Special Documentation

LPWAN communication protocol, model NETRIS®1 (EU868, IN865)

EN

WIKA

Prior to starting work, read the operating instructions!
Keep for later use!

Content

Content

1. General Information

Note:
This protocol description applies to all Netris®1 devices using the EU868 or IN865 LoRaWAN® regional parameter set. If you are using devices with a different regional parameter configuration, please refer to the relevant protocol documentation.

1.1 Abbreviations and Definitions

LPWAN	Low-power wide-area network, a category of wireless digital data network.
Network	In this document, LPWAN for which a specific device is designed, and configured to communicate with.
Packet	A unit of radio transmission; it can contain LPWAN network management data, as well as zero, one, or several messages following the application protocol described in the present document.
Platform	Generic term for the data processing and storage system that will bring meaning to the data sent by the device.
Alarm	In this document, “alarm” is used as a generic technical term for condition-based packets sent by the device and do not assume any level of severity.
Process Alarm	Alarm related to the measurement value
Technical Alarm	Alarm related to the overall instrument status as well as the quality and reliability of the measurement of each channel

1.2 Scope of this Document

This technical guide describes the wireless communication protocol used by NETRIS®1. It is intended both for developers who are designing a protocol interpreter for the product and for those seeking a comprehensive understanding of the capabilities of this WIKA product. The document covers both available NETRIS®1 LPWAN versions, LoRaWAN® and mioty®.

1.3 Conventions

As a convention, all the traffic that is sent wirelessly from a connected device to the network (via one or several gateways) is called “upstream traffic” or “Uplink” and all the traffic that is sent wirelessly by the network to a device is called “downstream traffic” or “Downlink”. Multi-byte fields are encoded following a “big-endian” convention (“network order”). The order for the transmission of bytes is the same as the left-to-right reading order, and bytes are numbered starting with 0.
Bits are numbered from left-to-right, starting at 7 and ending at 0, with bit 7 representing the most significant bit (MSB).

Example

Byte	0								1								2…		
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	…
Value	MSB	…						LSB	MSB	…						LSB	MSB	…	

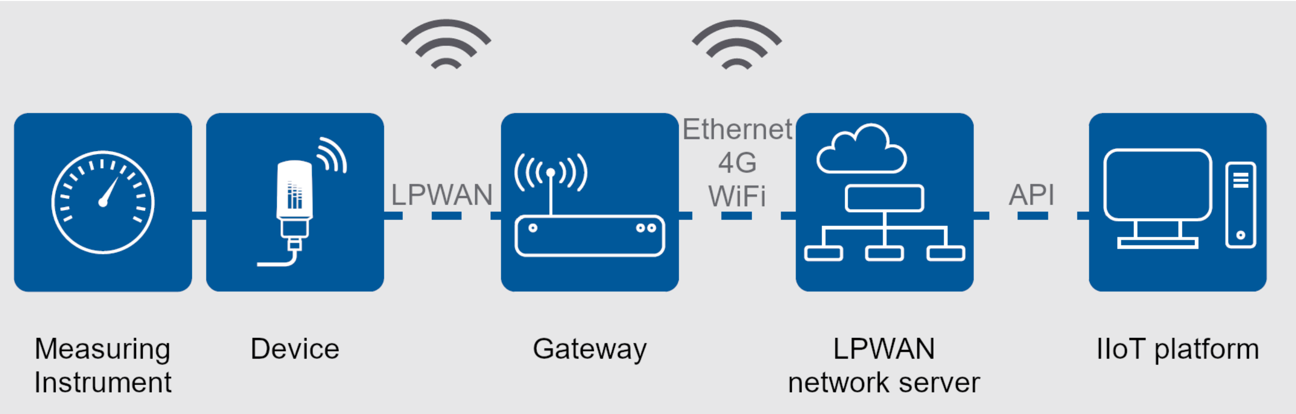
The digits in the document are written in English notation using ‘.’ as decimal separator and ‘,’ as a separator for large numbers. Example: 1,023.42

14625126.03 01/2026 EN

2. Application Protocol Description

2.1 Purpose

The purpose of the application protocol is to enable the device to communicate with an IIoT platform where the data can be used for storage, and further processing.



The protocol was designed to be compact to minimise the energy consumption (for longer battery life) and use the shared radio spectrum more efficiently to enable more instruments to be connected to a given network.
The translation, in the upstream and downstream directions, between this optimised, binary, context-dependent protocol, and a more versatile high-level protocol chosen by the customer for data processing, storage and display is performed by a software component called the protocol decoder.

2.2 Protocol Key-Points

- The device "wakes up" at adjustable time intervals to acquire a measurement point. The measured value is then checked for specific user-defined conditions (process alarms).
- One out of every N (user defined) measurement point is transmitted to the platform.
- The device sleeps most of the time to save power. One or more user-defined commands to change its configuration can be received at the end of each uplink transmission.
- Should the device encounter any anomaly during internal self-tests, alarm messages will be generated and transmitted.

2.3 Measurement Encoding

Device measurement data is expressed on a generic unitless scale [2,500…12,500] (encoded as a 16-bit integer) corresponding to the default full scale. One unit of measurement is equivalent of 0.01 % of the span of the instrument. Process alarm thresholds are expressed on the same scale.
The starting value 2,500 will correspond to the Measuring Range Start (MRS) of NETRIS®1.
The ending value 12,500 will correspond to the Measuring Range End (MRE).
The conversion between unitless digital data and the physical value is performed using the following formula:

$$physical\ value = \left(\left(\frac{digital\ value - 2{,}500}{10{,}000}\right) * span\right) + start\ of\ measuring\ range$$

Where the span of the device is defined using the following formula:

$$span = end\ of\ measuring\ range - start\ of\ measuring\ range$$

From a protocol standpoint, data is considered valid between 0 and 15,000 (decimal) allowing values of -25 % to 125 % of the instrument’s measurement range to be encoded.

Please be aware: This does not imply the instrument is capable of covering this extended span.

Accuracy outside of the instrument’s measurement range will typically be degraded or unspecified.

The resolution of the encoding used for data transmission (0.01 % of span) is generic and must not be confused with the resolution and accuracy of the instrument.
Please refer to the documentation of your instrument for technical specifications and information about accuracy, usable range, safety limits, etc.

