WaRP7: The IoT and Wearable Development Platform

Hardware UserManual

v0.4

May 24, 2016

TableofContents

Table of Contents

1. Introduction

1.1 PlatformPurpose

The WaRP7 is the next generation Internet of Things (IoT) and Wearable's Reference Platform. WaRP7 is a powerful, low-cost platform designed for rapid prototyping and reduces time to market. WaRP7 is optimized, comes is a tiny form factor and yet flexible enough to offer all the advantages of traditional development tools. It has been architected and designed from the ground up to address key challenges in the IoT and wearables markets, such as battery life, connectivity, user experience and miniaturization. WaRP7 is based on the NXP i.MX 7Solo applications processor that features an advanced implementation of the ARM® Cortex®-A7 core, as well as the ARM® Cortex®-M4 core. It comes with features such as on-board sensors, connectivity including NFC, Bluetooth®, Bluetooth Smart and Wi-Fi® and on-board external LPDDR3 memory.

This document is intended as an introduction to the WaRP7 CPU Boardand IO Board hardware and focuses primarily on its initial setup and basic usage.

1.2 Kit Contents

In the box you will find the following items as shown in **Figure1**.

- WaRP7 CPU Board
- WaRP7 IO Board
- Lithium Polymer Battery
- Quick StartGuide.

The display for the kit can be purchased separately (*details coming soon*). Check for availability at www.element14.com/warp7

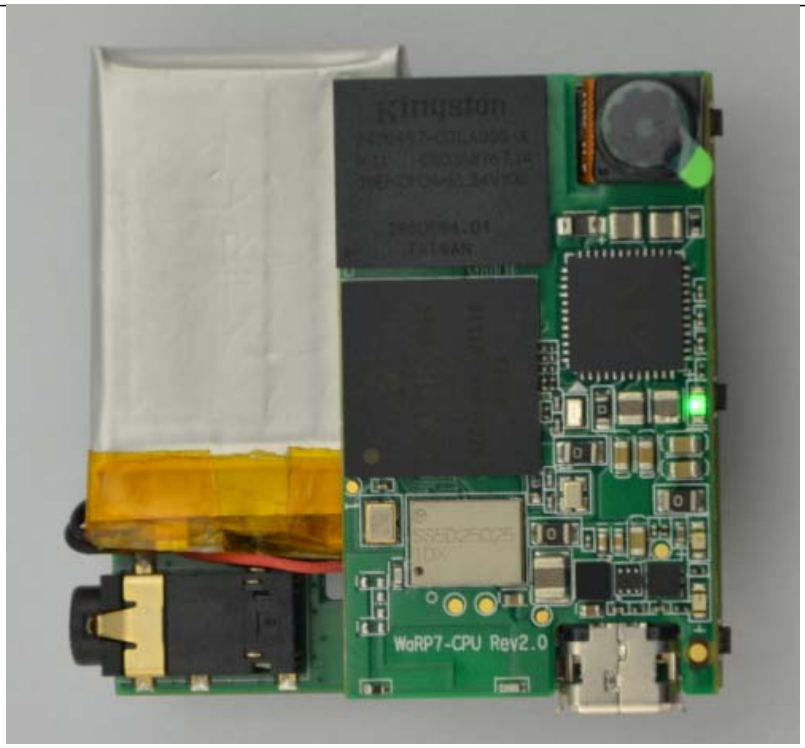
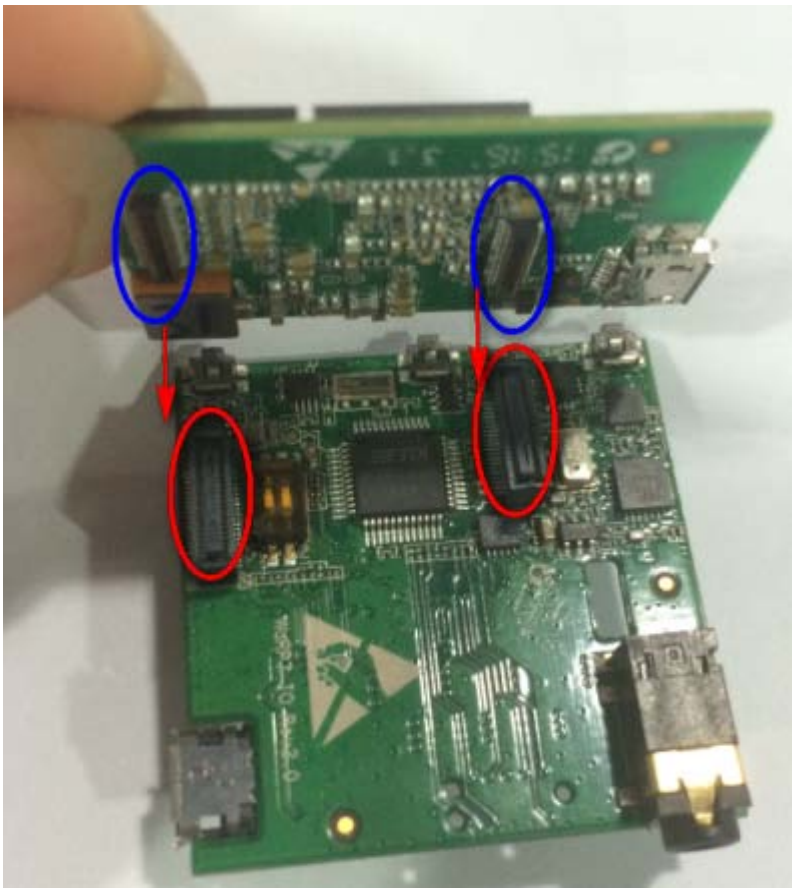


Figure 1 WaRP7

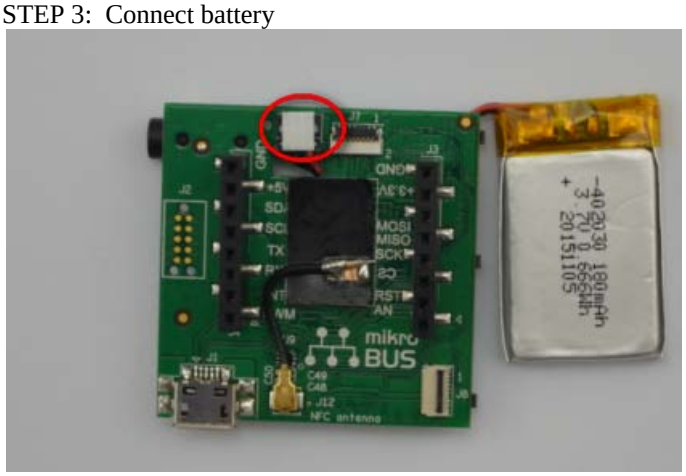
1.2.1 Getting Started with Hardware

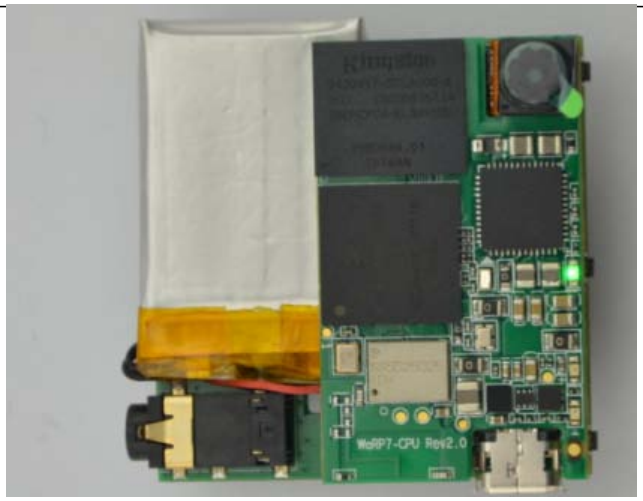
- STEP 1: Connect NFC cables to IO board

