

# KIM2

## Datasheet



Reference:	KINEIS-NT-22-0600
Version:	0.4
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## List of abbreviations

TBC: To Be Confirmed

TBD: To Be Determined

# 1. Introduction

Kinéis products make satellite connectivity easy to access and it is our goal to make integration and industrialization process as streamlined as possible.

The KIM2 module developed by Kinéis is a low-power bidirectional communication module design for Kinéis satellite IoT services and fully certified by Kinéis.

This document is the datasheet for the KIM2 transceiver module by Kinéis, which is complemented by the integration manual (see §1.2 **Related documents** for reference).

The module is specifically designed for ease of use, to shorten development time and thus decrease time to market. It offers IoT device manufacturers the possibility to integrate their end devices quickly and easily into the Kinéis network and is available for industrialization of satellite connected devices in large volumes.

## 1.1. Revision history

Issue	Date	Modifications
0.1		Document creation
0.2	Jan 26, 2023	Engineering Samples release for Beta Testing
0.3	Dec 6, 2023	Engineering Samples release for Beta Testing with new features: <ul style="list-style-type: none"><li>- Implementation of radio configuration</li><li>- Availability of LD-A2 modulation (low-data rate Argos-2: <math>\pm 1.1</math>rad BPSK, 400bits/s)</li></ul>
0.4	Jan 16, 2024	Update for CE and FCC certifications

## 1.2. Related documents

RDx	Reference	Title
RD1	KINEIS-MI-22-0601 - KIM2 Integration manual	Integration manual
RD2	KINEIS-MI-24-0069 - KIM2 Installation manual	Installation manual

## 1.3. Versioning

HW release	FW release	Datasheet version	Integration manual version
Engineering samples	KIM2_v1.0	KIM2 Datasheet v0.2	KIM2 Integration manual v0.2
Engineering samples	df88832__0x1,0ct 18 2023_07:37:19	KIM2 Datasheet v0.3	KIM2 Integration manual v0.3

## 1.4. Next features

Below is a list of features that will be implemented in the next releases:

- Low power consumption in Standby, Running and Reception modes
- Software management of EXT\_WKUP and KIM\_INT pins
- MAC implementation (periodic transmission, satellite pass predictions, satellite detection etc...)
- Automatic user data management ("push-and-forget")

## 2. Product description

### 2.1. Overview

Kim2 is the first bidirectional communication module compatible with the Kinéis constellation. It enables communication with all the Kinéis polar LEO satellites and provides global connectivity to IoT devices for data collection and positioning. The use of Kinéis RF signals and protocols ensures very low power consumption for devices within line-of-sight of the satellites.

Its main features are:

- Kinéis transmission with low-data rate uplink message formats, allowing 19 Bytes of user data
- Kinéis downlink reception for acknowledgment of uplink messages or data downlink messages
- Typical 3.6V DC power supply for compatibility with standard IoT batteries
- Autonomous mode or single commands mode available
- Transmission strategy management

KIM2 module is designed in SMT package integrating digital and baseband processor based on Kinéis waveforms, RF transceiver with power amplifying stage and controls.

KIM2 module is easy to use with a standard UART interface and communicates with external host by advanced command interface (AT command), as well as available GPIOs.

## 2.2. Main characteristics

Specification	Description
RF Tx standard Power	27dBm (500mW)
TX Frequency Range	399.9 – 403 MHz
RX Frequency Range	400.6 – 400.7 MHz (Kinéis satellite Downlink frequencies)
TX Modulations	Kinéis low-data rate (LD-K) modulation ( $\pm 1.1$ rad BPSK) Argos low-data rate (LD-A2) modulation ( $\pm 1.1$ rad BPSK) Argos low-data rate (VLD-A4) modulation ( $\pm 1.1$ rad BPSK)
RX Modulation	Kinéis downlink (DLK) modulation ( $\pm 1.1$ rad BPSK)
TX data rates	200 bits/s with VLD-A4 modulation 300 bits/s with LD-K modulation 400 bits/s with LD-A2 modulation
RX data rate	320 bits/s with DLK modulation
Power Supply	3.6VDC typical
Communication Interface	3.3V UART
DC, Digital & RF Connections	Board edge connection
Package	48-pin surface-mount module
Operating temperature	-40°C to +85°C
Storage temperature	-40°C to +90°C
Size	36.6 x 25.4 x 5 mm <sup>3</sup>
Certification	Kinéis, CNES CE pending FCC pending



