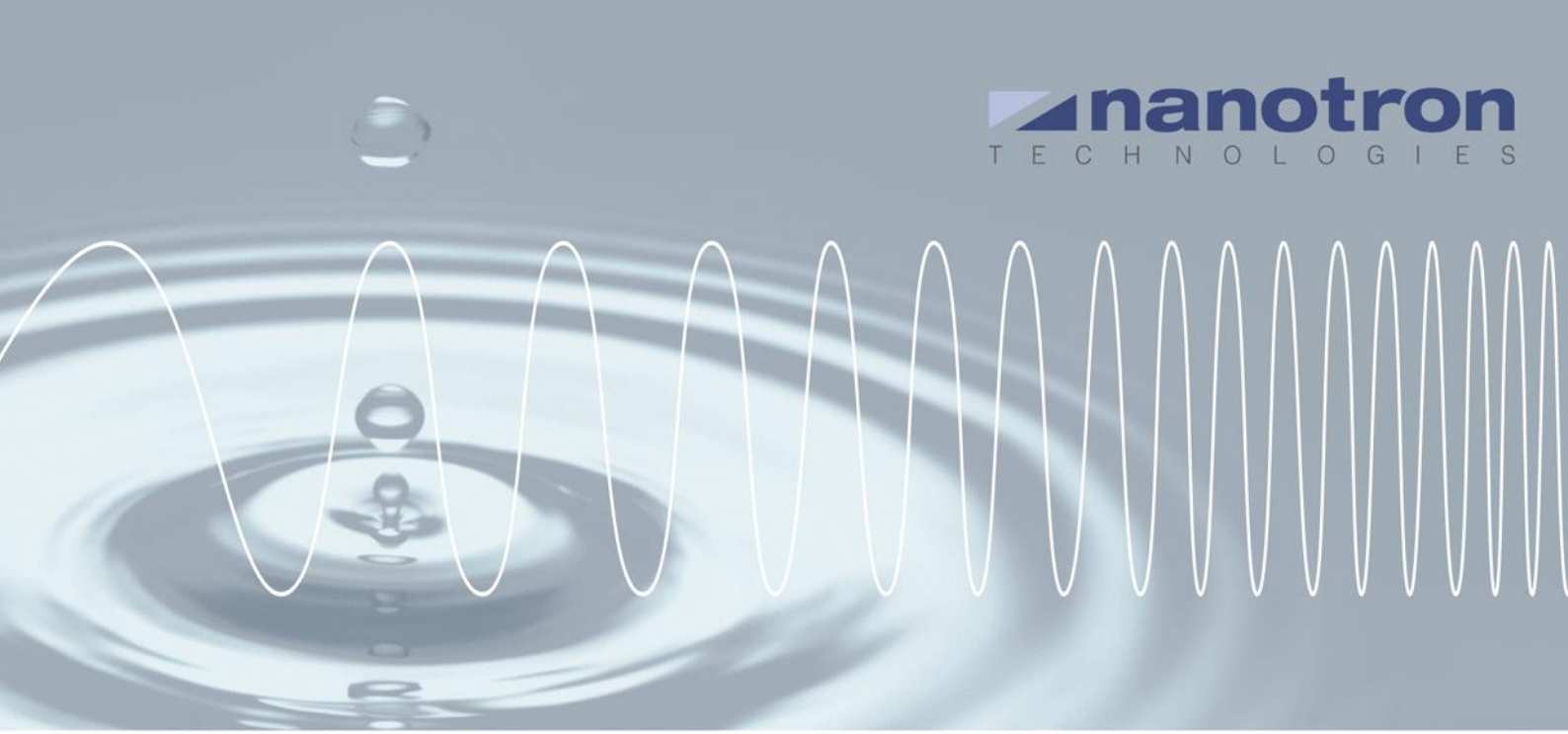

swarm bee LE DK+ Board - User Guide

1.2

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Document Information

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Contents

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1 General Function

The swarm bee LE DK+ Board serves as a development tool for developing, testing and debugging software for Nanotrons swarm bee LE module. Several test points and connectors help to measure certain hardware parameters, such as RF output power or current consumption.
In the following document for the swarm bee LE DK+ Board sometimes in figures and tables the term “swarm bee kit” is used.