14625126.03 01/2026 EN

Example 1

A digital value of 4,500 on a NETRIS®1 standard signal sensor module with a range of **0-25 mA** corresponds to a physical value of 5 mA.

$$span = 25mA - 0mA = 25mA$$

$$physical\ value = \left(\left(\frac{4{,}500 - 2{,}500}{10{,}000}\right) * 25mA\right)$$

$$physical\ value = 5mA$$

Example 2

A digital value of 6,500 on a NETRIS®1 standard signal sensor module with a range of **0-10 V** corresponds to a physical value of 4V.

$$span = 10V - 0V = 10V$$

$$physical\ value = \left(\left(\frac{6{,}500 - 2{,}500}{10{,}000}\right) * 10V\right)$$

$$physical\ value = 4V$$

The following table gives more examples of data representation:

NETRIS®1 Variant	16-bit data value (or alarm threshold)			
	0x09C4 = 2,500 dec	**0x30D4 = 12,500 dec**	**0x0CB3 = 3,251 decimal (3,251 – 2,500) * 0.01 % = 7.51 % of span**	**0x2DD2 = 11,730 decimal (11,730 – 2,500) * 0.01 % = 92.30 % of span**
Analog 0 … 10 V	min. => 0 V	max. => 11 V	(7.51 % * span) = 0.826 V	(92.3 % * span) = 10.153 V
Analog 4 … 20 mA	min. => 0 mA	max. => 25 mA	(7.51 % * span) = 1.878 mA	(92.3 % * span) = 23.075 mA
RTD	min. => -200 °C	max. => 850 °C	(7.51 % * span) – 200 = -121.15 °C	(92.3 % * span) - 200 = 769.15 °C

2.4 Process Alarms

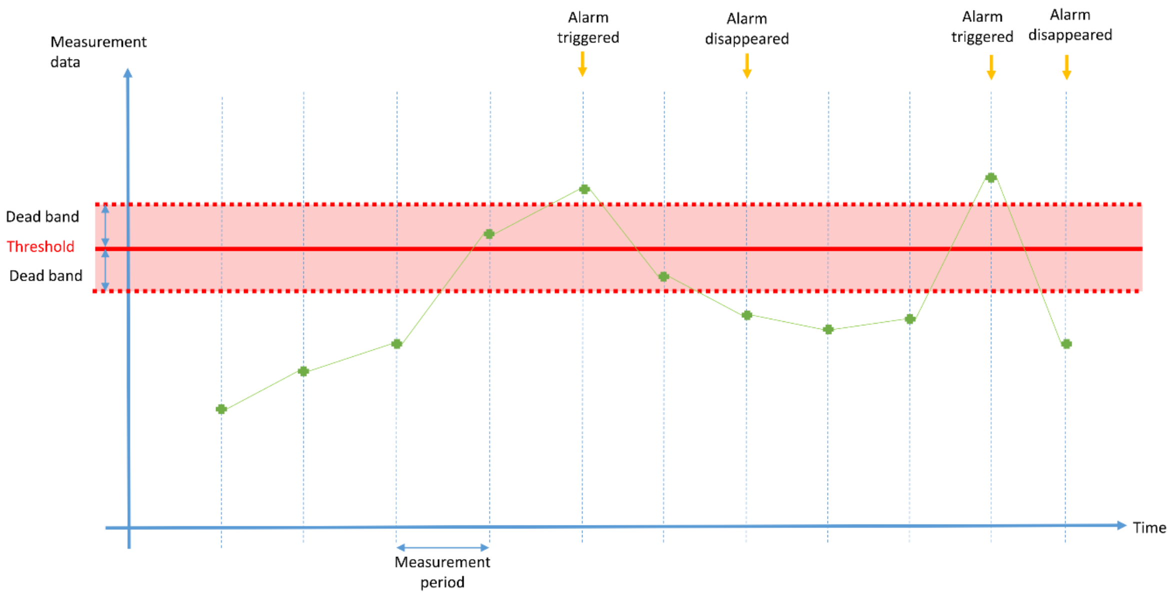
Process alarms are a feature of the device. Each time a measurement is taken, the measured value and slope (defined as currently measured value – previous value) can be compared to user-defined thresholds. If a value is outside of a threshold, a message will immediately be transmitted to the network without waiting for the normal transmission interval.
As taking a measurement requires only a fraction of the energy needed for transmitting it, the use of process alarms in combination with measurement and transmission periods that are different from each other enables energy-saving strategies.
Configuring alarms when the measurement and transmission periods are equal provide little to no benefit as all measurement points will be available to the platform, and various condition-based triggers can be implemented here. Similarly, configuring different periods for measurement and transmission without configuring any process alarm increase energy usage with little to no gain.
There are three distinct types of process alarms, each in two “directions” that can be configured:

Process alarm	Parameters		
	Threshold	Dead band[1]	Delay
High threshold	Value [2,500 … 12,500] 0.01 % of span	Value [0 … 10,000] 0.01 % of span	n/a
Low threshold			n/a
High threshold with delay			Value [1 … 65,535] in units of 1 s
Low threshold with delay			
Rising slope	Value [0 … 10,000][2] 0.01 % of span/minute	n/a	n/a
Falling slope		n/a	n/a

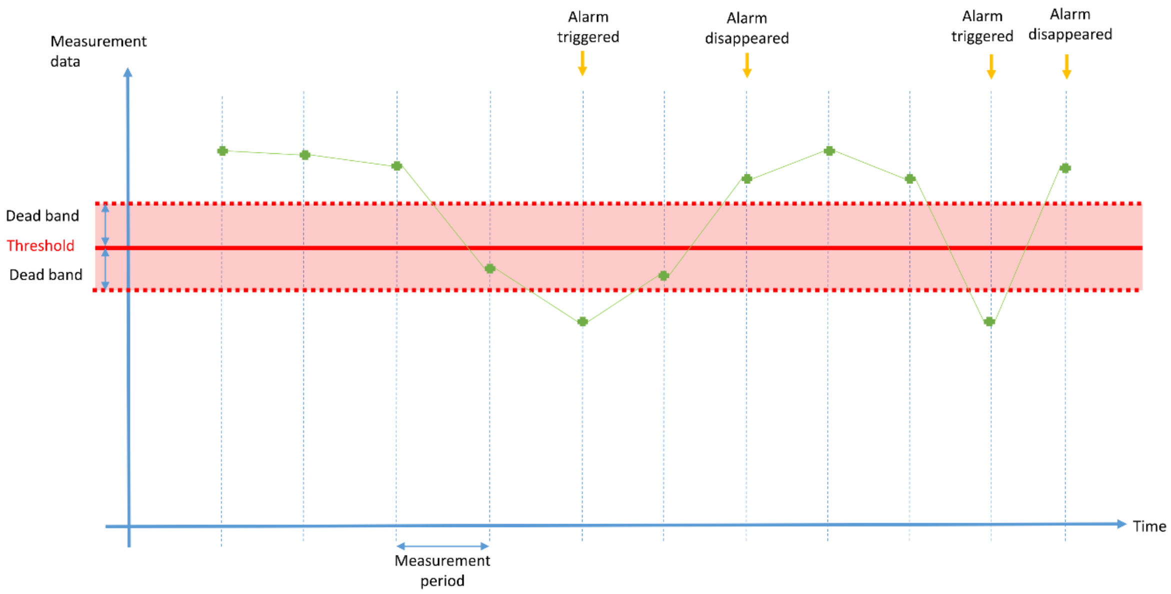
[1] Dead band setting is common to all alarms.

[2] Slope Threshold is defined as an absolute value and the direction defined by the rising/falling alarm.

