# FEATURES

- Built-in RapidSTM32 native-support bootloader.

- ARM 32-bits Cortex^{TM} – M3 Processor (STM32F103RET6)
    - 90MIPS maximum speed
    - 64 KBytes SRAM
    - 51 GPIO
    - 16 channels 12-bit, 1μs ADC
    - 5 USART, 3 SPI, 2 I^{2}C, 1 CAN
    - On-chip temperature sensor
    - 4 General purpose 16-bits timers with 4 IC/OC/PWM per timer
    - 2 16-bits Advanced control timers
    - 2 Watchdog timer
    - 2 channels 12-bit DAC
    - USB 2.0 full speed interface

- Two onboard crystals
    - 32 kHz (for real-time clock)
    - 8 MHz (for MCU clock)

- Power supply management
    - Reverse supply voltage protection
    - USB or External (up to 15VDC) supply input selection via jumper settings
    - 3.3V (up to 800mA) LDO regulator for internal and external circuitries

- Flash programming
    - 496Kbytes available flash memory
    - In-Application Programming via either USB HID or serial (RS232) interfaces directly from Matlab^{TM} or MS Windows^{TM}.
    - Automatic compile and download directly from Matlab^{TM}.

- Other onboard peripherals
    - 3 user LED (red, yellow, green)
    - 2 user logic (H/L) input jumpers
    - 10K potentiometer

    - High capacitance (0.33F) capacitor as RTC backup battery
    - RS232 (3232-series) level converter
    - Micro SD card socket

- Four built-in operating modes selectable via jumper settings
    - USB Mass Storage Device (micro SD card reader)
    - In-application programming via USB HID interface
    - In-application programming via serial (RS232/USART) interface
    - Stand-alone custom user application

- RoSH compliant

SAMPLE APPLICATIONS

- Affordable Rapid Prototyping training tools (especially for Automatic Control and Digital Signal Processing studies) when used together with RapidSTM32 blockset, example features include:
    - Support C code generation of a custom user program for STM32 from a Simulink^{TM} model (see minimum requirements).
    - Support various Hardware-in-the-Loop (HIL) simulation configurations, e.g. data acquisition in to, signal generation from Matlab^{TM}/Simulink^{TM}, and closed-loop control HIL simulation design and analysis.

- Create a data logger to micro SD card (FAT32) program directly from a Simulink model.

- Use in a laboratory as embedded system training kits or in-the-field for any student projects.

- Generic microcontroller evaluation board.
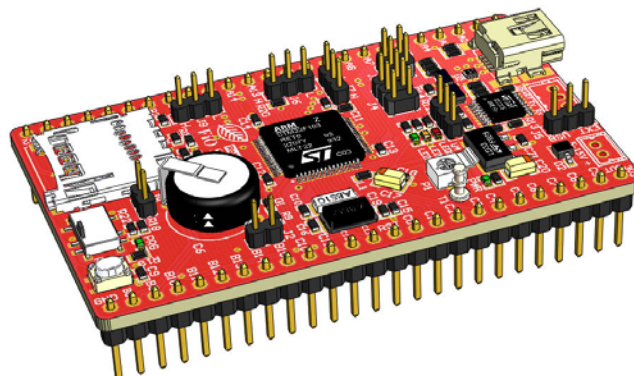
FiO Std

INTRODUCTION

FiO Std is an evaluation board (EVB) from FiO family of evaluation boards that are based on STMicroelectronics STM32[TM] ARM 32-bits Cortex[TM] – M3 processors.

FiO EVBs have been primarily designed as affordable embedded system training boards for used by instructors and students to supplement such courses and curriculums as design and analysis of automatic or embedded control systems and digital signal processing (DSP) systems. It is hoped that the introduction of FiO and RapidSTM32 Blockset will help lower the barrier and open up opportunities for more users to play around with Rapid Prototyping technology.

FiO family of evaluation boards have been specifically designed to be applicable both as LAB kits for uses in laboratories as well as a stand-alone system for used in-the-field in any student's science and engineering projects.

When used together with RapidSTM32 Blockset, FiO Std offers several capabilities, for examples:

- Real-Time Hardware in the Loop Simulations via USB HID.

