SKU609 Ultra Wideband Module Datasheet

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Revision History

Revision	Description	Approved	Date
V1.01	Initial Release	Benson	20181201
V1.02	Change temperature parameters	Benson	20200915
V1.03	Update I2C interface	Sherman	20211112

Contents

1 General Description

The SKU609 module is based on Decawave's DW1000 Ultra Wideband (UWB) transceiver IC, which is an IEEE 802.15.4-2011 UWB implementation. It integrates UWB and Bluetooth® antenna, all RF circuitry, Nordic Semiconductor nRF52832 and a motion sensor.

Figure 1-1: SKU603 Top View

2 Applications

- Healthcare (locate assets, patients & staff) .
- Industrial (asset-tracking, factory automation).
- Retail (security, navigation, customer analytics).
- Consumer (connected home, sports analytics).

3 Features

- Ranging accuracy to within 10cm.
- 6.8Mbps data rate.
- 60m line-of-sight range typical.
- IEEE 802.15.4-2011 UWB compliant.
- Nordic Semiconductor nRF52832.
- Bluetooth® connectivity.
- Bluetooth® chip antenna.

◆ Motion sensor: 3-axis accelerometer.

◆Current consumption optimised for low power sleep mode: <15μA.

◆Supply voltage: 2.8 V to 3.6 V.

◆Size: 19.1 mm x 26.2 mm x 2.6 mm.

3 Key Benefits

◆ Enables anchors, tags & gateways to quickly get an entire RTLS system up-and-running

◆ Accelerates product designs for faster Time-to-Market & reduced development costs

◆Over-the-air updates

◆ User API to SKU609 firmware (available as a library) for user code customisation

◆ On-board Bluetooth® SMART for connectivity to phones/tablets/PCs

◆ SPI, UART and Bluetooth® APIs to access SKU609 firmware from an external device

