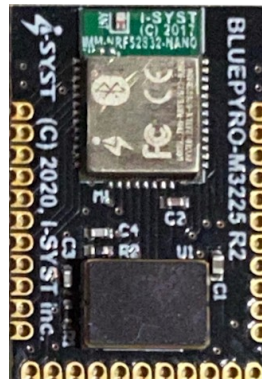


BLUEPYRO-M3225

System on Module

Excelitas PYD2592

ARM® M4F Bluetooth® 5



Revision history

Version	Date	Note	Contributor(s)	Approver
1.0	16 Mar. 2021	Initial version	Nguyen Hoang Hoan	Nguyen Hoang Hoan

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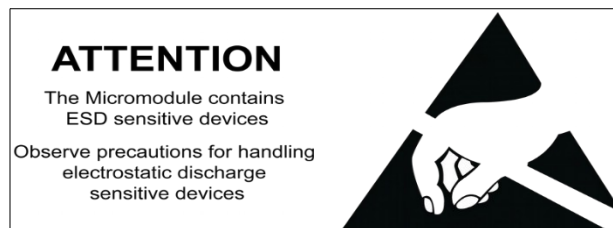
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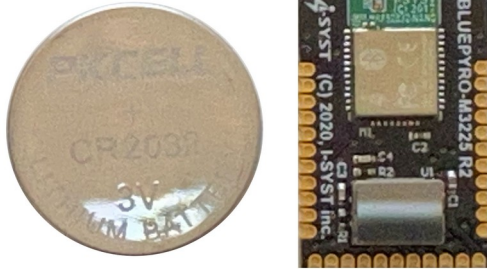
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1. Introduction



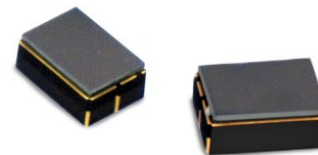
The BLUEPYRO-M3225 is an ultra low-power, miniature (22 x 15mm), low profile motion/proximity detection System on Module. It is an integration of an **I-SYST BLYST Nano Bluetooth® 5** module with an **Excelitas PYD2592**, a dual element PIR sensor with digital output and wake-up/sleep mode functionality. With a 64MHz **Nordic nRF52832 ARM® M4F** at its core and 27 programmable GPIO, it is the perfection solution for fast times to market, while addressing the growing global demands for additional sensor functionality and connectivity, particularly in

support of low-power, low-cost, industrial design, IoT application requirements. A full open source SDK is available for writing user application firmware directly on the module. Hence eliminating the requirement of an external MCU, reducing costs and time to market.

1.1 PYD2592 Overview

The Excelitas DigiPyro® PYD 2592 is a parallel opposed format, two elements detector based on fully RoHS compliant pyroelectric material. The signal is converted to a digital value using Sigma-Delta and DSP techniques. A configurable motion detection unit is implemented. Once motion was detected, an interrupt will be send to the host system. Putting the host system to sleep an overall ultra low power consumption will be achieved. All data is accessible by the host system to enable advanced signal analysis with your own detection criteria.

- Integrated digitization
- Motion detection unit with Interrupt function
- Responsivity: 3.7kV/W
- Low-power consumption of only 3µA at 1.8V.
- Dual detector with 2x1mm² elements
- 146° field-of-view
- LCC SMD housing for re-flow soldering
- Details: <https://www.excelitas.com/product/pyd-2592-dual-element-low-power-smd-digipyro>



1.2 BLYST Nano Overview

With a design based on the Nordic nRF52832 SoC, combining a low power 64 MHz ARM Cortex-M4F and the 2.4 GHz radio in a single chip, the BLYST Nano SoM (System on Module) is the perfect way to catch this new Bluetooth IoT wave driven by both Bluetooth® 5 and Bluetooth® Mesh.

- The BLYST Nano is low power and small enough, at 10 x 7 x 1.6 mm, for wearable and sensor

applications.

