



PIC32CX-BZ2 and WBZ45 Family

PIC32CX-BZ2 and WBZ45 Family Product Brief

Introduction

The PIC32CX-BZ2 family is a general purpose, low-cost, 32-bit Microcontroller (MCU) family of devices supporting multi-protocol wireless interfaces (Bluetooth® and Zigbee®), hardware-based security accelerator, transceiver and Power Management Unit (PMU).

The WBZ45 Module is a series of fully RF-certified wireless modules that contain the PIC32CX-BZ2 wireless MCUs with the following antenna options:

- PCB Antenna
- u.FL Connector for External Antenna

In addition to the Bluetooth Low Energy (Bluetooth 5.2) and Zigbee (Zigbee 3.0) wireless protocol support, the PIC32CX-BZ2 devices and the WBZ45 modules also support a rich set of standard MCU peripherals, such as Analog-to-Digital Converter (ADC), Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I²C), Quad I/O Serial Peripheral Interface (QSPI), Universal Asynchronous Receiver-Transmitter (UART) and Serial Wire Debug (SWD).

PIC32CX-BZ2 SoC Family Features

The following section lists the PIC32CX-BZ2 SoC related features:

Operating Conditions of MCUs

- 1.9V to 3.6V, -40°C to +125°C, DC to 64 MHz
 - AEC Q100 Grade 1 qualified

Core: 64 MHz ARM® Cortex® -M4

- 3.35 Coremark®/MHz
- 4 KB Combined Instruction Cache and Data Cache
- 8-Zone Memory Protection Unit (MPU)
- Thumb®-2 Instruction Set
- Digital Signal Processing ASE Rev 2
- Nested Vector Interrupt Controller (NVIC)
- Embedded Trace Module (ETM) with Instruction Trace Stream
- Core Sight Embedded Trace Buffer (ETB)
- Trace Port Interface Unit (TPIU)
- IEEE® 754-Compliant Floating Point Unit (FPU)

Memories

- 1 MB On-Chip Self-Programmable Flash with:
 - Error Correction Code (ECC)
 - Prefetch module to speed up Flash accesses

- 20-years of data retention support
- 32 KB NVR Flash (8 Sectors)
 - Private/public boot code and data
 - NV calibration data
- 128 KB Multi-Port Programmable QoS SRAM Main Memory
 - 64 KB of Error Correction Code (ECC) RAM option
- Up to 4 KB of Tightly Coupled Memory (TCM)
- Up to 8 KB Backup SRAM
- Single 32-bit Backup Register

System

- Power-on Reset (POR) and Brown-out Detect (BOD)
- Internal and External Clock Options
- External Interrupt Controller (EIC)
- Up to four External Interrupts
- One Non-maskable Interrupt
- 2-pin Serial Wire Debug (SWD) Programming, Test and Debugging Interface

Supported Connectivity Standards

- Complies with:
 - Bluetooth v5.2
 - IEEE 802.15.4, Zigbee 3.0
 - ETSI EN 300 328 and EN 300 440 Class 2
 - FCC CFR47 Part 15 and ARIB STD-T66

Power Supply

- Integrated PMU with:
 - Buck (DC-DC/switching) mode; supports High Power (PWM) and Low Power (PSK) mode
 - MLDO (linear) mode
- On-board 1.2V Voltage Regulator (CLDO)
- Power-on Reset (POR) and Brown-out Detect (BOD) on 3.3V and 1.2V Rails
- Run, Idle, Dream, Sleep, Deep Sleep and Extreme Deep Sleep Modes
- Sleep Walking Peripherals
- Embedded Buck/LDO Regulator Supporting On-the-Fly (OTF) Selection

2.4 GHz RF Transceiver

- Integrated 2.4 GHz Ultra-low Power RF Transceiver shared among Bluetooth, Zigbee Modems, Link (MAC) Controllers and Proprietary Modulation Schemes
- Integrated 16 MHz ± 20 ppm Crystal Oscillator (External Low Cost Crystal)
- Two PA Design Architecture (LPA (+4 dBm) and MPA (+12 dBm)) to Improve TX Power Efficiency
- Low RBOM Two-port TRX RFFE Architecture
 - Integrated balun (single-ended RF output) and TRX switch
- Hardware Radio Arbiter with Programmable QoS:
 - Resolution per packet level
 - Time-division coexistence between Bluetooth and 802.15.4

- Based on shared transceiver and antenna
- Maintains connections of 802.15.4 and Bluetooth simultaneously

Bluetooth

- Bluetooth Low Energy 5.2 Certified
- Up to +12 dBm Programmable Transmit Output Power
- Typical Receiver Power Sensitivity:
 - -95 dBm for Bluetooth Low Energy 1 Mbps
 - -92 dBm for Bluetooth Low Energy 2 Mbps
 - -102 dBm for Bluetooth Low Energy 125 Kbps
 - -99 dBm for Bluetooth Low Energy 500 Kbps
 - Digital RSSI indicator (-50 dBm to -90 dBm)
- Bluetooth Supported Features:
 - 2M uncoded PHY
 - Long range (Coded PHY)
 - Channel selection algorithm #2
 - Advertising extensions, offloads CPU with hardware-based scheduler
 - High duty cycle non-connectible advertising
 - Data length extensions
 - Secure connections
 - Privacy upgrades (with hardware white-list support)
- ECDH P256 Hardware Engine for Link Key Generation when Bluetooth Pairing
- AES128 Hardware Module for Real-Time Bluetooth Payload Data Encryption
- Preprogrammed MAC Address
- Bluetooth Qualification Test Facility (BQTF) Certification
- Bluetooth Low Energy Profiles:
 - Bluetooth Low Energy peripheral and central roles
 - Bluetooth Low Energy APIs for application layer to implement standard or customize GATT based profiles/ services
 - Microchip Transparent UART Service
 - Battery Service
 - Device Information Service
 - Custom Service
 - Multi-link and multi-role
- Bluetooth Low Energy Services:
 - Provisioning
 - Over-the-Air (OTA) update (also known as DFU)
 - Advertisement/Beacon
 - Personalized configuration
 - Alert notification service

