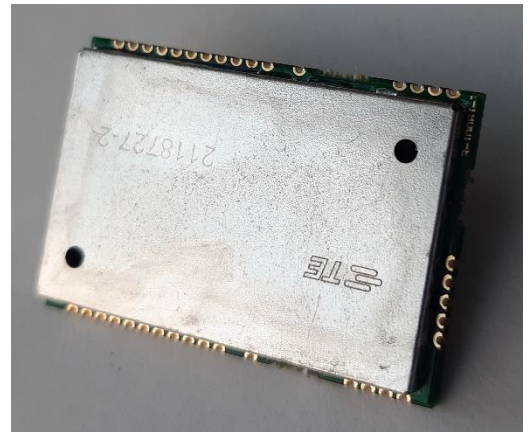


KIM1

Operational Description



Reference:

KINEIS-NT-23-0186

Issue:

1.0

Date:

24/05/2023

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1. Introduction

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

It enables communication with all the Kinéis/Argos polar LEO satellites and provides global connectivity to IoT devices for data collection and positioning. The use of Argos RF signals and protocols ensures very low power consumption for device within line of sight of Kinéis/Argos satellites.

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 device in large volumes.

This document describes the operational modes of the KIM1 module, complementing the datasheet and integration manual.

It details:

- The block diagram
- The RF part
- The associated antennas

Warning: Please refer to the paragraph below, **1.1 Versioning**, to make sure you are reading the documentation suited to your module version.

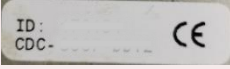
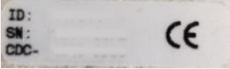





For further assistance, feel free to contact Kinéis at the following link: <https://www.kineis.com/contact/>

1.1. Versioning

Please refer to the table below to identify the version of the documentation (Datasheet and Integration Manual) related to your module series, considering the following information:

- The hardware (HW) version, determined by the Serial Number
- The firmware (FW) or software (SW) version, determined with the AT command AT+FW=?

Warning: most of the time, the Serial Number can be an indication for the FW version looking at the correspondence table below. However, the FW version must be finally determined with the AT command AT+FW=? since the KIM1 may have been reprogrammed with a newer FW version after manufacturing.

Label	Serial number	Manufacturing FW version	Datasheet reference and version	Integration Manual reference and version
 	0719 -xxxx 1219 -xxxx 0120 -xxxx 0220 -xxxx	KIM_HW1.1_ •SW0.2 •SW1.0 KIM_HW1.3_ •SW1.0 •SW1.1 •SW1.2	KINEIS-SP-20-0147 KIM1 Datasheet v1.0.pdf	KINEIS-NT-19-0018 KIM1 Integration Manual v2.0.pdf
	KIM132008 xxxxxx	KIM_HW1.3_SW1.3	KINEIS-SP-20-0147 KIM1 Datasheet v1.2.pdf	KINEIS-NT-19-0018 KIM1 Integration Manual v2.0.pdf
	KIM132103 xxxxxx	KIM1_V1.4	KINEIS-SP-20-0147 KIM1 Datasheet v1.2.pdf	KINEIS-NT-19-0018 KIM1 Integration Manual v2.1.pdf
	KIM132109 xxxxxx	KIM1_V2.0	KINEIS-SP-20-0147 KIM1 Datasheet v2.0.pdf	KINEIS-NT-19-0018 KIM1 Integration Manual v2.2.pdf
	KIM132111 xxxxxx KIM132112 xxxxxx KIM132201 xxxxxx	KIM1_V2.1		KINEIS-NT-19-0018 KIM1 Integration Manual v2.3.pdf
	KIM1523 xxxxxxx	FW3.x.x	KINEIS-SP-20-0147 KIM1 Datasheet v2.1.pdf	KINEIS-NT-19-0018 KIM1 Integration Manual v2.4.pdf

All further modules will be produced and distributed with the latest hardware and software versions. In case of any doubt regarding your module version and corresponding documentation, do not hesitate to contact us.

1.2. Revision history

Issue	Date	Ref	Modifications
1.0	May 24, 2023	VG	Document creation for FCC submission

1.3. Related documents

- KINEIS-SP-20-0147 KIM1 Datasheet
- KINEIS-NT-19-0018 Integration Manual

2. Product description

2.1. Overview

KIM1 is a Kinéis compliant transmitter enabling to send messages of useful data to 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.

