



GNM1 D

M-BUS COMMUNICATION PROTOCOL

Revision 0

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1.1 Introduction

The serial interface implemented in GNM1D models supports the M-Bus protocol. In this document only the information necessary to read Data Measurement from GNM1D has been reported (not all the parts of the protocol have been implemented).

1.2 M-BUS functions

The below reported functions are available on GNM1D:

- Single control character procedure SND_NKE
- Data Transfer (Request/Respond Procedure REQ/RSP)
- Reset function
- Switching Baudrate function
- Changing Primary Address
- Primary Data Request (SND_UD)

1.2.1 Single control character procedure SND_NKE

This procedure is useful to start up the communication either after a communication's interruption or just at the beginning of it. The master sends a Request Frame to Slave which responds with a single character (E5h) if it is correctly addressed. Therefore, SND_NKE is an initialization procedure.

It is necessary to use the SND_NKE function to initialize the Slave's answer with the first frame.

Request frame (From Master to Slave)

| Description | Length | Value | Note |
|--------------------------|--------|---------------------|---|
| Start | 1 byte | 10h | |
| Control | 1 byte | 40h | |
| Physical Address (Slave) | 1 byte | 1 to F7h (1 to 247) | |
| Check Sum | 1 byte | | Check Sum: is the arithmetical sum (without carry) of the Control Field and the Physical Address (Slave). |
| Stop | 1 byte | 16h | |

Response frame in case of correct action (From Slave to Master)

| Description | Length | Value | Note |
|-------------------|--------|-------|------|
| Confirm Character | 1 byte | E5h | |

After the reception of a valid telegram, the Slave has to wait before answering (see also EN13757-3), as shown in the Table below (three Slave BAUDRATEs are available).

| BAUD RATE | Min. | Max. |
|-----------|---------|----------|
| 300 BAUD | 36,6 ms | 1,15 s |
| 2400 BAUD | 4,6 ms | 187,5 ms |
| 9600 BAUD | 1,2 ms | 84,4 ms |

Response frame in case of incorrect action (From Slave to Master)

When a fault has been detected as a result of the checks (Start/Parity/stop bits per character, Start/Check Sum/Stop Character per telegram format), the transmission shall not be accepted and the reply shall not be sent by the slave to master. The master must interpret the lack of a reply as a fault or wrong address.

1.2.2 Request/Respond Procedure (REQ/RSP)

This procedure is requested from Master to Slave and typically generates the complete data transfer from Slave to Master according to Class 2, EN13757-3. All data are transferred through M-bus. The complete serial Slave Response take four Long Frames. If the Slave has been previously programmed through a Primary Data Request (SND_UD) then the Request/Respond Procedure (REQ/RSP) returns only the selected data.

| Long Frame | GNM1D |
|------------------------|--|
| #1 (transmitted first) | Energy Measurement – Instantaneous variables |
| #2 | Partial and Tariff meters |

The DIF byte contains the coding for each transmitted parameter (32-bit integer or 16-bit integer). VIF/VIFE bytes contain the measurement unit and its multiplier. There are three categories:

- Primary unit measurement
- Extended unit measurement
- User's measurement

Each Data measurement available in GNM1D is packed with its DIF, VIF, VIFE, Data field, this last contains the numerical representation of the measured value. VIFE is not present in case of Primary unit measurement. Transmission order is shown in Table 1. In the Data Field, the LSB is transmitted/received first.

Request frame (From Master to Slave) – REQ_UD2 → RSP_UD

| Description | Length | Value | Note |
|--------------------------|--------|---------------------|--|
| Start | 1 byte | 10h | |
| Control | 1 byte | 01FV1011b | F = FCB-Bit V = FCV-Bit (set to one if the FCB/FCV protocol is active) |
| Physical Address (Slave) | 1 byte | 1 to F7h (1 to 247) | |
| Check Sum | 1 byte | | Check Sum; is the arithmetical sum (without carry) of the Control Field and the Physical Address (Slave) |
| Stop | 1 byte | 16h | |