- STEP 2: Connect CPU board

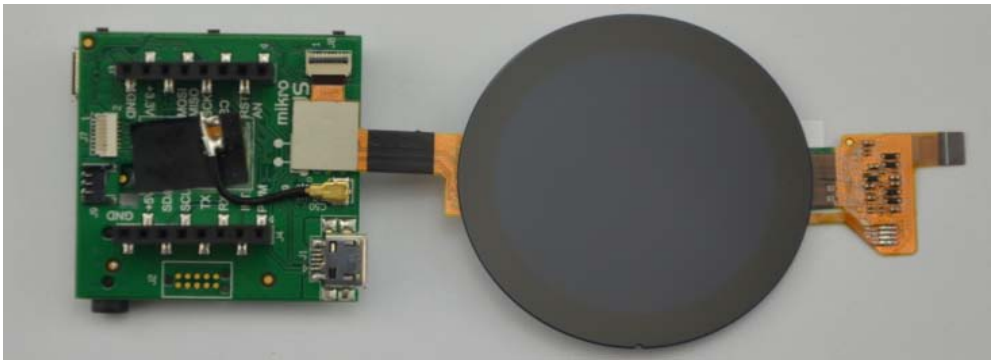


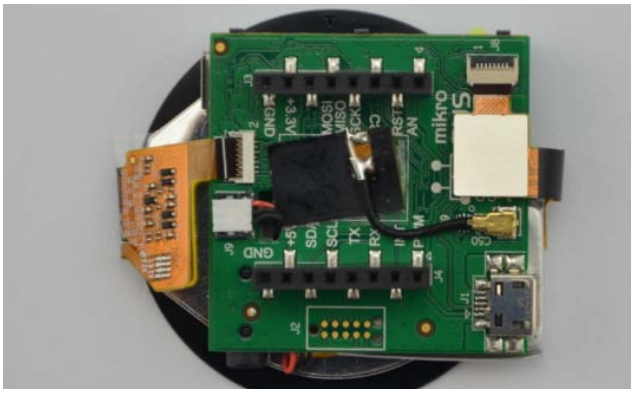
- STEP 3: Connect battery

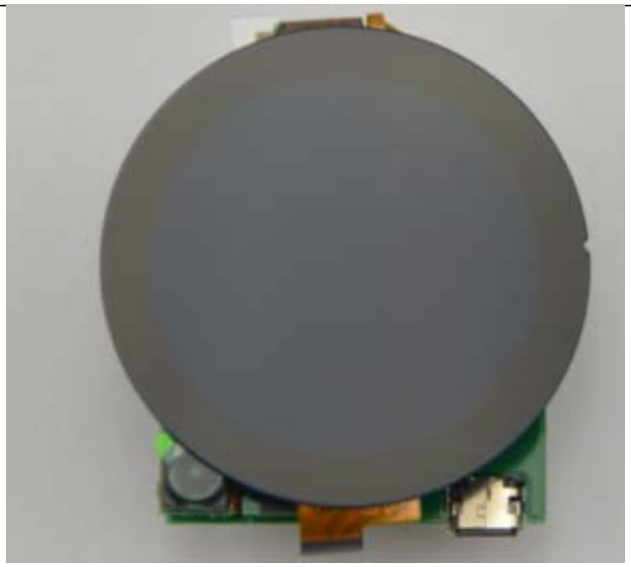




- STEP 4: Connect LCD







Connect USB

Figure 2 WaRP7 connected

2 WaRP7 Hardware Overview

The WaRP7 is the nextgeneration Wearable's Reference Platform basedon the NXPiMX7 Solo applications processor.
The kit consists of 2 boards

- A **CPU board** featuring the ARMCortex-A7 based iMX7 processor, memory, power management and a combo WiFi/BLE module.
- An **IOboard** which provides interface to variety of sensors, expansion and debugging capabilities.

2.1 Features/Specifications

Features		
CPUBoard		
Processor	NXPiMX7S ARMCortex-A7/Cortex-M4	
Memory	8GB,8bitEmbeddedMMC/512MBLPDDR3	
PMIC	PF3000PMICandBC3770batterycharger.	
Wireless	ComboWiFI/BLE	
Display/Camerainterface	MIPI-DSIconnector MIPI-CSIconnector	
PowerSource	USB/Battery	
PCB	38mm x23mm	10layers
Indicators	1-Power,1–User	
IOBoard		
DebugSupport	JTAG,SerialHeader	
Sensors	Accelerometer,Magnetometer PressureSensorGyroscope	
Audio	Stereocodec–MicIn/LineOut	
Expansion	MikroEClickheader	

