

DOCUMENTATION

Telegram structure for LoRa water meter V2

Rev. 1.3

INNOTAS GMBH



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2 Revision index

REVISION	DATE	CHANGE
1.0	12 March 2024	First edition
1.1	8 April 2024	Update
1.2	28 January 2025	Tracing omitted, 2-byte join attempts, 3 standard products.
1.3	12 June 2026	Minor corrections

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DOCUMENTATION

Telegram structure for LoRa water meters

3 Preliminary note

The LoRa water meter add-on V2 is a comprehensive revision that includes changes to key functions compared to the first version.

Among other things, a higher LoRa stack (1.03) has been implemented.

Existing telegrams have been modified, and new telegrams have been added. This applies to both upload and download telegrams.

Therefore, when using the Innotas water meter attachment version 2, it is necessary to create a new device profile in the LoRa server and implement a new decoder!

4 Upload protocols

Various transmission modes are available in the water meter module, which differ in terms of telegram content and transmission frequency.

The transmission mode “2 days” (protocol 1 every 2 days) is set as standard, unless the customer has ordered a different setting.

The customer can change the transmission modes on the device via the optical head and IrDA interface or remotely via a download protocol.

The identifier for the protocol type currently being transmitted is encoded in the port number. The protocol number is the same as the port number.

4.1 Protocol 1

Used for transmission modes “1 per day”, “2 days” and “4 days”

4 bytes Current meter reading as a 4-byte number in litres.

4-byte meter reading as at the annual reference date, expressed as a 4-byte number in litres.

4-byte meter reading at the end of the last month as a 4-byte number in litres

1 byte for the last month and the year-end month, each as a half-byte value from 1 to 12

2-byte error and status code

A reading is taken once a year (annually) at the end of a month selected by the user (annual reference date) and additionally at the end of each month (monthly reference date).

At the end of the user-selected “annual reference month”, the two meter readings are identical. Payload example: 00001b9d0000108600001b05520003

→ 0x00001b9d ZS:	7069
→ 0x00001086 ZSYST:	4230
→ 0x00001b05 ZSMST:	6917
→ 0x52	
○ Year_Month:	2
○ Month_Last:	5
→ 0x0003 STATUS,	
○ ERROR_BACKFLOW:	false
○ ERROR_ZEROFLOW:	false
○ ERROR_RESET:	false
○ ERROR_RF-traffic overflow:	false
○ ERROR_CS:	false
○ ERROR_BATTLOW:	false
○ ERROR_SABOT:	false
○ ERROR_MESS:	false
○ ERROR_LEAKAGE:	false
○ ERROR_FROST:	false
○ INSTALL:	"no"
○ INTERVAL:	"2 days"

4.2 Protocol 3

Usage for transmission interval “Statistics”

4 bytes Current meter reading as a 4-byte number in litres.

4-byte meter reading as at the reference date, expressed as a 4-byte number in litres.

4-byte meter reading at the end of the last month as a 4-byte number in units

1 byte for the last month and the reference month of the year, each as a half-byte value from 1 to 12

2-byte maximum flow rate for the last day (00:00–24:00) in litres/hour (measured and averaged over one minute)

1 byte downtime for the last day (0–24 hours) as a percentage with 0.5% resolution (0–200)

2 bytes: Number of starts (start of flow after standstill) on the last day (0–24 hours) 2 bytes:

Error and status code

Example payload: 000081db0000575600007e765202d0c300100001

→ 0x000081db ZS:	33243
→ 0x00005756 ZSYST:	22358
→ 0x00007e76 ZSMST:	32374
→ 0x52	
○ Year_Month:	2
○ Month_Last:	5
→ 0x02d0 Max_DF_L_per_h:	720
→ 0xc3 Still_proz_per_day:	97.5
→ 0x0010 Max_Start_Day:	16
→ 0x0001 STATUS,	
○ ERROR_BACKFLOW:	false
○ ERROR_ZEROFLOW:	false
○ ERROR_RESET:	false
○ ERROR_RF-traffic overflow:	false
○ ERROR_CS:	false
○ ERROR_BATTLOW:	false
○ ERROR_SABOT:	false
○ ERROR_MESS:	false
○ ERROR_LEAKAGE:	false
○ ERROR_FROST:	false
○ INSTALL:	"no"
○ INTERVAL:	"STATISTIC"

4.3 Protocol 4

Usage for transmission interval “history”

4-byte current meter reading as a 4-byte number in litres.

4 bytes Meter reading on the reference date as a 4-byte number in litres.

4 bytes Meter reading at the end of the previous month as a 4-byte number in units

1 byte: last month and reference month of the year, each as a half-byte value from 1 to 12

4 bytes timestamp (internal time in the water meter at the time of reading) 2 bytes flow rate for the full hour (-1h)

2 bytes flow rate for the previous hour (-2h)

• • • •

2-byte flow rate for the full hour (-12) 2-

byte error and status code

Please note: the internal clock is used to determine the time, which may differ from the server time.

