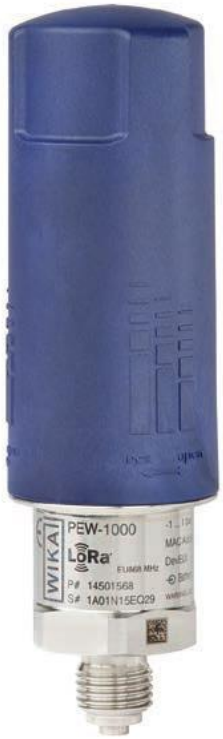
Special Documentation

Special Documentation for LPWAN communication protocol, model PEW-1000

EN



PEW-1000

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

Content

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1. General Information

1.1 Abbreviations and Definitions

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.
Channel	Each parameter measured by an instrument is associated with a channel. Channels are defined by a channel number, the physical parameter they measure and a physical unit.
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.
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 LPWAN communication protocol used by the PEW. 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 PEW LPWAN versions, LoRaWAN® and mioty®.

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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

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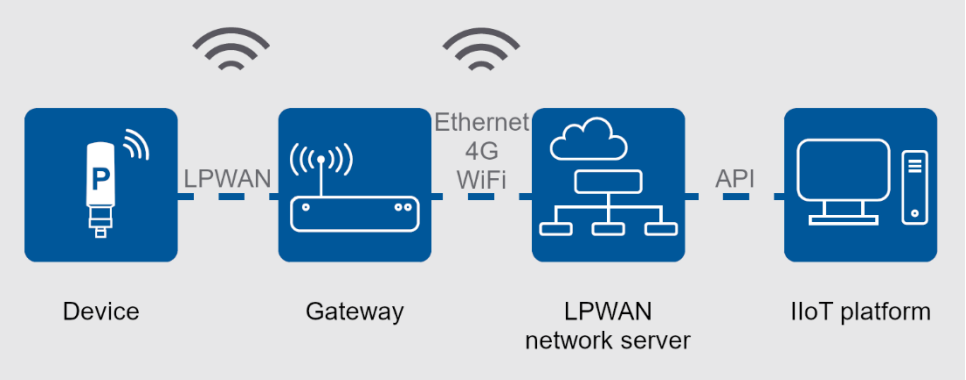
2. Application Protocol Description

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 points 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 Data Channels

The PEW-1000 offers two measurement channels:

Channel Number	Physical measurand	Note
0	Pressure	Main channel: Measurement provided by the electronic pressure sensor.
1	Temperature	Secondary Channel: Temperature inside the pressure sensor housing. **Note:** This is neither a process nor an ambient temperature!

2.4 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 device full scale measurement range. 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). 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 actually capable of covering this extended span.

Accuracy outside of the instrument's measurement range will typically be degraded or unspecified.
For the PEW-1000, the span and start of the measurement range of channel 0 (pressure) are variable and depends on the pressure range ordered by the customer. The span and start of the measurement range of channel 1 (temperature) are fixed for every device.

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.

Example
A digital value of 11,730 on a PEW-1000 with pressure range of -1 … 9 bar corresponds to a physical value of 8.23 bar:

$$span = 9\ bar - (-1\ bar) = 10\ bar$$

$$physical\ value = \left(\left(\frac{11{,}730 - 2{,}500}{10{,}000}\right) * 10\ bar\right) + (-1\ bar)$$

$$physical\ value = 8.23\ bar$$

The following table gives more examples of data representation:

Instrument measurement range	16-bit data value (or alarm threshold)			
	0x09C4 = 2,500 dec	**0x30D4 = 12,500 dec**	**0x099E = 2,462 dec (2,462 – 2,500) * 0.01 % = 7.51 % of span**	**0x2DD2 = 11,730 dec (11,730 – 2,500) * 0.01 % = 92.30 % of span**
0…10 bar	min. => 0 bar	max. => 10 bar	(-0.38 % * span) + min. = -0.038 bar	(92.3 % * span) + min. = 9.23 bar
-1…0 bar	min. => -1 bar	max. => 0 bar	(-0.38 % * span) + min. = -1.0038 bar	(92.3 % * span) + min. = -0.077 bar

