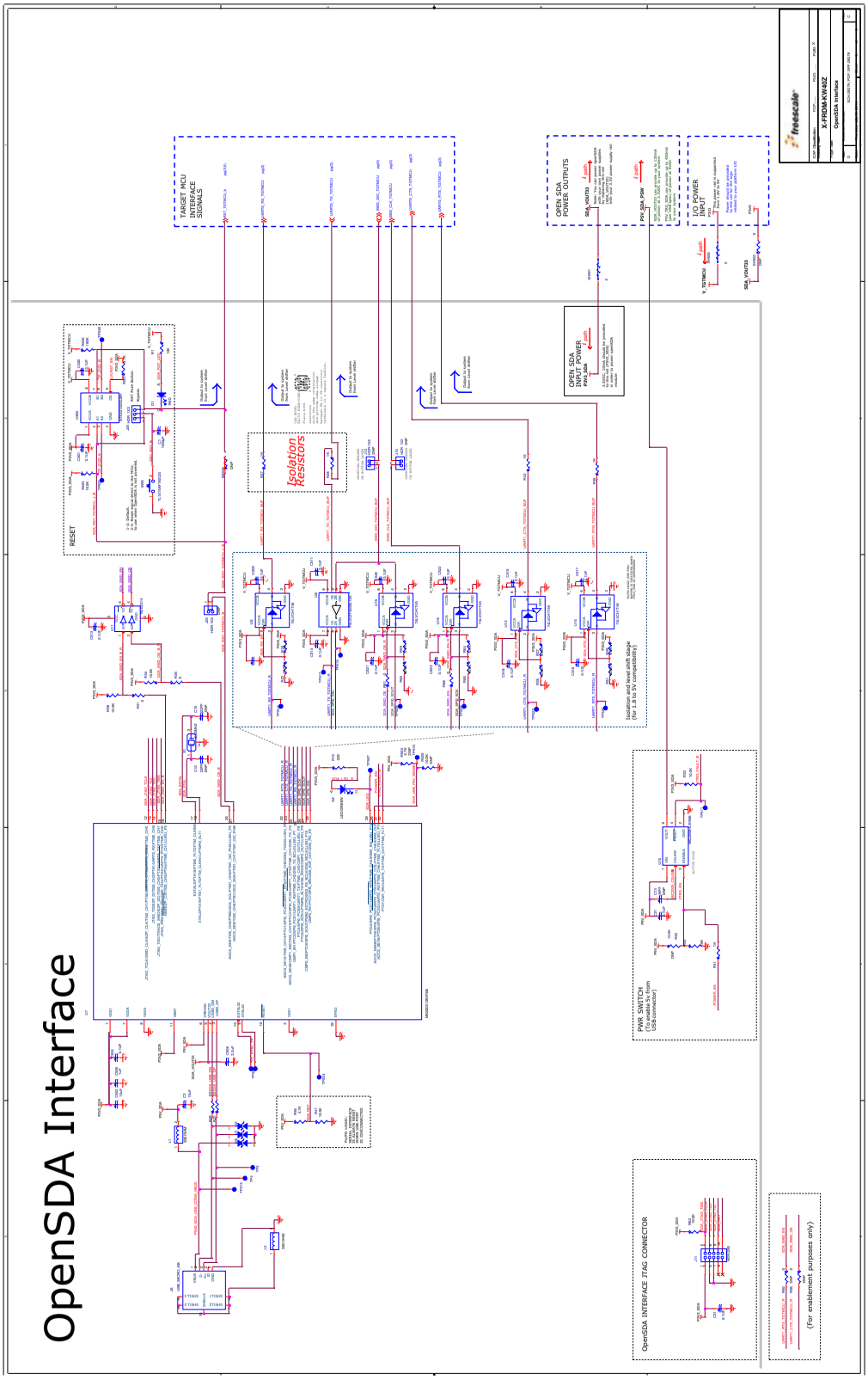

Figure 21. FRDM-KW40Z board schematic rev. C (sheet 2 of 3)