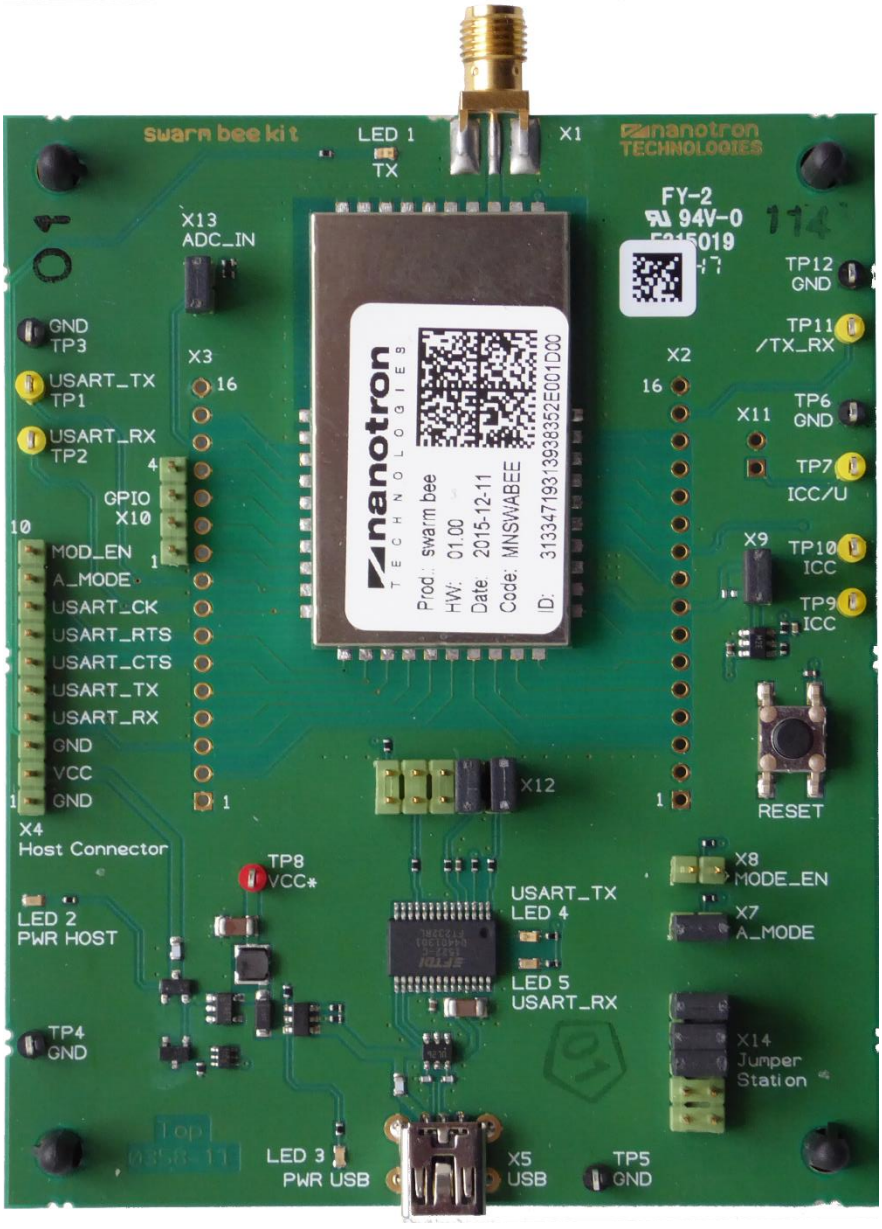

Figure 1-1: Swarm bee LE DK+ Board

2 Technical Data

User and debugging interface 1…….…. ST microcontroller embedded USART, 500 bps…2 Mbps

User and debugging interface 2…….…. USB, converted to USART by FTDI chip, 115kbps

