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swarm bee LE V3 DK+ User Guide

1.2

NA-20-0386-0006

Document Information

Document Title:	*swarm* bee LE V3 DK+ User Guide
Document Version:	1.2
Current Date:	2021-04-07
Print Date:	2021-04-07
Document ID:	NA-20-0386-0006
Document Author:	MBOR

Contents

1. Introduction

The *swarm* bee LE V3 DK+ Board is a tool to develop, test and debug software based on Nanotron's *swarm* bee LE V3 module. Several connectors and test points help to measure particular parameters, such as RF output power or current consumption.

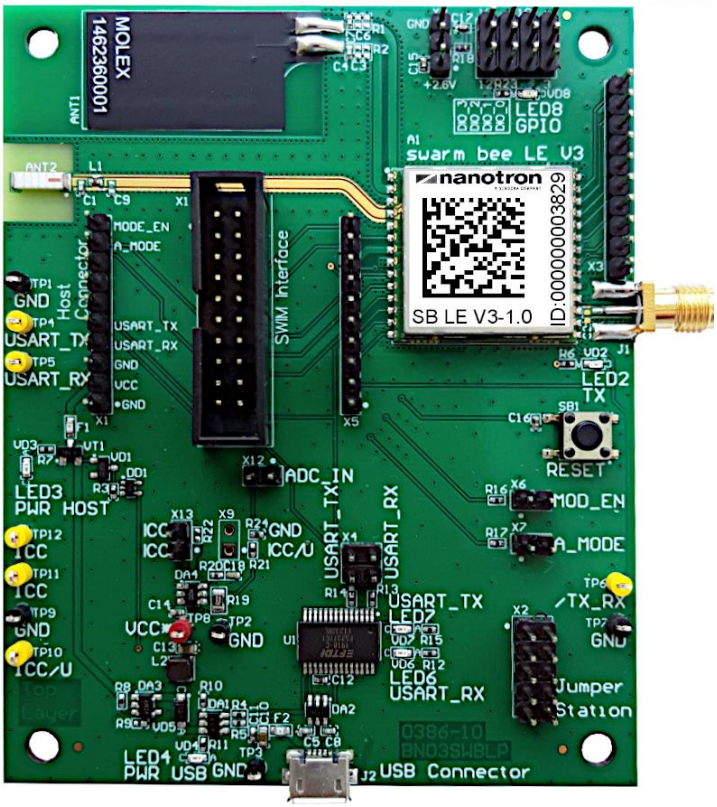

Figure 1-1: *swarm* bee LE V3 DK+ Board

2. Technical Data

User and debugging interface 1 ..... *swarm* bee LE V3 USART, 500 bps to 1 Mbps, default 115.2kbps
User and debugging interface 2 ..... USB, converted to USART by FTDI chip, 115.2kbps

Supply voltage via host connector .....+3.1 V…+5.5 V
Power consumption over host connector (@ 3.3 V).....max. 250 mA
Maximum supply voltage ripple when supplied via host connector .....30 mVpp
Supply via micro USB ..... standard 5 V USB power supply
Power consumption over USB .....max. 200 mA

Operating temperature.....-30°C to +85°C
Dimensions (L x W x H) .....80 mm x 100 mm x 22 mm
Weight.....46 grams

Note: All technical data related to the *swarm* bee LE V3 module can be found in [1]

