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AN063: GPIO Features

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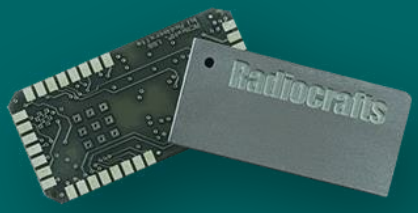


GPIO features in RIIM

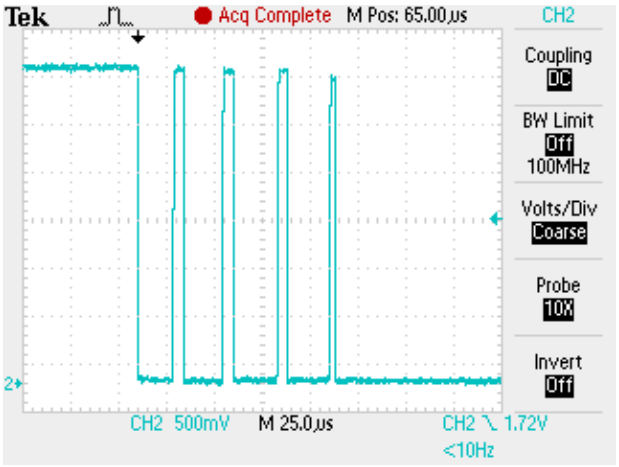
By Thomas S. Knutsen

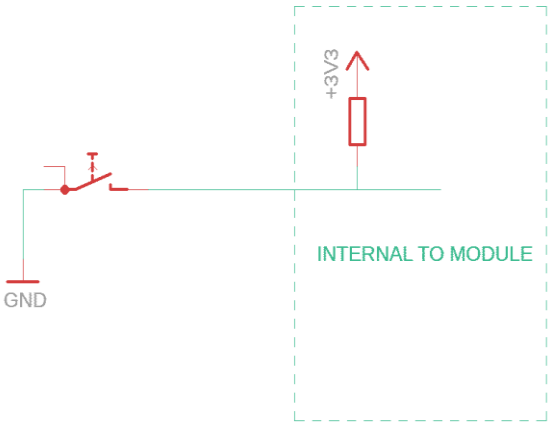
Background

There are a lot of features supported by the GPIO ports in RIIM. In this Application Note we show examples of how we solve some common problems, including use of common functions like Interrupts and PWM.

Debouncing using an interrupt and timer

All common types of push buttons will, when connected to a pin on a module, have some quite visible bounces when switching:





When connected to an input of a digital device that does edge detection, these spikes will each count as a button push.

When using modules that have ICI (Radiocrafts Intelligent C-programmable I/O) it is possible to use an edge interrupt and a timer to archive debouncing. This code for RIIM outlines the basics:

```
#include "RIIM_UAPI.h"
static uint8_t debounceTimer;

void debounce()
{
    if(GPIO.getValue(GPIO_5)== 0)
    {
       Util.printf("debounced\n");
    }
    Timer.stop(debounceTimer);

}

void interruptHandler(enum GPIO_Pin pin)
{
    Util.printf("interrupt\n");
    Timer.start(debounceTimer);
}

RIIM_SETUP()
{
    // Start as a router, leaf or border router.
    const uint8_t nwKey[16]={0,1,2,3,4,5,6,7,8,9,9,11,12,13,14,15};
    Network.setNWKey((uint8_t*)nwKey);
    Network.startMeshRouter();

    debounceTimer = Timer.create(ONE_SHOT, 100, debounce); // define the debounce
timer
    GPIO.setDirection(GPIO_5, INPUT); // using GPIO5 for the button input
    GPIO.setHandler(GPIO_5, FALLING_EDGE, PULL_UP, interruptHandler); // define
the interrupt handler
}
```