- With 30 programmable I/O pins, it's versatile enough to fit any control and automation application.
- With a hardware floating-point unit, algorithms can be directly implemented on the device, allowing more real-time sensor fusion processing.
- It is a complete System on the Module with all required components (crystals, coils, DC/DC, etc.) built-in and ready to use. So you don't need to take up more board space with add-on components needed to support a given module

Features

- 32 bits ARM® Cortexm-M4F @ 64MHz.
- 2.4GHz transceiver, Bluetooth® 5 LE
- 64KB SRAM.
- 512KB Flash
- 32 MHz Crystal 10PPM
- 32.768 KHz Crystal 20PPM
- DC/DC power mode configuration
- 30 configurable I/O pins
- Type 2 NFC-A Tag with wakeup on field
- 8 configurable 12 bits, 200 ksp/s ADC
- Digital microphone interface
- 3 x 4 channels PWM
- AES hardware encryption
- Temperature sensor
- Up to 4 PWM
- Digital interfaces SPI Master/Slave, 2-wire Master (I2C compatible), UART (CTS/RTS)
- Quadrature decoder
- Low power comparator
- Operating voltage : 1.8V to 3.6V
- Dimension : 10 x 7 x 1.6 mm
- FCC, IC, CE certified

1.3 Application

- Smart Home products
- Industrial mesh networks
- Smart city infrastructure
- Wireless intrusion detection
- Battery operated

2. Specifications

Radio	
Frequency Band	2.4 GHz ISM
On-air data rate	2 Mbps and 1 Mbps Bluetooth LE 1 Mbps ANT 2 Mbps and 1 Mbps 2.4 GHz proprietary
Output power	Programmable: -20 to +4 dBm in 4 dB steps
Sensitivity	-96 dBm Bluetooth LE 1 Mbps -89 dBm Bluetooth LE 2 Mbps -93 dBm 1 Mbps ANT -30 dBm whisper mode
RSSI	1 dB resolution

Radio current consumption with DC/DC at 3V	7.5 mA – TX at +4 dBm output power 5.3 mA – TX at 0 dBm output power 5.4 mA – RX at 1 Mbps
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Microcontroller

CPU	ARM® Cortex™ M4F
Floating Point Unit	Yes
Memory	Flash 512 KB (+ cache), 64 KB RAM
GPIO	32 configurable

Peripherals

NFC	NFC-A Tag
ADC	12-bit 200 ksps
Comparators	General purpose, low-power
Interfaces	SPI/2-wire/I ² S/UART/PDM/QDEC
Security	AES-128/ECB/CCM/AAR
Timers/Counters	32-bit

System

System peripheral bus	20-channel PPI
Power supply	Automatic system power
System current consumption DC/DC at 3V	DC/DC (1.7 V to 3.6 V), LDO (1.7 V to 3.6 V) 0.3 μA – No RAM retention 1.2 uA – All peripherals in IDLE mode 1.6 uA – All peripherals IDLE mode (32 kHz + RTC) 20 nA per 4 KB - RAM retention

Performance

Coremark	215 EEMBC CoreMark® (3.36 CoreMark/MHz) 58 CoreMark®/mA (Flash)
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3. Hardware Specification

