Hardware Guide

T32CM11
Zigbee 2.4-GHz RF SoC

Description

The T32CM11 is an ultra-low power, high-performance 2.4GHz wireless SoC supporting Zigbee 3.0 to facilitate home & building automation, smart lighting, smart locks, sensor network applications, etc. This document is to guide design engineers seeking to integrate the "CM11" in hardware designs.

Part Number Information

Table 1 T32CM11 Part Number Information

Part Number	Type	Package	Shipping
T32CM11C10GQ40-AR	SoC	QFN5x5 – 40L	Reel (R)
T32CM11C10GQ40-AT	SoC	QFN5x5 – 40L	Tray (T)

Development Kits

Table 2 Dev Kit Information

Part Number	Part Name	Description
DKNCM11C10-02	Zigbee Eval Kit CM11	Evaluation board with PCB trace antenna, limited I/O, and integrated SEGGER J-Link onboard programmer and debugger. USB or CR2450 coin cell powered.
DKRCM11C10-25	Zigbee Radio Board CM11	Development board with selectable antenna (PCB trace / SMA) and 10 dBm Transmit Power. Use with HOST Board.
DKR-HOST-00-A	Main Development Board	Development board with integrated SEGGER J-Link onboard programmer and debugger, full I/O breakout. Compatible Trident Radio Boards plug into the HOST Board. USB or externally powered.

[Insert sub-sections with pictures and features summary?]

Programming and Debugging Interface

The Trident Development Kits features an onboard SEGGER J-Link (J-Link OB) debugger microcontroller, which is not user-programmable and connects via the USB Type-C port. The J-Link OB enables code downloading, debugging functionalities, and provides a virtual COM port for general-purpose serial data transfer. The diagram below illustrates the connection between the target T32CM11 device and the J-Link OB.

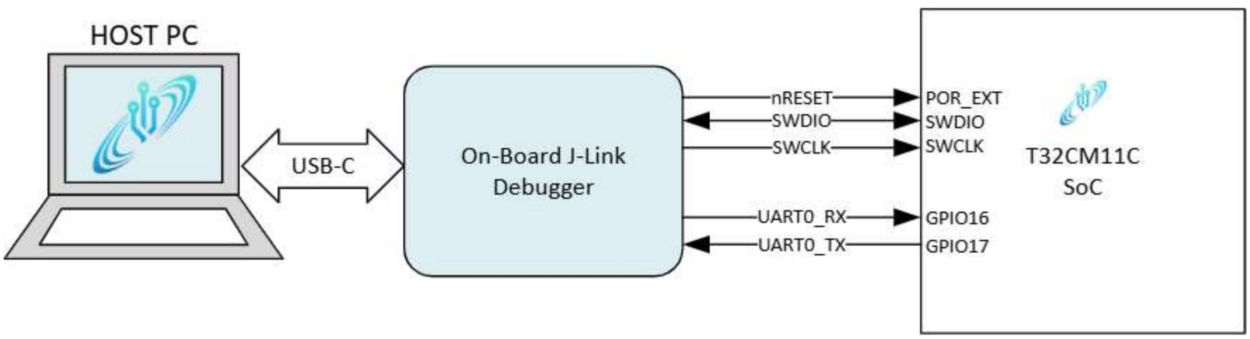
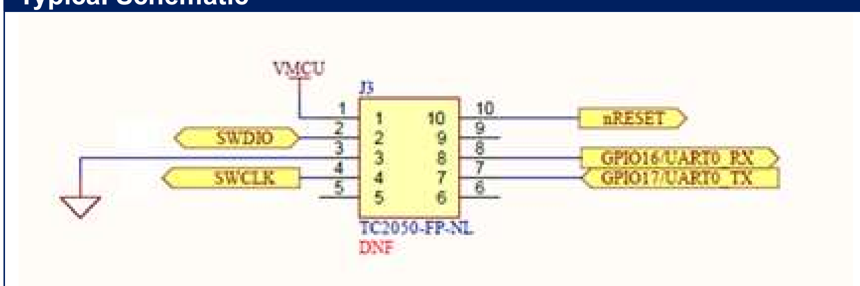
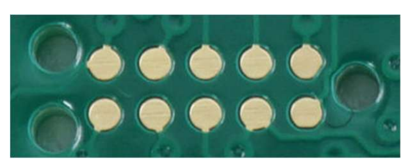


Figure-1 Programming and Debugging Overview

Dev Kit Programming Headers

When the CM11 SoC is being added to a design, a Serial Wire Debug (SWD) interface needs to be included to program and test the SoC. For Trident Dev Kits and Reference Designs, 10-pin Tag-Connect™ TC2050-NL-FP Footprint for development use.

Table 3 Typical Programming Header

Typical Schematic	Typical Footprint
	TC2050-NL-FP Footprint 

Note: The similar 6-pin footprints on Trident hardware are for factory use only, and not for use in development.