3. Block Diagram

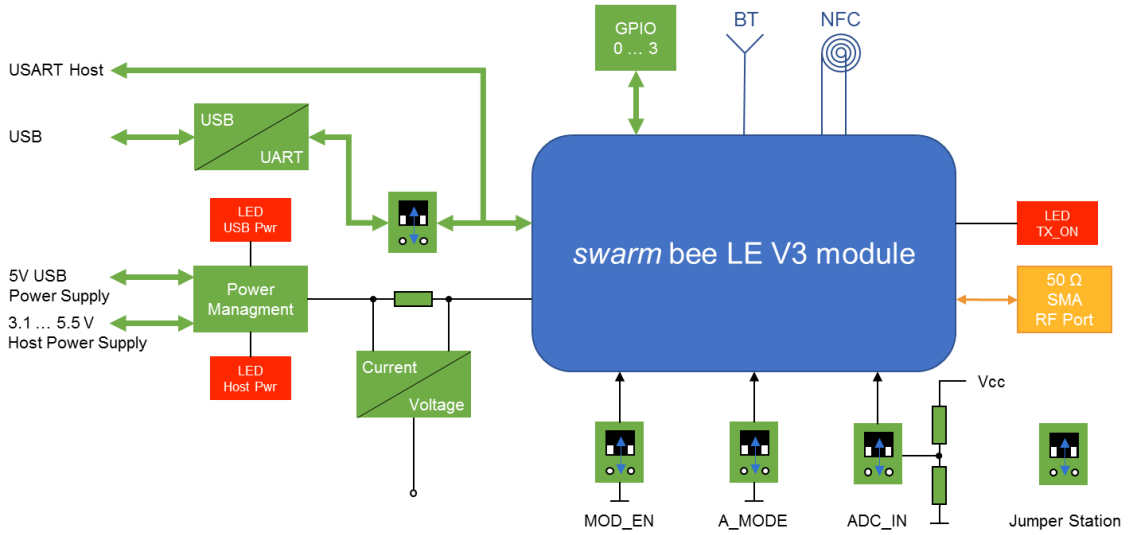

Figure 3-1: Block diagram of *swarm* bee LE V3 DK+ Board

Note: Bluetooth and NFC are currently not supported and will be enabled in the future by firmware update.