Supply voltage via host connector ……..…….....+3.1 V…+5.5 V

Power consumption over host connector……..……max. 135mA

Maximum supply voltage ripple when supplied via host connector ……30 mVpp

Supply via USB …….…….... standard USB power supply

Power consumption over USB.....…..…….....……..…..…….. max. 115 mA

Operating temperature…… -30°C…+85°C

Dimensions (L x W x H)..... 80 mm x 100 mm x 22 mm

Weight……45 g

3 Block Diagram

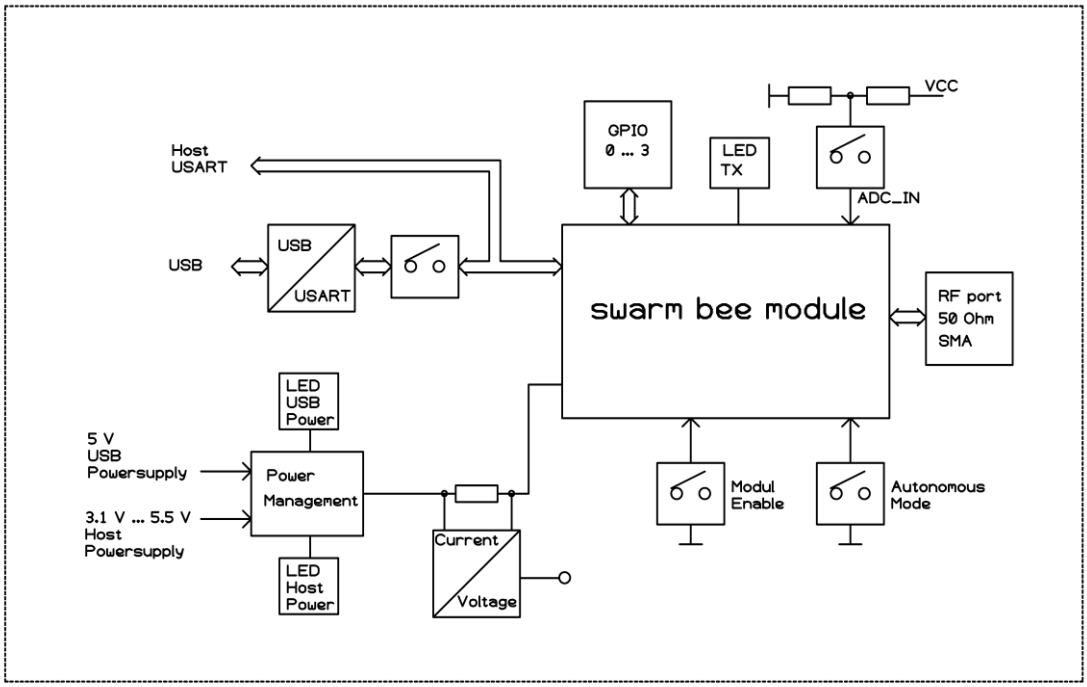

Figure 3-1: Block diagram of swarm bee LE DK+ Board

4 Connector Configuration

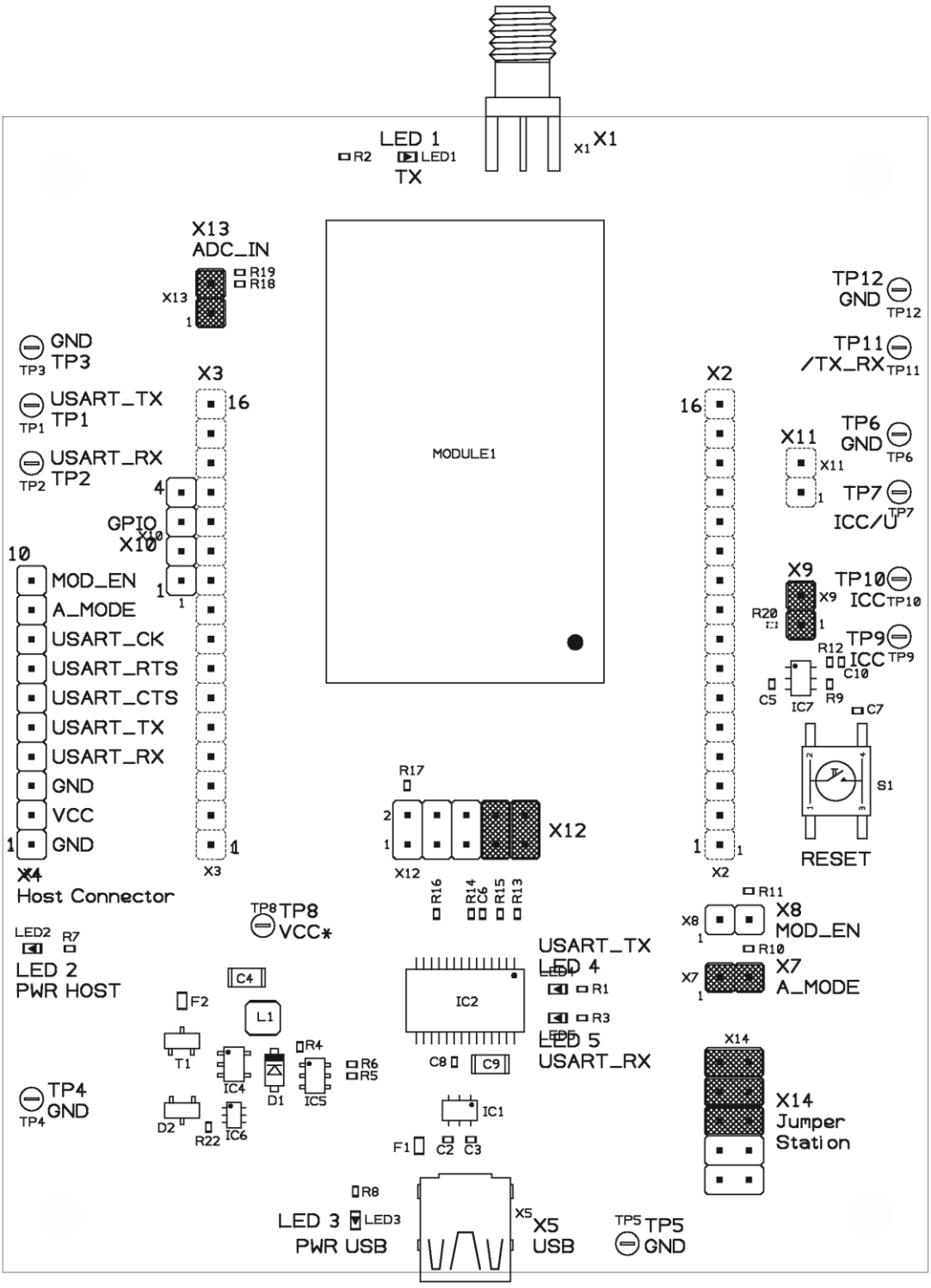

Abbildung 4-1: Swarm bee LE DK+ Board, assembly and connector configuration

Table 4-1: Swarm bee LE DK+ Board connector configuration

Connector No.	Description	Type	Default State
X1	RF port	SMA type, 50 Ohm impedance	assembled
X2	Swarm bee LE pins lead through	Pin connector, 16 pole	not assembled
X3	Swarm bee LE pins lead through	Pin connector, 16 pole	not assembled
X4	Host connector	Pin connector, 10 pole	assembled, open
X5	USB	Mini-B	assembled
X7	Enable autonomous mode	Pin connector, 2 pole, jumper	assembled, closed
X8	Enable swarm bee LE module	Pin connector, 2 pole, jumper	assembled, open
X9	Measurement of current profile	Pin connector, 2 pole, jumper	assembled, closed
X10	GPIO ports 0…3, swarm bee LE pins lead through	Pin connector, 4 pole	assembled, open
X11	Voltage output of current profile	Pin connector, 2pole	not assembled
X12	USB to Serial	Pin connector, 2 x 5 pole	assembled, partially closed
X13	ADC input for measuring supply voltage	Pin connector, 2 pole, jumper	assembled, closed
X14	Jumper station	Pin connector, 2 x 5 pole	fitted with 3 spare jumper bridges

4.1 Connector Description

4.1.1. Connector X1

X1 is a SMA connector with 50 Ohm impedance. It is terminated directly to the swarm bee LE module RF port.