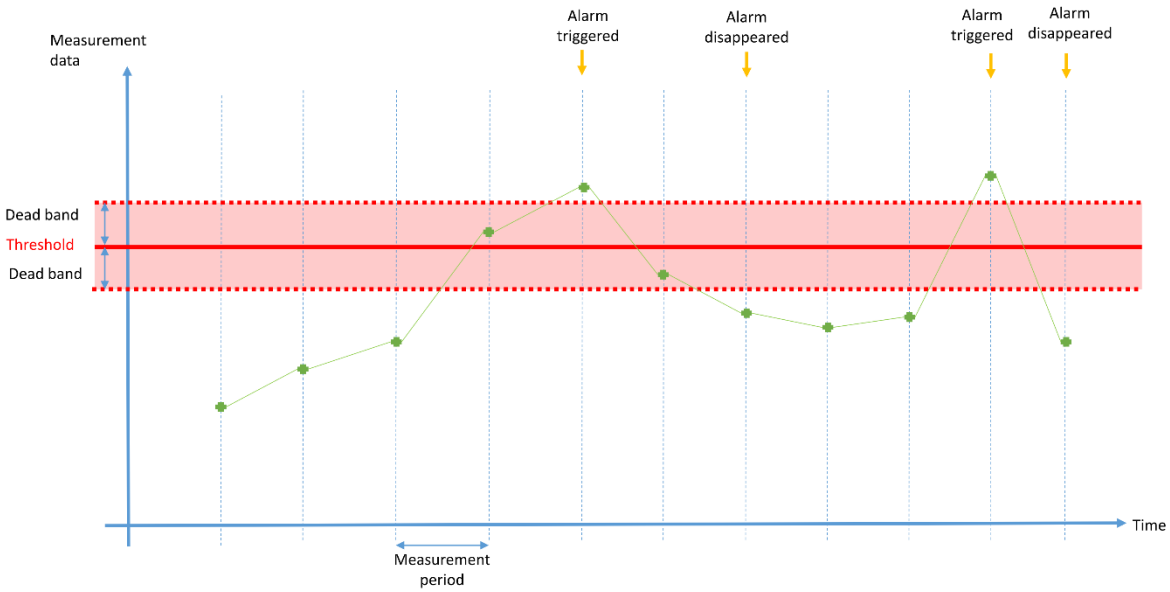
2.5 Process Alarms

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 different types of process alarms, each in two “directions” that can be configured:

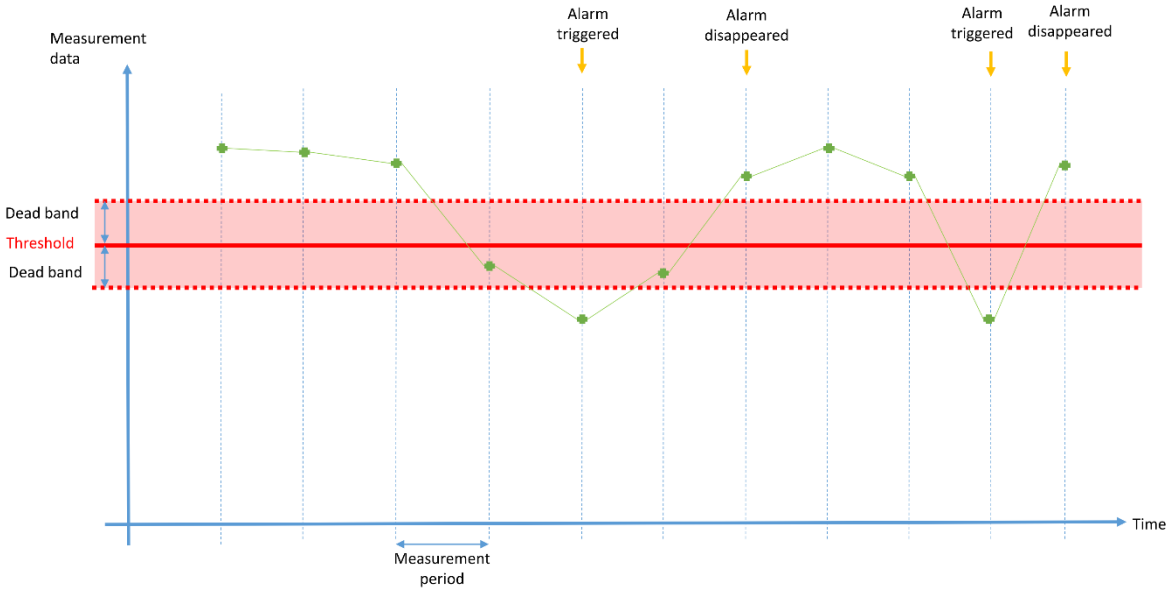
Process alarm	**Parameters**		
	Threshold	**Dead band**[1]	**Delay**
High threshold	Value [2,500 … 12,500] 0.01 % of span	Value [0 … 10,000] 0.01 % of span	n/a
Low threshold			n/a
High threshold with delay			Value [1 … 65,535] in units of 1 s
Low threshold with delay			
Rising slope	Value [0 … 10,000][2]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

