



# SMART BOARD

*OpenSensIOT*

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Datasheet, Ver. 0.9

# Table of contents

1	Introduction.....	3
2	Features.....	3
3	Connector functions and pinout.....	4
3.1	Daughter board connector.....	4
3.2	Battery connector.....	5
3.3	Power switch connector.....	5
3.4	Program and debug connector.....	5
3.5	USB connector.....	6
3.6	ePaper display connector.....	6
3.7	GSM antenna connector.....	6
3.8	ADS1292R ECG connectors.....	7
3.9	AFE4490 pulse oxymeter connectors.....	7
3.10	ADS1231ID strain gauge connectors.....	8
4	Connectivity map.....	8
4.1	MCU pin map (U5; STM32F427VGT6).....	8
4.2	Port extender pin map (U22; MCP23S09E/MG).....	10
4.3	Port extender pin map (U20; MCP23S17).....	10
5	Component references.....	11
6	Revision history.....	11
7	Environmental and EMC.....	11
8	Important notice.....	12
9	Support.....	12
10	Purchase.....	12

# 1 Introduction

OpenSensIoT board is state of the art open-source development platform. With its powerful 32-bit ARM®Cortex® processor, low-power sensors with local telemetry acquisition and comprehensive collection of radios, OpenSensIoT development board was designed to provide its users quick prototyping and low-cost development for variety of embedded IoT applications in a small size.

User-friendly OpenSensIoT development kit comes equipped with numerous C-code examples and complete low-level drivers for both basic and advanced prototyping and development. Software package comes with various projects which are primarily designed for Atollic True Studio IDE for STM32.

## 2 Features

- High-performance ARM®Cortex®-M4 (STM32F427VGT6)
  - 180 MHz core clock
  - FPU core
  - 2MB internal flash
  - 256+4 kB RAM
- 8Gb SLC NAND Flash memory (S34ML08G201BHI000)
  - 4-bit ECC
  - Open NAND Flash Interface (ONFI) 1.0
  - 100,000 Program / Erase cycles (Typ) (with 4-bit ECC per 528 bytes)
  - 10 Year Data retention (Typ)
- 24-Bit High-precision AD converter with analog input from Wheatstone bridge (ADS1231ID)
  - Internal amplifier with gain of 128
  - Low input noise (35 nVrms)
  - Input EMI filter
  - Sample rate: 80 samples per second
- 24-Bit Analog Front-End for Biopotential Measurements with u.FL connectors (ADS1292R)
  - Programmable gain of 1, 2, 3, 4, 6, 8 or 12
  - Low input noise (8  $\mu$ Vrms)
  - Programmable data rate from 125 to 8k samples per second
  - Low power: 335  $\mu$ W/channel
  - CMRR: -105 dB
- Integrated Analog Front End (AFE) for Pulse Oximeters (AFE4490)
  - Integrated LED Driver (H-Bridge, Push, or Pull)
  - 110-dB Dynamic Range Across Full Range
  - Input noise: 50 pA RMS (at 5- $\mu$ A PD Current)
  - 13.5 Noise-Free Bits (at 5- $\mu$ A PD Current)
  - Analog Ambient Cancellation Scheme
- iNEMO 6DoF inertial measurement unit (LSM9DS0TR)
  - Accelerometer  $\pm 2g/\pm 4g/\pm 6g/\pm 8g/\pm 16g$
  - Gyroscope  $\pm 245/\pm 500/\pm 2000$  dps
  - Magnetometer  $\pm 2/\pm 4/\pm 8/\pm 12$  gauss
  - 16-bit data output
  - Temperature sensor (12-bit data)