KIM1 module is designed in SMT package integrating digital and baseband processor.

KIM1 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 features

Specification	Description
RF Tx Power	1W calibrated conducted RF level
Frequency Range	399.9 - 403 MHz*
Modulation	±1.1rad BPSK (Argos 2 compliant)
Over-the-Air data rate	400 bits/s for LD-A2 modulation 300 bits/s for LD-K modulation 200 bits/s for VLD-A4 modulation
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, FCC

*: until further notice, Kinéis satellites only receive signals in frequency range [401.620 -401.680 MHz].

2.3. Block diagram

The KIM1 block diagram shown below depicts the MCU DSP (RF Digital processor) and internal clock system (TCXO) in charge of the modulation, RF sections with power amplifiers and filters, DC supply, control, GPIO and UART section.

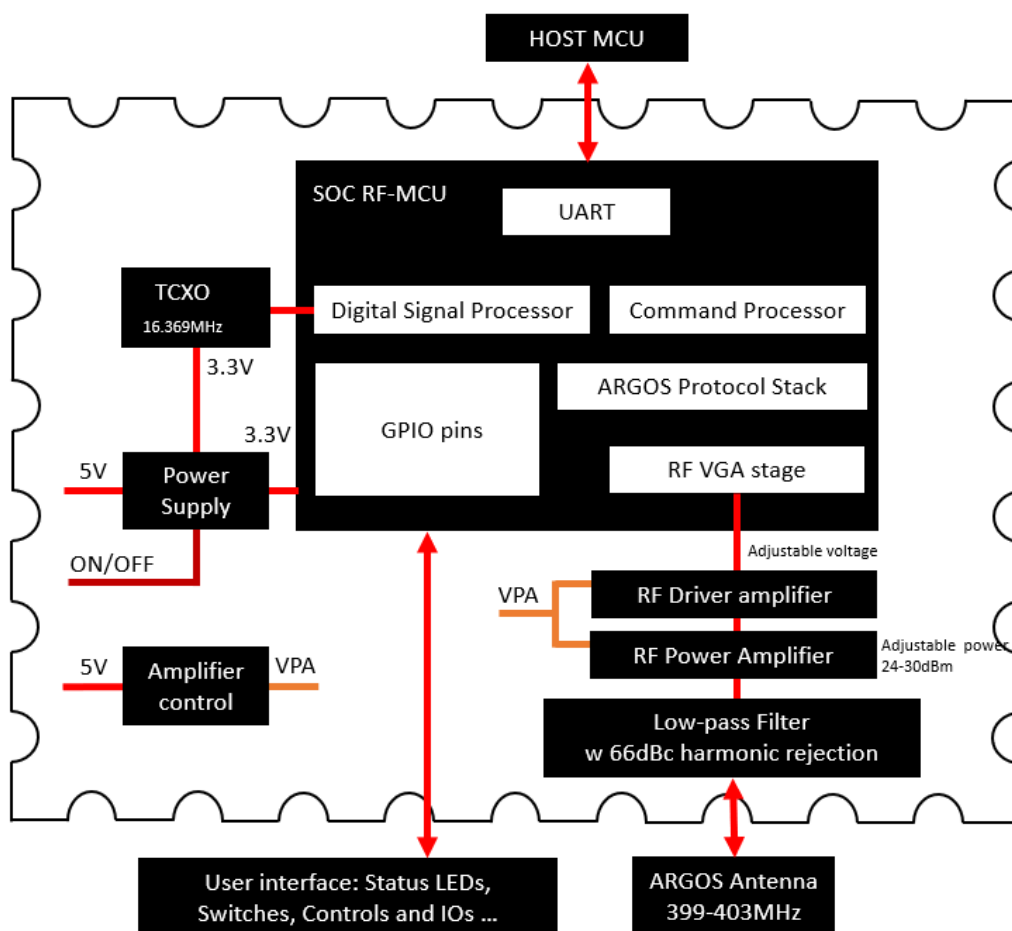


Figure 1: KIM1 block diagram

2.4. Power supply

The KIM1 must be supplied by +5VDC only. It is required to properly supplied the power amplifier part. A low-dropout regulator +3.3VDC is integrated to supply internal parts such as the SoC (MCU+RF) and the TCXO.

