aquaradio® MultiCom

External radio module system
with multi-protocol communication

Protocol Wireless M-Bus (OMS) & LoRaWAN

Manufacturer :	INTEGRA Metering AG
Device :	aquaradio® MultiCom

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Version	Date	Modification(s)
01	19.04.2022	First internal version
02	16.03.2023	Corrections/Improvements
03	20.11.2023	First version

Original instructions

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The figures and information in these instructions are subject to technical changes that become necessary to improve the product.

1. Overview

1.1 Firmware Version

This document is valid for the following Firmware:

Module	Version	Communication Protocol
aquaradio® MultiCom (AQR-MC)	V3.8.X	Wireless M-Bus / LoRaWAN

This document describes only the radio communication which is the output of the aquaradio® MultiCom.

The product is fully configurable and the frame content depends on the settings. There are 4 possibilities described below.

Input interface	Communication output	See chapter
Pulses	wM-Bus/OMS	Chapter 2
Pulses	LoRaWAN	Chapter 3
M-Bus	wM-Bus/OMS	Chapter 2
M-Bus	LoRaWAN	Chapter 3

With M-Bus interface reading, the main field, Serial number, Manufacturer, Version and Type are sent based on the connected device information:

- Main Volume for Water Configuration
- Main Energy for Energy Configuration

2. Wireless M-Bus / OMS Protocol

The device communicates according to EN 13757-3 and EN 13757-4. In this document, these standards are referred to as EN 13757.

The device supports only some of the telegrams defined in this document.

2.1 Standard Telegram

Standard telegram when the module is connected to the meter.

Names	Data	length (bytes)	Note
L-Field	variable	1	data length: LEN-1
C-Field	0x44	1	Send, no reply
M-Field	0xB425	2	manufacturer code
A-Field	variable	4	BCD Serial number Module
A-Field	0x05	1	version number module
A-Field	0x0E	1	device type = system component
ELL	0x8C	1	Extended LinkLayer
CC-Field	0x00	1	CC-Field
Access Number	0x00	1	Access number
CI-Field	0x72	1	Long Telegram
Ident. No.	variable	4	BCD Serial number Meter
M-Field	0xB425	2	manufacturer code

Meter-Version	0x01	1	Version number meter for Pulse configuration
	variable	1	Version number of connected M-Bus meter
meter-device type	0x0E	1	Component system
	variable	1	Type of connected M-Bus meter
TC 2 (access counter)	variable	1	transmission counter
status-field	variable	1	Status
Configuration-field	0x0000	2	

Record	DIF	DIFE1	VIF (depends on unit)	VIFE	Datatype
(1) Main Volume	0x04	-	0x13 (liter), 0x16 (m^3) [3]	-	Int 32 bit
(2) Reverse volume	0x84	0x10	0x13 (liter)	-	Int 32 bit
(3) Date and time[4]	0x04	-	0x6D	-	Int 32 bit
(4) Main Volume Historic	0x44 /0x7C[5]	-	0x13, 0x16 [3]	-	Int 32 bit
(5) Date historic	0x42	-	0x6C	-	Int 16 bit
(6) Info status	0x02	-	0xFD	0x17	Int 16 bit
(7) Battery life	0x02	-	0xFD	0x74	Int 16 bit

[3] The VIF value depends on the configuration of the module.

[4] As long as the date/time of the module is not configured, the date/time is then set invalid IV-Bit

[5] If a historical volume is not yet acquired, the value is DIF=0x7C (wrong value status).

2.2 Description of "Status Field" values in long Header

The following table details the different values for Alarm management.

Bit 0	Not used
Bit 1	Not used
Bit 2	Low batteries – 18 months before end of life
Bit 3	Not used
Bit 4	Not used
Bit 5	Leakage
Bit 6	Burst
Bit 7	Reverse flow

2.3 Description of "ErrorFlag" values in WMBUS payload

The following table details the different values for Alarm management.