4.1.2. Connectors X2, X3, X10

The pin connectors X2, X3 and X10 lead through pins of the swarm bee LE module. X2 and X3 are not assembled by default, but it is possible to contact the pin holes by measuring probes. Independently from other connections at the swarm bee LE DK+ Board all pins of swarm bee LE module except GND pins are lead to X2 and X3.
A detailed pin description of the swarm bee LE module pins can be found in the swarm bee LE datasheet.

Table 4-2: X2 pin assignment

X2 Pin No.	**Swarm bee LE module pin no.**
1	GND - not connected to swarm bee LE
2	GND - not connected to swarm bee LE
3	37
4	38
5	39
6	40
7	7
8	8
9	4 (A_MODE)
10	5 (/NRST)
11	6 (MOD_EN)

X2 Pin No.	Swarm bee LE module pin no.
12	7
13	8
14	9
15	11
16	GND - not connected to swarm bee LE

Table 4-3: X3 pin assignment

X3 Pin No.	Swarm bee LE module pin no.
1	GND - not connected to swarm bee LE
2	36 (DIV_COEX)
3	35 (TX_ON)
4	34 (DIO_3)
5	33
6	32
7	31
8	30 (UART RX)
9	29 (UART_TX)
10	28
11	27 (DIO_2)
12	26 (DIO_1)
13	25 (DIO_0)
14	24 (ADC_IN)
15	23
16	GND - not connected to swarm bee LE

Table 4-4: X10 pin assignment

X10 Pin No.	Swarm bee LE module pin no.
1	34 (DIO_3)
2	27 (DIO_2)
3	26 (DIO_1)
4	25 (DIO_0)

4.1.3. Connector X4

The swarm bee LE module on the swarm be LE DK+ Board can be controlled from a host controller over the connector X4 (USART / UART interface). Pins 4 …10 are connected directly to the swarm bee LE module. A detailed pin description of these swarm bee LE module pins can be found in the swarm bee LE datasheet.

Table 4-5: X4 pin assignment

X4 Pin No.	Description	Type	Remarks
1	GND	Circuitry ground	
2	VCC	External operating voltage 3.1 V … 5.5 V	
3	GND	Circuitry ground	
4	USART_RX	Serial port RX	seen from swarm bee LE controller
5	USART_TX	Serial port TX	seen from swarm bee LE controller
6	USART_CTS	Serial port clear to send	Not used for UART
7	USART_RTS	Serial port request to send	Not used for UART
8	USART_CK	Serial port clock	Not used for UART
9	A_MODE	Enable autonomous mode (set = off, open = on)	
10	MOD_EN	Enable Module (set = disabled, open = enabled)	

4.1.4. Connector X5

X5 is a standard Mini-USB B connector for connecting and powering the swarm bee LE DK+ Board from a host PC.

4.1.5. Connector X7

By bridging the Jumper X7 the autonomous mode for the swarm bee LE module can be disabled. With a closed X7 the host mode is enabled. The manual settings of X7 are overwritten by a signal which comes over X4/ pin9 from a host controller.

4.1.6. Connector X8

By bridging the Jumper X8 the swarm bee LE module can be disabled. With not bridged X8 the swarm bee LE module is enabled. The manual settings of X8 are overwritten by a signal which comes over X4 / pin10 from a host controller.

4.1.7. Connector X9

X9 can be used for measuring the currents of the power down modes of the swarm bee LE module. The default jumper bridge has to be replaced by current meter. If X9 is open, the swarm bee LE module is not powered.

4.1.8. Connector X11

X11 is not a jumper but a measuring point for the supply current profile of the swarm bee LE module translated into voltage. X11 is not assembled by default. More details about the function are shown in chapter 5.1.

4.1.9. Connector X12

X12 connects the signals of the USART bus of the swarm bee LE module to the USB to Serial converter circuit. If X12 is set for USB operation, the connector X4 should not be connected to a host controller. In this case X4 can only be used for measurements of the USART bus signals.

