# WirelessUSB™ PRoC™ Flash Programmable MCU + Radio

## Features

- Microcontroller with Programmable System-on-Chip (PSoC®)
  - 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
  - Four analog blocks provide:
    - Two comparators with DAC Refs
    - Two ADCs with 10-bit resolution
  - Four digital blocks provide:
    - 8- to 32-bit timers, counters, and pulse-width modulators (PWMs
    - Cyclical redundancy check (CRC) and pseudo random sequence (PRS) modules
    - Full-duplex UART, SPI master or slave
    - Connectable to all GPIO pins
  - 18 GPIO lines which are individually configurable. P0 [1:0], P1[7:0], P2[7:0]

- 2.4-GHz direct-sequence spread spectrum (DSSS) radio transceiver
  - Operates in the unlicensed Industrial, Scientific and Medical band (ISM) band (2.4 GHz to 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 2.7 V to 3.6 V

- Operating temperature from 0 °C to 70 °C

- Offered in a small footprint 48-pin QFN
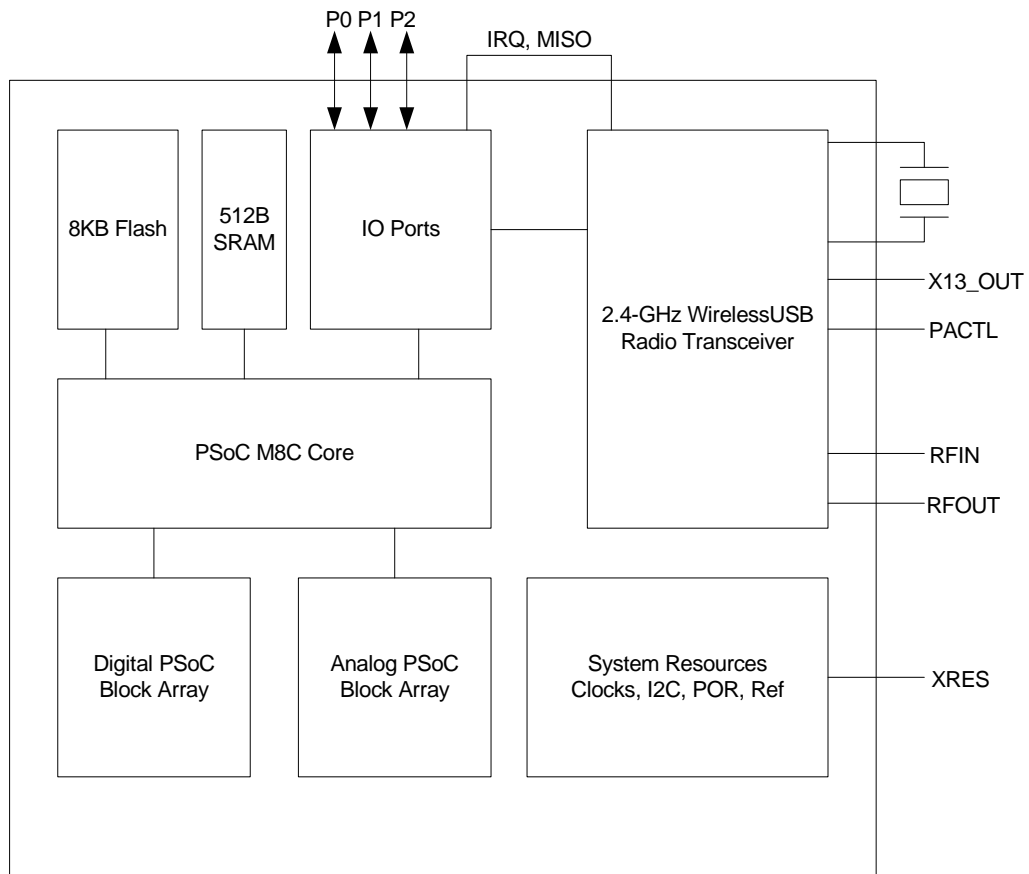
## Applications

- Consumer and PC
  - Locator alarms
  - Presenter tools
  - Remote controls
  - Toys
  - White goods

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

## PRoC Block Diagram

# Contents

## 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 ISM frequency band (2.400 GHz to 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 programmable system-on-chip. 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 datasheet.