4. Connector Configuration

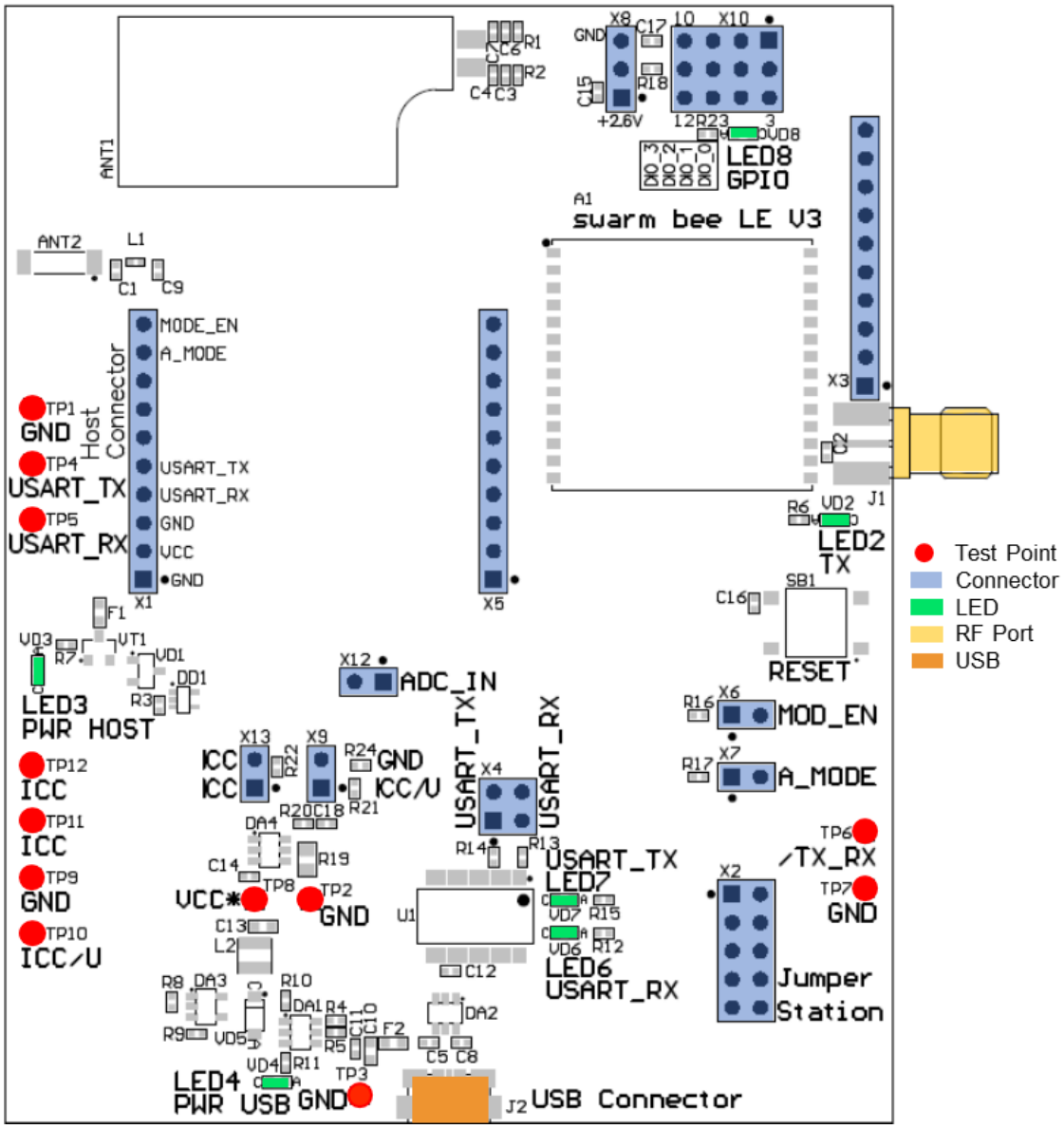

Figure 4-1: *swarm* bee LE V3 DK+ Board, assembly and connector configuration

Note: ANT1 and ANT2 are for future use

Table 4-1: *swarm* bee LE V3 DK+ Board connector configuration

Connector No.	Description	Type	Default State
J1	RF port	SMA type, 50 Ohm impedance	Open
J2	USB	micro-USB	Open
X1	Host connector	Pin connector, 10 poles	Open
X2	Jumper station	Pin connector, 2 x 5 poles	Spare jumpers
X3	*swarm* bee LE pin header	Pin connector, 10 poles	Open
X4	USB to Serial bridge	Pin connector, 2 x 2 poles, jumper	Closed
X5	*swarm* bee LE pin header	Pin connector, 10 poles	Open
X6	Enable *swarm* bee LE module	Pin connector, 2 poles, jumper	Open
X7	Enable autonomous mode	Pin connector, 2 poles, jumper	Closed
X8	Pull-up or pull-down bridge	Pin connector, 3 poles, jumper	Open
X9	Current to voltage converter	Open lead	Open
X10	GPIO Jumper Matrix	Pin connector, 3 x 4 poles, jumper	Open
X11	Reserved	Connector, 10 poles	Reserved
X12	ADC input for measuring supply voltage	Pin connector, 2 poles, jumper	Closed
X13	Measurement of current profile	Pin connector, 2 poles, jumper	Closed

4.1. Connector Description

All electrical parameters except those explicitly stated in this documents refer to the ones specified in the *swarm* bee LE V3 data sheet [1].

4.1.1. Connector J1

J1 is a SMA connector with 50 Ohm impedance. It is terminated directly to the RF port of the *swarm* bee LE V3 module. The output power is calibrated to be close to +20 dBm.

Note1: The provided antenna to this development kit has a gain of 3 dBi. To be in accordance with regional regulations it is required to lower the emitted power by 3 dB by using the STXP API command. Example: STXP 50. See also the API 3.0 User Guide [2].

Note 2: Depending on the gain of the connected antenna, be aware that it may exceed the +20 dBm radiated power which may conflict with regional regulations. In this case it is possible to reduce the emitted power by the appropriate API command as explained above.

4.1.2. Connector J2

J2 is a standard micro-USB-B connector to connect the *swarm* bee LE V3 DK+ Board to a host PC (data and power) or a USB power pack or supply.

4.1.3. Connector X1

The Host Connector serves to connect the serial interface of a host controller to the *swarm* bee LE V3. It can also be used as alternative power supply instead of the USB one. When supplied via pin 2 it takes precedence to the USB power supply. The A_MODE and MOD_EN can also be controlled over this connector.

Table 4-2: X1 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1	Ground			
2	Vcc	Supply voltage		+3.1V…+5.5V
3	Ground			
4	USART_RX	Input: Serial receiving line	19	If connected to a host remove jumpers on X4. See Figure 4-2
5	USART_TX	Output: Serial transmission line	12	
6	Not connected			
7	Not connected			
8	Not connected			
9	A_MODE	Input: Autonomous (high) or host-controlled mode (low)	9	Default high
10	MOD_EN	Input: Module enabled (high) or disable (low)	11	Default high

Note: All levels except Vcc and MODE_EN refer to 2.6 V. MOD_EN refers to Vcc. In any case refer to the s*warm* bee LE V3 Data sheet [1].

USART settings are: 115.2 Kbps, 1 start bit, 8 data bits, 1 stop bit, no parity, no flow control

4.1.4. Connector X2

The Jumper Station serves to park spare jumpers. It has no electrical function.

4.1.5. Connector X3

Table 4-3: X3 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1	Ground			
2	ADC_IN	Input: Measures the voltage referred to 2.6 V	21	2.6 V max.
3	DIO_0	Input or Output. Can be used for wake-up and interrupt source	22	If connected to an external device remove jumpers on X10. See Figure 4-3
4	DIO_1	Input or Output. Can be used as interrupt source	23	
5	DIO_2	Input or Output. Can be used as interrupt source	24	
6	DIO_3	Input or Output. Can be used as interrupt source	25	
7	USART_TX	Output: Serial transmission line	12	If connected to a host remove jumpers on X4. See Figure 4-2
8	USART_RX	Input: Serial receiving line	19	
9	TX_ON	Transmitter on (min. on time 50 ms)	26	
10	DIV_COEX	Can be used for co-existence purposes with external BT or Wi-Fi systems	27	

Note: All levels refer to 2.6 V. In any case refer to the s*warm* bee LE V3 Data sheet [1].

4.1.6. Connector X4

The USB to Serial bridge serves to connect or disconnect the USB to serial converter to the UART lines. The jumpers shall be removed if a serial interface is connected to the Host connector X1. See Figure 4-2.

