

Marvell Semiconductor

# Kinoma Element

## Hardware Technical Reference Manual

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# Kinoma Element

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Preview Copy

## Kinoma Element Hardware Technical Reference Manual

This document describe Kinoma Element Board circuit functions.

### Photo of Kinoma Element PCB

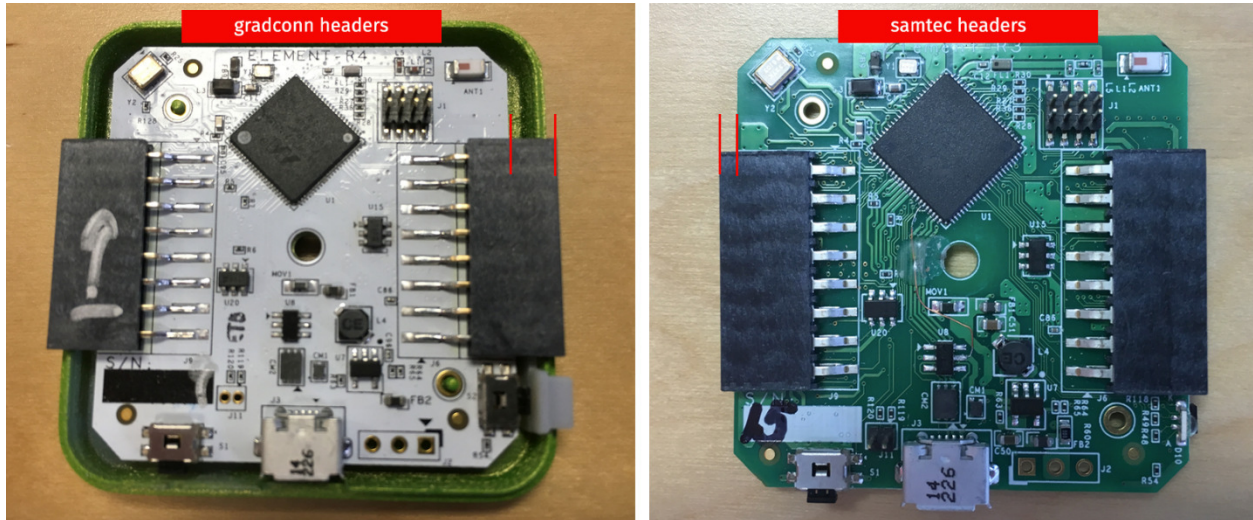


Figure 1 Element PCB assembly

### Block Diagram

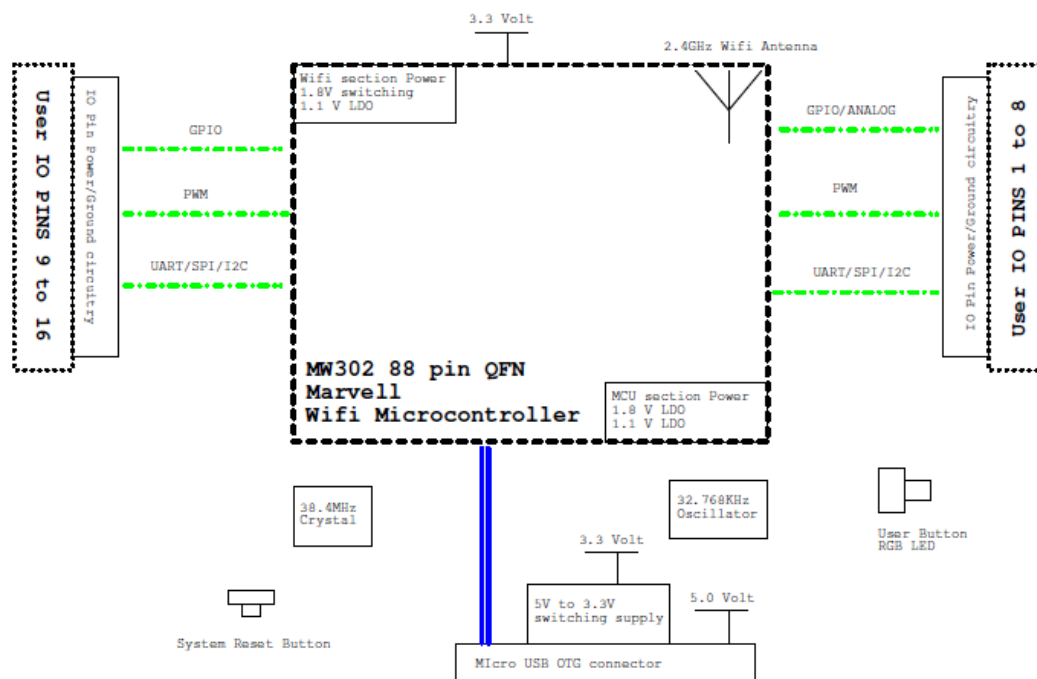


Figure 2 Element Block Diagram

## Power supply architecture

Element power supply has two main sections, system wide input from either micro USB connector or from dedicated J2 pins. Both inputs are tied together and feed on board 3.3 volt supply.

