Special Documentation

Special Documentation for BLE communication protocol, model NETRIS®1

EN

NETRIS®1

WIKA

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

Content

1. General Information

1.1 Abbreviations and Definitions

ATT	Attribute Protocol
BLE	Bluetooth® Low Energy
GAP	Generic Access Profile
GATT	Generic Attribute Profile
LPWAN	Low-power wide-area network
N	Notify
R	Read
SIG	Special Interest Group
TLV-Format	Type, Length, Value Format
UUID	Universal Unique Identifier
W	Write

1.2 Scope of this Document

This document describes the protocol for the Bluetooth® communication with NETRIS®1 devices. The communication interface can be used together with the dedicated “myWIKA wireless device” mobile application available for Android and iOS. It is also possible to communicate with the device using for example a compatible Bluetooth® gateway together with the information on the following pages.

1.3 Conventions

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. Protocol Description

2.1 General architecture

The Bluetooth® Low Energy communication in NETRIS®1 provides two different operating modes.

Advertising Mode

- Identify a device.
- Provide data at regular time intervals (Logging).
- Enter connected mode.

Connected Mode

- Detailed Device information.
- Customize the device.
- Send Commands.

2.2 Device compatibility

The device is compatible with Bluetooth® Low Energy 4.2 and newer versions. For the connected mode, the communication partner must support BLE Secure Pairing with Passkey.

2.3 Bluetooth® password protection

To connect to the NETRIS®1 device each product has been assigned an individual 6-digits password. The password is provided in the Quick Start Guide documents packed in a red envelope in your device packaging. When connected to the device, the password can be changed by the user.
The device allows up to 5 tries to enter the correct password during the paring process. After that the device will be locked. After interrupting the power supply or removing the battery, 5 attempts are available again. If this is not possible for technical reasons, e.g. because the sensor cannot be reached to open the housing, contact technical support.

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3. Advertising mode

Advertising frames are sent every 1,25 seconds. Please note that the measured value is only updated in the configured measurement period.

The advertising data follows a format for organizing data similar to the TLV (Type, Length, Value) format used in data communication, except that the length comes before the type:

Advertising Data Structure		
Length	AD Type	AD Data

Two data structures are used, one for the device name and the other one to represent the sensor data. Each advertising message has a total length of 31 bytes.

3.1 Device name

The device name consists of 11 ASCII bytes. By default, after production, it represents the device serial number but can also be changed depending on individual needs (e.g. to represent a specific measuring point).

Bluetooth® SIG AD type: 0x09 Complete Local Name

AD Structure for Device name		
Length	AD Type	AD Data
0x0C	0x09	“Device Name”

3.2 Sensor data

The measured sensor value is included in the advertising by default. The data can also be hidden using the “Hide Advertising Data” characteristic described in the configuration service. In this case Byte 4…9 are not transmitted.

Bluetooth® SIG AD type: 0xFF Manufacturer Specific Data

AD Structure for Sensor data		
Length	AD Type	AD Data
0x0C	0xFF	See specific payload below

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3. Advertising mode

Sensor data Payload

Byte	Name	Note
0-1	BLE manufacturer ID	0x0989: WIKA manufacturer ID
2	Product ID	16 = BLE + LPWAN version 17 = BLE only version
3	Product Sub ID	Sensor ID Bit [4…0]: 0 = RTD 1 = Norm signal 2 = TRW LPWAN ID Bit [7…5]: 0 = No LPWAN 1 = MIOTY 2 = LoRaWAN®
4	Status byte	Alarm status: Bit 0: Process Alarm ongoing Bit 1: Technical alarm Bit 2: Device alarm Bit 3: Measurement input alarm Update counter Bit [7…4]: Incremented by one on each change on measure or alarm status
5	Measuring Unit	See Appendix A
6-9	Measurement Value	32 bits float value (LSB first) of the sensor value
10	Battery Level	% of remaining capacity For externally powered devices, value is set to 0x80

4. Connected mode

4.1 GATT general description

To establish a two-way communication via Bluetooth®, a connection based on the GATT (Generic Attribute Profile) protocol is required. The peripheral device can only connect to one central device (e.g. Smartphone) at the same time. During a connection, Advertising frames are no longer published.
The device provides three services adopted from the SIG and three custom services.

4.2 Adopted Services

The following Bluetooth® SIG standard services are integrated in the device. For more information, please refer to the specification on the Bluetooth® website.

