Sub-1GHz 6LoWPAN Network Processor

Accelerate your 6LoWPAN Development

Applications

- *Large scale mesh networks that require IP backbone interconnectivity*
- *Automated Meter Reading*
- *Street Lighting Systems*
- *Home/Building automation*
- *Industrial control and monitoring*
- *Mesh sensor networks*

Product Description

The ***CC1180*** is a cost-effective, low power, sub-1GHz 6LoWPAN Network Processor that provides 6LoWPAN functionality with a minimal development effort.

The ***CC1180*** is a preloaded version of ***CC1110F32***, where TI third party Sensinode's 6LoWPAN stack, NanoStack 2.0 Lite, runs on the ***CC1180*** Network Processor. The application controlling the Network Processor runs on an external host microcontroller. The ***CC1180*** handles all the timing critical and processing intensive 6LoWPAN protocol tasks, and leaves the resources of the application microcontroller free to handle the application.

CC1180 makes it easy to add 6LoWPAN functionality to new or existing products at the same time as it provides great flexibility in choice of microcontroller. How to use Sensinode NanoStack 2.0 is described in the User's Guide SWRU298.pdf.

CC1180 interfaces almost any microcontroller through a UART interface; ***CC1180*** can e.g. be combined with an MSP430.

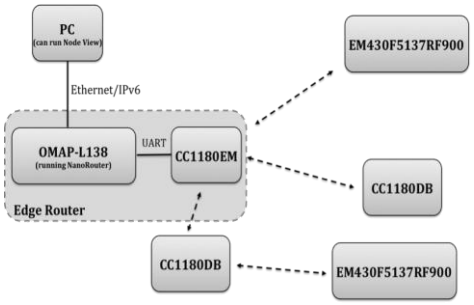
The ***CC1180*** contains a bootloader, Sensinode NanoBoot. The bootloader is used to download the Sensinode 6LoWPAN stack, NanoStack 2.0 Lite.

CC1180 supports Sensinode's simple NAP protocol API. The NAP Protocol API has only a small amount of API calls to learn, which drastically simplifies the development of 6LoWPAN applications. The API has a socket like approach, to enable easy and fast integration between the host and network processor.

CC1180 comes preloaded with Sensinode NanoBoot and a TI IEEE EUID (MAC address); the MAC address can be read and written using NanoBoot.

Key Features

- Simple integration of 6LoWPAN with mesh support into any design
- Running Sensinode's mature and stable 6LoWPAN mesh stack, NanoStack 2.0 Lite
- UART interface to microcontroller running the application
- Supports updating of the NanoStack 2.0 Lite 6LoWPAN stack using Sensinode NanoBoot API. Over-The-Air updates are supported, provided that the host microcontroller has enough memory to store the new stack image.
- Example 6LoWPAN mesh system overview



- Radio features:
  - 315/433/868/915 MHz ISM/SRD bands
  - Output power: -30dBm to +10dBm
  - Date rates: 50, 100, 150 and 200kbps
  - AES-CCM* secured IEEE802.15.4e payloads, using network-wide key.
  - Excellent receiver sensitivity and best in class robustness to interferers
- Power Supply
  - Wide supply voltage range (2.0V – 3.6V)
  - Low current consumption
- External System
  - Very few external components
- RoHS compliant 6x6 mm QFN 36 package

Note: Erasing the chip will result in having a blank device, with no possible way to recover the Sensinode NanoBoot.

Table of Contents

Abbreviations

AES	Advanced Encryption Standard
API	Application Programming Interface
ARIB	Association of Radio Industries and Businesses
BOM	Bill of Materials
CFR	Code of Federal Regulations
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DC	Direct Current
EM	Evaluation Module
ESD	Electro Static Discharge
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FCS	Frame Check Sequence
I/O	Input / Output
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial, Scientific and Medical
JEDEC	Joint Electron Device Engineering Council
kB	1024 bytes
kbps	kilobits per second
LQI	Link Quality Indicator
LSB	Least Significant Byte
MAC	Medium Access Control
MSB	Most Significant Byte
NA	Not Available
NC	Not Connected
PA	Power Amplifier
PCB	Printed Circuit Board
PER	Packet Error Rate
PHY	Physical Layer
RAM	Random Access Memory
RF	Radio Frequency
RoHS	Restriction on Hazardous Substances
RSSI	Received Signal Strength Indicator
RX	Receive
TBD	To Be Decided / To Be Defined
TI	Texas Instruments
TX	Transmit
UART	Universal Asynchronous Receiver/Transmitter
USART	Universal Synchronous/Asynchronous Receiver/Transmitter

1 Electrical Characteristics

For Electrical Characteristics tables, see SWRS033.pdf.

2 Pin and I/O Port Configuration

The ***CC1180*** has the exact same pinout as ***CC1110F32*** and is shown in Figure 1 and Table 1.