Real-Time Hardware in the Loop (HIL) Simulation via USB HID interface		Maximum Update Rate[1] (Hz)
Open-Loop	Target → Host (Data Acquisition)	450
	Host→Target (Signal Generation)	200
Closed-Loop	Target↔Host (Control System)	200

- Higher HIL update rate available via other specially designed interfaces.

- Create working stand-alone embedded systems from Simulink[TM] models with just one click.

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1 The actual update rate depends on several factors such as the host PC speed and other USB hardware in the communication loop; for example, communication speed is faster when the target is connected directly to host USB controller than via a USB hub.

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- Generated source code compatible with Realview MDK[TM] for ARM with options for automatic compile and download option.

- Data logger to micro SD card (FAT32).

- Support simulation and code generation for typical peripherals such as push/toggle button or character LCD.

- Supported on-chip peripherals include Digital IO, ADC, DAC, RTC, PWM, USART, USB (Virtual COM) and more.

- Support integration with Finite State Machine simulation and code generation via Stateflow[TM] and Stateflow Coder[TM].

MINIMUM REQUIREMENTS

Minimum requirements for FiO Std to fully function with RapidSTM32 Blockset.

- Matlab[TM] 2009a (v7.8)
- Simulink[TM] (v7.3)
- Real-Time Workshop[TM] (v7.3)
- Real-Time Workshop Embedded Coder[TM] (v7.3)
- Realview MDK[TM] for ARM (v4.0)
- Microsoft .NET Framework (v3.5)

CAUTIONS!!

All FiO EVBs are pre-installed with proprietary bootloader. FiO EVBs are solely intended to be programmed using FiO own Flash programmer which can program any FiO EVBs directly from Matlab and MS Windows via USB or RS232 interfaces. DO NOT use STMicroelectronics Flash Loader Program to program FiO EVBs because this will erase the pre-installed bootloader and void your warranty totally. Therefore, jumper J8 should not be tampered with in any circumstances.

FURTHER INFORMATION
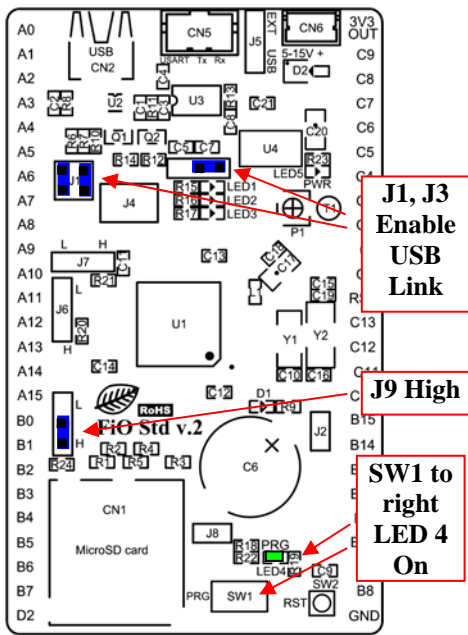
For further information and tutorials please visit: http://www.aimagin.com/learningresources
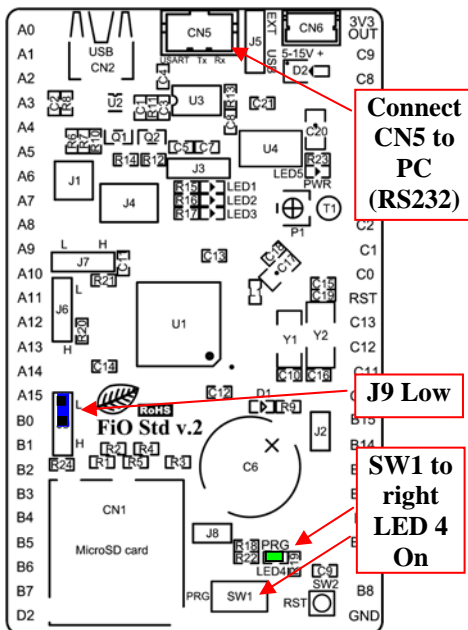
OPERATING MODES

FiO Std supports 4 operating modes

1. In-Aplication Programming via USB HID
2. In-Aplication Programming via RS232
3. Mass Storage Device (microSD card reader)
4. Run Custom User Program

The following figures show required jumper(s) and program switch (SW1) settings for each operating mode. Each operating mode can be activated by pressing the reset switch (SW2).