◆ Low-power hardware design and software architecture for longer battery life

4 Applications Block Diagram

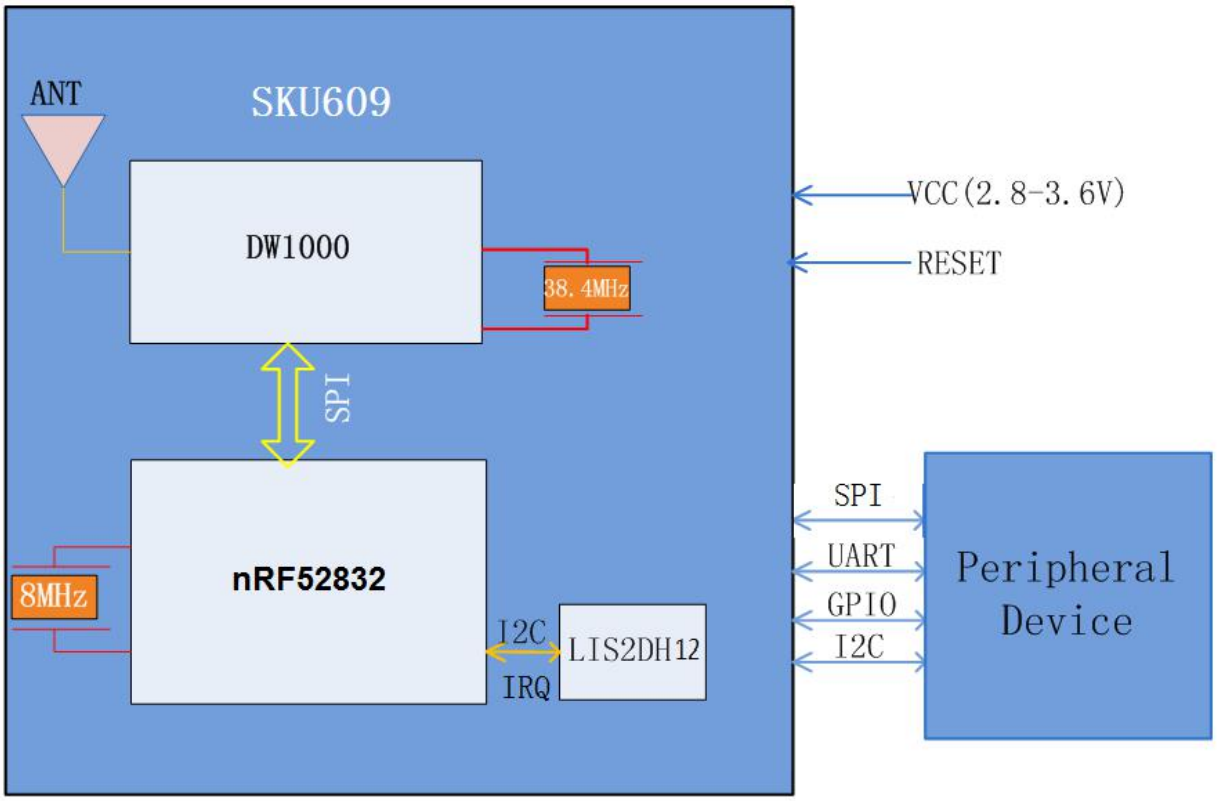

Figure 4-1: SKU609 Block Diagram

5.Electrical Specification

The following tables give detailed specifications for the SKU609 module. Tamb = 25 ˚C for all specifications given.

5.1 Nominal Operating Conditions

Table 5-1: SKU609 Operating Conditions

Parameter	Min.	Type	MAX.	Units	Condition/Note
Operating temperature	-40		+85	˚C	
Supply voltage VCC	2.8	3.3	3.6	V	Normal operation
Voltage on VDDIO for programming OTP	3.7	3.8	3.9	V	Supply is connected to the OTP in the SKU609 this supply is connected to the VDDIO test point which is underneath the PCB

5.2 DC Characteristics

Table5-2: SKU609 Receiver DC Characteristics

Parameter	Min.	Type	Max.	Units	Condition/Note
Supply current in DEEPSLEEP mode		4		µA	All peripherals in lowest power consumption mode Achievable where RTC and accelerometer are disabled with custom firmware.
Supply current in DEEP SLEEP mode		12		µA	RTC and accelerometer operational, all other peripherals in lowest power consumption mode
Supply current in IDLE mode		13		mA	MCU and DW1000 awake
TX peak current		111		mA	
TX mean current		82		mA	
RX peak current		154		mA	
RX mean current		134		mA	
Current in Bluetooth® discovery mode		6		mA	

Digital input voltage high	0.7		VCC	V	
Digital input voltage low	GND		0.3	V	
Digital output voltage high	0.7		VCC	V	
Digital output voltage low	GND		0.3	V	

5.3 Receiver AC Characteristic

Table 5-3: SKU609 Receiver AC Characteristic

Parameter	Min.	Type	Max.	Units	Condition/Note
Frequency range	6240		6739.2	MHz	Centre Frequency 6489.6 MHz (only in china）
Frequency range	3774		4243.2	MHz	Centre Frequency 3993.6 MHz

5.4 Receiver Sensitivity Characteristics

Tamb = 25˚C, 20 byte payload. These sensitivity figures assume an antenna gain of 0dBi and should be modified by the antenna characteristics, depending on the orientation of the SKU609.

Table 5-4: SKU609 Typical Receiver Sensitivity Characteristics

Packet Error Rate	Data Rate	Receiver Sensitivity	Units	Condition/Note		
1%	6.8Mbps	-98*(-92)	dBm/500 MHz	Preamble 128	Carrier frequency offset ±10 ppm	All measurements performed on Channel 5, PRF 64 MHz
10%	6.8Mbps	-99*(-93)	dBm/500 MHz	Preamble 128		

*equivalent sensitivity with Smart TX Power enabled. This is enabled in the onboard firmware.

5.5Transmitter AC Characteristics

Table 5-5: SKU609 Transmitter AC Characteristics

Parameter	Min.	Type	Max.	Units	Condition/Note
Output power spectral density			-41.3*	dBm/MHz	
Output Channel Power		-17		dBm/500MHz	

* If using the pre-loaded embedded firmware of the SKU609 module.

