# WirelessUSB™ PRoC™ Flash Programmable MCU + Radio

## Features

- **Microcontroller with Mixed Signal Array**
  - Cypress M8C CPU
  - CPU clock up to 12 MHz
  - Internal oscillator—no crystal required
  - 8-KB Flash Program Memory with EEPROM emulation
  - 512 Bytes SRAM Data Storage
  - 4 Analog Blocks Provide:
    - 2 Comparators with DAC Refs
    - Two 8-bit 28-Channel ADCs
  - 4 Digital Blocks Provide:
    - 8- to 32-bit Timers, Counters, and PWMs
    - CRC and PRS modules
    - Full-Duplex UART, SPI Master or Slave
    - Connectable to all GPIO pins
- **2.4-GHz DSSS radio transceiver**
  - Operates in the unlicensed Industrial, Scientific and Medical (ISM) band (2.4 GHz –2.483 GHz).
  - –95 dBm receive sensitivity
  - Up to 0 dBm output power
  - Range of up to 50 meters or more
  - Data throughput of up to 62.5 kbits/sec
  - Highly integrated low cost, minimal number of external components required
  - DSSS baseband controller
  - 13-MHz crystal clock
  - Integrated 30-bit Manufacturing ID
- **Operating voltage from 2.7V to 3.6V**
- **Operating temperature from 0° to 70°C**
- **Offered in a small footprint 48 QFN**

## Applications

- **Consumer/PC**
  - Locator Alarms
  - Presenter Tools
  - Remote Controls
  - Toys
  - White Goods
- **Building/Home Automation**
  - Climate Control
  - Lighting Control
  - Smart Appliances
  - On-site Paging Systems
  - Alarm and Security
- **Industrial Control**
  - Inventory Management
  - Factory Automation
  - Data Acquisition
  - Automatic Meter Reading (AMR)
- **Transportation**
  - Diagnostics
  - Remote Keyless Entry
- **Medical**

## Functional Description

The CYWUSB6953 WirelessUSB™ PRoC™ (Programmable Radio System-on-Chip) device is the world's first low-cost Flash programmable microcontroller with an integrated 2.4-GHz radio transceiver.
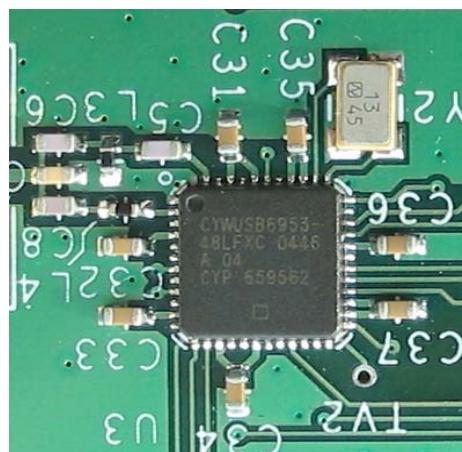