1.1 USB IAP

J1, J3 Enable USB Link

J9 High

SW1 to right LED 4 On

1.2 RS232 IAP

Connect CN5 to PC (RS232)

J9 Low

SW1 to right LED 4 On

1.3 Mass Storage Device

J1, J3 Enable USB Link

J4 Enable LED1 and LED3

insert uSDcard

LED1 On when uSDcard inserted

LED3 flashes when read /write

J9 Low

SW1 to left LED 4 Off

1.4 Run Custom User Program

J9 High

SW1 to left LED 4 Off
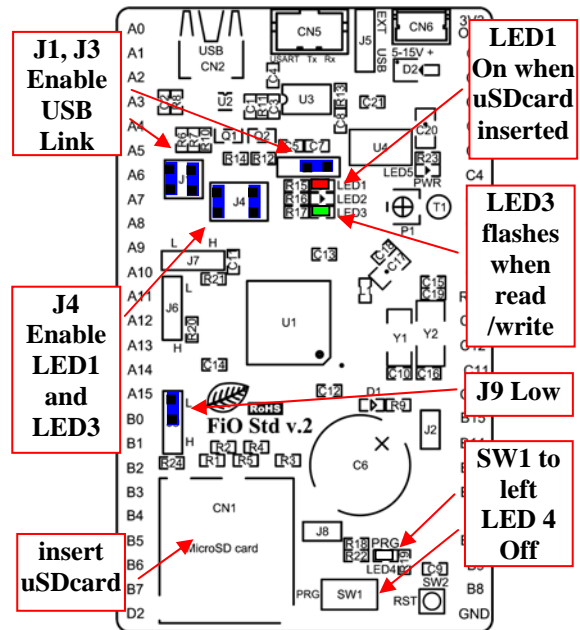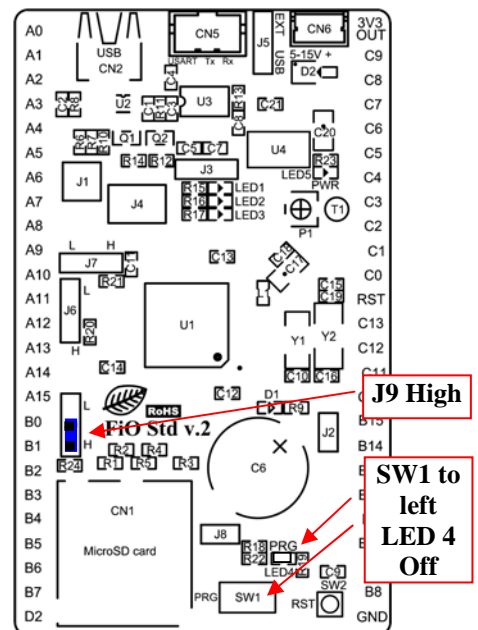
Warning: J8 should not be tampered with at all. Warranty is void if J8 is tampered.

Note: Other jumpers, e.g. J2, J6, J7 not mentioned in the above figures may be set or not, depending upon required functionalities.

