MODBUS-RTU Data Format for Magnetic Flowmeter

(Model: LDG)

1 Basic Principle of the Bus Access

The Modbus is operating according to the Master/Slave – principle. Each bus is operated by exactly one Modbus Master which can exchange data with the other Modbus Slaves allocated to the bus. The number of Slaves to be operated on the bus is defined by the used physics of the bus.

With Modbus each action of the bus viewed follows the same pattern. Firstly the Master sends a **Query** which the Slave has to answer with a **Response**. Selection of the required Slave is realised by a unit address comprised in the Query and Response function. This address has to be allocated clearly to any Slave related to the bus. The Master in its turn has to know each of the unit addresses on the bus which it wants to contact.

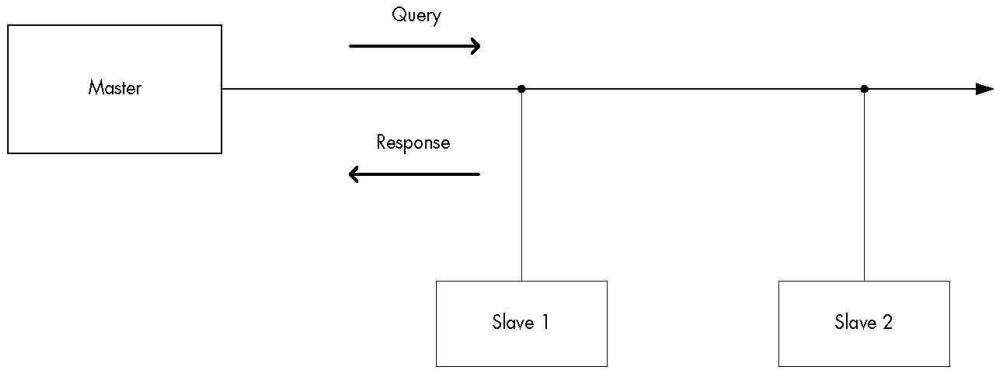

Figure 1.1: Basic pricicple of the bus access

2 Transmission Mode RTU

In the transmission mode "RTU" described hereunder, the appearance of each individual Byte to be transmitted is defined on the lowest logical level as follows :

2.1 Bit structure in the Byte:

A transmitted Byte is coded as:
8 Bit binary value, hexadecimal 0 - 9 and A - F.
The least significant Bit is sent and received first

All devices connected to the bus have to interpret each transmitted Byte analogously in this manner. Methods for an automatic recognition of baud rates are not assigned and hence the same baud rate must be used by the Master as well as all Slaves allocated to the bus. No specific baud rate is specified by the Modbus; typical baud rates are 9600 or 19200.

3 Telegram Frame

A Modbus telegram consists of the actual utilization information (data structure) which is to be transmitted between Master and Slave. This utilization information is supplemented by a function number and the unit address. A CRC check number, computed over the fields "slave address", "function number" and "data structure", is added as protection against transmission errors.

Telegram Frame as scheme:

For both data directions (Query and Response) the telegram frame is identical.

For the individual sections in the telegram frame the following applies :

3.1 Unit Address

Coding:	8 Bit binary value
Permissible unit addresses:	1 – 247
Broadcast Address:	0

3.2 Function Number

Coding:	8 Bit binary value
Permissible Codes:	1 – 255 (private codes, public codes and reserved codes)

3.3 Data Structure

Coding: binary
Interpretation of the information inside the data structure has to be coordinated between Master and Slave within the so called unit profile (not subject of this description) as also usual in other transmission protocols dependent on any specific function number. However, because the length of the data structure within the telegram frame is missing, in Modbus the frame recognition of the details concerning assignment between function number and the related data structure arranged within the unit profile between Master an Slave is of dependent nature.

3.4 CRC

Protection of the telegram is achieved by a Cyclical Redundancy Check (CRC) in form of a 16 Bit binary value. The least significant byte is sent and received prior to the higher significant byte. The CRC total is formed across the entire telegram and then appended at the end.

RTU Telegram Frame

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data 1	Data 0	CRC	CRC
8 Byte	8 Byte	8 Byte	8 Byte	8 Byte	8 Byte	8 Byte	8 Byte

4. Query Command

(1) Master Query Commend

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	03	0	00--35	0	1	XX	XX

(2) Slave Response

0	1	2	3	4	5	6
Slave Address	Function Number	Length	Data1	Data0	CRC	CRC
1~99	03	2	HIGH BYTE	LOW BYTE	XX	XX

5. Write Command

(1) Master Query Commend

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	06	0	00—35	HIGH BYTE	LOW BYTE	XX	XX

(2) Slave Response

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	06	0	00—35	HIGH BYTE	LOW BYTE	XX	XX