Table 4 Typical Programming Header Pin-out

Pin No.	Pin Name	Description
1	VMCU	3.3V DC Supply Voltage
2	SWDIO	Serial Wire Data
3	GND	Ground connection
4	SWCLK	Serial Wire Clock
7	GPIO17 / **UART0_TX**	UART Data Transmitted from CM11 / Received by connected HOST
8	GPIO16 / **UART0_RX**	UART Data Received by CM11 / Transmitted by Connected HOST
10	nRESET	Pulled low to reset the CM11
5, 6, 9	NC	No connection

**The UART0 lines can be re-configured to other GPIO, the associations shown here are the default.*

Dev Kit Programing Cable

Tag-Connect TC2050 10 Pin “No legs” Plug-of-Nails™ cables TC2050-IDC-NL, TC2050-IDC-NL-050-ALL, or equivalents, can be used with DKR-HOST board to program an external target board with a TC2050-NL-FP Footprint.

Serial UART

Serial Interface

The CM11 supports up to three (3) UART interfaces, one with CTS/RTS flow control, the others without. The default configuration allows communication on UART0.

Table 5 Default I/O Assignments for SWD and UART0

Pin No.	Pin Name	Type	Description
25	GPIO17	DIO	multi-function digital I/O, default UART0_TX
26	GPIO16	DIO	multi-function digital I/O, default UART0_RX
29	SWDIO	DIO	ARM MCU ICE data (SWDIO)
30	SWCLK	DIO	ARM MCU ICE clock (SWCLK)

The Trident Evaluation and Development Kits listed in Table 2 have built-in hardware support though the On-board J-Link Debugger for serial communication with UART0 at the default GPIO. See the Dev Kit Manual for more details.

If other serial cables or adapters are used, they must support +3.3V TTL level UART signals.
Example: FTDI TTL-232R-3V3

PC Serial Interface Configuration

This example assumes a default baud rate of 230400.

1. Connect Dev Kit or Sample Device via USB cable to a computer containing a serial emulator, such as TeraTerm or PuTTY.

2. Select the communication port (COM port) ID assigned by the HOST PC to the attached

3. Set serial port configurations:
    - Baud: 230400
    - Data: 8 Bit
    - No parity
    - 1 Stop bit
    - No Flow Control

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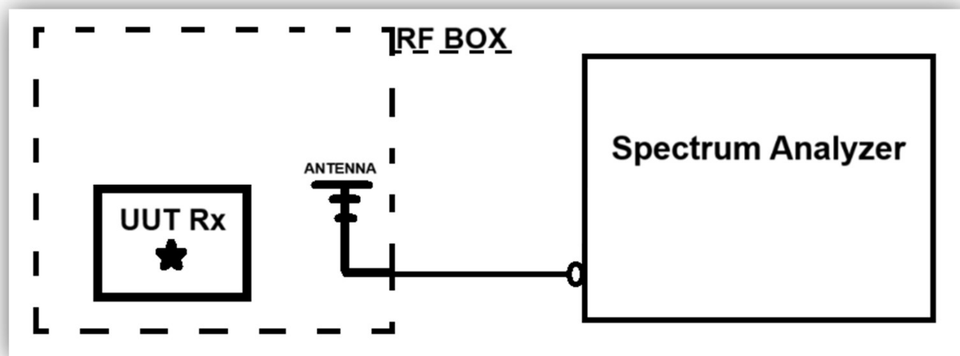
Calibration

Crystal Calibration

Devices designed with the T32CM11 SoC will require a crystal calibration process to ensure accurate frequency control and stable operation. Trident CLI supports this process.

Calibration Setup



General Procedure:

1. Setup Spectrum Analyzer center frequency to 2405MHz
2. Place UUT in RF shield box
3. Send command to UUT to start constant Transmit on 916MHz using CLI or compiled app.
4. Check transmit frequency of UUT with spectrum analyzer
5. If center frequency **is not** within ±28.7kHz of 2405MHz
    a. Try XTAL_TRIM value by sending command to UUT
    b. If the transmit frequency is LOWER THAN 2405MHz, then decrease the trim value
    c. If the transmit frequency is HIGHER THAN 2405MHz, then increase trim the value
    d. Repeat until acceptance criteria is met, then move to step 6
6. If center frequency **is** within ±28.7kHz of 2405MHz
    a. Store trim value on UUT using CLI or compiled app
7. Reset UUT by power cycle