**Figure 1. Typical Implementation**

## PRoC Block Diagram
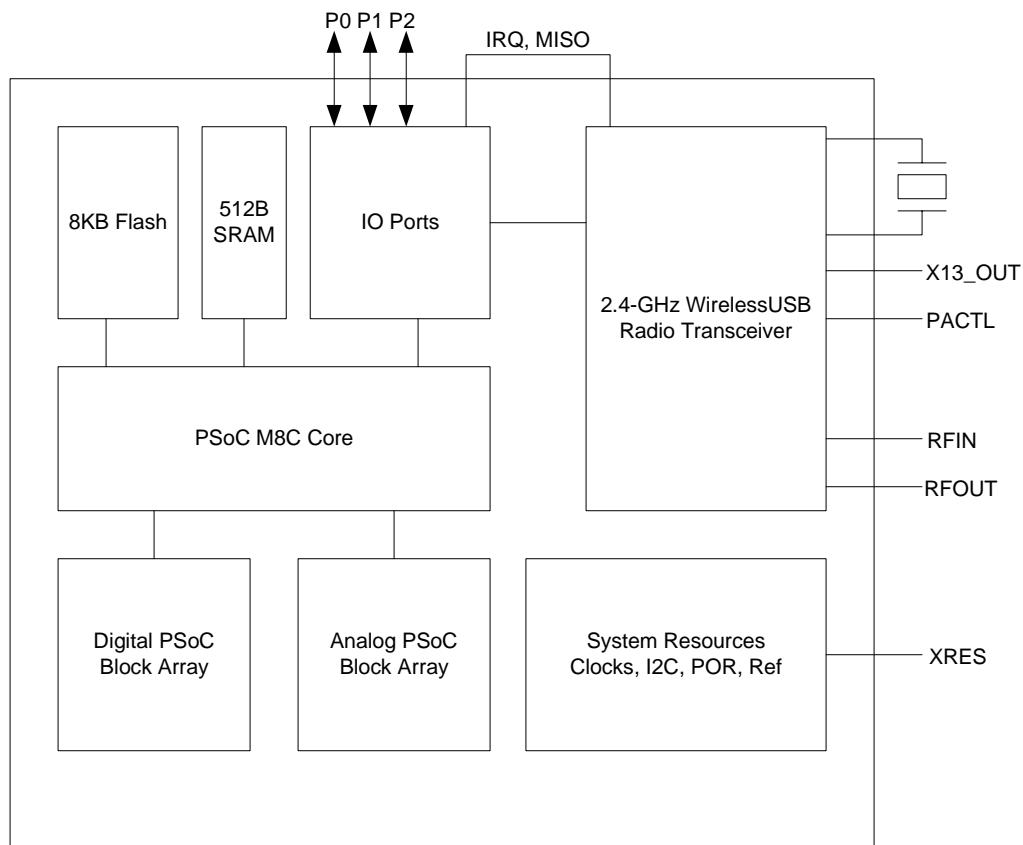


**Figure 2. PROC Block Diagram**

## Functional Overview

The CYWUSB6953 is a complete Radio System-on-Chip device, enabling many simple RF systems to be implemented with a single device and a handful of discrete components. The CYWUSB6953 is designed to implement low cost wireless systems operating in the worldwide 2.4-GHz Industrial, Scientific, and Medical (ISM) frequency band (2.400 GHz–2.4835 GHz).

The radio meets the following world-wide regulatory requirements:

- **Europe**
  - ETSI EN 301 489-1 V1.4.1
  - ETSI EN 300 328-1 V1.3.1
- **North America**
  - FCC CFR 47 Part 15
- **Japan**
  - ARIB STD-T66

The microcontroller is a powerful mixed-signal array. It has highly reconfigurable and flexible digital and analog blocks. The microcontroller core is the M8C 8-bit engine that supports a rich instruction set. It contains 512 Bytes of data SRAM and 8 Kbytes code Flash memory. Full data on the microcontroller can be found in the CY8C21534 datasheet and the PSoC™ Technical Reference Manual

The radio is a high-performance 2.4-GHz transceiver with a fully integrated DSSS baseband. The radio and baseband are both code and frequency agile. Protocols supporting frequency agile direct-spread interference avoidance algorithms such as WirelessUSB are fully compatible with this radio. Full data on the radio can be found in the CYWUSB6935 data sheet.

## Radio Data Rate Considerations

The PSoC Designer tool provides a software-based SPI User Module for control of the radio portion of the PRoC. Therefore, there is a direct relationship between CPU clock speed and supportable radio data rate. For operation of CPU clock rates less than 12 MHz, radio data rate must be set to 16 Kbps. Also note that for operation at $V_{CC} < 3.0V$, the CPU clock rate must be set to 3 MHz per the CY8C21534 data sheet. Therefore, at operation below 3V, the radio data rate must be set to 16 Kbps.