3.1 Module Diagram

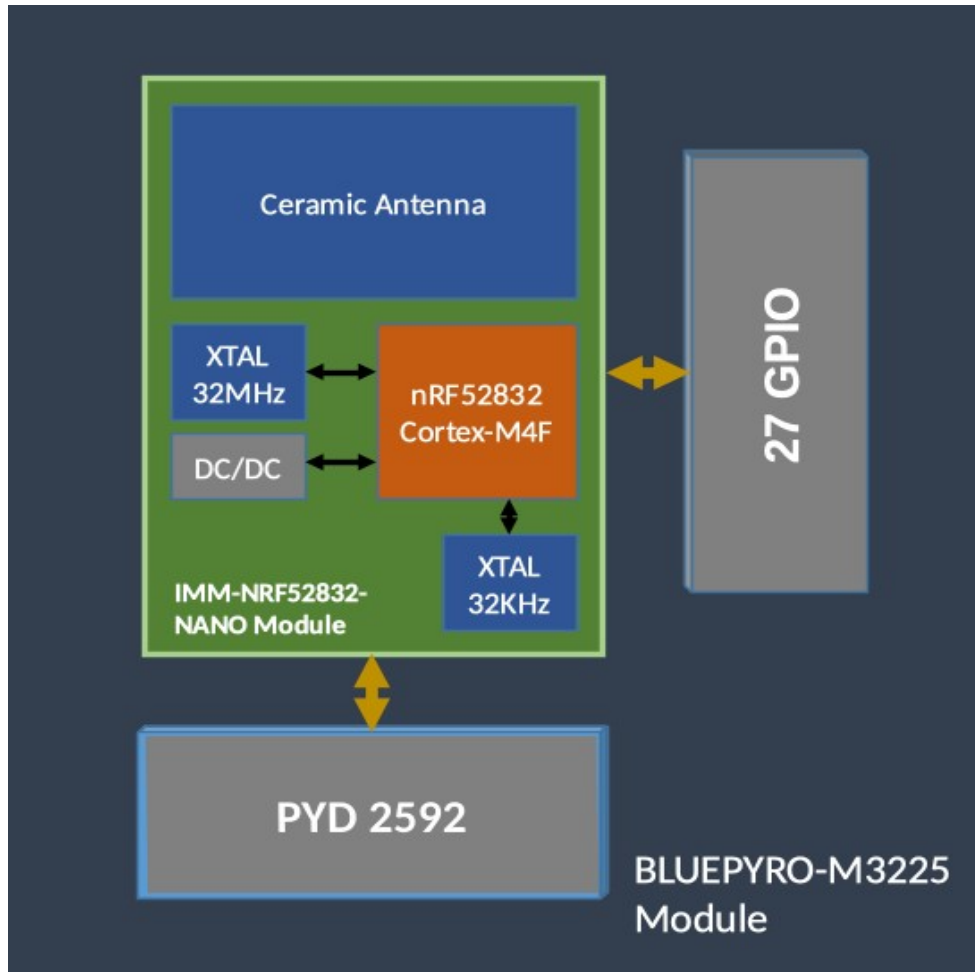


Figure 1: BLUEPYRO-M3225 module

3.1.1 Dimensions and I/O pins layout

Bellow is the direct relationship of the module pads and the nRF52832 I/O pins.