5.6 Absolute Maximum Ratings

Table 5-6: SKU609 Absolute Maximum Ratings

Parameter	Min.	Max.	Units
Supply voltage	2.8	3.9	V
Receiver power		0	dBm
Temperature - Storage temperature	-40	+125	˚C
Temperature – Operating temperature	-40	+85	˚C
ESD (Human Body Model)		2000	V
SKU609 pins other than VCC, VDDIO and GND		3.6	Note that 3.6 V is the max voltage that may be applied to these pins

Stresses beyond those listed in this table may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions beyond those indicated in the operating conditions of the specification is not implied. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

6 Module Pinout and Pin Description

6.1 Module Pinout

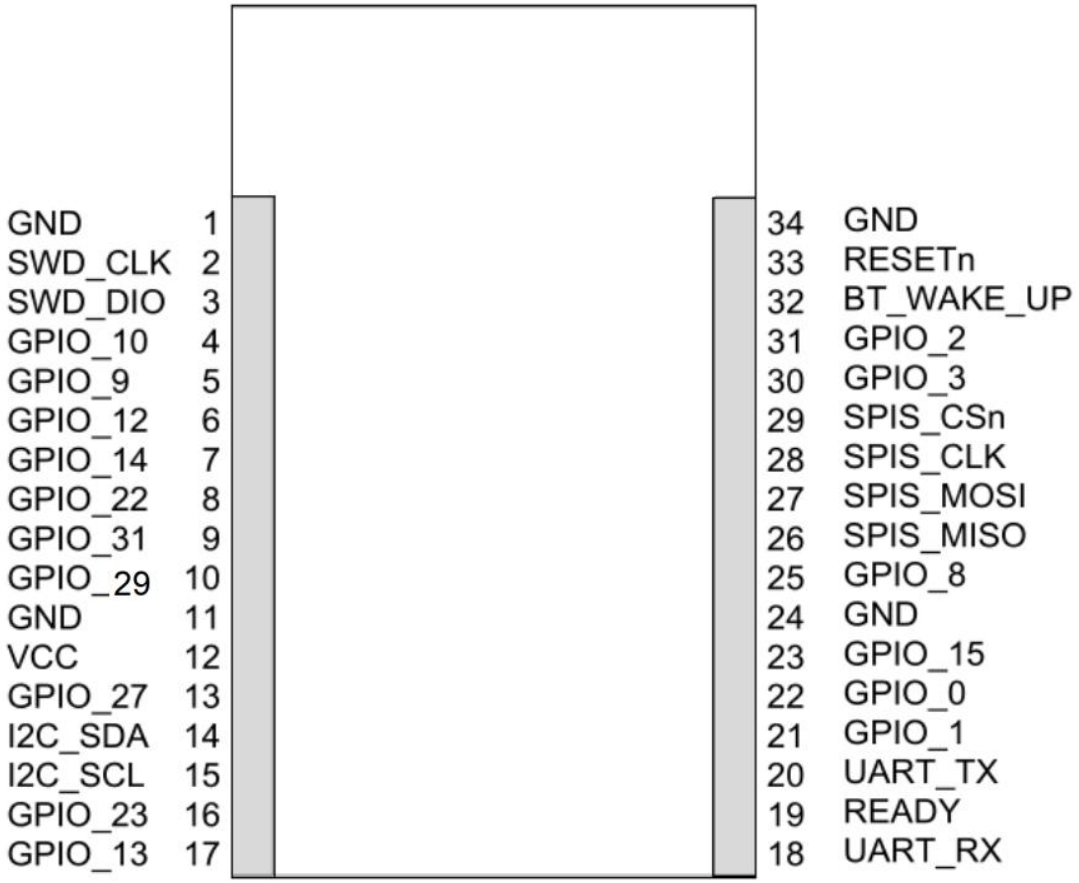

Figure 6-1: SKU609 Module Pinout (TOP View)

6.2 Pin Description

Table 6-1: SKU609 Pin Description

Pin No.	Pin Name	I/O	Description
1	GND	G	Common ground.
2	SWD_CLK	P	Serial wire debug clock input for debug and programming of Nordic Processor.
3	SWD_DIO	DIO	Serial wire debug I/O for debug and programming of Nordic Processor
4	P0.10	DIO	General purpose I/O pin.
5	P0.09	DIO	General purpose I/O pin.
6	P0.12	DIO	General purpose I/O pin.
7	P0.14	DIO	General purpose I/O pin.
8	P0.22	DIO	General purpose I/O pin.