Table 4-6: X12 pin assignment

X12 Pin No.	Description	Type	Remarks
1	GND	Circuitry ground	
2	USART_CLK	Serial port clock	For measuring the clock
3 - 4	USART_RTS	Serial port request to send	Jumper bridge, normally open
5 - 6	USART_CTS	Serial port clear to send	Jumper bridge, normally open
7 - 8	USART_TX	Serial port TX	Jumper bridge, normally closed
9 - 10	USART_RX	Serial port RX	Jumper bridge, normally closed

4.1.10. Connector X13

The supply voltage can be measured by the swarm bee LE module with an internal AD-Converter. Therefore a jumper bridge has to set over X13. With respect to the AD-converters internal supply voltage, the supply voltage of the swarm bee LE module is divided by 2.2273 for measuring.

4.1.11. Connector X14

The “Jumper Station” X14 acts as parking place for not used jumper bridges.

5 Testpoints

The swarm bee LE DK+ Board provides testpoints for measurements. The testpoints are suited for connecting probes of oscillators or multimeters.

Table 5-1: Testpoints pin assignment

Testpoint No.	Description	Function	Remarks
TP1	USART_TX	Serial port TX	Connected to swarm bee LE module, X4 and X12
TP2	USART_RX	Serial port RX	Connected to swarm bee LE module, X4 and X12
TP3	GND	Circuitry ground	
TP4	GND	Circuitry ground	
TP5	GND	Circuitry ground	
TP6	GND	Circuitry ground	
TP7	ICC/U	Supply current converted to voltage	Supply current is converted to a voltage, relation is 1:10 (100mA → 1V), see chap. 5.1
TP8	VCC*	Supply voltage	Supply voltage for swarm bee LE module
TP9	ICC	For measuring powerdown current	Same function as X9, see chap. 4.1.7
TP10	ICC	For measuring powerdown current	Same function as X9, see chap. 4.1.7
TP11	/TX_RX	Hardware TX indicator	TX = LOW, RX (2.8 V) = HIGH
TP12	GND	Circuitry ground	

5.1 Testpoint TP7

On Testpoint TP7 the supply current of the swarm bee LE module is mapped to an equivalent voltage. The relation between the supply current and the equivalent voltage is 100mA → 1V. On TP7 the user can measure the currents of diverse operating states of the swarm bee LE module, i.e. TX current and RX current. A current profile can be measured over the time, which allows the user to optimize the power consumption of the module.

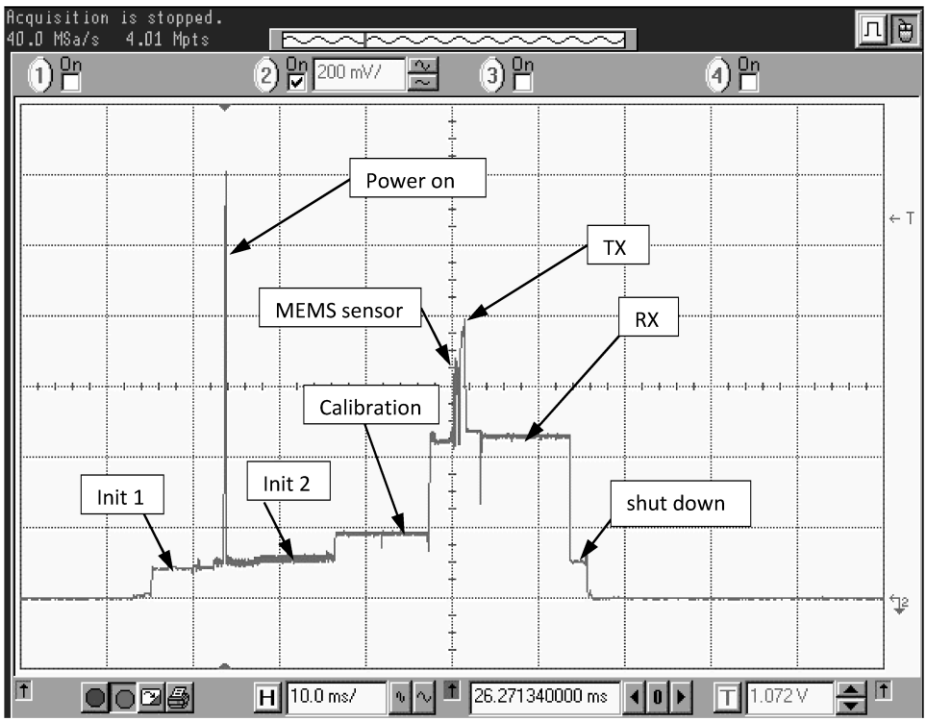

Figure 5-1: Screenshot of a typical swarm bee LE module current profile

Figure 5-1 shows the current consumption of several operating states of the swarm bee LE module.