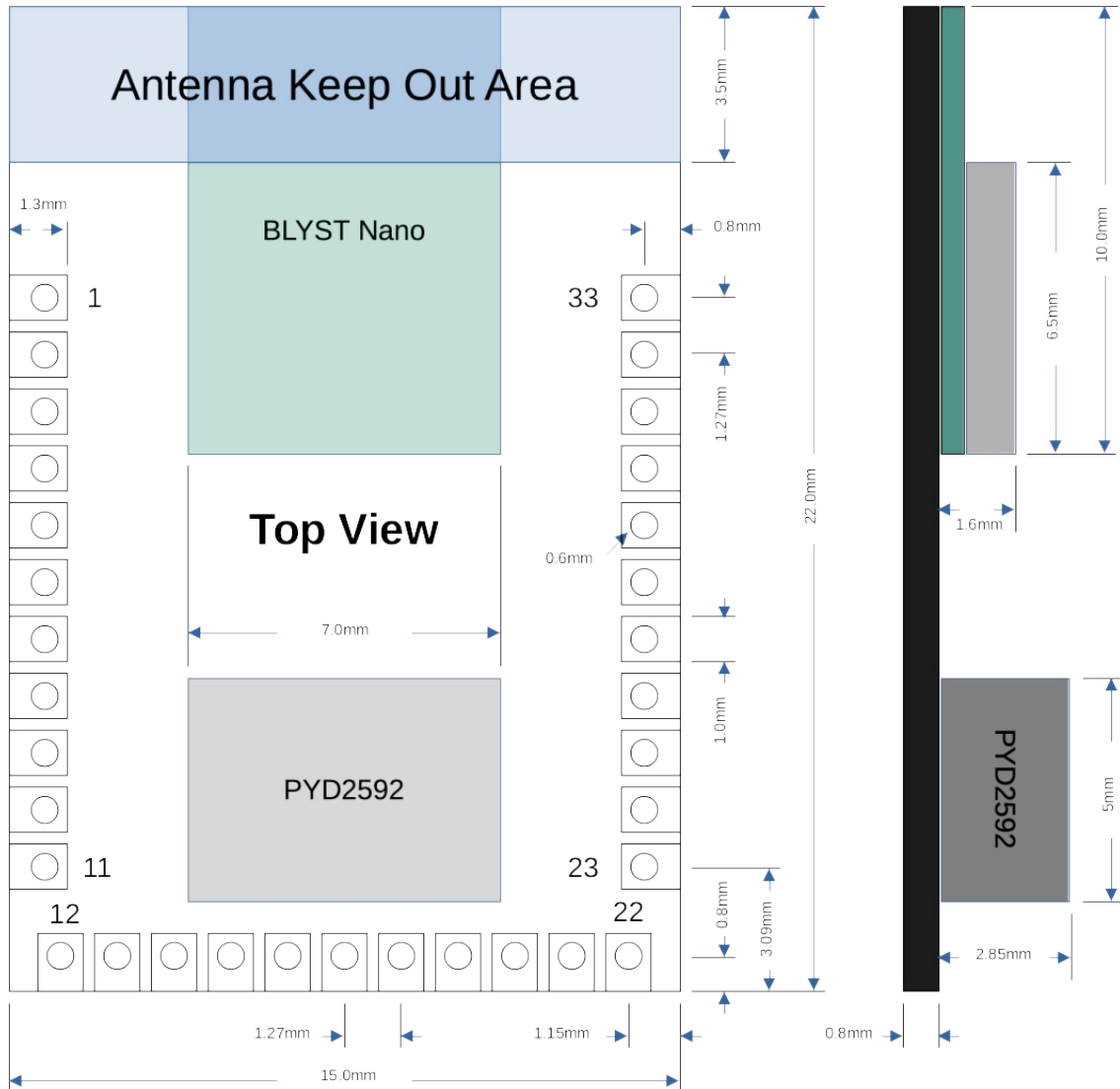


Figure 2: Dimensions top view

3.1.2 Pin Description

Pin Number	Pin Name	Description
1	P0.22	GPIO 22
2	P0.20	GPIO 20
3	P0.19	GPIO 19
4	P0.18	GPIO 18
5	P0.17	GPIO 17
6	P0.16	GPIO 16
7	P0.15	GPIO 15
8	P0.14	GPIO 14
9	P0.13	GPIO 13
10	P0.12	GPIO 12
11	P0.11	GPIO 11
12	P0.10/NFC2	GPIO 10 or NFC2 tag
13	P0.09/NFC1	GPIO 9 or NFC1 tag
14	P0.08	GPIO 8
15	NC	No connection
16	P0.05	GPIO 5
17	P0.04	GPIO 4
18	nRESET	Reset active low
19	SWDIO	SWD Data
20	SWDCLK	SWD Clock
21	GND	Ground
22	VDD	Power 1.8V-3.6V
23	P0.03/AIN1	GPIO 3 or Analog Input 1
24	P0.02/AIN0	GPIO 2 or Analog Input 0
25	P0.31/AIN7	GPIO 31 or Analog Input 7
26	P0.30/AIN6	GPIO 30 or Analog Input 6
27	P0.29/AIN5	GPIO 29 or Analog Input 5
28	P0.28/AIN4	GPIO 28 or Analog Input 4
29	P0.27	GPIO 27
30	P0.26	GPIO 26
31	P0.25	GPIO 25
32	P0.24	GPIO 24
33	P0.23	GPIO 23

3.1.3 PCB Footprint

Note : Do not route any traces or planes under the indicated antenna area.