Table 4-4: X4 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1-2	USART_TX	Output: Serial transmission line	12	If closed do not connect to X1 or X3
3-4	USART_RX	Input: Serial receiving line	19	

Note: All levels refer to 2.6 V. In any case refer to the s*warm* bee LE V3 Data sheet [1].

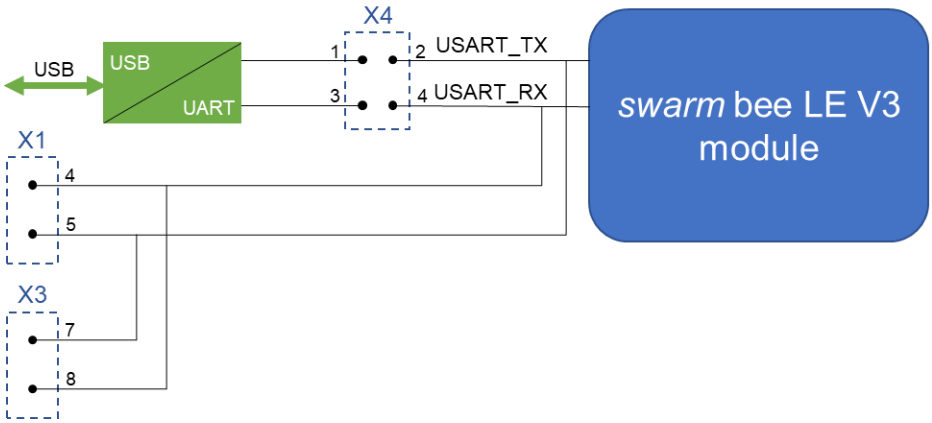

Figure 4-2: USART connectors

4.1.7. Connector X5

Table 4-5: X5 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1	Ground			
2	\TX_RX	Output: RX (high), TX (low)	15	Transceiver direction
3	Reserved		-	Do not use
4	+2V6	µController voltage. Can be used for level shifters	13	
5	MOD_EN	Input: Module enabled (high) or disable (low)	11	
6	\NRST	Input: Resets µController, active (low)	10	
7	A_MODE	Input: Autonomous (high) or host-controlled mode (low)	9	
8	VIN	Output: Supply voltage of *swarm* bee LE V3 module	7	
9	Reserved		-	Do not use
10	Reserved		-	Do not use

Note: All levels refer to 2.6 V. In any case refer to the s*warm* bee LE V3 Data sheet [1].

4.1.8. Connector X6

Is a jumper bridge which enables or disables the *swarm* bee LE V3 module.

Table 4-6: X6 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1-2	MOD_EN	Jumper	11	Closed: disabled, Open: enabled

Note: MOD_EN level refers to Vcc. In any case refer to the s*warm* bee LE V3 Data sheet [1].

4.1.9. Connector X7

Is a jumper bridge which sets the *swarm* bee LE V3 module into autonomous or host-controlled mode.

Table 4-7: X7 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1-2	A_MODE	Jumper	9	Closed: host controlled Open: autonomous mode

Note: All levels refer to 2.6 V. In any case refer to the s*warm* bee LE V3 Data sheet [1].

4.1.10. Connector X8

The pull-up or pull-down bridge serves in conjunction with jumper matrix X10 to determine the logical level of the GPIOs if configured as input. See Figure 4-3.

Table 4-8: X8 connector pin assignment

Pin No.	Description	Type	Module Pin	Comments
1-2	Pull-up	+2.6V	13	Logic high
2-3	Pull-down	Ground		Logic low

4.1.11. Connector X9

At this two leads the instantaneous current can be measured. When connecting to an oscilloscope, the current profile can be seen. Therefore, the current is converted into a voltage. 100 mA corresponds to 1.0 V (1:10). See also Figure 4-5. It measures the sum of all currents consumed by the module.

4.1.12. Connector X10

This jumper matrix can be used to either set a GPIO pin to logical high or low if configured as input or to display the state of a GPIO through a LED when configured as output. Figure 4-3 shows the principle. The RC element 1K/47µF composes an elementary debouncing circuit.

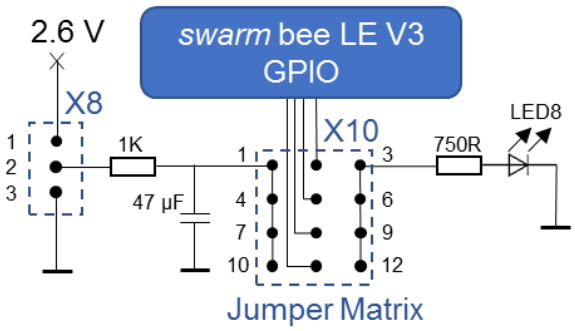

Figure 4-3: Jumper matrix with pull-up and pull-down jumper

How to configure each GPIO is explained in details in the *swarm* bee API3.0 User Guide [2] sect 5.6.11 and followings.

