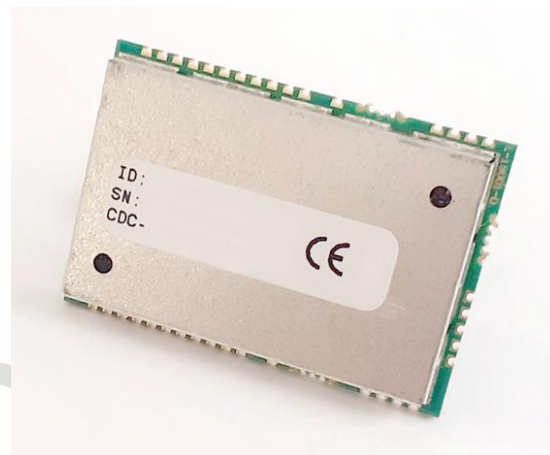


KIM1

Datasheet



Reference: KINEIS-SP-20-0147

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Date: June 16, 2020

1.1. Introduction

The KIM1 module developed by Kinéis is a low-power transmitter module based on Argos-2 standard and fully certified by Kinéis and CNES (French Space Agency).

It enables communication with all the Kinéis/Argos polar LEO satellites, to provide global connectivity to IoT devices for data collection and localization.

The use of Argos RF signals and protocols ensures very low power consumption and a global coverage.

The module is specifically designed for ease of use, to shorten development time and speed up time to market.

1.2. Revision history

Revision	Date	Ref	Modification
V0	10 April 2020	CT / HC	Creation
V1	16 June 2020	HC / CT	Modification Electrical, mechanical & pinning, adding soldering, packaging and marking

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2. Product description

2.1. Overview

KIM1 module is designed in SMT package integrating digital & baseband processor based on Argos-2 waveforms, RF transmitter with output power capabilities up to 1W and controls. It ensures a very low power consumption and an optimized energy saving for better autonomy.

KIM1 module is easy to use with a standard UART interface and communicate with external host by advanced command interface (AT command), as well as available GPIOs. It offers to IoT device manufacturers the possibility to quickly and easily integrate their end devices into the Kinéis network.

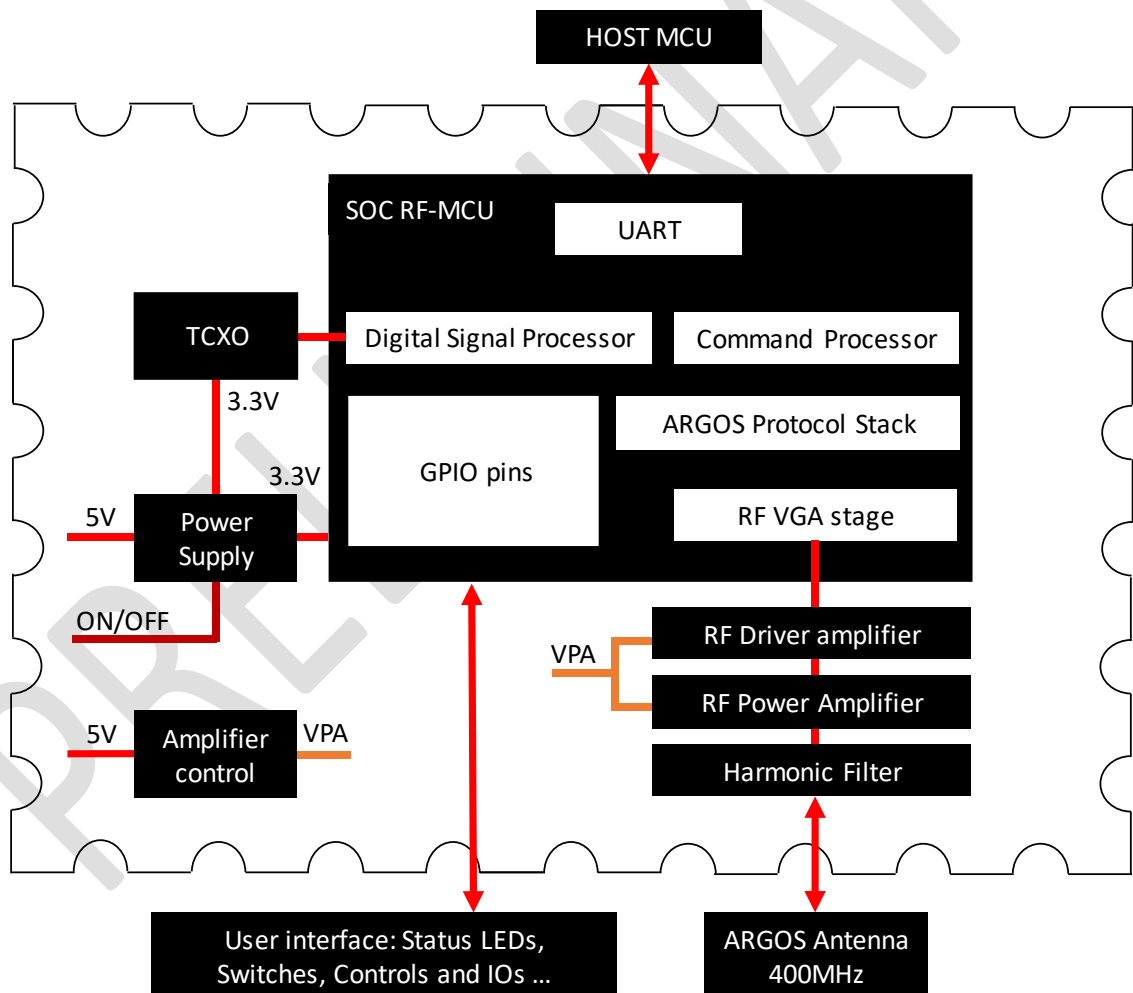
2.2. Main features

Specification	Description
RF Tx Power	Optimized for 1W Adjustable at 250mW, 500mW, 750mW or 1W
Frequency Range*	399,910 - 401,680 MHz
Modulation	±1.1rad PSK (ARGOS-2 compliant)
Over-the-Air data rate	400 bit/s
Power Supply	5V
Communication Interface	3.3V UART
DC, Digital & RF Connections	Board edge connection
Package	Surface-mount module
Operating temperature	-20°C to +55°C
Storage temperature	-40°C to +90°C
Humidity	10% - 90% non-condensing
Size	31.2 x 21 x 3.5 mm ³
Certification	Kinéis & CNES, CE