802.15.4/Zigbee Modulation Scheme

- 802.15.4/Zigbee Physical Layer Service Unit (PSDU) Data Rate: 250 Kbps
- Programmable RX Mode
 - -103 dBm RX sensitivity in the Continuous mode
 - -98 dBm sensitivity in RPC mode
 - RPC mode provides lower power consumption in RX mode to support California Green Energy Specification at the system level

- TX Output Power up to +12 dBm
- Hardware Assisted MAC
 - Auto acknowledge
 - Auto retry
 - Channel access back-off
- Preprogrammed MAC Address
- SFD Detection; Spreading; De-spreading; Framing; CRC-16 Computation
- Independent TX/RX Buffers for Improved CPU Offloading While Handling Zigbee Data
 - 128-byte TX and 128-byte RX frame buffer
- Hardware Security
 - Advanced Encryption Standard (AES)
 - True Random Number Generator (TRNG)
- Zigbee Stack Support
 - Zigbee 3.0 ready
 - Zigbee Pro 2017
 - Zigbee green power support (proxy, sink and multi-sensor)

Proprietary

- Proprietary Data Rates: 500 Kbps, 1 Mbps and 2 Mbps
- TX Output Power up to +12 dBm
- Receiver Sensitivity up to -96 dBm
- Hardware Assisted MAC
 - Auto acknowledge
 - Auto retry
 - Channel access back-off
- SFD Detection; Spreading; De-spreading; Framing; CRC-16 Computation
- Independent TX/RX Buffers for Improved CPU Offloading While Handling Zigbee Data
 - 128-byte TX and 128-byte RX frame buffer
- Hardware Security
 - Advanced Encryption Standard (AES)
 - True Random Number Generator (TRNG)

High Performance Peripherals

- 16-Channel Direct Memory Access Controller (DMAC)
 - Built-in CRC with memory CRC generation/monitor hardware support
- One Quad I/O Serial Peripheral Interface (QSPI)
 - execute-In-Place (xIP) support
 - Dedicated AHB memory zone

System Peripherals

- 32-Channel Event System
 - All channels can be connected to any event generator
 - All channels provide a pure asynchronous path
 - Twelve channels support synchronous and re-synchronous
- Four Serial Communication Interfaces (SERCOM), Each Configurable to Operate as:
 - USART with full-duplex and single-wire half-duplex configuration

- ISO7816
- I²C up to 1 MHz (three SERCOMs support I²C)
- LIN Commander/Responder
- RS485
- SPI inter-byte space
- Four 16-bit Timers/Counters (TC), Each Configurable as:
 - 16-bit TC with two compare/capture channels
 - 8-bit TC with two compare/capture channels
 - 32-bit TC with two compare/capture channels
- Two 24-bit Timer/Counters for Control (TCC) with Extended Functions:
 - Up to six compare channels with optional complementary output
 - Generation of synchronized Pulse Width Modulation (PWM) pattern across port pins
 - Deterministic fault protection, fast decay and configurable dead-time between complementary output
 - Dithering that increases resolution with up to 5 bits and reduces quantization error
- One 16-bit Timer/Counters for Control (TCC) with Extended Functions:
 - Up to two compare channels with optional complementary output
- 32-bit Real Time Counter (RTCC) with Clock/Calendar Function
- Up to one Wake-up Pin with Tamper Detection and Debouncing Filter
- Watchdog Timer (WDT) with Window Mode
- Deadman Timer (DMT)
- CRC-32 Generator
- Frequency Meter (FREQM)
- Two Configurable Custom Logic (CCL)
- One Analog Comparator (AC) with Window Compare function
- One Temperature Sensor (Die Temperature)

Advanced Analog

- 12-bit ADC SAR Module (ADC):
 - Up to Eight Analog Channels
 - Up to Two MSPS conversion rate
 - Multiple trigger sources
 - Supports die temperature sensor built into RF-Analog (not an external “ambient” temperature sensor)
 - Two Analog Comparator (AC) with Window Compare Function or single Analog Comparator
 - One dedicated AC and second AC is shared with PMU Controller

Security

- AES Engine with Support for 128/192/256-bit Cryptographic Key
- One AES with 256-bit Key Length and up to 2 MB/s Data Rate
 - Five confidential modes of operation (ECB, CBC, CFB, OFB and CTR)
 - Supports counter with CBC-MAC mode
 - Galois Counter Mode (GCM)
- True Random Number Generator (TRNG)
- Public Key Cryptography Controller (PUKCC) and Associated Classical Public Key Cryptography Library (PUKCL)
 - RSA and DSA algorithm
 - Elliptic Curves Cryptography (ECC), ECC GF (2n) and ECCGF (p)
- Integrity Check Module (ICM) Based on Secure Hash Algorithm (SHA1, SHA224 and SHA256), DMA Assisted

Oscillators

- 16 MHz, ± 20 PPM Crystal/Resonator Oscillator or External Clock (POSC) for 2.4G RF Transceiver
- Shared System PLL with Bluetooth/Zigbee RF Data Converter PLL
- 32.768 kHz Ultra-low Power Internal Oscillator
- Higher Accuracy 32.768 kHz, ± 250 ppm Clock Options
 - POSC derived 32 kHz clock
 - 32.768 kHz crystal/resonator oscillator (SOSC)
 - External 32.768 kHz clock source
- 8 MHz Internal RC Oscillator (FRC)

I/O

- Flexible Peripheral Pin Select (PPS) Support
- High-Current Sink/Source on Most I/O Pins
- Configurable Open-Drain Output on Digital I/O Pins
- Up to 27 Programmable I/O Pins