Bit 0	Tamper
Bit 1	Not used
Bit 2	Burst
Bit 3	Leakage
Bit 4	Not used
Bit 5	Not used
Bit 6	Not used
Bit 7	No consumption
Bit 8	Low batteries – 18 months before end of life
Bit 9	Reverse flow
Bit 10	Overflow

Bit 11	Not used
Bit 12	Not used
Bit 13	Not used
Bit 14	Not used
Bit 15	Not used

2.4 Example of frames (uncrypted)

3C 44 B4 25 91 99 99 88 05 0E 8C 20 33 72 44 33 22 11 B4 25 01 0E D5 00 00 20 04 13 00 00 00 00 84 10 13 00 00 00 00 04 6D 1B 2F F1 2B 7C 13 00 00 00 00 02 FD 17 00 00 02 FD 74 D0 16

61 bytes C=44 A=91 CI=72 11223344 IMT 01 (PMK water meter) 0E (Bus / System component) Acc=xx Status=00 Signature=xxxx

DIF	VIF	Unit	StorageNr	Tariff	Function	Description	Value	Unit	Data	Type
04	13	0	0	0	Instantaneous Value	Volume	0	l	32Bit Integer/Binary	Type B - Binary Integer
84 10	13	0	0	1	Instantaneous Value	Volume	0	l	32Bit Integer/Binary	Type B - Binary Integer
04	6D	0	0	0	Instantaneous Value	Time Point	17.11.2023 15:27	Date+Time	32Bit Integer/Binary	Type F - Date and time (CP32)
7C	13	0	1	0	Value during error state	Volume	0	l	8 digit BCD	Type A - Integer BCD
02	FD 17	0	0	0	Instantaneous Value	Error Flags (binary)	0000000000000000		16 Bit Integer/Binary	Type D - Boolean
02	FD 74	0	0	0	Instantaneous Value	Remaining Battery Lifetime	5840	d	16 Bit Integer/Binary	Type B - Binary Integer

3. LoRaWAN Protocol

The following LoRa functionality which are part of the LoRa Alliance specification is stated to emphasize the requirement for LoRa compatibility in typical environments.

The device built-in radio is compliant with LoRa Alliance.

3.1 LoRa parameters

By default the meter operates in OTAA with the following parameters :

RECEIVE_DELAY1	1s
RECEIVE_DELAY2	2s (must be RECEIVE_DELAY1 + 1s)
JOIN_ACCEPT_DELAY1	5s
JOIN_ACCEPT_DELAY1	6s
MAX_FCNT_GAP	16384
ADR_ACK_LIMIT	64
ADR_ACK_DELAY	32
ACK_TIMEOUT 2	+- 1s (random delay between 1 and 3 seconds)

OTAA AppKey and NwkKey are unique for each device

3.2 Frame emission interval

Messages are emitted twice a day at 06.00 and 18.00 UTC. A randomization of emission time of 0 to 4 minute is done to avoid collisions.

3.3 Communication Key Management

Data required to register device on the network (in OTAA : dev_eui, app_key, in ABP : dev_eui, dev_addr, app_skey, nwk_skey) can be provided through Integra Metering Key Management System.

It allows secure transfer from manufacturer to customer and potential end user: keys can be claimed (and seen) only once by the final user or authority that will register the device.

3.4 Connection strategy

Communication mode is OTAA.

At each emission date, if the meter is not connected to network it will make a join attempt instead of transmitting a payload. Once connected the meter will send uplink frames.

No downlink is supported by meter.

Join can be triggered manually via ParamApp

3.5 OMS over LoraWAN

Telegram definition is the same as described in section §3.2 with the following deviations:

- Encryption mode is 0 (no encryption of telegram in the LoraWAN Payload)
- CRCs removed from telegram
- Payload :

Field name in OMS over LoRaWAN	Equivalent field in OMS
RECORD 1 (main volume)	RECORD 1
RECORD 2 (reverse volume)	RECORD 2
RECORD 3 (error indicator)	RECORD 6
RECORD 4 (remaining battery lifetime)	RECORD 7

3.6 WMBus telegram over LoRa

Standard telegram when the module is connected to the meter.