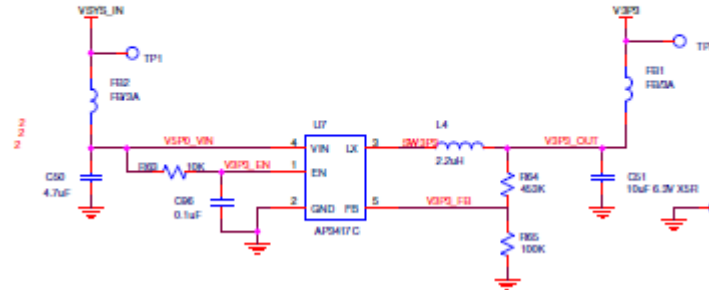


Figure 3 on board 5 volt to 3.3 volt switching supply

## On chip power regulators

MW302 contains on-chip power supplies for 1.8 volt and 1.1 volt. There are two sets of on chip power supplies, one for microcontroller part and another for wifi part. The 1.8 volt supply for wifi part is a switching supply controller utilizes L3. All other supplies are low drop out regulators that require output capacitor only.

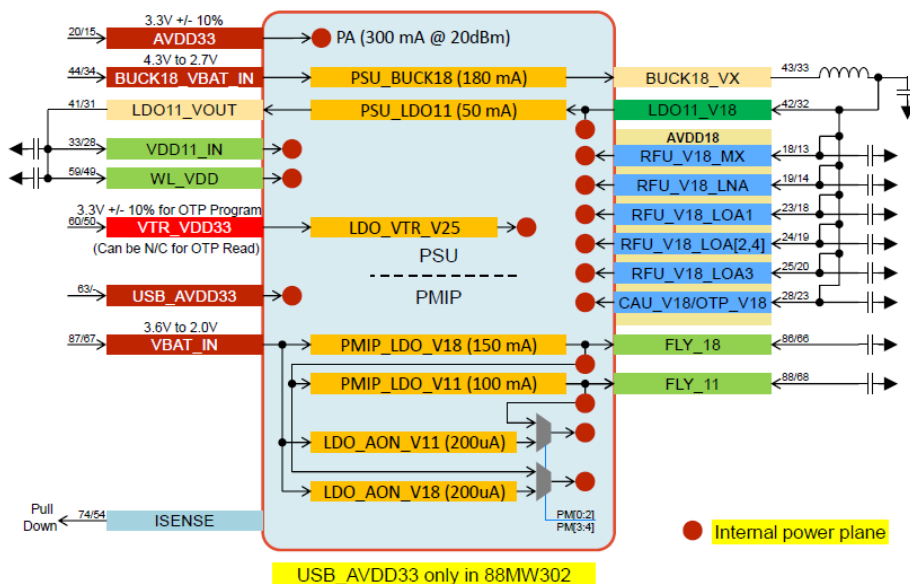


Figure 4 MW302 on chip power supplies

## IO power

Element use 3.3 volt IO power for all signals including QSPI flash and sleep clock.

## Reference clocks

System wide clock is derived from Y1 38.4 megahertz crystal. For the mw302 power management, a sleep clock oscillator Y2 runs at 32.768 Kilohertz.

## Reset

MW302 chip has on chip power on reset circuitry. It is also connected to a reset push button S1.

## User Button

A user definable button S2 and RGB color LED D10 is provided on one side of element.

## Micro USB OTG port

The USB OTG port can be used to power the device, connect to a PC as USB-CDC device, and connect to a USB device such as flash-drive and USB web cam

## User connectors

There are sixteen user IO connections, eight on each side of element. Every pin can be configured as

1. Digital GPIO
2. 3.3 volt Power supply pin
3. Ground pin
4. Pins on the Right hand side (where push button and LED locate) are also capable of analog input
5. Some pins carry serial ports such as UART, I2C and SPI.
6. Pins on the right hand side can be used as General Purpose timers or Pulse width modulated outputs.

## Power/Ground circuitry for User IO pins

To provide power or ground to every pin, the element utilizes external logic control and small power mosfets as shown below schematic sections. Every user IO pin has a P-channel mosfet transistor to connect to 3.3 volt power rail and an N-channel mosfet transistor to connect to ground reference. Signal PIN1 is connected to connector PIN1.