6. Query Flow rate, Flow velocity, Percentage, Empty Pipe Ratio, Alarm

(1) Master Query

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	04	0	0	0	5	XX	XX

(2) Slave Response

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Slave Address	Function Number	Byte Number	Hi-Byte of Flow Rate	Low-Byte of Flow rate	Unit Symbol	Hi-Byte of Velocity	Low-Byte of Velocity	Hi-Byte of Percentage	Low-Byte of Percentage	Hi-Byte of Empty Pipe	Low-Byte of Empty Pipe	Alarm State	crc	crc
1-99	04	10												

B7 of **Unit Symbol** is symbol for flow direction, B7 = 0 (Flow rate is Fwd Flow); B7 = 1 (Flow rate is Rev Flow)

B6B5B4 of Unit Symbol is decimal position:

B6B5B4 = 0 .00000 B6B5B4 = 1 0.0000 B6B5B4 = 2 00.000

B6B5B4 = 3 000.00 B6B5B4 = 4 0000.0 B6B5B4 = 5 00000.

B3B2B1B0 of Unit Symbol is Unit of flow rate:

B3B2B1B0 = 0 LTR / s B3B2B1B0 = 1 LTR / m B3B2B1B0 = 2 LTR / h

B3B2B1B0 = 3 M3 / s B3B2B1B0 = 4 M3 / m B3B2B1B0 = 5 M3 / h

B3B2B1B0 = 6 T / s B3B2B1B0 = 7 T / m B3B2B1B0 = 8 T / h

Flow velocity: XX．XXX m / s;

Percentage: XXX．XX ％;

Empty Pipe Ratio: XXXXX ％;

Alarm State:

B0 = 1 Upper Limit Alarm; B1 = 1 Low Limit Alarm;

B2 = 1 Empty Pipe Alarm; B3 = 1 System Alarm

7. Query **Total Flow**

(1) Master Query

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	04	0	5	0	5	XX	XX

(2) Slave Response

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Slave Address	Function Number	Byte Number	Fwd Total Flow 3	Fwd Total Flow 2	Fwd Total Flow 1	Fwd Total Flow 0	Rev Total Flow 3	Rev Total Flow 2	Rev Total Flow 1	Rev Total Flow 0	Total Flow Unit	Reserved	Crc	Crc
1-99	04	10										0		

Total Flow = Byte3 Byte2 Byte1 Byte0

Total Flow Unit = 00	000000.000 Ltr	Total Flow Unit = 01	0000000.00 Ltr
Total Flow Unit = 02	00000000.0 Ltr	Total Flow Unit = 03	000000000. Ltr
Total Flow Unit = 04	000000.000 M3	Total Flow Unit = 05	0000000.00 M3
Total Flow Unit = 06	00000000.0 M3	Total Flow Unit = 07	000000000. M3
Total Flow Unit = 08	000000.000 T	Total Flow Unit = 09	0000000.00 T
Total Flow Unit = 10	00000000.0 T	Total Flow Unit = 11	000000000. T

8. Query Fwd Flow Rate and Fwd Total Flow

(1) Master Query

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	04	0	10	0	4	XX	XX

(2) Slave Response

0	1	2	3	4	5	6	7	8	9	10	11	12
Slave Address	Function Number	Byte Number	Flow Rate	Flow Rate	Unit Symbol	Fwd Total Flow	Fwd Total Flow	Fwd Total Flow	Fwd Total Flow	Total Flow Unit	Crc	Crc
1-99	04	8										

8. Query Rev. (Reverse) Flow Rate and Rev (Reverse) Total Flow

(1) Master Query

0	1	2	3	4	5	6	7
Slave Address	Function Number	Register 1	Register 0	Data1	Data0	CRC	CRC
1~99	04	0	14	0	4	XX	XX

(2) Slave Response

0	1	2	3	4	5	6	7	8	9	10	11	12
Slave Address	Function Number	Byte Number	Flow Rate	Flow Rate	Unit Symbol	Rev Total Flow	Rev Total Flow	Rev Total Flow	Rev Total Flow	Total Flow Unit	Crc	Crc
1-99	04	8										

9. Register Address

PLC Addresses（Decimal）	**Protocol Addresses (HEX)**	**Data Format**	**Description**
4112	0x1010	Float Inverse	Flow Rate
4114	0x1012	Float Inverse	Flow Velocity
4116	0x1014	Float Inverse	Flow Percentage
4118	0x1016	Float Inverse	Fluid Conductivity
4120	0x1018	Long Inverse	Integer of Total Forward Flow
4122	0x101A	Float Inverse	Decimal of Total Forward Flow
4124	0x101C	Long Inverse	Integer of Total Reverse Flow
4126	0x101E	Float Inverse	Decimal of Total Reverse Flow
4128	0x1020	Unsigned short	Flow rate Unit
4129	0x1021	Unsigned short	Total Flow Rate
4131	0x1022	Unsigned short	Upper Limit Alarm
3413	0x1023	Unsigned short	Lower Limit Alarm