- Generic Access Service (GAP)
- Battery Service
- Device Information Service

4.3 Custom Services

In the following service description, the following terminology is used:

- R Read action is possible
- W Write action is possible
- N Notification is possible

The “Notify” action permits to update the data automatically without activating the “Read” function each time data is updated.

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4.3.1 Configuration Service

The configuration service allows configuration of the device including alarm and transmission parameters. For details how to configure the device via Bluetooth® please also refer to chapter 4.4.

Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Sensor type Selection	F13A300C164C469787E9EDF95FD0653F	uint8	1	-	R/W	Select connected sensor configuration based on device type: **Standard Signal:** 1: Milliampere 2: Volt **RTD:** 1: PT100 2Wire 2: PT100 3Wire 3: PT1000 2Wire 4: PT1000 3Wire 5: Potentiometer
Measure Unit	F13A300D164C469787E9EDF95FD0653F	uint8	1	-	R/W	This value reflects the sensor Measuring unit (Appendix A) Can only be changed for temperature devices (°C/°F)
Offset	F13A300A164C469787E9EDF95FD0653F	float	4	Measure Unit	RW	Measuring value Offset
Gain	F13A300E164C469787E9EDF95FD0653F	float	4	-	RW	Measuring value Gain

Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Calibration Date	F13A300F164C469787E9EDF95FD0653F	uint8[]	3	-	R/W	Device Calibration Date Format: [YY, MM, DD]
Calibration range start	F13A3010164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Calibrated measuring range limit start
Calibration range end	F13A3011164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Calibrated measuring range limit end
Lead Resistance	F13A100C164C469787E9EDF95FD0653F	float	4	Ohm	R/W	To be used with 2 wires PT100 and P1000n (only for RTD version)
Enable Sensor Supply	F13A100D164C469787E9EDF95FD0653F	uint8	1	-	R/W	When set, it allows to power the sensor attached to NETRIS®1. Versions with external supply will not be switched off after a measurement.
Sensor boot time	F13A100E164C469787E9EDF95FD0653F	uint16	2	Milliseconds	R/W	The time between powering the sensor and start to read measurement.

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Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Alarm Configuration	F13A3001164C469787E9EDF95FD0653F	uint8	1	Bitfield	R/W	Enable or disable alarms: Bit 0: Low threshold Bit 1: High Threshold Bit 2: Low slope Bit 3: High slope Bit 4: Delayed Low threshold Bit 5: Delayed High threshold Bit = 1 ➔Enabled
Low Alarm threshold	F13A3002164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Low threshold value when the alarm will be activated.
High Alarm threshold	F13A3003164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	High threshold value when the alarm will be activated.
Falling Alarm slope	F13A3004164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Low slope value when the alarm will be activated.
Rising Alarm slope	F13A3005164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	High slope value when the alarm will be activated.
Delayed Low Alarm threshold	F13A3006164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Delayed Low threshold value when the alarm will be activated.
Delayed Low Alarm delay	F13A3007164C469787E9EDF95FD0653F	uint16	2	Seconds	R/W	Delay value for delayed low threshold alarm

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Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Delayed High Alarm threshold	F13A3008164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Delayed High threshold value when the alarm will be activated.
Delayed High Alarm delay	F13A3009164C469787E9EDF95FD0653F	uint16	2	Seconds	R/W	Delay value for delayed high threshold alarm
Dead band	F13A300B164C469787E9EDF95FD0653F	float	4	Measure Unit	R/W	Hysteresis value for the threshold alarms
Configuration ID	F13A1001164C469787E9EDF95FD0653F	uint8	1	-	R	A new configuration ID is generated automatically for each new configuration.
Measurement period with alarm	F13A1002164C469787E9EDF95FD0653F	uint32	4	Seconds	R/W	Measurement period when ≥1 alarm is active
Measurement period no alarm	F13A1003164C469787E9EDF95FD0653F	uint32	4	Seconds	R/W	Measurement period when no alarms are active
Transmission multiplier with alarm	F13A1004164C469787E9EDF95FD0653F	uint16	2	-	R/W	Transmission period = measurement period * transmission multiplier