## Pin Descriptions

| Pin QFN | Name | Type | Die | Description |
|---------|------|------|-----|-------------|
| **Analog RF** | | | | |
| 47 | RFIN | | Radio | Modulated RF signal received. |
| 2 | RFOUT | | Radio | Modulated RF signal to be transmitted |
| **Crystal / PA Control** | | | | |
| 38 | X13 | I | Radio | Crystal Input |
| 37 | X13IN | I | Radio | Crystal Input |
| 24 | X13OUT | O | Radio | Reference Clock Output |
| 35 | PACTL | IO | Radio | External Power Amplifier control. Pull-down or make output |
| **Reserved** | | | | |
| 23, 25 | MISO | IO | Radio, MCU | Radio SPI Master In, Slave Out. Connect pins 23 and 25 on the application board |
| 17, 21 | IRQ | IO | Radio, MCU | Radio Interrupt. Connect pins 17 and 21 on the application board |
| **Microcontroller Digital/Analog** | | | | |
| 13 | P0[0] | IO/M | MCU | Analog Column Mux Input |
| 14 | P0[2] | IO/M | MCU | Analog Column Mux Input |
| 41 | P1[0] | IO/M | MCU | I2C Serial Data (SDA) |
| 36 | P1[1] | IO/M | MCU | I2C Serial Clock (SCL) |
| 42 | P1[2] | IO/M | MCU | |
| 44 | P1[4] | IO/M | MCU | Optional External Clock Input (EXT-CLK) |
| 34 | P1[5] | IO/M | MCU | I2C Serial Data (SDA) |
| 6 | P1[6] | IO/M | MCU | |
| 33 | P1[7] | IO/M | MCU | I2C Serial Clock (SCL) |
| 8 | P2[0] | IO/M | MCU | Direct switched capacitor block input |
| 31 | P2[1] | IO/M | MCU | Direct switched capacitor block input |
| 9 | P2[2] | IO/M | MCU | Direct switched capacitor block input |
| 30 | P2[3] | IO/M | MCU | Direct switched capacitor block input |
| 10 | P2[4] | IO/M | MCU | |
| 29 | P2[5] | IO/M | MCU | |
| 12 | P2[6] | IO/M | MCU | |
| 28 | P2[7] | IO/M | MCU | |
| 7 | XRES | I | MCU | Active HIGH external reset with internal pull-down |
| **Power and Ground** | | | | |
| 4, 11, 15, 18, 26, 27, 32, 39, 40, 43, 45 | $V_{CC}$ | | | Supply Voltage |
| 1, 3, 5, 46, 48 | GND | | | Ground Connection |
| PADDLE | GND | | | Ground Connection |
| 19, 20 | RSVD | | | Connect to Ground |
| 16, 22, | NC | | | No Connect |
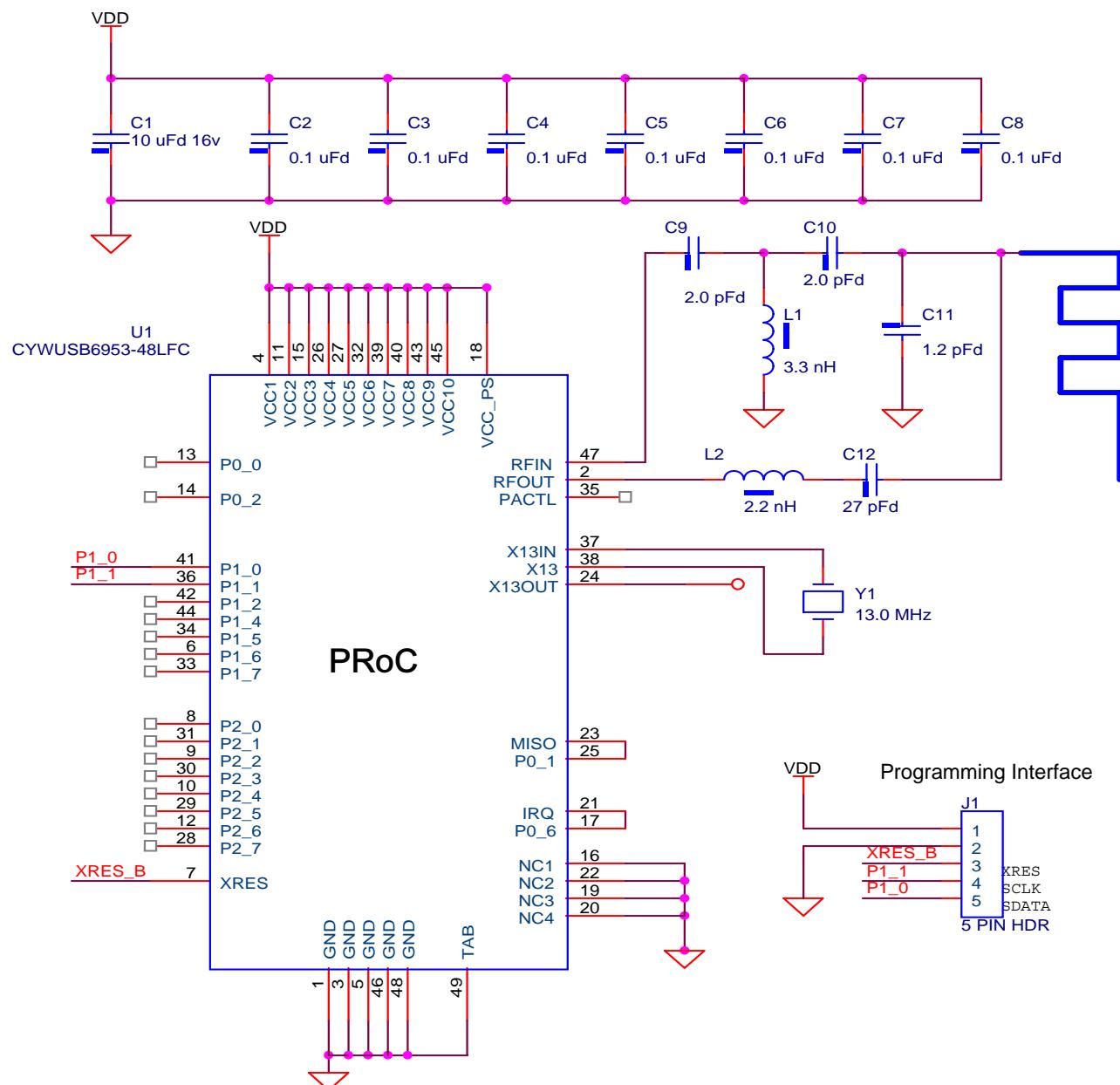
## PRoC Absolute Maximum Ratings