## 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 $V_{CC} < 3.0$ V, the CPU clock rate must be set to 3 MHz per the CY8C21534 datasheet. Therefore, at operation below 3 V, 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 and 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 and 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 | I$^2$C serial data (SDA) |
| 36 | P1[1] | IO/M | MCU | I$^2$C 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 | I$^2$C SDA |
| 6 | P1[6] | IO/M | MCU | |
| 33 | P1[7] | IO/M | MCU | I$^2$C 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 |

## Application Example
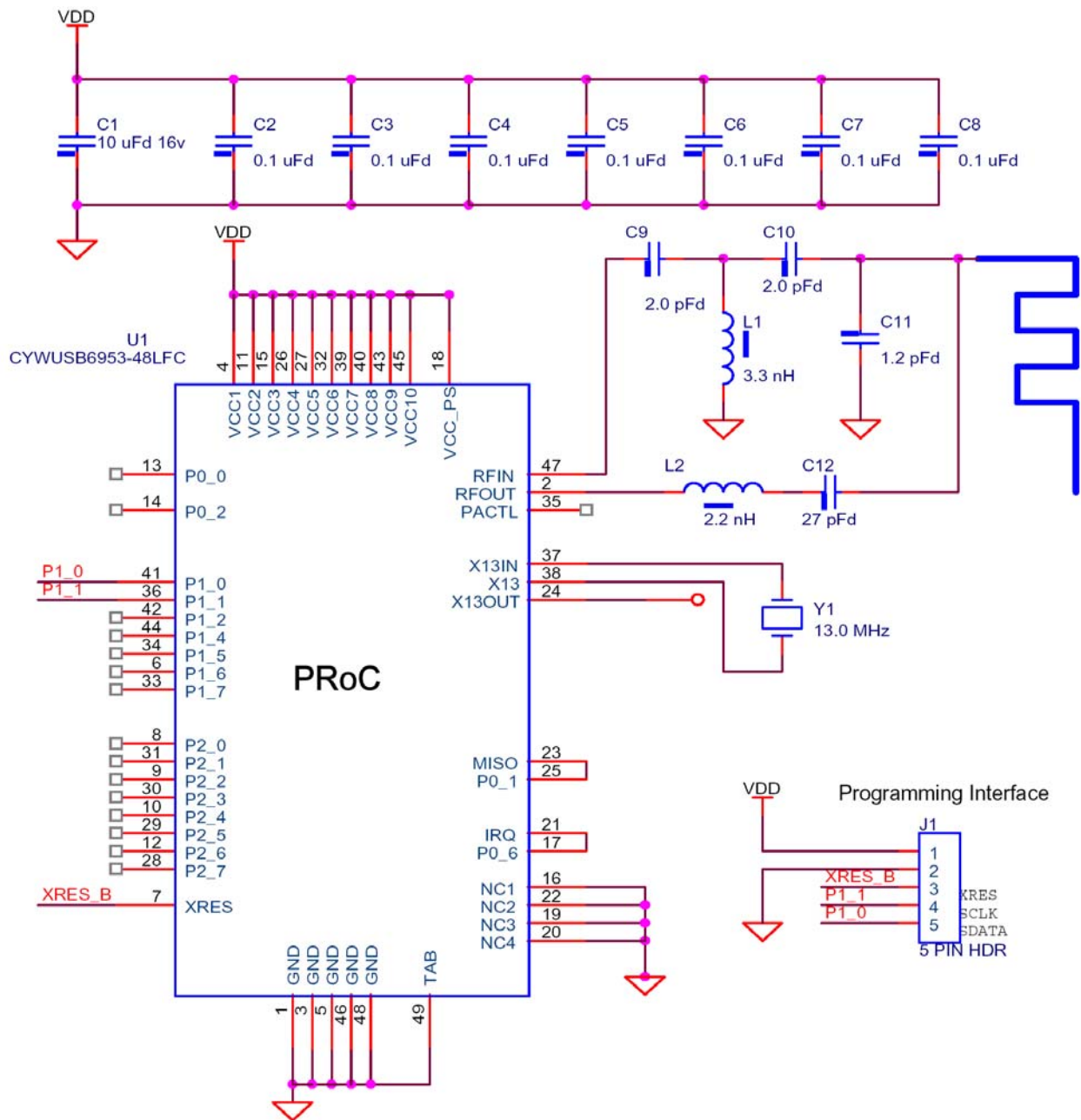
## PRoC Absolute Maximum Ratings

| Parameter | Description | Min | Typ | Max | Unit |
|-----------|-------------|-----|-----|-----|------|
| $T_{STG}$ | Storage temperature | −55 | – | 100 | °C |
| $T_A$ | Ambient temperature with power applied | 0 | – | 70 | °C |
| $V_{dd}$ | Supply voltage on $V_{CC}$ Relative to GND | −0.3 | – | 3.9 | V |