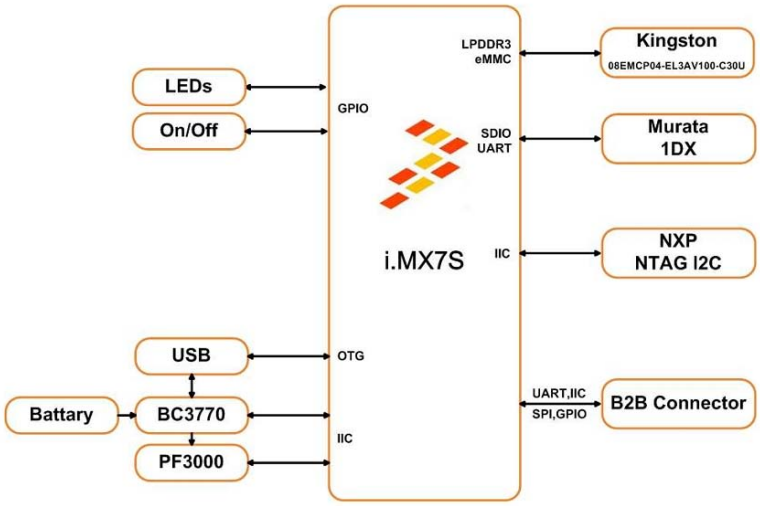


Figure 3 CPU Board

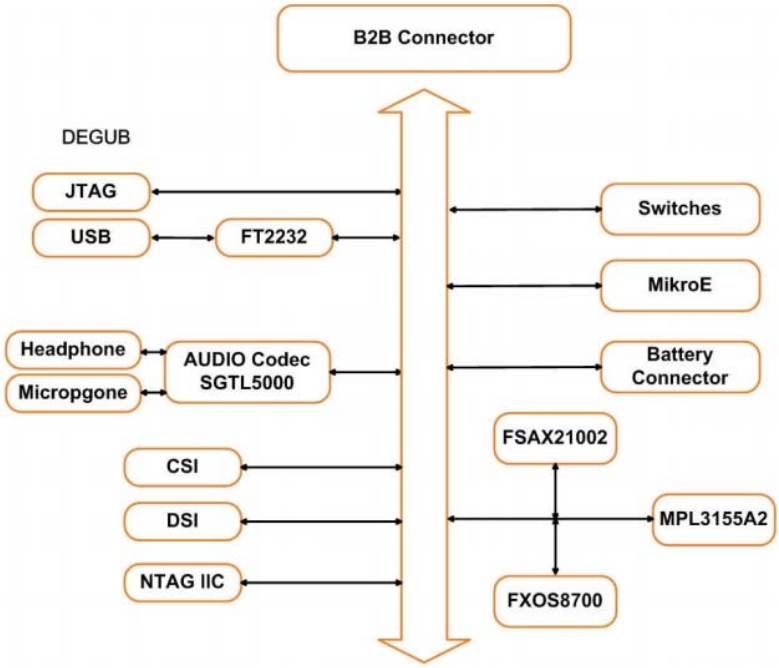
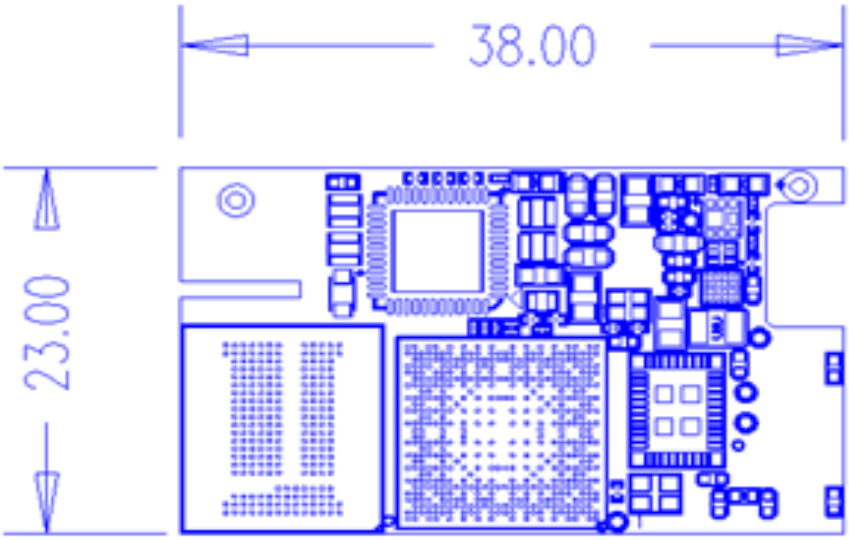