Package

- PIC32CX1012BZ25048 Package:
 - 48-pin QFN
 - Size – 7 mm x 7 mm x 0.9 mm

WBZ45 Module Features

The following section lists the WBZ45 Module related features, which complement SoC features:

WBZ45 Module Variants

- WBZ451 based on (PIC32CX1012BZ25048 SoC)
 - WBZ451PE (PCB)
 - WBZ451UE (u.FL)

Antenna

- On-Board PCB Antenna
- External Antenna

Clock Management

- Integrated 16 MHz POSC

System Peripheral, Advanced Analog and Security

- All features of SoC are accessible

Package and Operating Conditions

- WBZ451
 - 39-pin SMD package with Shield CAN
 - Size – 15.5 mm x 20.7 mm x 2.8 mm
- Operating Conditions
 - 1.9V to 3.6V, -40°C to +85°C, DC to 64 MHz

Certifications

- Certified to FCC, ISED and CE Radio Regulations
- RoHS and REACH Compliant

Note: Traditional LIN documentation uses the terminology “Master” and “Slave”. The equivalent Microchip terminology used in this document is “Commander” and “Responder”, respectively.

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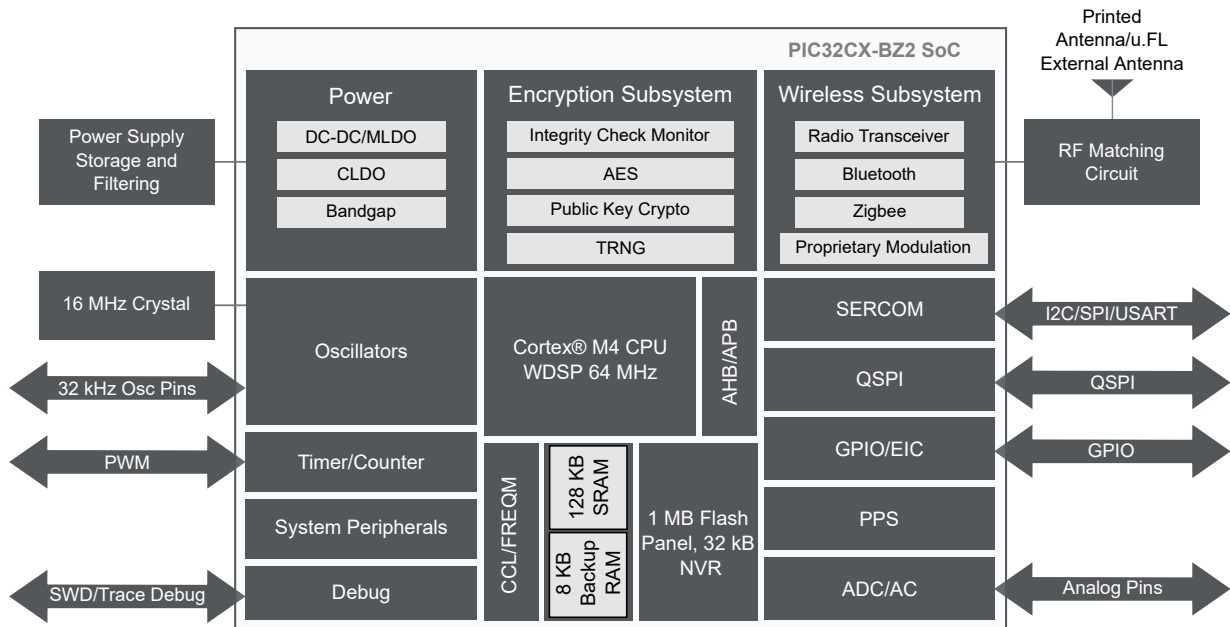
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PIC32CX-BZ2 and WBZ45 Family System Block Diagram

1. System Block Diagram

Figure 1-1. System Block Diagram



Note: Traditional AHB and APB documentation uses the terminology “Master” and “Slave”. The equivalent Microchip terminology used in this document is “Manager” and “Subordinate” respectively.

PIC32CX-BZ2 and WBZ45 Family Configuration Summary

2. Configuration Summary

Table 2-1. PIC32CX-BZ2 and WBZ45 Family Features

Device	Program Memory (KB)	Data Memory (KB)	Pins	Package	Peripherals														Analog		Security			Wireless				
					SERCOM	Timer/Counter (TC)	TCC (24-bit/16-bit)	QSPI	DMA Channels	RTCC	CCL/LUT	WDT	DMT	Frequency Measurement	Event System (Channels)	External Interrupt Lines	GPIO Pins	Analog Comparators (Channels)	ADC (Channels)	Temperature Sensor	AES	TRNG	Public Key Cryptography (PUKCC)	Integrity Check Monitor	Max TX Power (dBm)	Bluetooth 5.2	802.15.4/Zigbee 3.0	
PIC32CX1012BZ25048	1024	128	48	QFN	4	4	2/1	Y	16	Y	1/2	Y	Y	Y	32	4	29	2	8	Y	Y	Y	Y	Y	Y	12	Y	Y
WBZ451			39	LGA																								