2.4.1 High Threshold Alarm

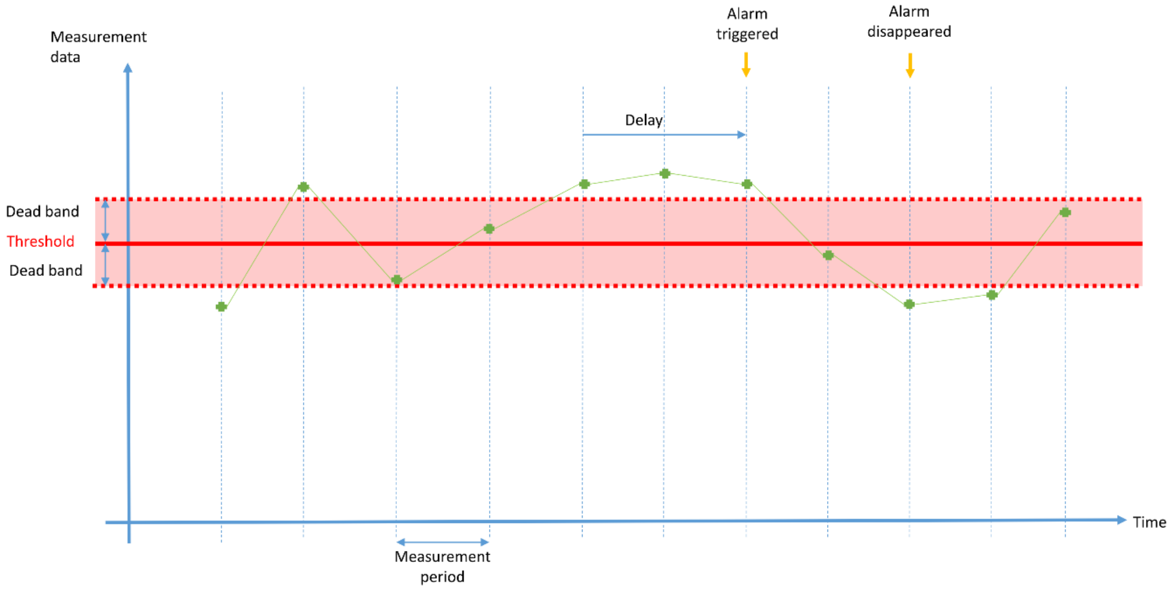


2.4.2 Low Threshold Alarm

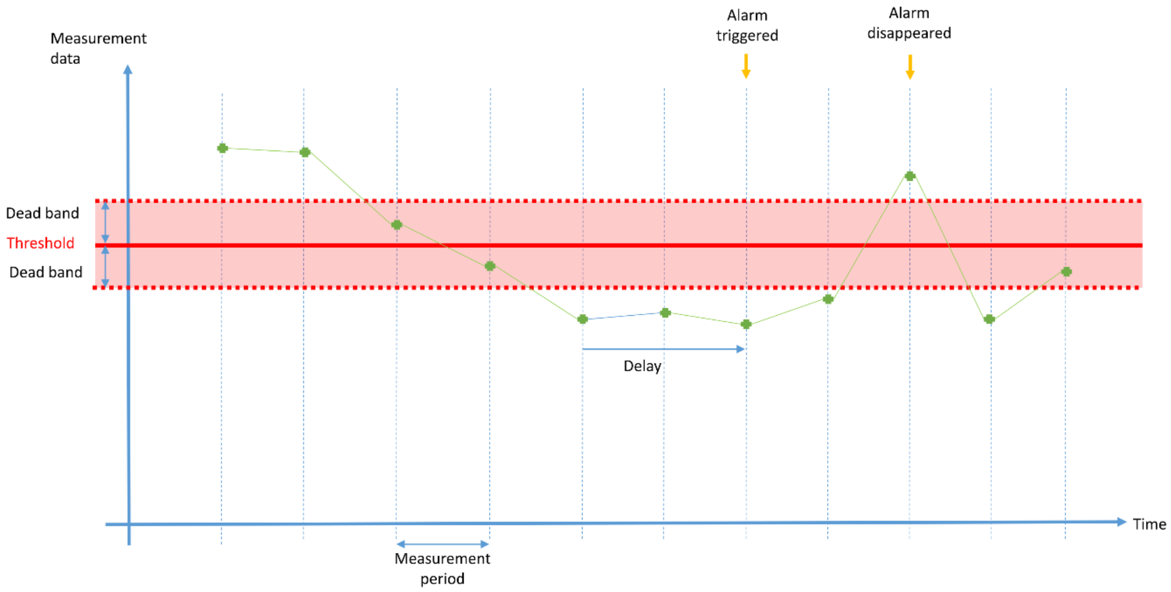


14625126.03 01/2026 EN

2.4.3 High Threshold Alarm with Delay

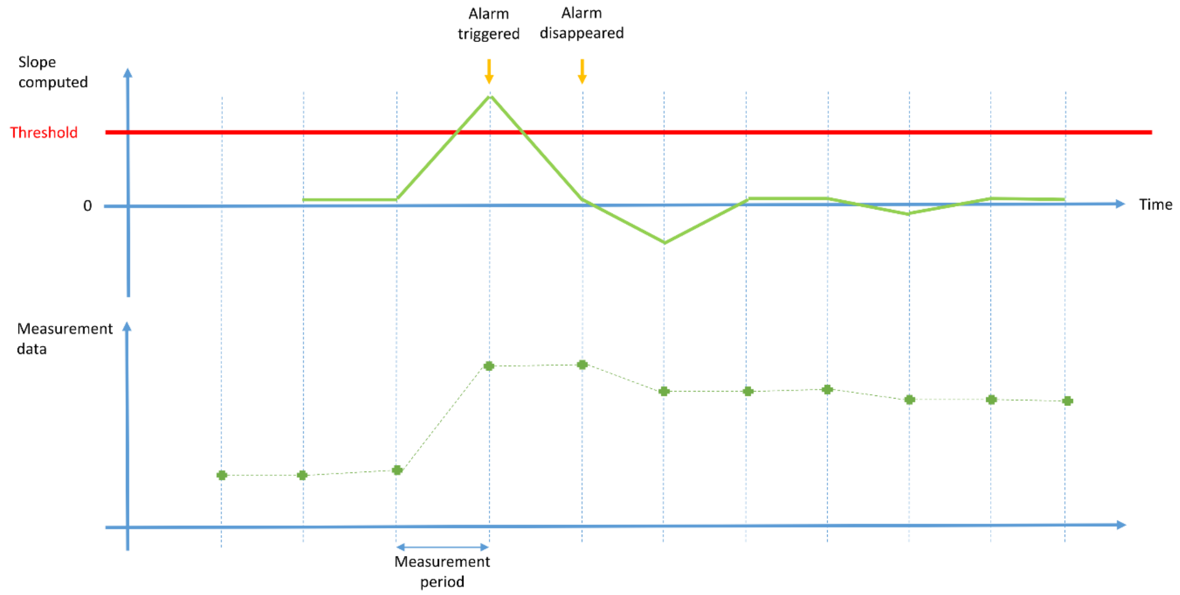


2.4.4 Low Threshold Alarm

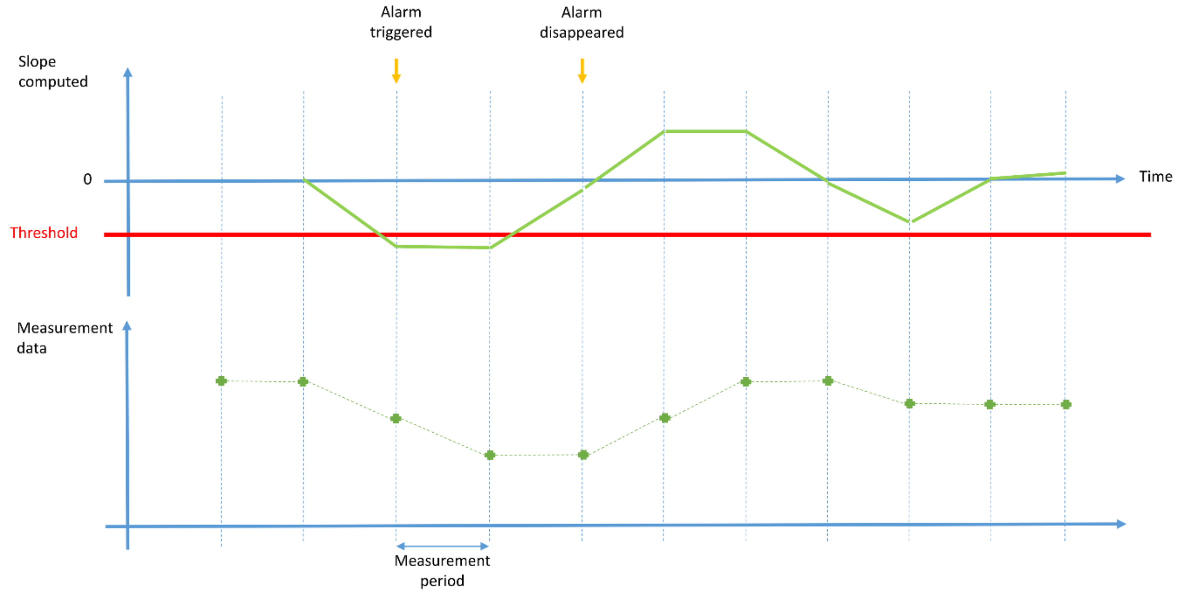


14625126.03 01/2026 EN

2.4.5 Rising Slope Alarm



2.4.6 Falling Slope Alarm



2.5 Configuration Identifier

NETRIS®1 can be configured remotely using LoRaWAN® or Bluetooth® to suit the application. Several parameters such as measurement period, transmission period, alarms, etc. can be set.
To interpret the meaning of upstream messages, the IIoT platform needs to know the configuration currently active in the device. This is why all upstream messages include a "configuration identifier" (Config ID) and all downstream packets, which can contain several commands changing the device configuration include a "transaction identifier" (Transaction ID). One Bit in the Config ID byte is used to indicate the platform that the configuration has been changed locally using the Bluetooth® interface.
The Config ID Byte is composed as follows:

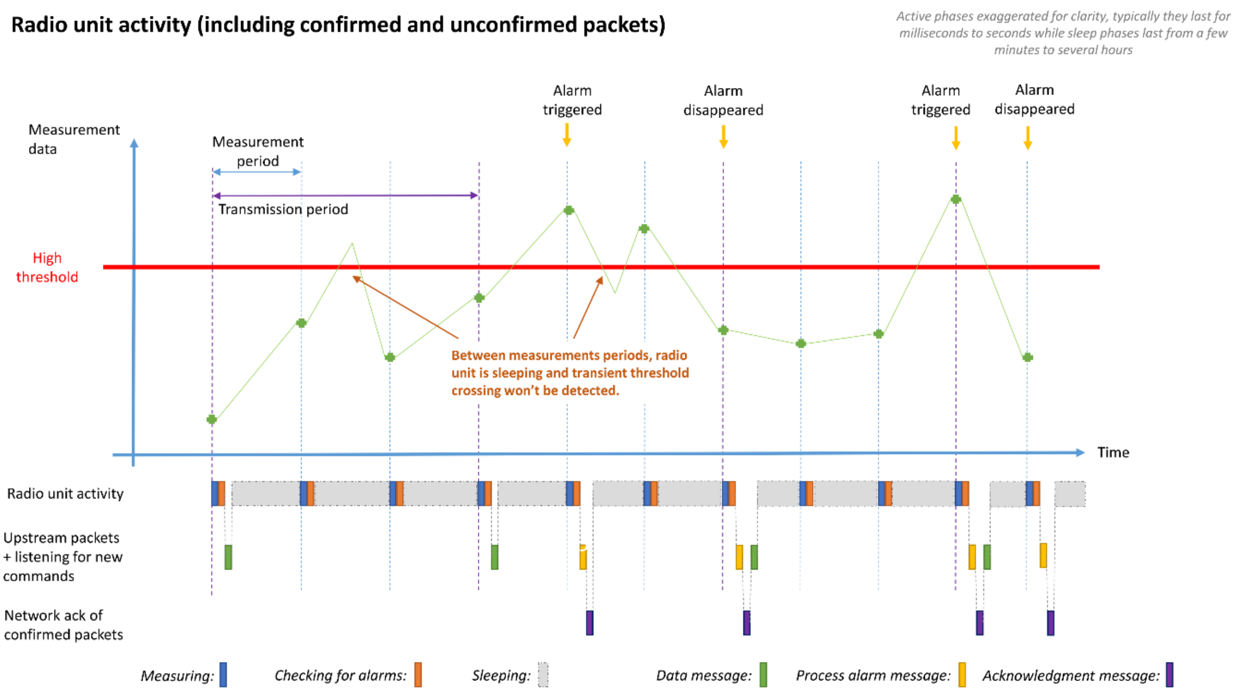
Bit	7	6	5-0
Description	Reserved	Local Configuration Indicator	Configuration Identifier

When a downstream packet with transaction identifier X results in a change of configuration of the device (configuration successful) then all the following upstream packets will use value X as Config ID.
So, when a new configuration is sent, the platform should select a value for the transaction ID between 1 and 63, which is different from the current Config ID of NETRIS®1. Using a sequential value is convenient but not mandatory. Value 0 is, by convention, used to indicate the factory configuration, and thus shall be used as a transaction ID when sending a "reset to factory configuration" command.
Values above 63 are reserved and must be avoided. After value 63 is reached, next value should be 1 (roll-over) by convention.
For the configuration status message (chapter 3.6), NETRIS®1 uses the transaction ID of the packet it is responding to instead of the current configuration ID.

14625126.03 01/2026 EN

2.6 Typical Product Behaviour

The figure below represents the temporal behaviour of a NETRIS®1 device when a measured value of a data channel is fluctuating and a high threshold process alarm is configured:



It shows, that in practice the device sleeps most of the time and wakes up only for short moments to record the measured value, check if user-defined alarm conditions are present or not and periodically send and receive data from the LPWAN network.