| Parameter | Description | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| | Storage Temperature | −55 | | 100 | °C |
| | Ambient Temperature with power applied | 0 | | 70 | °C |
| | Supply Voltage on $V_{CC}$ relative to VSS | −0.3 | | 3.9 | V |
| | DC Voltage to logic inputs | −0.3 | | $V_{CC}$ + 0.3 | V |
| | DC Voltage applied to outputs in High-Z State | −0.3 | | $V_{CC}$ + 0.3 | V |
| | Maximum current into any port pin | −25 | | 50 | mA |
| | Static Discharge Voltage (RF) | | | 500 | V |
| | Static Discharge Voltage (Other) | | | 1600 | V |
| | Latch-up current | | | 200 | mA |

## PRoC Operating Conditions

| Parameter | Description | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 2.7 | 3 | 3.6 | V |
| TA | Ambient temperature | 0 | 25 | 70 | °C |

## PRoC DC Electrical Characteristics

| Parameter | Description | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 2.7 | 3 | 3.6 | V |
| $I_{CC}$ | Supply Current (Radio in Power Down) | | 1.7 | 2 | mA |
| RX $I_{CC}$ | Supply Current Radio Receive | | 61.3 | | mA |
| TX $I_{CC}$ | Supply Current Radio Transmit | | 74.7 | | mA |
| SYNTH SETTLE $I_{CC}$ | Current Consumption with Synthesizer on, No Transmit or Receive | | 33.0 | | mA |
| IDLE $I_{CC}$ | Supply Current Radio Idle | | 5 | | mA |
| $I_{SLEEP}$ | Sleep Mode Supply Current | | 3 | 20 | uA |