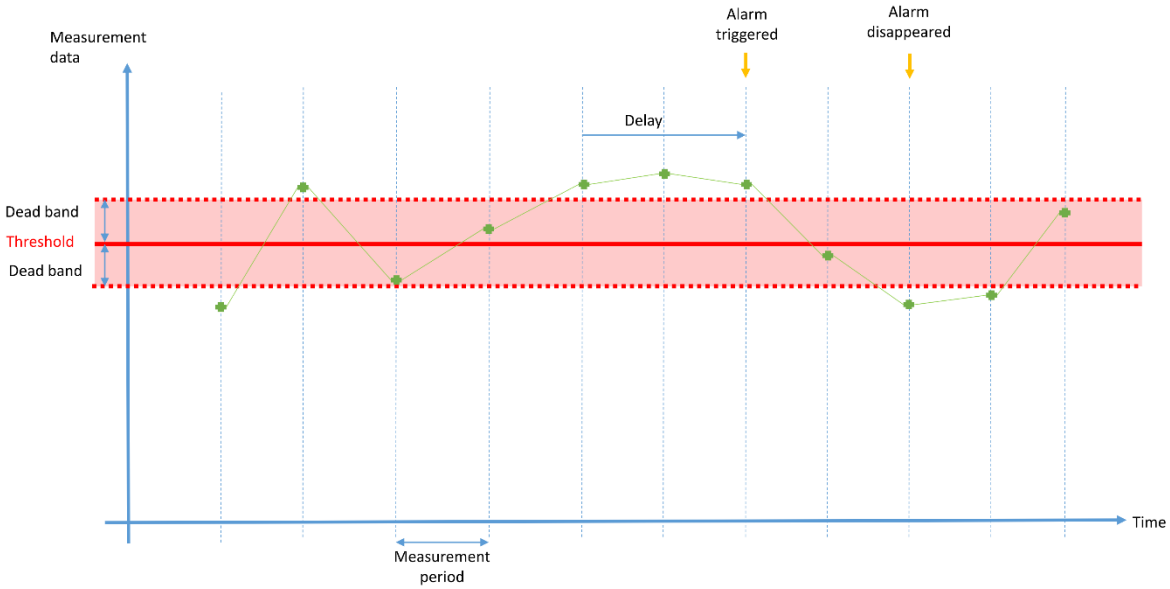
2.5.1 High Threshold Alarm



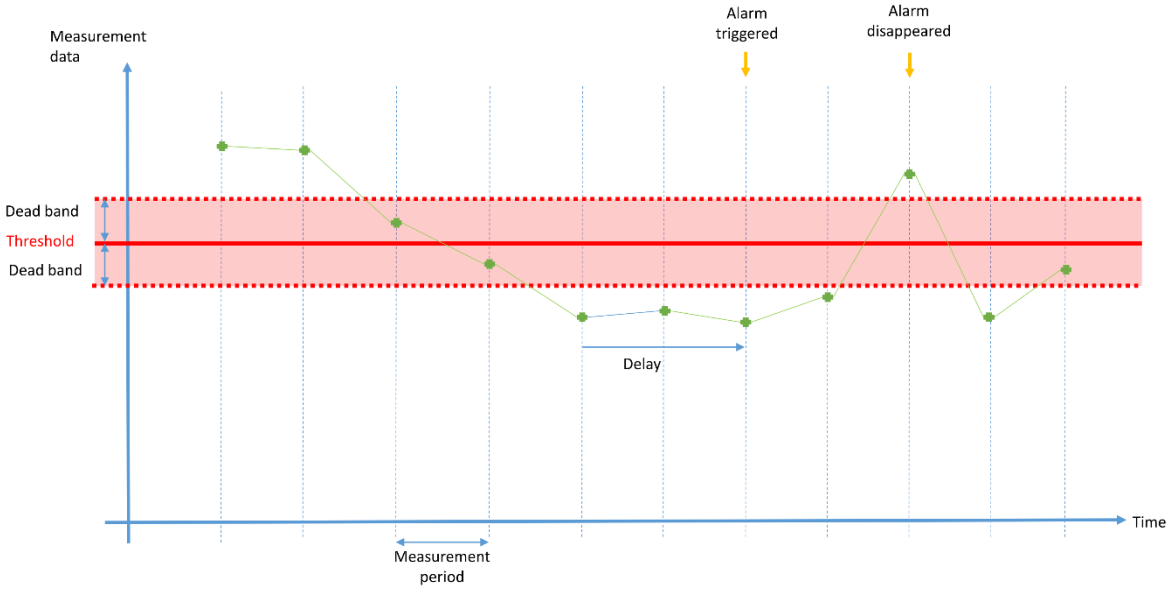
2.5.2 Low Threshold Alarm



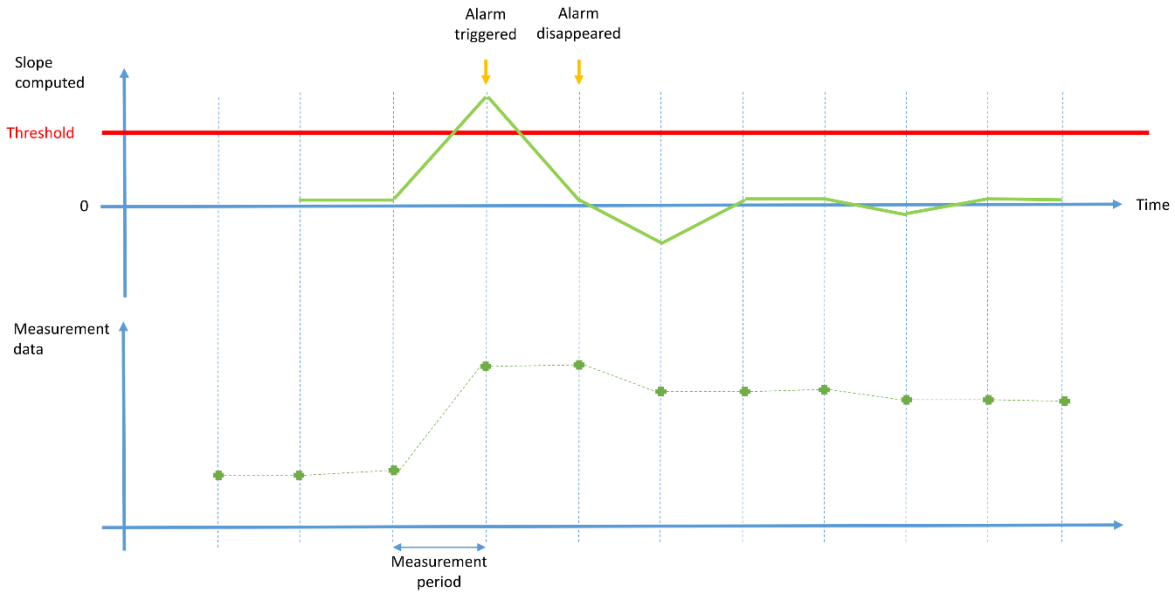
2.5.3 High Threshold Alarm with Delay



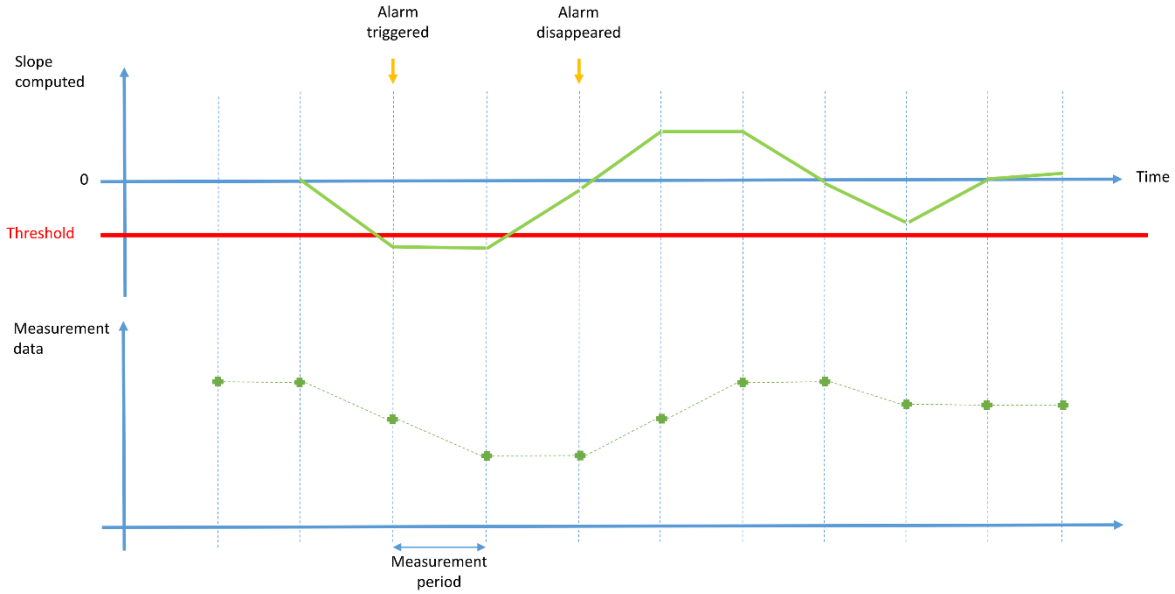
2.5.4 Low Threshold Alarm



2.5.5 Rising Slope Alarm



2.5.6 Falling Slope Alarm



2.6 Configuration Identifier

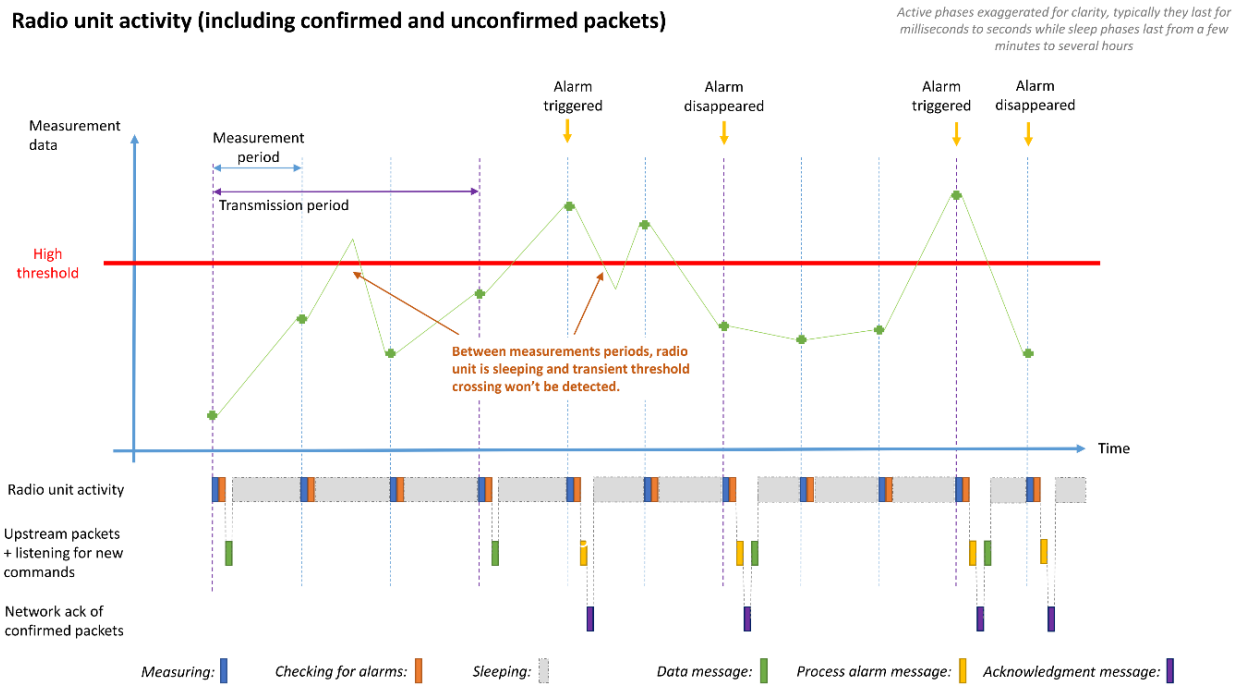
PEW-1000 can be configured remotely using LoRaWAN® or Bluetooth® to suit the application. Several