netvox R311FA1 Wireless 3 Axis Accelerometer Sensor User Manual

Wireless 3-axis Accelerometer Sensor
R311FA1
User Manual

Contents

Introduction

R311FA1 is the LoRaWAN TM Class A device that detects three-axis acceleration and is compatible with the LoRaWAN protocol. When the device moves or vibrates over the threshold value, it immediately reports the acceleration and velocity of the X, Y, and Z axes.

LoRa Wireless Technology:

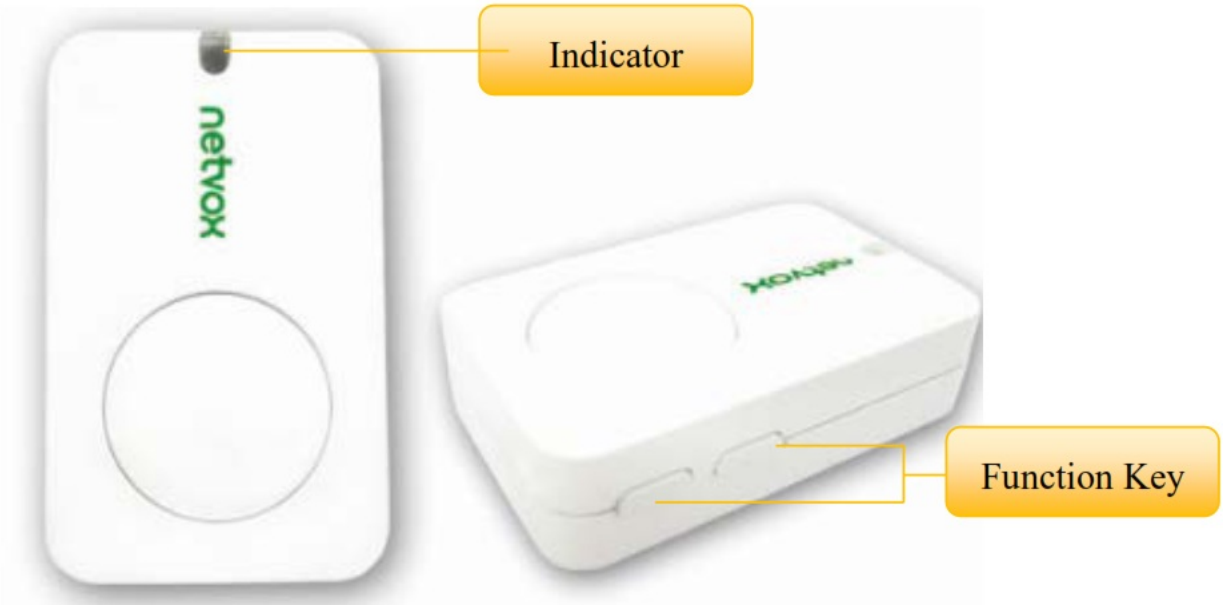
Lora is a wireless communication technology famous for its long-distance transmission and low power consumption. Compared with other communication methods, LoRa spread spectrum modulation technique greatly

extends the communication distance. It can be widely used in any use case that requires long-distance and low-data wireless communications. Examples, automatic meter reading, building automation equipment, wireless security systems, and industrial monitoring. It has features like small size, low
power consumption, long transmission distance, strong anti-interference ability and so on.

LoRaWAN:

LoRaWAN uses LoRa technology to define end-to-end standard specifications to ensure interoperability between devices and gateways from different manufacturers.

Appearance



Main Features

- Adopt SX1276 wireless communication module
- 2 sections 3.0V CR2450 button batteries
- Detect the three-axis acceleration and velocity of the device and the voltage
- Compatible with LoRaWAN Class A
- Frequency-hopping spread spectrum technology
- Configuration parameters can be configured through third-party software platforms, data can be read and alarms can be set via SMS text and email (optional)
- Available third-party platform: Actility / ThingPark, TTN, MyDevices/Cayenne
- Low power consumption and long battery life

Note:

Battery life is determined by the sensor reporting frequency and other variables, please refer to http://www.netvox.com.tw/electric/electric_calc.html On this website, users can find battery lifetime for varied models at different configurations.