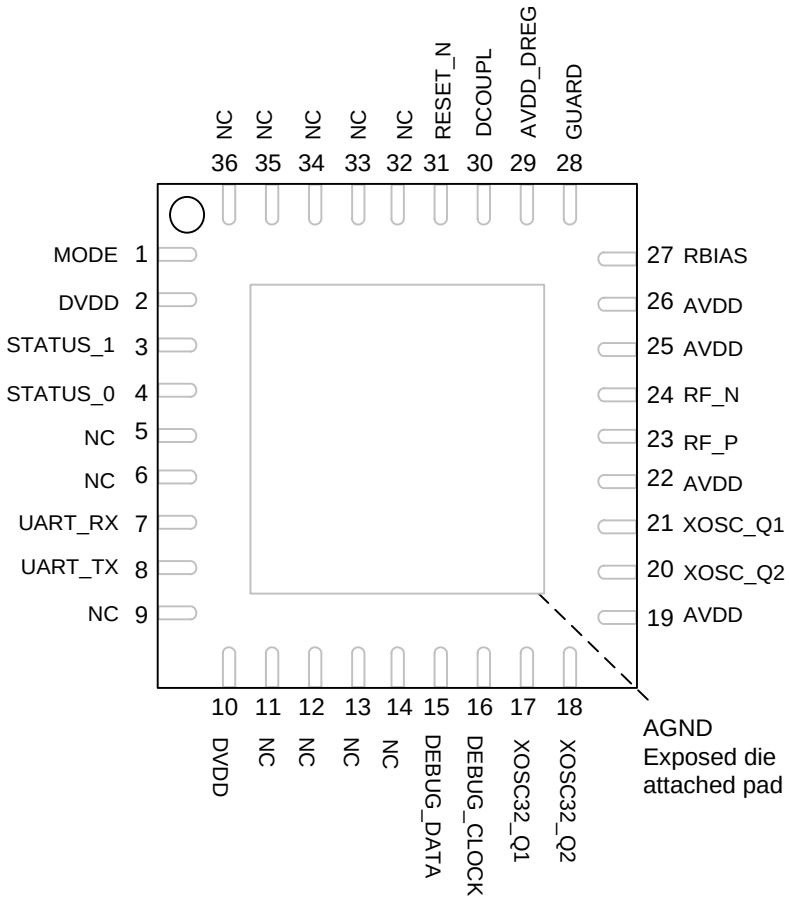


Figure 1: Pinout top view

Note: The exposed die attach pad **must** be connected to a solid ground plane as this is the ground connection for the chip.

Pin	Pin name	Pin type	Description
-	GND	Ground	The exposed die attach pad must be connected to a solid ground plane
1	MODE	Digital Input	*CC1180* Input, connection with host MCU to control application or bootloader mode [2]. **Must** be high by default. Falling edge toggles mode.
2	DVDD	Power (Digital)	2.0V-3.6V digital power supply for digital I/O
3	STATUS_1	Digital Output	*CC1180* Output, can be connected to e.g. LED to indicate application / bootloader mode [2].
4	STATUS_0	Digital Output	*CC1180* Output, can be connected to e.g. LED to indicate application / bootloader mode [2].
5	NC	D I/O	NC
6	NC	D I/O	NC
7	UART_RX	Digital Input	*CC1180* USART0 RX Input, connection to host MCU [2].
8	UART_TX	Digital Output	*CC1180* USART0 TX Output, connection to host MCU [2].
9	NC	D I/O	NC
10	DVDD	Power (Digital)	2.0V-3.6V digital power supply for digital I/O
11	NC	D I/O	NC
12	NC	D I/O	NC
13	NC	D I/O	NC
14	NC	D I/O	NC
15	DEBUG_DATA	D I/O	Debug Data
16	DEBUG_CLOCK	D I/O	Debug Clock
17	XOSC32_Q1	D I/O	32.768 kHz crystal oscillator pin 1
18	XOSC32_Q2	D I/O	32.768 kHz crystal oscillator pin 2
19	AVDD	Power (Analog)	2.0V-3.6V analog power supply connection
20	XOSC_Q2	Analog I/O	26 MHz crystal oscillator pin 2
21	XOSC_Q1	Analog I/O	26 MHz crystal oscillator pin 1, or external clock input
22	AVDD	Power (Analog)	2.0V-3.6V analog power supply connection
23	RF_P	RF I/O	Positive RF input signal to LNA in receive mode Positive RF output signal from PA in transmit mode
24	RF_N	RF I/O	Negative RF input signal to LNA in receive mode Negative RF output signal from PA in transmit mode
25	AVDD	Power (Analog)	2.0V-3.6V analog power supply connection
26	AVDD	Power (Analog)	2.0V-3.6V analog power supply connection
27	RBIAS	Analog I/O	External precision bias resistor for reference current
28	GUARD	Power (Digital)	Power supply connection for digital noise isolation
29	AVDD_DREG	Power (Digital)	2.0V-3.6V digital power supply for digital core voltage regulator
30	DCOUPL	Power decoupling	1.8V digital power supply decoupling
31	RESET_N	DI	Reset, active low
32	NC	D I/O	NC
33	NC	D I/O	NC
34	NC	D I/O	NC
35	NC	D I/O	NC
36	NC	D I/O	NC

Table 1: Pinout overview

3 Application Circuit

Since CC1180 is a preloaded version of CC1110F32, the application circuit for CC1180 can be found in [1].

Figure 2 shows the software architecture for an application circuit where the CC1180 network processor is controlled from a host MCU.