- Piezoresistive Absolute Pressure Sensor (LPS25HB)
  - 260-1260 hPa absolute pressure range
  - High-resolution mode: 0.01 hPa RMS
  - Low power consumption of 4  $\mu$ A
  - 24-bit data output
  - Programmable output data rate from 1 to 25 Hz
- Infrared thermopile sensor (TMP007AIYZF)
  - Accuracy: 0.5°C
  - Resolution: 12 Bits
  - Range: 0°C to +65°C
- GPS (Quectel L70R)
  - Supports autonomous GPS C/A, SBAS function (including WAAS and EGNOS) and AGPS (EASY function)
- High-Efficient 3G Wireless Module (Cinterion EHS5)
  - EHS5-US (850/1900 MHz) for North America, and EHS5-E (900/2100 MHz) rest of the world. USB, Embedded TCP/IP with TLS 1.2
- Bluetooth Multi Mode (PAN1026)
  - Bluetooth 4.0 (LE) embedded GATT profile with high level API commands
  - High sensitivity (-88 dBm typ.)
  - Tx power control up to a maximum of 4.0 dBm (typical)
- ePaper display; AMEPD (GDE021A1)
  - 172×72 pixels display
  - Bi-stable display
  - White reflectance above 30%
  - Contrast ratio above 7:1

## 3 Connector functions and pinout

### 3.1 Daughter board connector

- Designator: P1
- Pin count: 20
- Type: Samtec LSS-110-03-L-DV-A-K
- Connector pinout:

Pin	Function	Pin	Function
1	Ground	2	+3.0V_MB
3	GPIO12	4	VBAT (Fused 200mA)
5	ADS1929R_SCLK	6	I2C1_CLK
7	ADS1929R_CS	8	I2C1_SDA
9	ADS1929R_DRDY	10	I2C2_SDA
11	ADS1929R_DOUT	12	I2C2_CLK
13	ADS1929R_DIN	14	AFE4490_CS
15	SB_IO_EXT_CS	16	SPI1_MOSI
17	SB_IO_EXT_RESET	18	SPI1_MISO
19	SB_IO_EXT_INT	20	SPI1_CLK

### 3.2 Battery connector

- Designator: P11
- Pin count: 4
- Type: JST S4B-XH-A
- Connector pinout:

Pin	Function
1	Battery +
2	Battery +
3	Battery -
4	Battery -

### 3.3 Power switch connector

- Designator: P12
- Pin count: 2
- Type: MOLEX 53398-0271
- Connector pinout:

Pin	Function
1	Vbat (47k resistor)
2	SWITCH_ON_VBAT

### 3.4 Program and debug connector

- Designator: P3
- Pin count: 9
- Type: MOLEX 53047-0910
- Connector pinout:

Pin	Function
1	CPU VDD
2	TRACESWO
3	UART3-TX (SPI3_SCK)
4	SWDIO
5	SWCLK
6	UART3-RX (SPI3_MISO)
7	CPU_NRST
8	Ground
9	BS_ENABLE

### 3.5 USB connector

- Designator: P13
- Pin count: 5
- Type: MOLEX 1051330001 Micro USB
- Connector pinout:

Pin	Function
1	Vcc
2	Data -
3	Data +
4	ID (100k to ground)
5	Ground

### 3.6 ePaper display connector

- Designator: P10
- Pin count: 24
- Type: Samtec Hirose FH12-24S-0.5SV
- Connector pinout:

Pin	Function	Pin	Function
1	/	2	GDR
3	RESE	4	VGL
5	VGH	6	TSCL
7	TSDA	8	BS1
9	E_INK_BUSY	10	E_INK_RES#
11	E_INK_DC#	12	E_INK_CS#
13	SPI3_SCK	14	SPI3_MOSI
15	EINK_DVDD	16	EINK_DVDD
17	Ground	18	VDD
19	/	20	VSH
21	PREVGH	22	VSL
23	PREVGL	24	VCOM

### 3.7 GSM antenna connector

- Designator: P8
- Pin count: 2
- Type: Hirose U.FL-R-SMT
- Connector pinout:

Pin	Function
1	Signal
2	GND

### 3.8 ADS1292R ECG connectors

- Designator: P14
- Pin count: 2
- Type: Hirose U.FL-R-SMT
- Connector pinout:

Pin	Function
1	LeftArmElectrode
2	GND

- Designator: P15
- Pin count: 2
- Type: Hirose U.FL-R-SMT
- Connector pinout:

Pin	Function
1	RightArmElectrode
2	GND

### 3.9 AFE4490 pulse oxymeter connectors

- Designator: P17
- Pin count: 2
- Type: MOLEX 53261\_0271
- Connector pinout:

Pin	Function
1	DET_N
2	DET_P

- Designator: P18
- Pin count: 2
- Type: MOLEX 53261\_0271
- Connector pinout:

Pin	Function
1	TX_LED_N
2	TX_LED_P

### 3.10 ADS1231ID strain gauge connectors

- Designator: P21
- Pin count: 2
- Type: MOLEX 53261\_0271
- Connector pinout:

Pin	Function
1	+3.0V_SG_AVDD
2	AINP

- Designator: P22
- Pin count: 2
- Type: MOLEX 53261\_0271
- Connector pinout:

Pin	Function
1	AINN
2	+3.0V_SG_AVDD

## 4 Connectivity map

Pin mapping from MCU to peripheral devices on main and daughter board. Serial and GPIO, including port extender pins. Full schematics, user guide and programming manual is available in product documentation or visit: <http://www.smartkey.si/>

### 4.1 MCU pin map (U5; STM32F427VGT6)

MCU pin	Device pin	Type	Function
PA0	BT_RTS	USART2	PAN1026 bluetooth module serial interface signal
PA1	BT_CTS	USART2	PAN1026 bluetooth module serial interface signal
PA2	BT_RXD	USART2	PAN1026 bluetooth module serial interface signal
PA3	BT_TXD	USART2	PAN1026 bluetooth module serial interface signal
PA4	EEPROM_CS	SPI3	EEPROM Chip select
PA5	SPI1_SCK	SPI1	SPI clock for MCP23S17 and AFE4490
PA6	SPI1_MISO	SPI1	SPI MISO for MCP23S17 and AFE4490
PA7	SPI1_MOSI	SPI1	SPI MOSI for MCP23S17 and AFE4490
PA8	IO_EXT_INT	Interrupt In	Interrupt from MCP23S09E
PA9	USB_VBUS	GPIO in	USB Vbus detect
PA10	E-INK_BUSY	GPIO in	eink display status
PA11	USB D-	USB	USB negative data line
PA12	USB D+	USB	USB positive data line
PA13	SWDIO	Programming	Data IO used for programming and debug
PA14	SWCLK	Programming	Clock IO used for programming and debug
PA15	IO_EXT_CS	SPI3	MCP23S09E chip select
PB0	AD_USB_DETECT	ADC in	USB input voltage
PB1	VBAT_ADC	ADC in	Battery voltage
PB2	/	BOOT1	Connected to ground
PB3	TRACESWO	Debug	Trace signal for debug
PB4	E_INK_DC#	GPIO out	eink display DC# signal
PB5	GPIO12	GPIO out	GPIO12 output driver for buzzer