| $V_{IO}$ | DC voltage to logic inputs | −0.3 | – | $V_{CC} + 0.3$ | V |
| $V_{IOZ}$ | DC voltage applied to outputs in High-Z State | −0.3 | – | $V_{CC} + 0.3$ | V |
| $I_{MIO}$ | Maximum current into any port pin | −25 | – | 50 | mA |
| ESD | Electrostatic discharge voltage (Other) | – | – | 1600 | V |
| $I_{LU}$ | 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 | μA |

## Ordering Information

| Part Number | Radio | Package Name | Package Type | Operating Range |
|---|---|---|---|---|
| CYWUSB6953-48LFXC | Transceiver | 48-pin QFN | Pb-free 48 QFN package (Punch Type) | Commercial |
| CYWUSB6953-48LTXC | Transceiver | 48-pin QFN | Pb-free 48 QFN package (Sawn Type) | Commercial |

### Ordering Code Definition

CY  WUSB  6953  48-LFX/LTX  C
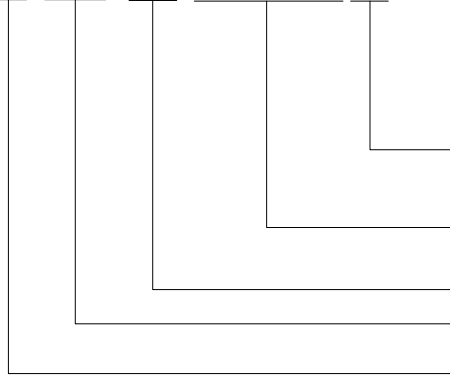
Temperature range: Commercial

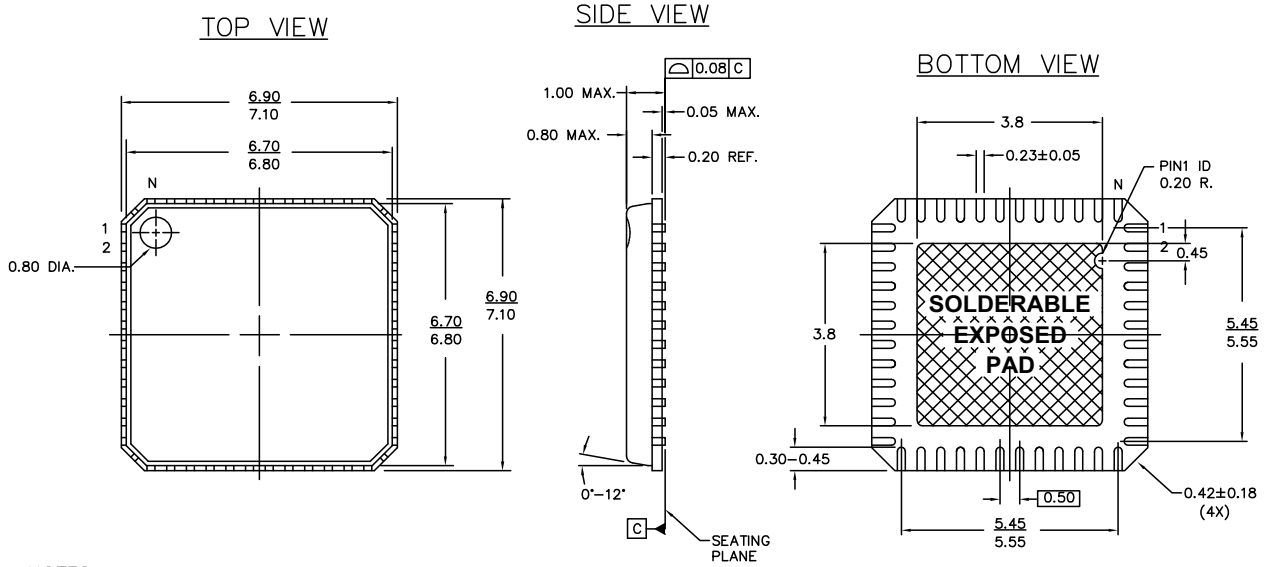Pb-free 48 QFN package (Punch Type)
Pb-free 48 QFN package (Sawn Type)
X = Pb-free