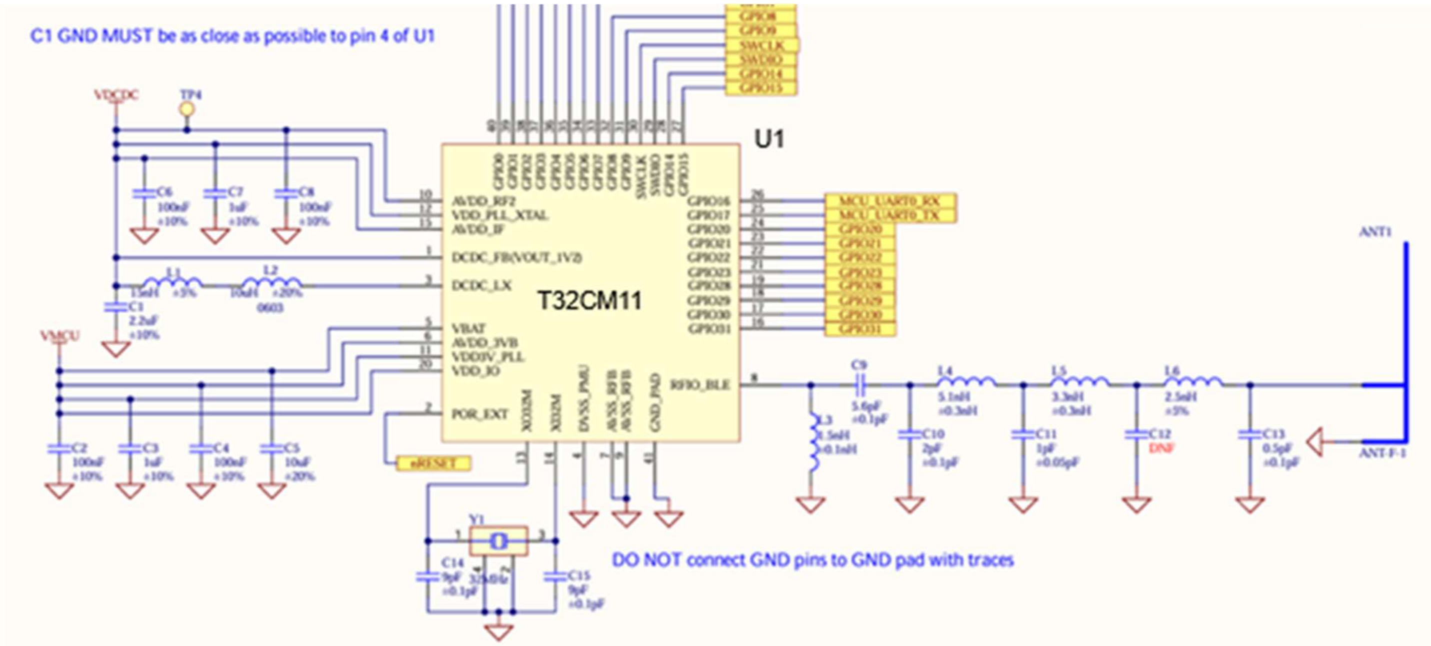
RF Interface, Harmonic filtering and Matching.

The sub-GHz RF interface on the T32CM11 consists of a single-ended RF Input / Output pin (RFIO, pin 8) for both transmitting and for receiving.

The RF matching network for the T32CM11 will generally consist of a Pi matching section, a low-pass filter section, and an antenna impedance matching section. The first Pi matching section section is used to transform the impedance of the T32CM11 I/O pin to match the low-pass filter section. The low-pass filter is designed to suppress transmitter harmonics, ensuring compliance with regulatory spectral emission limits while still allowing good overall signal transmission efficiency in both directions for transmit and receive. The antenna matching section is used to match the feed point impedance of the antenna to the impedance of the filter section, which is usually chosen to be close to 50 ohms.

Typical RF Matching Network

The reference RF matching network for the T32CM11 is shown in the application schematic below.



In the figure above, the T32CM11 matching section consists of L3 and C9.

The low pass filter section consists of L4, L5, C10 and C11.

The antenna matching Pi network consists of C12, L6 and C13.

These component values should be suitable for most applications assuming layout recommendations are followed, but it should be noted that the antenna matching components C12, L6 and C13 will vary depending on the feed point impedance of the antenna used in the design and will most likely need to be changed.

Power Amplifier

The RF power amplifier inside the T32CM11, which is connected to the RFIO pin during transmit, can produce maximum output power levels of approximately +10 dBm of RF output power.

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PCB Layout

Proper PCB layout and impedance control are critical for minimizing losses, optimizing RF performance and meeting regulatory requirements. Some general rules that should be followed whenever possible are:

Keep the RF layout from the T32CM11 to the antenna as compact as possible and keep trace length short.

Maintain continuous solid ground plane under the RF section to minimize inductance and path length between ground connections.

Capacitors that connect to ground in the low pass filter and matching sections (such as C10, C11, C12 and C13) should have pads on the signal path to minimize series inductance. They should not ne connected to the signal path by a trace.

If long traces must be used in the RF signal path, they should be designed for a controlled impedance that is matched at both ends to reduce reflections, high VSWR and losses.