Timestamp format

4 bytes (32 bits) Order Bit 31 ... Bit 0

Bit 31 ... Bit 26	6 bits Year minus 2000 (range 0 to 63 = years 2000 to 2063)
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Bit 25 ... Bit 22 4-bit month

Bit 21 ... Bit 17 5-bit day

Bit 16 ... Bit 12 5-bit hour

Bit 11 ... Bit 6 6-bit minute

Bit 5 ... Bit 0 6-bit seconds

Example: 07/11/2024 3:02 am and 22 seconds

Hex 0x62ce3096 Bin 01100010 11001110 00110000 10010110 = 24/11/7/3/2/22

Example payload:

```
0000002e000000175000002c752699618050000000000000000000000000000000000000000000000000
```

→ 0x000002e0 ZS: 33243

→ 0x00000175 ZSYST: 22358

→ 0x000002c7 ZSMST: 32374

→ 0x52

○ Year Month: 2

○ Month Last: 5

→ 0x69961805 Time

○ YEAR 26

○ MON: 6

○ DAY: 11

○ HOUR: 1

○ MIN: 32

○ SEC: 5

→ 0x00 Flow -1h 0

→ 0x00 Flow -2h 0

→

→ 0x00 Flow -12h 0

→ 0x0000 STATUS,

- ERROR_BACKFLOW: false
- ERROR_ZEROFLOW: false
- ERROR_RESET: false
- ERROR_RF-traffic overflow: false
- ERROR_CS: false
- ERROR_BATTLOW: false
- ERROR_SABOT: false
- ERROR_MESS: false
- ERROR_LEAKAGE: false
- ERROR_FROST: false
- INSTALL: "no"
- INTERVAL: "HIST"

4.4 Log 5

Protocol 12 is only sent upon request by the server.

The last 12 monthly values are transmitted in reverse chronological order. 1 byte:
month of the first value [1–12]

1 byte: Year of the first value minus 2000, i.e. 24 for the year 2024

bytes: Meter reading in litres at the end of the respective month (1)

.....

....

4 bytes: Meter reading in litres at the end of the respective month (12)

4.5 Log 6

Protocol 6 contains the last 12 half-monthly meter readings as a 4-byte number

1-byte month of the first meter reading from 1 (January) to 12 (December) e.g. 11 =

November 1 byte year of the first value -2000, i.e. 24 for the year 2024

4-byte meter reading for the last half-month

e.g. on 15 November

4-byte meter reading for the penultimate half-month

e.g. on 15 October

...

4-byte meter reading for the half-month one year ago

e.g. on 15 December of the

previous year Protocol 5 is only sent upon request by the server.

4.6 Protocol 9

Protocol 9 contains the number of bytes sent, broken down by spreading factor. Protocol 9 is only sent upon request by the server.

4 bytes Number of bytes sent in SF7 4

bytes Number of bytes sent in SF8 4 bytes

Number of bytes sent in SF9 4 bytes

Number of bytes sent in SF10 4 bytes

Number of bytes sent in SF11 4 bytes

Number of bytes sent in SF12 (number of bytes with LSB first)

2 bytes Number of JOIN attempts

2 bytes Controller VDD in mV 2 bytes

Error and status code

Example payload: 0x1F0000002F0000001F000000200000001F0000002100000000050B978002

→ 31 bytes in SF7

→ 47 bytes in SF8

→ 31 bytes in SF9

→ 32 bytes in SF10

→ 31 bytes in SF11

→ 33 bytes in SF12

→ 5 join attempts

→ 2967 mV

→ 0x8002 STATUS,

4.7 Protocol 11

Protocol 11 is sent as an installation telegram after initial activation and thereafter only upon request by the server.

4 bytes Current meter reading as a 4-byte number in

litres. 1 byte Hardware version

1 byte Software version

4 bytes BCD device

number

4-byte BCD water meter number

1 byte chip temperature in °C

2 bytes VDD of the controller in mV

1 byte max. backflow in litres until error

1 byte Start-up flow rate for leak detection in litres/h

1 byte max. number of hours of continuous flow until a leakage error is triggered 1

byte number of days of inactivity until an inactivity error

1 byte Number of days until forced rejoin (cyclical force rejoin*), 0 means disabled*

2 bytes option switch

2 bytes error and status code

*Force Rejoin causes the modules to restart randomly during the day after x days. The random function ensures that, following a rejoin of entire properties, not all devices are active at the same time.

To avoid excessive data traffic, force rejoin is limited to values ≥ 10 days. The setting

“0” disables Force Rejoin completely.

Unlike the initial join process, no installation telegrams are sent after Force Rejoin.