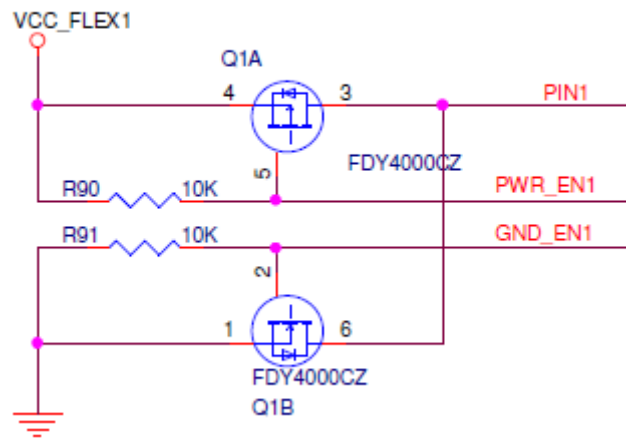


Figure 5 P and N channel mosfets

Each mosfet gate is driven by the serial in parallel out shift registers with separate output latch. Output latches are required so there will be no spurious switching while shifting out settings serially. There are two shift register chips, each has eight outputs, controls four of eight pins each. For each shift register four outputs control p-channel mosfet transistors and other four controls n-channel mosfet transistors.

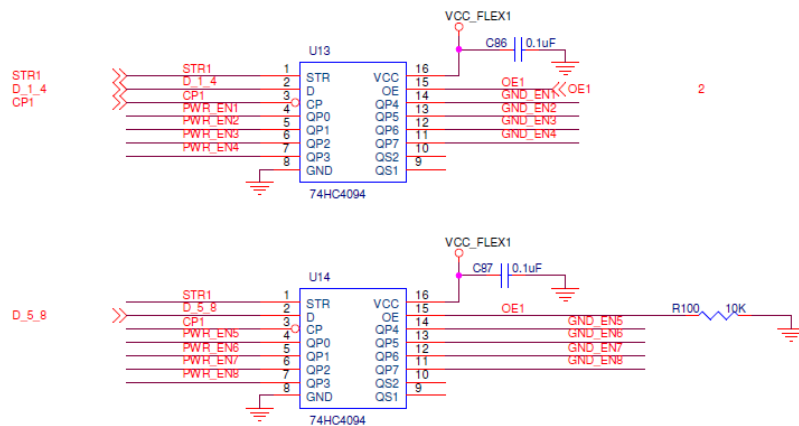


Figure 6 serial in-parallel out shift registers

Setting parallel output signal (PWR\_EN1 shown in Figure 3) connected to p-channel mosfet gate to logic HIGH will turn OFF the transistor, setting PWR\_EN1 logic LOW will turn the p-channel mosfet transistor ON, connecting IO pins to 3.3 volt power. Similarly, but of opposite logic states, setting logic LOW to parallel outputs of shift register connected to N-channel mosfet transistor gate (GND\_EN1 shown in figure 3) will turn the transistor OFF and setting GND\_EN1 to HIGH will turn the transistor ON.

Software ensures that both P-channel and N-channel mosfet transistors will NEVER on simultaneously to avoid power to ground low resistance path through transistors.

## Boot process

The mw302 boots as soon as power is applied and power on reset released. First instruction is fetched from on chip boot ROM. Boot rom will determine secondary boot source. Element board is configured to boot from a QSPI flash chip. First part of SPI chip has the secondary boot code known as boot2. Boot2 will further fetch microcontroller firmware and wifi firmware from appropriate locations in the flash device.

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## Kinoma Element

### Appendix A user pin to mw302 GPIO map

| Element Pin No | GPIO | Feature | UART     | SPI      | I2C      | GPT(PWM) | OTHER    |
|----------------|------|---------|----------|----------|----------|----------|----------|
| 1              | 42   | ADC0 0  |          | SSP1 CLK |          |          | KP DKIN0 |
| 2              | 43   | ADC0 1  |          | SSP1 FRM |          |          | KP DKIN1 |
| 3              | 44   | ADC0 2  | UART1 TX | SSP1 TXD |          |          | KP DKIN2 |
| 4              | 45   | ADC0 3  | UART1 RX | SSP1 RXD |          |          | KP DKIN3 |
| 5              | 46   | ADC0 4  |          | SSP2 CLK |          |          | KP DKIN4 |
| 6              | 47   | ADC0 5  |          | SSP2 FRM |          |          | KP DKIN5 |
| 7              | 48   | ADC0 6  | UART2 TX | SSP2 TXD |          |          | KP DKIN6 |
| 8              | 49   | ADC0 7  | UART2 RX | SSP2 RXD |          |          | KP DKIN7 |
| 9              | 0    |         |          | SSP0 CLK |          | GPT0 CH0 | KP MKIN4 |
| 10             | 1    |         |          | SSP0 FRM |          | GPT0 CH1 | KP MKIN5 |
| 11             | 2    |         | UART0 TX | SSP0 TXD |          | GPT0 CH2 | KP MKIN6 |
| 12             | 3    |         | UART0 RX | SSP0 RXD |          | GPT0 CH3 | KP MKO0  |
| 13             | 18   |         |          | SSP1 CLK | I2C1 SDA | GPT3 CH1 | KP MKO9  |
| 14             | 19   |         |          | SSP1 FRM | I2C1 SCL | GPT3 CH2 | KP MKO10 |
| 15             | 20   |         |          | SSP1 TXD | I2C0 SDA | GPT3 CH3 | KP MKO11 |
| 16             | 21   |         |          | SSP1 RXD | I2C0 SCL | GPT3 CH4 | KP MKO12 |

