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CY8CKIT-062-WIFI-BT

PSoC™ 6 Wi-Fi Bluetooth® pioneer kit guide

Document Number. 002-22677 Rev. *I

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Safety and regulatory compliance information



Regulatory compliance information

Contains transmitter module FCC ID: VPYLB1DX and IC: 772C-LB1DX

This kit is intended to use for ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY and is not considered by Cypress Semiconductor to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio-frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio-frequency interference. Operation of the equipment may cause interference with radio communications, in which case users at their own expense will be required to take whatever measures may be required to correct this interference.

The kit contains [Type 1DX \(LBEE5KL1DX\)](#) certified module from Murata. Due to change in the antenna pattern/type and gain used in this kit, Class II permissive changes are required to recertify this kit. The radiated emission tests must be performed again to obtain a new FCC ID for this host kit. Most conducted RF test results may still be reused. Customer also needs to take their product through other FCC/ISED testing such as unintentional radiators (FCC sub part 15B) and any other required regional product certifications including but not limited to EU directives. See [FCC Regulatory Certification Guide](#) by Murata on information on pre-certified and reference certified module concepts and information on what additional test are required for FCC certification. Customer should consult a Telecommunication Certification Body (TCB) lab for guidance on other requirements for the device certification.

For details on the Type 1DX module from Murata, see <https://wireless.murata.com/type-1dx.html>.



This kit contains electrostatic discharge (ESD)-sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused kits in the protective shipping package.



End-of-Life/Product Recycling

The end-of life for this kit is five years from the date of manufacture mentioned as a bar code on the back of the kit box. Contact your nearest recycler for information on discarding the kit.

General safety instructions

ESD protection

ESD can damage boards and associated components. Cypress recommends that you perform procedures only at an ESD workstation. If an ESD workstation is unavailable, use appropriate ESD protection by wearing an anti-static wrist strap attached to a grounded metal object.

Handling boards

This kit is sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad, if available. Do not slide the board over any surface.

1. Introduction



Thank you for your interest in the CY8CKIT-062-WIFI-BT PSoC™ 6 Wi-Fi Bluetooth® pioneer kit. This kit enables you to evaluate and develop your applications using the [PSoC™ 6 MCU](#).

The PSoC™ 6 MCU is an ultra-low-power PSoC™ device specifically designed for wearables and IoT products. It is a programmable embedded system-on-chip, integrating a 150-MHz Arm® Cortex®-M4 as the primary application processor, a 100-MHz CM0+ that supports low-power operations, up to 1 MB flash and 288 KB SRAM, CAPSENSE™ touch-sensing, and programmable analog and digital peripherals that allow higher flexibility, in-field tuning of the design, and faster time-to-market.

The PSoC™ 6 Wi-Fi Bluetooth® pioneer board offers compatibility with shields compatible with Arduino. The board features a PSoC™ 6 MCU, a 512-Mb NOR flash, an on-board programmer/debugger (KitProg3), a 2.4-GHz WLAN and Bluetooth® functionality module (CYW4343W), a five-segment CAPSENSE™ slider, two CAPSENSE™ buttons, one CAPSENSE™ proximity sensing header, an RGB LED, two user LEDs, USB host and device features, and one push button. The board supports operating voltages from 1.8 V to 3.3 V for the PSoC™ 6 MCU.

The kit package includes a CY8CKIT-028-TFT display shield that contains a 2.4-inch TFT display, a motion sensor, ambient light sensor, a 32-bit audio codec, and a PDM microphone.

You can use ModusToolbox™ software to develop and debug your PSoC™ 6 MCU projects. ModusToolbox™ software is a set of tools that enable you to integrate Cypress devices into your existing development methodology.

If you are new to PSoC™ 6 MCU and Eclipse IDE for ModusToolbox™ software, see the application note [AN228571 - Getting started with PSoC™ 6 MCU on ModusToolbox™ software](#) to help you familiarize with the PSoC™ 6 MCU and help you create your own design using the ModusToolbox™ software.

1.1 Kit contents

The kit package has the following contents, as shown in Figure 1-1.

- PSoC™ 6 Wi-Fi Bluetooth® pioneer board
- CY8CKIT-028-TFT display shield
- USB Type-A to Type-C cable
- Four jumper wires (4 inches each)
- Two proximity sensor wires (5 inches each)
- Quick start guide

Figure 1-1. Kit contents



Inspect the contents of the kit; if you find any part missing, contact your nearest Cypress sales office for help: www.cypress.com/support.

1.2 Getting started

This guide will help you to get acquainted with the PSoC™ 6 Wi-Fi Bluetooth® pioneer kit:

- The [Kit operation chapter on page 22](#) describes the CY8CKIT-062-WIFI-BT baseboard and CY8CKIT-028-TFT shield hardware features and functionalities.
- The [Hardware on page 36](#) provides a detailed hardware description, methods to use the on-board components, kit schematics, the bill of materials (BOM), and an FAQ.

1.3 Board details

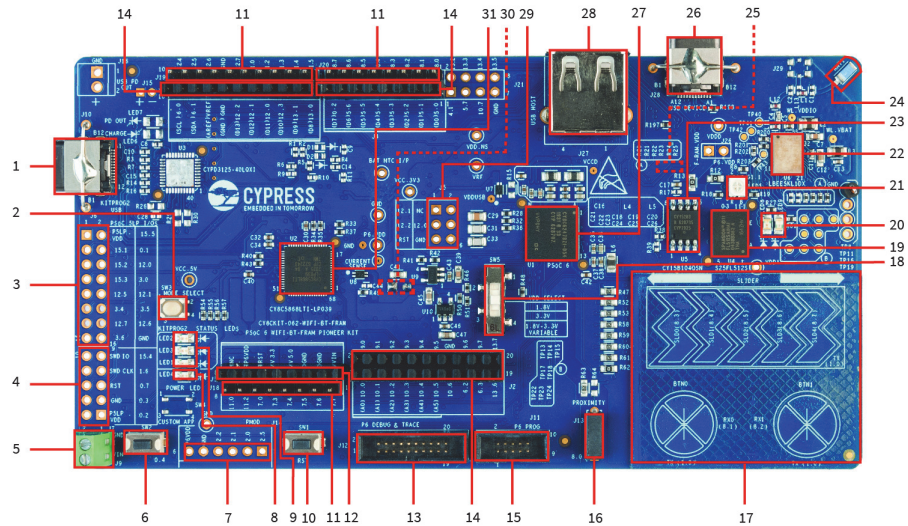
1.3.1 CY8CKIT-062-WIFI-BT board details

Figure 1-2 shows the pioneer board, which has the following features:

- PSoC™ 6 MCU
- Expansion headers that are compatible with Arduino Uno 3.3-V shields¹ and Digilent Pmod modules
- Type 1DX ultra-small 2.4-GHz WLAN and Bluetooth® functionality module
- 512-Mbit external quad-SPI NOR flash that provides a fast, expandable memory for data and code
- KitProg3 onboard programmer/debugger, USB to UART/I2C/SPI bridge functionality
- CAPSENSE™ touch-sensing slider (five elements) and two buttons, all of which are capable of both self-capacitance (CSD) and mutual-capacitance (CSX) operation, and a CSD proximity sensor that allows you to evaluate Cypress' fourth-generation CAPSENSE™ technology
- 1.8-V to 3.3-V operation of PSoC™ 6 MCU is supported. An additional 330-mF super-capacitor is provided for backup domain supply (VBACKUP)
- Two user LEDs, an RGB LED, a user button, and a reset button for PSoC™ 6 MCU.
- One button and three LEDs for KitProg3.

1. 5-V shields are not supported.

Figure 1-2. Pioneer board



- | | |
|---|---|
| 1. KitProg3 USB Type-C connector (J10) | 16. CAPSENSE™ proximity header (J13) |
| 2. KitProg3 programming mode selection button (SW3) | 17. CAPSENSE™ slider and buttons (BTN0, BTN1, SLIDER) |
| 3. KitProg3 I/O header (J6)* | 18. PSoC™ 6 VDD selection switch (SW5) |
| 4. KitProg3 programming/GPIO header (J7)* | 19. Infineon 512-Mbit serial NOR flash memory (S25FL512S, U4) |
| 5. External power supply connector (J9) | 20. PSoC™ 6 user LEDs (LED8, LED9) |
| 6. PSoC™ 6 user button (SW2) | 21. RGB LED (LED5) |
| 7. I/O header compatible with Digilent Pmod (J14)* | 22. Wi-Fi/Bluetooth® module (LBEE5KL IDX, U6) |
| 8. Power LED (LED4) | 23. Infineon EXCELON™ Ultra Quad-SPI F-RAM (CY15B104QSN, U5) |
| 9. KitProg3 status LEDs (LED1, LED2, LED3) | 24. Wi-Fi-Bluetooth® antenna (ANT1) |
| 10. PSoC™ 6 reset button (SW1) | 25. VBACKUP and PMIC control selection switch (SW7)** |
| 11. PSoC™ 6 I/O headers (J18, J19, J20) | 26. PSoC™ 6 USB device Type-C connector (J28) |
| 12. Power header compatible with Arduino Uno R3 (J1) | 27. PSoC™ 6 MCU (CY8C6247BZI-D54, U1) |
| 13. PSoC™ 6 debug and trace header (J12) | 28. PSoC™ 6 USB host Type-A connector (J27) |
| 14. I/O headers compatible with Arduino Uno R3 (J2, J3, J4) | 29. ICSP header compatible with Arduino Uno R3 (J5)* |
| 15. PSoC™ 6 program and debug header (J11) | 30. PSoC™ 6 power monitoring jumper (J8)** |
| | 31. KitProg3 programmer and debugger based on PSoC™ 5LP (CY8C5868LTI-LP039, U2) |

*Footprints only, not populated on the board
 **Components at the bottom side of the board

Figure 1-3. Pioneer board pinout

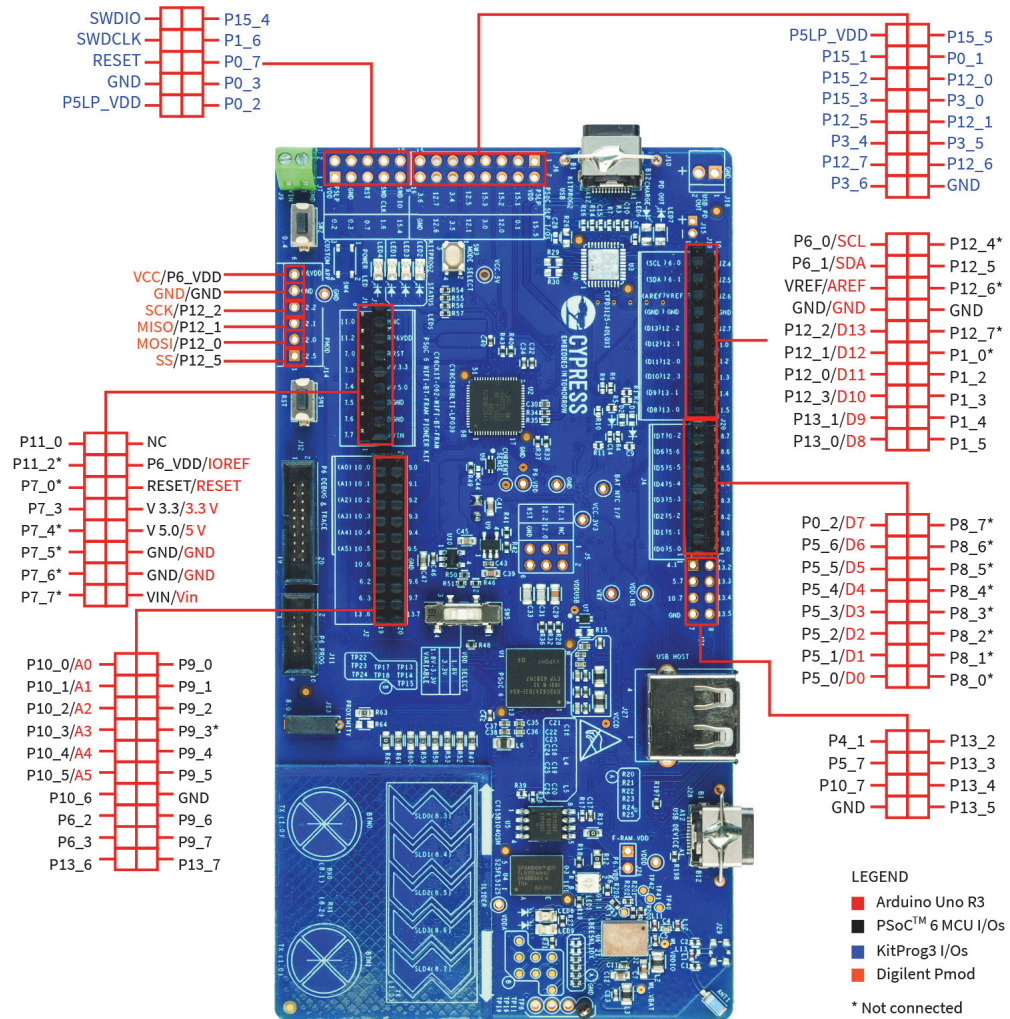


Table 1-1. Pioneer board pinout

PSoC™ 6 pin	Primary on-board function	Secondary on-board function	Connection details
XRES	Reset	—	
P0.0	WCO IN	—	
P0.1	WCO OUT	—	
P0.2	Header compatible with Arduino J4.8, D7	—	
P0.3	RGB LED (red)	—	
P0.4	User button with Hibernate wakeup capability	—	
P0.5	PMIC control	—	
P1.0	CAPSENSE™ Tx	GPIO on non-Arduino header (J19.5)	Populate R174 to connect to the header or remove R62 to disconnect from CAPSENSE™.
P1.1	RGB LED (green)	—	
P1.2	GPIO on non-Arduino header (J19.4)	—	
P1.3	GPIO on non-Arduino header (J19.3)	—	
P1.4	GPIO on non-Arduino header (J19.2)	—	
P1.5	User LED (orange)	GPIO on non-Arduino header (J19.1)	Connected to primary and secondary functions by default. Remove R27 to disconnect from the LED.
P2.0	SDIO DATA0	J25.7 (WL_JTAG_TMS)	Remove R122 (or R110) and mount R115 to disconnect from PSoC™ 6 MCU and connect the Wi-Fi/Bluetooth® module to the JTAG connector.
P2.1	SDIO DATA1	J25.3 (WL_JTAG_TDI)	Remove R32 (or R111) and mount R116 to disconnect from PSoC™ 6 MCU and connect the Wi-Fi/Bluetooth® module to the JTAG connector.
P2.2	SDIO DATA2	J25.5 (WL_JTAG_TDO)	Remove R128 (or R112) and mount R117 to disconnect from PSoC™ 6 MCU and connect the Wi-Fi/Bluetooth® module to the JTAG connector.
P2.3	SDIO DATA3	J25.1 (WL_JTAG_TRSTN)	Remove R109 (or R132) and mount R114 to disconnect from PSoC™ 6 MCU and connect the Wi-Fi/Bluetooth® module to the JTAG connector.
P2.4	SDIO CMD	—	
P2.5	SDIO CLK	J25.9 (WL_JTAG_TCK)	Remove R108 (or R28) and mount R113 to disconnect from PSoC™ 6 MCU and connect the Wi-Fi/Bluetooth® module to the JTAG connector.