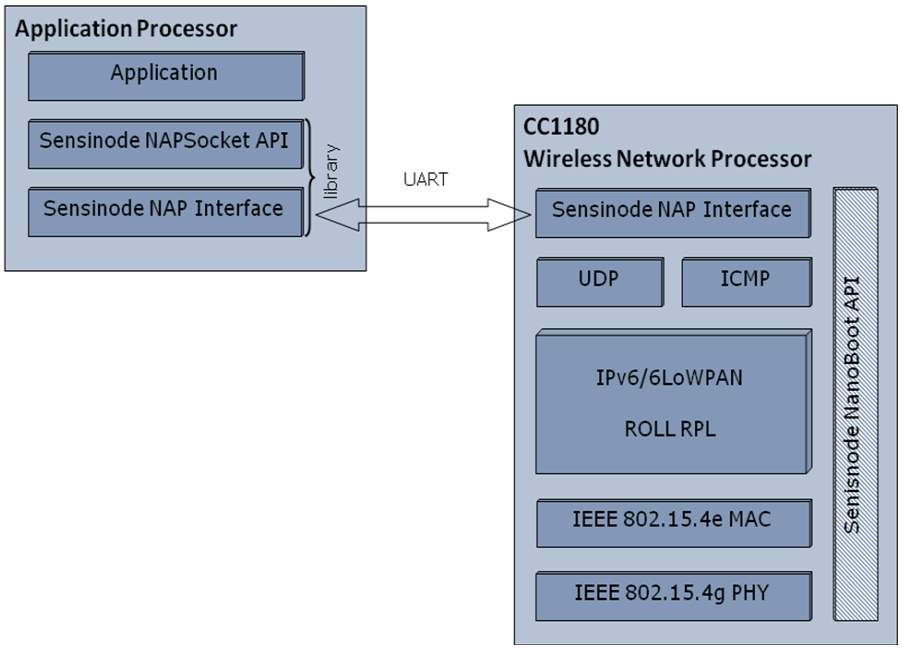


Figure 2. CC1180 based 6LoWPAN System

4 Sensinode NanoBoot API

4.1 Introduction

This section contains protocol description of Sensinode NanoBoot – the NanoStack 2.0 Lite bootloader. NanoBoot is a separate software component that can be used to update the 6LoWPAN stack firmware installed in flash. The Sensinode NanoStack 2.0 Lite stack firmware is encrypted; it is not possible to download stack firmware not verified by Sensinode. The use of bootloader requires the device that uploads the new flash image (i.e. the host) to implement the host part of the bootloader protocol.

4.2 Overview

NanoBoot is installed into flash address 0x0000. When the CC1180 device is powered up, the bootloader is initialized. Depending on the contents of the flash memory at address 0x6FF7 the software will remain in bootloader mode or the Sensinode NanoStack 2.0 Lite 6LoWPAN stack will be executed. The Bootloader will remain active if the byte value is 0xFF, while value 0x00 will cause the 6LoWPAN stack to start executing.

The Bootloader requires a total of 5kB of flash memory. CC1180 has 32kB of flash in total, thus 27kB of flash memory is available for the NanoStack 2.0 Lite 6LoWPAN stack. Available RAM is not affected.

The MAC address of CC1180 is stored at flash address 0x6FF8 and is 8 bytes long.

4.2.1 Changing Application Mode

Before the application MCU can communicate with the NanoBoot module on the CC1180 the module must be enabled properly. This is done by pulling CC1180 MODE signal down to ground (0 volts); this causes a falling edge interrupt to occur. The NanoBoot mode is toggled on each falling edge of the MODE signal. The currently active mode can be identified from the state of the STATUS_0 (pin 4) and STATUS_1 (pin 3) pins. When STATUS_0 and STATUS_1 are constantly high, the CC1180 device is in bootloader mode. See [2] for details.

4.3 NanoBoot Protocol

The Sensinode NanoBoot protocol has been designed to be an easy-to-parse, low-overhead serial protocol that has enough flexibility and extendibility for the NanoBoot bootloader. Low complexity has been an important design goal so that the protocol can be efficiently parsed even on MCUs with very limited resources. The potentially limited serial port data rates have imposed the need for a very low overhead compared to the actual payload data. Each packet of bootloader protocol is a NAP configuration packet with a special control byte (CT). This allows the application MCU to use the same NAP protocol implementation for all communication with the CC1180 device. See [2] for more details on the Sensinode NAP Protocol.

The high level packet format is described in Table 2.

Byte	**1**	**2**	**3**	**4**	**5**	**…**	**N**
Name	Length	'N'	'A'	CT	cmd_id	[Variable]	CS

Table 2. High level NAP packet format

4.3.1 Length Byte

The first byte of a packet is **always** the total length of the packet **not including** the length byte itself but **including** the last byte (**CS**). The byte is in normal host order *i.e.* MSB.

4.3.2 Header Bytes

The two bytes following the Length byte are ASCII characters 'N' and 'A' (0x4e and 0x41 respectively). The two bytes are static and present in all packets. Wrong bytes will result in that NanoBoot discards the packet.

4.3.3 CT Byte

The Sensinode NAP protocol specifies a control (CT) byte to separate control and data messages as well as used protocol and addressing modes. This byte is 0xCD for NAP configuration message identifying NanoBoot protocol data. Packets with unknown CT byte will be discarded.