## 2.3. Functional description

KIM2 is a Kinéis compliant transceiver: it enables sending messages of 19 Bytes of user data to Kinéis satellites and receiving messages of 16 Bytes from Kinéis satellites. The module is controlled by AT commands indicating the uplink message payload and requested service, then performs the RF signal modulation processing to transmit the data to the satellite. When asked for a downlink message, it performs the demodulation and informs the host microcontroller with AT commands.

Kim2 module main functions:

- Uplink messages formatting and RF Signal generation
- Downlink message reception (data downlink and uplink acknowledgment)
- Kinéis bidirectional protocol management
- Message queue management (*future releases*)
- Transmission profiles management (*future releases*)
- Energy-saving deep sleep mode (*future releases*)

The KIM2 block diagram shown below depicts the sections of the module:

- MCU (Microcontroller Unit) embedding the firmware, with UART and GPIO interface
- Integrated transceiver (I/Q processor and RF modulator) and internal clock system (TCXO)
- RF Front-End including TX power amplifiers and harmonic filter, TX/RX switch, LNA (Low-Noise Amplifier) for the reception and RX SAW filter
- Power section with DC supply

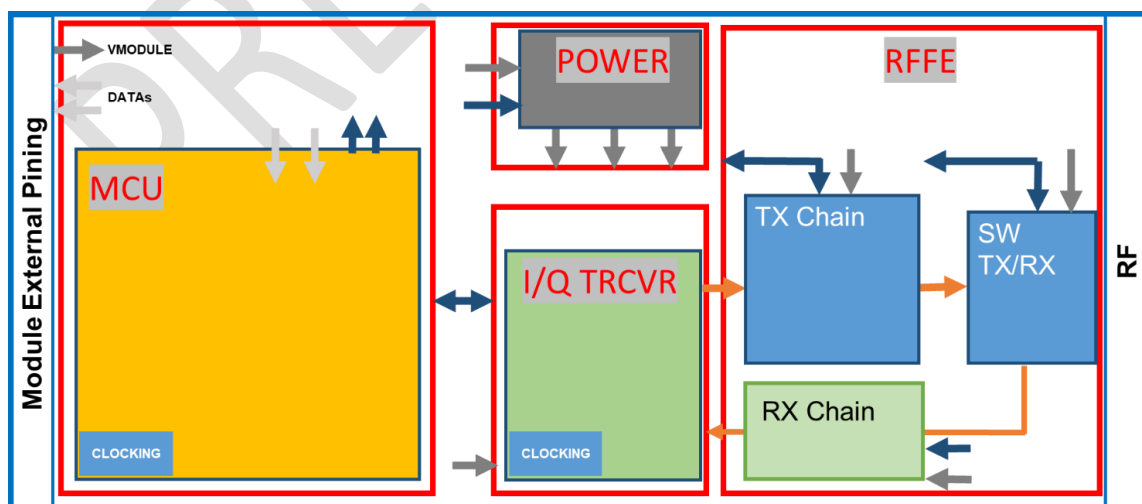


Figure 1: KIM2 functional diagram

## 2.4. State transition diagram

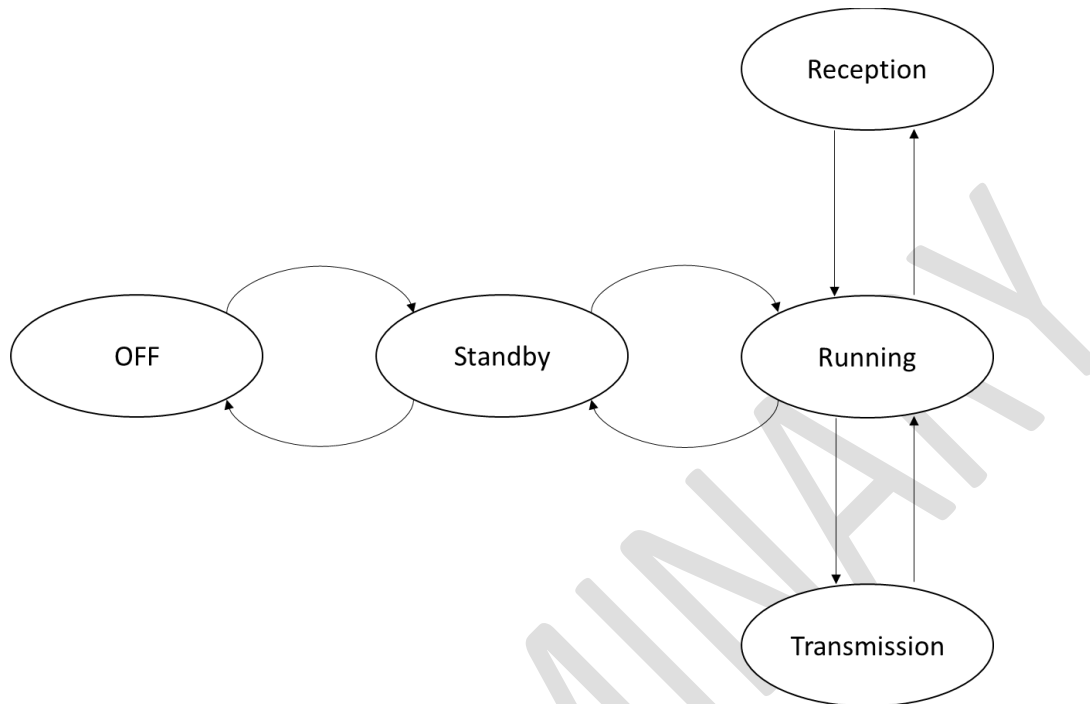


Figure 2: KIM2 state diagram

When the KIM2 is powered at VDD, it can follow different modes:

**OFF** mode: when the EXT\_PWR\_EN pin is low, MCU power supply is off, power supply of analog parts are disabled too 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 the transition to the Running Mode. *This mode will be optimized for low power consumption in future releases, but currently drains as much current as the 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 TCXO and the internal power amplifiers, and a signal is transmitted to the antenna corresponding to the specified Kinéis message.

**Reception** mode: this mode is activated when a transmission command calls for the reception of a downlink message (acknowledgment or downlink user message)

# 3. Electrical specifications

## 3.1. Absolute Maximum Ratings


Symbol	Description	Condition	Min	Max	Unit
VDD	Supply voltage			5.5	V
IDD	Supply current			500	mA
Ptot	Total power consumption			1500	mW
VIO	I/O voltage		-0.3	3.6	V
Ves	Electrostatic handling	HBM*	-250	250	V
Top	Operating temperature		-40	+85	°C
Tstg	Storage temperature		-40	+90	°C
Pin	Input signal strength			10	dBm

\*: Human Body Model (HBM), per standard ANSI/ESDA/JEDEC JS-001, all pins

Note: KIM2 module is not protected against reverse voltage. Be careful when supplying the 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.