*: please refer to Kinéis/Argos System Specifications to choose the suitable frequency band(s) compatible with Argos-2 BPSK transmissions within this frequency range. As of June 2020, Kinéis satellites only receive signals in frequency band B1 [401.62 - 401.68MHz]

2.3. Functional description

KIM1 is a Kinéis and Argos-2 compliant transmitter; it enables sending messages of up to 31 Bytes of useful data to Argos and Kinéis satellites. The module receives AT commands indicating the transmission parameters and message payload and then performs the RF signal modulation processing to transmit the data to the satellite. The KIM1 bloc diagram shown below depicts the MCU DSP (RF Digital processor) and internal clock system (TCXO) in charge of Argos-2 modulation, RF sections with power amplifiers and filters, DC supply, control, GPIO and UART (Universal Asynchronous Receive Transmit) section.



Functional diagram

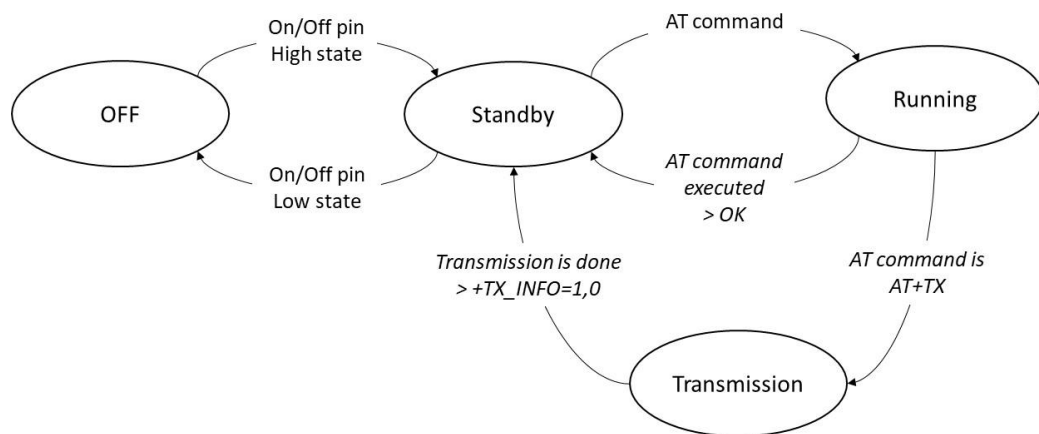
2.4. Commands/controls

ON/OFF

A shutdown feature is available on the KIM1 module when VDD pin is powered, controlled via the ON/OFF pin (5):

- ON/OFF pin is set to high level: internal regulators are enabled, supplying all internal voltages needed by the module for digital and RF functions.
- ON/OFF pin is set to low level: internal regulators are disabled, digital and RF functions of the module are shut down, reducing drastically the power consumption.

2.5. State transition diagram



State diagram

When the KIM1 is powered at VDD, it can follow different modes:

- **OFF Mode:** when the ON/OFF pin is low, the internal power supply is off and the consumption is very low (quiescent current of the internal regulator).
- **Standby Mode:** when the ON/OFF pin is high, this is the default mode. The RF digital processor is waiting for AT commands, allowing to transition to Running mode.
- **Running Mode:** this mode is activated when the RF digital processor receives an AT command, for the duration of execution of the AT command.
- **Transmission Mode:** this mode is activated when the RF digital processor receives a transmission AT command. It activates the TCX0 and internal power amplifiers and a signal is transmitted to the antenna corresponding to the specified Kinéis message.

3. Electrical specifications

3.1. Absolute Maximum Ratings

Symbol	Description	Condition	Min	Max	Unit
VDD	Supply voltage		-0.3	5.5	V
IDD*	Supply current	VDD=5V		750	mA
Ptot*	Total power consumption	VDD=5V		3.75	W
VIO	I/O voltage		-0.3	5.5	V
Ves	Electrostatic handling	HBM**	-1000	1000	V
Top	Operating temperature		-20	+55	°C
Tstg	Storage temperature		-40	+90	°C

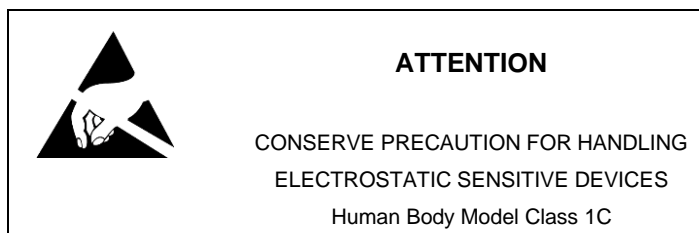
*: for Engineering Samples (see §8.2 Versioning), max supply current is 1060mA @ 5V DC supply, and max total power is 5.3W

** : Human Body Model (HBM), per ANSI/ESDA/JEDECJS-001, all pins

Note: KIM1 module is not protected against reverse voltage. Be careful when supplying module.

The product must be powered by a voltage supply compliant with the applicable security standards and categorized as ES1 or PS1 with a maximum power limited to 15W or less.

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected. Exposure to absolute maximum rating conditions for extended periods may affect device reliability



3.2. Nominal Operation Ratings

1. Electrical

Symbol	Description	Condition	Min	Typ	Max	Unit
VDD*	Supply voltage		4.5	5	5.5	V
IDD	Supply current		200		550	mA
V UART	UART voltage			3.3	3.6	V
VIO	Other I/O voltage			3.3	3.6	V
Top	Operating temperature		-20	+20	+55	°C

*: Use of a stabilized 5V power supply is recommended; in case of lower supply by external host (ie. 3.3V) a boost converter connected to a source with sufficient supply current is needed.