Set up Instruction

On/Off

Power on	Insert batteries. (users may need a screwdriver to open); (Insert two sections of 3V CR2450 button batteries and close the battery cover.)
Turn on	Press any function key, and the indicator flashes once.
Turn off (Restore to factory set ting)	Press and hold the function key for 5 seconds, and the green indicator flashes 20 times.
Power off	Remove Batteries.
Note:	1. Remove and insert the battery; the device memorizes the previous on/off st ate by default. 2. On/off interval is suggested to be about 10 seconds to avoid the interferenc e of capacitor inductance and other energy storage components. 3. Press any function key and insert batteries at the same time; it will enter engineer testing mode.

Network Joining

Never joined the network	Turn on the device to search the network. The green indicator stays on for 5 seconds: success The green indicator remains off: fail
Had joined the network	Turn on the device to search the previous network. The green indicator stays o n for 5 seconds: success The green indicator remains off: fail
Fail to join the network	Suggest checking the device verification information on the gateway or consult ing your platform service provider.

Function Key

Press and hold for 5 seconds	Restore to factory setting / Turn off The green indicator flashes 20 times: succe ss The green indicator remains off: fail
Press once	The device is in the network: green indicator flashes once and sends a report The device is not in the network: the green indicator remains off

Sleeping Mode

The device is on and in the network	Sleeping period: Min Interval. The device report change exceeds the setting value port will be sent network according to Min

Low Voltage Warning

Low Voltage	2.4V

Data Report

The device will immediately send a version packet report and two attribute data reports. Data will be reported by default setting before any configuration.
Default setting:
Max Interval: 3600s
Min Interval: 3600s (The current-voltage is detected every Min Interval by default.)
Battery Voltage Change: 0x01 (0.1V)
Acceleration Change: 0x03 (m/s^2)

R311FA1 Three-axis acceleration and velocity: s:

1. After the three-axis acceleration of the device exceeds ActiveThreshold, a report is sent immediately to report the three-
   axis acceleration and velocity.
2. After reporting, the three-axis acceleration of the device needs to be lower than InActiveThreshold, and the duration is
   greater than 5s (cannot be modified). Then, the next detection will start. If the vibration continues during this process after
   the report is sent, the timing will restart.
3. The device sends two data packets, one is the acceleration of the three axes, and the other is the velocity of the three axes.The interval between the two packets is 10s.

Note:

1. The device report interval will be programmed based on the default firmware.
2. The interval between two reports must be the minimum time.The reported data is decoded by the Netvox LoRaWAN Application Command document and
   http://loraresolver.netvoxcloud.com:8888/page/index

Data report configuration and sending period are as follows:

Min Interval (Unit: second)	Max Interval (Unit: second)	Reportable Change	Current Change? Reportable Change	Current Change < Reportable Change
Any number between 1-65535	Any number between 1-65535	Can not be 0.	Report per Min Interval	Report per Max Interval

5.1 ActiveThreshold and InActiveThreshold

Formula	Active Threshold/ InActiveThreshold = Critical value + 9.8+ 0.0625 * The gravitational acc eleration at standard atmospheric pressure is 9.8 m/s2 * The scale factor of the threshold i s 62.5 mg
Active Threshold	Active Threshold can be changed by ConfigureCmd Active Threshold range is 0x0003-0x 0OFF (default is 0x0003);
InActiveThreshold	InActiveThreshold can be changed by ConfigureCmd InActiveThreshold range is 0x0002- 0x0OFF (default is 0x0002) * Active Threshold and InActiveThreshold can not be the sam e
Example	Assuming that the critical value is set to be 10m/s2, the Active Threshold would be set 10/ 9.8/0.0625=16.32 Active Threshold would be set integer as 16.