**ATTENTION**

CONSERVE PRECAUTION FOR HANDLING  
ELECTROSTATIC SENSITIVE DEVICES  
Human Body Model Class 1A

## 3.2. Nominal Operation Ratings

### 3.2.1. Electrical

Symbol	Description	Condition	Min	Typ	Max	Unit
VDD*	Supply voltage		3.3	3.6	5	V
IDD (Off)	Quiescent current, Off mode			0.9		μA
IDD (Standby)	Supply current, Standby mode			16		mA
IDD (Transmission)	Supply current, Transmission mode	VDD=5V		281		mA
		VDD=3.6V		390		
		VDD=3.3V		425		
V UART	UART voltage			3.3	3.6	V
VIO	Other I/O voltage			3.3	3.6	V
Top	Operating temperature		-40	+25	+85	°C

### 3.2.2. Radio frequency

#### 3.2.2.1. Transmission

Symbol	Description	Condition	Min	Typ	Max	Unit
Frequency			399.9		403.0	MHz
Power			500	520	550	mW
			27.0	27.2	27.4	dBm
Data rate	VLD-A4 modulation			200		bits/s
	LD-K modulation			300		bits/s
	LD-A2 modulation			400		bits/s

### 3.2.2.2. Reception

Symbol	Condition	Min	Typ	Max	Unit
Frequency		400.6		400.7	MHz
Data rate	DLK modulation		320		Bits/s
Sensitivity range	Tamb = 25°C FER ≤ 10 <sup>-3</sup>	-130		-75	dBm

## 3.2.3. Logic

### 3.2.3.1. Digital inputs

Symbol	Description	Condition	Min	Typ	Max	Unit
VIL	Input voltage, low	VDD=3.6V			0.8	V
VIH	Input voltage, high		2.4			V
VIL_0	Input voltage Low state for ON/OFF pin (5)				0.8	V
VIH_0	Input voltage High state for ON/OFF pin (5)		2.4			V
VIBPC	Input voltage range, for DEBUG and UART			3.3	5	V
I <sub>i</sub>	Input leakage current			-10		10

### 3.2.3.2. Digital outputs

Symbol	Description	Condition	Min	Typ	Max	Unit
I <sub>OH</sub>	Output current, high	VOL=2.4V		8		mA
I <sub>OL</sub>	Output current, low	VIL=0.4V	2	8		mA
I <sub>oz</sub>	Tri-State output leakage current	VDD_IO =5V			0.8	mA

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

## 3.3. Current consumption

All current consumptions in this paragraph are measured at the nominal supply voltage value 3.6V. The values indicated will change in future firmware releases after power consumption optimization, especially in Standby mode.

Note: The use of KIM2 module with lower supply voltage than specified in paragraph 2.2 will significantly decrease the RF performance and the transmission power to the satellite. Kinéis does not guarantee performance nor product liability outside of typical operation ranges.

### 3.3.1. Consumption profile overview

Mode	Duration (ms)	Current consumption (mA)		
		Min	Typ	Max
-	-			
Off	Controlled by host MCU		9e-4	
Standby	Controlled by host MCU or depending on implemented scenario		16*	
Running	Controlled by host MCU		19	
Transmission	Transmission cycle consists of TCXO warmup + Transmission, see values in paragraph 3.3.2	see paragraph below		
Reception			75	

\* The values indicated will change in future firmware releases after power consumption optimization

### 3.3.1.1. Transmission mode

The KIM2 current consumption in transmission mode depends on the length of the message transmitted, as well as the transmission power configured. After receiving a transmission AT command, the KIM2 begins the TCXO warmup and then transmits the Kinéis message to the satellite via the RF output.

Below are the duration and current consumption values @VDD=3.6V for the successive steps of the transmission mode, with the typical transmission power of 500mW / 27dBm:

Status	Duration (ms)			Current consumption (mA)		
	Min	Typ	Max	Min	Typ	Max
TCXO warmup		2000				6
Transmissions (VLD-A4)	515		965			
Transmission (LD-K)		995.4		373	390	407
Transmission (LD-A2)	360		920			

### 3.3.1.2. Reception mode

Below are the duration and current consumption values @VDD=3.6V for the successive steps of the reception mode:

Status	Duration (ms)			Current consumption (mA)		
	Min	Typ	Max	Min	Typ	Max
TCXO warmup		2,000				6
Reception	Until reception of a downlink message		15,000 (15-second timeout)		75	





## 4.2. Pin descriptions

The table below gives the pin numbers and status of KIM2 module.