Note: For a proper debouncing, always connect the jumper as input on X10 first and then change the polarity on X8. Otherwise, an unpredictable behavior will occur.

4.1.13. Connector X11

Reserved and for future use.

4.1.14. Connector X12

When the jumper is closed, the input voltage of the *swarm* bee LE V3 module can be measured by the µController with the corresponding API 3.0 commands [2] GBAT. If a voltage is injected at pin 2 of X3 leave the connector open.

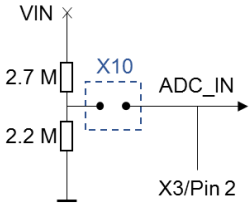

Figure 4-4: Voltage divider

4.1.15. Connector X13

This jumper bridge when opened allows to connect a current measuring device, like an amperemeter, in series to the main power supply of the *swarm* bee LE V3 module VIN. It measures the sum of all currents consumed by the module.

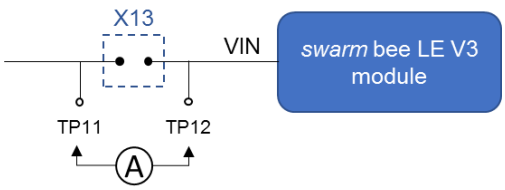

Figure 4-5: Current measurement

5. Test Points

The *swarm* bee LE V3 DK+ Board provides test points for measurements. The test points are suited to connect oscilloscope or multimeter probes.

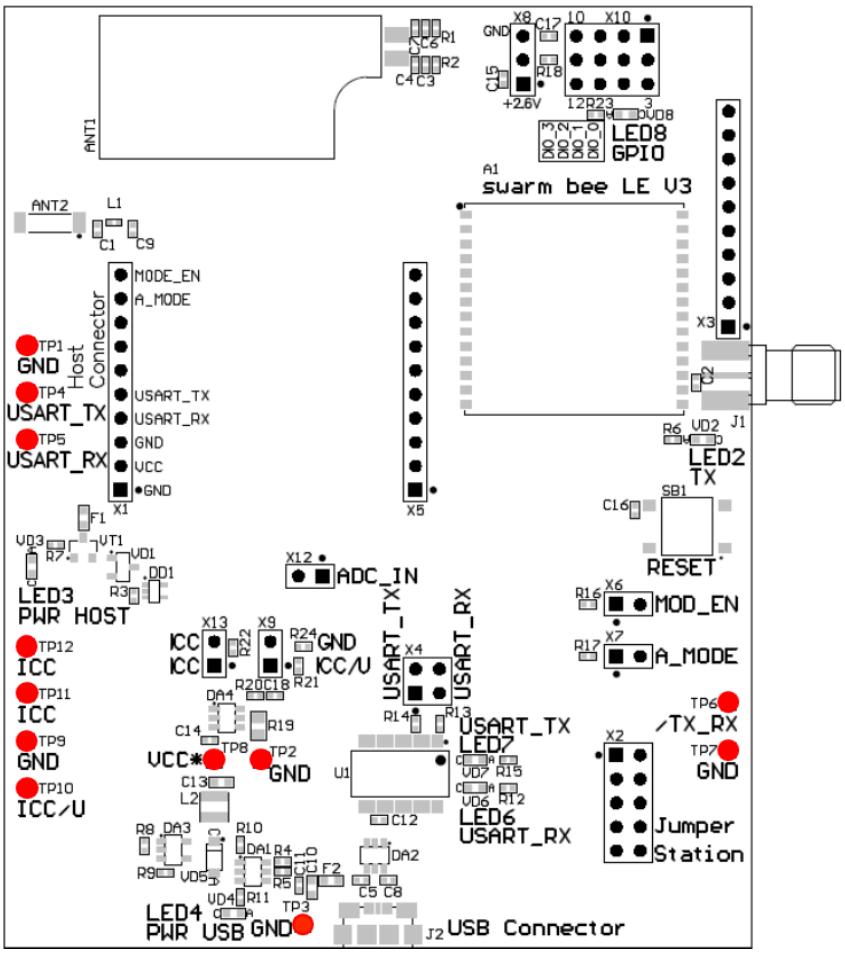

Figure 5-1: Test points position

Table 5-1: Test points pin assignment

TP No.	Description	Function	Comments
TP1	GND	Ground	
TP2	GND	Ground	
TP3	GND	Ground	
TP4	USART_TX	Output: Serial transmission line	
TP5	USART_RX	Input: Serial receiving line	
TP6	/TX_RX	Hardware TX indicator	TX = low, RX (2.65 V) = high (nanoLOC)
TP7	GND	Ground	
TP8	VCC*	Supply voltage	Supply voltage of the *swarm* bee LE module
TP9	GND	Ground	
TP10	ICC/U	Supply current converted to voltage	Supply current is converted to a voltage, ratio is 1:10 (100mA → 1V), see sect. 4.1.11 and 5.1
TP11	ICC	Current measurement	Same function as X13, see chap. 4.1.15
TP12	ICC	Current measurement	Same function as X13, see chap. 4.1.15