SCHEMATIC DIAGRAM

MCU

U1 STM32F103RET6

Pin	Signal		Pin	Signal
14	PA0-WKUP		26	PB0

CN2 Mini USB-B
- 6 SH1
- 7 SH2
- 8 SH3
- 9 SH4
- 1 Vbus
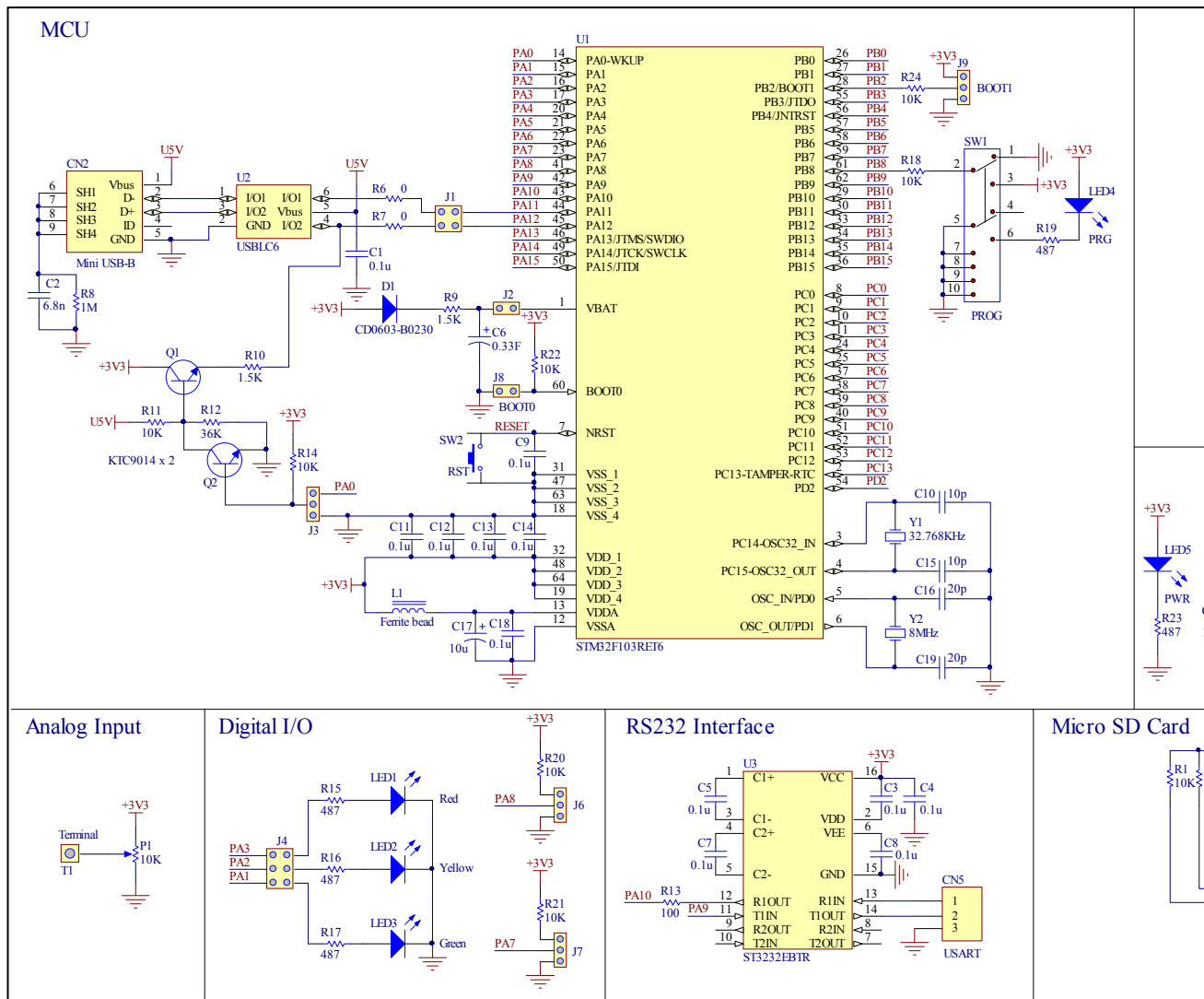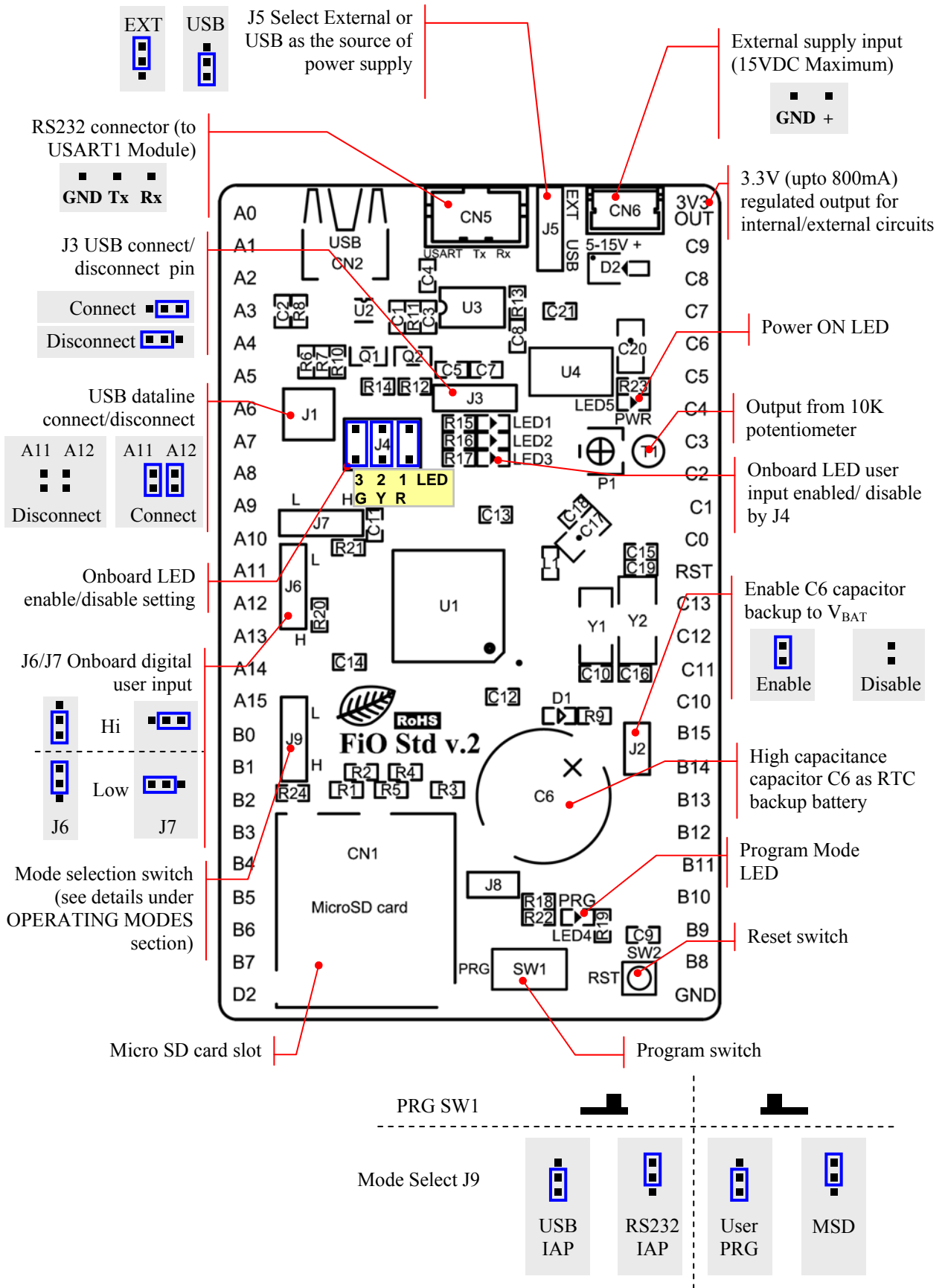- 2 D-
- 3 D+
- 4 ID
- 5 GND