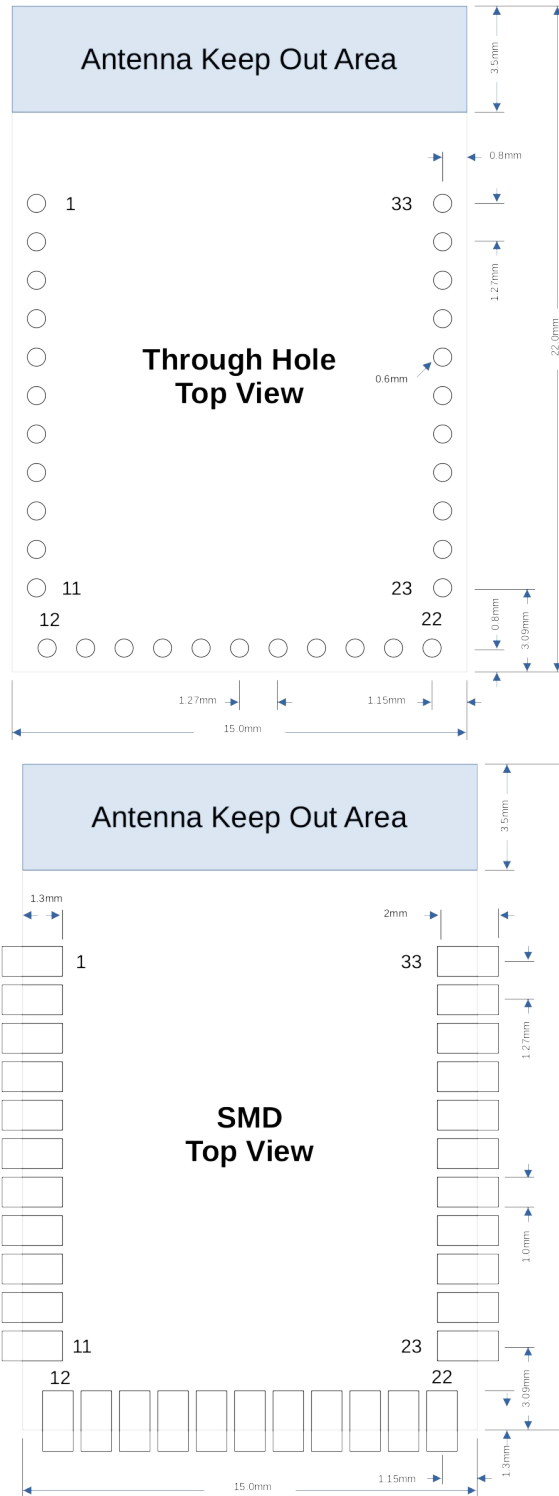


Figure 3: PCB footprint top view

4. Tested lens

4.1 Muhwa 3328-1-R Overview

The 3328-1-R is an HDPE Fresnel Lens designed and manufactured by Muhwa Industrial Co., Ltd.. By using a series of concentric grooves and patterns, these contours act as individual refracting surfaces, which bend parallel light rays to a common focal length, allowing the paired IR sensor to achieve enhanced distance detection and FoV performance. The **BLUEPYRO-M3225** was tested in factory walk-test lab with 3328-1-R and the optical performance met or surpassed motion detection expectations of lens datasheet. A different lens would be required if the application requires different performance requirements.

Features of 3328-1-R:

- Standard, off-the-shelf lens
- Tooled for high volume requirements
- Sleek, flat-ish shape, ideal for Industrial Designs
- Multiple colors available: Natural / White / Black
- Installation: Wall mounted
- Installation Height: 1.2m
- Detection Distance: 5-6m (or more depending on electronics)
- Angle: 110° - 120°
- Lens Size: 8mm x 24mm
- Patent Issued
- Details <http://www.twmuhwa.com/product/nice-sensitivity-fresnel-lens>