9	P0.31	DIO	General purpose I/O pin. ADC function of nRF52
10	P0.29	DIO	General purpose I/O pin. ADC function of nRF52
11	GND	G	Common ground
12	VCC	P	External supply for the module. 2.8V - 3.6V
13	GND	G	Ground
14	I2C_SDA (Master)	DIO	P0.30; Master I2C Data Line.Internal connected to LIS2DH12 SDA.Leave unconnected if not used.
15	I2C_SCL (Master)	DO	P0.28; Master I2C Clock Line.Internal connected to LIS2DH12 SCL.Leave unconnected if not used.
16	P0.23	DIO	General purpose I/O pin. Leave unconnected if not used.
17	P0.13	DIO	General purpose I/O pin. Leave unconnected if not used.
18	UART_RX	DI	UART_RX
19	READY	DO	Generated interrupt from the device.Indicates events such as SPI data ready, or location data ready.
20	UART_TX	DIO	UART_TX, This is also the ADC function of the nRF52832
21	GPIO1	DIO	General purpose I/O pin of the DW1000.It may be configured for use as a SFDLED driving pin that can be used to light a LED when SFD (Start Frame Delimiter) is found by the receiver. Leave unconnected if not used.
22	GPIO0	DIO	General purpose I/O pin of the DW1000.It may be configured for use as a RX OK LED driving pin that can be used to light a LED on reception of a good frame. Leave unconnected if not used.
23	P0.15	DIO	General purpose I/O pin. Leave unconnected if not used.
24	GND	G	Common GND
25	P0.08	DIO	General purpose I/O pin. Leave unconnected if not used.
26	SPIS_MISO (P0.07)	DIO	Configured as a SPI slave this pin is the SPI data output. Leave unconnected if not used.
27	SPIS_MOSI (P0.06)	DO	Configured as a SPI slave this pin is the SPI data input. Leave unconnected if not used.
28	SPIS_CLK (P0.04)	DI	Configured as a SPI slave this pin is the SPI clock. This is also the ADC function of the nRF52.Leave unconnected if not used.
29	SPIS_CSn (P0.03)	DI	Configured as a SPI slave this pin is the SPI chip select. This is an active low enable input. The high-to-low transition on SPICSn signals the start of a new SPI transaction. This is also the ADC function of the nRF52 and DEEPSLEEP states and may cause spurious interrupts unless pulled

			low.Leave unconnected if not used.
30	GPIO3	DO	It may be configured for use as a TXLED driving pin that can be used to light a LED following a transmission.Leave unconnected if not used.
31	GPIO2	DO	This pin is configured for use as a TXLED driving pin that can be used to light a LED during transmit mode.Leave unconnected if not used.
32	BT_WAKE_UP (P0.02)	DI	When this pin is asserted to its active low state the Bluetooth device will advertise its availability for 20 seconds by broadcasting advertising packets. This is also the ADC function of the nRF52832.Leave unconnected if not used.
33	RESETn	DI	Reset pin. Active Low Input. Leave unconnected if not used.
34	GND	G	Common ground.

(1) P:Power supply

(2) DI:Default Input

(3) DO:Default Output

(4) DIO:Default Input/Output

(5) G:Ground

Table 6-2: Internal nRF52832 pins used and their function

nRF52832 Pin	Function
P0.19	DW_IRQ
P0.16	DW_SCK
P0.20	DW_MOSI
P0.18	DW_MISO
P0.17	DW_SPI_CS
P0.24	DW_RST
P0.25	ACC_IRQ
P0.30	I2C_SDA
P0.28	I2C_SCL

DW1000's GPIOs 5, 6 control the DW1000 SPI mode configuration. Within the DWM1001 module, those GPIOs are unconnected and will be internally pulled down. Consequently, SPI will be set to mode 0.