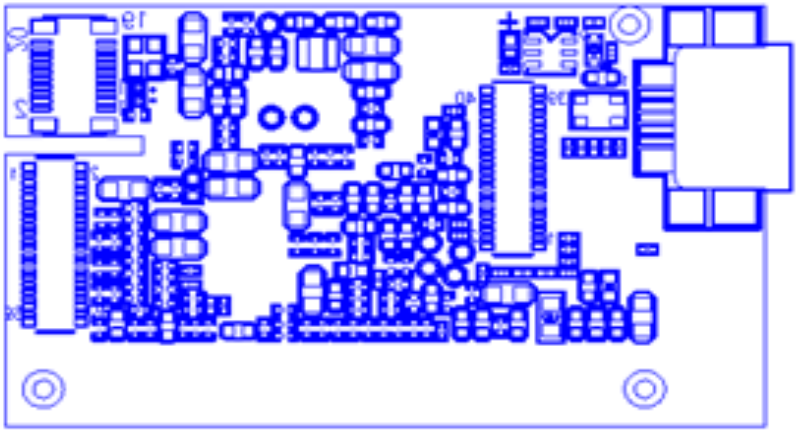
Figure 4 IO Board

2.2 BoardDimensionandOperatingEnvironment

Table1WaRP7CPU BoardDimensions

Length	38mm
Width	23mm
PCBThickness	1.0mm

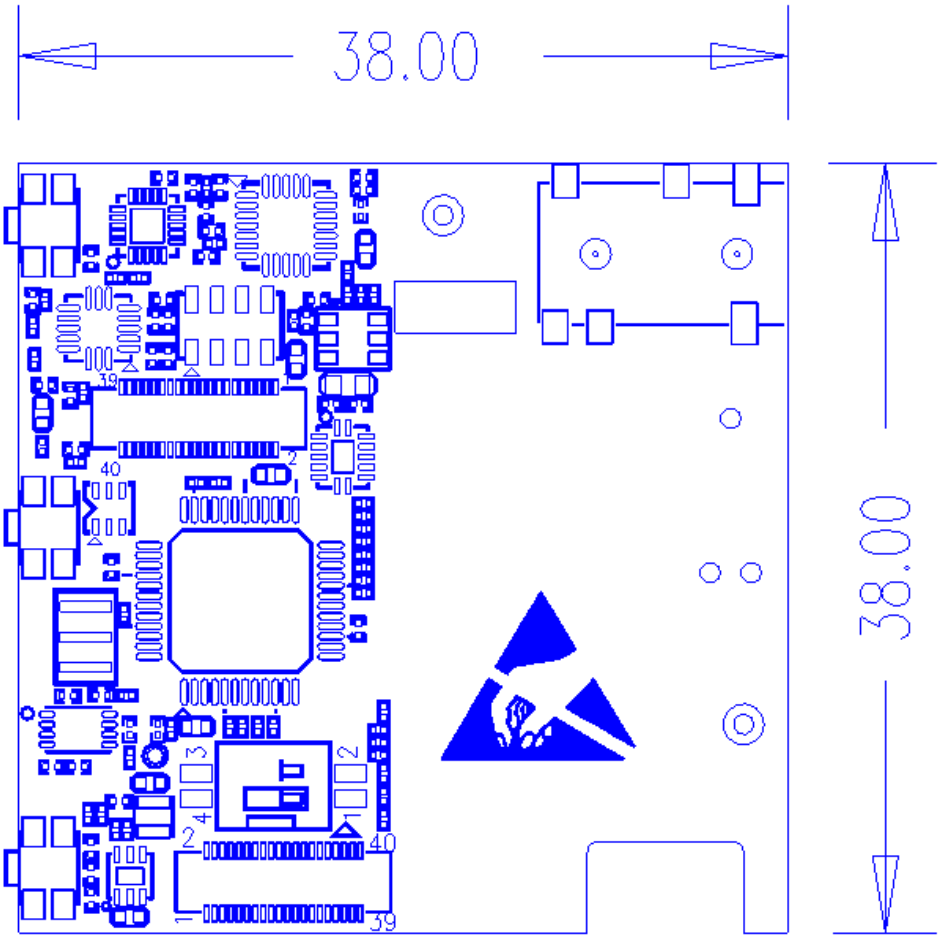




The board operates in the commercial temperature range, 0°C~85°C

Table2 WaRP7 IO Board Dimensions

Length	38mm
Width	38mm
PCBThickness	1.0mm



3 Hardware Overview

3.1 CPUBoard

3.1.1 CPU

Main Processor: NXPMCIMX7S3DVK08SA -i.MX7Swith12mmx12mmMAPBGA,0.4mm

Thei.MX7S applications processor houses an ARMCortex-A7coreandanARMCortex-M4.The device is targeted for IoT, Wearable and general embedded markets.

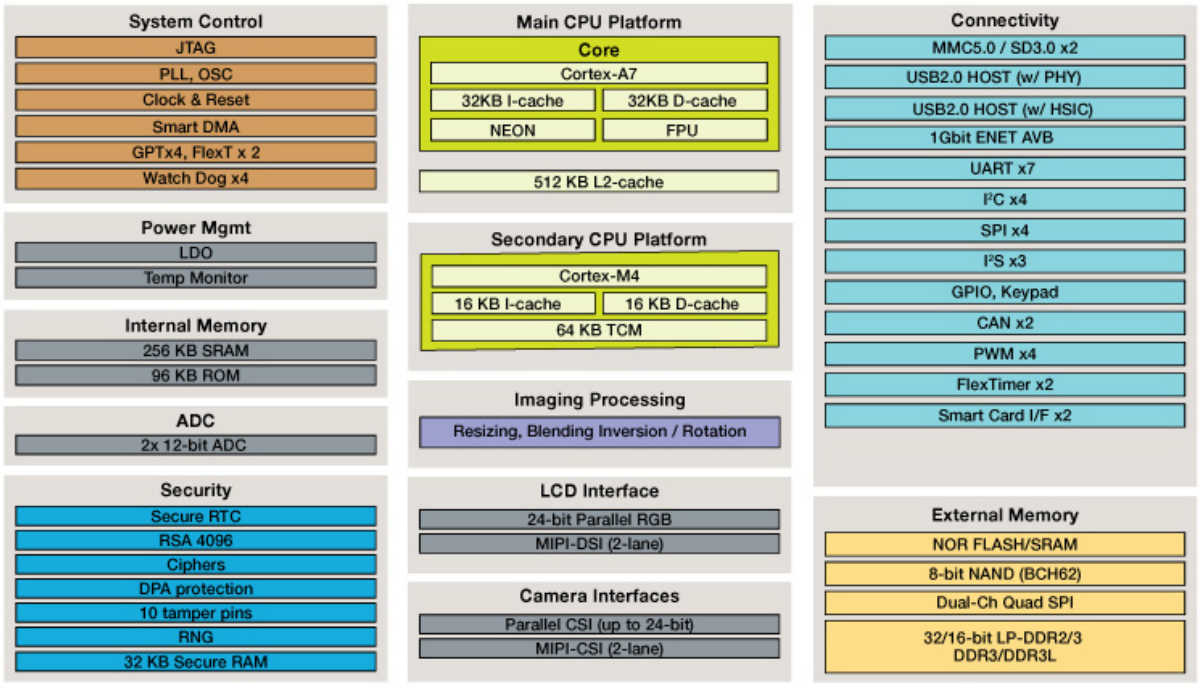


Figure 5 iMX7S SoC Diagram

3.1.2 MemoryeMCP–LPDDR3andeMMC

The CPU Board features a Multi-Chip Package Memory08EMCP04-EL3AV100-C30U from Kingston which combines 8GBeMMC and 512MB Low Power DDR3 synchronous dynamic RAM. This comes in 221-ballFBGA package.

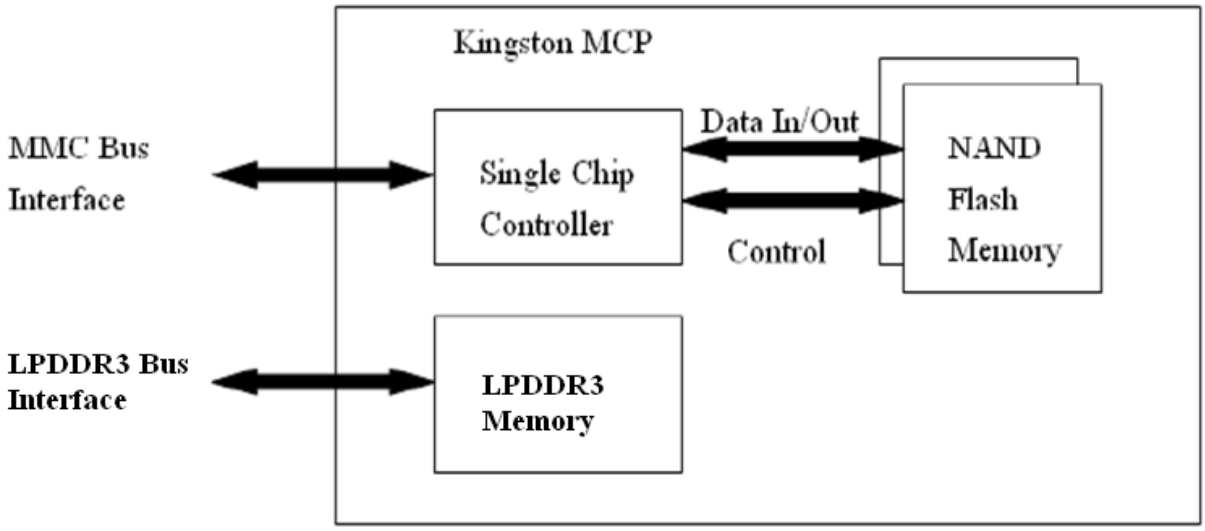


Figure 6KingStoneMCP Block Diagram

3.1.3 Video and Display

The WaRP7 CPU board provides output videofrom MIPI-DSI and accepts input through MIPI-CSI

3.1.3.1 **MIPI-DSI**

The CPU board includes a MIPI-DSI connector for outputting output the video from the i.MX7SMIPI-DSIPHY via the MIPI-DSI interface.