Table 5-2: Description of operating modes shown in Figure 5-1

Short term	Description
Init 1	Wakeup after deep sleep
Power on	Switching on the DC/DC converter for supplying the RF power amp and nanoLOC
Init 2	Initialisation of nanoLOC
Calibration	Frequency calibration of nanoLOC
MEMS sensor	Initialisation of the build in MEMS sensor
TX	Transmitting
RX	Receiving
Shut down	Shut down to deep sleep

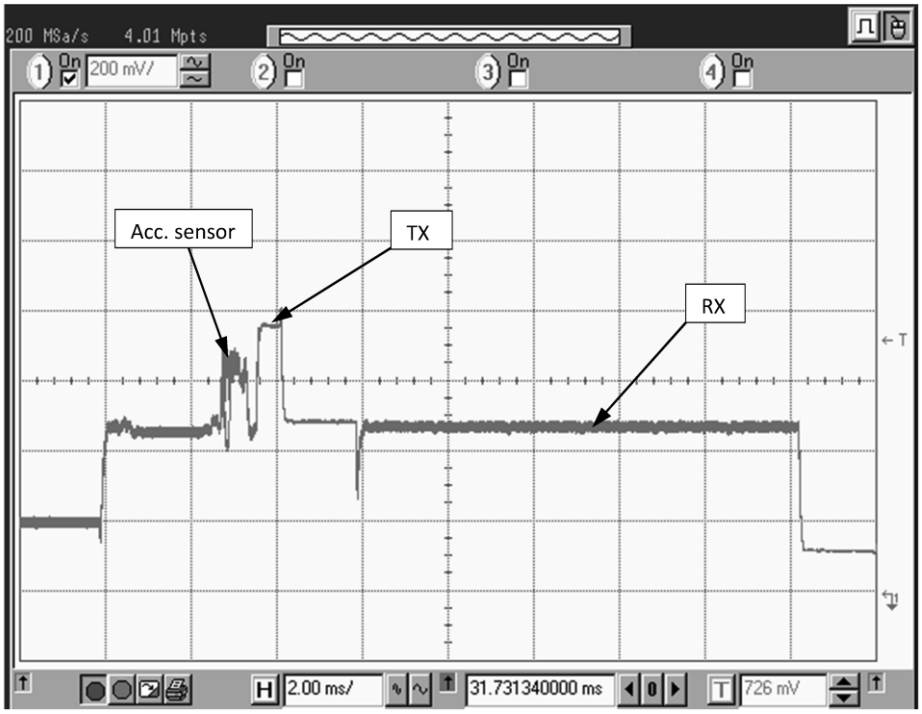

Figure 5-2: Expanded detail of the current profile screenshot

Because the swarm bee LE module includes a DC/DC converter, the current profile shows a ripple generated by the switching of this DC/DC converter. Depending on load and input voltage the ripple can rise up to 100mV.
This ripple does not represent the ripple of the internal supply voltage of the swarm bee LE module.

