swarm bee ER Module
Embedded Ultra Wide Band Radio
Location Awareness and Concurrent Wireless Communication

Overview

swarm **bee** location sensors are highly integrated wireless modules and deliver precise location information in real-time. Concurrent wireless data communication makes it easy to coordinate a swarm of independent radio nodes. The Ultra Wide Band (UWB) version called *swarm* bee ER is going to serve applications for very precise and reliable distance or location information between 0 and 20 Meter. The module utilizes the same comprehensive *swarm* API (Application Programming Interface) as all other *swarm* bee products. Main features include:

- **Integrated API**
  The integrated firmware *swarm* API enables customers to speed up development and get the products to market quickly.

- **Ranging & Communication**
  Autonomous *swarm* bee ER radio modules are able to measure the distance between them using time-of-flight (TOF) technology. At the same time they send out broadcast packets (blinks) advertising their ID. These blinks can be located in nanotron's time-difference-of-arrival (TDOA) location framework. The module support concurrent data communication.

- **Movement & Temperature Detection**
  The on-board MEMS sensor detects 3D acceleration and temperature changes. The sensor is controlled by the *swarm* API.

- **Enhanced Resolution (ER)**
  In the product name the suffix ER stands for Enhanced Resolution and signifies Micro-Location with UWB achieving 10 cm location accuracy.

Key Features

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KeyFrequency Bands	6 bands with fc from 3.5 to 6.5 GHz
Data Rates.............................	110 Kbps, 850 Kbps, 6.8 Mbps
Packet Size.......................................	up to 1023 Bytes
ToA capture accuracy	10 cm
Ranging distance..	50 m
RF output power	-14 or -10 dBm
Transmit power density...............................	< -41.3 dBm / MHz
RF sensitivity @ 110 Kbps	-102 dBm typ.*
RF sensitivity @ 6.8 Mbps	-92 dBm typ. *
RF interface	50 Ohm RF Port
Host interface (UART)................................	115 kbps ~ 1 Mbps
Supply voltage	3.0 V ~ 5.5 V
Active current consumption TX.............................	max. 170 mA
Active current consumption RX	max. 130 mA
Current consumption in standby mode .... (CPU stopped, all peripherals on)	6.5 mA
Current consumption in snooze mode .... (Autonomous mode enabled, all peripherals off)	max. 6 µA
Current consumption in nap mode .... (CPU stopped, GPIO off, UART off, MEMS alert)	max. 20 µA*
Current consumption in nap mode .... (CPU stopped, GPIO alert, UART off, MEMS off)	max. 500 µA
Current consumption in deep-sleep mode .... (module completely disabled)	≤ 1 µA
Operating temperature range	-30°C to +85°C
Dimensions	40 mm × 24 mm × 3.5 mm
Weight	7 g

swarm API

The common *swarm* API supports three protocols: ASCII and BINARY on the host interface and AIR for controlling the module over the air. The ability of the module to be configured over the air allows for entirely autonomous operation even stand-alone without a host controller.

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 ER 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
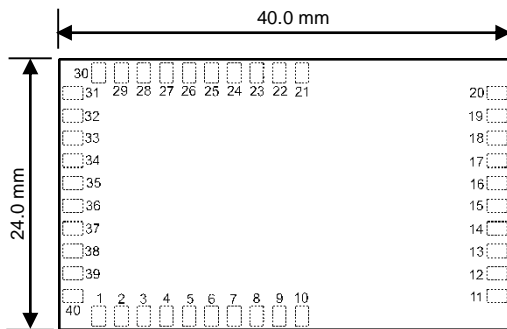
swarm bee ER Module – Top View

Pin Description

Pin No.	Pin Name	Pin No.	Pin Name
1,5,7,9,11,23, 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	29	UART_TX
6	MOD_EN	30	UART_RX
8	+3V	34	DIO_3
13	RF_PORT	35	TX_ON
24	ADC_IN	36	DIV_COEX

Applications

The *swarm* bee ER module targets the market for autonomous smart items. Specifically it is going to serve applications for very precise and reliable distance or location information between 0 and 20 Meter. This is required for exclusion zone applications improving operator safety in underground mines and harsh industrial environments. The module serves as a hardware platform for tags and

sensors and can be operated stand-alone for lowest possible cost or with an external host controller for additional item intelligence.

swarm bee LE Dev. Board & DK Plus

swarm bee ER 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 ER. The Dev. Board consists of a *swarm* bee ER 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.

swarm bee ER Development Board

swarm bee ER DK Plus Board

Ordering Information

Order No.	Description
MN01SWBER	*swarm* bee ER
BN01SWBEM	*swarm* bee ER Development Board
BN01SWBEP	*swarm* bee ER Development Kit Plus Board
KN01SWBER	*swarm* bee ER Development Kit Plus
PE232RG	Optional USB-to-Serial Cable for *swarm* bee ER Development Board