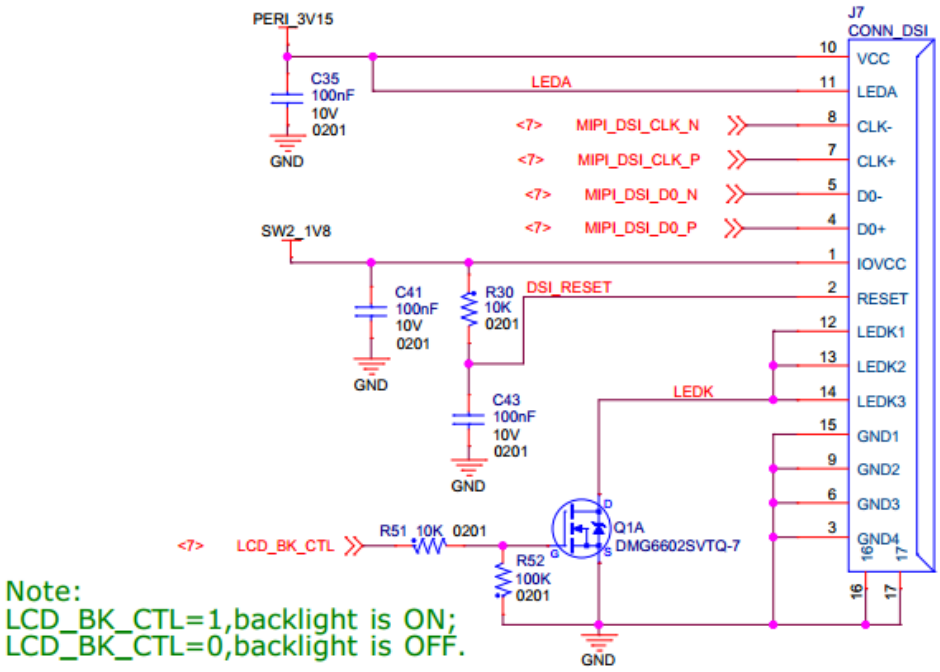


Figure 7MIPI-DSI connector

3.1.3.2 Capacitive Touch Screen

Capacitive touch screen is supported by I2C via touch screen port.

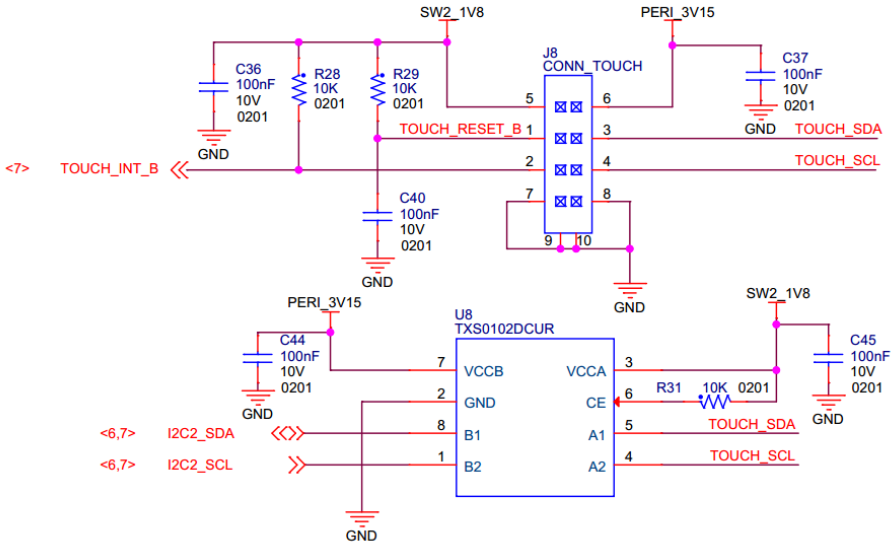


Figure 8Touch Screen Interface

3.1.3.3 MIPI-CSI

The CPU board includes a MIPI-CSI camera connector for connecting a CSI camera module.

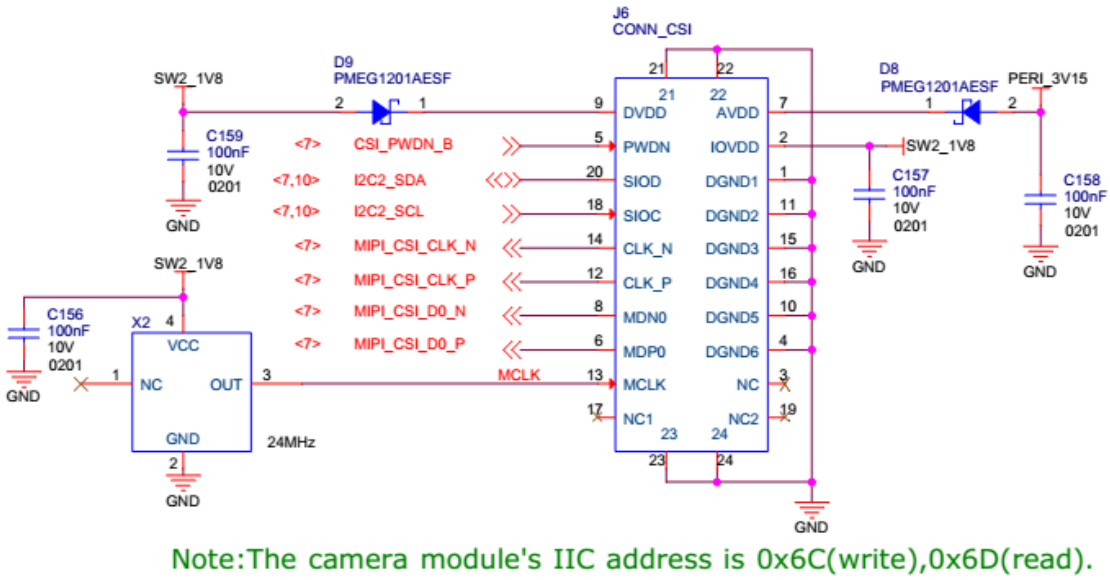


Figure 9MIPI CSI connector

3.1.4 Connectivity

The WaRP7 board will provide a number of connectivity include Wi-Fi, Bluetooth, Bluetooth(BLE), and USB-OTG. There will be provision for NFC as a passive tag primarily for Bluetooth pairing.

3.1.4.1 Wi-Fi/Bluetooth

The MurataType1DX module is an ultra-small module that includes 2.4GHz WLAN IEEE 802.11b/g/n and Bluetooth Version 4.0 plus EDR functionality. Based on Broadcom BCM4343W,the module provide high-efficiency RF front-end circuits.