3. Upstream Messages

3.1 General Format

Upstream messages are sent wirelessly by the NETRIS®1 to the network and interpreted by the IIoT platform. Each upstream LPWAN packet contains a single message as its payload. The packet format is as follows:

Byte	Note
0	Message type, see next table for details
1	Current configuration identifier (config ID)
2…n	Content of the message, depending on message type

The first byte of the message describes its type:

Value (hex)	Upstream message types
0x01	Data message with no alarm ongoing
0x02	Data message with at least one alarm ongoing
0x03	Process alarm message
0x04	Technical alarm message
0x05	Device alarm message
0x06	Configuration status message
0x07	Device identification message
0x08	Keep alive message
0x0A	Measurement input failure alarm message
0x0B	Main configuration status message (mioty® only)
0x0C	Process Alarm Configuration message (mioty® only)
0x0D	Channel Property Configuration message (mioty® only)

3.2 Data Message with or without ongoing Alarm

The data message contains the latest value measured by the device. In case of an error during the measurement the data value will be set to 0xFFFF.
The message is formatted as follows:

Byte	Value	Note
0	Data message type	In accordance with upstream messages type table (0x01, 0x02)
1	Config ID	Current configuration identifier
2	0x00	Reserved
3-4	Data value	2500…12500 value (unit 0.01 %)

3.2.1 Example 1

Upstream packet: 0x01 00 00 2E 97

Decoding	
01	Data message, no alarm ongoing
00	Configuration ID = 0, NETRIS®1 is using the factory configuration
00	Reserved
2E 97	Measurement value at 94.27 % of span

3.2.2 Example 2

Upstream packet: 0x02 07 00 1E B0

Decoding	
02	Data message, at least one alarm is active
07	Configuration ID = 7
00	Reserved
1E B0	Measurement value at 53.56 % of span

3.3 Process Alarm Message

A process alarm message contains one or more process alarms that have been triggered or disappeared after a measurement. The message is event-based and depends on user configuration.
The message is formatted as follows:

Byte	Value	Note
0	0x03	Process alarm has been triggered and/or disappeared
1	Config ID	Current configuration identifier
2	0x00	Reserved
3	Alarm type	See alarm type table below
4-5	Related value	See related value table below

Alarm type

Bit	Description	Value
7	Sense	0: The latest measurement has triggered an alarm 1: The latest measurement has made an alarm disappeared
6	Reserved	Always 0
5-0	Alarm type	Bit 0: Low threshold Bit 1: High threshold Bit 2: Falling slope Bit 3: Rising slope Bit 4: Low threshold with delay Bit 5: High threshold with delay

14625126.03 01/2026 EN

Related Values

Process alarm type	Value
Low threshold	Triggering/disappearing value: 2,500…12,500 value (0.01 % of span)
High threshold	
Low threshold with delay	
High threshold with delay	
Falling slope	Triggering/disappearing slope, absolute value: 0…10,000 value (0.01 % span/minute)
Rising slope	

3.3.1 Example 1

Upstream packet: 0x03 11 00 00 0D 73

Decoding	
03	Process alarm message
11	Configuration ID = 17
00	Reserved
00	An alarm was triggered of the “Low threshold” type
0D 73	The measurement that triggered the alarm was at 9.43 % of span

3.3.2 Example 2

Upstream packet: 0x03 0F 00 88 00 D9

Decoding	
03	Process alarm message
0F	Configuration ID = 15
00	Reserved
88	Alarm disappeared, of the “Rising slope” type
00 D9	Slope that made the alarm disappear = +2.17 % of span/minute

3.3.3 Example 3

Upstream packet: 0x03 0F 00 20 2C A8 02 26 B8

Decoding	
03	Process alarm message
0F	Configuration ID = 15
00	Reserved
20	Alarm triggered, “High threshold with delay” type
2C A8	Measurement that triggered the alarm = 89.32 %
02	Alarm triggered, “High threshold” type
26 B8	Measurement that triggered the alarm = 74.12 %

3.4 Technical Alarm Message

This message signals an internal failure of the device.
The message is formatted as follows:

Byte	Value	Note
0	0x04	Technical alarm has been triggered
1	Config ID	Current configuration identifier
2	0x00	Reserved
3 - 4	Alarm type	Type of internal failure

3.5 Device Alarm Message

Device alarms are always enabled. They do not relate directly to the measurement itself but to the system health in general.
The message is formatted as follows:

Byte	Value	Note
0	0x05	Device alarm has been triggered
1	Config ID	Current configuration ID
2-3	Alarm type	See alarm type table below

Alarm Type

Bit	Description	Value
15-4	Reserved	0
3	Configuration Error	1: Internal configuration error
2	Duty cycle alarm	1: RF emission duty cycle exceeded[3]
1	Reserved	0
0	Low battery	1: Battery voltage below 2.7V. **Please change battery soon.**

3.5.1 Example

Upstream packet: 0x05 00 00 01

Decoding	
05	Device Alarm
00	Configuration ID = 0 (default)
0001	Low battery alarm triggered

[3] This message is received *after* the device is forced to pause all communication for some times to respect regional legal limits of radio spectrum use. Loss of messages is possible.

3.6 Configuration Status Message

The configuration status message is sent by the device after receiving a command to inform the platform whether the command received was valid or not.
If additional information was requested, the data will also be transmitted with this message.
The message is formatted as follows:

Byte	Value	Note
0	0x06	Configuration status
1	Transaction ID	Transaction identifier used by the downstream packet the device is responding to
2	Response Status	See Response Status table below
3-n		Response data depending on Downstream Request

Response Status

Bit	Name	Description
7-4	Configuration Status Value	2: Configuration applied with success 3: Configuration rejected – At least one parameter is incorrect 6: Command Success (e.g. Battery reset, Get configuration, …) 7: Command failed All others reserved.
3-0	Reserved	

3.6.1 Get main configuration response

Byte	Value	Note
4-7	Measurement period when no alarms are active	Period in seconds
8-9	Transmission multiplier when no alarms are active	Transmission period = measurement period * transmission multiplier
10-13	Measurement period when ≥1 alarm is active	See above
14-15	Transmission multiplier when ≥1 alarm is active	
16	0x00	Reserved

3.6.2 Get process alarm configuration response

Byte	Size (bytes)	Bit	Value	Note
4	1		0x00	Reserved, must always be 0x00
5	2		Dead band, common to all non-slope alarms	0…10,000 in increments of 0.01 % of span; common to all non-slope alarms
7	1	*7*	Alarm 1: Low threshold	For each alarm, the bit value means: 1: enabled 0: disabled
		6	Alarm 2: High threshold	
		5	Alarm 3: Falling slope	
		4	Alarm 4: Rising slope	
		3	Alarm 5: Low threshold with delay	
		2	Alarm 6: High threshold with delay	
		1-0	0	Reserved
8-23	2		Threshold value for alarm 1	Included only if the respective alarm is enabled (see Byte 7) Thresholds in: 2,500…12,500 (0.01% of span) Slope values in: 0…10,000 (0.01% of span/minute) Delays in seconds
	2		Threshold value for alarm 2	
	2		Slope value for alarm 3	
	2		Slope value for alarm 4	
	2		Threshold value for alarm 5	
	2		Delay value for alarm 5	
	2		Threshold value for alarm 6	
	2		Delay value for alarm 6	

3.6.3 Example

Upstream packet: 0x06 03 20

Decoding	
06	Configuration Status message
03	Transaction ID = 3 (Device is responding to a configuration change with Transaction ID 3)
20	Configuration was accepted and applied