5.2 Calibration

The accelerometer is a mechanical structure that contains components that can move freely.
These moving parts are very sensitive to mechanical stress, far beyond solid-state electronics.
The 0g offset is an important accelerometer indicator because it defines the baseline used to measure acceleration.
After installing R311FA1, users need to let the device rest for 1 minute, and then power on. Then, turn on the device n the network. After that, the device will automatically execute the calibration.
After calibration, the reported three-axis acceleration value will be within 1m/s 2 . **When the acceleration is within it can be judged that the device is stationary.**

5.3 Example of ReportDataCmd

FPort 0x06

Bytes	1	1	1
	Version	DeviceType	ReportType

Version– 1 byte –0x01——the Version of NetvoxLoRaWAN Application Command Version
DeviceType– 1 byte – Device Type of Device
The device type is listed in Netvox LoRaWAN Application Devicetype doc
ReportType – 1 byte –the presentation of the NetvoxPayLoadData according to the device type
NetvoxPayLoadData– Fixed bytes (Fixed =8bytes)

Device	Device Type	Report Type	NetvoxPayLoadData				
R311 FA I (R3 11FD)	OxC7	0x01	Battery (I Byte, unit:0.1 V)	acceleration (Float 16_2Bytes, m/s2)		acceleration (Float 16_2 Bytes, m/s')	Reserved (1 Byte, fixed Ox00)
		0x02	velocity (Float 16 2 Bytes, mm/s)	velocity (Float 16 Bytes, mm/s)	velocity (Float 16 2Bytes, mtn/s)	Reserved (2Bytes, fixed Ox00)	

Example of uplink: # packet 1: 01C7011E6A3E883E1F4100

1st byte (01): Version nd
2nd byte (C7): DeviceType 0XC7 R311FA1 rd
3rd byte (01): ReportType th
4 thbyte (1E): Battery 3v , 1E Hex=30 Dec 30*0.1v=3v th th
5th 6 byte (6A3E): Acceleration X, float32(3E6A0000) = 0.22851562 m/s 2
7 th8 byte (883E): Acceleration Y, float32(3E880000) = 0.265625 m/s 2 th
9 th 10 byte (1F41): Acceleration Z, float32(411F0000) = 9.9375 m/s 2
11th byte (00): Reserved

packet 2: 01C70212422B42C7440000

1 st byte (01): Version
2 ndbyte (C7): DeviceType 0XC7 R311FA1

3rdbyte (02): ReportType
4'th 5 byte (1242): Acceleration X, float32(42120000) = 36.5 mm/s
6th 7 byte (2B42): Acceleration Y, float32(422B0000) = 42.75 mm/s
8th9 byte (C744): Acceleration Z, float32(44C70000) = 1592.0 mm/s
10th th ~11 byte (0000): Reserved

*** R311FA1 value uses big-endian computing.**
* Because of the length limitation of R311FA1 instruction. Therefore, R311FA1 sends out 2 bytes and adds 0 to the data to form 4 bytes of float32.

5.4 Example of ConfigureCmd

port 0x07

Bytes	1	1	
	Camden	DeviceType	

Camden– 1 byte

DeviceType– 1 byte – Device Type of Device
NetvoxPayLoadData– var bytes (Max=9bytes)

Description	Device	Cmd ID	Device Type	NetvoxPayLoadData				
Config ReportReq	R3I1FAI	Ox01	OxC7	Minime (2bytes Unit: s)	Maxime (2bytes Unit: s)	BatteryChange (byteUnit: 0.1v)	AccelerationChange (2byte Unitm/s2)	Reserved (2Bytes, Fixed Ox00)
Config reporters		0x81		Status (0x0Osuccess)		Reserved (8Bytes, Fixed Ox00)		
ReadConfig ReportReq		0x02		Reserved (9Bytes, Fixed Ox00)				

ReadConfig ReportRsp		0x82		MinTime (2bytes Unit: s)	MaxTime (2 bytes Units)	BatteryChange (1byteUnit: 0.1v)	AccelerationChange (2byte Unitm/s2)	Reserved (2Bytes,Fixed Ox00)

(1) Command Configuration:
MinTime = 1min, MaxTime = 1min, BatteryChange = 0.1v, Acceleratedspeedchange = 1m/s²
Downlink : 01C7003C003C0100010000 003C(Hex) = 60(Dec)
Response 81C7000000000000000000 Configuration success
81C7010000000000000000 Configuration failure
(2) Read Configuration:
Downlink 02C7000000000000000000
Response 82C7003C003C0100010000 Current configuration