5.1. Test point TP10

On test point TP10 the supply current of the *swarm* bee LE module is converted to an equivalent voltage. The ratio between the supply current and the equivalent voltage is 100mA → 1V. This means, the current of the different operating states of the *swarm* bee LE V3 module like the TX current and the RX current, can be measured at this point. With an oscilloscope, a current profile can be measured over the time, which allows to optimize the power consumption of the module to the needs in relation to the configurable parameters via the API [2]. Figure 5-2 shows the current consumption of the *swarm* bee LE V3 module at different operating states.

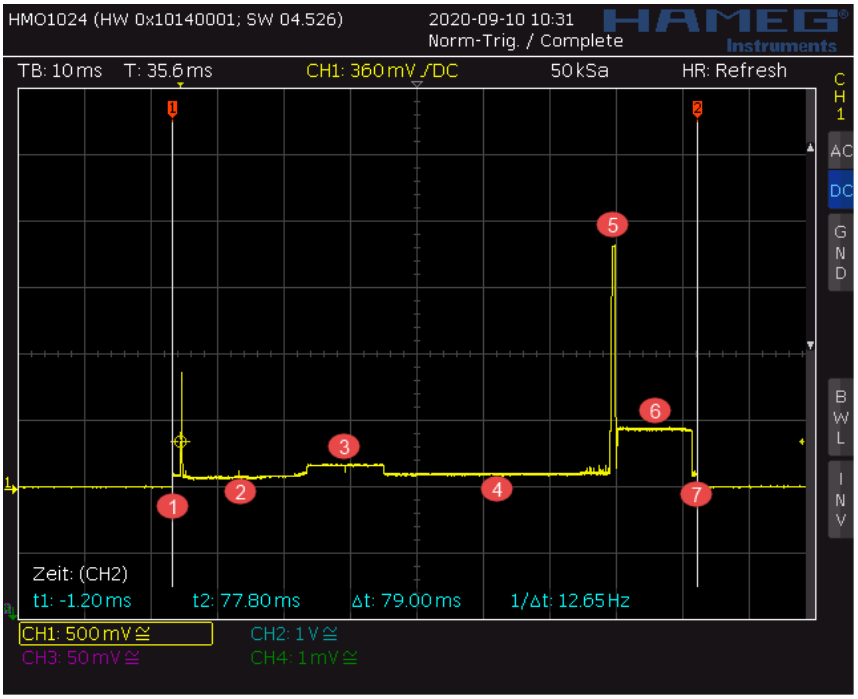

Figure 5-2: Screenshot of a typical *swarm* bee LE module current profile

Table 5-2: Description of operating modes shown in Figure 5-2

State	Description
1	Wakeup after nap mode
2	Switching on the DC/DC converter for supplying the RF power amp and nanoLOC Initialization of nanoLOC
3	Frequency calibration of nanoLOC
4	Initialization of the MEMS sensor
5	Transmitting Broadcast ID
6	Receiving Window
7	Shut down to nap mode

6. LEDs

Several LEDs have been placed to display the status of particular functions.