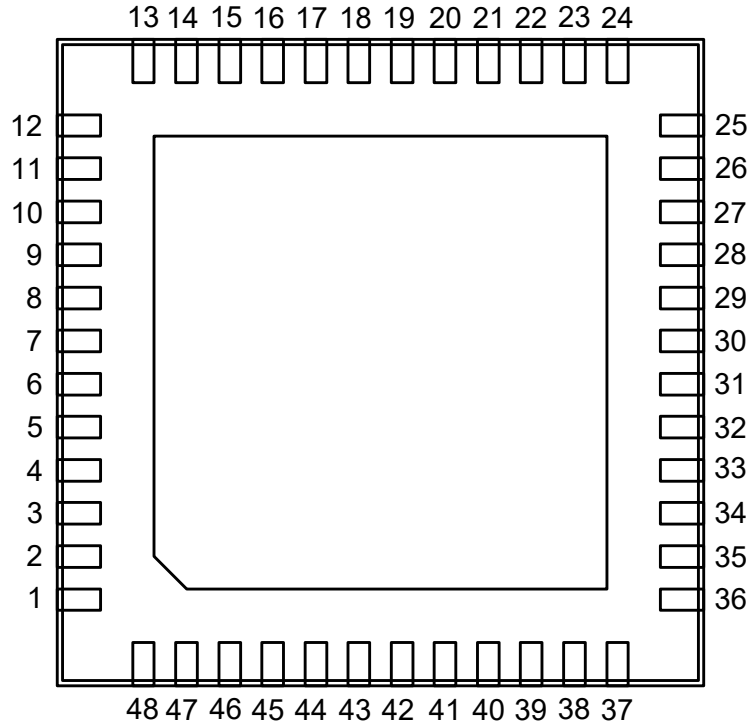
PIC32CX-BZ2 and WBZ45 Family

Pin Details of PIC32CX-BZ2 and WBZ45 Family

3. Pin Details of PIC32CX-BZ2 and WBZ45 Family

This section provides details on pin diagrams and signal names along with the device pinout for each variant of SoC and module type of the PIC32CX-BZ2 and WBZ45 family.

Figure 3-1. PIC32CX1012BZ25048 Pin Diagram (Bottom View)

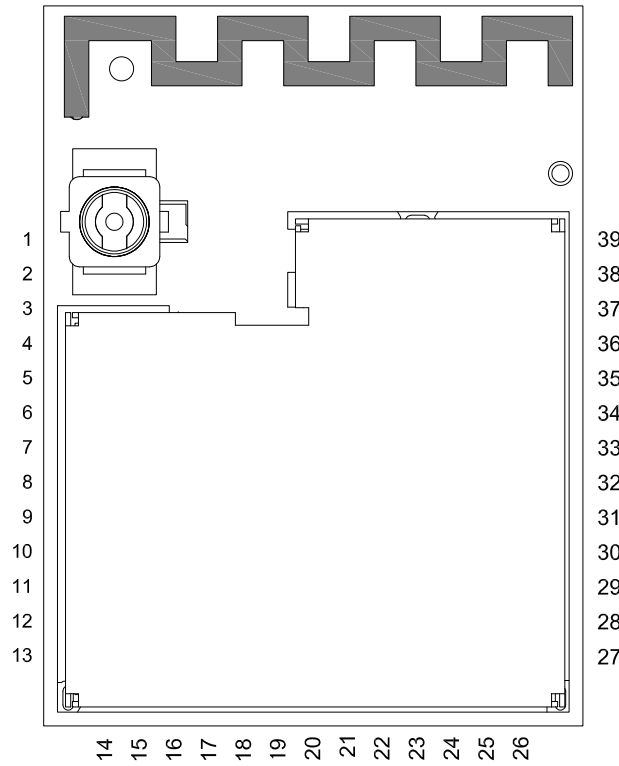


PIC32CX1012BZ25048

PIC32CX-BZ2 and WBZ45 Family

Pin Details of PIC32CX-BZ2 and WBZ45 Family

Figure 3-2. WBZ451 Module Pin Diagram (Top View)



WBZ451

Table 3-1. Pin Details of PIC32CX-BZ2 and WBZ45 Family

SoC	Module	Pin Name ⁽¹⁾⁽²⁾⁽⁶⁾
PIC32CX1012BZ25048	WBZ451	
—	1, 2, 8, 11, 19, 26	GND ⁽³⁾
1	—	PMU_BK
2	—	VPMU_VDD
3	—	PMU_MLDO
4	20	PA0/RA0/QSPI_DATA2/RTC_IN3
5	21	PA1/AC_CMP1/RA1/QSPI_DATA3/RTC_IN2
6	35	PA2/AC_CMP0/RA2/RTC_IN1
7	24	PA5/RA5/SERCOM0_PAD0
8	27, 28	VDD
9	25	PA6/AC_CMP1_ALT/RA6/SERCOM0_PAD1
10	31	PA7/RA7/SERCOM1_PAD0/TRACECLK
11	29	PA8/RA8/SERCOM1_PAD1
12	30	PA9/RA9/RTC_IN0_ALT/SERCOM1_PAD2

PIC32CX-BZ2 and WBZ45 Family

Pin Details of PIC32CX-BZ2 and WBZ45 Family

.....continued

SoC	Module	Pin Name ⁽¹⁾⁽²⁾⁽⁶⁾
PIC32CX1012BZ25048	WBZ451	
13	32	PA10/RA10/RTC_OUT_ALT/SERCOM1_PAD3
14	22	PB12/RB12/QSPI_DATA0
15	23	PB13/RB13/QSPI_DATA1/RTC_EVENT
16	33	PA13/RA13/SERCOM2_PAD0
17	34	PA14 /RA14/ SERCOM2_PAD1
18	—	CLDO_O
19	—	BUCK_CLDO
20	—	EXTR
21	—	BUCK_BB
22	—	XO_N/XO-
23	—	XO_P/XO+
24	—	BUCK_PLL
25	—	BUCK_LPA
26	—	LPA_OUT/LPA
27	—	MPA_OUT/MPA
28	—	BUCK_MPA
29	3	NMCLR
30	4	PB0/AC_AIN2/AN4/RB0
31	38	PB1/AC_AIN3/AN5/RB1
32	37	PB2/AC_AIN0/AN6/RB2
33	5	PB3/AC_AIN1/AN7/RB3
34	39	PB4/AN0/INT0/RB4/TRACEDATA3
35	6	PB5/AN1/RB5/TRACEDATA0
36	7	AVDD
37	12	PB6/AN00, AN2/RB6/TRACEDATA1
38	13	PB7/LVDIN/AN3/RB7/TRACEDATA2, CM4_SWO
39	—	VDD
40	15	PB9/RB9/CM4_SWDIO
41	14	PB8/RB8/CM4_SWCLK
42	16	PA4/RA4/RTC_OUT/SERCOM0_PAD3