## Appendix C Extension power unit connections

A battery power pack can be added to the element board. It is required when USB port is connected to a device. A battery may be connected to J2. For devices which require proper power control switch, two GPIO signals are available on J11, power enable output and fault flag input.

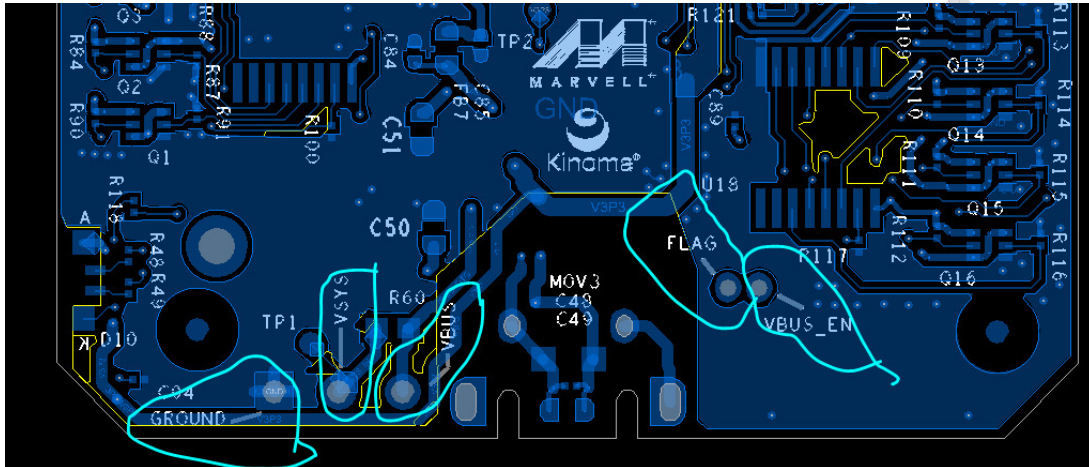


Figure 7 extension power connections



## I2C bus

Multiple I2C bus devices can be connected to the same I2C BUS. I2C bus can operate only when ALL devices on the bus are powered, and every device has unique bus address. It is also important to calculate total pull up resistance. All pull up resistors between SDA or SCL to 3.3 Volt will form parallel resistance.

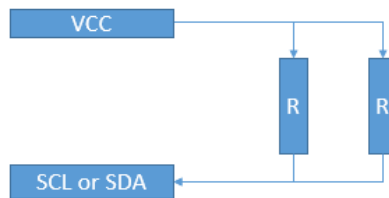


Figure 9 I2C bus pull up resistors in parallel

Total resistance can be calculated as below. There are many web sites offer web based parallel resistance calculations.

$$1/R_{\text{total}} = 1/R_1 + 1/R_2 \dots 1/R_n$$

$$R_{\text{total}} = (R_1 * R_2 * \dots R_n) / (R_1 + R_2 + \dots R_n)$$

For example, if two i2c devices each has 10 kilo ohm pull up resistor on module would effectively create a 5 kilo ohm pull up for the bus. If 10 devices are connected it would become a 1 kilo ohm pull up.

When total pull up resistance gets smaller, it become stronger driving force towards logic HIGH on the SCL or SDA to a state that the IO driver may not be able to drive it to acceptable logic LOW level on all devices. General rule of thumb, TOTAL resistance should be larger than 3 kilo-ohms.

## Reference documents

1. Marvell semiconductor web site mw300 wifi-microcontroller specifications

<http://www.marvell.com/microcontrollers/wi-fi-microcontroller-platform/>

2. Kinoma Element Schematics

element-dvt-Nov30.pdf

3. Kinoma Element PCB design files

151441201FBRD.zip, 151441201FAB.zip, 151441201ASSY.zip

4. In-Circuit Tester Functional Specifications