Pin	Name	Type	Description	Comment
1	GND	Power	Ground	
2	USR_NRST	Input		3.3V typical - Active: Low Should not be left floating
3	GND	Power	Ground	
4	USR_I00	Input/Output		3.3V typical
5	KIM_INT (USR_I01)	Output	KIM2 Interrupt pin	Allows module to wake up host micro-controller, 3.3V typical
6	EXT_WKUP	Input		Wake Up from external Host
7	GND	Power	Ground	
8	JTMS_SWDIO			Programming and debug
9	JTCK_SWCLK			Programming and debug
10	GND	Power	Ground	
11	VDD	Power	Positive supply voltage	3.6V typical
12	VDD	Power	Positive supply voltage	3.6V typical
13	GND	Power	Ground	
14	GND	Power	Ground	
15	EXT_PWR_ON	Input	Module powering	Module active: High Module inactive: Low Pin input must be actively terminated
16	USR_I02	Input/Output		3.3V typical
17	USR_I03	Input/Output		3.3V typical
18	KIM_TX (USR_I04)	Output	TX Status pin	TX mode: High / RX mode: Low, 3.3V typical
19	KIM_RX (USR_I05)	Output	RX Status pin	RX mode: High / TX mode: Low, 3.3V typical
20	NC			
21	GND	Power	Ground	

Pin	Name	Type	Description	Comment
22	NC			
23	NC			
24	GND	Power	Ground	
25	NC			
26	GND	Power	Ground	
27	NC			
28	NC			
29	GND	Power	Ground	
30	GND	Power	Ground	
31	KIN_ANT	RF	Common TX / RX antenna port	50ohm port
32	GND	Power	Ground	
33	GND	Power	Ground	
34	GND	Power	Ground	
35	GND	Power	Ground	
36	GND	Power	Ground	
37	LPUSART_TX	Output	Communication UART Transmit	3.3V typical
38	LPUSART_RX	Input	Communication UART Receive	3.3V typical
39	GND	Power	Ground	
40	I2C_SDA		Low power I2C Data	3.3V typical
41	I2C_SCL		Low power I2C Clock	3.3V typical
42	GND	Power	Ground	
43	GND	Power	Ground	
44	USB_DM		USB “-” Line	5V typical
45	GND	Power	Ground	
46	NC			
47	GND	Power	Ground	
48	USB_DP		USB “+” Line	5V typical

The KIM2 module must be integrated under the conditions described in the typical integration circuit of the KIM2 Integration Manual (reference available in paragraph 1.3 Versioning). Please make sure to consider these recommendations to avoid any integration issue.

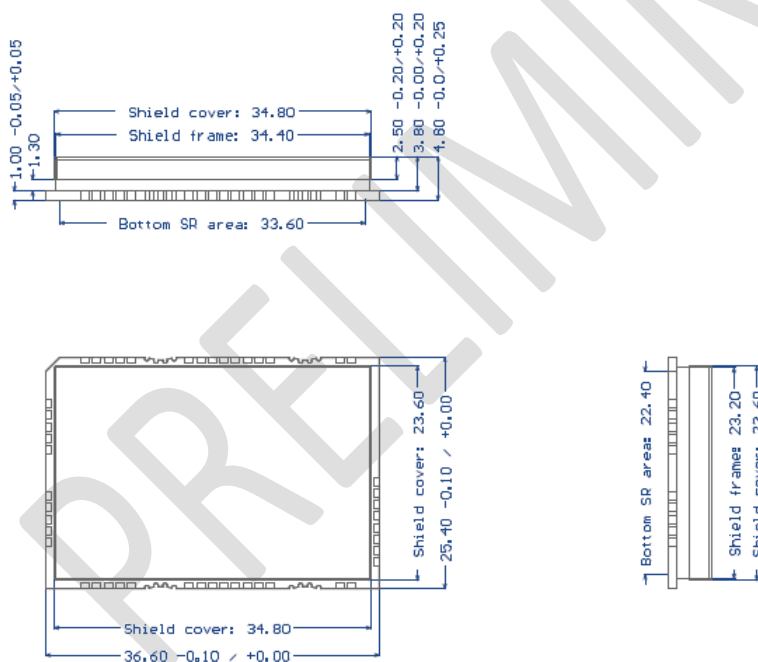
# 5. Mechanical specifications

The KIM2 is a SMT module with size 36.6 x 25.4 x 5mm and a maximum weight of 6g.