<table>
<tr><td>Description</td><td>Device</td><td>Cmd ID</td><td>Device Type</td><td colspan="4">NetvoxPayLoadData</td></tr>
<tr><td rowspan="2">SetActiveThresholdReq</td><td rowspan="9">R311E+1</td><td>0x03</td><td rowspan="9">(1\c –</td><td>ActiveThreshold (2Bytes)</td><td>InActiveThreshold (2Bytes)</td><td colspan="2">Reserved (SBytes,Fixed Ox00)</td></tr>
<tr><td rowspan="2">SetActiveThresholdFtsp</td><td rowspan="2">1</td><td colspan="2">Status (0x00_success)</td><td colspan="2">Reserved (8Bytes, Fixed Ox00)</td></tr>
<tr><td colspan="4">Reserved (9Bytes,Fixed Ox00)</td></tr>
<tr><td>GetActiveThresholdReq</td><td>Ox04</td><td>ActiveThreshold (2Bytes)</td><td colspan="2">InActiveThreshold (2Bytes)</td><td>Reserved (SBytes,Fixed Ox00)</td></tr>
<tr><td>GetActiveThresholdRsp</td><td>0x84</td><td colspan="2">RestoreReportSet (I byte, Ox00_DO NOT report when sensor restore; Ox01_DO report when sensor restore)</td><td colspan="2">Reserved (8Bytes, Fixed Ox00)</td></tr>
<tr><td>SetRestoreReportReq</td><td>0x07</td><td colspan="2">Status (0x00_success)</td><td colspan="2">Reserved (8Bytes, Fixed Ox00)</td></tr>
<tr><td>SetRestore reporters</td><td>0x87</td><td colspan="4">Reserved (9Bytes, Fixed Ox00)</td></tr>
<tr><td>GetRestoreReportReq</td><td>Ox08</td><td colspan="3" rowspan="2">RestoreReportSet (I byte, Ox00_DO NOT report when sensor restore; Ox01_DO report when sensor restore)</td><td rowspan="2">Reserved (8Bytes, Fixed Ox00)</td></tr>
<tr><td>GetRestore reporters</td><td>0\m,</td></tr>
</table>

Assuming that the ActiveThreshold is set to 10m/s2, the value to be set is 10/9.8/0.0625=16.32, and the last value obtained is an integer and is configured as 16.
Assuming that the InActiveThreshold is set to 8m/s2, the value to be set is 8/9.8/0.0625=13.06, and the last value obtained is an integer and is configured as 13.

(3) Configure device parameters ActiveThreshold=16, InActiveThreshold=13

Downlink: 03C70010000D0000000000 0010(Hex) = 16(Dec) , 000D(Hex) = 13(Dec)
Response 83C7000000000000000000 (configuration is successful)
83C7010000000000000000 (configuration failed)

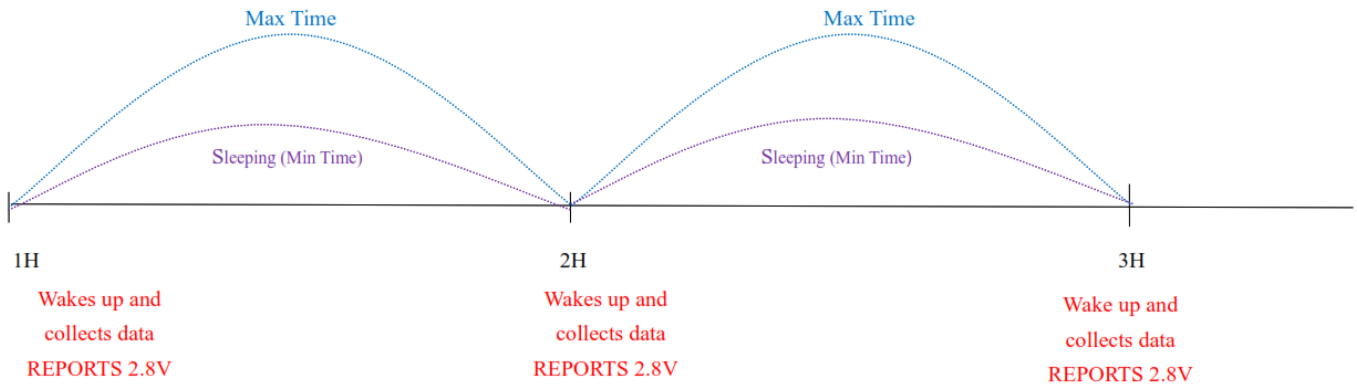
(4) Read device parameters

Downlink: 04C7000000000000000000
Response: 84C70010000D0000000000 (device current parameter)