Response frame in case of correct action (From Slave to Master)

| Description | Length | Value | Note |
|--------------------------|-------------|---------------------|--|
| Start | 1 byte | 68h | |
| L Field | 1 byte | | L Field: is the bytes' number calculated starting from the Control Field up to the MDH Field (if the latter is present; otherwise up to the last byte of the Data User). |
| L Field | 1 byte | | See above. |
| Start | 1 byte | 68h | |
| Control | 1 byte | 08h | |
| Physical Address (Slave) | 1 byte | 1 to F7h (1 to 247) | |
| CI | 1 byte | 72h | |
| Ident. Nr. | 4 Byte | | |
| Manufr. | 2 Byte | 1C36h | "GAV", ID Manuf. according to EN60870 |
| Version | 1 Byte | | Read from GNM1D |
| Medium | 1 Byte | 02h | 02h = Electricity |
| Access No. | 1 Byte | | Incremented after each REQ_UD2 procedure |
| Status | 1 Byte | | |
| Signature | 2 Byte | 00h | It is always 00 for all |
| DIF | 1 byte | | Coding of the first transmitted value |
| DIFE | 1 byte | | Coding of sub-unit only (max #4 DIFE) |
| VIF | 1 byte | | Unit and Multiplier of the first transmitted value |
| VIFE | 1 byte | | Unit and Multiplier of the first transmitted value (optional) |
| Data | 2 or 4 byte | | First transmitted value (single measure) |
| ... | ... | ... | |
| MDH | 1 Byte | 1Fh | In the last Long Frame of the slave the questioned byte is 0Fh. The latter (0Fh) indicates that the slave has been completely read. |
| Check Sum | 1 byte | | Check Sum: is the arithmetical sum (without carry) starting from Control Field to the MDH Field (if present, otherwise the last Data byte) |
| Stop | 1 byte | 16h | |

NOTE: each transferred measurement requires: DIF, DIFE (optional), VIF, VIFE (optional) and Data (2 or 4 Byte).

See also Table 1

The device supports the **FCB/FCV-bit transfer protocol**. This mechanism is activated if the FCB-bit is set to one in the Request Frame generated by the Master, otherwise the mechanism is ignored by the Slave. The FCB/FCV protocol allows a safer transfer from Slave to Master when the Slave response has more than one Long Frame. After a SND_NKE Procedure, the Master transmits in the REQ_UD2 → RSP_UD a Control Field with FCB-bit set to one (Control Field = 7Bh) and the Slave will reply with the first Long Frame. If this data is correctly received from the Master, the Master itself will send to the Slave a new Request Frame with the FCB-bit cleared (Control Field = 5Bh), hence the Slave will send the next Long Frame. On the contrary, if the Master did not correctly receive the first Long Frame from the Slave, it can send to the Slave the Control Field = 7Bh another time, in this way the Slave will repeat the First Long Frame. The same is valid for the Second Long Frame. The last Long Frame transmitted by the Slave does not have the MDH Field, this absence has to be interpreted by the Master as the receipt of the last Long Frame from the Slave. After a SND_NKE procedure, the slave is always set on the first frame, even if the last transmitted frame was not the last.

“Version” Field, which is directly read from the device, gives the instrument version:

| “Version” Field (decimal) | Device |
|---------------------------|--------|
| 196 | GNM1D |

The meter supports the “secondary address” addressing and its research through the wild card. The latter corresponds to the nibble “Fh” and can substitute one BCD digit of the secondary address so that, during the slave’s selection, it can be ignored. It is so possible to address groups of slaves whose secondary address is the same except for the wild card. An appropriate algorithm allows the master to identify all slaves among those present in the network. The sub unit function allows to mark electrical variables with the same engineering unit (for example W, which engineering unit is Watt). The meter supports the sub-unit, give a look at Table 2.

1.2.3 Reset Function

This function code is used by the Master and resets the Slave. After a Reset, the FCB/FCV-bit mechanism is re-initialized. Also, a Primary Data Request is automatically de-selected.