Table6-3: I2C slave devices address I2C

I2C slave device	Address
LIS2DH12	0X19

7 PCB Design Guide

When designing the PCB onto which SKU609 will be soldered, the proximity of the SKU609 on-board ceramic monopole antenna to metal and other non-RF transparent materials needs to considered carefully. Two suggested placement schemes are shown below. In the areas marked “Keep-Out Area” there should be no metal either side, above or below (e.g. do not place battery under antenna).The placement schemes in Figure 7-1 show an application board with no non-RF transparent material in the keep-out area, or an application board with the antenna projecting off of the board so that the keep out area is in free-space. In this second scheme it is still important not to place metal components above or below the antenna in a system implementation.

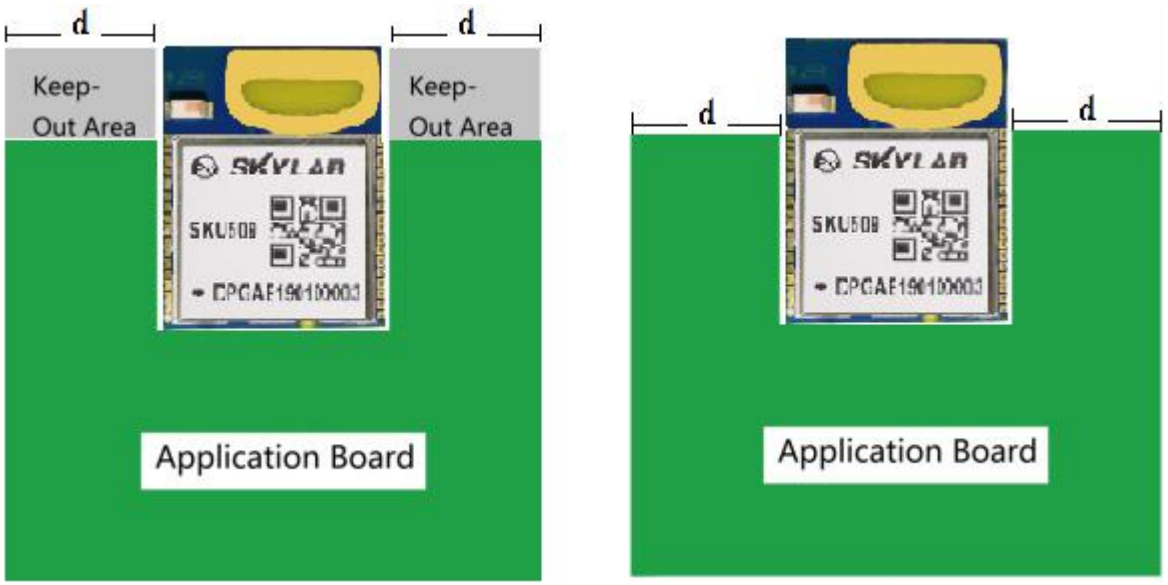

Figure 7-1: SKU609 Typical Lead-free Soldering Profile

8 PCB Footprint and Dimensions

8.1 Module Drawings

All measurements are given in millimetres.