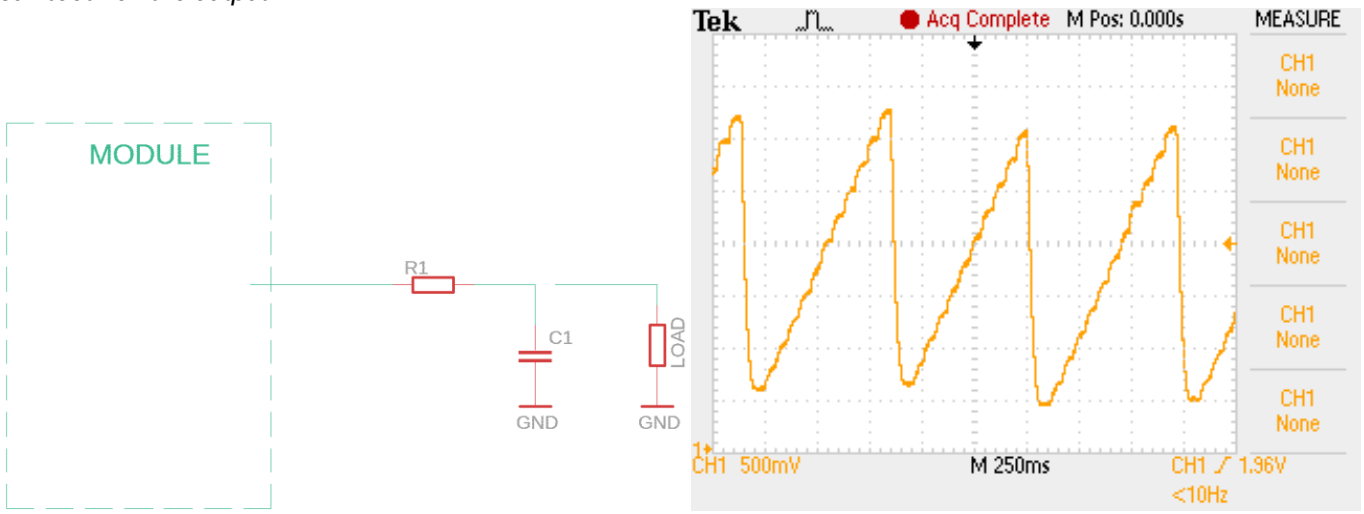
In RIIM_setup we define a timer that is a single shot timer that runs for 100ms. Port GPIO_5 is setup as an input with interrupt on falling edge and internal pullup. When this interrupt is triggered, it runs the interruptHandler routine that starts the debounce timer. After 100ms this timer expires and the routine debounce is executed. The Util.printf statements are there to show the triggering of the interrupt and the expiration of the debounce timer.

Pulse With Modulation

PWM is useful to get an analog voltage from a digital pin, without the use of a DAC, dimming of LEDs, clocking of external circuitry etc. ICI has PWM implemented, and an example is shown here:

```
#include "RIIM_UAPI.h"
uint8_t TimerHandle;
uint16_t i;

void TimerPWM()
{
    i = i+20;
    if(i > 1000){i = 0;}
    GPIO.startPWM(GPIO_6, 300, i);
}

RIIM_SETUP()
{
    // Start as a router, leaf or border router.
    const uint8_t nwKey[16]={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15};
    Network.setNWKey((uint8_t*)nwKey);

    GPIO.setDirection(GPIO_6, OUTPUT);

    TimerHandle=Timer.create(PERIODIC, 50, TimerPWM);
    Timer.start(TimerHandle);
    i = 0;
    return UAPI_OK;
}
```

In this application we define a timer to trigger each 50ms. This increases the PWM duty cycle in order to get a sawtooth on the output.



