

# swarm bee LE Module

## Embedded 2.4 GHz Chirp Radio

## Location Awareness and Concurrent Wireless Communication

### Overview

*swarm bee LE* is nanotron's second generation *swarm* product family combining flexibility and integration with enhanced power management, simultaneous support for collaborative and fixed location systems, all housed in a rugged module suitable for embedded industrial environments.

- **Integrated API**  
The integrated firmware *swarm API* enables customers to speed up development and get the products to market quickly.
- **Ranging & Communication**  
With nanoLOC *swarm bee LE* radios can measure distance to each other using Time of Flight (TOF). At the same time, data can be exchanged between them.
- **Movement & Temperature Detection**  
The on-board MEMS sensor detects 3D acceleration and temperature changes. The sensor is controlled by *swarm API*.
- **RSSI Detection**  
RSSI values of signals from remote nodes are readable through *swarm API*.
- **Low Energy (LE)**  
With a new power saving concept, the radios can go to power-down mode to save energy consumption and thus ensure a longer battery lifetime. The power-down period is configurable through *swarm API*.

### Key Features

Frequency range .....	ISM-band 2.4 GHz (2.4~2.4835)
Modulation .....	Chirp Spread Spectrum (CSS)
Transmission Modes ....	80 MHz, 1 Mbps or 250 Kbps
ToA capture accuracy .....	< 1 ns (better than 30 cm)
Typical air time per ranging cycle .....	1.8 ms
RF output power .....	configurable -22 to +16 dBm
RF sensitivity @ 80/1 mode .....	-89 dBm typ.
RF sensitivity @ 80/4 mode .....	-95 dBm typ.
RF interface .....	50 Ohm RF Port
Host interface .....	UART 115 kbps
Supply voltage .....	3.0 V ~ 5.5 V
Maximum supply voltage ripple .....	20 mVpp
Active current dissipation .....	max. 120 mA during transmission, 60 mA during receive (at 20 °C, 3.3 V, in 80/1 mode)
Current dissipation in standby mode .....	6.5 mA (CPU stopped, all peripherals remain alert)
Current dissipation in deep-sleep mode .....	≤ 1 µA (module completely disabled)
Operating temperature range .....	-30 °C to +85 °C
Dimensions .....	40 x 24 x 3.5 mm
Weight .....	7 g

## swarm API

From version 2.1 onwards, the enhanced firmware *swarm* API supports three protocols – ASCII, BINARY and AIR - for direct communication between host and *swarm* radios as well as for reconfiguration of remote *swarm* radio nodes over the air.

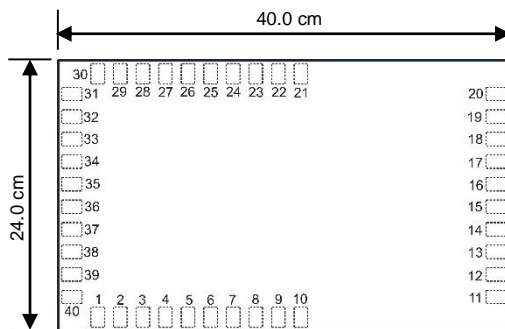
Using API commands, MEMS sensor data, RSSI value, battery level etc. of *swarm* radios can be accessed. Refer to [1] for a detailed description of API commands.

## Power Supply & Power Management

A single 3.3 V supply voltage is required to operate the radio. Supply voltage tolerances allow for direct connection to a 3.6 V LiPo battery or 5 V USB.

The *swarm* bee LE radio can go to sleep and only wake up periodically. The underlying power management concept enables the cooperation between the radios even if they sleep most of the time.

## Module Dimension & Pin Assignment



swarm bee LE Module – Top View

## Pin Description

Pin No.	Pin Name	Pin No.	Pin Name
1,5,7,8,9,11,23,28,31-33,36-40	Reserved	25	DIO_0
2	VIN	26	DIO_1
3,10,12,14-22	GND	27	DIO_2
4	A_MODE	29	UART_TX
6	MOD_EN	30	UART_RX
13	RF_PORT	34	DIO_3
24	ADC_IN	35	TX_ON

## Applications

The *swarm* bee LE radio is a fully integrated wireless node. It works in applications with both collaborative location technology based on TOF (ranging) and fixed location technology based on TDOA (time difference of arrival), and supports concurrent communication. Depending on application requirements, *swarm* bee LE can be designed as a basic tag without host controller or as a smart tag with an external host. Refer to [2] for more information.

## swarm bee LE Development Kit (Plus)

*swarm* bee LE Development Kit (“DK” for short) and DK Plus are useful tools for users to get quick acquaintance with the basic functionalities of *swarm* bee LE. The DK consists of DK Board (see figure below), *swarm* API, sniffer Firmware, *swarm* PC Tool and sniffer GUI. The *swarm* PC Tool demonstrates ranging application, sensor monitor etc. The DK Plus consists of DK Plus Board and the same software as DK.



swarm bee LE Development Kit Board

## Ordering Information

Order No.	Description
MNSWABEE	<i>swarm</i> bee LE
BNSWABEE	<i>swarm</i> bee LE Development Kit Board
BNSWABEEP	<i>swarm</i> bee LE Development Kit Plus Board
KNSWABEEN	<i>swarm</i> bee LE Development Kit
KNSWABEEP	<i>swarm</i> bee LE Development Kit Plus
PE232RG	Optional USB-to-Serial Cable for <i>swarm</i> bee LE Development Kit

## References

- [1] *swarm* API Description
- [2] Application Note – Tag Design with *swarm* bee LE

Today nanotron's *embedded location platform* delivers location-awareness for safety and productivity solutions across industrial and consumer markets. The platform consists of chips, modules and software that enable precise real-time positioning and concurrent wireless communication. The ubiquitous proliferation of interoperable location platforms is creating the location-aware Internet of Things.

Visit [www.nanotron.com](http://www.nanotron.com) for more information on nanotron's complete line of products and tools or write to us at nanotron Technologies GmbH, Alt-Moabit 60, 10555 Berlin, Germany.