




# NL01A

## Datasheet

Includes:

NL01A



version 1.1  
Nanoleaf  
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# 1.

# Overview

NL01A is EFR32MG21A010F-based modules developed by Nanoleaf.

Table 1-1. NL01A

Module	NL01A
Core	EFR32MG21
Antenna	Onboard antenna
Dimensions (unit: mm)	$(17.50 \pm 0.10) \times (22.50 \pm 0.10) \times (3.20 \pm 0.10)$
Schematics	See <i>Figure 5-1</i> for details.

 **Note:**

For more information on EFR32MG21, please refer to [EFR32MG21 Datasheet](#).

Table 1-2. NL01A Specifications

Categories	Items	Specifications
Certification	RF certification	SRRC, FCC, CE (RED), IC, NCC, KCC, TELEC (MIC) ** (All Ongoing)
	Green certification	RoHS, REACH
Test	Reliability	HTOL/HTSL/uHAST/TCT/ESD
2.4GHz Proprietary	Modulation Type	GFSK
	Frequency range	2402 MHz ~ 2480 MHz
Thread	Modulation Type	QPSK
	Frequency range	2405 MHz ~ 2480 MHz
Hardware	Peripheral interface	ADC/GPIO/I <sup>2</sup> C/I <sup>2</sup> S/SPI/UART
		GPIO/PWM
	Operating voltage	2.7 V ~ 3.8 V
	Operating current	Average: 10 mA
	Minimum current delivered by power supply	200 mA
	Operating temperature range	-40 °C ~ 85 °C
Storage temperature	-40 °C ~ 85 °C	



Categories	Items	Specifications
Software	External interface	-
	Moisture sensitivity	level Level 3
	Firmware upgrade	OTA (via network)/Download and write via host
	Software development	Supports Cloud Server Development/SDK for custom firmware development
	User configuration	Cloud Server, Android/iOS app



# 2.

# Pin Description

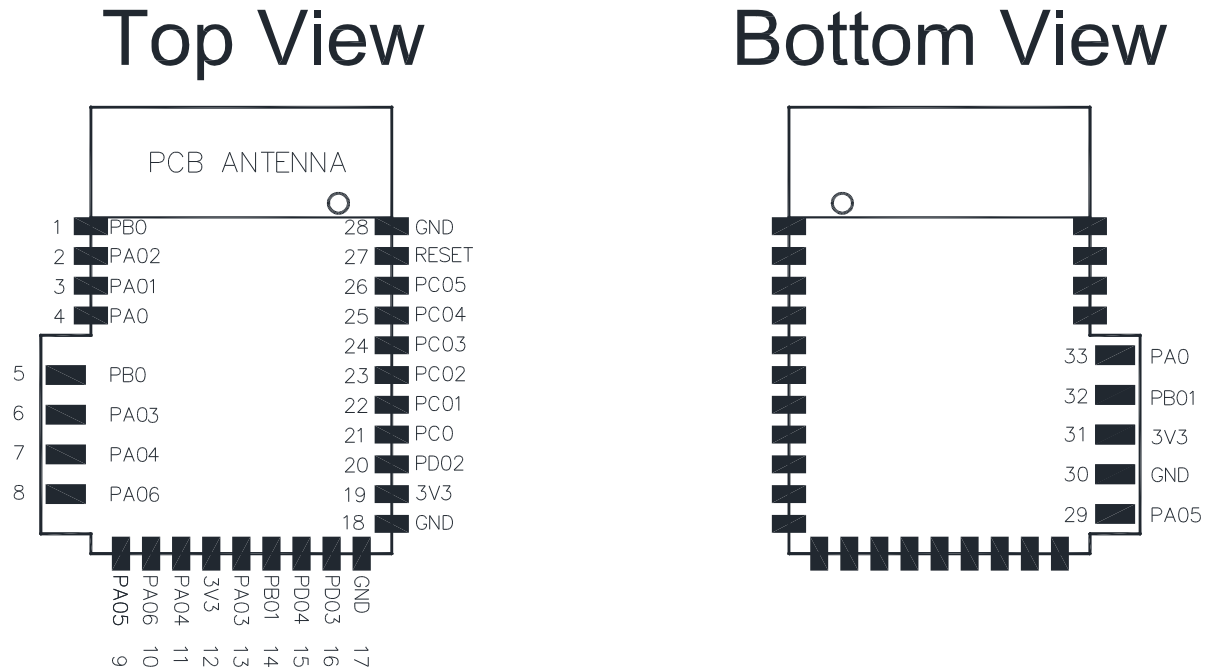


Figure 2-1. NL01 Pin Layout (top View & Bottom View)

**Note:**  
All Gnd Pin should connect to Fatherboard GND

Figure 2-1 shows the pin distribution of the NL01A.