Table 1-1. Pioneer board pinout (*continued*)

PSoC™ 6 pin	Primary on-board function	Secondary on-board function	Connection details
P3.0	BT UART TXD	–	BT UART TXD pin of the Wi-Fi/Bluetooth® module
P3.1	BT UART RXD	–	BT UART RXD pin of the Wi-Fi/Bluetooth® module
P3.2	BT UART CTS	–	BT UART CTS pin of the Wi-Fi/Bluetooth® module
P3.3	BT UART RTS	–	BT UART RTS pin of the Wi-Fi/Bluetooth® module
P3.4	BT REG ON	–	BT REG ON pin of the Wi-Fi/Bluetooth® module
P3.5	BT HOST WAKE	–	BT HOST WAKE pin of the Wi-Fi/Bluetooth® module
P4.0	BT DEV WAKE	–	BT DEV WAKE pin of the Wi-Fi/Bluetooth® module
P4.1	Header J21.1	–	
P5.0	Arduino J4.1, D0 UART RX KitProg3 UART TX	–	Remove R159 to disconnect from KitProg3 UART TX.
P5.1	Arduino J4.2, D1 UART TX KitProg3 UART RX	–	Remove R156 to disconnect from KitProg3 UART RX.
P5.2	Arduino J4.3, D2 UART RTS KitProg3 UART CTS	–	Remove R93 to disconnect from KitProg3 UART CTS. This will also disconnect RTS and SPI lines from KitProg3.
P5.3	Arduino J4.4, D3 UART CTS KitProg3 UART RTS	–	Remove R88 to disconnect from KitProg3 UART RTS. This will also disconnect CTS and SPI lines from KitProg3.
P5.4	Arduino J4.5, D4	–	
P5.5	Arduino J4.6, D5	–	
P5.6	Arduino J4.7, D6	–	
P5.7	Header J21.3	–	
P6.0	Arduino J3.10, SCL KitProg3 I2C SCL	–	Remove R141 to disconnect from KitProg3 I2C SCL.
P6.1	Arduino J3.9, SDA KitProg3 I2C SDA	–	Remove R150 to disconnect from KitProg3 I2C SDA.
P6.2	GPIO on non-Arduino header (J2.15)	–	
P6.3	GPIO on non-Arduino header (J2.17)	CAPSENSE™ shield	Remove R44 to disconnect from GND and populate R145 to connect to the CAPSENSE™ shield (hash pattern on the board).
P6.4	TDO/SWO	–	
P6.5	TDI	–	
P6.6	TMS/SWDIO	–	Remove R194 to disconnect from KitProg3 SWDIO.

Table 1-1. Pioneer board pinout (*continued*)

PSoC™ 6 pin	Primary on-board function	Secondary on-board function	Connection details
P6.7	TCLK/SWCLK	–	Remove R183 to disconnect from KitProg3 SWCLK.
P7.0	TRACECLK	GPIO on non-Arduino header (J18.6)	Populate R181 to connect to J18 header.
P7.1	CINTA	–	
P7.2	CINTB	CSH	Remove C31 (0.47 nF) and populate 10 nF for CSH.
P7.3	GPIO on non-Arduino header (J18.5)	CSH	Remove R146 to disconnect from header and populate C29 (10 nF) for CSH.
P7.4	TRACEDATA[3]	GPIO on non-Arduino header (J18.4)	Populate R178 to connect to J18.
P7.5	TRACEDATA[2]	GPIO on non-Arduino header (J18.3)	Populate R179 to connect to J18.
P7.6	TRACEDATA[1]	GPIO on non-Arduino header (J18.2)	Populate R180 to connect to J18.
P7.7	CMOD	GPIO on non-Arduino header (J18.1)	Populate R142 to connect to J18.
P8.0	Proximity	GPIO on non-Arduino header (J20.1)	Populate R64 with zero ohm to connect to header.
P8.1	CAPSENSE™ Button0 Rx	GPIO on non-Arduino header (J20.2)	Remove R61 to disconnect CAPSENSE™ pad and populate R172 to connect to header.
P8.2	CAPSENSE™ Button1 Rx	GPIO on non-Arduino header (J20.3)	Remove R60 to disconnect CAPSENSE™ pad and populate R166 to connect to header.
P8.3	CAPSENSE™ Silder0 Rx	GPIO on non-Arduino header (J20.4)	Remove R53 to disconnect CAPSENSE™ pad and populate R153 to connect to header.
P8.4	CAPSENSE™ Silder1 Rx	GPIO on non-Arduino header (J20.5)	Remove R52 to disconnect CAPSENSE™ pad and populate R152 to connect to header.
P8.5	CAPSENSE™ Silder2 Rx	GPIO on non-Arduino header (J20.6)	Remove R47 to disconnect CAPSENSE™ pad and populate R149 to connect to header.
P8.6	CAPSENSE™ Silder3 Rx	GPIO on non-Arduino header (J20.7)	Remove R58 to disconnect CAPSENSE™ pad and populate R158 to connect to header.
P8.7	CAPSENSE™ Silder4 Rx	GPIO on non-Arduino header (J20.8)	Remove R59 to disconnect CAPSENSE™ pad and populate R160 to connect to header.
P9.0	GPIO on non-Arduino header (J2.2)	–	

Table 1-1. Pioneer board pinout (*continued*)

PSoC™ 6 pin	Primary on-board function	Secondary on-board function	Connection details
P9.1	GPIO on non-Arduino header (J2.4)	—	
P9.2	GPIO on non-Arduino header (J2.6)	—	
P9.3	TRACEDATA[0]	GPIO on non-Arduino header (J2.8)	Populate R162 to connect to header.
P9.4	GPIO on non-Arduino header (J2.10)	—	
P9.5	GPIO on non-Arduino header (J2.12)	—	
P9.6	GPIO on non-Arduino header (J2.16)	—	
P9.7	GPIO on non-Arduino header (J2.18)	—	
P10.0	GPIO on header compatible with Arduino J2.1, A0	—	
P10.1	GPIO on header compatible with Arduino J2.3, A1	—	
P10.2	GPIO on header compatible with Arduino J2.5, A2	—	
P10.3	GPIO on header compatible with Arduino J2.7, A3	—	
P10.4	GPIO on header compatible with Arduino J2.9, A4 PDM_CLK	—	
P10.5	GPIO on header compatible with Arduino J2.11, A5 PDM_DAT	—	
P10.6	GPIO on non-Arduino header (J2.13)	—	
P10.7	Header J21.5	—	
P11.0	FRAM CS	GPIO on non-Arduino header (J18.8)	Connected to primary and secondary functions by default. Remove R175 to disconnect from J18 and load R39 (10K) as F-RAM pull-up.
P11.1	RGB Blue LED	—	
P11.2	QSPI FLASH CS	GPIO on non-Arduino header (J18.7)	Populate R177 to connect to J18, remove R176 to disconnect from flash.
P11.3	QSPI FLASH/ FRAM DATA3	—	

Table 1-1. Pioneer board pinout (*continued*)

PSoC™ 6 pin	Primary on-board function	Secondary on-board function	Connection details
P11.4	QSPI FLASH/ FRAM DATA2	–	
P11.5	QSPI FLASH/ FRAM DATA1	–	
P11.6	QSPI FLASH/ FRAM DATA0	–	
P11.7	QSPI FLASH/ FRAM CLK	–	
P12.0	J3.4 on header compatible with Arduino, D11 SPI MOSI	ICSP header (J5.4) and Pmod header (J14.2)	Remove R77 to disconnect from KitProg3_SPI lines.
P12.1	J3.5 on header compatible with Arduino, D12 SPI MISO	ICSP header (J5.1) and Pmod header (J14.3)	Remove R85 to disconnect from KitProg3_SPI lines.
P12.2	J3.6 on header compatible with Arduino, D13 SPI CLK	ICSP header (J5.3) and header compatible with Pmod (J14.4)	Remove R81 to disconnect from KitProg3_SPI lines.
P12.4	KitProg3 SPI SELECT	GPIO on non-Arduino header (J19.10)	Connected to primary function by default. Populate R74 to connect to J19 or remove R83 to disconnect KitProg3_SPI_SELECT.
P12.5	PMOD SPI SELECT, J14.1	GPIO on non-Arduino header (J19.9)	Connected to primary and secondary functions by default. Remove R73 to disconnect from J19 or remove R82 to disconnect PMOD_SPI_SELECT.
P12.6	ECO IN	GPIO on non-Arduino header (J19.8)	
P12.7	ECO OUT	GPIO on non-Arduino header (J19.6)	
P13.0	GPIO on header compatible with Arduino J3.1, D8	–	
P13.1	GPIO on header compatible with Arduino J3.2, D9	–	
P13.2	USB HOST EN	GPIO on non-Arduino header (J21.2)	
P13.3	USB_INT_L	GPIO on non-Arduino header (J21.4)	

Table 1-1. Pioneer board pinout (*continued*)

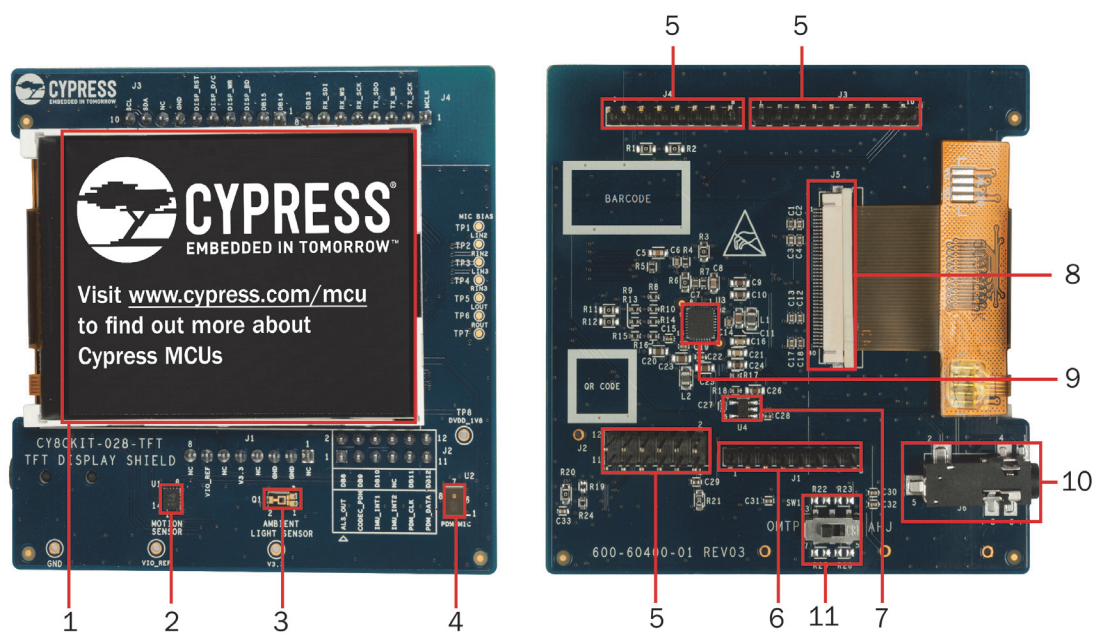
PSoC™ 6 pin	Primary on-board function	Secondary on-board function	Connection details
P13.4	USB_DEV_VBUS_DET	GPIO on non-Arduino header (J21.6)	
P13.5	GPIO on non-Arduino header J21.8	–	
P13.6	GPIO on non-Arduino header J2.19	CAPSENSE™ shield	Remove R44 to disconnect from GND and populate R45 to connect to the CAPSENSE™ shield (hash pattern on the board).
P13.7	User LED (red)	GPIO on non-Arduino header (J2.20)	Remove R31 to disconnect from LED.

1.3.2 CY8CKIT-028-TFT board details

Figure 1-4 shows the TFT display shield that has the following features:

- A 2.4-inch thin-film transistor (TFT) LCD module with 240 × 320 pixel resolution.
- A three-axis acceleration and three-axis gyroscopic motion sensor.
- A PDM microphone for voice input.
- A 32-bit stereo codec with microphone, headphone, and speaker amplifier capability.
- An audio jack with a provision of connecting both AHJ and OMTP headphones. The headset standard can be set by an on-board switch.
- An ambient light sensor IC made of an NPN phototransistor.
- An LDO that converts 3.3 V to 1.8 V for the digital supply of the audio codec.

Figure 1-4. TFT display shield



1. 2.4-inch TFT display
2. Motion sensor (U1)
3. Ambient light sensor (Q1)
4. PDM microphone (U2)
5. I/O headers compatible with Arduino (J2, J3, J4)
6. Power header compatible with Arduino (J1)
7. TFT display power control load switch (U4)
8. TFT display connector (J5)
9. Audio codec (U3)
10. Audio jack (J6)
11. Audio jack selection (OMTP/AHJ) switch (SW1)

Table 1-2. TFT shield pinout

Pin #	Arduino pin	Arduino function	TFT shield function	Pioneer board connection
J1.1	VIN	VIN	NC	VIN
J1.2	GND	GND	GND	GND
J1.3	GND	GND	GND	GND
J1.4	5 V	5 V	NC	5 V
J1.5	3.3 V	3.3 V	VCC 3.3V	3.3 V
J1.6	RESET	RESET	NC	SWD RESET
J1.7	I/O REF	I/O REF	VIO REF	P6 VDD
J1.8	–	–	NC	NC
J2.1	A0	ADC0	ALS OUT	P10[0]
J2.2	–	–	TFT DISP DB8	P9[0]
J2.3	A1	ADC1	Codec PDN SW	P10[1]
J2.4	–	–	TFT DISP DB9	P9[1]
J2.5	A2	ADC2	IMU INT1	P10[2]
J2.6	–	–	TFT DISP DB10	P9[2]
J2.7	A3	ADC3	IMU INT2	P10[3]
J2.8	–	–	NC	P9[3]
J2.9	A4	ADC4 / SDA (I2C)	PDM CLK	P10[4]
J2.10	–	–	TFT DISP DB11	P9[4] ^a
J2.11	A5	ADC5	PDM DATA	P10[5]
J2.12	–	–	TFT DISP DB12	P9[5]
J3.1	D8	DIGITAL I/O	TFT DISP DB14	P13[0]
J3.2	D9	PWM	TFT DISP DB15	P13[1]
J3.3	D10	SS/PWM	TFT DISP RD_L	P12[3]
J3.4	D11	MOSI/PWM	TFT DISP WR_L	P12[0]
J3.5	D12	MISO	TFT DISP D/C	P12[1]
J3.6	D13	SCK	TFT DISP RST_L	P12[2]
J3.7	GND	GND	GND	GND
J3.8	AREF	analog ref i/p	NC	VREF
J3.9	SDA	SDA	I2C SDA (IMU and audio codec)	P6[1]
J3.10	SCL	SCL	I2C SCL (IMU and audio codec)	P6[0]
J4.1	D0	RX	I2S MCLK	P5[0]
J4.2	D1	TX	I2S TX SCK	P5[1]
J4.3	D2	DIGITAL I/O	I2S TX WS	P5[2]
J4.4	D3	PWM, I/O	I2S TX SDO	P5[3]
J4.5	D4	DIGITAL I/O	I2S RX SCK	P5[4]
J4.6	D5	PWM, I/O	I2S RX WS	P5[5]
J4.7	D6	PWM, I/O	I2S RX SDI	P5[6]
J4.8	D7	DIGITAL I/O	TFT DISP DB13	P0[2]

a. Mount R162 (on the Pioneer board) to connect J2.10 of the TFT board to P9[4].

1.4 Additional learning resources

Cypress provides a wealth of data at www.cypress.com/psoc6 to help you to select the right PSoC™ device for your design and to help you to quickly and effectively integrate the device into your design.

1.5 Technical support

For assistance, go to www.cypress.com/support. Visit community.infineon.com to ask your questions in Infineon developer community.

You can also use the following support resources if you need quick assistance:

- [Self-help \(Technical Documents\)](#)
- [Local Sales Office Locations](#)

1.6 Documentation conventions

Table 1-3. Document conventions for guides

Convention	Usage
Courier New	Displays user entered text and source code
<i>Italics</i>	Displays file locations, file names, and reference documentation: Read about the <i>sourcefile.hex</i> file in the <i>PSoC™ Creator user guide</i> .
File > Open	Represents menu paths: File > Open > New Project
Bold	Displays commands, menu paths, and icon names in procedures: Click the File icon and then click Open .
Times New Roman	Displays an equation: $2 + 2 = 4$
Text in gray boxes	Describes cautions or unique functionality of the product.

1.7 Acronyms

Table 1-4. Acronyms used in this document

Acronym	Definition
ADC	analog-to-digital converter
BOM	bill of materials
CINT	integration capacitor
CMOD	modulator capacitor
CPU	central processing unit
CSD	CAPSENSE™ sigma delta
CTANK	shield tank capacitor
DC	direct current
Del-Sig	delta-sigma
ECO	external crystal oscillator
ESD	electrostatic discharge
FPC	flexible printed circuit

Table 1-4. Acronyms used in this document (*continued*)

Acronym	Definition
GPIO	general-purpose input/output
HID	human interface device
I ² C	Inter-Integrated Circuit
IC	integrated circuit
ICSP	in-circuit serial programming
IDAC	current digital-to-analog converter
IDE	integrated development environment
LED	light-emitting diode
PC	personal computer
PCM	pulse code modulation
PD	power delivery
PDM	pulse density modulation
PTC	positive temperature coefficient
PWM	pulse width modulation
RGB	red green blue
SAR	successive approximation register
SMIF	serial memory interface
SPI	serial peripheral interface
SRAM	serial random access memory
SWD	serial wire debug
TFT	thin-film transistor
UART	universal asynchronous receiver transmitter
USB	Universal Serial Bus
WCO	watch crystal oscillator

2. Kit operation



This chapter introduces you to various features of the PSoC™ 6 Wi-Fi Bluetooth® pioneer board, including the theory of operation and the on-board KitProg3 programming and debugging functionality, USB-UART, USB-I2C and USB-SPI bridges.