parameters such as measurement period, transmission period, alarms, etc. can be set.
To interpret the meaning of upstream messages, the IIoT platform needs to know the configuration currently active in the device. This is why all upstream messages include a “configuration identifier” (Config ID) and all downstream packets, that 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 the PEW-1000. 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.

2.7 Typical Product Behaviour

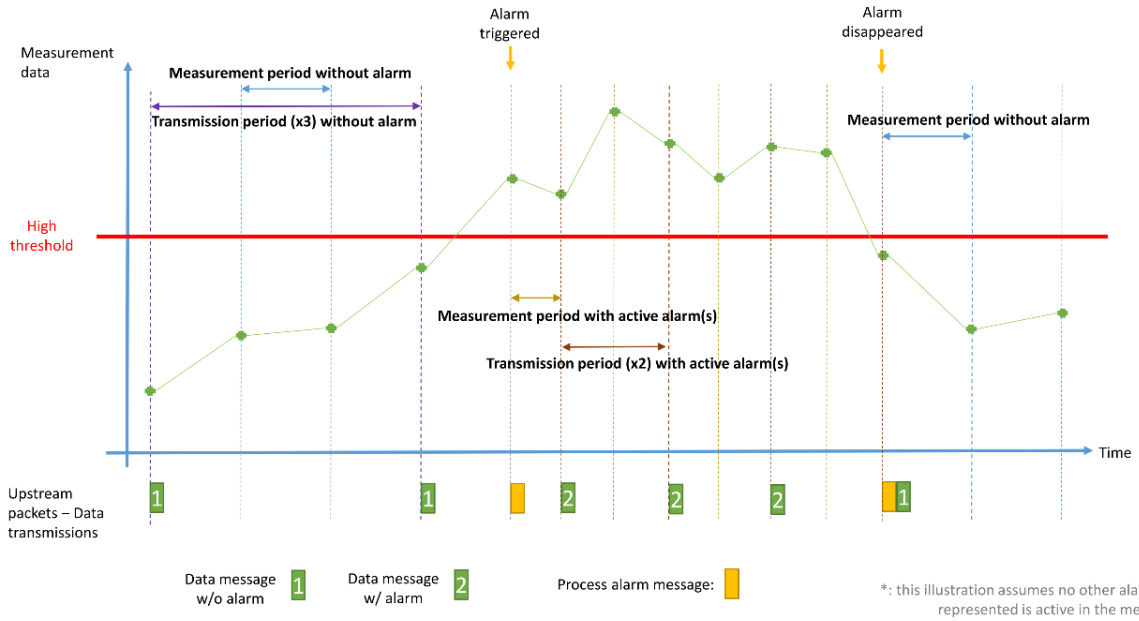
The figure below represents the temporal behaviour of a PEW-1000 device when a measured value of a data channel is fluctuating and a high threshold process alarm is configured:



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.

The following diagram shows in more detail the behaviour of the measurement and transmission periods in case of an active alarm. In this example the periods when an alarm is active are configured to half of the periods when no alarm is active.