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Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Transmission multiplier no alarm	F13A1005164C469787E9EDF95FD0653F	uint16	2	-	R/W	Transmission period = measurement period * transmission multiplier
Command Status	F13A1006164C469787E9EDF95FD0653F	uint8	1		R/W/N	See Chapter 4.4
Hide advertising data	F13A1008164C469787E9EDF95FD0653F	bool	1	-	R/W	0 = Advertising frame contains measurement data 1 = Advertising frame does not contain measurement data
Custom BLE Name	F13A1009164C469787E9EDF95FD0653F	utf8[]	0-11	-	R/W	Device name in Advertisement frame. When this field is empty, the device serial number is used.
BLE Security Key	F13A100A164C469787E9EDF95FD0653F	utf8[]	6	-	R/W	6-digit Passkey for pairing with the device

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4.3.2 Product Status Service

Measurement status information

Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Sensor Description	B75C300C3BBC4FB7A7EA37BA44F4C0B0	utf8	32	-	R	Description of the active sensor type e.g. PT100 2Wire.
Measurand	B75C300D3BBC4FB7A7EA37BA44F4C0B0	uint8	1	-	R	Physical measurand (Appendix B)
Accuracy	B75C300A3BBC4FB7A7EA37BA44F4C0B0	uint16	2	0.001%	R	Device Accuracy
Process Alarm status	B75C30013BBC4FB7A7EA37BA44F4C0B0	uint8	1	-	R/N	Active alarm bitfield: 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
Measurement Input Failure Alarm Status	B75C300B3BBC4FB7A7EA37BA44F4C0B0	uint8	1	-	R/N	Bit 0: General Error Bit 1: Sensor Warning 1 Bit 2: Meas. Limit High Bit 3: Meas. Limit Low Bit 4: Sensor Warning 2
Measure Value	B75C30003BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R/N	Value measured by the device. **Note:** Value is updated in the configured measurement period only.

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Characteristic	UUID	Format	Length [Bytes]	Unit	Type	Description
Alarm threshold	B75C30023BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R/N	In case of rising or falling threshold alarm: Device sensor value when alarm condition is raised.
Delayed Alarm threshold	B75C30033BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R/N	In case of delayed rising or falling threshold alarm: Device sensor value when alarm condition is raised.
Alarm Slope	B75C30043BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R/N	In case of rising or falling slope alarm: Computed slope value when alarm condition is raised.
Measurement Range Start	B75C30053BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R	Start of device measuring range
Measurement Range End	B75C30063BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R	End of device measuring range
Measure min. range limit	B75C30083BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R	Minimum physical measuring limit
Measure max. range limit	B75C30093BBC4FB7A7EA37BA44F4C0B0	float	4	Measure Unit	R	Maximum physical measuring limit

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Device status information

Characteristic	UUID	Format	Length [Bytes]	Type	Description
BLE MAC address	B75C10013BBC4FB7A7EA37BA44F4C0B0	uint8[]	6	R	Bluetooth® module MAC address
BLE Version	B75C10023BBC4FB7A7EA37BA44F4C0B0	utf8	3	R	BLE specification version
LPWAN EUI	B75C10033BBC4FB7A7EA37BA44F4C0B0	uint8[]	8	R	In case of an LPWAN device: LoRaWAN® DevEUI
LPWAN Version	B75C100A3BBC4FB7A7EA37BA44F4C0B0	uint8[]	5	R	LPWAN specification version
LoRaWAN® AppEUI	B75C10093BBC4FB7A7EA37BA44F4C0B0	uint8[]	8	R	LoRaWAN® AppEUI
LoRaWAN® Join Status	B75C10073BBC4FB7A7EA37BA44F4C0B0	bool	1	R/N	True if Device has joined a network
Technical Alarm Status	B75C10043BBC4FB7A7EA37BA44F4C0B0	uint8	1	R/N	Internal failure status code
Device Alarm Status	B75C10053BBC4FB7A7EA37BA44F4C0B0	uint8	1	R/N	Bit 0: Low Battery Bit 2: LPWAN Duty Cycle Bit 3: Internal Error All others reserved
Battery Voltage	B75C10063BBC4FB7A7EA37BA44F4C0B0	uint16	2	R	Battery Voltage in mV Devices with external power: 0xFFFF
Article number	B75C100B3BBC4FB7A7EA37BA44F4C0B0	utf8	10	R	Device Article number

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4.3.3 Data Logging Service

The NETRIS®1 device is keeping track of all Process alarms that appear and stores them in a list together with the corresponding measurement value. The log file can be retrieved via Bluetooth® using the following procedure.
A maximum of 256 log entries can be stored in a ring buffer style.
The Request commands will open a logging retrieve session window. The session has a timeout of 30s which is restarted with each following command. After the timeout or when the close command is sent, the complete log buffer will be cleared automatically (One time read only!)