Bits	Description Option switches (flags)
15+14	Confirm mode, 0= Disable, 1= ALL, 2= every 2 telegrams, 3= every 5 telegrams
13	1= OTAA, 0= ABP
12	1= ADR on, 0= ADR off
11	1= LINKCHECK on, 0= LINKCHECK off
10	1= RTC AUTO SYNC on, 0= RTC AUTO SYNC off
9	1 = ALARM MESSAGE on, 0 = ALARM MESSAGE off
8	Reserve
7+6+5	Transmission interval, 0=HIST, 1=Statistics, 2=1 Day, 3=2 Days, 4=4 Days, 5=Option 1, 6=OPTION2, 7=OPTION 3
4-0	Reserve

4.8 Numerical representation

Value	Display
Current meter reading	Hex, MSB first, e.g. 0000012C = 300 litres
Meter reading on the reference date	Hex, MSB first, e.g. 001F 5C40 = 2055.232 litres = 2055.232 m ³
Reference date month	Hex, e.g. 0x01=January; 0x0C=December (0x00 for monthly)
Last month and year reference month	Hex, e.g. 0x3C = March/December
Max./min flow rate for the last day	Hex, MSB first, e.g. 04CD = 1229 l/h
Downtime of the last day	Hex, MSB first, e.g. C1 = 193 / 2 = 96.5%
Number of starts on the last day	Hex, MSB first, e.g. 0012 = 18 starts
Flow rate within a past hour	Hex, MSB first, e.g. 01C2 = 450 litres
Number of bytes sent	Hex, LSB first , e.g. 2A01 0000 = 298 bytes
Number of JOIN attempts	Hex, two bytes, e.g. 0104 = 258 join attempts
Device number/counter number	Hex 4-byte BCD LSB first, e.g. 08000000 = "00000008"

4.9

4.10 Error and status bits

Byte	Bit No.	Meaning/Function
MSB	7	Return
MSB	6	Standstill
MSB	5	RESET error
MSB	4	RF traffic overflow
MSB	3	CS error
MSB	2	Low battery
MSB	1	Tamper
MSB	0	Measurement error
LSB	7	Leakage
LSB	6	Frost
LSB	5	Reserve
LSB	4	
LSB	3	Transmission interval according to bits 0+1+2 (0) Transmission interval 2 minutes (1)
LSB	2	Transmission interval, 0=HIST, 1=Statistics, 2=1 Day, 3=2 Days, 4=4 Days, 5=Option 1, 6=OPTION2, 7=OPTION 3
LSB	1	
LSB	0	
LSB	0	

Option telegrams are not currently implemented.

The Frost warning is set when the measured temperature is below 2°C. When the temperature rises above 5°C, the warning is reset. Please note that the internal temperature measurement is subject to a certain degree of inaccuracy and the warning is intended for guidance only. The resolution of the temperature measurement is limited to one K.

RF traffic overflow is a status bit that is set if the number of 320 transmission bytes was exceeded the previous day. The spreading factor is not taken into account here, even though the warning is more critical with large spreading factors.

It is automatically reset if the number falls below this threshold for a full day.

This indicates to the operator that there is a problem in the interaction between the server and the water meter. A one-off or very rare occurrence of RF traffic overflow is not critical. This happens, for example, when a device is put into operation and sends installation telegrams. If it occurs frequently, e.g. several times a month or on several consecutive days, the cause should be investigated to avoid shortening the battery life. As a rule, a setting in the server will be the critical factor.

A two-byte counter is implemented in the module, which counts the days with RF traffic overflow.

4.11 Transmission intervals

The following transmission intervals are available:

- HISTORY Twice a day, Telegram 5 with hourly values for the last 12 hours. Cycle time 12 hours
- Statistics Once a day with log 3 (maximum flow rate, downtime and number of start-ups) Cycle time 24 hours
- Once a day Once a day Log 1 Cycle time 24 hours
- 2 days every 2 days Protocol 1, factory default setting Cycle time 48 hours
- 4 days Every 4 days Log 1 Cycle time 96 hours
- Option 1 Not implemented
- Option 2 not implemented
- Option 3 not implemented

After the device starts up (Join), 20 telegrams with a cycle time of 2 minutes are sent to Port 11 for commissioning. (The cycle time may be slightly longer if the duty cycle is exceeded due to large spread factors). The start of the cycles begins at the join time; it does not run synchronously with the top of the hour! The first telegram (cycle 0) is sent after a successful connection (Join). When evaluating consumption values, the possible time deviation between the device's internal time and the server time must be taken into account. The normal cycle time can be reset to 2 minutes at any time via the optical interface for a further 20 installation telegrams. Please note: frequent use of the 2-minute mode shortens the battery life!

Updating the time via LoRa

The water meter can request the current time from the LoRa server and adjust its internal clock. To do this, the request is generated on the 17th of each month and sent to the server with the next regular telegram. The server transmits the current time immediately after the telegram.