MCU pin	Device pin	Type	Function
PB6	USART1_TX	USART1	USART 1 transmit
PB7	USART1_RX	USART1	USART 1 receive
PB8	I2C1_CLK	I2C1	ADS1231 clock
PB9	I2C1_SDA	I2C1	ADS1231 data
PB10	I2C2_CLK	I2C2	TMP007A and LPS25HB clock
PB11	I2C2_SDA	I2C2	TMP007A and LPS25HB data
PB12	GSM_DTR0	USART3	EHS5 GSM module serial interface signal
PB13	GSM_CTS0	USART3	EHS5 GSM module serial interface signal
PB14	GSM_RTS0	USART3	EHS5 GSM module serial interface signal
PB15	GSM_DSRO	USART3	EHS5 GSM module serial interface signal
PC0	SB_IO_EXT_RESET	GPIO out	MCP23S17 IO extender reset
PC1	SB_IO_EXT_CS	GPIO out	MCP23S17 IO extender chip select
PC2	BT_RESET	GPIO out	PAN1026 bluetooth module reset
PC3	BT_WAKE_UP	Interrupt in	PAN1026 bluetooth module interrupt
PC4	CS_ACCEL_MAG	GPIO out	LSM9DS0TR accelerometer & magnetometer chip select
PC5	CS_GYRO	GPIO out	LSM9DS0TR gyroscope chip select
PC6	GPS_RXD	USART6	L70R GPS module serial interface signal
PC7	GPS_TXD	USART6	L70R GPS module serial interface signal
PC8	CPU_PWR_ON	GPIO out	Board power on signal
PC9	BAT_DETECTION	Interrupt in	Battery insert detection pulse
PC10	SPI3_SCK	SPI3	MCP23S09E & GDE021A1 & EEPROM clock (Alt. Bootstrap UART3-TX)
PC11	SPI3_MISO	SPI3	MCP23S09E & GDE021A1 & EEPROM MISO (Alt. Bootstrap UART3-RX)
PC12	SPI3_MOSI	SPI3	MCP23S09E & GDE021A1 & EEPROM MOSI
PC13	NC	/	Not connected
PC14	OSC32_IN	RTC	32.768kHz crystal
PC15	OSC32_OUT	RTC	32.768kHz crystal
PD0	NAND_D2	FMC	S34ML08G data
PD1	NAND_D3	FMC	S34ML08G data
PD2	E_INK_CS#	SPI3	eink display chip select
PD3	IO_EXT_RESET	GPIO out	MCP23S09E reset
PD4	NAND_nRE	FMC	S34ML08G control
PD5	NAND_nWE	FMC	S34ML08G control
PD6	NAND_R/B	FMC	S34ML08G control
PD7	NAND_Nce	FMC	S34ML08G control
PD8	GSM_TXD0	USART3	EHS5 GSM module serial interface signal
PD9	GSM_RXD0	USART3	EHS5 GSM module serial interface signal
PD10	GSM_DCDO	USART3	EHS5 GSM module serial interface signal
PD11	NAND_CLE	FMC	S34ML08G control
PD12	NAND_ALE	FMC	S34ML08G control
PD13	GSM_LEVEL_SHIFTER_OE	GPIO out	SN74AVC4T774 output enable for GSM USART
PD14	NAND_D0	FMC	S34ML08G data
PD15	NAND_D1	FMC	S34ML08G data
PE0	E_INK_RES#	GPIO out	eink display reset
PE1	AFE4490_CS	SPI1	AFE4490 chip select
PE2	ADS1929R_SCLK	SPI4	ADS1929R clock
PE3	ADS1929R_CS	SPI4	ADS1929R chip select

MCU pin	Device pin	Type	Function
PE4	ADS1929R_DRDY	Interrupt in	ADS1929R data ready interrupt
PE5	ADS1929R_DOUT	SPI4	ADS1929R MISO
PE6	ADS1929R_DIN	SPI4	ADS1929R MOSI
PE7	NAND_D4	FMC	S34ML08G data
PE8	NAND_D5	FMC	S34ML08G data
PE9	NAND_D6	FMC	S34ML08G data
PE10	NAND_D7	FMC	S34ML08G data
PE11	SWITCH	Interrupt in	Switch interrupt
PE12	GSM_RING0	GPIO in	EHS5 GSM module ring
PE13	GSM_RESET	GPIO out	EHS5 GSM module reset
PE14	SB_IO_EXT_INT	Interrupt in	MCP23S17 interrupt on input change
PE15	GSM_AUTO_ON	GPIO out	EHS5 GSM module power control
BOOT0	BS_ENABLE	Debug/Prog.	BOOT0 signal for USART3 boot

#### 4.2 Port extender pin map (U22; MCP23S09E/MG)

Extender pin	Device pin	Type	Function
GPOI 0	BT_ON_OFF	output	PAN1026 bluetooth module power
GPOI 1	GPS_ON_OFF	output	L70R GPS module power
GPOI 2	GSM_ON_OFF	output	EHS5 GSM module power
GPOI 3	/	/	
GPOI 4	ACCEL_MAG_INT	input	LSM9DS0TR accelerometer & magnetometer interrupt
GPOI 5	GYRO_INT	input	LSM9DS0TR gyroscope interrupt
GPOI 6	GPIO10	input	PCBA Revision coding
GPOI 7	GPIO11	input	PCBA Revision coding