NL01A have 33 pins. Please see the pin definitions in Table 2-1.

Table 2-1. NL01A Pin Definitions

Pin(s)	Pin Name	Description
PIN1	PB0	GPIO
PIN2	PA02	GPIO/DBG_SWDIO
PIN3	PA01	GPIO/DBG_SWCLK
PIN4	PA0	GPIO
PIN5	PB0	GPIO
PIN6	PA03	GPIO
PIN7	PA04	GPIO
PIN8	PA06	GPIO
PIN9	PA05	GPIO
PIN10	PA06	GPIO
PIN11	PA04	GPIO
PIN12	3V3	3.3V
PIN13	PA03	GPIO
PIN14	PB01	GPIO
PIN15	PD04	GPIO/Flash_SSN
PIN16	PD03	GPIO/Flash_MISO
PIN17	GND	GND
PIN18	GND	GND
PIN19	3V3	3.3V
PIN20	PD02	GPIO/Flash_MOSI
PIN21	PC0	GPIO/Flash_SPI_CLK
PIN22	PC01	GPIO
PIN23	PC02	GPIO
PIN24	PC03	GPIO
PIN25	PC04	GPIO
PIN26	PC05	GPIO
PIN27	RESET	DBG_RESET
PIN28	GND	GND
PIN29	PA05	GPIO
PIN30	GND	GND
PIN31	3V3	3.3V
PIN32	PB01	GPIO
PIN33	PA0	GPIO



# 3. Functional Description

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## 3.1. Core

The ARM Cortex-M processor includes a 32-bit RISC processor integrating the following features and tasks in the system:

- ARM Cortex-M33 RISC processor achieving 1.50 Dhrystone MIPS/MHz
- ARM TrustZone security technology
- Embedded Trace Macrocell (ETM) for real-time trace and debug
- Up to 1024 kB flash program memory
- Up to 96 kB RAM data memory
- Configuration and event handling of all modules
- 2-pin Serial-Wire debug interface

## 3.2. Memory

### 3.2.1. SPI Flash

NL01A currently integrate a 8-Mbit SPI flash and also supports these SPI modes: Standard SPI, DIO (Dual I/O), DOUT (Dual Output), QIO (Quad I/O) and QOUT (Quad Output).



# 4. Electrical Characteristics

**Note:**

Unless otherwise specified, measurements are based on  $V_{DD} = 3.3\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$ .

## 4.1. Electrical Characteristics

Table 4-1. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Operating temperature	-	-40	20	85	$^\circ\text{C}$
Maximum soldering temperature (Condition: IPC/JEDEC J-STD-020)	-	-	-	260	$^\circ\text{C}$
Supply voltage	VDD	2.7	3.3	3.8	V
Input logic level low	$V_{IL}$	-	-	$0.3 \cdot IOVDD$	V
Input logic level high	$V_{IH}$	$0.7 \cdot IOVDD$	-	-	V
Output logic level low	$V_{OL}$	-	-	$0.2 \cdot IOVDD$	V
Output logic level high	$V_{OH}$	$0.8 \cdot IOVDD$	-	-	V

## 4.2. RF Radio

Table 4-2. RF Radio Characteristics

MODE	Description	Min	Typ	Max	Unit
Thread Radio, 250 kbps O-QPSK DSSS	Input frequency	2405	-	2480	MHz
	Output Power	-	-	10	dBm
	Sensitivity	-	-104.5	-	dBm
Bluetooth® Low Energy Radio GFSK	Input frequency	2402	-	2480	MHz
	Output Power	-	-	10	dBm
	Sensitivity@1 Mbps GFSK	-	-94.4	-	dBm





### 4.3. Power Consumption

The following power consumption data were obtained from the tests with a 3.3 V power supply and a voltage stabilizer, in 25 °C ambient temperature. All data are based on 50% duty cycle in continuous transmission mode.