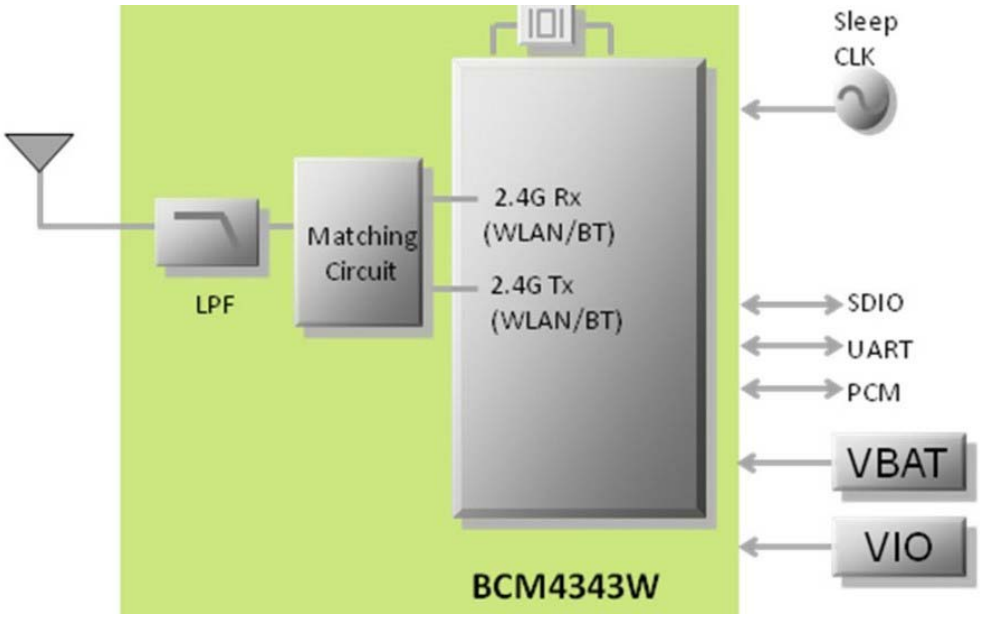


Figure 10Murata 1DX module

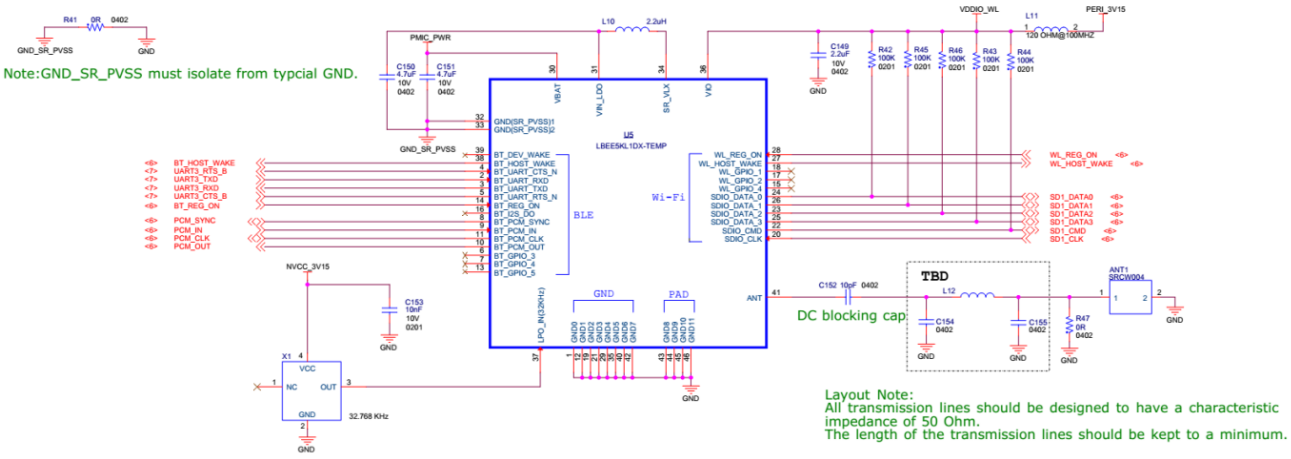


Figure 11Design implementation of 1DX

3.1.4.2 **USB-OTG**

The CPU board provides a USB micro-AB connector to support USB-OTG function powered by the USBOTG1 module on i.MX7S.

3.1.4.3 **NFC**

The board provides support for NFC using the NXPNT3H1101W0FHK. In addition to the passive NFC Forum compliant contact less interface, the IC features an I2C contact interface, which can communicate with i.mx7 ifNTAGI2C is powered from an external power supply. An additional externally powered SRAM mapped into the memory allow safest data transfer between the RF and I2C interfaces and vice versa, without the write cycle limit a tions of the EEPROM memory.

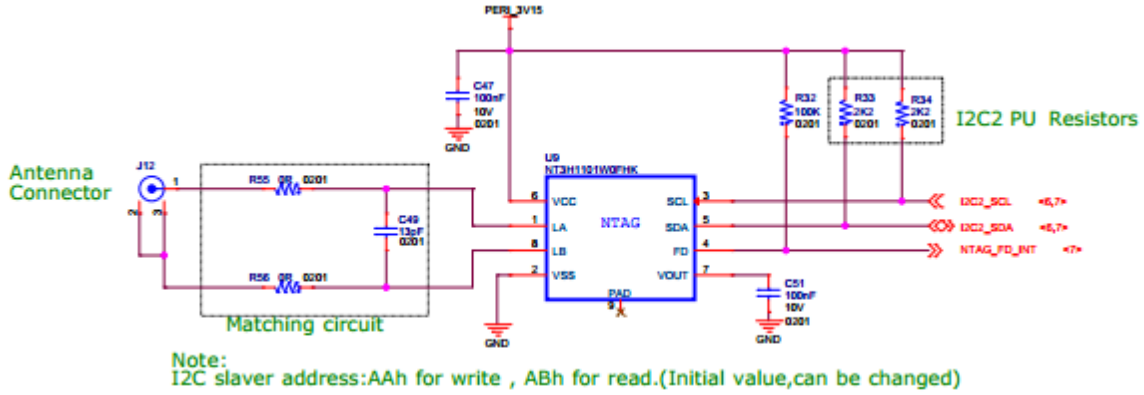


Figure 12NFC circuitry

3.1.5 PowerManagement

3.1.5.1 Power Management IC

The NXPPF3000 power management integrated circuit(PMIC)features a configurable architecture that supports numerous outputs with various current ratings as well as programmable voltage and sequencing. This enables the PF3000 to power the core processor, external memory and peripherals to provide a single-chip system power solution.