2.1 Theory of operation

The PSoC™ 6 Wi-Fi Bluetooth® pioneer kit is built around the PSoC™ 6 MCU; [Figure 2-1](#) shows the block diagram of the device. For details of the PSoC™ 6 MCU features, see the [device datasheet](#).

Figure 2-1. PSoC™ 6 MCU block diagram

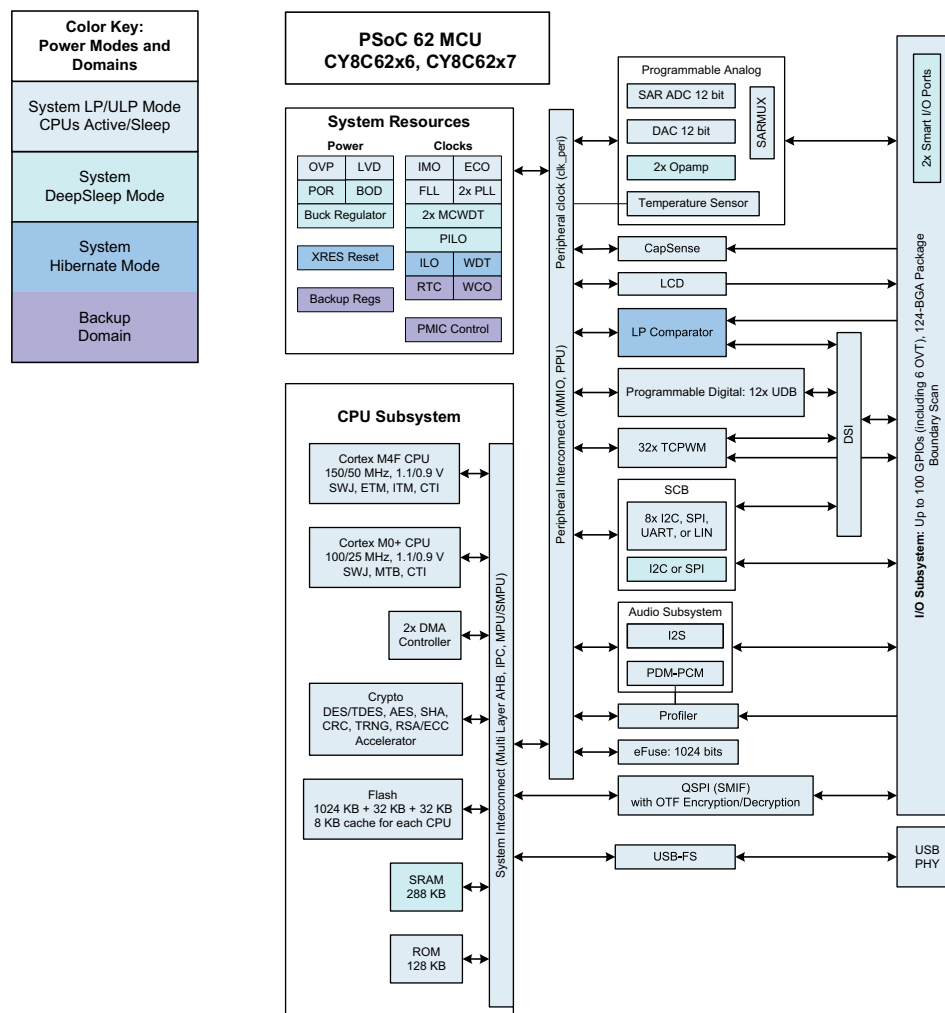
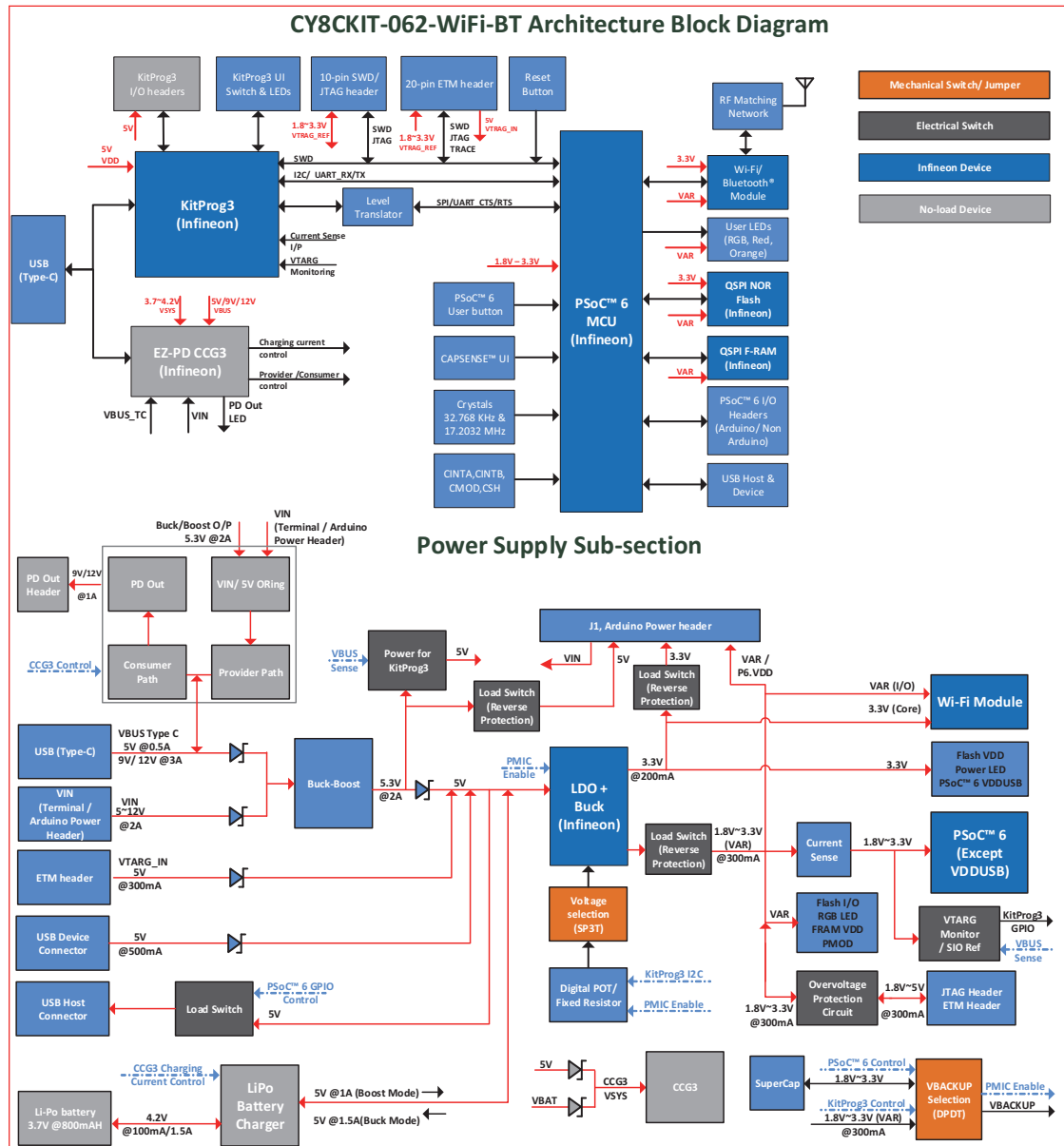


Figure 2-2 shows the block diagram of the pioneer board.

Figure 2-2. Pioneer board block diagram



This Wi-Fi Bluetooth® pioneer kit comes with the PSoC™ 6 Wi-Fi Bluetooth® pioneer board, which has the CY8CKIT-028-TFT display shield connected, as Figure 2-3 shows.

Figure 2-3. PSoC™ 6 Wi-Fi Bluetooth® pioneer board and TFT display shield

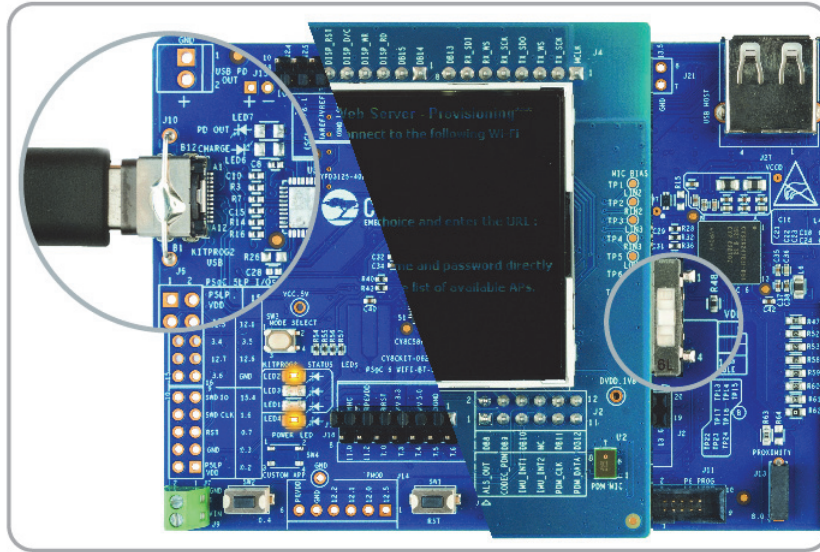
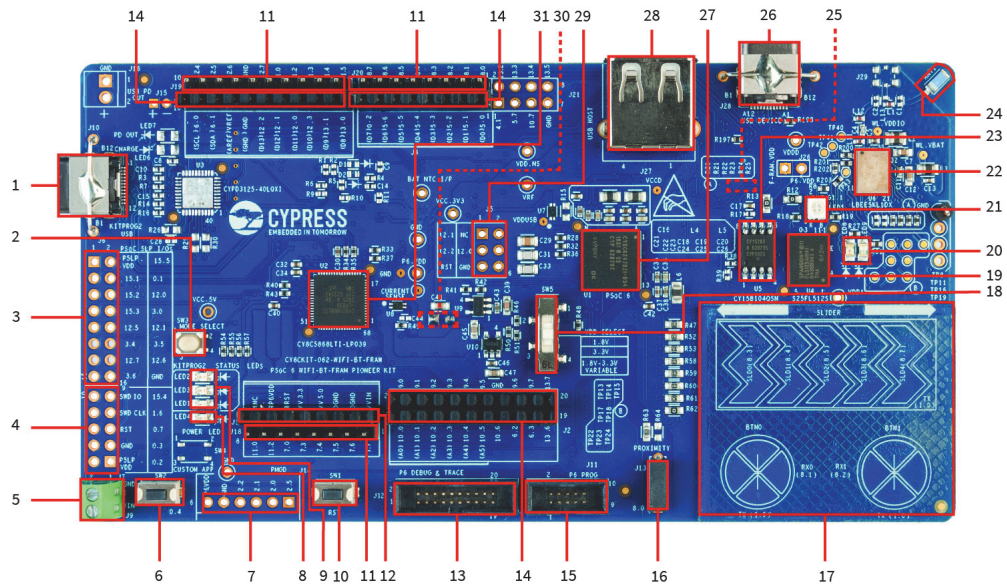


Figure 2-4 shows the markup of the pioneer board.

Figure 2-4. PSoC™ 6 Wi-Fi Bluetooth® pioneer board - top view



The PSoC™ 6 Wi-Fi Bluetooth® pioneer board has the following peripherals:

1. **KitProg3 USB connector (J10):** The USB cable provided along with the PSoC™ 6 Wi-Fi Bluetooth® pioneer kit connects between this USB connector and the PC to use the KitProg3 on-board programmer and debugger and to provide power to the pioneer board.
2. **KitProg3 programming button (SW3):** This button can be used to switch between the KitProg3 operation modes (proprietary SWD programming/CMSIS-DAP mode).
3. **KitProg3 I/O header (J6):** This header brings out several GPIOs of the on-board KitProg3 PSoC™ 5LP device. This includes the USB-I2C, USB-UART, and USB-SPI bridge lines. The additional PSoC™ 5LP MCU pins are direct connections to the internal programmable analog logic of the PSoC™ 5LP MCU. For details on KitProg3, see the [KitProg3 user guide](#).
4. **KitProg3 programming (J7):** This header brings out more GPIOs of the PSoC™ 5LP MCU. It also contains a five-pin SWD programming header for the PSoC™ 5LP MCU.
5. **External power supply VIN connector (J9):** This connector connects an external DC power supply input to the on-board regulators. The voltage input from the external supply should be between 5 V and 12 V.
6. **PSoC™ 6 MCU user button (SW2):** This button can be used to provide an input to the PSoC™ 6 MCU. Note that by default the button connects the PSoC™ 6 MCU pin to ground when pressed, so you need to configure the PSoC™ 6 MCU pin as a digital input with resistive pull-up for detecting the button press. This button also provides a wake-up source from low-power modes of the device.
7. **I/O header compatible with Digilent Pmod (J14):** This header can be used to connect 1 × 6 pin modules compatible with Digilent Pmod.
8. **Power LED (LED4):** This is the amber LED that indicates the status of power supplied to the board.
9. **KitProg3 status LEDs (LED1, LED2, and LED3):** Red, amber, and green LEDs (LED1, LED2, and LED3 respectively) indicate the status of KitProg3. For details on the KitProg3 status, see the [KitProg3 user guide](#).
10. **PSoC™ 6 MCU reset button (SW1):** This button is used to reset the PSoC™ 6 MCU. It connects the PSoC™ 6 MCU reset (XRES) pin to ground.
11. **PSoC™ 6 MCU I/O headers (J18, J19, and J20):** These headers provide connectivity to PSoC™ 6 MCU GPIOs that are not connected to the headers compatible with Arduino. Most of these pins are multiplexed with on-board peripherals and are not connected to the PSoC™ 6 MCU by default. For detailed information on how to rework the kit to access these pins, see [Table 1-1 on page 12](#).
12. **Power header compatible with Arduino (J1):** This header powers the shields compatible with Arduino. It also has a provision to power the kit through the VIN input.
13. **PSoC™ 6 MCU debug and trace header (J12):** This header can be connected to an embedded trace macrocell (ETM)-compatible programmer/debugger.
14. **I/O headers compatible with Arduino Uno R3 (J2, J3, and J4):** These I/O headers bring out pins from the PSoC™ 6 MCU to interface with the shields compatible with Arduino. Some of these pins are multiplexed with on-board peripherals and are not connected to PSoC™ 6 MCU by default. For detailed information on how to rework the kit to access these pins, see [Table 1-1 on page 12](#).