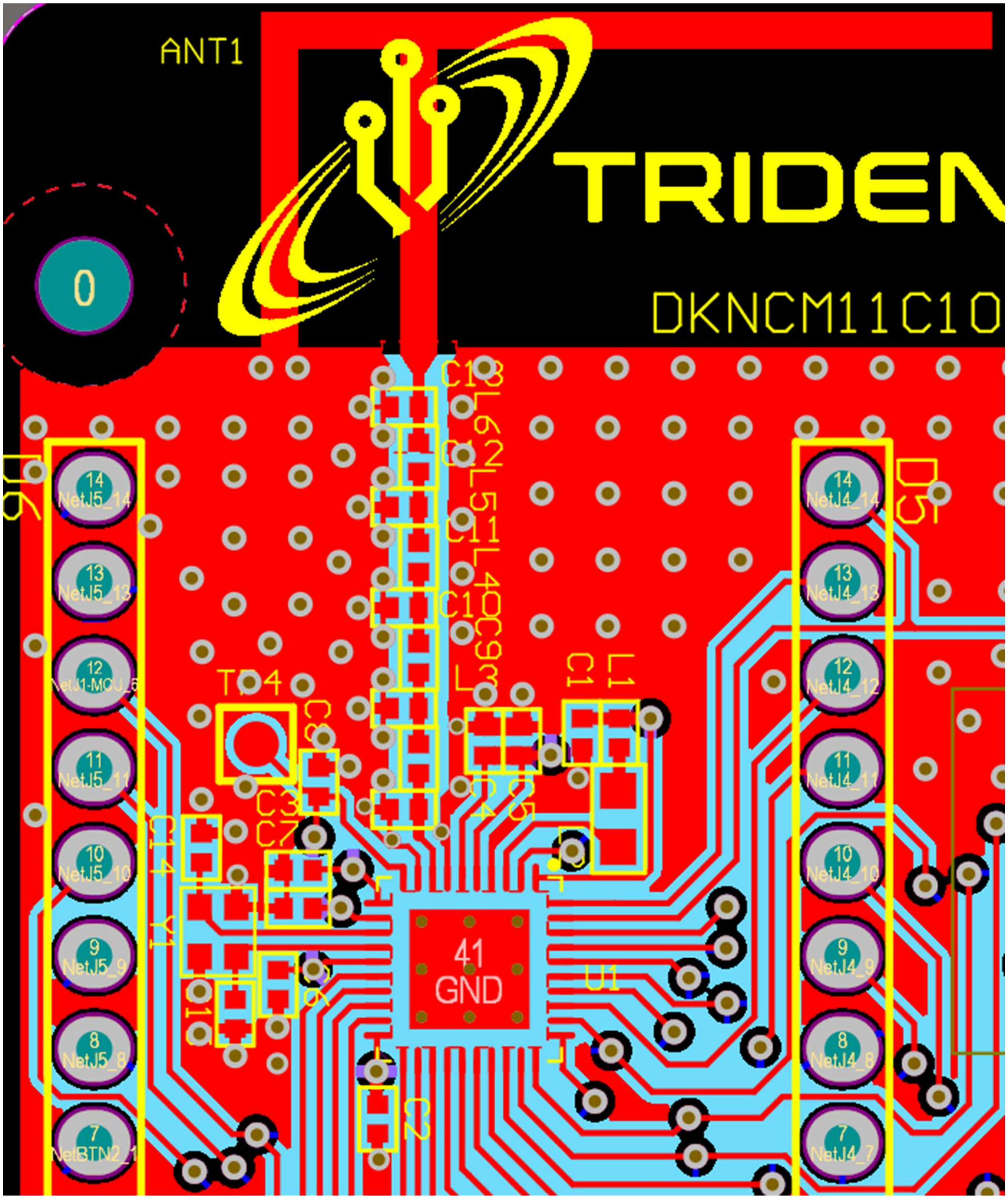
Use multiple ground vias to reduce net inductance on RF components where space permits.

Do not connect any of the T32CM11 ground pins on the edge of the device to the central ground pad under the T32CM11. This may introduce noise into the radio circuits and degrade performance.

Connect the ground side of the capacitor C1 in the DC-DC converter directly to the DVSS_PMU pin (pin 4) of the T32CM11.

Keep DC-DC converter components C1, L1 and L2 close to the T32CM11 with short direct connections to minimize radiated noise.

The diagram below shows a typical PCB layout for the T32CM11:



Revision History

Revision	Date	Description
0.1		Beta Release

Related Documentation

	Document ID	Description
Data Sheet	**DS-ZG-0001-01**	Datasheet: T32CM11 Zigbee 2.4GHz RF SoC
Manual	**MAN-ZB-0002-01**	Manual: T32CM11 Reference Manual

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