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



3. Upstream Messages

3.1 General Format

Upstream messages are sent wirelessly by the PEW-1000 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
0x0B	Main configuration status message (mioty® only)
0x0C	Process Alarm Configuration message (mioty® only)
0x0D	Channel Property Configuration message (mioty® only)

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3.2 Data Message with or without ongoing Alarm

The data message contain the latest value for each channel 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	Battery Voltage	Current battery voltage in 0.1 V steps
3-4	Pressure Value	2,500…12,500 value (unit 0.01 %)
5-6	Temperature value	2,500…12,500 value (unit 0.01 %)

3.2.1 Example 1

Upstream packet: 0x01 00 23 09 B9 1A F0

Decoding	
01	Data message, no alarm ongoing
00	Configuration ID = 0, PEW-1000 is using the factory configuration
23	Battery voltage = 3.5 V
09 B9	Pressure value at -0.11 % of span → -0.011 bar (for 0…10 bar sensor)
1A F0	Temperature value = 23.14 °C (-45 … 110 °C sensor scale)

3.2.2 Example 2

Upstream packet: 0x02 00 23 09 B9 1A F0

Decoding	
02	Data message, with ongoing alarm
00	Configuration ID = 0, PEW-1000 is using the factory configuration
23	Battery voltage = 3.5 V
09 B9	Pressure value at -0.11 % of span → -0.011 bar (for 0…10 bar sensor)
1A F0	Temperature value = 23.14 °C (-45 … 110 °C sensor scale)

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. If several alarms appear at the same time, all alarm types and the associated value pairs are concatenated one after the other in the same message.
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	Alarm type	See alarm type table below
3-4	Related value	See related value table below
5	Alarm type	Optional additional alarms if appeared at the same time
6-7	Related value	

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	Channel ID	0: Pressure 1: Temperature
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

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 00 01 19 B4

Decoding	
03	Process alarm message
00	Configuration ID = 0
01	Low Threshold alarm has been triggered on the pressure channel
19 B4	Pressure value = +40.80% of full scale => 4.08bar (for a 0-10 bars sensor).

3.3.2 Example 2

Upstream packet: 0x03 0F 44 00 D9

Decoding	
03	Process alarm message
0F	Configuration ID = 15
44	Falling slope alarm has been triggered on the temperature channel
00 D9	Slope that made the alarm disappear = +2.17 % of span/minute

3.4 Technical Alarm Message

Technical alarms are related to the overall instrument status as well as the quality and reliability of the measurements of each channel. They are always enabled and cannot be configured by the end user.
The message is formatted as follows:

Byte	Value	Note
0	0x04	Technical alarm has been triggered
1	Config ID	Current configuration identifier
2	Alarm type	Type of failure

Alarm Type

Bit	Description	Value
7	Sense	0: Alarm appeared 1: Alarm disappeared
6-0	Status byte	Bit 0… 4: Sensor internal Errors Bit 5: Pressure value out of limit Bit 6: Temperature value out of limit

3.4.1 Example

Upstream packet: 0x04 00 20

Decoding	
04	Technical alarm message
00	Configuration ID = 0
20	Pressure value out of limit alarm appeared

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	Alarm type	See alarm type table below
3	Related value	See related value type table below

Alarm Type

Bit	Description	Value
7	Sense	0: Alarm appeared 1: Alarm disappeared
6	Reserved	Always 0
5-0	Alarm type	0x00: Low battery, please replace it soon. 0x04: Duty cycle alarm[3]

Related Value

Alarm type	Description	Value
0x00	-	No related value is send for this alarm
0x04	Battery Voltage	Battery voltage in 0.1 V steps

[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.

3.5.1 Example

Upstream packet: 0x05 00 00 1C

Decoding	
05	Device Alarm
00	Configuration ID = 0 (default)
00	Low battery alarm triggered
1C	Battery Voltage: 2.8 V

3.6 Configuration and Command Status Message

A status message is sent by the device after receiving a command or a configuration to inform the platform whether the received request was valid or not.
If a data request command was sent, 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, see following chapters

Response Status

Bit	Name	Description
7-4	Configuration Status Value	2: Configuration applied with success 3: Configuration rejected – At least one parameter is incorrect 5: Configuration discarded – Force drop received 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

This downlink response provides information about the common device configuration.

Byte	Value	Note
3	0x04	Command type the device is responding to: “Get Main Configuration”
4	Always 0x00	Command Status
5-8	Measurement period when no alarms are active	Period in seconds
9-10	Transmission multiplier when no alarms are active	Transmission period = measurement period * transmission multiplier
11-14	Measurement period when ≥1 alarm is active	See above
15-16	Transmission multiplier when ≥1 alarm is active	
17	0x00	Reserved
18	0= Data in BLE advertising frame 1= no data in BLE advertising frame	Activates or deactivates the transmission of measurement data in the Bluetooth® advertisement.

3.6.2 Get process alarm configuration response

This downlink response provides the information about the process alarm configuration per channel.

