

swarm bee LE Module

Embedded 2.4 GHz Chirp Radio

Location Awareness and Concurrent Wireless Communication

Overview

swarm bee LE is nanotron's first generation swarm product family combining flexibility and integration with enhanced power management housed in a rugged module suitable for embedded industrial environments. The swarm bee module provides continuous autonomous distance calculation, real-time location monitoring and concurrent wireless data communication using the same short RF signal.

- **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 accessible and 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 management concept the radios can work in different power modes to optimize energy consumption and lengthen the battery lifetime. Power modes can be configured 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 resolution	< 1 ns (better than 30 cm)
Typical air time per ranging cycle.....	1.8 ms
RF output power	-22 ~ 16 ± 2 dBm
RF sensitivity @80/1 mode.....	-89 dBm typ
RF interface.....	50 Ohm RF Port
Host interface (UART)	115 kbps ~ 2 Mbps
Supply voltage.....	3.3 V ~ 5.5 V
Maximum supply voltage ripple	20 mVpp
Active power consumption*	max. 120 mA during transmission, 60 mA during receive @80/1 mode
Power consumption in sleep mode*	5.5mA (transceiver disabled, all peripherals on)
Power consumption in snooze mode*	4.5 µA (transceiver disabled, all peripherals off, wake-up by timer)
Power consumption in nap mode**	4.5 ~ 600 µA (transceiver disabled, UART off, wake-up by interrupt)
Power consumption in deep-sleep mode*	≤ 1 µA (device completely disabled)
Operating temperature range	-30 ~ 85 °C
Dimensions	40 mm × 24 mm × 3.5 mm
Weight	7 g

*Power consumption in all modes is measured at 20°C, 3.3 V.

**Power consumption in nap mode depends on interrupt sources (GPIO pins, MEMS or both)

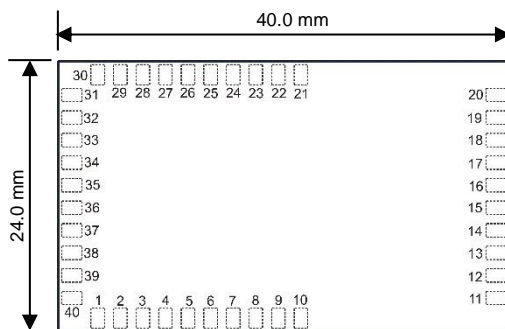
swarm API

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
1,7,9,11,23,28,31-33,37-40	Reserved	25	DIO_0
2	VIN	26	DIO_1
3,10,12,14-22	GND	27	DIO_2
4	A_MODE	34	DIO_3
6	MOD_EN	29	UART_TX
13	RF_PORT	30	UART_RX
24	ADC_IN	35	TX_ON
5	/NRST	36	COEX_DIV
8	+2V6	11	/TX_RX

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 data communication. Moreover, it can range and be located at the same time. 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 DK+

The *swarm* bee Development Kit Plus (DK+) is a useful tool for users to get quick acquaintance with the basic functionality of *swarm* bee LE. The Development Kit Plus consists of several DK+ Boards (see figure below) with antenna, *swarm* PC Tool which demonstrates ranging application, sensor monitor as well as to use the API via GUI and sniffer which allows to monitor the air interface.



swarm bee LE DK Plus Board

Ordering Information

Order No.	Description
MNSWABEE	<i>swarm</i> bee LE
KNSWABEEP	3 x DK+ Boards with <i>swarm</i> FW, 3 x antenna, sniffer GUI, <i>swarm</i> PC Tool
BNSWABEEP	Additional <i>swarm</i> bee LE Development Kit Plus Board

References

[1] *swarm* API User Guide V 3.0.

[2] Application Note – Tag Design with *swarm* bee LE

About Nanotron Technologies GmbH

Nanotron is a leading provider of electronic location awareness solutions. If knowing what, where and when is mission-critical to your business, rely on nanotron with Location Running. Nanotron's solutions deliver precise position data augmented by context information in real-time. Location Running means, reliably offering improved safety and increased productivity, 24 hours a day, 7 days per week: Location-Awareness for the Internet of Things (IoT).

Visit 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.