U2 USBLC6
- I/O1 I/O1
- I/O2 Vbus
- GND I/O2

C2 6.8n   R8 1M

Q1   R10 1.5K

R11 10K   R12 36K   R14 10K   KTC9014 x 2   Q2

D1 CD0603-B0230   R9 1.5K   J2   +3V3

C6 0.33F   R22 10K

J8 BOOT0

SW2 RST   RESET   C9 0.1u

J3 PA0

C11 0.1u   C12 0.1u   C13 0.1u   C14 0.1u

L1 Ferrite bead   C17 10u   C18 0.1u

C1 0.1u   R6 0   R7 0   J1

PA0-WKUP 14, PA1 15, PA2 16, PA3 17, PA4 20, PA5 21, PA6 22, PA7 23, PA8 41, PA9 42, PA10 43, PA11 44, PA12 45, PA13/JTMS/SWDIO 46, PA14/JTCK/SWCLK 49, PA15/JTDI 50

VBAT 1

BOOT0 60

NRST 7

VSS_1 31, VSS_2 47, VSS_3 63, VSS_4 18

VDD_1 32, VDD_2 48, VDD_3 64, VDD_4 19, VDDA 13, VSSA 12

PB0 26, PB1 27, PB2/BOOT1 28, PB3/JTDO 55, PB4/JNTRST 56, PB5 57, PB6 58, PB7 59, PB8 61, PB9 62, PB10 29, PB11 30, PB12 33, PB13 34, PB14 35, PB15 36

PC0 8, PC1 9, PC2 10, PC3 11, PC4 24, PC5 25, PC6 37, PC7 38, PC8 39, PC9 40, PC10 51, PC11 52, PC12 53, PC13-TAMPER-RTC 2, PD2 54

PC14-OSC32_IN 3, PC15-OSC32_OUT 4, OSC_IN/PD0 5, OSC_OUT/PD1 6

R24 10K   +3V3   J9   BOOT1

SW1   R18 10K   +3V3   +3V3   LED4   PRG   R19 487

PROG

Y1 32.768KHz   C10 10p   C15 10p   C16 20p   Y2 8MHz   C19 20p

+3V3   LED5   PWR   R23 487

Analog Input

Terminal   +3V3   P1 10K   T1

Digital I/O

R15 487   LED1   Red
R16 487   LED2   Yellow
R17 487   LED3   Green

PA3   J4   PA2   PA1

+3V3   R20 10K   PA8   J6

+3V3   R21 10K   PA7   J7

RS232 Interface

U3 ST3232EBTR
- C5 0.1u   1 C1+
- 3 C1-   C7 0.1u
- C2+
- 5 C2-
- VCC 16   +3V3   C3 0.1u   C4 0.1u
- VDD 2
- VEE 6   C8 0.1u
- GND 15

PA10   R13 100   PA9   12 R1OUT   R1IN 13
11 T1IN   T1OUT 14
9 R2OUT   R2IN 8
10 T2IN   T2OUT 7

CN5
1
2
3
USART

Micro SD Card

R1 10K

FiO Std PCB LAYOUT

EXT   USB

J5 Select External or USB as the source of power supply

External supply input (15VDC Maximum)

GND +

RS232 connector (to USART1 Module)

GND Tx Rx

3.3V (upto 800mA) regulated output for internal/external circuits

J3 USB connect/ disconnect pin

Connect

Disconnect

Power ON LED

USB dataline connect/disconnect

A11 A12   A11 A12

Disconnect   Connect

Output from 10K potentiometer

Onboard LED user input enabled/ disable by J4

Onboard LED enable/disable setting

Enable C6 capacitor backup to V_{BAT}

Enable   Disable

J6/J7 Onboard digital user input

Hi

Low

J6   J7

High capacitance capacitor C6 as RTC backup battery

Program Mode LED

Reset switch

Mode selection switch (see details under OPERATING MODES section)