Characteristic	UUID	Format	Length [Bytes]	Type
Logging Command	0A40000098FE43598EC97CCE2662D06F	Uint8	35	R/W/N

Command Table

Command	Description
0x00	Request data logging info table
0x01	Request data logging data
0x02	Close logging session

Step 1: Request data logging information

Writing the command value 0x00 to the Logging command will request the data logging information table answer containing an overview of the active alarms:

Byte	Field	Note
0	Response	0x80: Get data logging information table
1	Last packet indicator	While cleared, the 0x00 command need to be sent to get the whole table of information. When set to 1, the packet contains the last information table element
2	Payload length	The length of the whole payload excluding Command field, Last packet field and Payload length field
3	Alarm x ID	An arbitrary generated alarm ID unique for each alarm
4-5	Alarm x Start index	The start index into the data table for this alarm (index starting at 0)
6-7	Alarm x End index	The end index into the data table for this alarm (index starting at 0)

8-11	Alarm x code	The alarm status according encoding in Product Status Service with: Alarm x code [31] – Internal Failure Alarm Status Alarm x code [30...25] – Reserved (0) Alarm x code [24...16] –Measurement Input Alarm Status Alarm x code [15...8] – Reserved (0) Alarm x code [7...0] – Process Alarm Status
11…	The total package size of 35 byte is filled with the next Alarm IDs if available.	
The Alarm x ID + Alarm x Start index + Alarm x End index + Alarm x code are repeated for the total number of alarms with x = 1 to x = number of alarms		

Example

Command: 00

Response:

80 → Get data logging info

01 → Last package

12 → Payload length (18 byte)

00 → Alarm ID 0

00 00 → Start Index

04 00 → End Index

00 00 00 01 → Process Alarm, Low Threshold

01 → Alarm ID 1

00 00 → Start Index

04 00 → End Index

00 01 00 00 → Measurement Input, General Error

Step 2: Request data logging data

Writing the command value 0x01 to the Logging command will request the data logging data table containing the measurement data when the respective alarm ID occurred:

Byte	Field	Note
0	Response	0x81: Get data logging data table
1	Last packet	While cleared, the 0x01 command need to be sent to get the whole table of data. When set to 1, the packet contains the last logging data element
2	Payload length	The length of the whole payload excluding Command field, Last packet field and Payload length field
3 - 6	Measurement Value	Measurement value of sensor as Float in sensor unity encoded MSB first
7-10	Reserved	Reserved for future use
11…	The total package size of 35 byte is filled with the next Alarm values if available.	

Note:

No information is stored which sensor type was selected when the alarm occurred. It is recommended to clear the error log after the sensor type has been changed.

Example

Command: 01

Response:

81 → Get data logging data
01 → Last package
10 → Payload length:
41 BC 00 00→ Measurement value Alarm ID 0: 23.5
00 00 00 00 → Reserved
40 16 66 66→ Measurement value Alarm ID 1: 2.35
00 00 00 00 → Reserved

Step 3: Close data logging session

Writing the command value 0x02 to the Logging command will close the data logging session.

Byte	Field	Note
0	Response	0x82: Logging session closed

4.4 Device Commands

Via the Command Status characteristic in the configuration service, multiple device commands can be triggered. Also, any changes of the device configuration are only applied using the respective command. Each command is answered with a corresponding status that informs about success or failure.

Device Commands

Value	Command	Description
1	Apply Config	Applies all configuration parameters that have been changed.
2	Force LoRaWAN® Join	Triggers a LoRaWAN® Join Request if not yet connected to a network.
3	Force Data Transmission	Sends the current measurement value via LPWAN.
4	Factory config	Reset device to factory settings.
5	Force Measurement	Refresh measurement value.
6	Reset Energy Counter	Reset energy counter after battery has been replaced.

Return Status

Value	Description
0x80	Command Success
0x81	Error, unknown command
0x82	Device busy
0x83	Configuration check failed
0x84	Error writing Settings

Appendix

A. Unit Identifier

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

B. Measurand IDs

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

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