Part Number

Marketing Code: Wireless USB  family

Company ID: CY = Cypress

## Package Diagrams

Figure 1. 48-Pin QFN 7x7 mm LF48A (Punch)



NOTES:

1. ▨ HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.13g
4. ALL DIMENSIONS ARE IN MM [MIN/MAX]
5. PACKAGE CODE

| PART # | DESCRIPTION |
|--------|-------------|
| LF48 | STANDARD |
| LY48 | LEAD FREE |

51-85152 *E

**Figure 2.  48-pin QFN 7x7 mm LT48E (Sawn)**

TOP VIEW                    SIDE VIEW              BOTTOM VIEW
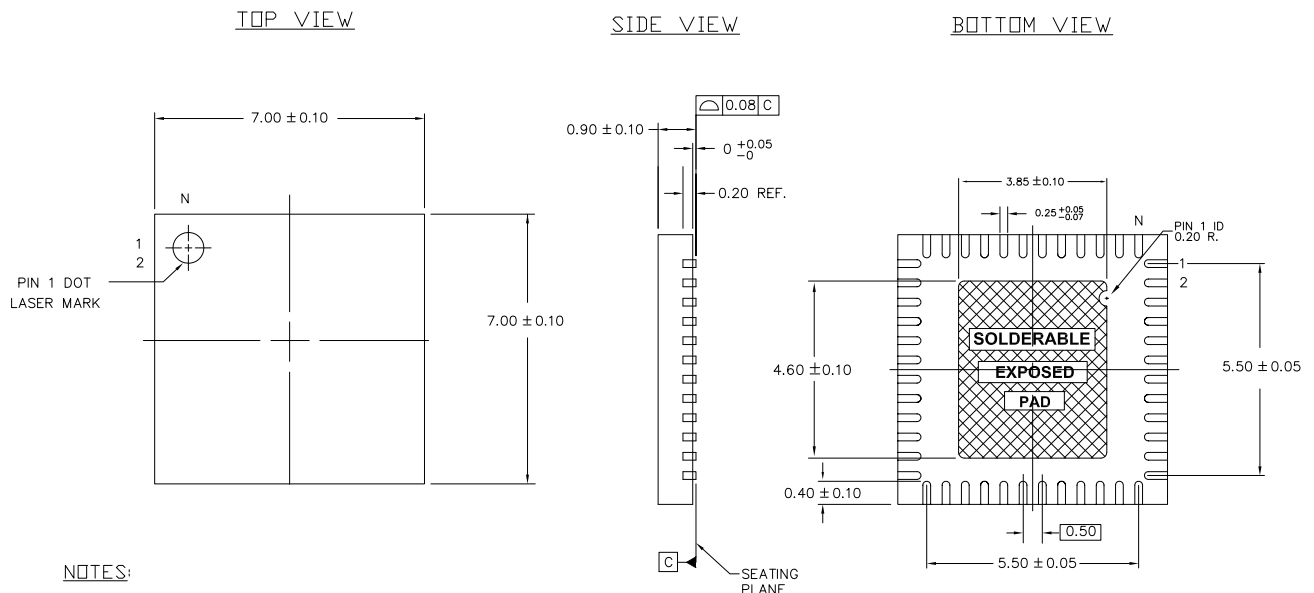