2. Radio Frequency

Symbol	Description	Condition	Min	Typ	Max	Unit
TX frequency			399,910		401,680	MHz
TX power			0.25		1	W
TX data rate			396	400	404	bits/s

3. Logic

a. Digital inputs

Symbol	Description	Condition	Min	Typ	Max	Unit
V _{IL}	Input voltage, low	V _{IO} =3.3V			0.8	V
V _{IH}	Input voltage, high	V _{IO} =3.3V	2			V
V _{IL_O}	Input voltage Low state for ON/OFF pin (5)	VDD=5V			0.8	V
V _{IH_O}	Input voltage High state for ON/OFF pin (5)	VDD=5V	2			V
V _{IBPC}	Input voltage range, for DEBUG and UART			3.3	3.6	V
I _I	Input leakage current		-10		10	μA
R _{PU}	Programmable Pull-Up Resistance			65		kΩ

b. Digital outputs

Symbol	Description	Condition	Min	Typ	Max	Unit
I _{OH}	Output current, high	V _{OL} =2.4V		8		mA
I _{OL}	Output current, low	V _{IL} =0.4V	2	8		mA
I _{oz}	Tri-State output leakage current	VDD_IO =5V			0.8	V

Note: The use of LED for status monitoring must be adjusted in current to meet Output current specifications

UART communication protocol is detailed in the document "KIM1 Integration manual" (see §8.3

Related documents for document reference).

3.3. Current consumption

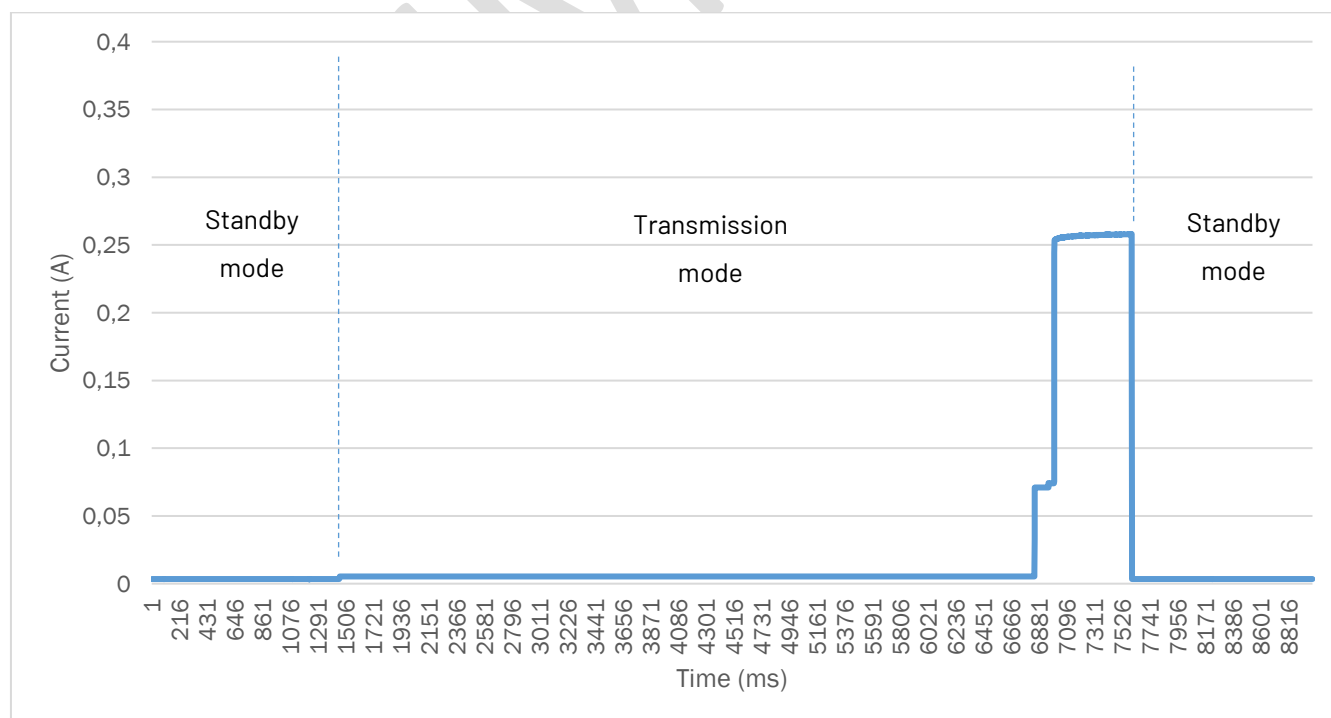
All current consumption in this paragraph are measured at the nominal supply voltage value 5V.

Note: Use of KIM1 module with lower supply voltage than specified in paragraph 3.2 will decrease significantly RF performance and Transmit power to satellite.

1. Consumption profile overview

Mode	Duration (ms)			Current consumption (mA)		
	Min	Typ	Max	Min	Typ	Max
Off	depends on operation				9e-6	
Standby	depends on operation			3.3	3.5*	7
Running	negligible					7
Transmission	4981		6584	see paragraph below		

* Current consumption in standby mode is higher before the first message transmission (typical value 5.5mA)



Consumption profile overview

2. Transmission mode

The transmission mode concentrates most of the KIM1 current consumption, and depends on the length of the message transmitted and the transmission power configured. After receiving a transmission AT command, the KIM1 begins TCXO warmup and then transmits the Kinéis message to the satellite via the RF output.

Below are the duration and current consumption values for the successive steps of the transmission mode:

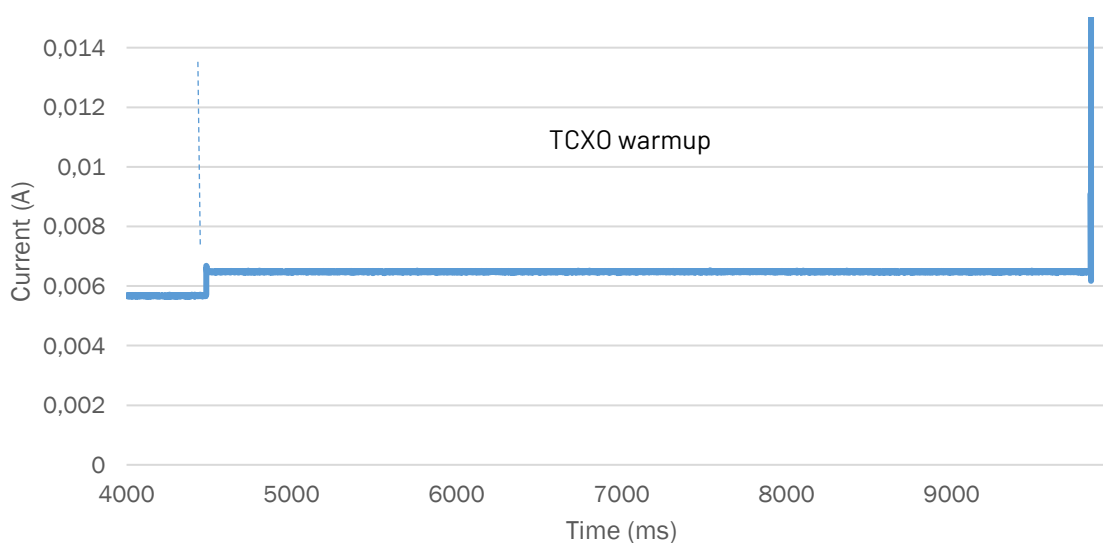
Status	Duration (ms)			Current consumption (mA)		
	Min	Typ	Max	Min	Typ	Max
TCXO warmup	4500	5000	5500	6	6.5	7
VPA_ON	90	100	110	101		111
Tx status	36	40	44	104		114
Transmission	355	*	930	see table below		

* Duration of transmission is detailed in the document "KIM1 Integration manual" (see §8.3

Related documents for document reference).

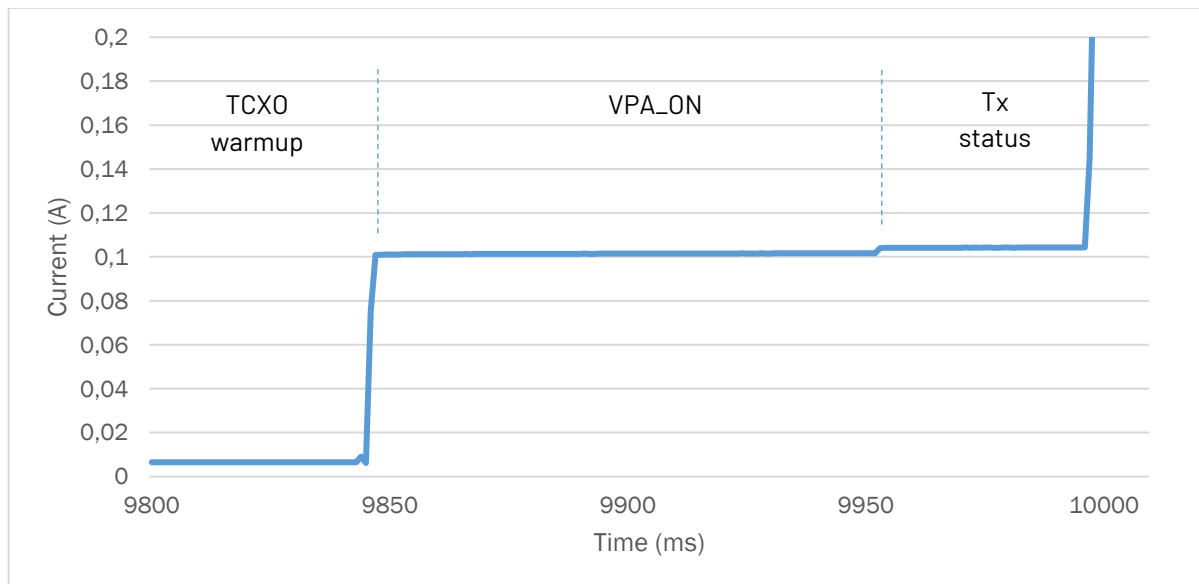
Note: the table above indicates current consumption for the first message transmitted, after the module has been shut down or put in Off mode. For the following messages transmitted, current consumption is lower: typical values are 5.5mA for TCXO warmup, 70mA for VPA_ON and 74mA for Tx_status.