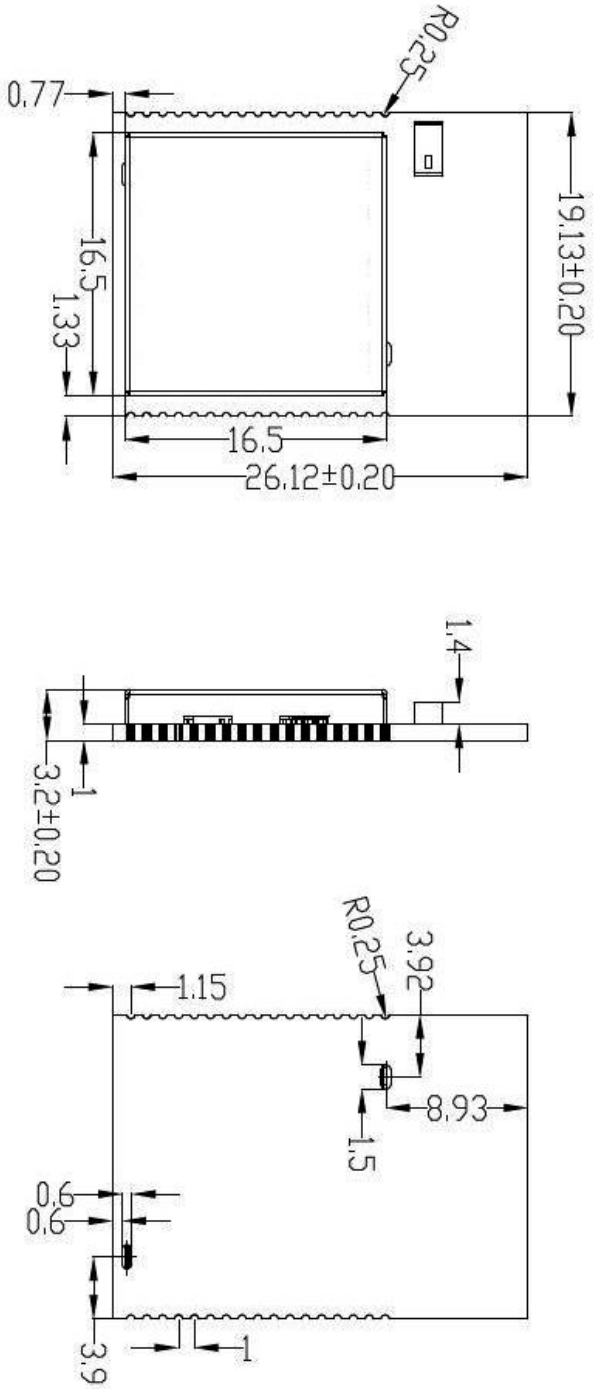

Figure 8-1: SKU609 PCB Footprint and Dimensions(units: mm)

8.2 Module Land Pattern

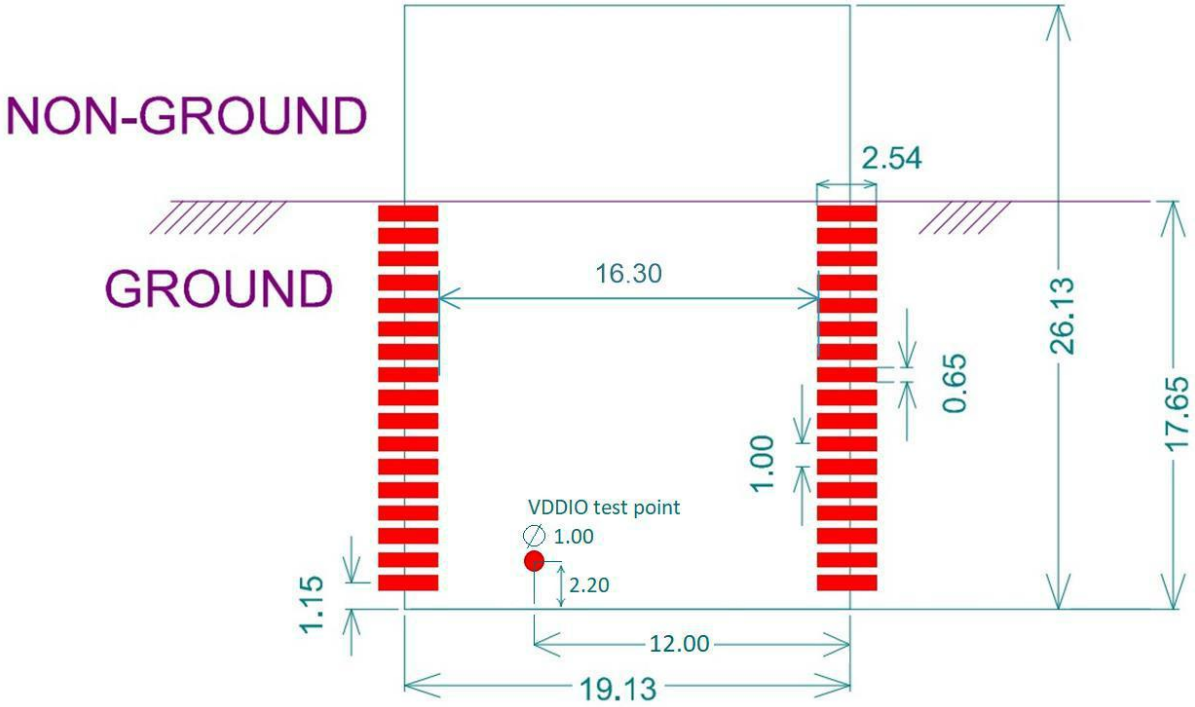

Figure 8-2: SKU609 Module Land Pattern (units: mm)