4.3.4 cmd_id byte

The cmd_id byte is a byte which defines the packet type. Packet types relevant to the NanoBoot are listed in Table 3.

cmd_id	Packet type
0x01	FLASH_WRITE_PAGE
0x81	FLASH_WRITE_PAGE_CONFIRM
0x02	FLASH_WRITE_PAGE_DONE
0x05	MAC_ADDRESS_READ
0x85	MAC_ADDRESS_READ_CONFIRM / MAC_ADDRESS_SET_CONFIRM
0x08	MAC_ADDRESS_SET
0x0A	APPLICATION_MODE_TOGGLE
0x8A	APPLICATION_MODE_TOGGLE_REPLY
0x09	UNSUPPORTED_MESSAGE
0x0B	VERSION_REQUEST
0x8B	VERSION_REPLY

Table 3. Command types

4.3.5 CS Byte

The checksum byte is calculated as Exclusive-OR (XOR) from all bytes of the packet (excluding the CS byte itself but including the length byte). The Sensinode NanoBoot protocol parser will discard packet if the checksum does not match.

4.4 API Commands

Table 4 describes the available commands and their respective payload structures. Bytes# describes variable fields of basic packet structure for each command.

Command	CC1180 DIR.	Byte #1	Byte #2	Byte #3	Byte #4	Byte #5	Byte #N
FLASH_WRITE_PAGE	IN	Page number	Encoding flag	Page setups	DATA byte 1	DATA byte 2	DATA byte 64
FLASH_WRITE_PAGE_CONFIRM	OUT	Page number	-	-	-	-	-
FLASH_WRITE_PAGE_DONE	OUT	Page number	-	-	-	-	-
MAC_ADDRESS_READ	IN	-	-	-	-	-	-
MAC_ADDRESS_READ_CONFIRM MAC_ADDRESS_SET_CONFIRM	OUT	MAC byte 1	MAC byte 2	MAC byte 3	MAC byte 4	MAC byte 5	MAC byte 8
MAC_ADDRESS_SET	IN	MAC byte 1	MAC byte 2	MAC byte 3	MAC byte 4	MAC byte 5	MAC byte 8
APPLICATION_MODE_TOGGLE	IN	-	-	-	-	-	-
APPLICATION_MODE_TOGGLE_ REPLY	OUT						
VERSION_REQUST	IN	-	-	-	-	-	-

Command	CC1180 DIR.	Byte #1	Byte #2	Byte #3	Byte #4	Byte #5	Byte #N
VERSION_REPLY	OUT	BL version byte	Application version byte 1	Application version byte 2	Application version byte 3	Application version byte 4	Application version byte 6
UNSUPPORTED_MESSAGE	OUT	Error type					

Table 4. Supported commands and their packet format

BL version byte – 0xf0 bits indicates integer part of version number, 0x0f bits indicates decimal part of version number, as integers. E.g. 0x10 shall be interpreted as version 1.0.

Application version byte – Version of the Sensinode NanoStack 2.0 Lite 6LoWPAN stack

Error type – 0x00 for NAP frame errors, any other value indicates a NanoBoot protocol error.

Encoding flag – is always 0x01.

4.5 State machine

This chapter describes the recommended method for implementing a state machine for a host application using NanoBoot protocol to communicate with a CC1180 network Processor. An example application that can be used to interact with the Sensinode NanoBoot bootloader to e.g. perform software update is described in CC-6LOWPAN-DK-868 User's Guide (SWRU298.pdf).

The figures below introduce the basic message flows that are supported in NanoBoot.

4.5.1 Example Message flows

Common for all figures below is that NanoBoot in ***CC1180*** **must be** set in NanoBoot mode before any communication is initiated. NanoBoot mode can be entered by setting the MODE pin to ground once, or by sending *APPLICATION_MODE_TOGGLE* NAP protocol message from Host to Network Processor; assuming it has a valid application which supports mode toggle.

Figure 3 explains how MAC address is set to a ***CC1180*** Network Processor. Same communication flow also applies for message pairs *MAC_ADDRESS_READ/MAC_ADDRESS_READ_CONFIRM* and *VERSION_REQUEST/VERSION_REPLY*.