15. **PSoC™ 6 MCU program and debug header (J11):** This 10-pin header allows you to program and debug the PSoC™ 6 MCU using an external programmer such as [MiniProg3](#) / [MiniProg4](#). In addition, an external PSoC™ 4, PSoC™ 5LP, or PSoC™ 6 device can be connected to this header and programmed using KitProg3.
16. **CAPSENSE™ proximity header (J13):** A wire can be connected to this header to evaluate the proximity sensing feature of CAPSENSE™.
17. **CAPSENSE™ slider (SLIDER) and buttons (BTN0 and BTN1):** The CAPSENSE™ touch-sensing slider and two buttons, all of which are capable of both self-capacitance (CSD) and mutual-capacitance (CSX) operation, allow you to evaluate the CAPSENSE™ technology. The slider and buttons have a 1-mm acrylic overlay for smooth touch sensing.
18. **System power V_{DD} selection switch (SW5):** This switch is used to select the PSoC™ 6 MCU V_{DD} supply voltage between a constant 1.8 V, a constant 3.3 V, and a variable 1.8 to 3.3 V. In the variable 1.8 to 3.3 V mode, the PSoC™ Programmer software can control the voltage via KitProg3.
19. **512-Mbit serial NOR flash memory (S25FL512S, U4):** The [S25FL512S](#) NOR flash of 512Mb capacity is connected to the serial memory interface (SMIF) of the PSoC™ 6 MCU. The NOR device can be used for both data and code memory with execute-in-place (XIP) support and encryption.
20. **PSoC™ 6 MCU user LEDs (LED8 and LED9):** These two user LEDs can operate at the entire operating voltage range of PSoC™ 6 MCU. The LEDs are active LOW, so the pins must be driven to ground to turn ON the LEDs.
21. **RGB LED (LED5):** This on-board RGB LED can be controlled by the PSoC™ 6 MCU. The LEDs are active LOW, so the pins must be driven to ground to turn ON the LEDs.
22. **Wi-Fi and Bluetooth® module (LBEE5KL1DX-883, U6):** This kit features the on-board Wi-Fi and Bluetooth® combination module to demonstrate the IoT features. LBEE5KL1DX is a Type 1DX module available with 2.4-GHz WLAN and Bluetooth® functionality. Based on Infineon AIROC™ CYW4343W Wi-Fi & Bluetooth® combo chip, this module provides high-efficiency RF front-end circuits.
23. **4-Mbit serial F-RAM (CY15B104QSN, U5):** This kit contains the CY15B104QSN 4-Mbit (512K × 8) Excelon™ F-RAM device, which can be accessed through the Quad SPI interface, which is capable of Quad SPI speed up to 108 MHz but PSoC™ 6 MCU is limited to 80 MHz.
24. **Wi-Fi-Bluetooth® antenna (ANT1):** This is the on-board antenna connected to the Wi-Fi and Bluetooth® module.
25. **VBACKUP and PMIC control selection switch (SW7, on the bottom side of the board):** This switches the VBACKUP supply connection to the PSoC™ 6 MCU between VDDD/KITPROG3 and the SUPER CAP/PSOC 6. When VDDD/KITPROG3 is selected, the regulator ON/OFF is controlled by KitProg3. When the SUPER CAP/PSOC 6 is selected, the regulator ON/OFF is controlled by the PSoC™ 6 MCU.
26. **PSoC™ 6 USB Type-C connector (J28):** The USB cable provided with the PSoC™ 6 Wi-Fi Bluetooth® pioneer kit can also be connected between this USB connector and the PC to use the PSoC™ 6 MCU USB device applications.
27. **PSoC™ 6 MCU (CY8C6247BZI-D54, U1):** This kit is designed to highlight the features of the PSoC™ 6 MCU. For details on PSoC™ 6 MCU pin mapping, see [Table 1-1 on page 12](#).
28. **PSoC™ 6 USB Type-A connector (J27):** USB devices can be connected to this USB Type-A connector and communicate with the PSoC™ 6 MCU USB host applications.

29. **ICSP header compatible with Arduino (J5):** This header provides an SPI interface for shields compatible with Arduino ICSP.
30. **PSoC™ 6 MCU current measurement jumper (J8, on the bottom side of the board):** An ammeter can be connected to this jumper to measure the current consumed by the PSoC™ 6 MCU.
31. **KitProg3 (PSoC™ 5LP) programmer and debugger (CY8C5868LTI-LP039, U2):** The PSoC™ 5LP device (CY8C5868LTI-LP039) serving as KitProg3, is a multi-functional system, which includes a programmer, debugger, USB-I2C bridge, USB-UART bridge, and a USB-SPI bridge. For details, see the [KitProg3 user guide](#).

See [Hardware functional description on page 36](#) for details on various hardware blocks.

For some devices in the PSoC™ 6 MCU family, simultaneous GPIO switching with unrestricted drive strengths and frequency can induce noise in on-chip subsystems affecting CAPSENSE™ and ADC results. For more details, see the Errata section of the corresponding [device datasheet](#).

[Table 2-1](#) shows the functionalities of the on-board selection switches.

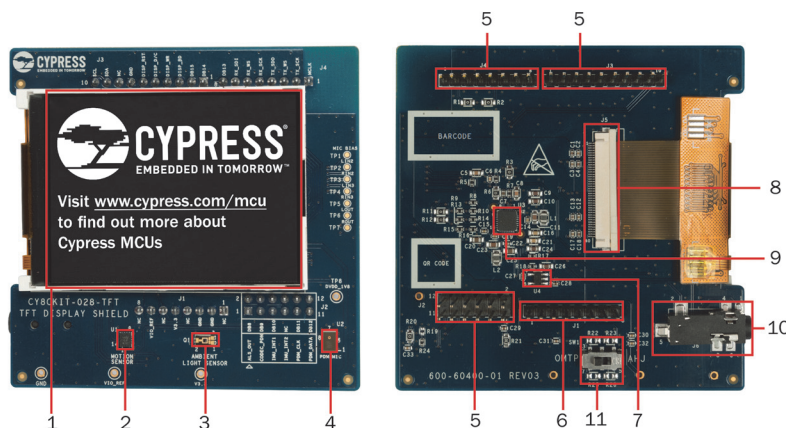
Table 2-1. Selection Switches on the Pioneer Board

Switch	Location on the Board	Purpose	Default Position
SW5	Front	Selects the V_{DD} supply of the PSoC™ 6 MCU between 1.8 V, 3.3 V, and the variable 1.8 V to 3.3 V, which is controlled by KitProg3.	3.3 V
SW7	Back	Selects the VBACKUP supply connection of the PSoC™ 6 MCU between V_{DDD} and the super-capacitor. When V_{DDD} is selected, the regulator can be turned ON/OFF by KitProg3. When the super-capacitor is selected, the PSoC™ 6 MCU can turn the regulator ON/OFF.	VDDD/ KITPROG3

2.2 CY8CKIT-028-TFT details

2.2.1 CY8CKIT-028-TFT display shield

Figure 2-5. TFT display shield

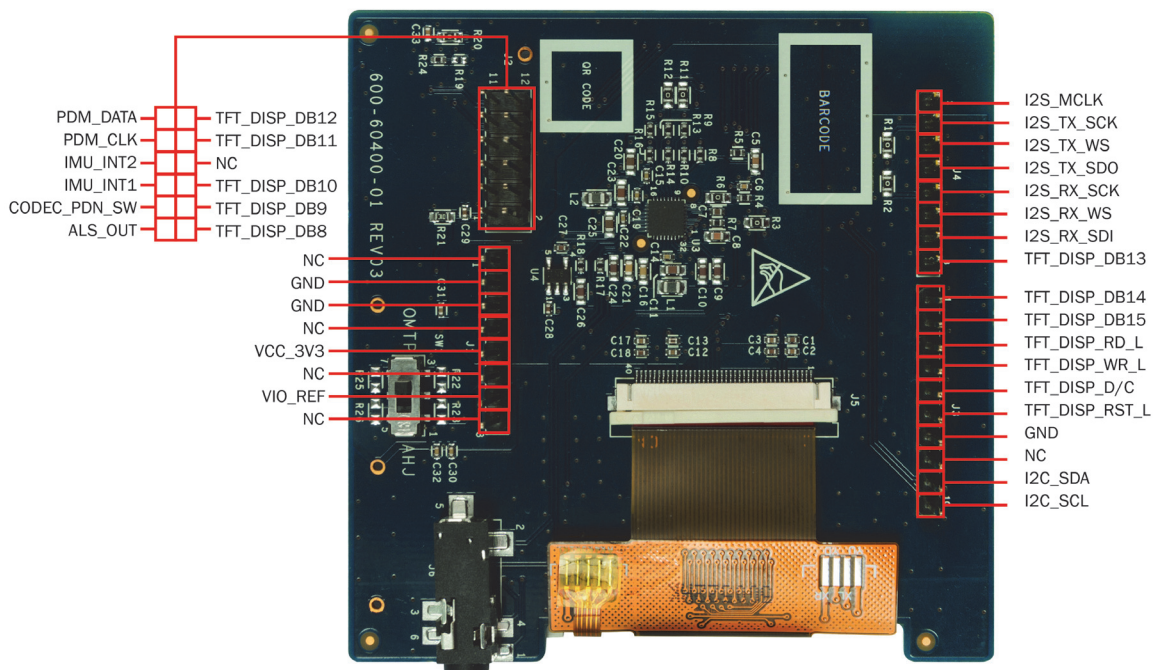


The TFT display shield has the following peripherals:

1. **2.4-inch TFT display:** This is a [Newhaven 2.4-inch TFT LCD](#) module with 240 × 320 pixel resolution and uses a [Sitronix ST7789 display controller](#). This display module is configured for an 8-bit parallel pinout connection (8080-Series) to interface with the PSoC™ 6 device on the baseboard.
2. **Inertial measurement unit (U1):** This inertial measurement unit (IMU) is a three-axis acceleration and three-axis gyroscopic motion sensor that can be used to count steps to emulate a pedometer or similar application.
3. **Ambient light sensor (Q1):** This is a high photosensitive NPN phototransistor IC that can be used to detect intensity of ambient light.
4. **PDM microphone (U2):** This microphone converts voice inputs to pulse-density modulated (PDM) digital signals.
5. **I/O header compatible with Arduino (J2, J3, and J4):** These headers interface with the PSoC™ 6 MCU GPIOs on the baseboard.
6. **Power header compatible with Arduino (J1):** This header receives power from header J1 on the board.
7. **Voltage regulator - 1.8 V (U4):** An LDO that converts 3.3 V to 1.8 V for the digital supply of the audio codec.
8. **TFT display connector (J5):** This connector is used to connect the TFT display to the circuits on the TFT display shield.
9. **Audio codec (U3):** This is a low power consumption, 32-bit stereo codec with speaker amplifiers. The left channel and right channel amplifier output pins of the device are connected to the on-board audio jack.
10. **Audio jack (J6):** The on-board audio jack provides a provision of connecting both AHJ and OMTP headphones. The headset standard can be set by an on-board switch SW1.
11. **Audio jack selection switch (SW1):** This on-board selection switch can set the headphone type either to AHJ and OMTP standard connected to the audio jack.

[Figure 2-6](#) shows the connectivity of the TFT display shield with the CY8CKIT-062-Wi-Fi Bluetooth® baseboard through the headers.

Figure 2-6. TFT shield pinout



Notes:

The TFT display operation at 1.8 V is currently not supported in this version of the kit. Ensure that the following conditions are met when the CY8CKIT-028-TFT display shield is mounted on the PSoC™ 6 Wi-Fi Bluetooth® pioneer board.

1. Ensure that SW5 is either set to 3.3 V or set to the 1.8 V–3.3 V VARIABLE with PSoC™ Programmer selecting a voltage of 2.5 V or higher.
2. If you want to erase the internal flash of the PSoC™ 6 MCU, ensure that the PSoC™ Programmer setting is not 1.8 V when the SW5 is set to the 1.8 V–3.3 V VARIABLE position.

2.3 KitProg3: On-board programmer/debugger

The PSoC™ 6 Wi-Fi Bluetooth® pioneer kit can be programmed and debugged using the KitProg3 onboard programmer/debugger with USB-UART, USB-I2C, and USB-SPI Bridge functionality. KitProg3 supports CMSIS-DAP and DAPLink mode for programming. A PSoC™ 5LP device is used to implement the KitProg3 functionality. For more details on the KitProg3 functionality, see the [KitProg3 user guide](#).

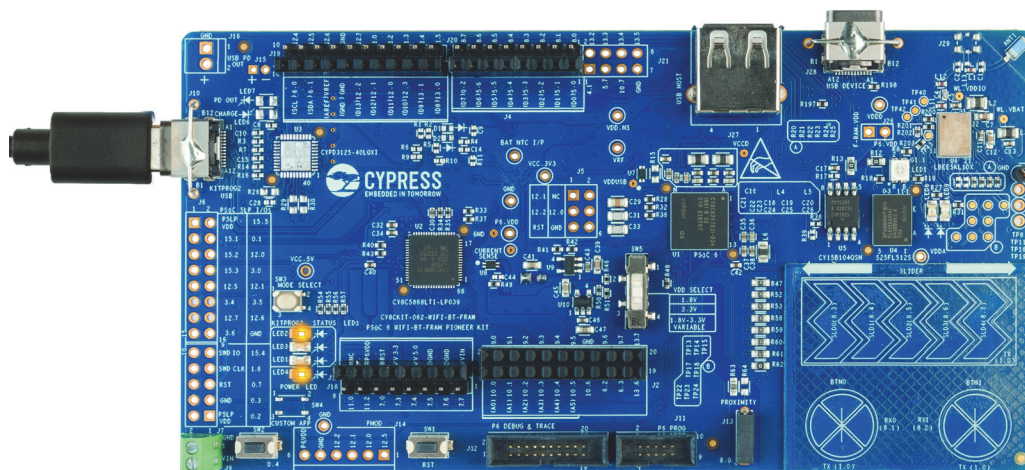
Note: If you are using Rev *F or higher (see Kit Revision on the box), please note that the silkscreen of the kit shows KitProg2 but KitProg3 is loaded on the kit.

2.3.1 Programming and debugging using ModusToolbox™ software

1. Connect the board to the PC using the provided USB cable through the KitProg3 USB connector, as shown in [Figure 2-7](#). It enumerates as a USB Composite Device if you are connecting it to your PC for the first time.
2. The KitProg3 on this kit is in CMSIS-DAP Bulk mode by default. The status LED (amber), LED2 and power LED (amber), LED4 are turned ON at this time. If you do not see the desired LED status, see the [KitProg3 user guide](#) for details on the KitProg3 status and troubleshooting instructions.

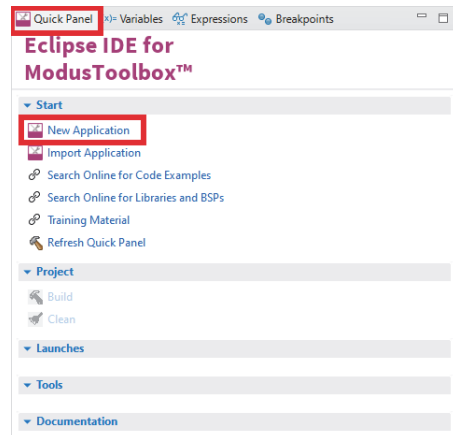
Note: Programming can be done in either KitProg3 programming modes, but it is recommended to program the kit in CMSIS-DAP Bulk mode.

Figure 2-7. Connect USB cable to the USB connector on the board



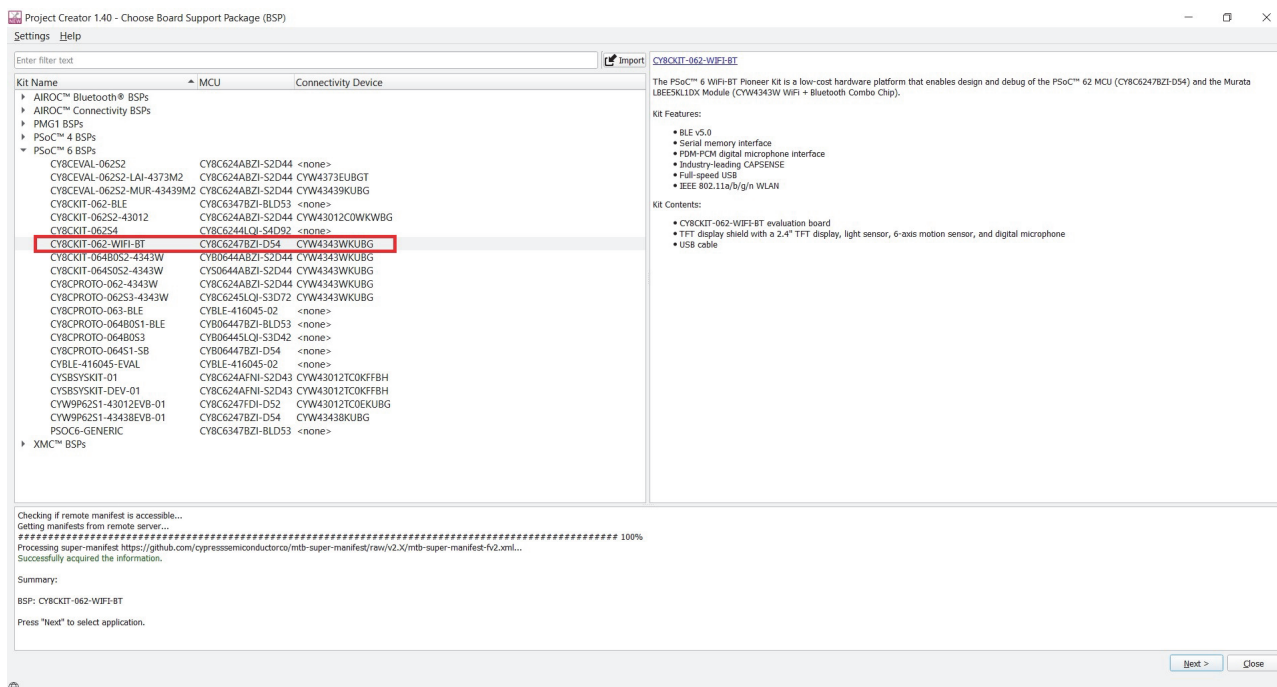
3. In the Eclipse IDE for ModusToolbox™ software, import the desired code example (application) into a new workspace.
 - a. Click **New Application** from the **Quick Panel**.