a. TCXO warmup



Current consumption profile for TCXO warmup

b. VPA_ON, Tx status

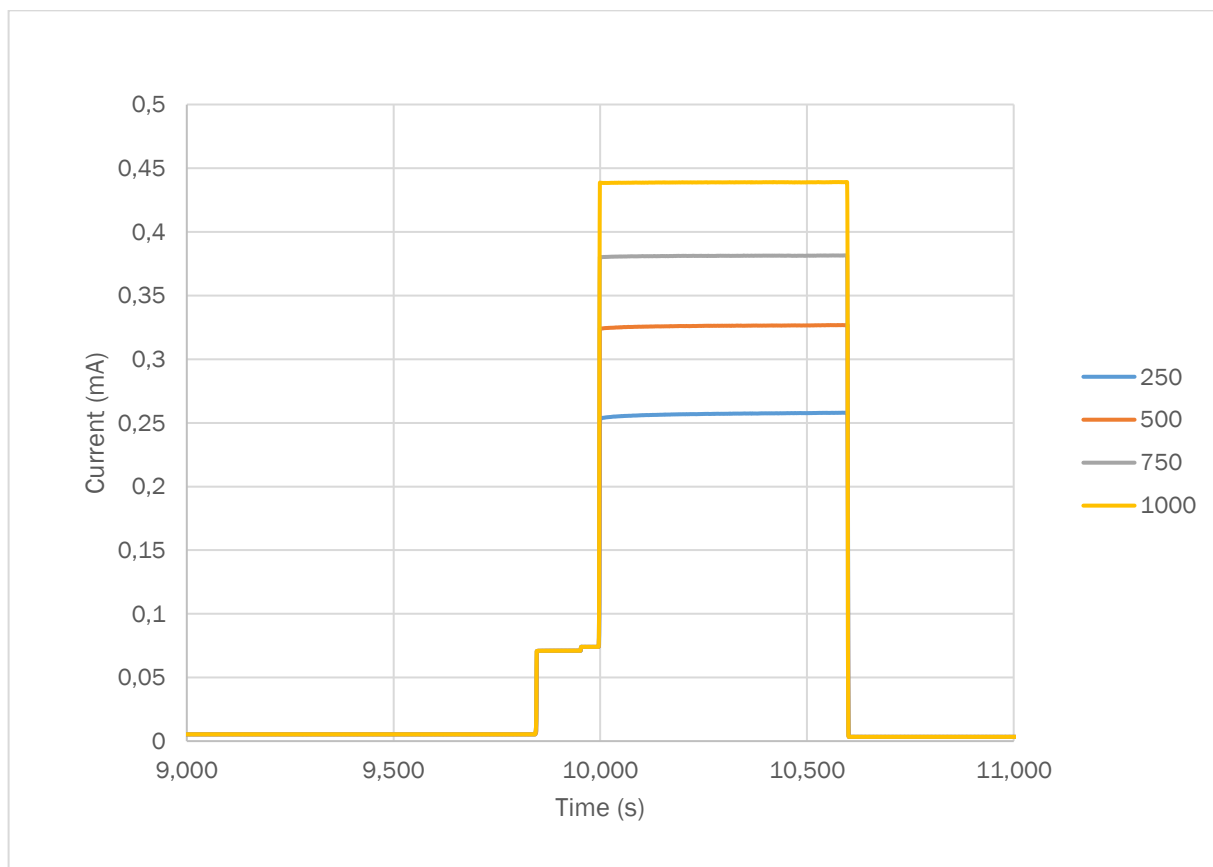


Current consumption profile for VPA_ON and Tx status

c. Transmission

The KIM1 current consumption in transmission mode depends on the RF transmission power set by the user. The table below show the current consumption expected for each of the configurable transmission power values.

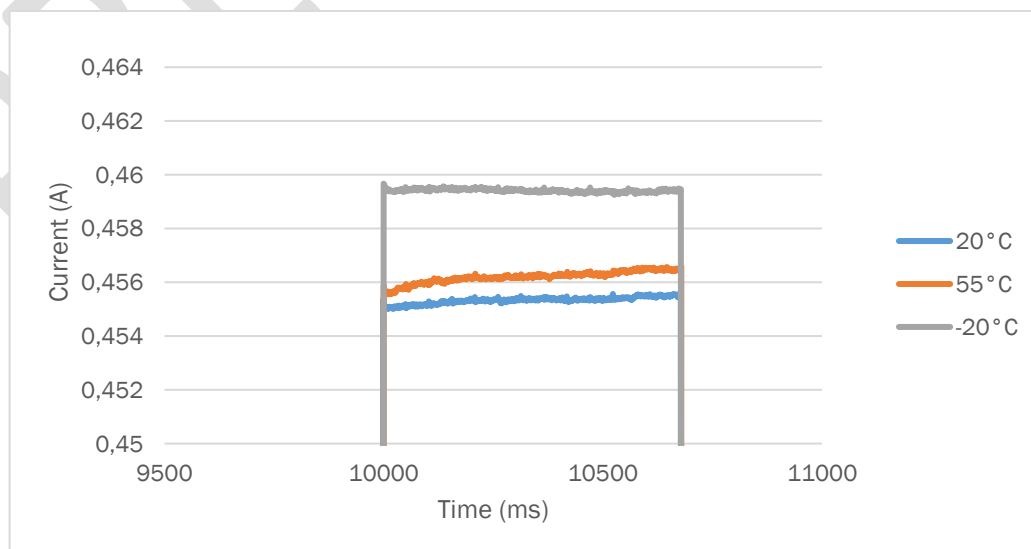
TX power configuration (mW)	TX power (dBm)			Current consumption (mA)		
	Min	Typ	Max	Min	Typ	Max
250	23	24	25	200		270
500	26	27	28	250		340
750	27.8	28.8	29.8	380		440
1000	29	30	31	450		550



Current consumption profile for transmission at different power values

d. Variation of temperature

When operated at the limit temperatures, current consumption can be increased as shown in the graph below:

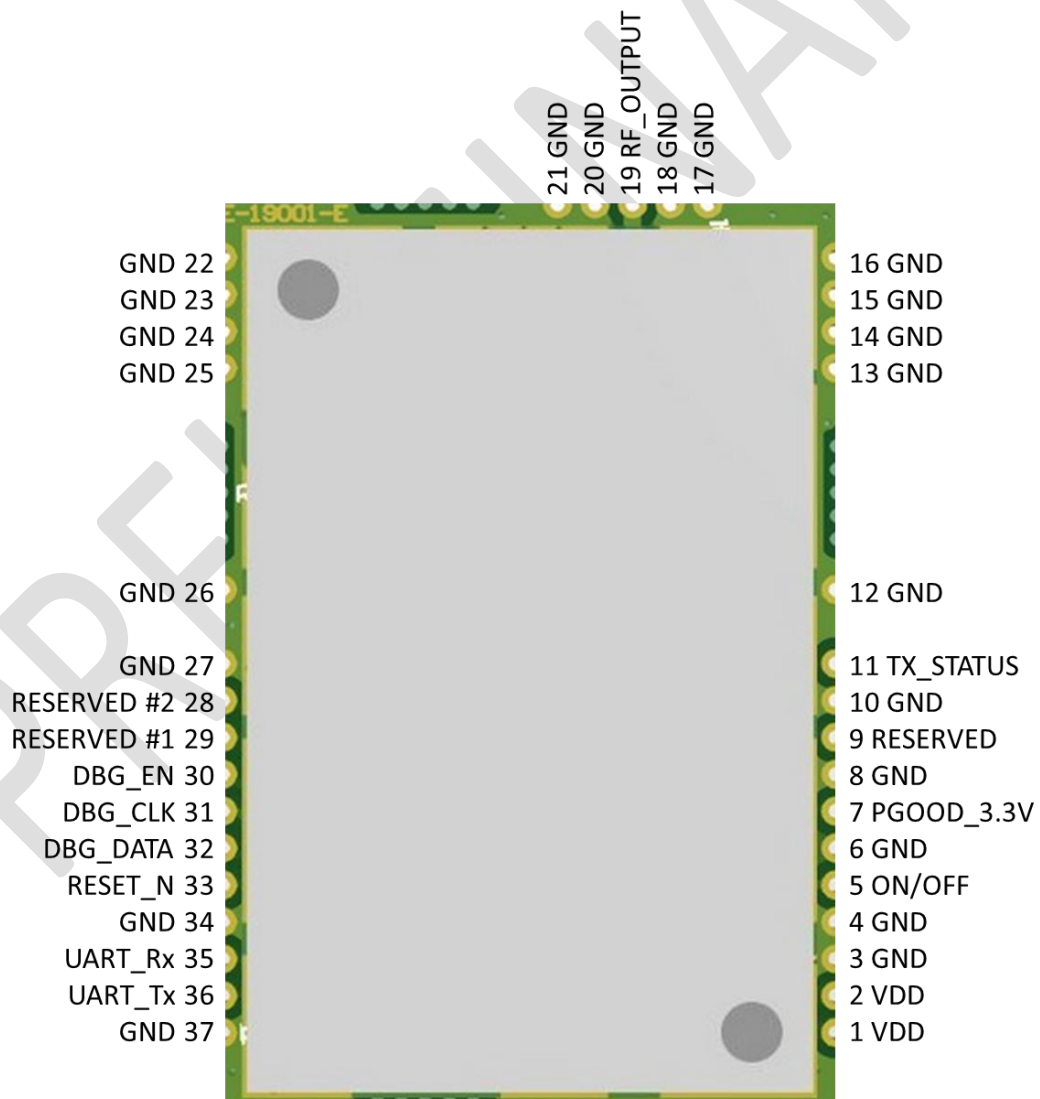


Consumption profile for transmission at limit temperature values

4. Module pin-out

The KIM1 is an SMT module with 37 pins dedicated to RF signal transmission, power supply, interface and control. Ground connections are dispatched along the module to ensure good electrical grounding and mechanical hold. RF_OUTPUT pin is a 50ohm output.

4.1. Pad assignment



KIM1 pad assignments

4.2. Pin Descriptions

The table below gives the pin numbers and status of KIM1 module

Pin	Name	Type	Description	Comment
1	VDD	Power	Positive supply voltage	5V typical
2	VDD	Power	Positive supply voltage	5V typical
3	GND	Power	Ground	Must be connected to ground
4	GND	Power	Ground	Must be connected to ground
5	ON/OFF	Input	Control of internal regulator, activate RF & digital processor	Module ON: High Module OFF: Low
6	GND	Power	Ground	Must be connected to ground
7	PGOOD_3.3V	Output	Internal 3.3V supply presence indicator	Digital and RF processor supplied. Optional LED with 1KΩ resistor can be added as indicator
8	GND	Power	Ground	Must be connected to ground
9	RESERVED	Input/Output	Do not connect	-
10	GND	Power	Ground	Must be connected to ground
11	TX_STATUS	Output	Transmission status	Transmission in progress: High Driving LED possible
12	GND	Power	Ground	Must be connected to ground
13	GND	Power	Ground	Must be connected to ground
14	GND	Power	Ground	Must be connected to ground
15	GND	Power	Ground	Must be connected to ground
16	GND	Power	Ground	Must be connected to ground
17	GND	Power	Ground	Must be connected to ground

Pin	Name	Type	Description	Comment
18	GND	Power	Ground	Must be connected to ground
19	RF_OUTPUT	RF Analog	RF signal pin (Kinéis) Matched to 50 ohms	RF output to connect to external antenna
20	GND	Power	Ground	Must be connected to ground
21	GND	Power	Ground	Must be connected to ground
22	GND	Power	Ground	Must be connected to ground
23	GND	Power	Ground	Must be connected to ground
24	GND	Power	Ground	Must be connected to ground
25	GND	Power	Ground	Must be connected to ground
26	GND	Power	Ground	Must be connected to ground
27	GND	Power	Ground	Must be connected to ground
28	RESERVED#2	Input/Output	Do not connect	-
29	RESERVED#1	Input/Output	Do not connect	-
30	DBG_EN	Input/Pull-down	In-circuit-debugger Enable	3.3V typical
31	DBG_CLK	Input/Pull-up	Debug CLOCK	3.3V typical
32	DBG_DATA	Input/Pull-up	Debug DATA	3.3V typical
33	RESET_N	Input/Pull-up	Device Reset input	3.3V typical - Active: Low
34	GND	Power	Ground	Must be connected to ground
35	UART_Rx	Input	Communication UART Receive (Data Rx)	3.3V typical
36	UART_Tx	Output	Communication UART Transmit (Data Tx)	3.3V typical
37	GND	Power	Ground	Must be connected to ground