14625126.03 01/2026 EN

3.7 Device Identification Message

After joining a network, the device transmits a message that contains all the metrological information necessary to decode the data packets and identify the unit.
The message is formatted as follows:

Byte	Value	Note
0	0x07	Device identification message
1	Config ID	Current configuration identifier
2	Product ID	WIKA wireless product ID for NETRIS®1 = 0x0F = 16
3	Product sub-ID	Sensor ID [Bit 4…0]: 0: RTD 1: E-Signal 2: TRW LPWAN ID [Bit 7…5]: 0: Reserved 1: mioty® 2: LoRaWAN®
4-5	Device Firmware Version	MAJOR.MINOR.PATCH = v[0-15].[0-15].[0-255] Hex-Coded: 0xMmPP
6-7	Device Hardware Version	MAJOR.MINOR.PATCH = v[0-15].[0-15].[0-255] Hex-Coded: 0xMmPP
8-18	Device Serial Number	Alphanumeric (ASCII)
19-22	Measurement Range Start	Lower bound of measurement range Float – Big endian encoded
23-26	Measurement Range End	Upper bound of measurement range Float – Big endian encoded
27	Physical Measurand	See Measurand ID table below
28	Unit	See Unit identifier table below

3. Upstream Messages

Measurand IDs

Measurand ID (dec)	Description
1	Temperature
13	Current
14	Voltage
18	Relative

Unit identifier

Unit ID (dec)	Description
1	[°C] degree Celsius
2	[°F] degree Fahrenheit
88	[V] Volt
90	[mA] milli Ampere
100	[%] percent

3.7.1 Example

Upstream packet: 0x07 00 0F 40 0200 0100 31413242334344454536 00000000 41200000 14 58

Decoding	
07	Device Identification
00	Configuration ID = 0 (default configuration)
0F	NETRIS®1 Product ID = 16
40	Product sub-ID = 2 ⇒ LoRaWAN® Version
0200	Firmware version = 0.2.0
0100	Hardware version = 0.1.0
31413242334344454536	Serial Number: “1A2B3C4D5E6”
00000000	Min. Range = 0.0 (float)
41200000	Max. Range = 10.0 (float)
14	Measurand = Voltage
58	Unit = Volt

3.8 Keep-Alive Message

The keep-alive frame is transmitted periodically every 24 hours. This setting is not adjustable. This guarantees that the device will be reachable at least once a day no matter how the transmission period is configured.
The message is formatted as follows:

Byte	Value	Note
0	0x08	Keep-alive message
1	Config ID	Current configuration identifier
2	Battery Status	Battery Event (Bit 7): 0: no Event 1: Device has restarted since the last keep-alive transmission Battery Level Indicator (Bit 6…0): Current estimated battery level in per cent (0-100) 0x7F: An error occurred during battery level computation. 0x7E: Device externally Powered

3.8.1 Example

Upstream packet: 0x08 00 3F

Decoding	
08	Keep Alive message
00	Configuration ID = 0 (default configuration)
3F	Battery Level estimation 63%, no additional battery event

3.9 Measurement Input Failure Alarm Message

This alarm type is always enabled and cannot be configured. It is related to the measurement signal input itself.
The message is formatted as follows:

Byte	Value	Note
0	0x0A	Measurement Input Failure Alarm message
1	Config ID	Current configuration identifier
2	0x00	Reserved
3-4	Alarm Type	See Alarm Type table below

Alarm Type
The alarm type has different meanings depending on the configured sensor type.

<table>
<tr><th rowspan="2">Bit</th><th rowspan="2">Name</th><th colspan="3">Sensor type</th></tr>
<tr><th>Analog 0V…10V</th><th>Analog 4mA…20mA</th><th>RTD</th></tr>
<tr><td>15-5</td><td>Reserved</td><td colspan="3">Not used</td></tr>
<tr><td>4</td><td>Sensor Warning 2</td><td>Not used</td><td>Measured value <3,4mA</td><td>Sensor Short circuit</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Measurement Limit Low</td><td colspan="3">The device minimum possible value has been reached. The measured value no longer changes as the sensor value continues to decrease.</td></tr>
<tr><td>0V</td><td>0mA</td><td>-210°C</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Measurement Limit High</td><td colspan="3">The device maximum possible value has been reached. The measured value no longer changes as the sensor value continues to increase.</td></tr>
<tr><td>12V</td><td>30mA</td><td>860°C</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Sensor Warning 1</td><td colspan="3">Measured value is still being determined but no longer conforms to the specified accuracy of the device.</td></tr>
<tr><td>Measured value >11V</td><td>Measured value >21,7mA</td><td>Sensor break</td></tr>
<tr><td>0</td><td>General Error</td><td colspan="3">This bit is always set in case of a measurement error. More details of the error can be shown in Bit 1…4</td></tr>
</table>

3.9.1 Example

Upstream packet: 0x0A 00 00 00 04

Decoding	
0A	Measurement Input Failure Alarm
00	Configuration ID = 0 (default configuration)
00	Reserved, always 0
0004	Measurement Limit High

4. Downstream Messages

Note: Devices including mioty® communication technology do not offer downstream message capabilities. Pleas configure your device using the Bluetooth® interface.

4.1 General Format

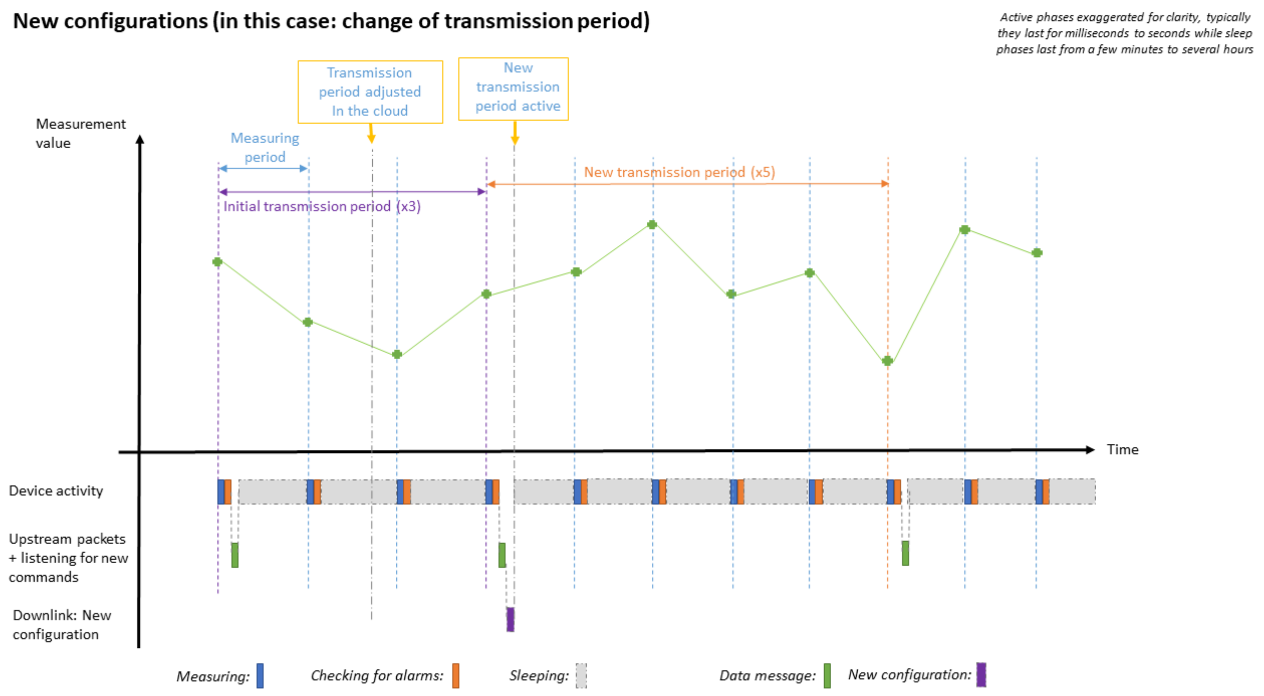
Downstream packets are usually sent by the IIoT platform to LoRaWAN® devices via the network in “store and forward” mode: they are scheduled in advance by the platform, stored in the LPWAN central server and transmitted just after an upstream packet has been received. The message is then interpreted by the device, which is expected to send a “configuration status” response (see chapter 3.6).
Downstream packets are identified using a transaction ID and can contain several commands.
The packets are formatted as follows:

Byte	Size (bytes)	Note
0	1	Transaction identifier (see chapter 2.5)
1	1	See command type table below
2, n+1	n (can be 0)	Command options (size depends on the command type)
n+2	1	Additional commands can be concatenated, one after another.
n+3…	m	

Downstream Command Types

Value (hex)	Upstream command types	Option size (bytes)
0x01	Reset to factory configuration	0
0x02	Set main configuration	13
0x04	Get main configuration	0
0x05	Reset battery indicator	1
0x20	Set process alarm configuration	20
0x40	Get process alarm configuration	1

The following diagram gives an indication how the device will react to a configuration change during runtime.



4.2 Reset to factory configuration command

This command will force the device to return to the factory configuration that is defined in the table below. It must not be sent with other commands in the same packet.

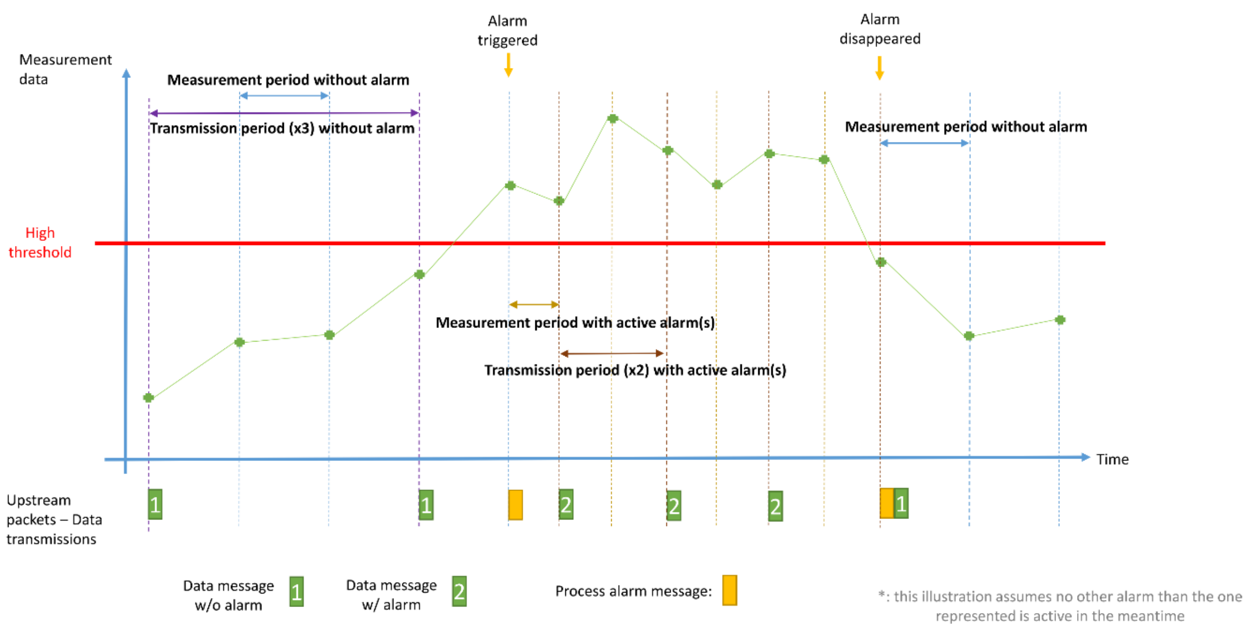
Byte	Size (bytes)	Value	Note
0	1	0x01	Reset to factory configuration command

4.3 Set main configuration

The main configuration of the device defines how often it wakes up to take a measurement, and what ratio of the measurements shall be transmitted to the platform as data messages.

Byte	Value	Note
0	0x02	Set main configuration command
1-4	Measurement period when no alarms are active	Period in seconds min. value = 1 s; max. value = 604800 s (7 days) Default: 60 s
5-6	Transmission multiplier when no alarms are active	Transmission period = measurement period * transmission multiplier max. transmission period 7 days, higher values are rejected Default: 30 (transmission every 1800s with 60s measurement period)
7-10	Measurement period when ≥1 alarm is active	Same unit, min./max., and default values as above
11-12	Transmission multiplier when ≥1 alarm is active	
13	0x00	Reserved, must always be transmitted with the given value

Measurement and transmission periods (different setting when at least one alarm is active or not)*



14625126.03 01/2026 EN

4.3.1 Example

Downstream packet: 0x07 02 000000B4 0005 0000003C 0003 00

Decoding	
07	Transaction ID; New Upstream messages will use Config ID 0x07
02	Set main configuration command
000000B4	Measurement period, no alarm = 180s = 3min
0005	Transmission multiplier, no alarm: 5 * 180s = 15min
0000003C	Measurement period, alarm active = 60s = 1min
0003	Transmission multiplier, alarm active: 3 * 1min = 3min
00	Reserved, always 0x00

4.4 Get main configuration

This command will trigger the device to send the current main configuration via LPWAN. It is especially useful in case the configuration was changed via the local interface. The local configuration change can be detected using the Config ID transmitted with each message.

Byte	Value	Note
0	0x04	Get main configuration command

4.5 Reset battery indicator

This command will reset the internal battery state of charge algorithm to a battery state of 100%. It should only be sent in case the device battery has been replaced.

Byte	Value	Note
0	0x05	Generic device command
1	0x00	Reset battery indicator command

14625126.03 01/2026 EN

4.6 Set process alarm configuration

This command can be used to activate and configure process alarms. All previous alarm configurations are replaced.

Attention: Please note that the total length of this configuration message is variable. Only the configuration values of the activated alarms must be included in the message.