Request frame

| Description | Length | Value | Note |
|--------------------------|--------|---------------------|---|
| Start | 1 byte | 68h | |
| L | 1 byte | 03h | |
| L | 1 byte | 03h | |
| Start | 1 byte | 68h | |
| Control | 1 byte | 53h or 73h | |
| Physical Address (Slave) | 1 byte | 1 to F7h (1 to 247) | |
| CI | 1 byte | 50h | Application Reset Code |
| Check Sum | 1 byte | | Check Sum: is the arithmetical sum (without carry) of Control Field, Physical Address (Slave) and CI-Field. |
| Stop | 1 byte | 16h | |

Response frame (correct action)

| Description | Length | Value | Note |
|-------------------|--------|-------|------|
| Confirm Character | 1 byte | E5h | |

1.2.4 Switching Baudrate Function

The Master can set the Slave’s Baud rate to a different value from 300 BAUD, 2400 and 9600 BAUDs are available (2400 is the default value). The Slave confirms the correctly received request by transmitting the E5h character and the old baudrate and uses the new baudrate from now on.

Request frame

| Description | Length | Value | Note |
|--------------------------|--------|---------------------|--|
| Start | 1 byte | 68h | |
| L | 1 byte | 03h | |
| L | 1 byte | 03h | |
| Start | 1 byte | 68h | |
| Control | 1 byte | 53h or 73h | |
| Physical Address (Slave) | 1 byte | 1 to F7h (1 to 247) | |
| CI | 1 byte | B8h/BBh/BDh | B8h = 300 BAUD, BBh = 2400 BAUD, BDh = 9600 BAUD |
| Check Sum | 1 byte | | Check Sum is the arithmetical sum (without carry) of Control Field, Physical Address (Slave) and CI-Field. |
| Stop | 1 byte | 16h | |

Response frame (correct action)

| Description | Length | Value | Note |
|-------------------|--------|-------|------|
| Confirm Character | 1 byte | E5h | |

1.2.5 Changing Primary Address

The Master can set the primary address of the Slave. The Slave confirms the correctly received request by transmitting the E5h character and uses the new address from now on.

Request frame

| Description | Length | Value | Note |
|------------------------------|--------|---------------------|--|
| Start | 1 byte | 68h | |
| L | 1 byte | 06h | |
| L | 1 byte | 06h | |
| Start | 1 byte | 68h | |
| Control | 1 byte | 53h or 73h | |
| Physical Address (Slave) | 1 byte | 1 to F7h (1 to 247) | |
| CI | 1 byte | 51h | |
| DIF | 1 byte | 01h | |
| VIF | 1 byte | 7Ah | |
| New Physical Address (Slave) | 1 byte | 1 to F7h (0 to 247) | |
| Check Sum | 1 byte | | Check Sum is the arithmetical sum (without carry) of Control Field, Physical Address (Slave) and CI-Field, DIF, VIF and New Physical Address (Slave) |
| Stop | 1 byte | 16h | |

Response frame (correct action)

| Description | Length | Value | Note |
|-------------------|--------|-------|------|
| Confirm Character | 1 byte | E5h | |

1.2.6 Primary Data Request (SND_UD)

The Master unit can acquire only a partition of all data stored in the energy meter GNM1D, by specifying the desired VIF, VIFE in a Primary Data Request procedure. It is possible to program the Slave in order to obtain one or more measurement up to 20. The slave confirms the request with the E5h character. From now onwards, each REQ_UD2 → RSP_UD shall generate the transfer of the only selected data instead of all Data Slave. For example, with 08h, FDh, 48h, the Master programs the Slave to obtain only the Volt*10 Data. With 08h, FFh, 03h only the Hz*10 measurement will be obtained. With the string : 08h, FDh, 48h, 08h, FFh, 03h both Volt*10 and Hz*10 are programmed. Note that the Data response is generated only starting from the next REQ_UD2 → RSP_UD. The Slave Response could take more than a Long Frame, in this case the FCB/FCV-bit Protocol should be activated from the Master.