The module is made of FR4 standard PCB with pin indentation on 4 sides, allowing soldering onto a host printed circuit board (PCB) using standard reflow process.

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

## 5.1. Module size



Dimensions are in mm

Tolerance:  $\pm 0.05$ mm unless specified

Shield part tolerance:  $\pm 0.20$ mm

Respect distance of 1.2mm around module without any component

Figure 4: KIM2 mechanical dimensions



## 5.2. Pad details

Pad details

Pin 1: Rectangle pad

Other pins: Rounded rectangle pad

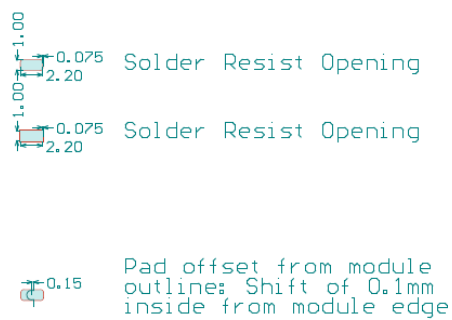


Figure 6: Pad details

Note: Altium library symbol and footprint are available on demand

# 6. Storage and soldering

## 6.1. Storage information

Kinéis declines all responsibility in case of product malfunction after improper storage or soldering.

### 6.1.1. Storage and handling

The KIM2 is sensitive to electrostatic discharge, it must be kept in antistatic enclosure during storage.

The storage specifications are detailed on maximum ratings table on paragraph 2.1.

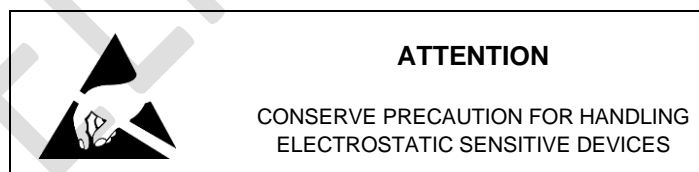
Do not expose the module to the following conditions:

- Corrosive gasses such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, or NOX
- Extreme humidity or salty air
- Prolonged exposure to direct sunlight
- Temperatures beyond those specified for storage

Do not apply mechanical stress.

Do not drop nor shock the module.

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



### 6.1.2. Moisture sensitivity

The KIM2 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 baking the module to avoid these degradations, see paragraph 6.2.

## 6.2. Soldering process

The KIM2 module is manufactured under ROHS process. As the module has an open shielding, it is sensible to moisture and humidity, we recommend baking the module at temperature of 90°C during at least 12h to avoid issues during manufacturing (see procedure jedec IPC/JEDEC J-STD-033D).