NOTES:

1. ⊠ HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO-220
3. PACKAGE WEIGHT: 0.14g
4. ALL DIMENSIONS ARE IN MM [MIN/MAX]

001-57024 *A

## Acronyms

**Table 1. Acronyms Used in this Document**

| Acronym | Description |
|---|---|
| ADC | analog-to-digital converter |
| AMR | Automatic meter reading |
| CRC | cyclic redundancy check |
| DAC | digital-to-analog converter |
| DSSS | direct-sequence spread spectrum |
| EEPROM | electrically erasable programmable read-only memory |
| GPIO | general purpose I/O |
| ISM | industrial, scientific, and medical band |
| PRoC™ | Programmable Radio System-on-Chip |
| PRS | pseudo random sequence |
| PSoC® | Programmable System-on-Chip |
| PWM | pulse-width modulator |
| QFN | quad flat no leads |
| SPI | serial peripheral interface |
| SRAM | static random-access memory |
| UART | universal asynchronous receiver/transmitter |
| USB | universal serial bus |

## Document Conventions

### Units of Measure

**Table 2. Units of Measure**

| Symbol | Unit of Measure |
|---|---|
| °C | degrees Celsius |
| dB | decibels |
| GHz | gigahertz |
| Kbps | kilobits per second |
| μA | microamperes |
| mA | milliamperes |
| MHz | megahertz |
| V | volts |

## Document History Page

| | | | | |
|---|---|---|---|---|
| **Document Title: CYWUSB6953 WirelessUSB™ PRoC™ Flash Programmable MCU + Radio**<br>**Document Number: 38-16017** | | | | |
| **Rev.** | **ECN No.** | **Orig. of Change** | **Submission Date** | **Description of Change** |
| ** | 329973 | BON | See ECN | New data sheet |
| *A | 337935 | BON | See ECN | In the Feature Section, changed "90 dBm receive sensitivity" to "– 90 dBm receive sensitivity", and "13 MHz crystal clock" to "13 MHz crystal clock"<br>In the Functional Overview, changed "CYWUSB6934" to "CYWUSB6935"<br>In the Application Example, changed "ISSP" to "Programming Interface" |
| *B | 380254 | BON | See ECN | 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 | BON | See ECN | Added the Radio Data Rate Considerations section |
| *D | 495870 | OYR | See ECN | Took off the photograph of the chip from the first page<br>Added Pb-free part numbers<br>Took off parts with lead<br>Quad flat package to QFN<br>Named Variables in Table |
| *E | 2620679 | CMCC/<br>PYRS | 12/12/08 | Added Package Handling information |
| *F | 3048368 | HEMP | 10/05/2010 | Sunset review; no technical updates.<br>Format updates per template.<br>Updated package diagram. |
| *G | 3322999 | ODC | 08/05/2011 | Updated Package Diagrams, Ordering Information, and Ordering Code Definition.<br>Added Acronyms and Document Conventions.<br>Added Table of Contents. |

# Sales, Solutions, and Legal Information

## Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at Cypress Locations.

| **Products** | | **PSoC Solutions** |
|---|---|---|
| Automotive | cypress.com/go/automotive | psoc.cypress.com/solutions |
| Clocks & Buffers | cypress.com/go/clocks | PSoC 1 \| PSoC 3 \| PSoC 5 |
| Interface | cypress.com/go/interface | |
| Lighting & Power Control | cypress.com/go/powerpsoc | |
| | cypress.com/go/plc | |
| Memory | cypress.com/go/memory | |
| Optical & Image Sensing | cypress.com/go/image | |
| PSoC | cypress.com/go/psoc | |
| Touch Sensing | cypress.com/go/touch | |
| USB Controllers | cypress.com/go/USB | |
| Wireless/RF | cypress.com/go/wireless | |