Byte	Size (bytes)	Bit	Value	Note
0	1		0x20	Set process alarm command
1	1		0x00	Reserved, must always be 0x00
2	2		Dead band, common to all non-slope alarms	0…10,000 in increments of 0.01 % of span; common to all non-slope alarms
4	1	*7*	Alarm 1: Low threshold	For each alarm, the bit value means: 1: enabled 0: disabled
		6	Alarm 2: High threshold	
		5	Alarm 3: Falling slope	
		4	Alarm 4: Rising slope	
		3	Alarm 5: Low threshold with delay	
		2	Alarm 6: High threshold with delay	
		1-0	0	Reserved
5-20	2		Threshold value for alarm 1	Included only if the respective alarm is enabled (see Byte 7) Thresholds in: 2,500…12,500 (0.01% of span) Slope values in: 0…10,000 (0.01% of span/minute) Delays in seconds
	2		Threshold value for alarm 2	
	2		Slope value for alarm 3	
	2		Slope value for alarm 4	
	2		Threshold value for alarm 5	
	2		Delay value for alarm 5[4]	
	2		Threshold value for alarm 6	
	2		Delay value for alarm 6[4]	

The slope value parameter is always positive but is interpreted differently for rising and falling slopes. For a rising slope, the alarm will be triggered if the value rises quicker than the value. For a falling slope, the alarm will be triggered if the value falls quicker than the value.

[4] If set to zero, the alarm will act as a standard alarm without delay.

14625126.03 01/2026 EN

4.6.1 Example

Downstream packet: 0x01 20 00 0064 40 2000

Decoding	
01	Transaction ID; New Upstream messages will use Config ID 1
20	Set process alarm configuration
00	Reserved, always 0x00
0064	Dead-Band setting: 100 * 0,01%
40	High Threshold Alarm activated
2000	High Threshold Alarm at 56,92% of Span

4.7 Get process alarm configuration

This command will trigger the device to send the current process alarm configuration via LPWAN. It is especially useful in case the configuration was changed via the local interface. The local configuration change can be detected using the Config ID transmitted with each message.

Byte	Value	Note
0	0x40	Get process alarm configuration command
1	0x00	Reserved, must always be 0x00

5. Connectivity protocol: LoRaWAN®

5.1 Radio network integration

NETRIS®1 is a “class A” battery-powered LoRaWAN® radio end-device using version 1.0.3 of the protocol and the regional radio parameters mentioned on the product label.
NETRIS®1 uses the OTAA “over–the-air activation” LoRaWAN® procedure. Each device is configured at the factory with a securely generated 128-bit random key. Knowledge of this key is required to enable a network to communicate with the device.
Only in case you have ordered the device to be used with your own network provider the following information are provided to you together with the device:

- LoRaWAN® DevEUI
- LoRaWAN® AppEUI
- 128-bit application key (AppKey)

Refer to the network service provider for further details on how to integrate your device. In case you are using a network server provided by WIKA, your device is already pre-attached.

5.2 Join procedure

At power on, NETRIS®1 will start a LoRaWAN® join sequence (1 try and 1 retry around 3 minutes later if the first try didn’t succeed). If a network is in radio range and has knowledge about the AppKey the device will join the network.
In case of fail, the device goes to sleep for a random period, then launches a new join sequence. The sleep duration between 2 join sequences will be defined as:

- 10 to 15 min, the first time,
- 55 to 60 min, the second time,
- 10h00 to 10h05, the following times.

It keeps this last period infinitely, until join success or reboot.

5.3 LoRaWAN® ports

All upstream traffic generated by NETRIS®1 is sent on LoRaWAN® port 1.
The device will process all data downstream messages, no matter via which port they have been received. However, it is recommended to use port 1 for downstream communication.

5.4 Message Confirmation

The following upstream messages are sent as “confirmed” LoRaWAN® packets:

- Process-, Technical-, Device- and Measurement input failure alarms
- Device identification
- Configuration status
- Keep alive

If the network server does not confirm the reception of these messages NETRIS®1 will try to retransmit them up to 3 times. Every two retries, the LoRaWAN® Spreading factor is incremented.

If three consecutive confirmed messages could not be transmitted, the device will perform a new network join process according to chapter 5.2.

14625126.03 01/2026 EN

6. Connectivity Protocol: mioty®

6.1 Radio network integration

NETRIS®1 is available with the wireless protocol mioty®, offering a robust radio transmission for difficult receiving conditions. The mioty® version only integrates an uplink functionality, so all the device configurations must be done using the local Bluetooth® configuration interface. Each device is configured at the factory with a securely generated 128-bit random key. Knowledge of this key is required to enable a network to communicate with the device. Only in case you have ordered the device to be used with your own network provider the following information are provided to you together with the device:

- mioty® EUI
- mioty® Short Address
- 128-bit application key (AppKey)

Refer to the network service provider for further details on how to integrate your device. In case you are using a network server provided by WIKA, your device is already pre-attached.

6.2 Device behaviour

Because device information and configurations cannot be requested using downlink functionalities, additional message types and product functionalities have been implemented.

6.2.1 Identification Message

The identification message (Chapter 3.7) is repeated a second time after startup together with the second measurement value. Additionally, transmission of the identification message can be requested using the Bluetooth® interface or the corresponding WIKA App.

6.2.2 Configuration Messages

After device startup and in case the device configuration has been changed via the Bluetooth® interface the device is transmitting its configuration using additional message IDs. These IDs are not implemented for the LoRaWAN® version.

Main Configuration Status Message

Byte	Value	Note
0	0x0B	Message ID for Device Main Configuration
1	Config ID	Current configuration ID
2-5	Measurement period when no alarms are active	Period in seconds
6-7	Transmission multiplier when no alarms are active	Transmission period = measurement period * transmission multiplier
8-11	Measurement period when ≥1 alarm is active	See above
12-13	Transmission multiplier when ≥1 alarm is active	
14	0x00	Reserved

Process Alarm Configuration Message

Byte	Bit	Value	Note
0		0x0C	Message ID for Process Alarm Configuration
1		Config ID	Current configuration ID
2		0x00	Reserved, always 0x00
3-4		Dead band, common to all non-slope alarms	0…10,000 in increments of 0.01 % of span; common to all non-slope alarms
5	*7*	Alarm 1: Low threshold	For each alarm, the bit value means: 1: enabled 0: disabled
	6	Alarm 2: High threshold	
	5	Alarm 3: Falling slope	
	4	Alarm 4: Rising slope	
	3	Alarm 5: Low threshold with delay	
	2	Alarm 6: High threshold with delay	
	1-0	0	Reserved
6-7		Threshold value for alarm 1	Included only if the respective alarm is enabled (see Byte 8) Thresholds in: 2,500…12,500 (0.01% of span) Slope values in: 0…10,000 (0.01% of span/minute)
8-9		Threshold value for alarm 2	
10-11		Slope value for alarm 3	
12-13		Slope value for alarm 4	
14-15		Threshold value for alarm 5	
16-17		Delay value for alarm 5	

Byte	Bit	Value	Note
18-19		Threshold value for alarm 6	Delays in seconds
20-21		Delay value for alarm 6	

Channel Property Configuration Message

Byte	Value	Note
0	0x0D	Message ID for Channel property Configuration
1	Config ID	Current configuration ID
2	0x00	Reserved, always 0x00
3-4	Measurement offset	Signed value in 2s complement

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