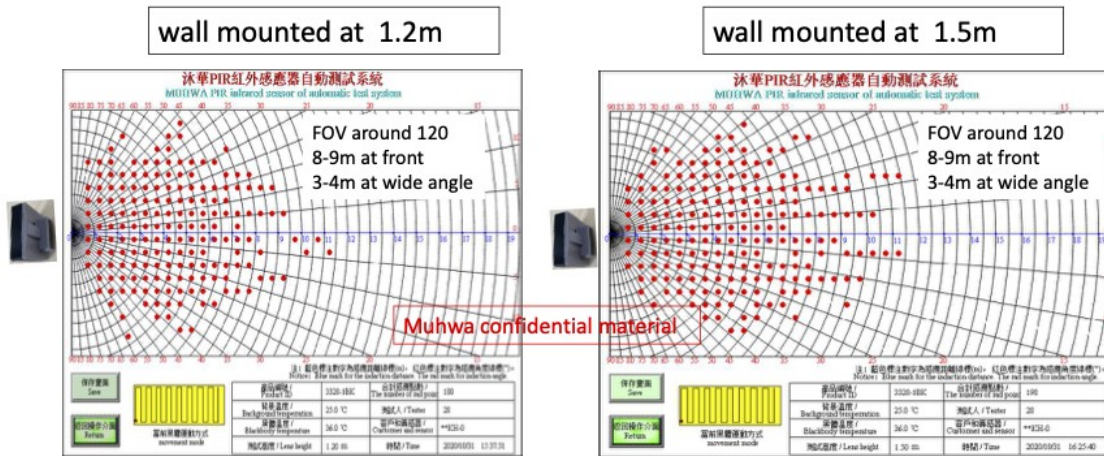


4.2 Muhwa 3328-1-R Test results

Download test report at [http://... link to be added](http://...)

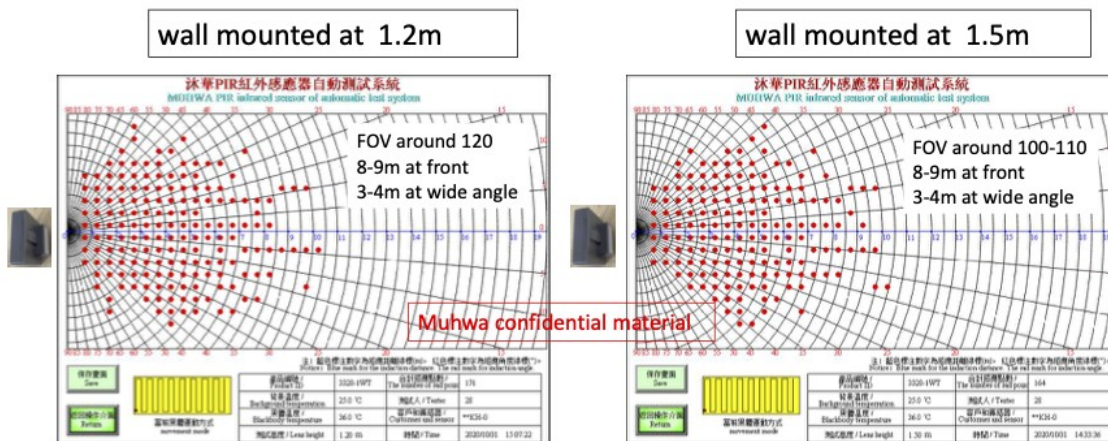
Muhwa 3328-1-R Fresnel Lens in black

www.twmuhwa.com



Muhwa 3328-1-R Fresnel Lens in white

www.twmuhwa.com



5. Development Resources

A high performance open source multi-architecture multi-platform object-oriented design library, IOsonata, with lots of peripheral and sensor drivers that are easily integrated with BLE in a few lines of code. The IOsonata library allows writing custom firmware as quickly and easily as Arduino for quick prototyping to production code without compromise.

There are lots of software development resources that are freely available for the nRF52832 as well as MicroPython ports.

Nordic provides a full range of SDKs with source for Bluetooth, Bluetooth Mesh, and other proprietary protocol.

A 100% Free software development environment using Eclipse IDE and GCC compiler with source debugging capabilities via OpenOCD and the IDAP-Link CMSIS-DAP Debug JTAG.

BLYST Nano documentations: <https://www.i-syst.com/products/blyst-nano>

IDAP-Link documentation & software: <https://sourceforge.net/projects/idaplinkfirmware/files/>

Nordic Bluetooth 5 SDK download: <https://www.nordicsemi.com/Software-and-tools/Software/nRF5-SDK/Download#infotabs>

Nordic Bluetooth Mesh SDK: <https://www.nordicsemi.com/Software-and-tools/Software/nRF5-SDK-for-Mesh/Download#infotabs>

Nordic developer forum: <https://devzone.nordicsemi.com>

Setting up Eclipse IDE & GCC based firmware development: <https://www.i-syst.com/article/eclipse-ide-firmware-development-iosonata>

Get started with Bluetooth firmware programming: <https://embeddedsoftdev.blogspot.com/2017/>