PIC32CX-BZ2 and WBZ45 Family

Pin Details of PIC32CX-BZ2 and WBZ45 Family

.....continued

SoC	Module	Pin Name ⁽¹⁾⁽²⁾⁽⁶⁾
PIC32CX1012BZ25048	WBZ451	
43	17	PB10/RB10/QSPI_CS
44	18	PB11/RB11/QSPI_SCK
45	9	PA11/RA11 ⁽⁴⁾ /SOSCI
46	10	PA12/ RA12 ⁽⁴⁾ /SOSCO
47	36	PA3/RA3/RTC_IN0/SERCOM0_PAD2/SCLKI
48	—	VPMU_VDD
—	—	NC

Notes:

1. All GPIOs (RAn and RBn) can be used by remappable peripherals via PPS.
2. All GPIOs (RAn and RBn) can be used as I/O Change Notification (IOCA_n and IOCB_n).
3. The metal paddle at the bottom of the device must be connected to the system ground.
4. This pin can be used as the Input-only pin if SOSC is not used.

4. Packaging Information

This chapter provides the information on package markings, dimension and footprint of the PIC32CX-BZ2 and WBZ45 family.

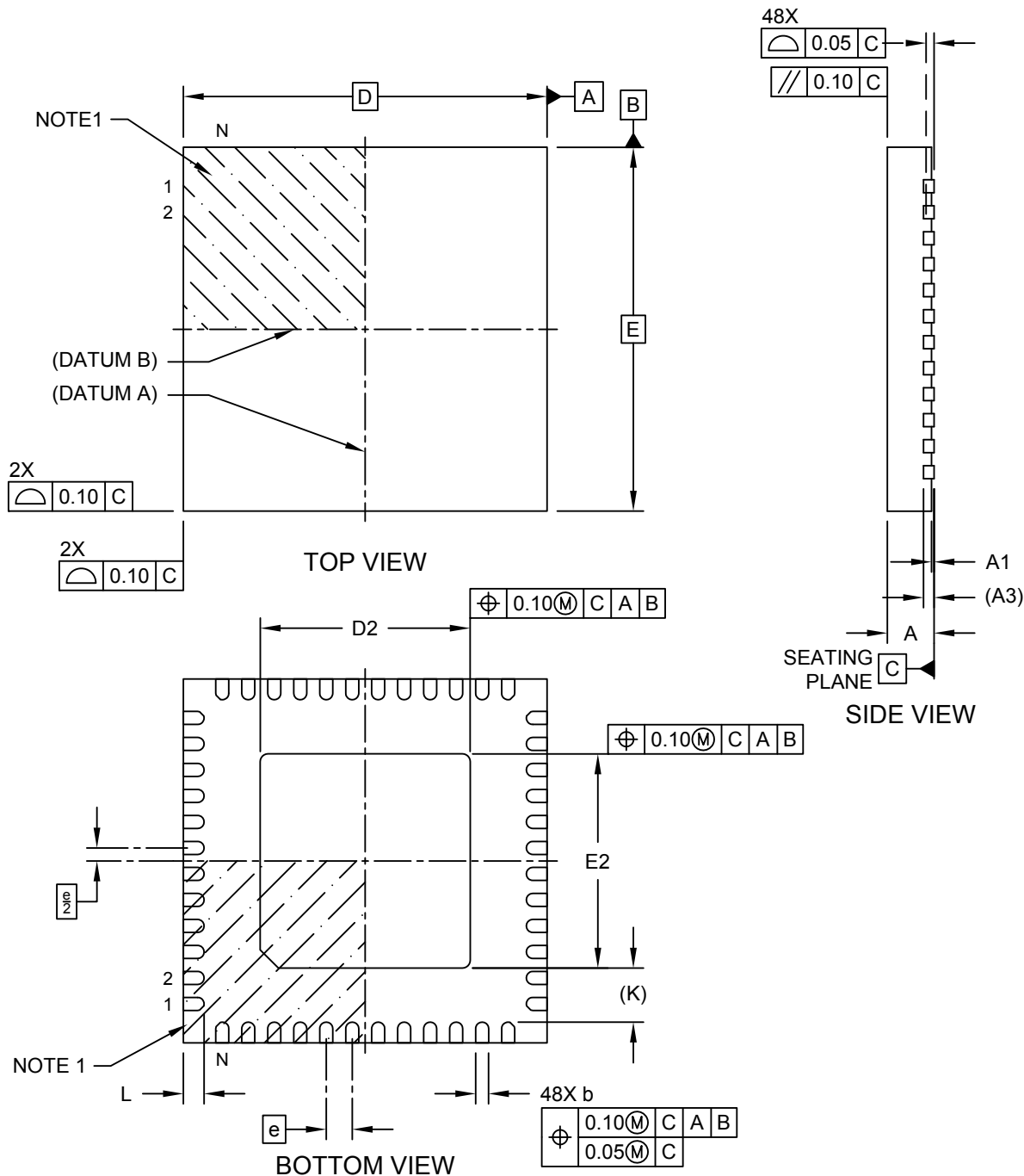
PIC32CX-BZ2 and WBZ45 Family

Packaging Information

4.1 PIC32CX-BZ2 SoC Packaging Information

48-Lead Very Thin Quad Flat, No Lead Package (MYX) 7x7x0.9 mm Body [VQFN] With 4.04x4.12 mm Exposed Pad