6 Schematic

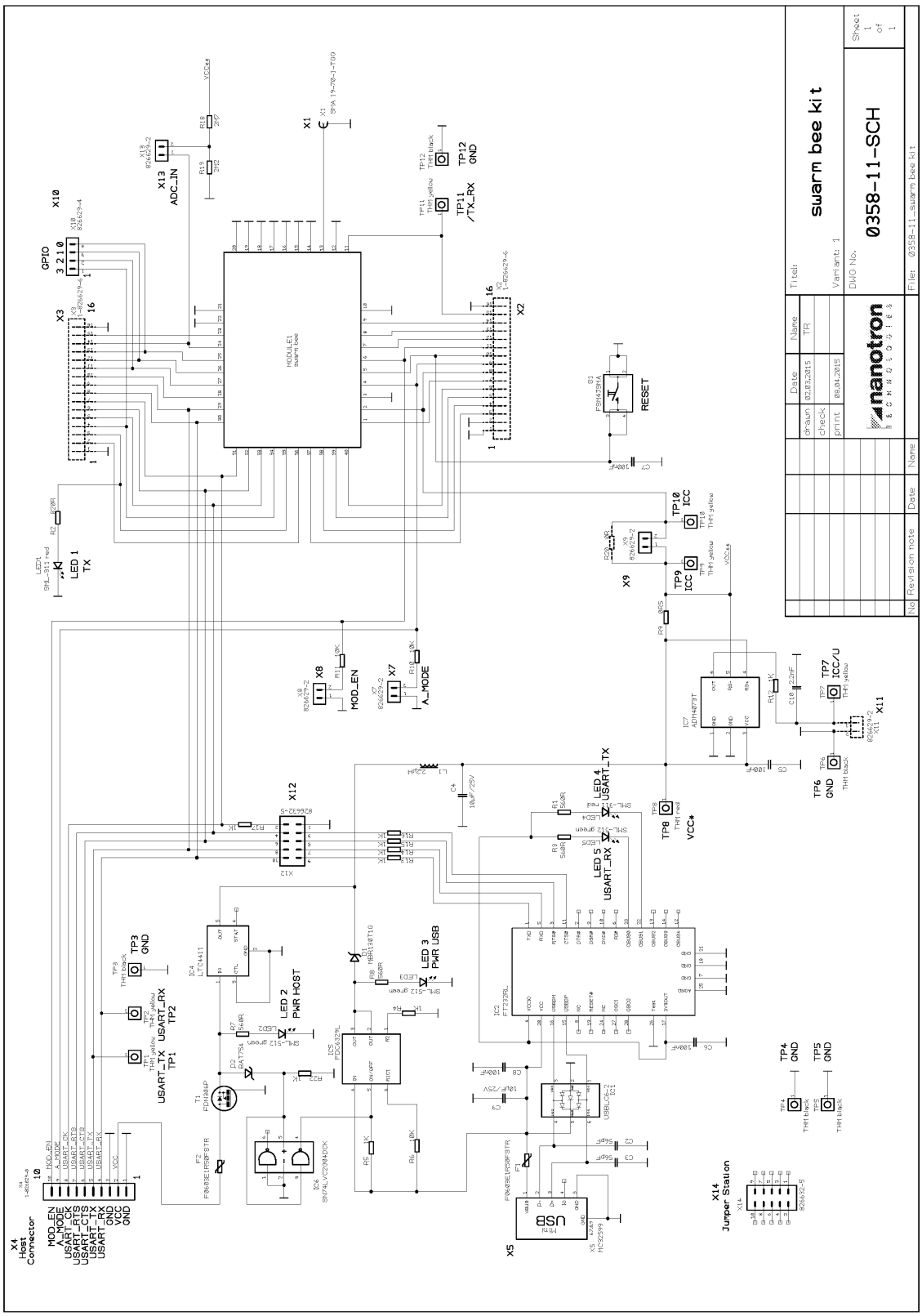

Figure 6-1: Swarm bee LE DK+ Board schematic

Date	Authors	Version	Description
2015-03-13	nanotron	1.0	Initial version
2016-05-24	nanotron	1.1	Jumper setting is changed
2016-11-10	MBO	1.2	Added pin description in Table 4-2, Table 4-3 & Table 4-4

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Statement according to FCC part 15.19:
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Statement according to FCC part 15.21:
Modifications not expressly approved by this company could void the user's authority to operate the equipment.

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The internal / external antennas used for this mobile transmitter must provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Statement according to FCC part 15.105:
This equipment has been tested and found to comply with the limits for a Class A and Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation and against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions as provided in the user manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: (1) reorient or relocate the receiving antenna, (2) increase the separation between the equipment and receiver, (3) connect the equipment into an outlet on a circuit different from that to the connected equipment, and (4) consult the dealer or an experienced technician for help.

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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 pre-cise real-time positioning and concurrent wireless com-munication. The ubiquitous proliferation of interoperable location platforms is creating the location-aware Internet of Things.

Headquartered in Berlin, Germany, *Nanotron Technologies GmbH* was founded in 1991 and is an active member of IEEE.

Further Information

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