## Ordering Information

| Part Number | Radio | Package Name | Package Type | Operating Range |
|---|---|---|---|---|
| CYWUSB6953-48LFC | Transceiver | 48 QFN | 48 Quad Flat Package | Commercial |

## Package Diagram

### 48-Lead QFN 7 × 7 mm LF48A



TOP VIEW
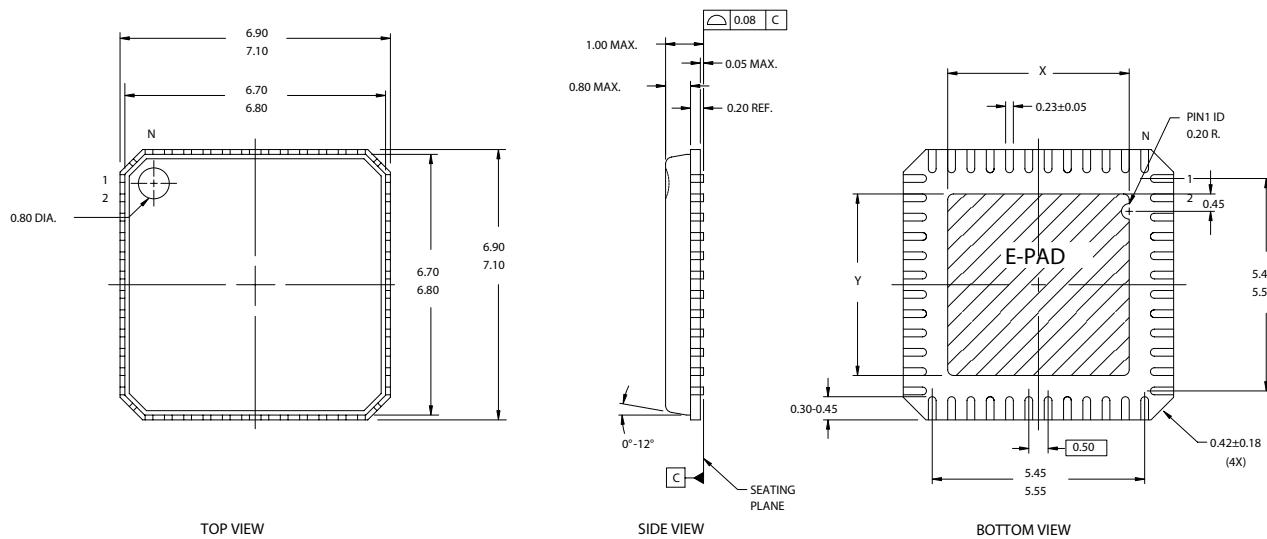
DIMENSIONS IN mm MIN.
MAX.

REFERENCE JEDEC MO-220

PKG. WEIGHT 0.13 gms

SIDE VIEW

BOTTOM VIEW

| E-PAD SIZE (X, Y MAX.) | PADDLE SIZE |
|---|---|
| 5.1 X 5.1 | 5.3 X 5.3 |
| 3.8 X 3.8 | 4.0 X 4.0 |

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## Document History Page

**Document Title: CYWUSB6953 WirelessUSB™ PRoC™ Flash Programmable MCU + Radio**
**Document Number: 38-16017**

| REV. | ECN No. | Issue Date | Orig. of Change | Description of Change |
|---|---|---|---|---|
| ** | 329973 | See ECN | BON | New data sheet |
| *A | 337935 | See ECN | BON | In the Feature Section, changed "90 dBm receive sensitivity" to "– 90 dBm receive sensitivity", and "13 MHz crystal clock" to "13 MHz crystal clock". In the Functional Overview, changed "CYWUSB6934" to "CYWUSB6935". In the Application Example, changed "ISSP" to "Programming Interface" |
| *B | 380254 | See ECN | BON | Updated the PRoC DC Electrical Characteristics. Changed "– 90 dBm receive sensitivity" to "– 95 dBm receive sensitivity" in the Feature section. Removed lead-free part offering. Changed supported CPU clock from 24 MHz to 12 MHz |
| *C | 392781 | See ECN | BON | Added the Radio Data Rate Considerations section |