Request frame (from Master to Slave)

| Description | Length | Value | Note |
|--------------------------------|--------|---------------------|---|
| Start | 1 byte | 68h | |
| L | 1 byte | | L Field is the number of byte calculated starting from the Control Field up to the last byte of the Data User. |
| L | 1 byte | | See above. |
| Start | 1 byte | 68h | |
| C | 1 byte | 53h or 73h | |
| Physical Address | 1 byte | 1 to F7h (1 to 247) | |
| CI | 1 byte | 51h | |
| Selector char | 1 byte | 08h | |
| Requested VIF #1 | 1 byte | | |
| Requested VIFE #1 (if present) | 1 byte | | |
| Selector char | 1 byte | 08h | |
| Requested VIF #2 | 1 byte | | |
| Requested VIFE #2 (if present) | 1 byte | | |
| ... | ... | ... | ... |
| Check Sum | 1 byte | | Check Sum is the arithmetical sum (without carry) starting from the Control Field until to the last requested VIF (or VIFE) |
| Stop | 1 byte | 16h | |

Response frame (correct action)

| Description | Length | Value | Note |
|-------------------|--------|-------|------|
| Confirm Character | 1 byte | E5h | |

1.2.7 Special Addresses

Primary test address = FEh is a test address, the slave always answers to the special address if no errors are present. The Slave answer contains its own Primary Address. The address FEh is normally used for point to point communication.

Primary broadcast address = FFh is a broadcast address, the slave executes the request received from the Master without generating any response on the M-Bus. Used by master for SND_NKE and Reset function

Address =FDh it is used by the master when questioning slaves using the secondary address instead of the primary address.

2 TABLES

2.1 Data format representation In GARO instruments

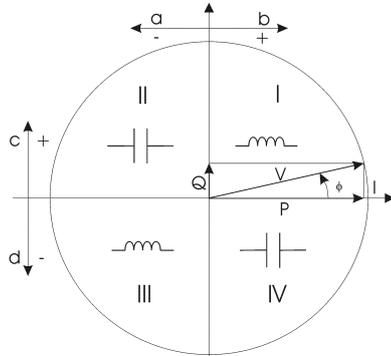
The variables are represented by integers or floating numbers, with 2's complement notation in case of "signed" format, using the following:

| Format | IEC data type | Description | Bits | Range |
|------------|---------------|---------------------------------|------|--|
| INT16 | INT | Integer | 16 | -32768 .. 32767 |
| UINT16 | UINT | Unsigned integer | 16 | 0 .. 65535 |
| INT32 | DINT | Double integer | 32 | $-2^{31} .. 2^{31}$ |
| UINT32 | UDINT | Unsigned double int | 32 | 0 .. $2^{32}-1$ |
| UINT64 | ULINT | Unsigned long integer | 64 | 0 .. $2^{64}-1$ |
| IEEE754 SP | | Single-precision floating-point | 32 | $-(1+[1 - 2^{-23}]) \times 2^{127} .. 2^{128}$ |

For all the formats the M-Bus byte order always is LSB->MSB (the LSB is transmitted/received first), as described in EN 60870-5-4 standard.

2.2 Geometric representation

According to the signs of the power factor, the active power P and the reactive power Q, it is possible to obtain a geometric representation of the power vector, as indicated in the drawing below, according to EN 60253-23:



- a = Exported active power
- b = Imported active power
- c = Imported reactive power
- d = Exported reactive power

Fig. 1 : Geometric Representation

According to the measurement mode (easy connection or bidirectional), the following sign convention is used in GNM1D SERIES.

- Easy connection mode
 - o I always >0
 - o P always >0
 - o kWh always increasing (MID version, GNM1D version)
 - o **kvarh increases only when Q>0**
 - o PF only with C and L (without sign) indication

| Application | Real measurement | Displayed values | Displayed energies | Notes |
|----------------------|------------------|------------------|---|----------------------------------|
| Easy connection mode | Quadrant I | A, W, var, L PF | kWh increases, kvarh increases | Measurement A or MID model GNM1D |
| | Quadrant II | A, W, -var, C PF | kWh increases, kvarh does not increase | Measurement A or MID model GNM1D |
| | Quadrant III | A, W, var, L PF | kWh increases, kvarh increases | Measurement A or MID model GNM1D |
| | Quadrant IV | A, W, -var, C PF | kWh increases, kvarh does not increase | Measurement A or MID model GNM1D |

2.3 Maximum and minimum electrical values

The maximum electrical input values are reported in the following table. If the input is above the maximum value the display shows “EEE”.