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	5	V
VIO	Other I/O voltage			3.3	3.6	V

*: 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. For further information, refer to the *KIM1 Integration Manual* (reference available in paragraph 1.1 Versioning).

2.5. RF SoC

A unique component integrates the MCU and the DSP.

The MCU part allows to communicate with a MCU host (mother board side) through a universal asynchronous receiver transmitter link (UART). It configures the transmission parameters such as (RF power, data to transmit), provides the identifiers, some status.

It offers general purpose input/output (GPIO) driven depending on the states of the module.

It contains the firmware including the Kinéis stack managing the DSP. The frame formatting respects the Kinéis specifications depending on the selected protocol (LDA2, VLDA4, LDK).

The DSP generates the RF signal, using the appropriate modulation (BPSK +/-1.1 rad), with a center frequency between 399.9-403MHz. The baudrate of phase deviations depends on selected modulations (LDA2, VLDA4, LDK).

The Phase locked loop (PLL) is clocked by a TCXO 16.369MHz ensuring a stable frequency generation between -20;+55°C.

2.6. Power Amplifier

The SoC power is configurable through internal registers, but it doesn't achieve 1W; two stages of amplification are used, a driver then a power amplifier, both cumulating 37dB.

2.7. Low-Pass filter

After amplification, the RF signal is filtered to pass the useful frequencies [399.9-403MHz] and cut the higher frequencies, particularly the second and third harmonics of the center frequency.

2.8. Antenna associated with

Two antennas have been tested associated with the KIM1 HW1.5 and complied with the limits imposed by the FCC 47 CFR part 25 and ISED RSS-170.

You shall respect the following integration details or use some antennas offering a lower gain, to benefit of the FCC/ISED limited module approach granted to the KIM1.

1. Module interface board

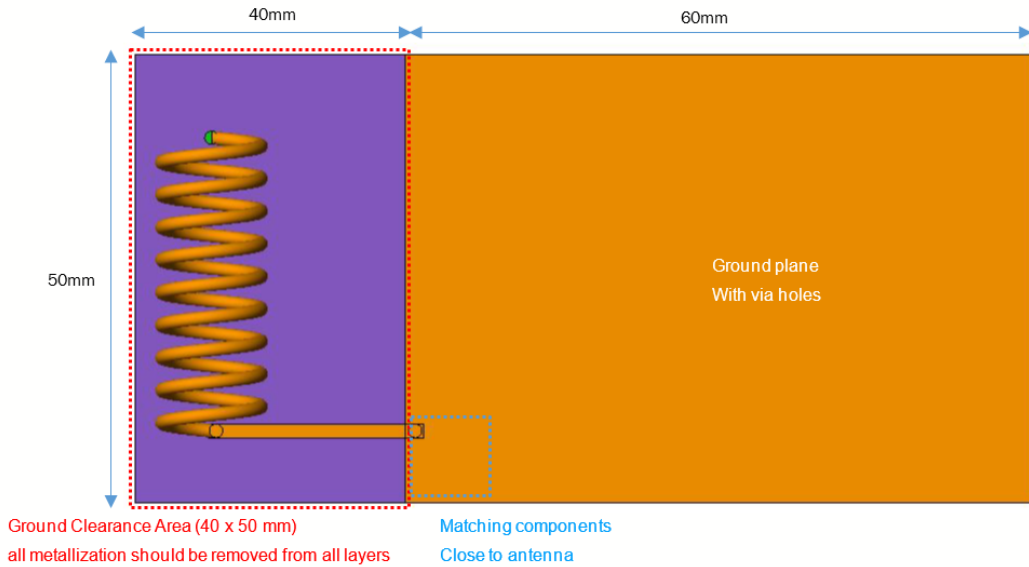
In the context of radio testing for the FCC/ISED, the KIM1 module was soldered on an interface board as illustrated below:



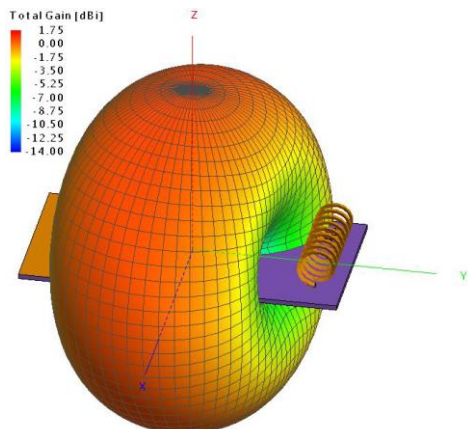
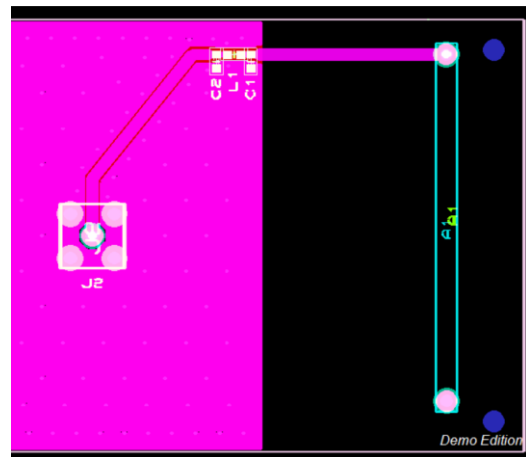
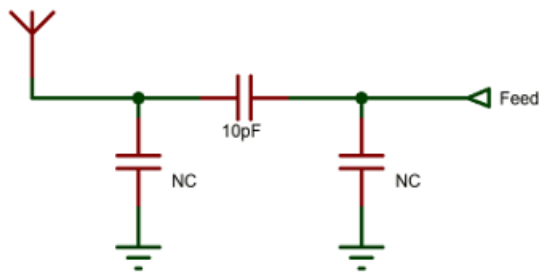
2. Coil antenna

First antenna model tested with the KIM1 and complying with the FCC requirements is a coil antenna, reference ANT-418-HETH by LINX.

Here is the given the PCB trace and dimensions to respect as a reference design:



This antenna must be adapted in impedance to match with 50Ω between 399–403MHz. A typical matching network is set between the KIM1 module, and the antenna as illustrated:



The coil antenna on its PCB is advised to be installed in vertical position (not as illustrated on simulation view) to benefit of a maximum radiation pattern oriented to the horizon.

The maximum gain of such antenna between 399–403MHz is specified to 0dBi.

3. Whip antenna

The second antenna model tested with the KIM1 and complying with the FCC requirements is a whip dipole antenna, reference CXL70-1Lw/I by PROCOM.



This antenna is advised to be installed in vertical position (as illustrated) to benefit of a maximum radiation pattern oriented to the horizon.



As this antenna offers a N-type connector, it is necessary to use an adapter. In the context of the radio testing for the FCC, a SMA coaxial cable of 1m long has been used.

2.9. RF exposure

Considering the maximum RF power provided by the KIM1, associated with both antennas described above, the calculations show a compliance with FCC 1.1307(b)(3)(i)(B) when used at a minimum distance of 20cm resulting in a SAR-based exemption.

3. Additional information

3.1. Contact & support

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

The post address of KINEIS is: 11 rue HERMES, 31520 RAMONVILLE-SAINT-AGNE, FRANCE

3.2. 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.

Kinéis products are warranted as per contract and general purchase condition, as long as they are used under the conditions described in the datasheet and the integration manual.

“Kinéis” and the Kinéis logo are trademarks of Kinéis SAS. For any communication or marketing needs, please contact our team.

3.3. Certification

The module KIM1 is certified to operate in several world's areas:

- In Europe, complying with the RED directive
- In USA, complying with the FCC

In addition, to operate on the Kinéis network, the module is certified against the transmitter certification requirements.

However, the KIM1 is a module intended to be integrated in a device so you must be aware that new tests or conformance demonstrations are required on the end-product, to obtain a certificate grant for this device.

The module KIM1 has been EU-type certified under the reference **20-104150_C** by the notified body 0536. The module KIM1 is certified by the FCC under the FCC ID: **2A96E-KIM1-HW1-5**

3.4. Frequency Use



The frequency band 401-403MHz is designated by International Telecommunication Union (ITU) as usable for Earth Exploration-Satellite Service, including the Global satellite data collection and positioning system, which is ARGOS, now operates by Kinéis company.

The French space agency CNES (Centre National d'Etudes Spatiales) manages the Argos program and endorses Kinéis through many operating parts.

The EESS frequency band being usable with limitations, please contact Kinéis to verify that your application with KIM1 is in respect of those limitations.

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.