9 Manufacturing Process Recommendations

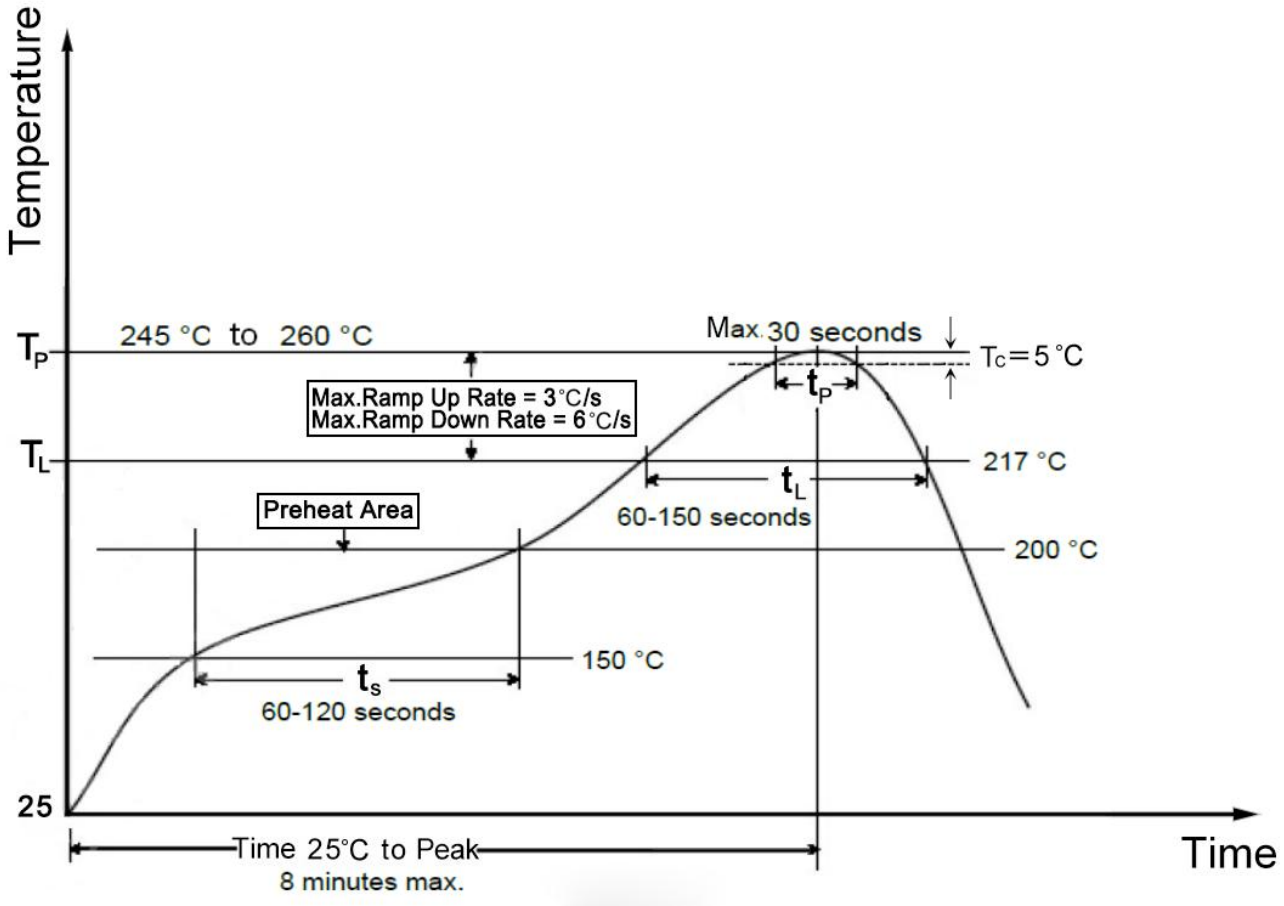

Figure 9-1: SKU609 Typical Lead-free Soldering Profile

Note： The final re-flow soldering temperature map chosen at the factory depends on additional external factors, for example, choice of soldering paste, size, thickness and properties of the module's baseboard etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