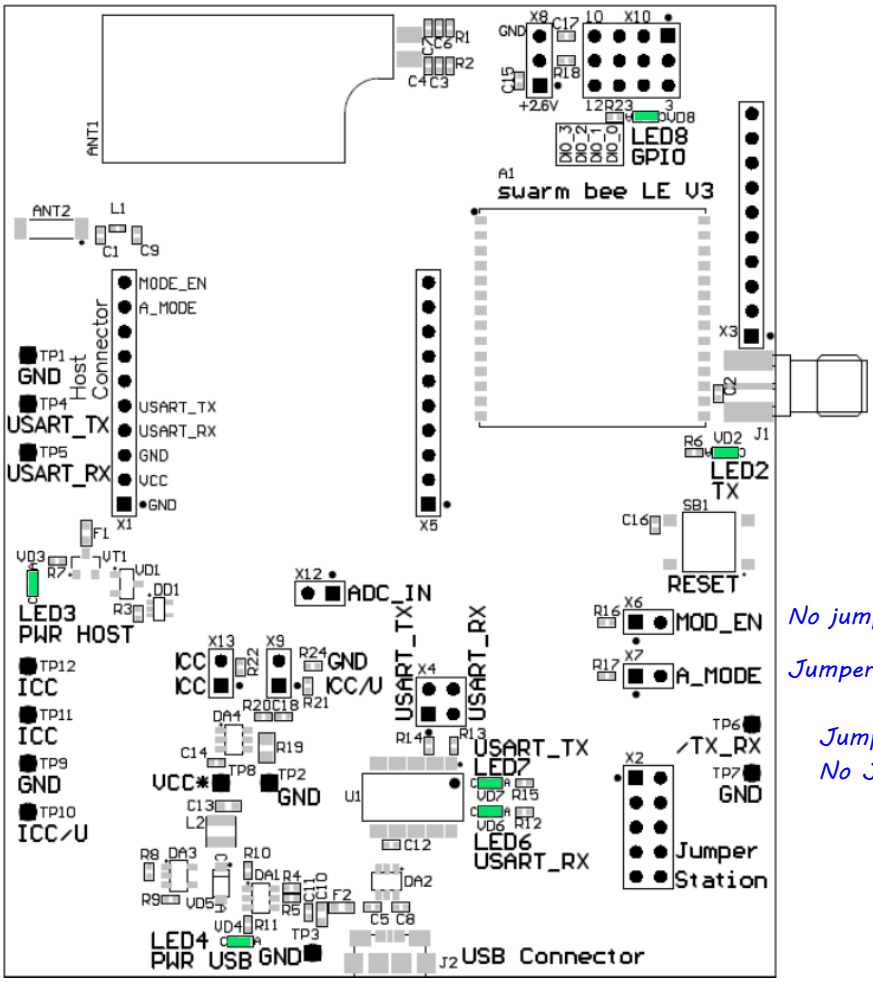

Figure 6-1: LEDs position

Table 6-1: LEDs assignment

TP No.	Description	Function	Comments
LED2	TX_ON	On: RF transmission	Luminescence 50 ms
LED3	PWR Host	External Power connected	PWR Host takes precedence on PWR USB
LED4	PWR USB	USB Power connected	
LED6	USART_RX	Status of serial RX line	
LED7	USART_TX	Status of serial TX line	
LED8	GPIO	If connected to jumper matrix status of the connected GPIO	High: On / Low: Off