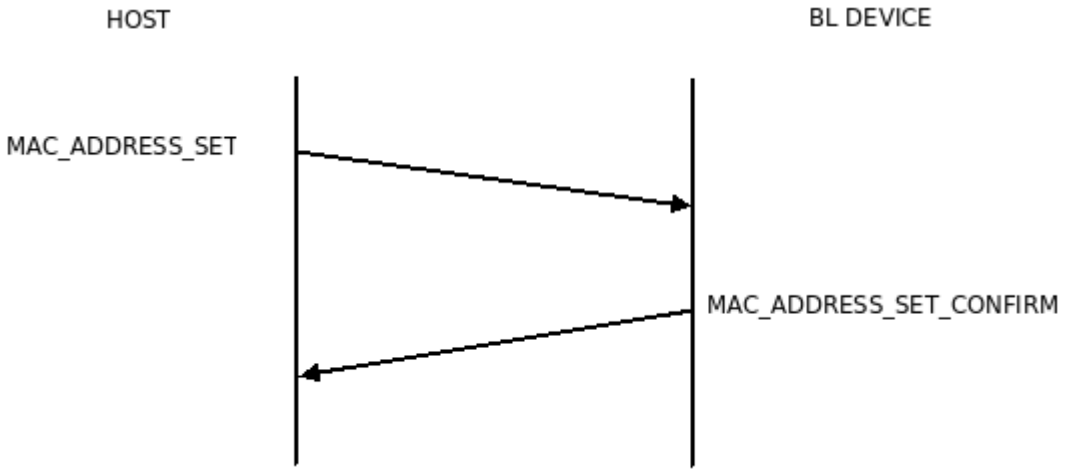


Figure 3. MAC address request

HOST represents PC or a host MCU device that implements the Host part of the communication protocol defined in this document. *BL Device* is the device running NanoBoot, i.e. ***CC1180***.

Figure 4 describes a situation where *HOST* sends an unrecognized message to *BL Device*. If *BL Device* is in NanoBoot mode it responds with *UNSUPPORTED_MESSAGE* cmd_id. If *CS* byte match fails, 'N' / 'A' headers are missing or *CT* byte does not match, then no *UNSUPPORTED_MESSAGE* response is sent as received data is quietly discarded on *BL Device*.

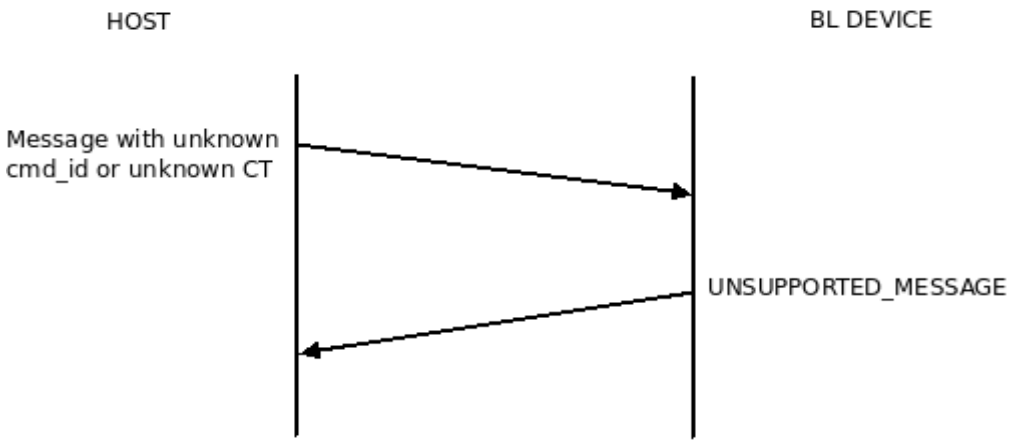


Figure 4. Unsupported data received by BL Device

To toggle between NanoBoot mode and application mode, message *APPLICATION_MODE_TOGGLE* can be used. This message type is one-way communication only as it switches *BL Device* mode immediately to application mode if NanoBoot is running when it is received. If the *HOST* sends the *APPLICATION_MODE_TOGGLE* message to *BL Device* while it is in application mode the *BL Device* will immediately toggle to NanoBoot mode.

4.6 Software update process

Software update can only be performed with a binary file provided by Sensinode Ltd. since Sensinode Ltd. encrypts the NanoStack 2.0 Lite 6LoWPAN stack. The *HOST* initializes communication by verifying that *BL Device* is in NanoBoot mode. This can be done by e.g. reading the MAC address of the ***CC1180*** device. If a valid reply is received, *BL Device* is in NanoBoot mode, since reading the MAC address is only possible if the device is in bootloader mode.

FLASH_WRITE_PAGE message consists of first page number, encoding flag, page setups and payload. Payload consists of 64 byte fragments of the complete binary file. The binary file has to be read so that first byte of *FLASH_WRITE_PAGE* payload is the 1024th byte of the binary file and the second byte of *FLASH_WRITE_PAGE* is the 1023rd byte of the binary file etc. Figure 5 demonstrates communication between *HOST* and *BL Device* during one flash page update.

