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 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 capture accuracy**.............. < 1 ns (better than 30 cm)
- **Typical air time per ranging cycle** .......................... 1.8 ms
- **RF output power**.............................. -22 ~ 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)**............... 500 bps ~ 2 Mbps
- **Supply voltage**......................... 3.0 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**..... 5.5 mA (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 or 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

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Pin No.</th>
<th>Pin Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,7,9,11,23,28, 31-33,37-40</td>
<td>Reserved</td>
<td>25</td>
<td>DIO_0</td>
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<tr>
<td>2</td>
<td>VIN</td>
<td>26</td>
<td>DIO_1</td>
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<tr>
<td>3,10,12,14-22</td>
<td>GND</td>
<td>27</td>
<td>DIO_2</td>
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<tr>
<td>4</td>
<td>A_MODE</td>
<td>29</td>
<td>UART_TX</td>
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<td>6</td>
<td>MOD_EN</td>
<td>30</td>
<td>UART_RX</td>
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<tr>
<td>13</td>
<td>RF_PORT</td>
<td>34</td>
<td>DIO_3</td>
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<tr>
<td>24</td>
<td>ADC_IN</td>
<td>35</td>
<td>TX_ON</td>
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<tr>
<td>5</td>
<td>/NRST</td>
<td>36</td>
<td>CO_DIV</td>
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<tr>
<td>8</td>
<td>+2V6</td>
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</table>

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 Dev. Board & DK Plus

swarm bee LE Development Board (“Dev. Board” for short) and Development Kit Plus (“DK Plus” for short) are useful tools for users to get quick acquaintance with the basic functionality of swarm bee LE. The Dev. Board consists of a swarm bee LE module, a header board and an antenna (see figure below). The DK Plus consists of several DK Plus Boards (see figure below) with antenna and swarm PC Tool which demonstrates ranging application, sensor monitor etc.

Ordering Information

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNSWABEE</td>
<td>swarm bee LE</td>
</tr>
<tr>
<td>BNSWABEE</td>
<td>swarm bee LE Development Board</td>
</tr>
<tr>
<td>BNSWABEEP</td>
<td>swarm bee LE Development Kit Plus Board</td>
</tr>
<tr>
<td>KNSWABEEP</td>
<td>swarm bee LE Development Kit Plus</td>
</tr>
<tr>
<td>PE232RG</td>
<td>Optional USB-to-Serial Cable for swarm bee LE Development Board</td>
</tr>
</tbody>
</table>

References


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 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.