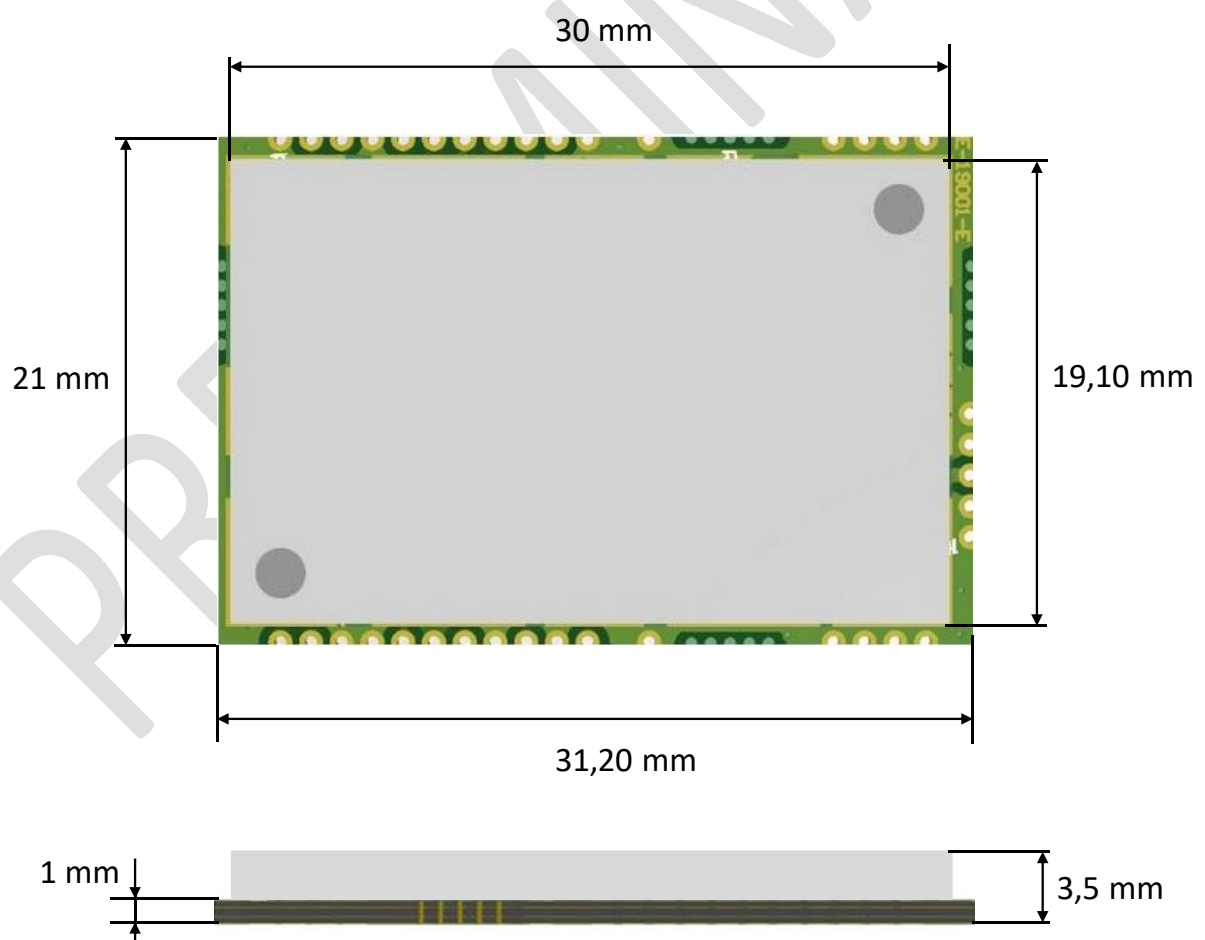
5. Mechanical specifications

The KIM1 is a SMT module has a size of 31.2mm x 21mm x 3.5mm for a maximum weight of 3g.

The module is made of FR4 standard PCB with pin castinations on 3 sides, that allow to be soldering onto a host printed circuit board (PCB) using standard reflow process.

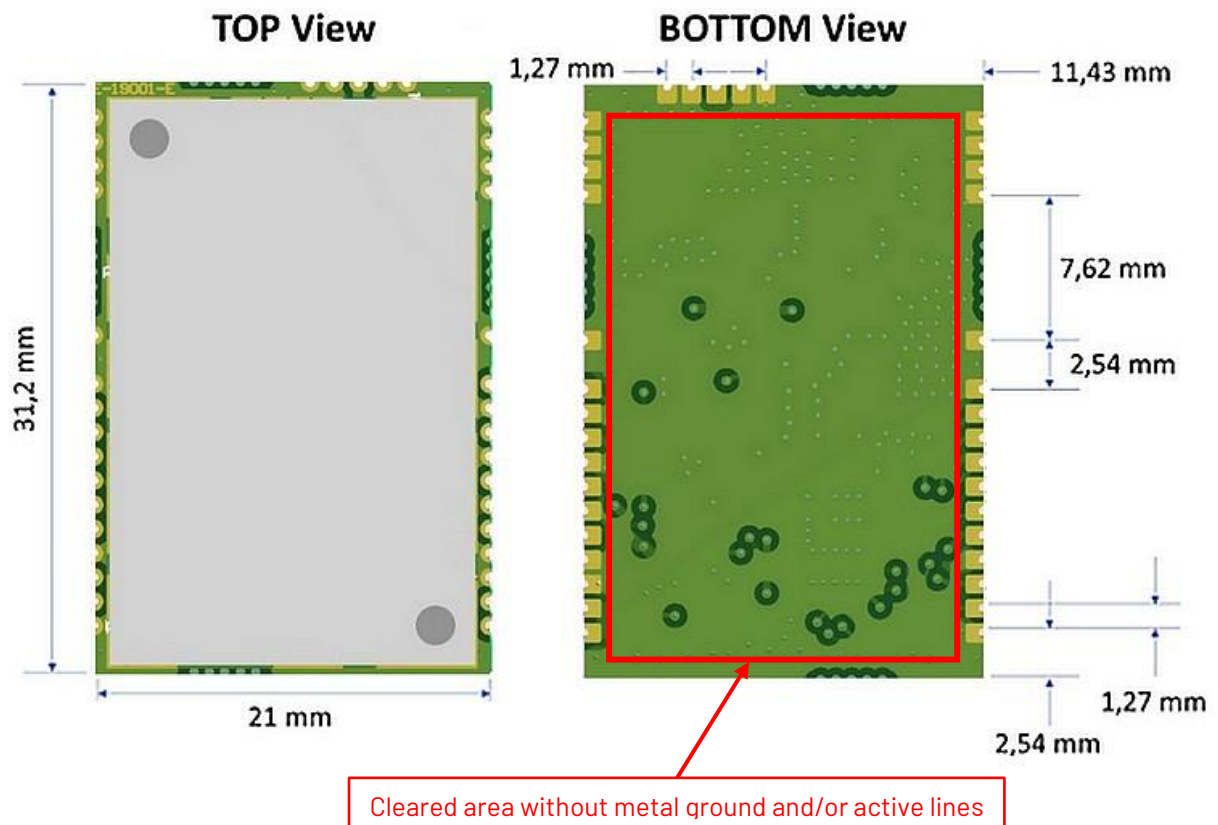
The castinations are metalized to ensure good soldering, and the pitch of the pins are standard to allow placement for low cost manufacturing process on host application board.

5.1. Module dimensions



Mechanical dimensions

5.2. Pin intervals



Pin pitch and placement

Important: The KIM1 module has solder mask on its bottom side. This solder mask covers the metal tracks and vias. To avoid short-circuit, host board area under the module should be left open without metal ground and/or active lines.



6. Storage and Soldering

6.1. Storage information

Storage and handling

The KIM1 are sensitive to electrostatic discharge, it must be kept in antistatic enclosure during storage.

The storage specification are detailed on maximum ratings table on paragraph 3.1.