(5) Configure DO report when sensor restore (When the vibration stops, R311FA1 will report an uplink package)
Downlink: 07C7010000000000000000
Response 87C7000000000000000000 (configuration success)
87C7010000000000000000 (configuration failure)
(6) Read device parameters
Downlink: 08C7000000000000000000
Response 88C7010000000000000000 (device current parameter)

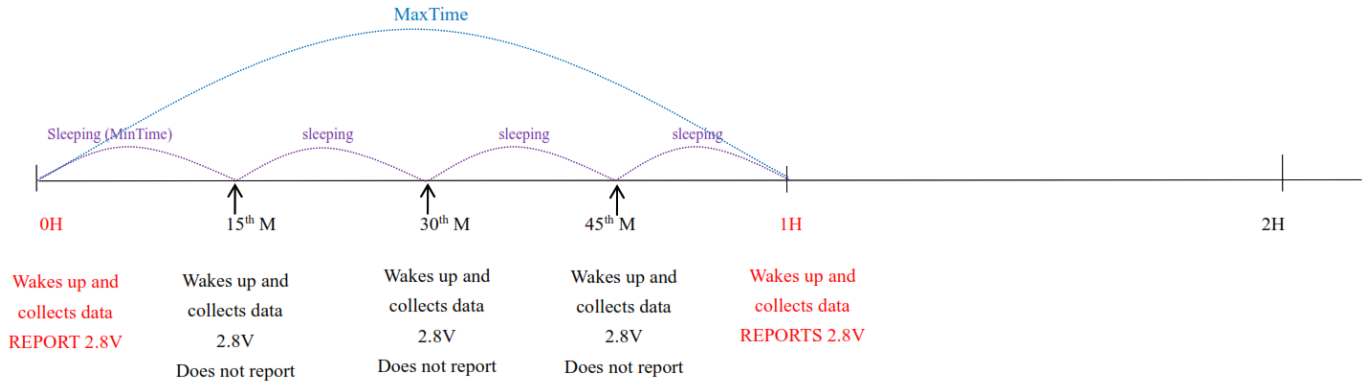
5.5 Example of MinTime/MaxTime logic

Example#1 based on MinTime = 1 Hour, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange=0.1V

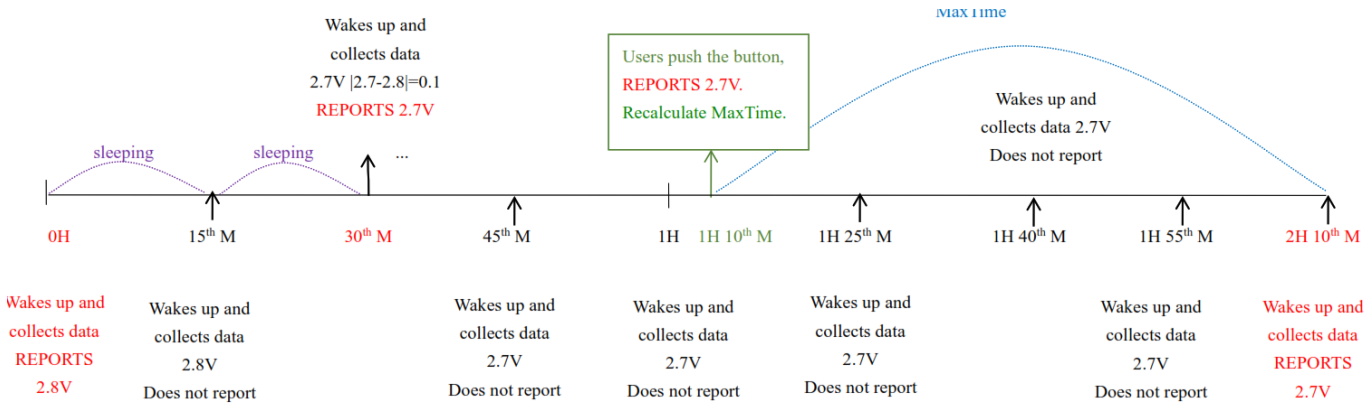


Note:
MaxTime=MinTime. Data will only be report according to MaxTime (MinTime) duration regardless BatteryVoltageChange value

Example#2 based on MinTime = 15 Minutes, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange= 0.1V.