Names	Data	length (bytes)	Note
L-Field	variable	1	data length: LEN-1
C-Field	0x44	1	Send, no reply
M-Field	0xB425	2	manufacturer code
A-Field	variable	4	BCD Serial number Module
A-Field	0x05	1	version number module
A-Field	0x0E	1	device type = system component
CI-Field	0x72	1	Long Telegram
Ident. No.	variable	4	BCD Serial number Meter
M-Field	0xB425	2	manufacturer code
Meter-Version	0x01	1	Version number meter for Pulse configuration
	variable	1	Version number of connected M-Bus meter
meter-device type	0x0E	1	Component system

	variable		1	Type of connected M-Bus meter	
TN	variable		1	Telegram number	
status-field	variable		1	Status	
Configuration-field	0x0020		2		
Record	**DIF**	**DIFE1**	**VIF (depends on unit)**	**VIFE**	**Datatype**
(1) Main Volume	0x04	-	0x13 (liter), 0x16 (m^3) [3]	-	Int 32 bit
(2) Reverse volume	0x84	0x10	0x13 (liter)	-	Int 32 bit
(6) Info status (Error Flag)	0x02	-	0xFD	0x17	Int 16 bit
(7) Battery life	0x02	-	0xFD	0x74	Int 16 bit

[3] The VIF value depends on the configuration of the module.

3.7 Description of "Status Field" values in long Header

The following table details the different values for Alarm management.

Bit 0	Not used
Bit 1	Not used
Bit 2	Low batteries – 18 months before end of life
Bit 3	Not used
Bit 4	Not used
Bit 5	Leakage
Bit 6	Burst
Bit 7	Reverse flow

3.8 Description of "ErrorFlag" values in LoRaWAN payload

The following table details the different values for Alarm management.

Bit 0	Tamper
Bit 1	Not used
Bit 2	Burst
Bit 3	Leakage
Bit 4	Not used
Bit 5	Not used
Bit 6	Not used
Bit 7	No consumption
Bit 8	Low batteries – 18 months before end of life
Bit 9	Reverse flow
Bit 10	Overflow
Bit 11	Not used
Bit 12	Not used
Bit 13	Not used
Bit 14	Not used
Bit 15	Not used

3.9 Example of frames

2D44B42508000020050772050000000B4250507010000200413B0E105008410131F00000002FD17000002FD74C916

46 bytes C=44 A=08 CI=72 5 IMT 05 (aquastream) 07 (Water meter) Acc=xx Status=00 Signature=xxxx

DIF	VIF	Unit	StorageNr	Tariff	Function	Description	Value	Unit	Data	Type
04	13	0	0	0	Instanta...	Volume	385456	l	32Bit Integer/Binary	Type B - Binary Integer
84 10	13	0	0	1	Instanta...	Volume	31	l	32Bit Integer/Binary	Type B - Binary Integer
02	FD 17	0	0	0	Instanta...	Error Flags (binary)	0000000000000000		16 Bit Integer/Binary	Type D - Boolean
02	FD 74	0	0	0	Instanta...	Remaining Battery Lifetime	5833	d	16 Bit Integer/Binary	Type B - Binary Integer

4. Supported Media / Units

The different tables show all Units supported by the device for Water and Thermal Energy M-Bus reading.

4.1 Volume application

Volume units	VIF/DIF
1 liter	0x04 / 0x13
10 liters	0x04 / 0x14
100 liters	0x04 / 0x15
1 m3	0x04 / 0x16
10 m3	0x04 /
100 m3	0x04 /
1000 m3	0x04 /

4.2 Energy application

Volume units	VIF/DIF
1 Wh	0x03
10 Wh	0x04
100 Wh	0x05
1 KWh	0x06
0,001 MWh	0x06
10 kWh	0x07
100 kWh	0xFB, 0x00
1 MWh	0xFB, 0x01
1 kJ	0x0b
10 kJ	0x0c
100 kJ	0x0d
1 MJ	0x0e
1 kJ	0x0e
10 kJ	0x0f
100 kJ	0xFB, 0x08
1 GJ	0xFB, 0x09