#### 4.3 Port extender pin map (U20; MCP23S17)

Extender pin	Device pin	Type	Function
GPA0	AFE_DIAG_END	input	AFE4490 diagnose end
GPA1	AFE_LED_ALM	input	AFE4490 led fault
GPA2	AFE_PD_ALM	input	AFE4490 photo diode fault
GPA3	AFE_ADC_RDY	input	AFE4490 ADC ready
GPA4	/	/	
GPA5	/	/	
GPA6	/	/	
GPA7	/	/	
GPB0	ADS1929R_START	output	ADS1929R start convert
GPB1	ADS1929R_RESET	output	ADS1929R reset
GPB2	ADS_NPWDN	output	ADS1929R power
GPB3	AFE_NPDN	output	AFE4490 power
GPB4	AFE_NRESET	output	AFE4490 reset
GPB5	/	/	
GPB6	/	/	
GPB7	/	/	

## 5 Component references

Component	Manufacturer	Document
STM32F427VGT6	STMicroelectronics	<a href="https://www.st.com/en/microcontrollers/stm32f427vg.html">https://www.st.com/en/microcontrollers/stm32f427vg.html</a>
S34ML08G201BHI000	Cypress semiconductor	<a href="http://www.cypress.com/part/s34ml08g201bhi000">http://www.cypress.com/part/s34ml08g201bhi000</a>
MCP23S09E/M	Microchip	<a href="https://www.microchip.com/wwwproducts/en/MCP23S09">https://www.microchip.com/wwwproducts/en/MCP23S09</a>
MCP23S17	Microchip	<a href="https://www.microchip.com/wwwproducts/en/MCP23S17">https://www.microchip.com/wwwproducts/en/MCP23S17</a>
PAN1026	Panasonic	<a href="https://na.industrial.panasonic.com/products/wireless-connectivity/bluetooth/multi-mode/series/pan1026-series/CS487">https://na.industrial.panasonic.com/products/wireless-connectivity/bluetooth/multi-mode/series/pan1026-series/CS487</a>
Quectel L70R	Quectel	<a href="https://www.quectel.com/product/l70r.htm">https://www.quectel.com/product/l70r.htm</a>
GDE021A1	GoodDisplay	<a href="https://www.smart-prototyping.com/image/data/9_Modules/10600471%20e%20ink%20paper%20v2.0/GDE021A1.pdf">https://www.smart-prototyping.com/image/data/9_Modules/10600471%20e%20ink%20paper%20v2.0/GDE021A1.pdf</a>
EHS5	Cinetron	<a href="https://www.gemalto.com/brochures-site/download-site/Documents/M2M_EHS5_datasheet.pdf">https://www.gemalto.com/brochures-site/download-site/Documents/M2M_EHS5_datasheet.pdf</a>
LSM9DS0TR	STMicroelectronics	<a href="https://www.st.com/content/st_com/en/products/mems-and-sensors/inemo-inertial-modules/lsm6ds3tr-c.html">https://www.st.com/content/st_com/en/products/mems-and-sensors/inemo-inertial-modules/lsm6ds3tr-c.html</a>
ADS1292R	Texas Instruments	<a href="http://www.ti.com/product/ADS1292R">http://www.ti.com/product/ADS1292R</a>
LPS25HB	STMicroelectronics	<a href="https://www.st.com/en/mems-and-sensors/lps25hb.html">https://www.st.com/en/mems-and-sensors/lps25hb.html</a>
TMP007AIYZF	Texas Instruments	<a href="https://www.ti.com/store/ti/en/p/product/?p=TMP007EVM">https://www.ti.com/store/ti/en/p/product/?p=TMP007EVM</a>
AFE4490	Texas Instruments	<a href="http://www.ti.com/product/AFE4490">http://www.ti.com/product/AFE4490</a>
ADS1231ID	Texas Instruments	<a href="http://www.ti.com/lit/ds/symlink/ads1231.pdf">http://www.ti.com/lit/ds/symlink/ads1231.pdf</a>

## 6 Revision history

Revision	Date	Description
<b>0.9</b>	7.1.2019	Preliminary release

## 7 Environmental and EMC

Preliminary tests were performed in development phase to check that product is capable of receiving CE or FCC certification.

Product is RoHS compliant.

## 8 Important notice

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## 9 Support

For technical support please visit: <http://www.smartkey.si/>

## 10 Purchase

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