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

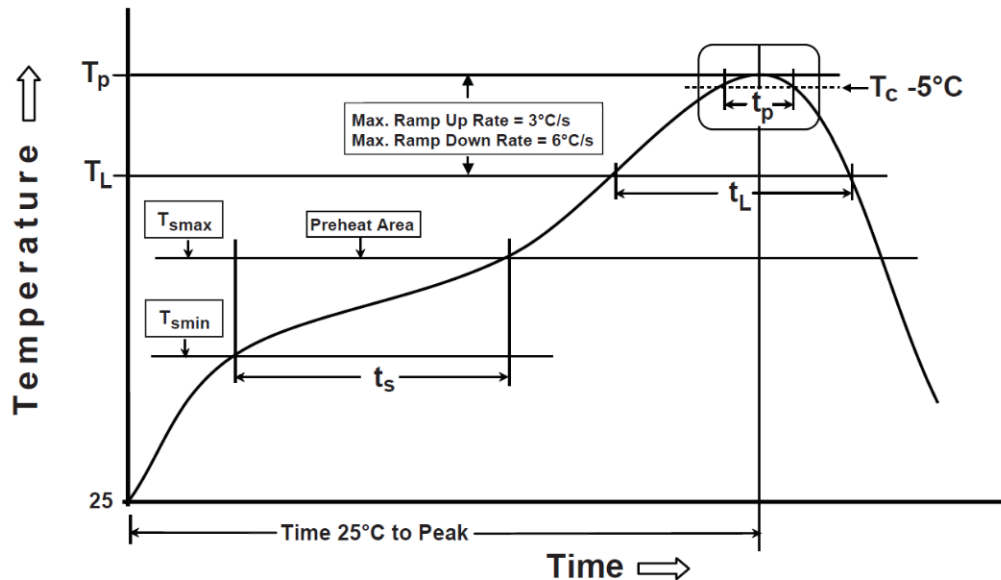


Figure 7: Temperature profile for soldering

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 $T_c - 5 °C$	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

KIM2 modules can be delivered:

- In individual package in thermoformed antistatic bags for small quantities.
- Antistatic trays are proposed in standard quantities of *TBD* units

All orders of modules are delivered in sealed pack with desiccant pack and humidity sensors.



Figure 8: Individual antistatic bags and 50 units plastic trays

## 7.2. Marking

TBD



# 8. Additional information

## 8.1. Contact and support

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

## 8.2. Known-issues

## 8.3. Specific terms of use

The KIM2 module must be used under the conditions described in the datasheet and in the KIM2 Integration Manual (see paragraph 1.2 Related documents for reference).

All voltage, current, duration values written in this document are measured with Kinéis equipment at operating temperature of 25°C and may differ when using a different equipment or setup.

## 8.4. Frequency Use

The frequency band 401-403MHz is designated by the International Telecommunication Union (ITU) as usable for Global satellite data collection and positioning system as ARGOS. The Centre National Etudes Spatiales (CNES) oversees the Argos program. The CNES endorses Kinéis to operate the frequency band allocated to Argos.

This frequency band is usable with limitations. Please contact Kinéis to verify that your application with KIM2 respects those limitations.

When certified by Kinéis to operate in this frequency band, there are no further limitations whatever countries of European Union.

As soon as the new satellite constellation will be in orbit, Kinéis will use in addition the frequency band 399.9-400.05MHz, designated as the MSS band (Mobile-Satellite Service).

The Federal Communications Commission (FCC) of USA has authorized Kinéis to use both frequency bands, MSS and EESS through a license registered under the reference SES-LIC-20220314-00271.

## 8.5. Certificate of conformance

### 8.5.1. CE

The KIM2 module is designed to comply with the EU standard and is currently under review.

### 8.5.2. FCC

The KIM2 is designed to comply with the FCC standards and is currently under review.

Please consult the RD2 to be aware about the installation constraints to benefit of the Kinéis grant or take the responsibility of the module through a change of FCC ID (new application).

## 8.6. Legal notices

Kinéis reserves the right to make changes, corrections, enhancements, modifications, and improvements to their products and/or to this document at any time without notice. Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

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## 8.7. Statements

### FCC requirements:

According to the definition of mobile and fixed device is described in Part 2.1091(b), this device is a mobile device. And the following conditions must be met:

1. This modular approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based timeaveraging duty factor, antenna gain and cable loss must satisfy MPE categorical exclusion requirements of 2.1091.
2. The EUT is a mobile device; maintain at least a 20cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.
3. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.
4. For a host using a certified modular with a standard fixed label, if the module's FCC Id is not visible when installed in the host, or if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module FCC ID: 2A96E-KIM2-HW1FW1" or "contains FCC ID: 2A96E-KIM2-HW1FW1" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.
5. The final host/module combination may also need to be evaluated against the FCC part25 criteria. The user's manual shall caution the user that changes or modifications not expressly

approved by the party responsible for compliance could void the user's authority to operate the equipment.

6. The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

PRELIMINARY