Figure 2-8. Create new application



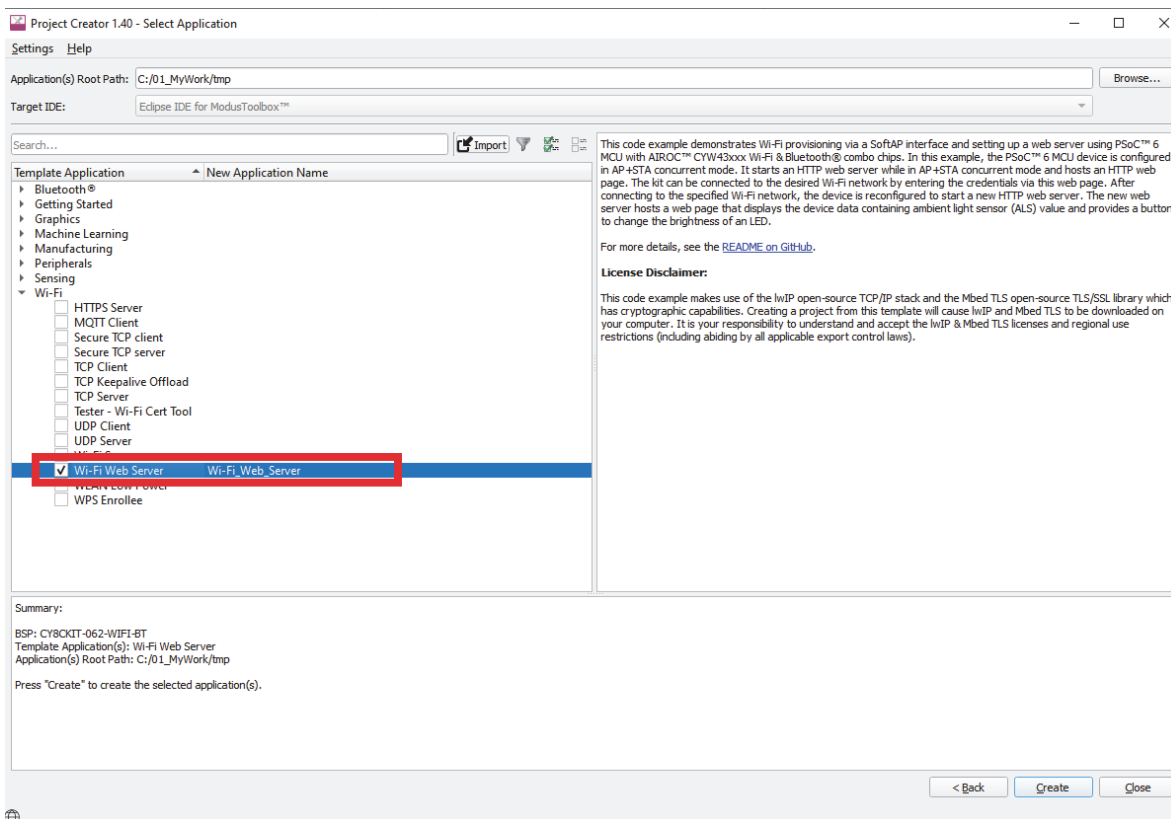
- b. Select the BSP in the **Choose Board Support Package** window and click **Next**.
The rest of the steps uses the CY8CKIT-062-WIFI-BT BSP for the sake of explanation.

Figure 2-9. Creating a new application: Choose board support package



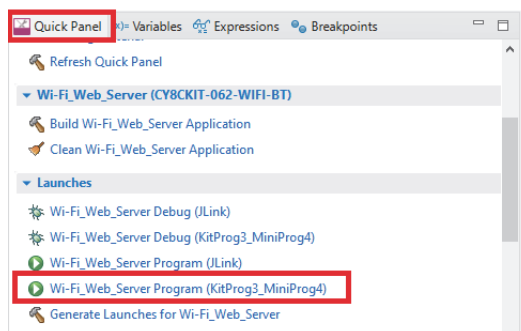
- c. Select the application in the **Select Application** window and click **Create**.

Figure 2-10. Creating a new application: Select Application



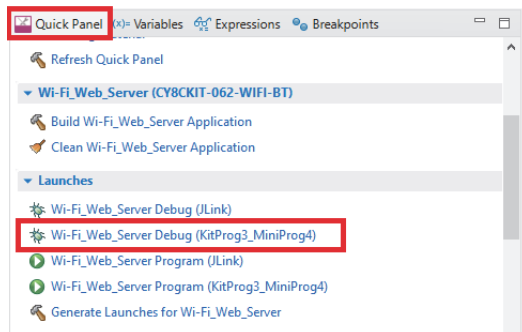
4. To build and program a PSoC™ 6 MCU application, in the Project Explorer, select **<App_Name>** project. In the Quick Panel, scroll to the **Launches** section and click the **<App_Name> Program (KitProg3_MiniProg4)** configuration as shown in Figure 2-11.

Figure 2-11. Programming in ModusToolbox™ software



- ModusToolbox™ software has an integrated debugger. To debug a PSoC™ 6 MCU application, in the Project Explorer, select **<App_Name>** project. In the Quick Panel, scroll to the **Launches** section and click the **<App_Name> Debug (KitProg3_MiniProg4)** configuration as shown in Figure 2-12. For more details, see the “Program and debug” section in the [Eclipse IDE for ModusToolbox™ user guide](#).

Figure 2-12. Debugging in ModusToolbox™ software



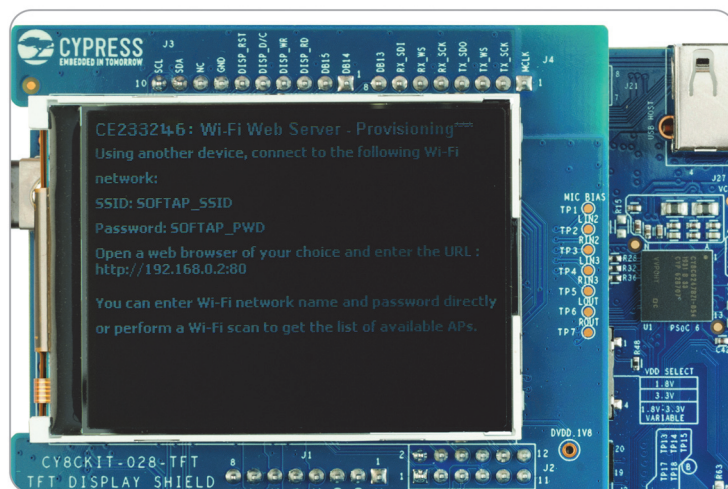
2.3.1.1 Using the OOB example – Wi-Fi_Web_Server

By default, the PSoC™ 6 Wi-Fi Bluetooth® pioneer kit is programmed with the *Wi-Fi_Web_Server* code example. The following steps describe on how to use the example. For a detailed description of the project, see the example's README.md file in the [GitHub repository](#). The README.md file is also in the application directory after the application is created.

Note: At any point of time, if you overwrite the OOB example, you can restore it by programming the *Wi-Fi_Web_Server* application.

- Connect the board to your PC using the provided USB cable through the KitProg3 USB connector.

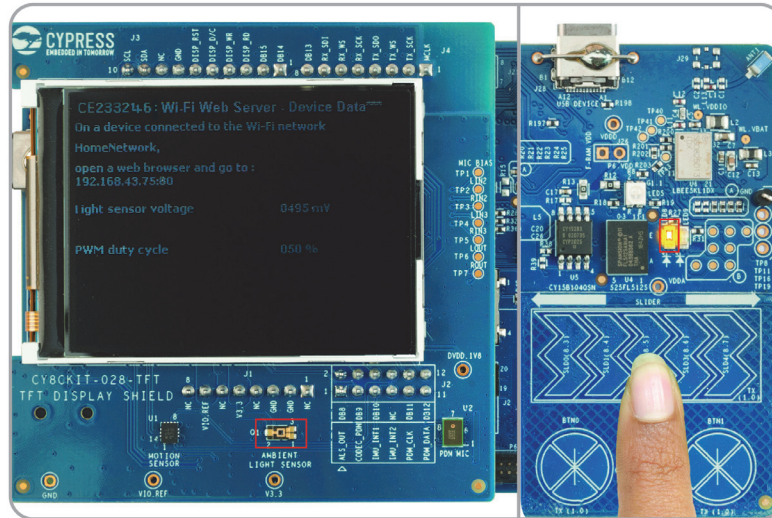
Figure 2-13. Kit connected to the PC



- Connect to the Wi-Fi network “SOFTAP_SSID” using “SOFTAP_PWD” as the password.
- On your PC, open a web browser of your choice and enter the URL: <http://192.168.0.2:80>
- Ensure you have a non-enterprise Wi-Fi network or a mobile hotspot operating at 2.4 GHz on another device.

- On the Web Server Demo – Home Page, enter your Wi-Fi network name and password of the non-enterprise network directly or perform a Wi-Fi Scan to select the network you wish to use to connect to the cloud.
- Once the device connection is successful, the TFT display is updated to show the Wi-Fi network name and the URL to be used to view the sensor data.
- Swipe your finger on the CAPSENSE™ slider to change the PWM duty cycle and LED8 brightness.

Figure 2-14. Use CAPSENSE™ slider to change PWM duty cycle and LED8 brightness



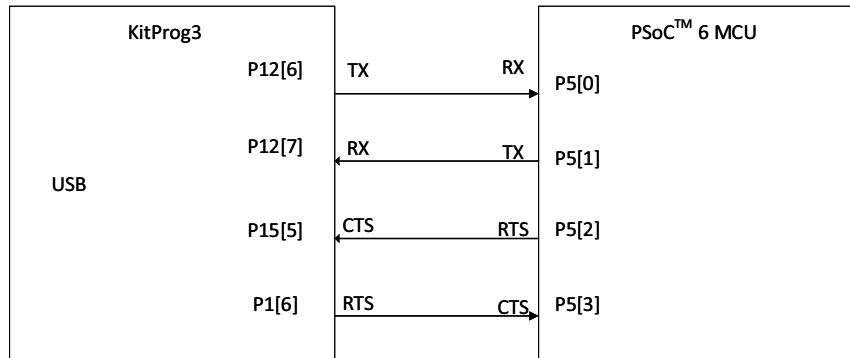
Note: If more than one kit is connected at the same time during OOB evaluation, the pre-programmed SSID would be the same for all kits. Thus, it may be difficult to identify the kit with which the device has established the connection. To avoid this scenario, reprogram each kit by changing the SOFTAP_SSID macro in the *web_server.h* file.

2.3.2 USB-UART bridge

KitProg3 on the PSoC™ 6 Wi-Fi Bluetooth® pioneer kit can act as a USB-UART bridge.

The UART Rx and Tx pins of KitProg3 are connected to the PSoC™ 6 MCU UART pins as follows:

Figure 2-15. UART connection between KitProg3 and PSoC™ 6 MCU

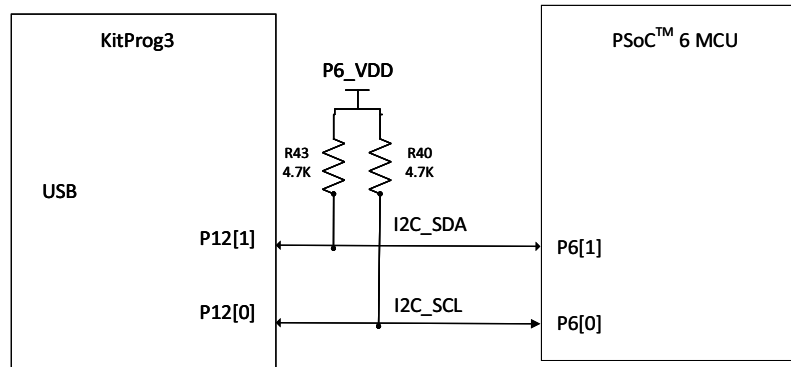


For more details on the KitProg3 USB-UART functionality, see the [KitProg3 user guide](#).

2.3.3 USB-I2C bridge

The KitProg3 can function as a USB-I2C bridge and communicate with an I2C master such as Bridge Control Panel (BCP). The I2C lines on the PSoC™ 6 MCU are hard-wired on the board to the I2C lines of the KitProg3, with onboard pull-up resistors as [Figure 2-16](#) shows. The USB-I2C bridge supports I2C speeds of 50 kHz, 100 kHz, 400 kHz, and 1 MHz. For more details on the KitProg3 USB-I2C bridge functionality, see the [KitProg3 user guide](#).

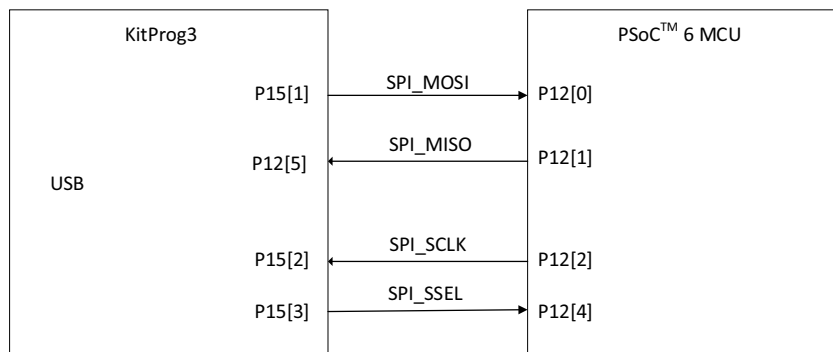
Figure 2-16. I2C connection between KitProg3 and PSoC™ 6 MCU



2.3.4 USB-SPI bridge

The KitProg3 can function as a USB-SPI bridge. The SPI lines between the PSoC™ 6 MCU and the KitProg3 are hard-wired on the board, as shown in the figure. For more details on KitProg3 USB-SPI functionality, see the [KitProg3 user guide](#).

Figure 2-17. SPI connection between KitProg3 and PSoC™ 6 MCU



3. Hardware



3.1 Schematics

See the schematic files available on the [kit webpage](#).

3.2 Hardware functional description

This section explains the individual hardware blocks of the PSoC™ 6 Wi-Fi Bluetooth® pioneer board.

3.2.1 PSoC™ 6 MCU (U1)

PSoC™ 6 MCU is an ultra-low-power PSoC™ family device specifically designed for wearables and IoT products. It is a programmable embedded system-on-chip, integrating a 150-MHz CM4 as the primary application processor, a 100-MHz CM0+ that supports low-power operations, up to 1 MB Flash and 288KB SRAM, CAPSENSE™ touch-sensing, and custom analog and digital peripheral functions. The programmable analog and digital peripheral functions allow higher flexibility, in-field tuning of the design, and faster time-to-market.

For more information, see the [PSoC™ 6 MCU webpage](#) and the [datasheet](#).

Simultaneous GPIO switching with unrestricted drive strengths and frequency can affect CAPSENSE™ and ADC performance. For details, see the “Errata” section of the corresponding [device datasheet](#).