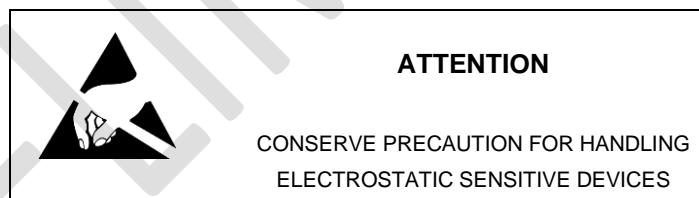
Do not expose the module to the following conditions:

- Corrosive gasses such as Cl₂, H₂S, NH₃, SO₂, or NO_x
- Extreme humidity or salty air
- Prolonged exposure to direct Sunlight
- Temperatures beyond those specified for storage

Do not apply mechanical stress

Do not drop or shock the module

Avoid static electricity, ESD and high voltage as these may damage the module



Moisture Sensitivity

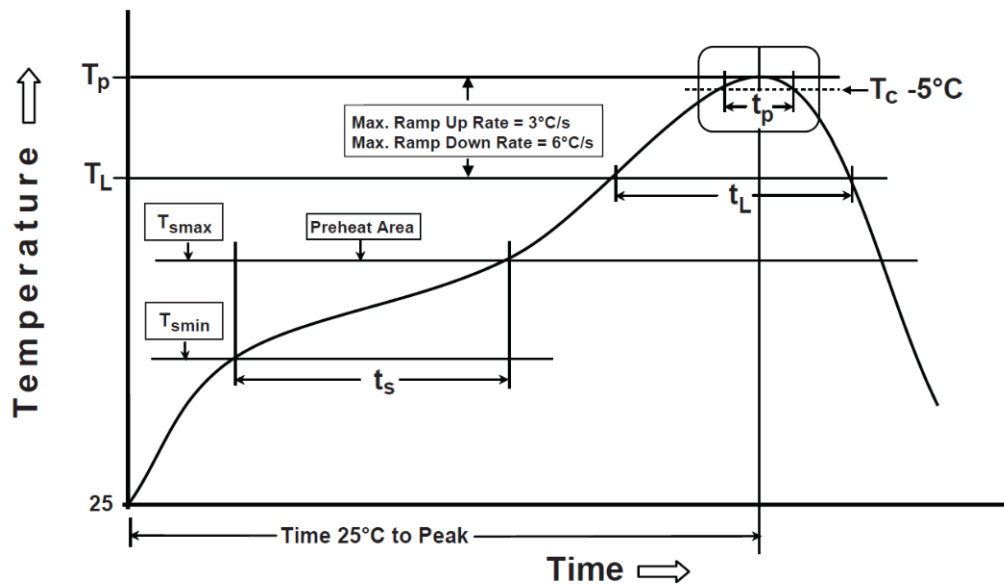
The KIM1 module has plastic package components which absorb moisture. During typical solder reflow operations when SMDs are module mounted onto a PCB, the entire PCB and device population are exposed to a rapid change in ambient temperature. Any absorbed moisture is quickly turned into superheated steam. This sudden change in vapor pressure can cause component failures and PCB degradation.

We recommend to bake the module see paragraph 6.2 (see jedec IPC/JEDEC J-STD-033D).

6.2. Soldering process

The KIM1 module is manufactured under ROHS process. As the module has an open shieding, it is sensible to moisture and humidity, we recommend to bake the module at temperature of 90°C during at least 12h to avoid issues during manufacturing (see jedec IPC/JEDEC J-STD-033D).

To achieve an optimum reflow process for mounting module on host PCB, we recommend the use of temperature profil detailed below (see jedec IPC/JEDEC J-STD-020E).



Preheat/Soak	
Temperature Min (T_{smin})	150 °C
Temperature Max (T_{smax})	200 °C
Time (t_s) from (T_{smin} to T_{smax})	60-120 sec
Ramp-up rate (T_L to T_p)	3 °C/sec max
Liquidous temperature (T_L)	217 °C
Time (t_L) maintained above T_L	60-150 sec

Peak package body temperature (T_p)	245°C (+0/-5°C)
Classification Temperature (T_c)	260 °C
Time (t_p) maintained above $T_c - 5^\circ C$	30 sec
Ramp-down rate (T_p to T_L)	6 °C/sec max
Time 25 °C to peak temperature	8 mn max

7. Ordering and Marking

7.1. Ordering

KIM1 modules are delivered in individual package in thermoformed antistatic bags.

For higher quantities, KIM1 module could be ordered in antistatic plastic trays (antistatic trays are proposed in standard quantities of 50 units and multiples of 50 units).



Complete information on plastic trays is available on request.

The ordered quantity of module are delivered in sealed pack with desiccant pack and humidity sensors.

7.2. Marking

Marking of the module is detailed as is, on sticker 20 x 10mm on the shielded cover of the module:

- ID: 6-digit Decimal ID (unique ID linked with Argos hexadecimal ID)
- SN: Serial Number : 2 digits for month / 2 digits for year of manufacturing - 4 last digit of Hexadecimal Argos ID number: Example : 0220-FFFF
- CDC: Internal manufacturer code 2 x 4 numbers: Example: 4416 - 0012 (subject to change)
- CE logo



KIM1 marking

8. Additional information

8.1. Contact & support

Product information, technical support and commercial contact are available from Kinéis at the following link:
<https://www.kineis.com/contact/>

8.2. Versioning

First manufacturing batches of KIM1 modules are designated "Engineering Samples" in this document:

- Decimal ID numbers starting with 179 (hexadecimal ID numbers starting with 5DDB1 and 5EC80)
- SN starting with 0719-, 1219- and 0120-

8.3. Related documents

The following documents are available from Kinéis upon request:

- **KIM1 Integration manual** from Kinéis (ref **KINEIS-NT-19-0018**)
- **PTT-A2/PMT-A2 Physical Layer Requirements** from CNES, (ref **2098**)

8.4. Legal notices

CE certification: as of June 2020, CE certification for KIM1 module is in preliminary testing phase

KIM1 must be used under the conditions described in the datasheet and the integration manual.

All voltage, current, duration values written in this document are measured with Kinéis equipment at operating temperature of 20°C and may differ when using a different equipment or setup.

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