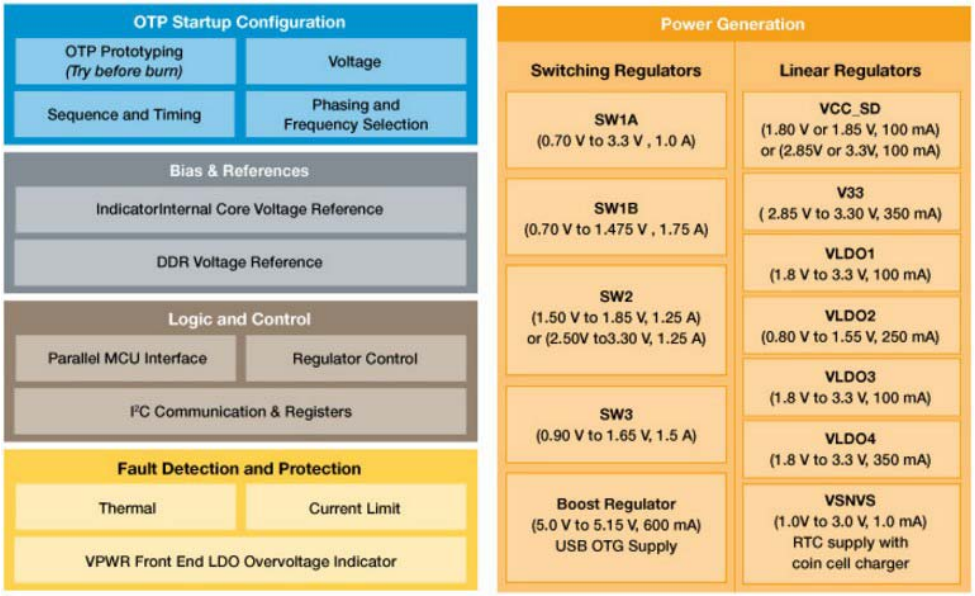


Figure 13PF3000 Functional Block diagram

3.1.5.2 PowerTreeDesign

The usage of PF3000 output is as shown in Table6 below.

Table2PF3000OutputPowerUpSequenceandUsage

PF0300 Channel	Voltage	Powerup sequence	Output Current	i.MX7PowerRail
SW1A	1.15V	1	1000mA	VDD_ARM
SW1B	1.15V	1	1750mA	VDD_SOC
SW2	1.8V	2	1250mA	VDDA_1P8_IN FUSE_FSOURCE VDD_XTAL_1P8 VDD_ADC1_1P8 VDD_ADC2_1P8 VDD_TEMPSENOR_1P8
SW3	1.5V	3	1500mA	NVCC_DRAM NVCC_DRAM_CKE
VSNVS	3.0V	0	1mA	VDD_SNVS_IN
SWBST		-	600mA	
VREFDDR		3	10mA	DRAM_VREF

VLDO1	1.8V	2	100mA	VDD_LPSR_IN
VLDO2	1.2V	-	250mA	
VLDO3	1.8V	2	100mA	NVCC_GPIO1/2
VLDO4	1.8V	-	350mA	
V33	3.15V	2	350mA	NVCC_xxxVDD_USB_OTG1_3P3_IN VDD_USB_OTG2_3P3_IN
VCC_SD	3.15V	3	100mA	NVCC_SD2

The following i.MX7S power rails must use the internal LDO outputs.

Table3 iMX7S Power Rails–Internal LDO

i.MX7SinternalLDOoutput	**i.MX7SPowerRail**
VDDD_1P0_CAP	VDD_MIPI_1P0 PCIE_VP PCIE_VP_RX PCIE_VP_TX
VDDA_PHY_1P8	VDDA_MIPI_1P8 PCIE_VPH PCIE_VPH_RX PCIE_VPH_TX
VDD_1P2_CAP	USB_VDD_H_1P2

3.1.5.3 **Battery Charger**

The NXPBC3770 is a fully programmable switching charger with dual-path output for single-cell Li-Ion and Li-Polymer battery. The dual-path output allows mobile applications with a fully discharged battery to boot up the system.

- High efficiency and switch-mode operation reduces heat dissipation and allows for higher current capability for a given package size
- Single input with a 20V with standing input and charges the battery with an input current up to 2A
- Charging parameters and operating modes are fully programmable over an I2C Interface that operates up to400kHz
- Highly integrated featuring OVP and Power FETs
- Supports1.5MHz switching capabilities

3.2 IOBoard

3.2.1 Audio

The IO board includes the FreescaleSGTL5000–aultra-low power audio codec with MICIn and Line Out capability.

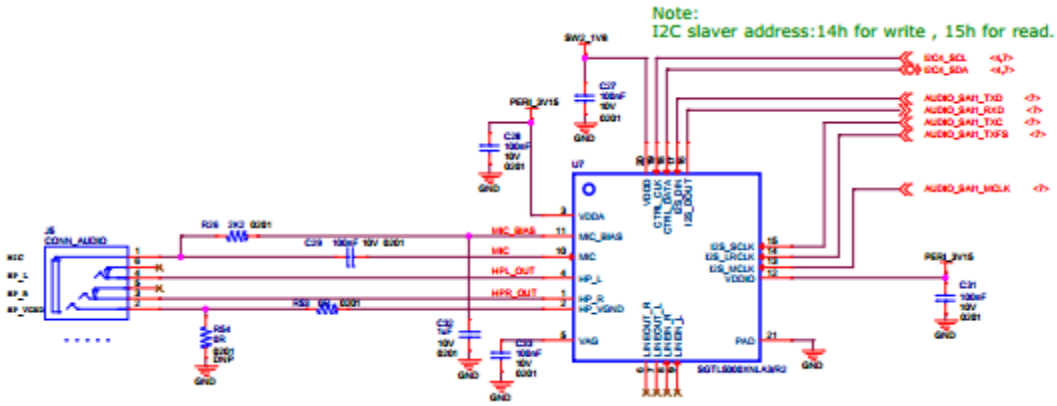


Figure 14Freescale SGTL5000 Audio Codec

3.2.2 Sensors

The WaRP7 board will include three sensors:altimeter, accelerometer and gyroscope.These three sensor chips share the I2C bus on i.MX7S. The sensors interrupts are wired to the processor as OR circuit. The software will determine which device asserted the interrupt.

3.2.2.1 Altimeter

The board features NXP'sMPL3115A2 precision a ltimeter. The MPL3115A2 is a compact piezoresistive absolute pressure sensor with an I2C interface. MPL3115 has a wide operating range of 20kPa to 110kPa, a range that covers all surface elevations on Earth.The fully internally compensated MEMS in conjunction with an embedded high resolution 24-bite quivalent ADC provide accurate pressure[Pascals]/altitude[meters] and temperature[degrees Celsius] data.