Micro SD card slot

Program switch

PRG SW1

Mode Select J9

USB IAP   RS232 IAP   User PRG   MSD

BILL OF MATERIALS

[Manufacture Part No.] Name	Designator	Source
[0603B682K500CT] 6.8nF	C2	www.es.co.th
[0603ZC104KAT2A] 0.1uF	C1, C3, C4, C5, C7, C8, C9, C11, C12, C13, C14, C18, C21	www.mouser.com
[C1608C0G1H100C] 10pF	C10, C15	www.mouser.com
[C1608C0G1H200J] 20pF	C16, C19	www.mouser.com
[293D106X0010A2TE3] 10uF	C17, C20	www.mouser.com
[EECS0HD334H] 0.33F	C6	www.mouser.com
[2908-05WB-MG] MicroSD socket	CN1	www.mouser.com
[67503-1020] USB Mini-B female	CN2	www.mouser.com
[CD0603-B0230] CD0603-B0230	D1	www.mouser.com
[STPS1L30M] STPS1L30M	D2	www.mouser.com
[MMZ1608S601A] Ferrite Beads	L1	www.mouser.com
[APT1608EC] LED Red	LED1	www.mouser.com
[APT1608YC] LED Yellow	LED2	www.mouser.com
[APT1608SGC] LED Green	LED3, LED4, LED5	www.mouser.com
[PVG3A103C01R00] 10K	P1	www.mouser.com
[KTC9014S-C-RTK/P] KTC9014	Q1,Q2	www.es.co.th
[0603WAJ0103T5E] 10K	R1, R2, R3, R4, R5, R11, R14, R18, R20, R21, R22, R24	www.es.co.th
[RC0603FR-0736KL] 36k	R12	www.mouser.com
[0603WAJ0101T5E] 100	R13	www.mouser.com
[CR0603-FX-4870ELF] 487	R15, R16, R17, R19, R23	www.mouser.com
[WR06X000PTL] 0	R6, R7	www.es.co.th
[RC0603JR-071ML] 1M	R8	www.mouser.com
[CRCW06031K50JNEB] 1.5k	R9, R10	www.mouser.com
[SSSS820201] Switch	SW1	www.mouser.com
[SKRPACE010] Switch	SW2	www.mouser.com
[534-1593-2] Terminal	T1	www.mouser.com
[STM32F103RET6TR] STM32F103RET6	U1	www.mouser.com
[USBLC6-2P6] USBLC6	U2	www.mouser.com
[ST3232EBTR] ST3232EBTR	U3	www.mouser.com
[LD1117S33TR] LD1117S33	U4	www.mouser.com
[ABS10-32.768KHZ-9-T] Xtal 32.768kHz	Y1	www.mouser.com
[ABM7-8.000MHZ-D2Y-T] Xtal 8MHz	Y2	www.mouser.com

ENGINEERING DRAWINGS (Units: mm)
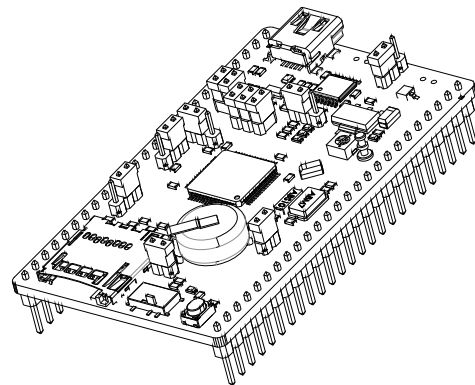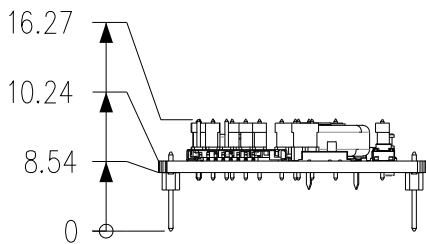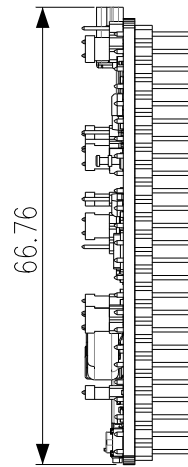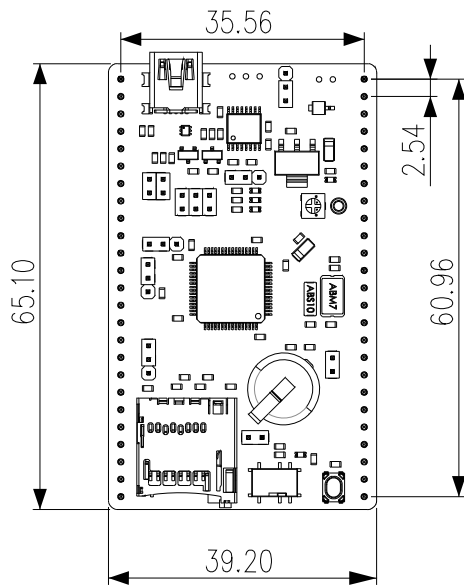
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