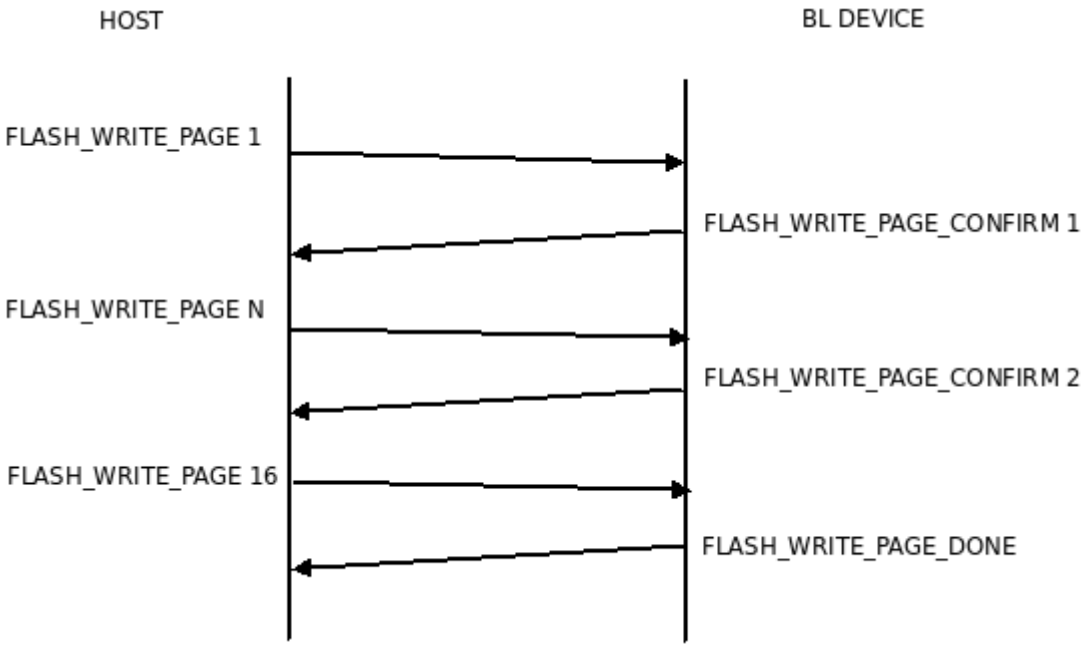


Figure 5. Software update process for one page

The single page flash update process is then repeated in order to send the complete binary file to *BL Device* in 64 byte blocks. If any errors occur during the process programming has to be restarted from beginning since binary is decrypted on *BL Device*. Possible error message is *UNSUPPORTED_MESSAGE*.

If programming is interrupted by the *BL Device* and it is not responding to *requests* it must be reset and NanoBoot mode initiated.

The NanoBoot cannot be overwritten as its bootloader flash memory area has write protection. Failure in the programming phase cannot cause errors to NanoBoot. The only way to remove the NanoBoot is to perform a complete chip erase via the debug interface. The debug interface is locked as well; the only allowed command is chip erase. *Note: Erasing the chip will result in having a blank **CC1110F32**, with no possible way to recover the Sensinode NanoBoot.*

4.6.1 FLASH_WRITE_PAGE message details

When a fragment of the firmware is sent to *BL Device,* headers of *FLASH_WRITE_PAGE* message must contain page specific and slice specific information. *Page Number*, *Encoding* flag and *Page Setup* contains information to which address the binary data payload *should* go on device. Page Number is offset multiple(s) of 1024 bytes and Page Setup is an offset multiple(s) of 64 bytes.

One flash page in **CC1180** is 1024 bytes. Therefore minimum Page Number is 1 and maximum Page Number is 27, as application firmware (stack) must be placed in segment from 0x0400 to 0x6FFF. If the binary is transferred in 64 byte blocks, it makes 16 blocks of 64 byte each per page. Therefore minimum Page Setup is 0 and maximum is 15 for one flash page.

Page number byte states to which page payload is going to be flashed.

Byte	Bit #7	Bit #6	Bit #5	Bit #4	Bit #3	Bit #2	Bit #1	Bit #0
Page Number	MSB	--	--	--	--	--	--	LSB
Page Setup	MSB	--	--	--	--	--	--	LSB

Table 5. FLASH_WRITE_PAGE message configuration bytes

Encoding flag is **always** 0x01.

5 Debug Interface

The CC1180 includes an on-chip debug interface, which communicates over a two-wire interface. The functionality of the debug interface in CC1180 is limited to erasing the on-chip flash memory. *Note: Erasing the chip will result in having a blank CC1110F32, with no possible way to recover the Sensinode NanoBoot. Do not connect the Debug Interface unless the intention is to remove the NanoBoot bootloader.*

The debug interface uses pins DEBUG_DATA and DEBUG_CLOCK. The only way to remove the NanoBoot bootloader is to perform a complete chip erase via the debug interface. For more information, see SWRS033.pdf.

6 Development Kit Ordering Information

Orderable Evaluation Module	Description	Minimum Order Quantity
CC-6LOWPAN-DK-868	Sub-GHz 6LoPWAN Development Kit, 868/915 MHz	1

Table 6. Development Kit Ordering Information

7 References

[1] CC1110 Datasheet (SWRS033.pdf)

[2] CC-6LOWPAN-DK-868 User's Guide (SWRU298.pdf)

8 General Information

8.1 Document History

Revision	Date	Description/Changes
SWRS113	29.08.2011	Initial Release
SWRS113A	09.09.2011	Editorial updates

Table 7: Document History

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
CC1180RSPR	ACTIVE	VQFN	RSP	36	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	CC1180	Samples
CC1180RSPT	ACTIVE	VQFN	RSP	36	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 85	CC1180	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