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



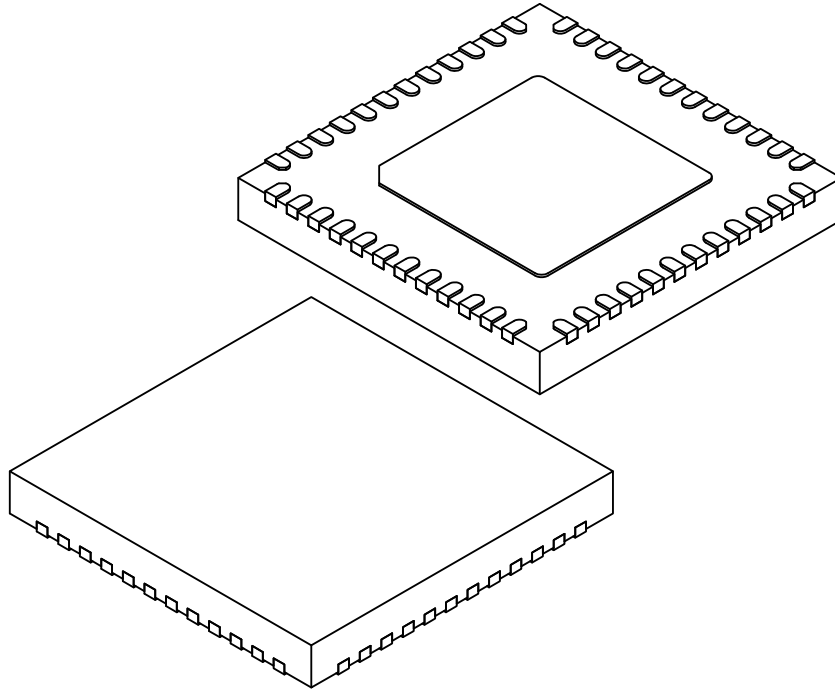
Microchip Technology Drawing C04-507 Rev A Sheet 1 of 2

PIC32CX-BZ2 and WBZ45 Family

Packaging Information

48-Lead Very Thin Quad Flat, No Lead Package (MYX) 7x7x0.9 mm Body [VQFN] With 4.04x4.12 mm Exposed Pad

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Terminals	N	48		
Pitch	e	0.50 BSC		
Overall Height	A	0.80	0.85	0.90
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3	0.20 REF		
Overall Length	D	7.00 BSC		
Exposed Pad Length	D2	3.94	4.04	4.14
Overall Width	E	7.00 BSC		
Exposed Pad Width	E2	4.02	4.12	4.22
Terminal Width	b	0.18	0.25	0.30
Terminal Length	L	0.35	0.40	0.45
Terminal-to-Exposed-Pad	K	1.04 REF		

Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package is saw singulated
- Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

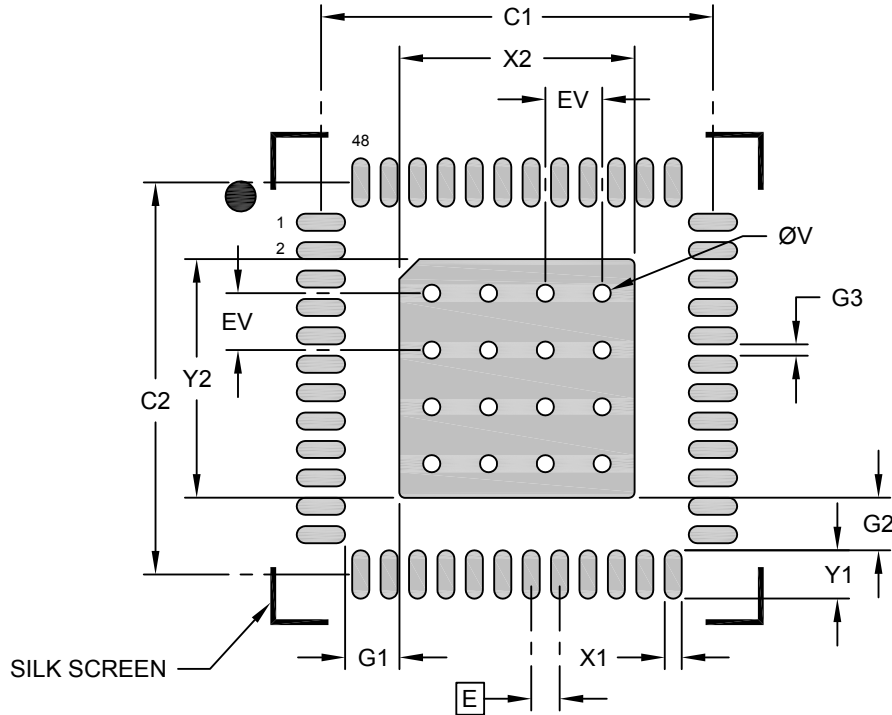
Microchip Technology Drawing C04-507 Rev A Sheet 2 of 2

PIC32CX-BZ2 and WBZ45 Family

Packaging Information

48-Lead Very Thin Quad Flat, No Lead Package (MYX) 7x7x0.9 mm Body [VQFN] With 4.04x4.12 mm Exposed Pad

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	0.50 BSC		
Optional Center Pad Width	X2			4.14
Optional Center Pad Length	Y2			4.20
Contact Pad Spacing	C1		6.90	
Contact Pad Spacing	C2		6.90	
Contact Pad Width (X48)	X1			0.30
Contact Pad Length (X48)	Y1			0.85
Contact Pad to Center Pad (X24)	G1	0.96		
Contact Pad to Center Pad (X24)	G2	0.93		
Contact Pad to Contact Pad (X44)	G3	0.20		
Thermal Via Diameter	V		0.30	
Thermal Via Pitch	EV		1.00	

Notes:

- Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2507 Rev A

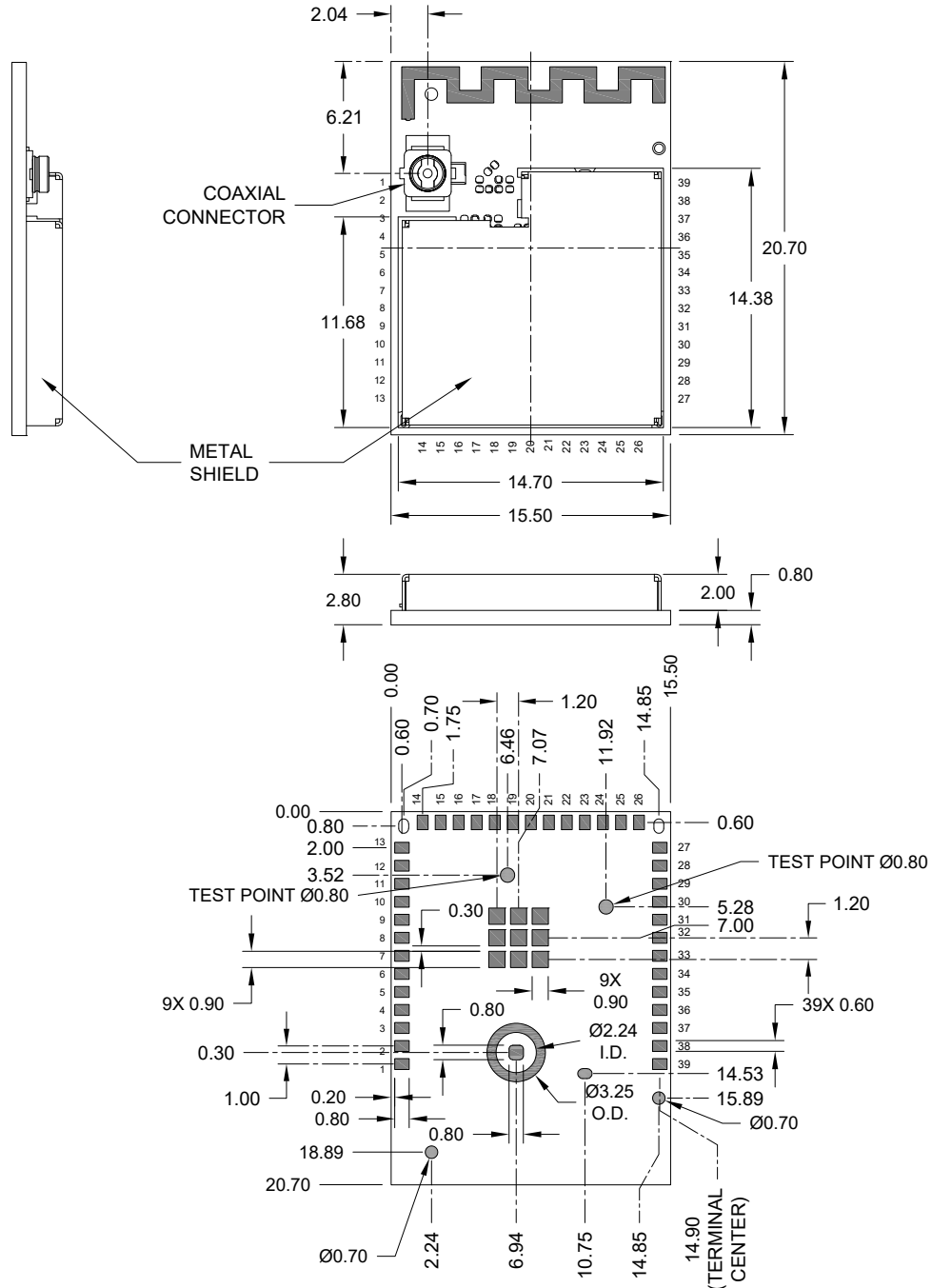
PIC32CX-BZ2 and WBZ45 Family

Packaging Information

4.2 WBZ451 Module Packaging Information

39-Lead PCB Module (ZSX) - 15.5x20.7x2.8 mm Body [MODULE] With Metal Shield and Coaxial Connector

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



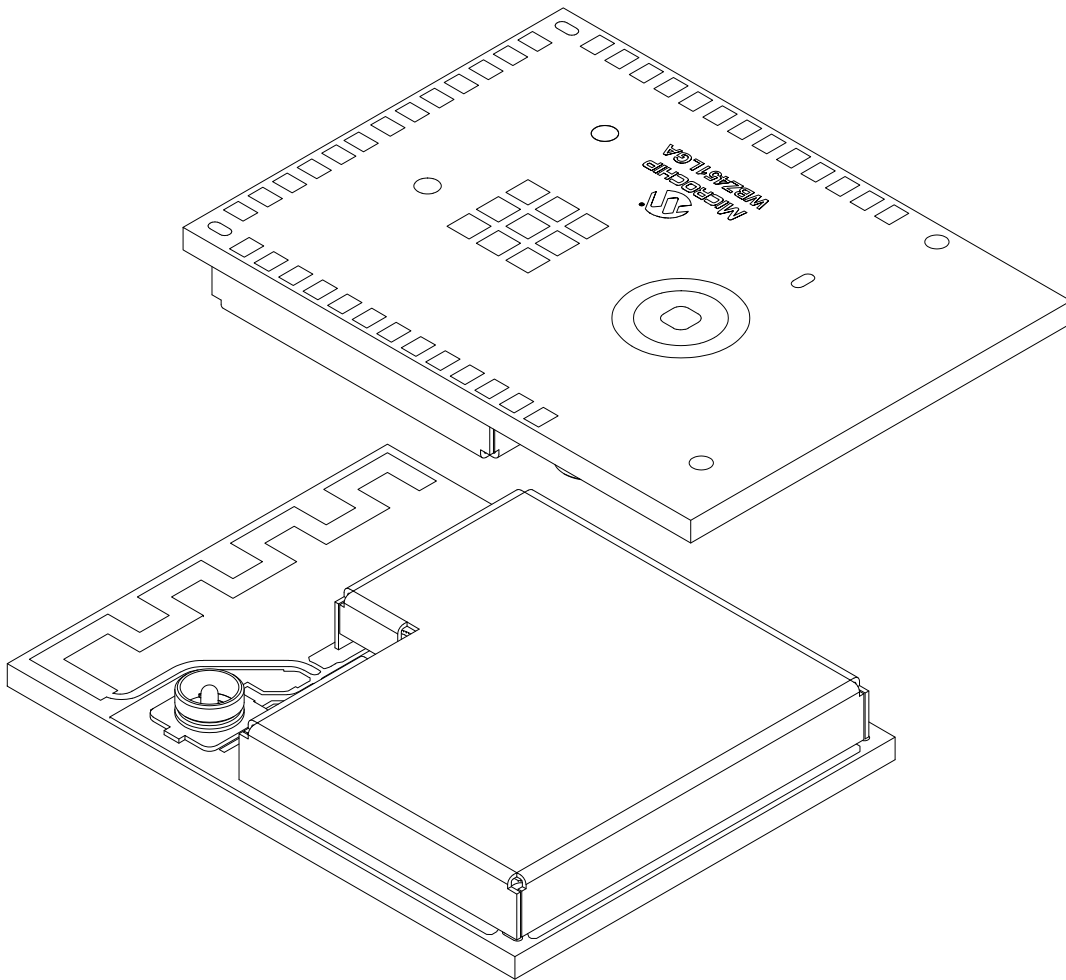
Microchip Technology Drawing C04-10052 Rev B Sheet 1 of 2