Table 4-3. Power Consumption

MODE	Specs	Min	Typ	Max	Unit
Thread Radio, 250 kbps O-QPSK DSSS	Thread Radio, Active RX Mode	-	9.4	-	mA
	Active TX Mode @ 0 dBm	-	9.3	-	mA
	Active TX Mode @ 10 dBm	-	33.8	-	mA
Bluetooth® Low Energy Radio	Thread Radio, Active RX Mode	-	8.8	-	mA
	Active TX Mode @ 0 dBm	-	9.3	-	mA
	Active TX Mode @ 10 dBm	-	33.8	-	mA

## 4.4. Reflow Profile

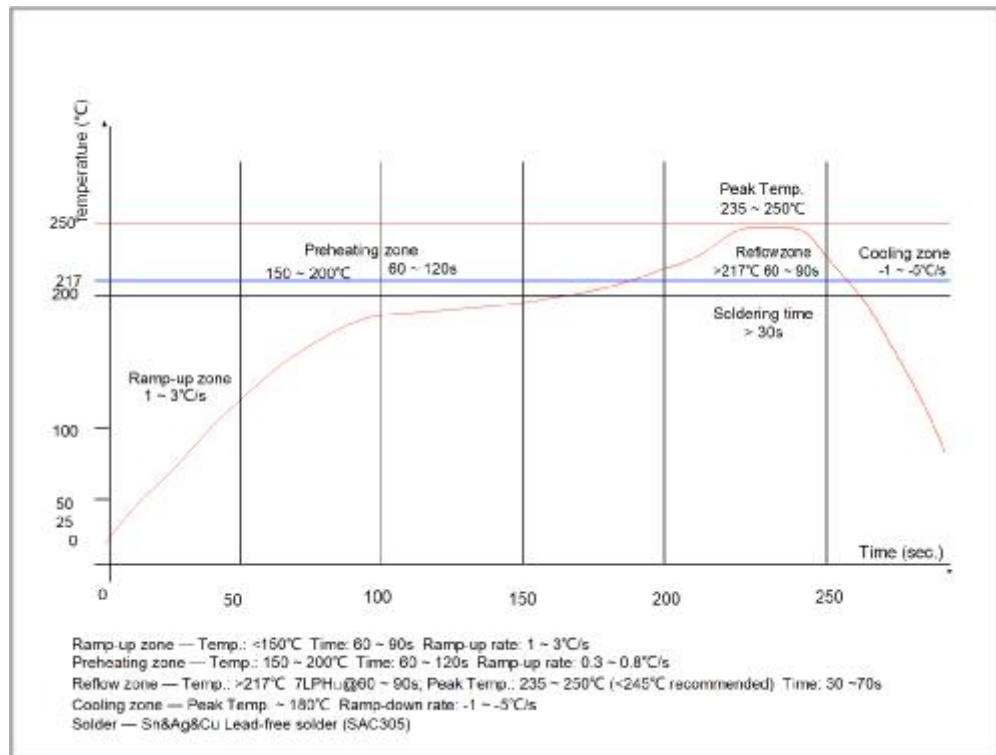


Figure 4-1. NL01A Reflow Profile

**Note:**

Solder the module in a single reflow. If the PCBA requires multiple reflows, place the module on the PCB during the final reflow.

## 4.5. Electrostatic Discharge

Table 4-4. Electrostatic Discharge Parameters

Name	Symb ol	Reference	Level	Max	Unit
Electrostatic Discharge (Human - Body Model)	V <sub>ESD</sub> (HBM)	Temperature: 23 ± 5 °C Based on ANSI/ESDA/JEDEC JS - 001 - 2014	2	2000	V
Electrostatic Discharge (Charged - Device Model)	V <sub>ESD</sub> (CDM)	Temperature: 23 ± 5 °C Based on JEDEC EIA/JESD22 - C101F	C2	500	

#### FCC Warning Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a 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. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. 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:

- - Reorient or relocate the receiving antenna.
- - Increase the separation between the equipment and receiver.
- - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- - Consult the dealer or an experienced radio/TV technician for help.

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

(2) This device must accept any interference received, including interference that may cause undesired operation.



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## Requirement per KDB996369 D03

### 2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.<sup>3</sup>

**Explanation:** This module meets the requirements of FCC part 15C(15.249)

### 2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices

**Explanation:** The EUT has a PCB Antenna, and the antenna use a permanently attached antenna which is not replaceable.

### 2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

**Explanation:** The module is not a limited module.

## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

**Explanation:** Yes, The module with trace antenna designs, the antenna type is PCB antenna.

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

**Explanation:** This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, The module belong to Part 15 Low Power Communication Device Transmitter.

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## 2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

**Explanation:** The EUT has a PCB Antenna, and the antenna use a permanently attached antenna which is unique.

## 2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

**Explanation:**The host system using this module, should have label in a visible area indicated the following texts: “Contains FCC ID: 2AEWY-NL01A

## 2.9 Information on test modes and additional testing requirements<sup>5</sup>

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

**Explanation:** Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

## **2.10 Additional testing, Part 15 Subpart B disclaimer**

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

**Explanation:** The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.