Table 2.3-1 – GNM1D (MID and non MID versions)

| | Max value | Min value |
|------|------------------|------------------|
| VL-N | 299V | 0 |
| A | 54A | 0 |

The overflow indication “EEE” is displayed when the MSB value of the relevant variable is 7FFFh.
The overflow indication “-EEE” is displayed when the MSB value of the relevant variable is 8000h.

2.4 Instantaneous variables and meters

Table 1 – GNM1D

| Length (byte) | VARIABLE ENG. UNIT | Data Format | Notes | #SUB UNIT | VIF byte | VIFE byte |
|-------------------------------------|-----------------------|----------------|---|--------------|-------------|--------------|
| FRAME #1 (transmitted first) | | | | | | |
| 4 | KWh (+) TOT | INT32 | Engineering unit: Wh*100 | 0 | 1 | - |
| 4 | Kvarh (+) TOT | INT32 | Engineering unit: kVarh*0,1 | 0 | 1 | 2 |
| 4 | W | INT32 | Engineering unit: Watt*0,1 | 0 | 1 | - |
| 4 | VAR | INT32 | Engineering unit: kVar*0.0001 | 0 | 1 | 2 |
| 4 | VA | INT32 | Engineering unit: kVA*0.0001 | 0 | 1 | 2 |
| 4 | A L | INT32 | Engineering unit: Ampere *0.001 | 0 | 1 | 1 |
| 4 | V L-N | INT32 | Engineering unit: Volt *0,1 | 0 | 1 | 1 |
| 2 | PF | INT16 | Negative values correspond to exported active power, positive values correspond to imported active power. Engineering unit: PF*0.001 | 0 | 1 | 2 |
| 2 | Hz | INT16 | Engineering unit: Hz*0.1 | 0 | 1 | 1 |
| FRAME #2 | | | | | | |
| 4 | DMD W | INT32 | Engineering unit: Watt*0.1 | 1 | 1 | - |
| 4 | DMD W max | INT32 | Engineering unit: Watt*0.1 | 2 | 1 | - |
| 4 | KWh (+) PAR | INT32 | Engineering unit: Wh*100 | 1 | 1 | - |
| 4 | Kvarh (+) PAR | INT32 | Engineering unit: kVarh*0,1 | 1 | 1 | 2 |
| 4 | KWh (+) tariff 1 | INT32 | Engineering unit: Wh*100 | 3 | 1 | - |
| 4 | KWh (+) tariff 2 | INT32 | Engineering unit: Wh*100 | 4 | 1 | - |
| FRAME #3 | | | | | | |
| 4 | KWh (-) TOT | INT32 | Engineering unit: Wh*100 | 2 | 1 | - |
| 4 | Kvarh (-) TOT | INT32 | Engineering unit: kVarh*0,1 | 2 | 1 | 2 |

Table 2 – GNM1D M-Bus Measurement Unit Coding (VIF/VIFE).

| Measurement Unit | VIF | VIFE #1 | VIFE #2 | |
|----------------------------|-----------------|------------------|-----------------|---|
| Watt*0.1 | 00101010b = 2Ah | - | - | PRIMARY M-BUS CODES |
| Wh*100 | 00000101b = 05h | - | - | |
| Hour*0.01 (operating time) | 10100110b = A6h | 01110100b = 74h | - | |
| Volt*0.1 | 11111101b = FDh | 01001000b = 48h | - | EXTENSION OF PRIMARY M-BUS CODES |
| Ampere * 0.001 | 11111101b = FDh | 01011001b = 59h | - | |
| PF*0.001 (dimensionless) | 11111101b = FDh | 10111010b = BAh | 01110011b = 73h | |
| Hz * 0.1 | 11111011b = FBh | 00101110b = 2Eh | - | |
| Kvarh * 0.1 | 11111011b = FBh | 100000010b = 82h | 01110101b = 75h | |
| Kvar * 0.0001 | 11111011b = FBh | 10010111b = 97h | 01110010b = 72h | |
| kVA * 0.0001 | 11111011b = FBh | 10110111b = B7h | 01110010b = 72h | |

Colours:



= Primary M-Bus Codes



= Extension of Primary M-Bus Codes



= Manufacturer-Specific