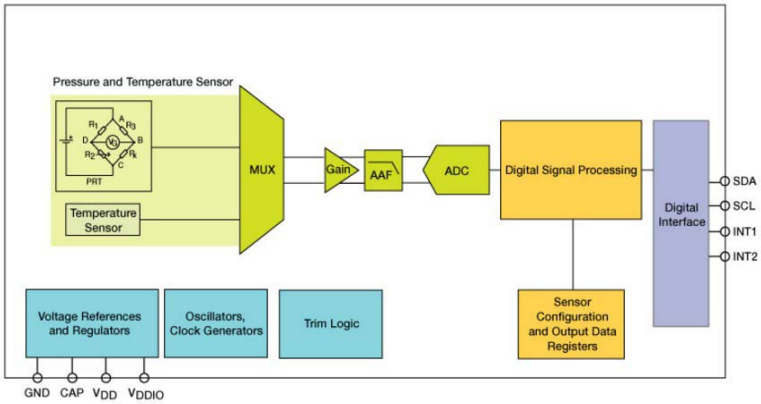


Figure 15MPL3115A2 Block Diagram

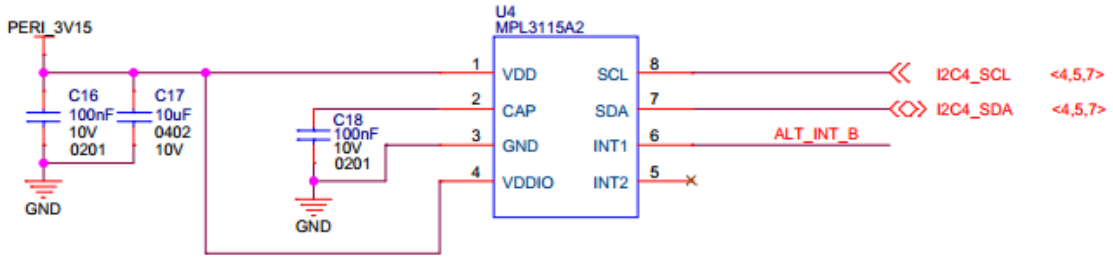


Figure 16Altimeter schematics

3.2.2.2 AccelerometerandMagnetometer

The board also features FXOS8700CQ 6-axis sensor combines industry-leading 14-bit accelerometer and 16-bit magnetometer sensors in a small 3x3x1.2mmQFN plastic package.

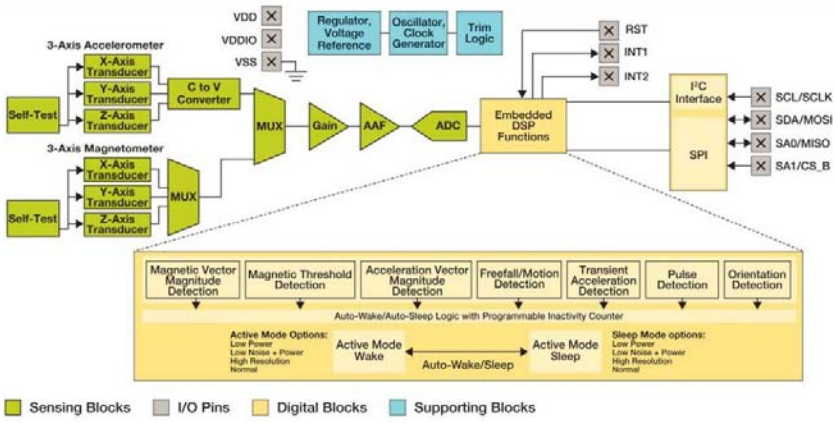


Figure 17FXOS8700CQ – Accelerometer/Magnetometer Block Diagram

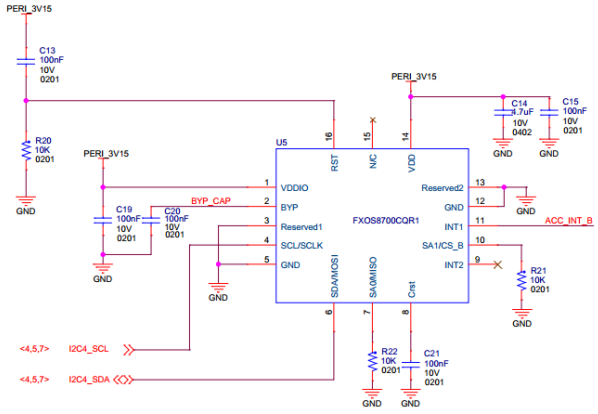


Figure 18 Accelerometer/ Magnetometer schematics

3.2.2.3 Gyroscope

The IO board also features the NXP's3-axisdigital gyroscope- FXAS21002.

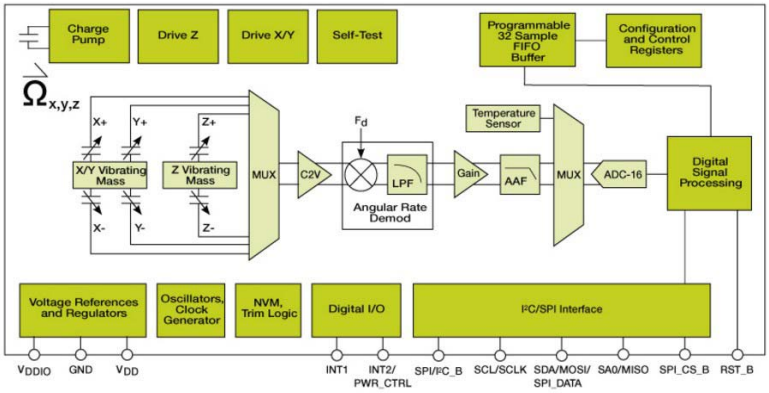


Figure 19FXAS21002 Gyroscope Block Diagram

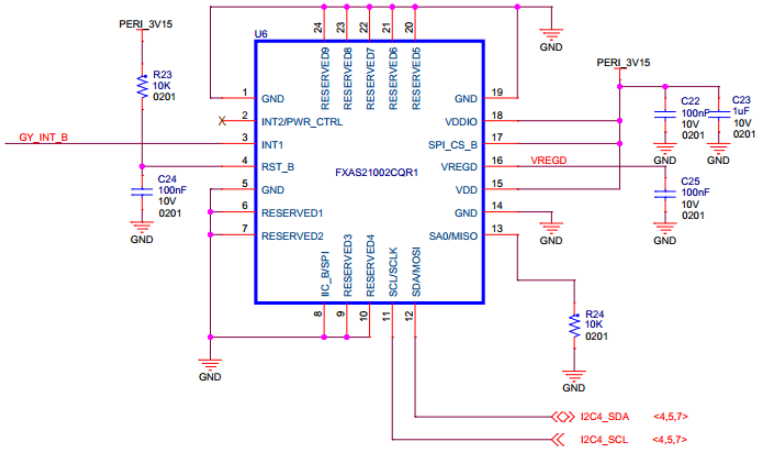


Figure 20Gyroscope schematics

3.2.3 Peripheral Expansion Port

The board provides expansion headers compatible with the **mikroBUS™** socket connection standard for accessing the following communication modules on i.MX7S:

- I2C
- SPI
- PWM
- UART
- GPIO

FCC Statement

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) this device may not cause harmful interference, and 2) this device must accept any interference received, including interference that may cause undesired operation.
Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

--Reorient or relocate the receiving antenna.

--Increase the separation between the equipment and receiver.

--Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

--Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. User should avoid un-intended operation of usage when it is collocated with other transmitters or antenna.