7. Schematic

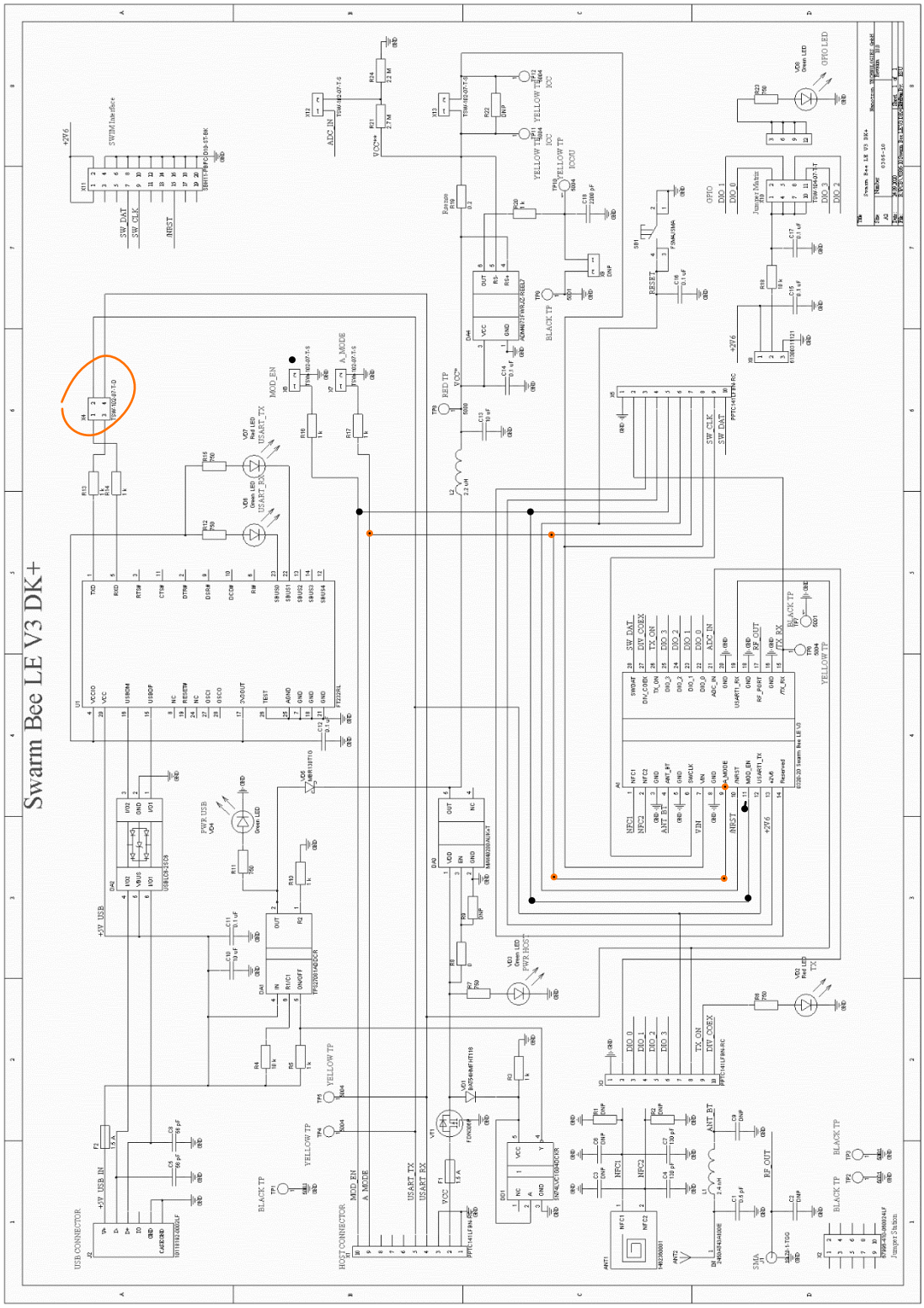

Figure 7-1: *swarm* bee LE V3 DK+ Board schematic

8. Dimensions

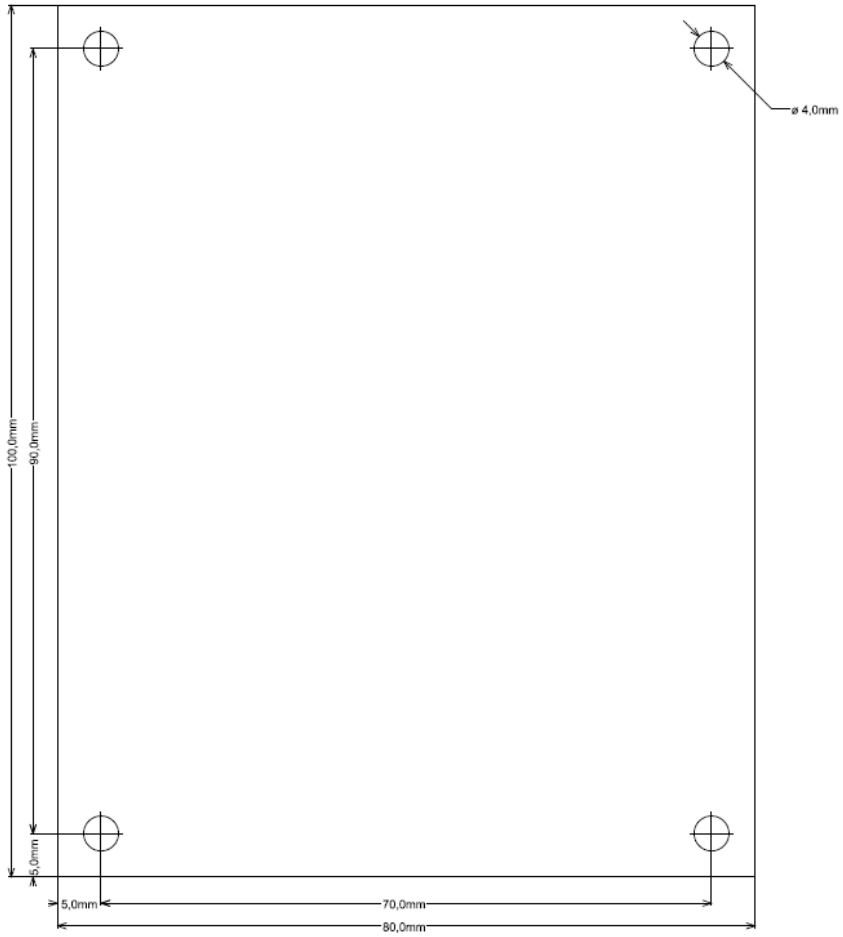

Figure 8-1: Dimensions of the *swarm* bee LE V3 DK+ board

9. References

[1] *swarm* bee LE V3 Data Sheet, Doc Id. NA-19-0382-0024
[2] Nanotron *swarm* API 3.0, NA-13-0267-0003

Document History

Date	Author	Version	Description
2020-10-28	MBOR	1.0	First Release
2021-03-04	MBOR	1.1	Corrections on power consumption
2021-04-07	MBOR	1.2	Corrections on USART connections

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