3.2.2 PSoC™ 5LP (U2)

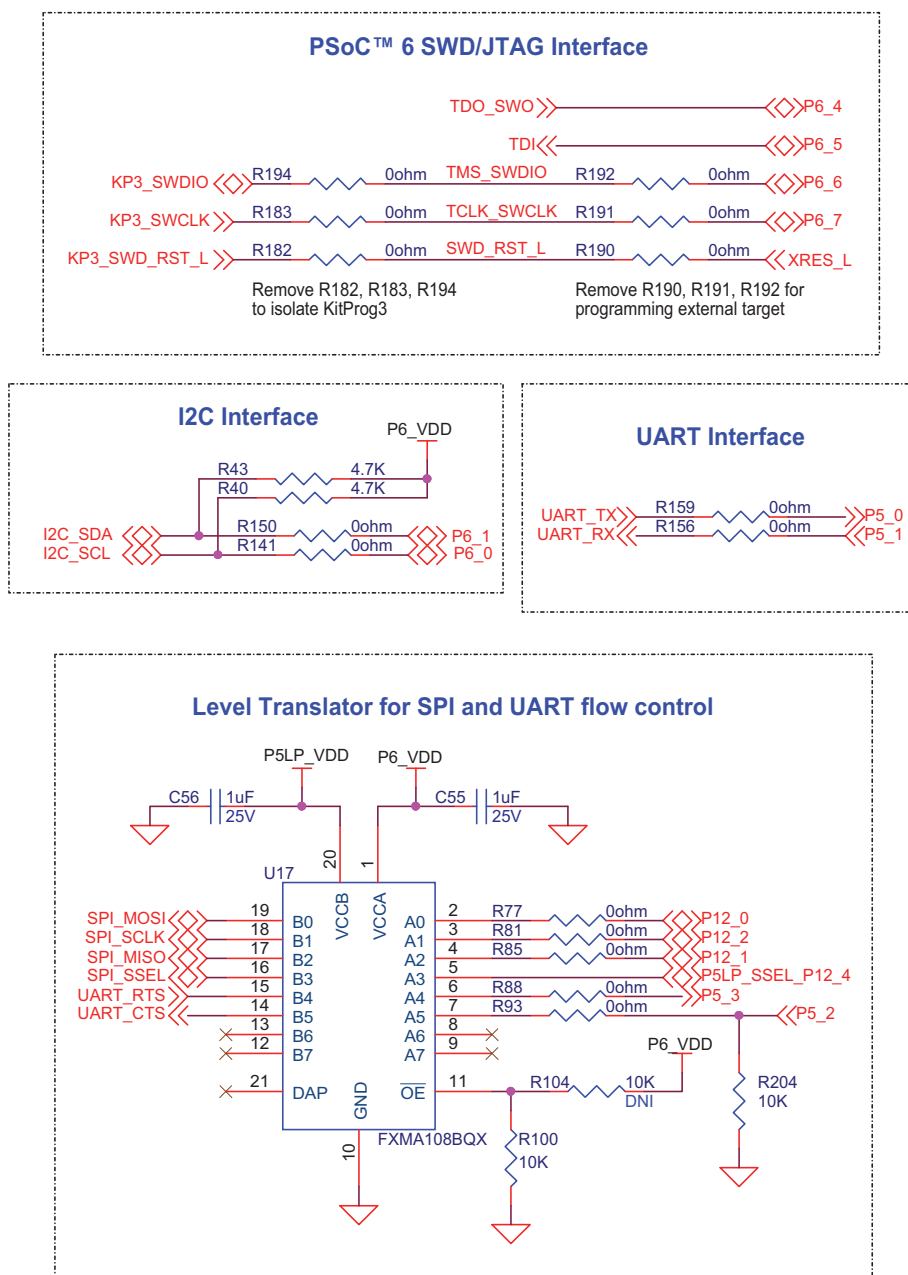
An on-board PSoC™ 5LP MCU (CY8C5868LTI-LP039) is used as KitProg3 to program and debug the PSoC™ 6 MCU. The PSoC™ 5LP MCU connects to the USB port of a PC through a USB connector and to the SWD and other communication interfaces of PSoC™ 6 MCU. The PSoC™ 5LP MCU is a system-level solution providing MCU, memory, analog, and digital peripheral functions in a single chip. The CY8C58LPxx family offers a modern method of signal acquisition, signal processing, and control with high accuracy, high bandwidth, and high flexibility. Analog capability spans the range from thermocouples (near DC voltages) to ultrasonic signals.

For more information, visit the [PSoC™ 5LP webpage](#). Also, see the [CY8C58LPxx family datasheet](#).

3.2.3 Serial interconnection between PSoC™ 5LP and PSoC™ 6 MCU

In addition to being used as an on-board programmer, the PSoC™ 5LP MCU functions as an interface for the USB-UART, USB-I2C, and USB-SPI bridges, as shown in [Figure 3-1](#). The USB-Serial pins of the PSoC™ 5LP are hard-wired to the I2C/UART/SPI pins of the PSoC™ 6 MCU. These pins are also available on the I/O headers compatible with Arduino; therefore, the PSoC™ 5LP MCU can be used to control shields compatible with Arduino with an I2C/UART/SPI interface.

Figure 3-1. Schematics of programming and serial interface connections



3.2.4 Power supply system

The power supply system on this board is versatile, allowing the input supply to come from the following sources:

- 5 V, 9 V, or 12 V from the on-board USB Type-C connector
- 5 V to 12 V power from a shield compatible with Arduino or from external power supply through VIN header **J9** or **J1**
- 5 V from an external programmer/debugger connected to **J11** and **J12**

The power supply system is designed to support 1.8 V to 3.3 V operation of the PSoC™ 6 MCU. In addition, an intermediate voltage of 5 V is required for operation of the KitProg3. Therefore, three regulators are used to achieve 1.8 V to 3.3 V and 5 V outputs – a buck boost regulator (**U30**) that generates a fixed 5 V from an input of 5 V to 12 V, and a main regulator (**U10**) that generates either a variable 1.8 V to 3.3 V, or a fixed 1.8 V, or a fixed 3.3 V from the output of **U30**. [Figure 3-2](#) shows the schematics of the voltage regulator and power selection circuits.

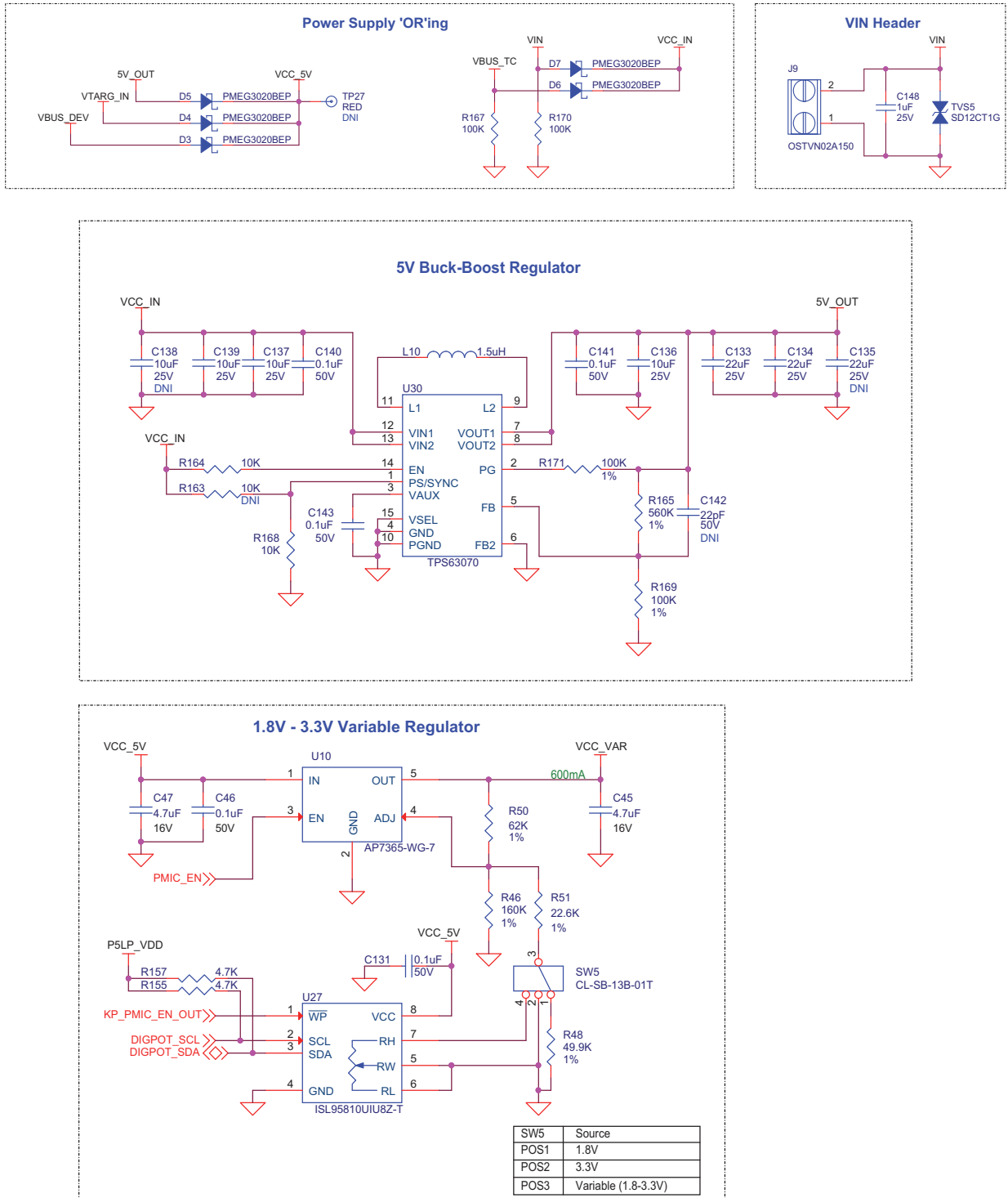
The voltage selection is made through switch **SW5**. In addition, an on-board 330-mF super capacitor (**C103**) can be used to power the backup domain (VBACKUP) of PSoC™ 6 MCU. The switch **SW7** selects the VBACKUP supply connection of the PSoC™ 6 MCU between V_{DD} and the super capacitor. When V_{DD} is selected, the variable regulator ON/OFF terminal is controlled by KitProg3. When the super capacitor is selected, the regulator ON/OFF terminal is controlled by the PSoC™ 6 MCU. To ensure proper operation of the PSoC™ 6 MCU, the super capacitor, when selected, must be charged internally by the PSoC™ 6 MCU before turning OFF the regulator. For details of the PSoC™ 6 MCU backup system and power supply, see the [PSoC™ 62 architecture technical reference manual](#).

Table 3-1 details the different powering scenarios for pioneer board.

Table 3-1. Power supply scenarios

Power inputs				Board condition	
USB	VIN	ETM header (VTARG_IN)	JTAG/SWD header (VTARG_REF)	Main regulator powered by	PSoC™ powered by
Non Type-C power adapter (legacy USB), 5 V	<5	N/A	N/A	Type-C	Main regulator
	>5	N/A	N/A	VIN	Main regulator
0 V	5 V–12 V	N/A	N/A	VIN	Main regulator
0 V	0 V	5 V	N/A	ETM (VTARG_IN)	Main regulator
0 V	0 V	0 V	N/A	Battery	Main regulator
0 V	0 V	0 V	1.8 V–3.3 V	N/A	JTAG/SWD (VTARG_REF)

Figure 3-2. Schematics of power supply system



3.2.5 Expansion connectors

3.2.5.1 *Headers compatible with Arduino (J1, J2, J3, J4, and J5)*

The board has five headers compatible with Arduino: **J1**, **J2**, **J3**, **J4**, and **J5** (**J5** is not populated by default). You can connect 3.3-V shields compatible with Arduino to develop applications based on the shield's hardware. Note that 5-V shields are not supported and connecting a 5-V shield may permanently damage the board. See [Table 1-1 on page 12](#) for details on the PSoC™ 6 MCU pin mapping to these headers.

3.2.5.2 *PSoC™ 6 MCU I/O headers (J18, J19, and J20)*

These headers provide connectivity to PSoC™ 6 MCU GPIOs that are not connected to the headers compatible with Arduino. Most of these pins are multiplexed with on-board peripherals and are not connected to the PSoC™ 6 MCU by default. For detailed information on how to rework the kit to access these pins, see [PSoC™ 6 Wi-Fi Bluetooth® pioneer board reworks on page 47](#).

3.2.5.3 *PSoC™ 5LP MCU GPIO header (J6)*

J6 is a 8 × 2 header provided on the board to bring out several pins of the PSoC™ 5LP MCU to support advanced features such as a low-speed oscilloscope and a low-speed digital logic analyzer. This header also contains the USB-UART, USB-I2C, and USB-SPI bridge pins that can be used when these pins are not accessible on the Arduino headers because a shield is connected. The additional PSoC™ 5LP pins MCU are connected directly to the internal programmable analog logic of PSoC™ 5LP MCU. J6 is not populated by default. Note that the SPI, RTS, and CTS lines on these headers are directly from PSoC™ 5LP MCU (before level translator).

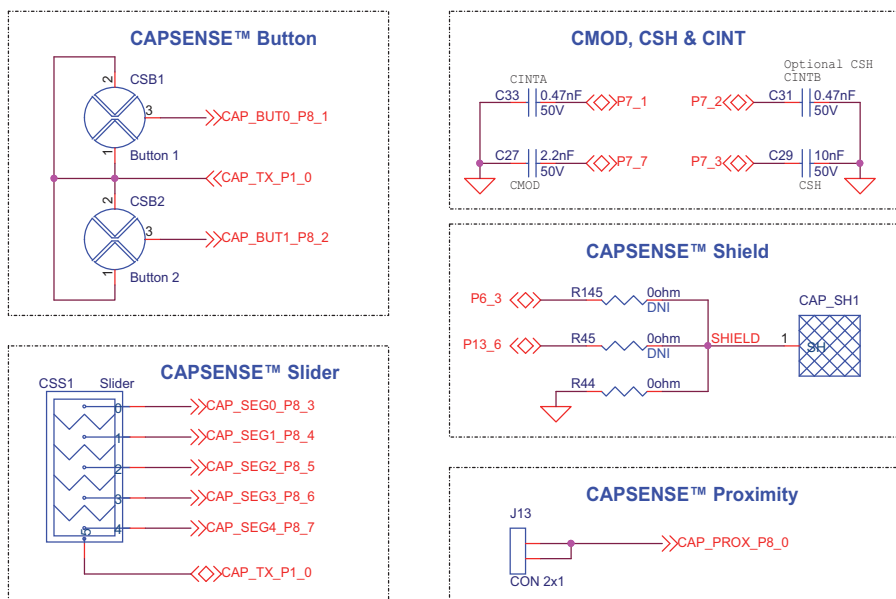
3.2.5.4 *KitProg3 programming/GPIO header (J7)*

A 5 × 2 header is provided on the board to bring out more PSoC™ 5LP MCU GPIOs. This header also brings out the PSoC™ 5LP MCU programming pins and can be programmed using [MiniProg4](#) and a five-pin programming connector. J7 is not populated by default.

3.2.6 CAPSENSE™ circuit

A CAPSENSE™ slider and two buttons, all of which support both self-capacitance (CSD) and mutual-capacitance (CSX) sensing, and a CSD proximity sensor (header) are connected to PSoC™ 6 MCU as [Figure 3-3](#) shows. Four external capacitors – C_{MOD} and C_{SH} for CSD, C_{INTA} and C_{INTB} for CSX are present on the pioneer board. Note that C_{SH} is not loaded by default. For details on using CAPSENSE™ including design guidelines, see the [Getting Started with CAPSENSE™ Design Guide](#).

Figure 3-3. Schematics of CAPSENSE™ circuit



3.2.7 LEDs

LED1, **LED2**, and **LED3** (red, amber, and green respectively) indicate the KitProg3 status (see the [KitProg3 user guide](#) for details). **LED4** (amber) indicates the status of power supplied to the PSoC™ 6 MCU.

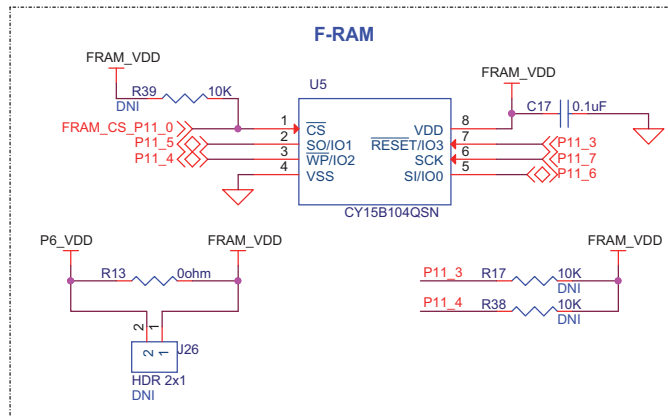
The pioneer board also has two user-controllable LEDs (**LED8** and **LED9**) and an RGB LED (**LED5**) connected to the PSoC™ 6 MCU pins for user applications.

3.2.10 Quad SPI F-RAM

The pioneer board contains the CY15B104QSN EXCELON™ F-RAM device, which can be accessed through Quad SPI interface. The F-RAM is 4-Mbit (512K × 8) and is capable of Quad SPI speed up to 108 MHz but the PSoC™ 6 MCU is limited to 80 MHz.

Note that if P6_VDD is set to 1.8 V, the speed is limited to 75 MHz. This limitation is only specific to this kit.