4.12

5 Download logs

After receiving a telegram, the server can send data or commands to the device. The download logs must be sent on channel 2.

Please note that frequent use of the download logs (e.g. daily retrieval of optional telegrams) places an additional strain on the battery and reduces the operating time of the devices.

Setting the device PIN

The command for setting the device PIN is 0x56 PIN0 PIN1
e.g. 0x56 0x12 0x34 sets the device PIN to 1234.

The factory default PIN is 0000 and is ignored by the PC program.
Only decimal numbers are accepted.

5.1



5.2 Querying the number of bytes sent

The command 0x57 causes the device to send the transmitted byte statistics to port 9.

5.3 Change the annual reference month

The annual reference date is determined once a year at a configurable end of the month. The factory default is December.

The command 0x58 followed by the month (0x01=January...0x0C=December) sets a different reference month.

Warning! If the reference month is changed retrospectively, the last reference value, including the month identifier, is transmitted and recalculated for the new reference date.

Changing the transmission interval

To change the transmission interval/transmission telegram, send the command 0x59 followed by the value of the first 3 bits from the table:

Command byte	Meaning/Function
Bit 0	Transmission interval, 00=HIST, 01=Statistics, 02=1 Day, 03=2 Days, 04=4 Days, 05=Option=1, 06=OPTION2, 07=OPTION3
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

e.g.: a telegram for all four days = 0x5904h

Perform a one-off ReJoin

With this command 0x60, the device will leave the network and initiate a one-off ReJoin process. This command can be useful when changing the network configuration (e.g. moving to a new server). The command expects a 1-byte parameter specifying the number of hours after which the ReJoin begins. The value range is between [0..255]h.

If set to zero, the ReJoin is triggered immediately upon receipt of the response telegram.

This one-off ReJoin has nothing to do with the ForceRejoin parameter, which triggers a cyclical ReJoin every x days and is part of the configuration.

No installation telegrams are sent after the one-off ReJoin. Example: 0x6018→

ReJoin 24 hours after receipt of the protocol

5.6 *Setting a meter reading*

The meter reading can be synchronised using the command 0x61 followed by a 4-byte meter reading. Upon receipt, the meter reading is set and the meter reading as of the reference date is reset to zero.

This command allows the meter reading to be synchronised with the mechanical meter reading via LoRa after the device has been activated.

Example: 0x61000000A → Sets meter reading to 10 litres

Warning! If the meter reading is subsequently changed, the last reference date value is set to “zero” and reset to the new reference date.

As the new meter reading cannot be received until after the next telegram has been sent, this command is particularly useful during installation telegrams (every 2 minutes). Otherwise, there may be too long a delay between the download command being issued on the server and its execution.

5.7 *Retrieving Telegram 5 (12 monthly values)*

Command 0x62 triggers the one-off transmission of log 5 (12 monthly values).

5.8 *Retrieving telegram 6 (12 half-monthly values)*

Command 0x68 triggers a one-off transmission of log 6 (12 half-monthly values).

5.9 *Retrieving Telegram 11*

Telegram 11 is sent as an installation telegram and contains information on the configuration of the devices. If a single installation telegram is to be sent again at a later date, command 0x63 is used.

5.10 *Enabling and disabling immediate alarm messages*

This command enables or disables the immediate transmission of alarm messages.

This applies to frost and leakage. The error bits are part of the 2 error and status bytes, which are transmitted in every regular telegram. If the alarm message is enabled, the error is transmitted immediately after it occurs via an additional regular telegram; otherwise, it is transmitted only with the next regular telegram.

This applies only to frost, leakage and backflow alarms.

Command 0x65 00 → immediate alarm disabled

Command 0x65 01 → : immediate alarm enabled for all values >0

5.11 Change Confirm Mode

To change the Confirm Mode (i.e. for every how many telegrams a confirmation is requested), send command 0x66 followed by the value of the first 2 bits from the table:

Command byte	Meaning/Function
Bit 0	00=Disable, 01=all, 02=every 2 telegrams, 03=all 5 telegrams
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

e.g.: 0x66 02h Confirm all 2 telegrams

5.12 Overview of download telegrams

Command	Parameter	Meaning/Function
0x56	2 bytes	Set device pin (0000 – 9999)
0x57	None	Query number of bytes sent
0x58	1 byte	Change annual reference date
0x59	1 byte	Change transmission interval
0x60	1 byte	Perform a one-off ReJoin in x hours
0x61	4 bytes	Set the counter value
0x62	without	Retrieve log with 12 monthly values
0x63	without	Retrieve a single installation telegram
0x65	1 byte	Turn immediate alarm notification on/off
0x66	1 byte	Change confirm mode
0x68	without	Retrieve log 6 with 12 half-monthly values