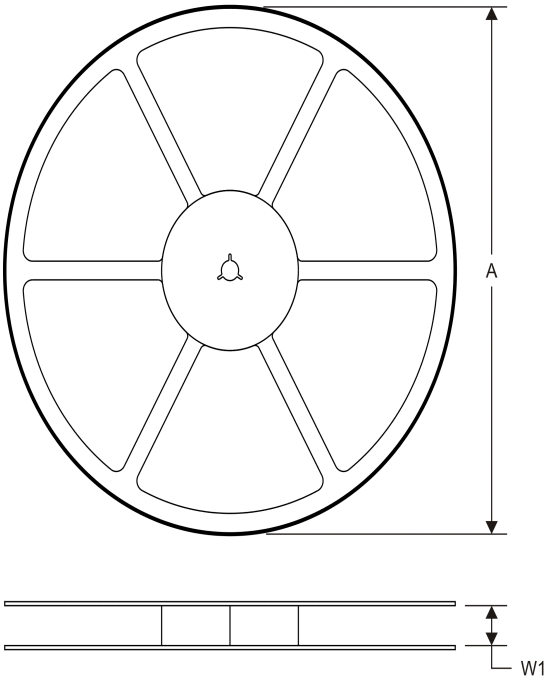
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

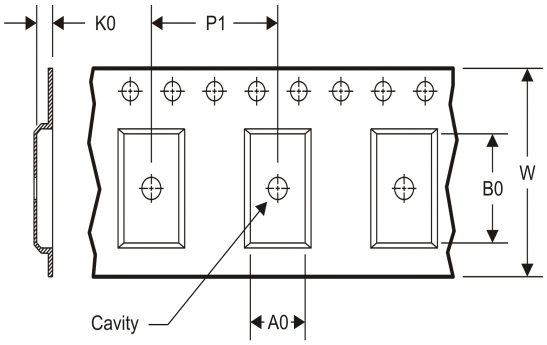
(4) Only one of markings shown within the brackets will appear on the physical device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



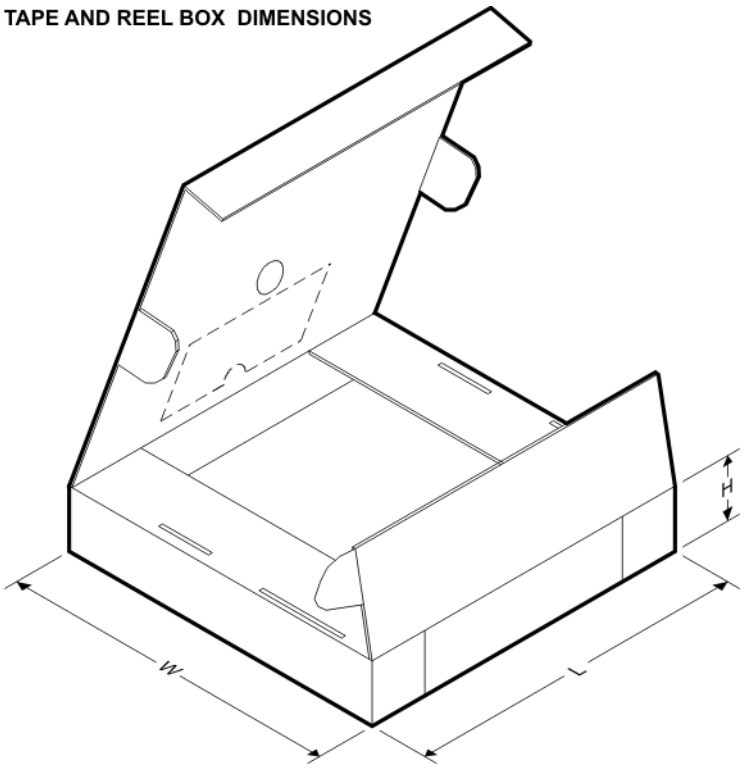
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CC1180RSPR	VQFN	RSP	36	2500	330.0	16.4	6.3	6.3	1.5	12.0	16.0	Q2
CC1180RSPT	VQFN	RSP	36	250	330.0	16.4	6.3	6.3	1.5	12.0	16.0	Q2