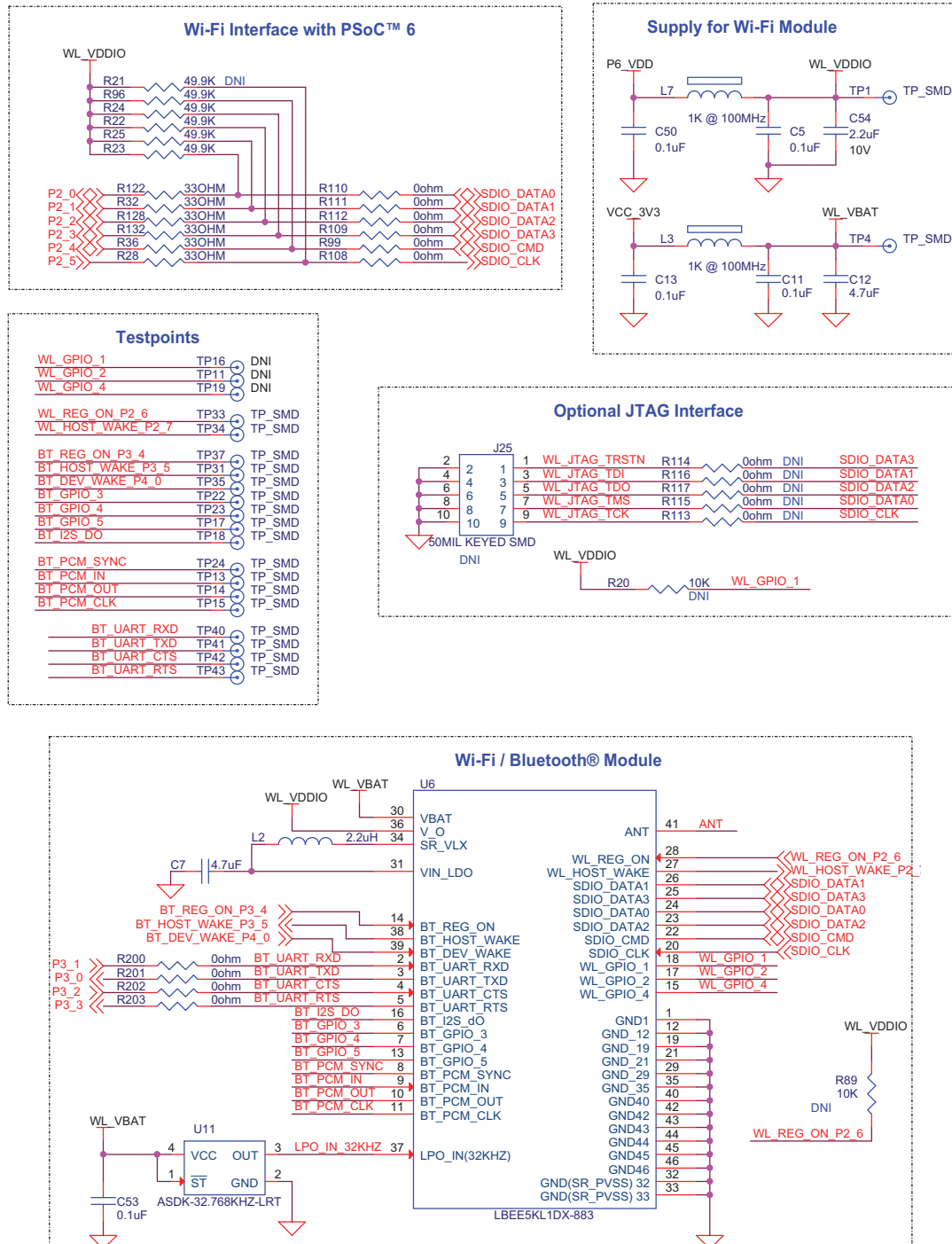
Figure 3-6. Schematics of Quad SPI F-RAM



3.2.11 Wi-Fi and Bluetooth® module

The pioneer board features an on-board Wi-Fi and Bluetooth® combination module to demonstrate the wireless communication features. This LBEE5KL1DX is a Type 1DX module available with 2.4-GHz WLAN and Bluetooth® functionality. Based on AIROC™ CYW4343W Wi-Fi & Bluetooth® combo chip, this module provides high-efficiency RF front-end circuits.

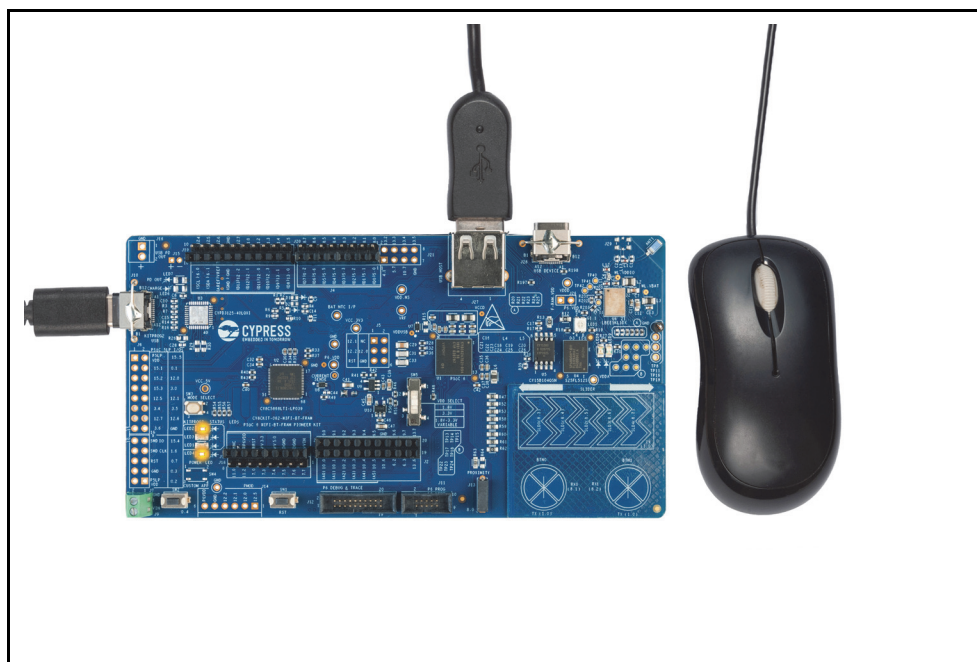
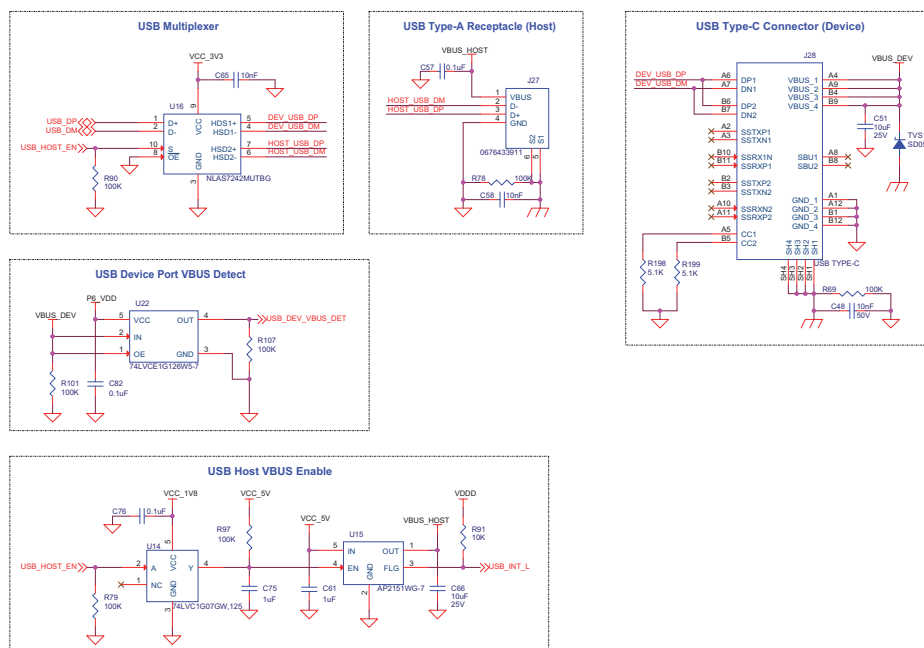
Figure 3-7. Schematics of Wi-Fi and Bluetooth® module



3.2.12 USB host and USB device connections

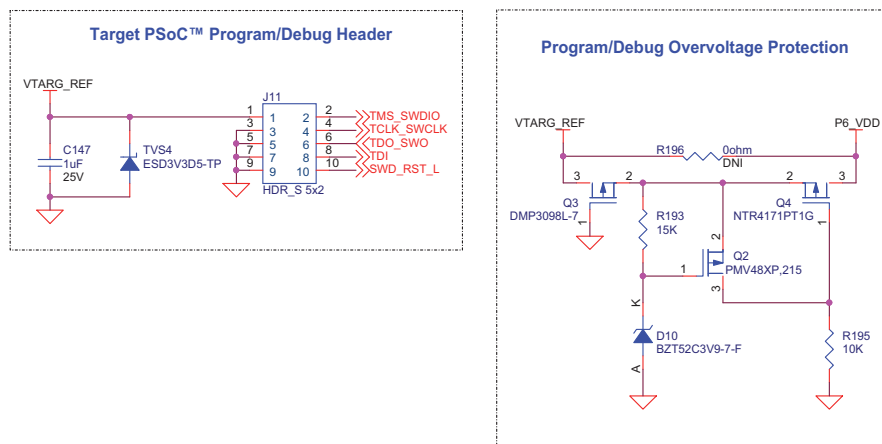
The PSoC™ 6 MCU can be configured as either a USB host or USB device. When PSoC™ 6 is programmed as a host controller, you can connect an external device such as mouse, keyboard, and flash memory to the USB Type-A receptacle port (J27). When the PSoC™ 6 MCU is programmed as a USB device, you can connect the kit either to a PC or to another host controller through a Type-C cable at the USB Type-C connector (J28).

Figure 3-8. Schematics of USB host and USB device connections

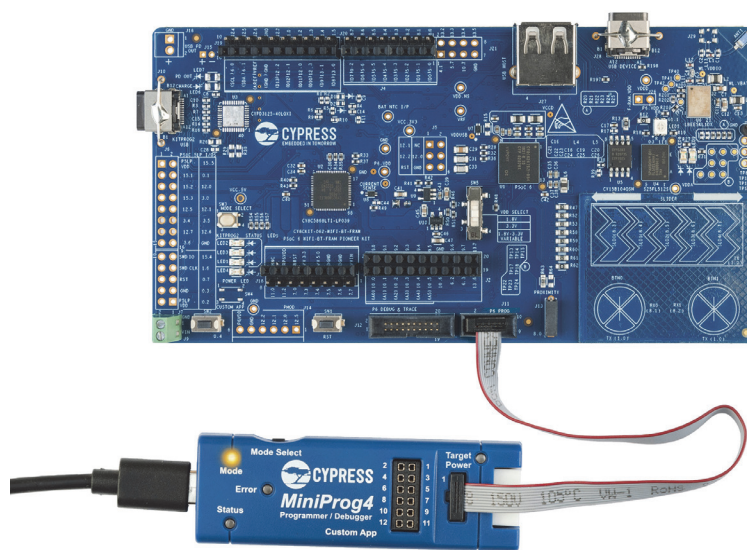


3.3.1 Bypass protection circuit on program and debug header (J11)

Figure 3-9. Schematics of Bypass protection circuit on program and debug header (J11)



Note that this change will compromise the protection circuit when an external supply is used and will permanently damage any 3.3-V device if the external voltage exceeds absolute maximum limit of the device. See the respective device datasheet for absolute maximum voltage limits.



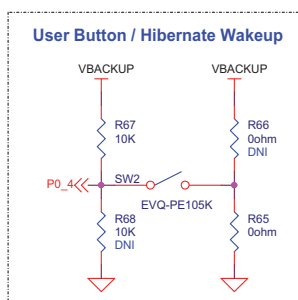
Notes:

1. If you are programming the PSoC™ 6 MCU using a MiniProg4 connected to J11, make sure that the voltage is set at either 2.5 V or at 3.3 V.
2. If you want to program the PSoC™ 6 MCU using MiniProg4 at the 1.8 V condition, make sure that you are populating the 0-ohm resistor R196 on the board. This is to bypass the overvoltage protection circuit, as the protection circuit does not allow programming of the device at 1.8 V.
3. Powering PSoC™ 6 through MiniProg4 sometimes turns on the LED4. This is due to the reverse conduction from PSoC™ 6 VDD domain to the VCC_3V3 domain when there is no USB device connected at J10.
4. Do not mount the CY8CKIT-028-Display shield on the PSoC™ 6 pioneer board at the time of programming and debugging through the J11 header. This causes extra load on the external programmer, and hence the programmer may not be able to power-up the PSoC™ 6 supply domain.

3.3.2 PSoC™ 6 MCU user button (SW2)

By default, this button connects the PSoC™ 6 MCU pin to ground when pressed; you need to configure the PSoC™ 6 MCU pin as a digital input with resistive pull-up for detecting the button press. If you want to sense active HIGH on the PSoC™ 6 MCU pin, resistor R67 should be removed and R68 should be populated. This will connect the button connecting the PSoC™ 6 MCU pin to VBACKUP when pressed. Additionally, footprints are provided for pull-up and pull-down resistors that can be populated if external pull-up is required.

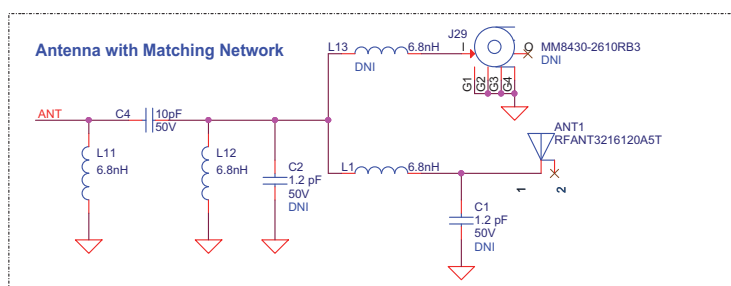
Figure 3-10. Schematics of PSoC™ 6 MCU user button (SW2)



3.3.3 SWD connector receptacle (J29)

This connector can be used for conductive measurements and can also be used to connect external antenna. This is not loaded by default. Remove L1, populate L13, and the SWD connector (J29) to connect the external antenna. See the BOM for recommended part numbers.

Figure 3-11. Schematics of SWD connector receptacle (J29)



3.3.4 CAPSENSE™ shield

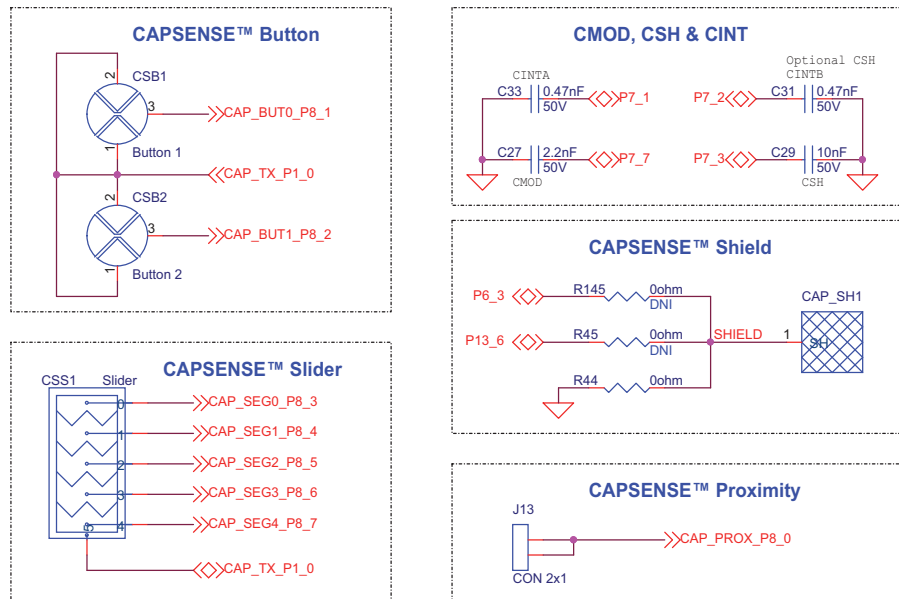
The hatched pattern around the CAPSENSE™ buttons and slider are connected to ground. If liquid tolerance is required, this pattern needs to be connected to the shield pin. This pattern can be connected to either of the two ports P6.3 or P13.6 populated by R145 or R45, respectively. In both cases, resistor R44 connecting the hatched pattern to ground needs to be removed.

Connecting the hatched pattern to shield instead of ground will also reduce the parasitic capacitance of the sensors.

3.3.5 CSH

The shield tank capacitor (CSH) is not populated by default. This capacitor is optional, and can be used for an improved shield electrode driver when CSD sensing is used. You can remove R146 to disconnect port 7.3 from header and populate C29 (10 nF) for CSH. See the bill of material (BOM) for the recommended part number.