Example#3 based on MinTime = 15 Minutes, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange= 0.1V.



Notes:

1. The device only wakes up and performs data sampling according to MinTime Interval. When it is sleeping, it does not collect data.
2. The data collected is compared with the last data reported. If the data change value is greater than the

ReportableChange value, the device reports according to the MinTime interval. If the data variation is not greater than the last data reported, the device reports according to the Maxime interval.

3. We do not recommend setting the MinTime Interval value too low. If the MinTime Interval is too low, the device wakes up frequently and the battery will be drained soon.
4. Whenever the device sends a report, no matter the result of data variation, button push, or Maxime interval, another cycle of MinTime / Maxime calculation is started.

5.6 The X, Y, and Z-axis direction of R311FA1

Installation

1. Remove the 3M adhesive on the back of the 3-axis Accelerometer Sensor and attach the body to the surface of a ct (please do not stick it to a rough surface to prevent the device from falling off after a long time of use).

Note

- Wipe the surface clean before installation to avoid dust on the surface affecting the adhesion of the device.
- Do not install the device in a metal shielded box or other electrical equipment around it to avoid affecting the wireless transmission of the device.

2. Installation Precautions

While installing, it is recommended to install R311FA1 horizontal while the generator is power-off and in static status. After installing and fixing R311FA1, please turn on the device. After the device is joined, one minute later, R311FA1 would perform the calibration of the device (the device cannot be moved after the calibration. If it needs to be moved, the device needs to be turned off/powered off for 1 minute, and then the calibration would be performed again). R311FA1 would need some time to gather the data of the three-axis accelerometer & the temperature of the generator while it is working normally. The data is a reference for the settings of ActiveThreshold & InActiveThreshold, it is also for checking if the generator is working abnormally.

3. When R311FA1 detects the data of the three-axis accelerometer exceeds ActiveThreshold, R311FA1 would report the data that is detected. After sending the data of the three-axis accelerometer, the data of the three-axis accelerometer of the device needs to be lower than InActiveThreshold and the duration has to be more than 5 seconds (cannot be modified) before the next detection.

Note

- While the data of the three-axis accelerometer of the device is lower than InActiveThreshold and the duration has to be lesser than 5 seconds, at this time, if the vibration continues (the data of the three-axis accelerometer is higher than InActiveThreshold), it will be delayed for 5 seconds. Until the data of the three-axis accelerometer is lower than InActiveThreshold, and the duration is more than 5 seconds.
- R311FA1 would send two packets, one is the data of the three-axis accelerometer, and the other would be sent after 10 seconds with the data of three-axis velocity. 3-axis Accelerometer Sensor (R311FA1) is suitable for the following scenarios:
- Industrial Equipment
- Industrial Instrument
- Medical Instruments When it necessary to detect 3-axis acceleration and velocity

Important Maintenance Instruction

Kindly pay attention to the following in order to achieve the best maintenance of the product:

- Keep the device dry. Rain, moisture, or any liquid might contain minerals and thus corrode electronic circuits. If the device gets wet, please dry it completely.
- Do not use or store the device in a dusty or dirty environment. It might damage its detachable parts and electronic components.
- Do not store the device under excessive heat conditions. High temperature can shorten the life of electronic devices, destroy batteries, and deform or melt some plastic parts.
- Do not store the device in places that are too cold. Otherwise, when the temperature rises to normal temperature, moisture will form inside, which will destroy the board.
- Do not throw, knock or shake the device. Rough handling of equipment can destroy internal circuit boards and delicate structures.
- Do not clean the device with strong chemicals, detergents or strong detergents.
- Do not apply the device with paint. Smudges might block in the device and affect the operation.
- Do not throw the battery into the fire, or the battery will explode. Damaged batteries may also explode.

All of the above applies to your device, battery and accessories. If any device is not working properly, please take it to the nearest authorized service facility for repair.

Documents / Resources

	netvox R311FA1 Wireless 3 Axis Accelerometer Sensor [pdf] User Manual R311FA1, Wireless 3 Axis Accelerometer Sensor, R311FA1 Wireless 3 Axis Accelerometer Sensor

References

- Netvox Command Resolver
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