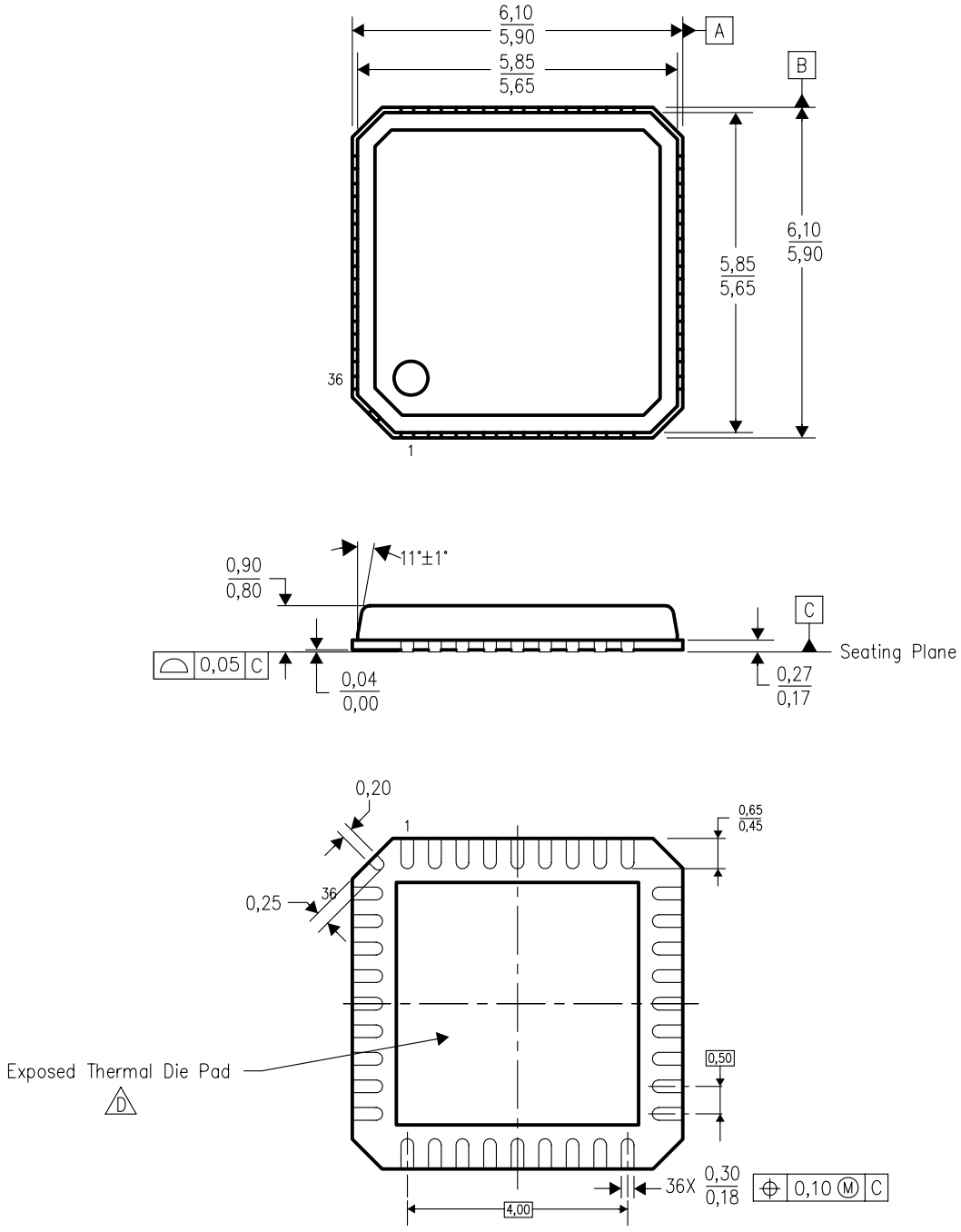
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CC1180RSPR	VQFN	RSP	36	2500	336.6	336.6	28.6
CC1180RSPT	VQFN	RSP	36	250	336.6	336.6	28.6

RSP (S–PQFP–N36) PLASTIC QUAD FLATPACK



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. QFN (Quad Flatpack No–Lead) Package configuration.
D. The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.

THERMAL PAD MECHANICAL DATA

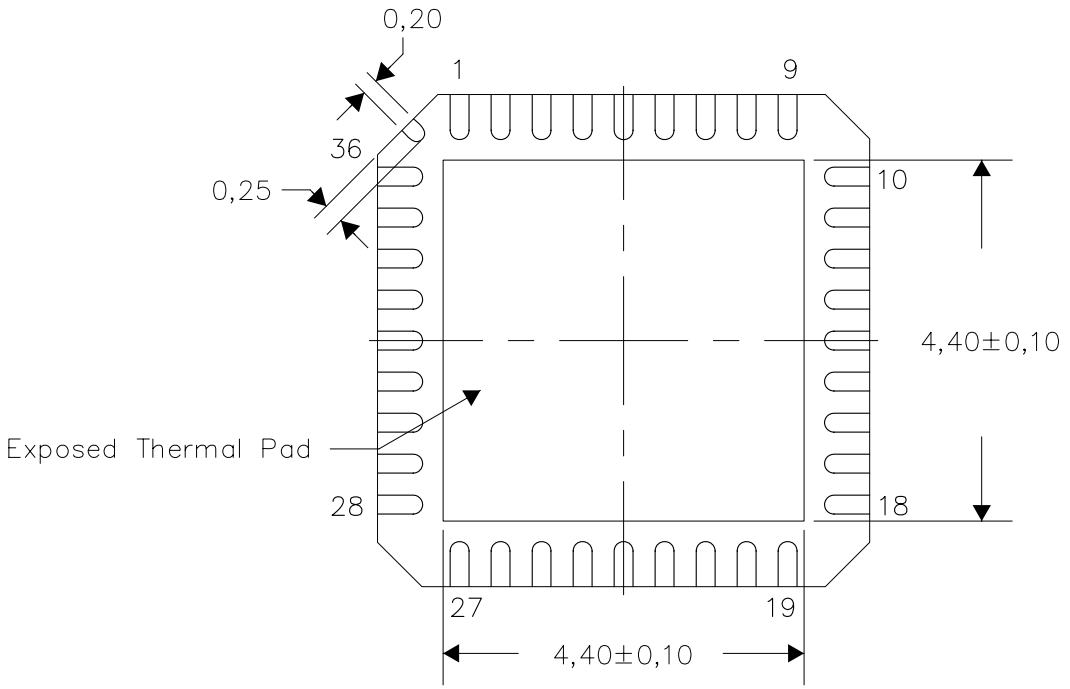
RSP (S–PVQFN–N36)

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No–Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

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