Figure 3-12. Schematics of CAPSENSE™ shield and CSH



3.3.6 Multiplexed GPIOs

Some PSoC™ 6 MCU pins are multiplexed with on-board peripherals and are not connected to connectors or other secondary components by default. See [Table 1-1 on page 12](#) for details on modification required to access these pins.

3.4 Bill of materials

See the BOM files in the [kit webpage](#).

3.5 Frequently asked questions

1. I don't have a Type-C connector on my PC. Can I still connect and use this kit?
2. How does CY8CKIT-062-WIFI-BT handle voltage connection when multiple power sources are plugged in?
3. How can I access smart I/O and other GPIOs connected to on-board peripherals?
4. Why does the red LED of RGB LED (LED5) light up when switch SW7 is set to the super capacitor position?
5. What are the three selection switches on baseboard used for?
6. What is the on-board jumper for?
7. What are the input voltage tolerances? Are there any overvoltage protection on this kit?
8. Why is the voltage of the kit restricted to 3.3 V? Can it drive external 5-V interfaces?
9. I powered my board from Arduino by mistake while powering the PSoC™ 6 MCU. Is my PSoC™ 6 device alive?
10. I am unable to program the target device.
11. Does the kit get powered when I power it from another Infineon kit through the J1 header?
12. What additional overlays can be used with CAPSENSE™?
13. What is Pmod?
14. With what type of shield from Infineon can I use this baseboard?
15. Why am I not able to program PSoC™ 6 MCU using MiniProg4 at 1.8 V?
16. How can SW2 be used for PMIC wake up?

1. I don't have a Type-C connector on my PC. Can I still connect and use this kit?
 Yes. To evaluate PSoC™ 6 MCU features, any PC with USB 2.0 connectivity is sufficient.

2. How does CY8CKIT-062-WIFI-BT handle voltage connection when multiple power sources are plugged in?
 There are five options to power the baseboard: Type-C USB connector (J10), external DC supply via VIN connector (J9/ J1), debug and trace header (J12, VTARG_IN), program and debug header (J11). Type-C and VIN take priority over other supply options. These inputs are ORed using a diode, and the higher voltage between the two take precedence. The output of the ORing diode is given to a buck-boost regulator (**U30**) that generates a constant 5.2 V. This output is ORed with the ETM supply (J12), which is typically 5 V. For most practical applications, the output from the 5.2-V regulator takes priority and the same is given as an input to the voltage regulator (U10). The output of the buck regulator (U30) is ORed with the supply voltage from the program and debug header (J11); the higher voltage takes precedence. See [Table 3-1 on page 39](#) for more details on voltage input and output scenarios.

3. How can I access smart I/O and other GPIOs connected to the on-board peripherals?
 The smart I/O (Port 8 and Port 9.3) and GPIO connected to the on-board peripherals are multiplexed with PSoC™ 6 MCU I/O headers (**J2** and **J20**). By default, some of these I/Os are connected to the on-board peripherals using series resistors. These resistors can be changed to route these I/Os to headers. See [Table 1-1 on page 12](#) for the list of resistors that needs to be changed.

4. Why does the red LED (LED5) light up when switch **SW7** is set to the super capacitor position?
 This behavior is observed if the super capacitor is charged below 1.5 V. The I/Os referring to this domain will leak current; in this case, P0[3]. The VBACKUP feature needs to be enabled in the device before switching **SW7** to the super capacitor position. See the device TRM or datasheet for options to enable super capacitor charging.

5. What are the selection switches on the baseboard used for?
[Table 2-1 on page 27](#) gives details on all two selection switches.

6. What is the on-board jumper used for?
 The jumper J8 can be used to measure the current of the PSoC™ 6 MCU without the need to desolder any component from the board. An ammeter can be connected across this jumper to measure the current consumed by the PSoC™ 6 MCU. Remove the jumper on J8, connect an ammeter (positive terminal of ammeter to Pin 2), and power the kit through USB connector J10.

7. What are input voltage tolerances? Are there any overvoltage protection on this kit?

Input voltage levels are as follows:

Table 3-2. Input voltage levels

Supply	Typical input voltage	Absolute maximum (overvoltage protection)
USB Type-C connector (J10)	4.5 V to 12 V	15 V
VIN connector (J9/J1)	5 V to 12 V	15 V
Debug and trace header (J12)	5 V	5.5 V
Program and debug header (J11)	1.8 V to 3.3 V	3.6 V

8. Why is the voltage of the kit restricted to 3.3 V? Can it drive external 5-V interfaces?

The PSoC™ 6 MCU is not meant to be powered for more than 3.6 V. Powering the PSoC™ 6 MCU to more than 3.3 V will damage the chip. You cannot drive the I/O system with more than 3.3-V supply voltages.

9. I powered my board from Arduino by mistake while powering the PSoC™ 6 MCU. Is my PSoC™ 6 MCU device alive?

Yes. The 3.3 V and 5 V on the power header compatible with Arduino are not input pins and have protection circuit to prevent the voltage from entering the board. VIN is an input pin and this is routed to the regulator, which is capable of taking an absolute maximum of 15 V. The P6.V_{DD} pin is not protected and care should be taken not to supply voltage to this pin.

10. I am unable to program the target device.

- Ensure that SW7 is in the VDDD/KITPROG3 position.
- Make sure that no external devices are connected to J11.
- Update your KitProg3 version to the latest using the steps mentioned in the [KitProg3 user guide](#).
- Ensure that the BSP selected in ModusToolbox™ software is CY8CKIT-062-WIFI-BT.

11. Is it possible to power the kit from another Infineon kit through the J1 header?

Yes, VIN pin on the J1 header is the supply input/output pin and can support up to 12 V.

12. What additional overlays can be used with CAPSENSE™?

Any overlay (up to 5-mm thickness) such as wood, acrylic, and glass can be used with CAPSENSE™. Note that additional tuning may be required when the overlay is changed.

13. What is Pmod?

The peripheral module or Pmod interface is an open standard defined by Digilent Inc. in the Digilent Pmod interface specification for peripherals used with FPGAs or microcontrollers. Several module types are available – from simple push buttons to more complex modules with network interfaces, analog to digital converters, or LCD displays. Peripherals compatible with Pmod are available from multiple vendors such as Diligent, Maxim Integrated, Analog Devices, and a variety of hobby sites. This kit supports only 1 × 6 pin interface compatible with Pmod.

14. What type of shield from Infineon is compatible with this baseboard?

Any shield compatible with Arduino Uno that supports 3.3-V operation is compatible with this pioneer board. The following Infineon shields are pin-compatible with this board:

- a. CY3280-MBR3
- b. CY8CKIT-022
- c. CY8CKIT-024
- d. CY8CKIT-026
- e. CY8CKIT-040
- f. CY8CKIT-046
- g. CY8CKIT-048

15. Why am I not able to program PSoC™ 6 MCU using MiniProg4 at 1.8 V?

The “program/debug overvoltage protection” circuit shown in [Bypass protection circuit on program and debug header \(J11\) on page 47](#) does not allow programming of the device at 1.8 V through MiniProg4. If you want to program the PSoC™ 6 MCU using MiniProg4 at the 1.8-V condition, make sure you are populating the 0-ohm resistor at R196 on the board. This resistor will bypass the protection circuit and will allow programming of the device at 1.8 V. Make sure you are not populating this resistor at any other voltage of operation.

16. How can SW2 be used for PMIC wakeup?

SW2 is connected to the PMIC_Wakeup_In pin (P0.4) of the PSoC™ 6 MCU. A logic HIGH input at the PMIC_Wakeup_In pin can wake up the system and enable the PMIC. See the “Backup” chapter in [PSoC™ 6 MCU architecture technical reference manual](#) for more details of this feature.

SW2 should be externally pulled down to ground to use PMIC control. Moreover, when the switch is pressed, the active HIGH logic should push P0.4 to the VBACKUP supply. However, the kit is configured by default to use active LOW logic as described in [Push buttons on page 43](#). In addition, in REV04 or later version of the kit, the active HIGH logic for SW2 pushes P0.4 to VBACKUP. Therefore, the following re-works on the kit are required to use the PMIC control feature:

- Remove R65 and populate the 0-Ω resistor R66.
- Remove R67 and populate a 10-kΩ resistor at R68.

Revision History



Document Revision History

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Revision	ECN Number	Issue Date	Description of Change
**	6077389	02/21/2018	New kit guide.
*A	6114582	03/30/2018	Updated Kit operation chapter on page 22 : Updated "CY8CKIT-028-TFT details" on page 27: Updated "CY8CKIT-028-TFT display shield" on page 27: Updated description. Updated table "TFT Shield Pinout".
*B	6165395	05/03/2018	Updated Hardware chapter on page 36 : Updated "Hardware functional description" on page 36: Updated "Push buttons" on page 43: Updated description. Updated "NOR flash" on page 43: Added image. Updated "Frequently asked questions" on page 50: Updated description.
*C	6402445	12/05/2018	Updated PSoC™ Creator chapter on page 19: Updated "Kit Code Examples" on page 22: Updated "Using the Kit Code Examples Built in PSoC™ Creator" on page 22: Updated table "Code Example in PSoC™ Creator". Updated Kit operation chapter on page 22 : Updated CY8CKIT-028-TFT Details: Updated CY8CKIT-028-TFT Display Shield: Updated description. Completing Sunset Review.
*D	6507995	03/12/2019	Updated Kit operation chapter on page 22 : Updated CY8CKIT-028-TFT Details: Updated CY8CKIT-028-TFT Display Shield: Updated description.

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*E	6537738	04/09/2019	Updated Kit operation chapter on page 22 : Updated "Theory of operation" on page 22: Updated description. Updated Hardware chapter on page 36 : Updated "Hardware functional description" on page 36: Updated "PSoC™ 6 MCU (U1)" on page 36: Updated description.
*F	6750993	12/13/2019	Updated Kit operation chapter on page 22 : Updated "Theory of operation" on page 22: Updated description. Updated hyperlinks. Updated Hardware chapter on page 36 : Updated "Hardware functional description" on page 36: Added "Quad SPI F-RAM" on page 44. Updated to new template.
*G	7062673	02/03/2021	Updated Safety and regulatory compliance information chapter on page 5 : Updated "Regulatory compliance information" on page 5: Updated description. Updated to new template.
*H	7112897	03/29/2021	Updated Safety and regulatory compliance information chapter on page 5 : Updated "Regulatory compliance information" on page 5: Updated description.
*I	7747938	04/27/2022	Replaced "BT" with "Bluetooth®" in required instances across the document. Replaced "CY8CKIT-062-WiFi-BT" with "CY8CKIT-062-WIFI-BT" in all instances across the document. Updated Document Title to read as "CY8CKIT-062-WIFI-BT PSoC™ 6 Wi-Fi Bluetooth® pioneer kit guide".

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Revision	ECN Number	Issue Date	Description of Change
*I (cont.)	7747938	04/27/2022	<p>Updated Introduction chapter on page 7:</p> <p>Updated description.</p> <p>Updated hyperlinks.</p> <p>Updated “Kit contents” on page 8:</p> <p>Updated Figure 1-1.</p> <p>Removed “Software introduction”.</p> <p>Updated “Board details” on page 9:</p> <p>Replaced “Hardware Introduction” with “Board details” in heading.</p> <p>Updated “CY8CKIT-062-WIFI-BT board details” on page 9:</p> <p>Updated description.</p> <p>Updated Figure 1-2.</p> <p>Updated Figure 1-3.</p> <p>Added Table 1-1.</p> <p>Updated “CY8CKIT-028-TFT board details” on page 18:</p> <p>Added Table 1-2.</p> <p>Updated “Technical support” on page 20:</p> <p>Updated description.</p> <p>Removed “PSoC™ Creator” chapter.</p> <p>Removed “WICED” chapter.</p> <p>Updated Kit operation chapter on page 22:</p> <p>Replaced “Kit Hardware” with “Kit operation” in heading.</p> <p>Added description.</p> <p>Updated “Theory of operation” on page 22:</p> <p>Replaced “CY8CKIT-062-WiFi-BT Details” with “Theory of operation” in heading.</p> <p>Updated description.</p> <p>Updated Figure 2-2.</p> <p>Updated Figure 2-3.</p> <p>Updated Figure 2-4.</p> <p>Updated Table 2-1.</p> <p>Removed table “Selection Switches on the Pioneer Board”.</p> <p>Removed figure “Pioneer Board Pinout”.</p> <p>Removed table “Pioneer Board Pinout”.</p> <p>Removed table “TFT Shield Pinout”.</p> <p>Updated “CY8CKIT-028-TFT details” on page 27:</p> <p>Updated “CY8CKIT-028-TFT display shield” on page 27:</p> <p>Updated description.</p> <p>Removed “KitProg2”.</p> <p>Added “KitProg3: On-board programmer/debugger” on page 30.</p> <p>Removed “EZ-PD™ CCG3 Type-C Power Delivery”.</p>

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*I (cont.)	7747938	04/27/2022	<p>Updated Hardware chapter on page 36:</p> <p>Replaced “Appendix” with “Hardware” in heading.</p> <p>Updated “Schematics” on page 36:</p> <p>Updated description.</p> <p>Updated “Hardware functional description” on page 36:</p> <p>Updated description.</p> <p>Updated “PSoC™ 6 MCU (U1)” on page 36:</p> <p>Updated description.</p> <p>Updated hyperlinks.</p> <p>Updated “PSoC™ 5LP (U2)” on page 36:</p> <p>Updated description.</p> <p>Updated “Serial interconnection between PSoC™ 5LP and PSoC™ 6 MCU” on page 37:</p> <p>Updated description.</p> <p>Updated Figure 3-1.</p> <p>Removed “EZ-PD CCG3 power delivery system”.</p> <p>Updated “Power supply system” on page 38:</p> <p>Updated description.</p> <p>Updated Table 3-1.</p> <p>Updated Figure 3-2.</p> <p>Updated “Expansion connectors” on page 41:</p> <p>Updated “Headers compatible with Arduino (J1, J2, J3, J4, and J5)” on page 41:</p> <p>Updated description.</p> <p>Updated “PSoC™ 6 MCU I/O headers (J18, J19, and J20)” on page 41:</p> <p>Updated description.</p> <p>Updated “PSoC™ 5LP MCU GPIO header (J6)” on page 41:</p> <p>Updated description.</p> <p>Updated “KitProg3 programming/GPIO header (J7)” on page 41:</p> <p>Replaced “custom application header” with “programming/GPIO header” in heading.</p> <p>Updated description.</p> <p>Updated hyperlinks.</p> <p>Updated “CAPSENSE™ circuit” on page 42:</p> <p>Updated Figure 3-3.</p> <p>Updated “LEDs” on page 42:</p> <p>Updated description.</p> <p>Updated hyperlinks.</p> <p>Updated “Push buttons” on page 43:</p> <p>Updated description.</p> <p>Updated Figure 3-4.</p>

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*I (cont.)	7747938	04/27/2022	<p>Updated “NOR flash” on page 43:</p> <p>Replaced “Cypress NOR Flash” with “NOR Flash” in heading.</p> <p>Updated description.</p> <p>Updated Figure 3-5.</p> <p>Updated “Quad SPI F-RAM” on page 44:</p> <p>Replaced “Cypress Quad SPI F-RAM” with “Quad SPI F-RAM” in heading.</p> <p>Updated Figure 3-6.</p> <p>Updated “Wi-Fi and Bluetooth® module” on page 45:</p> <p>Updated description.</p> <p>Updated Figure 3-7.</p> <p>Updated “USB host and USB device connections” on page 46:</p> <p>Updated Figure 3-8.</p> <p>Updated “PSoC™ 6 Wi-Fi Bluetooth® pioneer board reworks” on page 47:</p> <p>Updated “Bypass protection circuit on program and debug header (J11)” on page 47:</p> <p>Updated description.</p> <p>Updated Figure 3-9.</p> <p>Updated “PSoC™ 6 MCU user button (SW2)” on page 48:</p> <p>Updated Figure 3-10.</p> <p>Updated “SWD connector receptacle (J29)” on page 48:</p> <p>Updated Figure 3-11.</p> <p>Updated “CAPSENSE™ shield” on page 49:</p> <p>Updated description.</p> <p>Updated “CSH” on page 49:</p> <p>Updated Figure 3-12.</p> <p>Removed “Li-Po battery charger”.</p> <p>Updated “Bill of materials” on page 50:</p> <p>Updated description.</p> <p>Removed “WICED Configuration”.</p> <p>Updated “Frequently asked questions” on page 50:</p> <p>Updated description.</p> <p>Updated Table 3-2.</p> <p>Updated hyperlinks.</p> <p>Updated to new template.</p>