Byte	Bit	Value	Note
3		0x50: Pressure Configuration 0x51: Temperature Configuration	Command type the device is responding to
4		Always 0x00	Command Status
5		Channel number the following information apply to. 0: Pressure 1: Temperature	Channel number
6-7		Dead band, common to all non-slope alarms	0…10,000 in increments of 0.01 % of span; common to all non-slope alarms
8	*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
9-10		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) Delays in seconds
11-12		Threshold value for alarm 2	
13-14		Slope value for alarm 3	
15-16		Slope value for alarm 4	
17-18		Threshold value for alarm 5	
19-20		Delay value for alarm 5	
21-22		Threshold value for alarm 6	
23-24		Delay value for alarm 6	

3.6.3 Get channel property configuration response

This downlink response provides information about channel properties.

Byte	Value	Note
3	0x60: Pressure Configuration 0x61: Temperature Configuration	Command type the device is responding to
4	Command Status	Always 0x00
5	Channel number the following information apply to. 0: Pressure 1: Temperature	Channel number
6-7	Measurement offset	Signed value in 2s complement
8	0	Reserved

3.6.4 Reset battery indicator command status

Byte	Value	Note
3	0x40	Command type the device is responding to: “Reset battery indicator”
4	0: Battery reset successful 1: Battery reset not successful	Command Status

3.6.5 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

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 PEW-1000 LoRaWAN® Version = 11 mioty® Version = 22
3	Reserved	0
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	Pressure type	1 = Absolute 2 = Gauge / relative
20-23	Pressure Range Start	Lower bound of pressure measurement range Float – Big endian encoded
24-27	Pressure Range End	Upper bound of pressure measurement range Float – Big endian encoded
28-31	Temperature Range Start	Lower bound of temperature measurement range Float – Big endian encoded
32-35	Temperature Range End	Upper bound of temperature measurement range Float – Big endian encoded
36	Pressure Unit	See Unit identifier table below
37	Temperature Unit	

Unit identifier

Unit ID (dec)	Description
6	[psi]
7	[bar]
237	[MPa]
32	[°C] degree Celsius

3.7.1 Example

Upstream packet: 0x07 00 0B 00 0200 0100 50455753414D504C453031 01 00000000 41200000 c2340000 42Dc0000 07 20

Decoding	
07	Device Identification
00	Config ID = 0
0B	PEW-1000 LoRaWAN® Product ID = 11
00	Reserved
0200	Firmware Version 0.2.0
0100	Hardware Version 0.1.0
50455753414D504C453031	“PEWSAMPLE01”
01	Absolute pressure device
00000000	Pressure range start = 0 bar
41200000	Pressure range end = 10 bar
c2340000	Temperature range start = -45 °C
42Dc0000	Temperature range end = 110 °C
07	Pressure unit = bar
20	Temperature unit = °C

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.

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

4. Downstream Messages

Note: Devices including mioty® communication technology do not offer downstream message capabilities. Please 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:

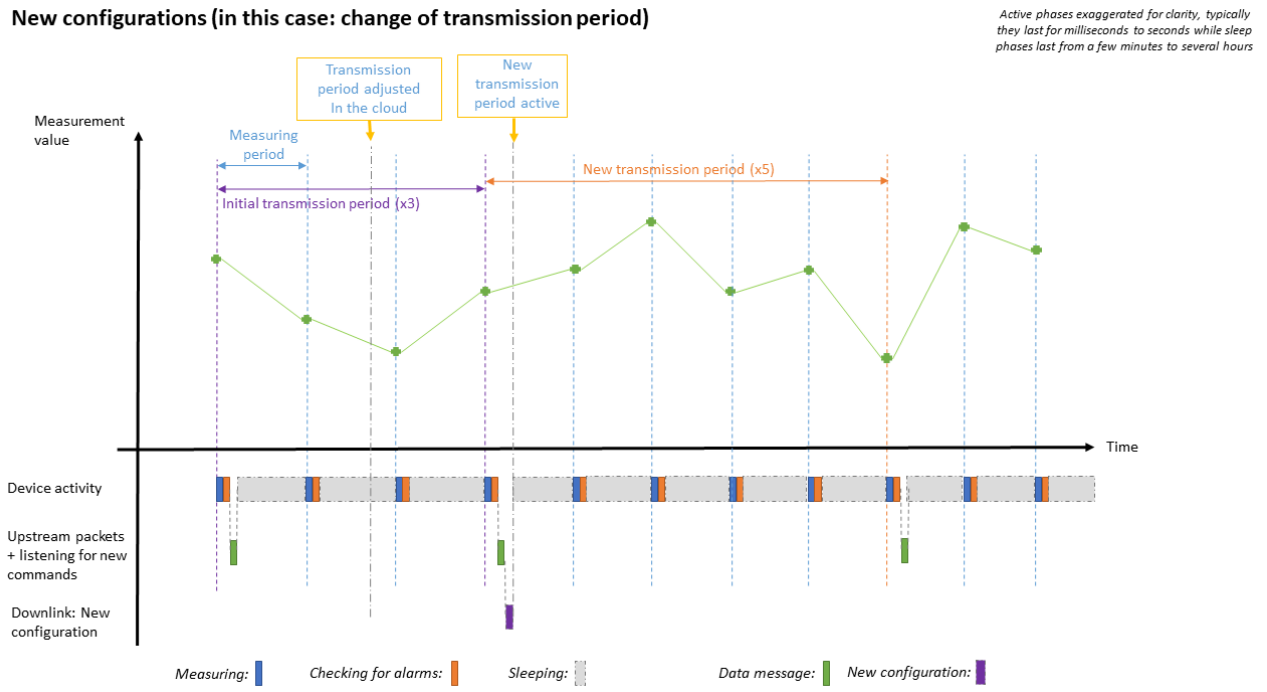
Byte	Size (bytes)	Note
0	1	Transaction identifier (see chapter 0)
1	1	Reserved, must always be 0x00
2	1	See command type table below
3, n+1	n (can be 0)	Command options (size depends on the command type)
n+2	1	Additional commands can be concatenated, one after another.
n+3…	m	