Analog to Digital converter

Using the analog to digital converter can be useful to sample an analog sensor or measure the battery voltage.

```
#include "RIIM_UAPI.h"
uint8_t TimerHandle;
uint8_t i;
static uint32_t milliVolts;

void Timer()
{
    ADC.init(ADC0, ADC_FIXED_REFERENCE, ADC_SAMPLING_DURATION_10_6_US);
    ADC.convertToMicroVolts(ADC0, &milliVolts);
    milliVolts /= 1000;
    Util.printf("%i\n", milliVolts);
}

RIIM_SETUP()
{
    // Start as a router, leaf or border router.
    const uint8_t nwKey[16]={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15};
    Network.setNWKey((uint8_t*)nwKey);

    ADC.init(ADC0, ADC_FIXED_REFERENCE, ADC_SAMPLING_DURATION_10_6_US);

    GPIO.setDirection(GPIO_5, OUTPUT);
    GPIO.setValue(GPIO_5, HIGH);

    TimerHandle=Timer.create(PERIODIC, 500, Timer);
    Timer.start(TimerHandle);
    return UAPI_OK;
}
```

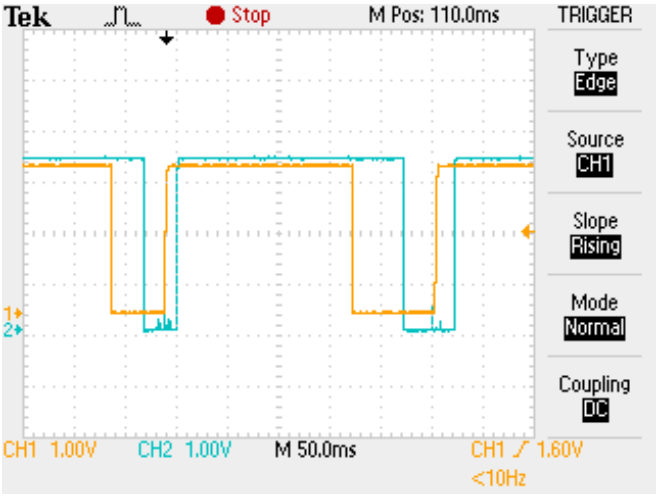
In this particular case GPIO_5 is set high, so that it works with the Sensorboard and the LDR (Light Dependent Resistor).

Reading quadrature encoder

A quadrature encoder can be read by using an interrupt on a flank on A, then determining if the B channel is leading or lagging.

```
#include "RIIM_UAPI.h"
uint8_t TimerHandle;
uint8_t i;
static uint32_t milliVolts;

void GPIOHandler(enum GPIO_Pin pin)
{
   if(GPIO.getValue(GPIO_6)==1)
  {
     i=i+1;
  }  else
  {
     i = i-1;
  }
  Util.printf("%i\n", i);
}

RIIM_SETUP()
{
    // Start as a router, leaf or border router.
    const uint8_t nwKey[16]={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15};
    Network.setNWKey((uint8_t*)nwKey);

    GPIO.setDirection(GPIO_6, INPUT);
    GPIO.setPull(GPIO_6, PULL_UP);
    GPIO.setDirection(GPIO_5, INPUT);
    GPIO.setHandler(GPIO_5, RISING_EDGE, PULL_UP, GPIOHandler);

    i = 100;
    return UAPI_OK;
}
```

The quadrature encoder may need de-bouncing, either in software using a timer or with a hardware RC network.



Exceptional low power consumption

Leaving the ports floating leads to higher power consumption than what you may desire. To get as low power consumption as possible, each of the unused ports should be put in a known state, for instance as an input with a pull down:

```
RIIM_SETUP()
{
    // Start as a router, leaf or border router.
    const uint8_t nwKey[16]={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15};
    Network.setNWKey((uint8_t*)nwKey);

    GPIO.setPull(GPIO_3, PULL_DOWN);
    GPIO.setDirection(GPIO_2, INPUT);
    GPIO.setPull(GPIO_2, PULL_DOWN);
    GPIO.setDirection(GPIO_1, INPUT);
    GPIO.setPull(GPIO_1, PULL_DOWN);
    GPIO.setDirection(GPIO_0, INPUT);
    GPIO.setPull(GPIO_0, PULL_DOWN);

    return UAPI_OK;
}
```

Shown here is an example with 4 ports. This should be applied to all GPIO ports that are not in use.

Document Revision History

Document Revision	Changes
1.0	Document created

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