10 Packaging Specification

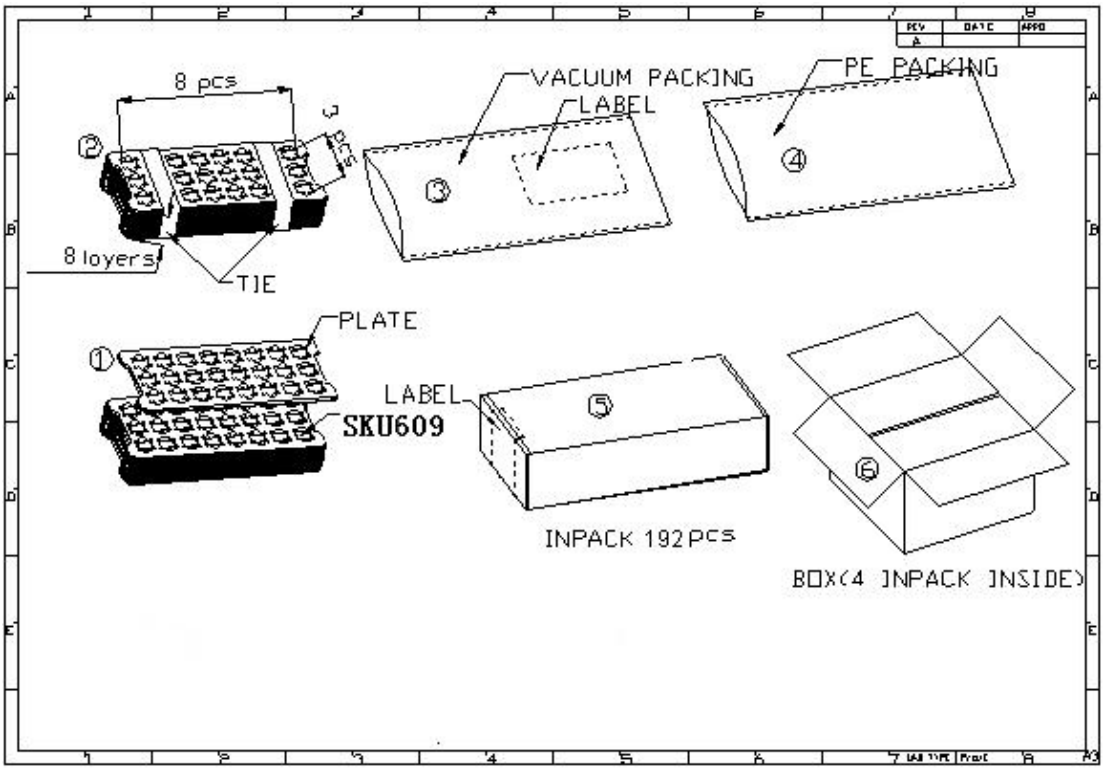

Figure10-1: SKU609 Packaging

SKU609 modules are put into tray and 528 units per tray. Each tray is ‘dry’ and vacuum packaging.

SKU609 series modules are Electrostatic Sensitive Devices and require special precautions while handling.

ESD precautions

The SKU609 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling the SKU609 modules without proper ESD protection may destroy or damage them permanently.

The SKU603 modules are electrostatic sensitive devices (ESD) and require special ESD precautions typically applied to ESD sensitive components. Proper ESD handling and packaging procedures must

be applied throughout the processing, handling, transportation and operation of any application that incorporates the SKU609 module. Don't touch the module by hand or solder with non-anti-static soldering iron to avoid damage to the module.

11 Contact Information

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