Downstream Command Types

Value (hex)	Upstream command types	Option size (bytes)
0x01	Reset to factory configuration	0
0x02	Set main configuration	14
0x04	Get main configuration	0
0x20	Set pressure process alarm configuration	20
0x21	Set temperature process alarm configuration	20
0x30	Set pressure channel properties	2
0x31	Set temperature channel properties	2
0x40	Reset battery indicator	0
0x50	Get pressure process alarm configuration	0

0x51	Get temperature process alarm configuration	0
0x60	Get pressure channel properties	0
0x61	Get temperature channel properties	0

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	Value	Note
2	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
2	0x02	Set main configuration command
3-6	Measurement period when no alarms are active	Period in seconds min. value = 2 s; max. value = 604800 s (7 days) Default: 60 s
7-8	Transmission multiplier when no alarms are active	Transmission period = measurement period * transmission multiplier Value = [1…604800] Default: 30 (transmission every 1800s)
9-12	Measurement period when ≥1 alarm is active	Same unit, min./max., and default values as above
13-14	Transmission multiplier when ≥1 alarm is active	
15	0x00	Reserved, must always be transmitted with the given value
16	BLE Configuration	0: BLE advertising frame includes measurement data 1: BLE advertising frame does not include measurement data. **Note:** Please check the PEW-1000 Bluetooth® documentation for more information.

4.3.1 Example

Downstream packet: 0x07 02 000000B4 0012 0000003C 0003 00 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
00	BLE advertising frame includes measurement data

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. The respond is send via the Configuration and Command Status Message command.

Byte	Value	Note
2	0x04	Get main configuration command

4.5 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
2	1		0x20: Pressure Configuration 0x21: Temperature Configuration	Set process alarm command
3	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
5	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
6-22	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.

4.5.1 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

4.6 Set channel properties

This command can be used to set the channel properties.

Byte	Value	Note
2	0x30: Pressure Configuration 0x31: Temperature Configuration	Set channel properties command
3-4	Measurement offset	Signed value in 2s complement

4.7 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.
The device will respond with a command status message described in chapter 3.6.

Byte	Value	Note
2	0x40	Reset battery indicator command

4.8 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
2	0x50: Pressure Configuration 0x51: Temperature Configuration	Get process alarm configuration command

4.9 Get channel properties

This command will trigger the device to send the current channel properties via LPWAN.

Byte	Value	Note
2	0x60: Pressure Configuration 0x61: Temperature Configuration	Get channel properties command

5. Connectivity protocol: LoRaWAN®

5.1 Radio network integration

The PEW-1000 LoRaWAN® version is a “class A” battery-powered radio end-device using version 1.0.3 of the protocol and EU868 regional parameters.
The device is using 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, the PEW-1000 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.
If the join attempt is unsuccessful, the device goes to sleep for a random period, then launches a new join sequence. The sleep duration between 2 join sequences is 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 the PEW-1000 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- and Device alarms
- Device identification
- Configuration status
- Keep alive

If the network server does not confirm the reception of these messages PEW-1000 will try to retransmit them up to 8 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.

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6. Connectivity protocol: mioty®

6.1 Radio network integration

The PEW-1000 is available with the wireless protocol mioty, offering a robust radio transmission for difficult receiving conditions. The mioty® version only integrates a downlink functionality, so all the device configuration 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. Messages that are channel specific are transmitted separately for each channel.

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
15	Data in advertising	0= Data in BLE advertising frame 1= no data in BLE advertising frame

Process Alarm Configuration Message

Byte	Bit	Value	Note
0		0x0C	Message ID for Process Alarm Configuration
1		Config ID	Current configuration ID
2		Channel number	Channel number the following information apply to. 0: Pressure 1: Temperature
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	

Byte	Bit	Value	Note
8-9		Threshold value for alarm 2	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) Delays in seconds
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	
18-19		Threshold value for alarm 6	
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	Channel number	Channel number the following information apply to. 0: Pressure 1: Temperature
3-4	Measurement offset	Signed value in 2s complement
5	0	Reserved

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