PIC32CX-BZ2 and WBZ45 Family

Packaging Information

39-Lead PCB Module (ZSX) - 15.5x20.7x2.8 mm Body [MODULE] With Metal Shield and Coaxial Connector

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



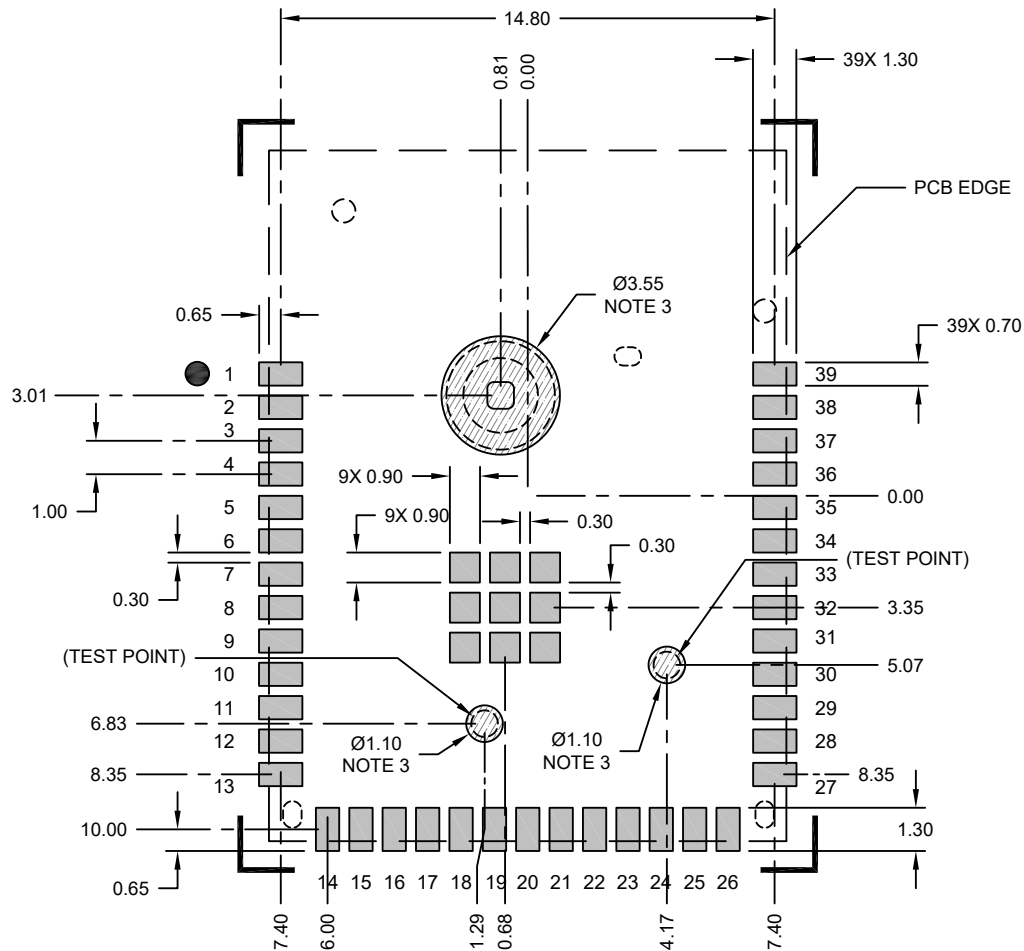
Microchip Technology Drawing C04-10052 Rev B Sheet 2 of 2

PIC32CX-BZ2 and WBZ45 Family

Packaging Information

39-Lead PCB Module (ZSX) - 15.5x20.7x2.8 mm Body [MODULE] With Metal Shield and Coaxial Connector

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Notes:

1. All dimensions are in millimeters.
2. Keep this area free from all metal, including ground fill.
3. Keep these areas free from routes and exposed copper. Ground fill with solder mask may be placed here.

Microchip Technology Drawing C04-12052 Rev B

PIC32CX-BZ2 and WBZ45 Family

Document Revision History

5. Document Revision History

Revision	Date	Section	Description
A	10/2022	Document	Initial revision

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