VMUBM2US1B1A

M-BUS COMMUNICATION PROTOCOL

Version 0 Revision 0

February 13th, 2017

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1.1 Introduction

The RS485 serial interface supports the M-BUS protocol. In this document only the information necessary to read Data Measurement from VMUBM2US1B1A is reported (not all the parts of the protocol have been implemented). VMUBM2US1B1A manages EM210 and EM26 energy analyzer series.
Set the RS485 Modbus communication parameters of EM210 and EM26 to 9600 bps and “none” parity to successfully communicate with VMUBM2US1B1A.

1.2 M-BUS functions

The below reported functions are available in VMUBM2US1B1A:

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

1.2.1 Single control character procedure SND_NKE

The questioned procedure is useful to start up the communication either after a communication 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 between before answering, as shown in the table below (three Slave BAUDRATEs are available).

BAUD RATE	Min.	Max.	EM2xx
300 BAUD	36,6 ms	1,15 s	50 ms
2400 BAUD	4,6 ms	187,5 ms	50 ms
9600 BAUD	1,2 ms	84,4 ms	50 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 will not be accepted and the reply will 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, EN 13757. All data are transferred through M-bus. The complete serial Slave Response (taking up maximum 11 Long Frames) depends on the THD enabling management in EM210 and on the set application in EM26. If the meter connected to VMUB is recognized but not managed, only one frame is sent (see column "OTHER" in the table below). 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	EM210 with THD management enabled	EM210 with THD management disabled	EM210 without THD management	EM26 with digital input counters and tariff management enabled	EM26 without digital input counters and tariff management disabled	OTHER
#1 (transmitted first)	Energy and System Powers Measurement	Energy and System Powers Measurement	Energy and System Powers Measurement	Energy and System Powers Measurement	Energy and System Powers Measurement	Error Flags and VMUB Firmware Revision
#2	System Voltage, Current and Frequency Measurement	System Voltage, Current and Frequency Measurement	System Voltage, Current and Frequency Measurement	System Voltage, Current and Frequency Measurement	System Voltage, Current and Frequency Measurement	*Not present*
#3	Phase Active and Reactive Powers Measurement	Phase Active and Reactive Powers Measurement	Phase Active and Reactive Powers Measurement	Phase Active and Reactive Powers Measurement	Phase Active and Reactive Powers Measurement	*Not present*
#4	Phase Apparent Power and Phase Power Factors Measurement	Phase Apparent Power and Phase Power Factors Measurement	Phase Apparent Power and Phase Power Factors Measurement	Phase Apparent Power and Phase Power Factors Measurement	Phase Apparent Power and Phase Power Factors Measurement	*Not present*
#5	Phase Voltage Measurement	Phase Voltage Measurement	Phase Voltage Measurement	Phase Voltage Measurement	Phase Voltage Measurement	*Not present*
#6	Run Hour Counters, Neutral Current and Current THD Measurement	Run Hour Counters, Neutral Current Measurement	Error Flags and VMUB Firmware Revision	Partial Energy and Phase Energy Measurement	Partial Energy and Phase Energy Measurement	*Not present*
#7	Voltage THD Measurement	Error Flags and VMUB Firmware Revision	*Not present*	DMD Powers and Run Hour Counter Measurement	DMD Powers and Run Hour Counter Measurement	*Not present*
#8	Error Flags and VMUB Firmware Revision	*Not present*	*Not present*	THD Measurement	THD Measurement	*Not present*
#9	*Not present*	*Not present*	*Not present*	Active Power Tariff Counters and digital Input counters Measurement	Error Flags and VMUB Firmware Revision	*Not present*
#10	*Not present*	*Not present*	*Not present*	Reactive Power Tariff Counters Measurement	*Not present*	*Not present*
#11	*Not present*	*Not present*	*Not present*	Error Flags and VMUB Firmware Revision	*Not present*	*Not present*

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. VMUBM2US1B1A uses two categories of VIF:

- Primary unit measurement
- Extended unit measurement

Each Data measurement available in the VMUBM2US1B1A 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. 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 number of bytes 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 EM2xx
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, Table 2, Table 3, Table 4 and Table 5

The device supports the **FCB/FCV-bit transfer protocol**. This mechanism is activated if the FCV-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. Conversely, 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.

The “Version” Field, which is directly read from the device, gives the instrument version through a specific identification code:

C. Gavazzi’s ID [DEC]	“Version” Field [HEX]	Device
78	4E	EM26-96 (AV5 model)
79	4F	EM26-96 (AV6 model)
210	D2	EM21072D (X and PF models)
211	D3	EM21072V

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 addresses are the same except for the wild card. An appropriate algorithm allows the master to identify all slaves among the ones present in the network.
The sub unit function allows marking electrical variables with the same engineering unit (for example: Wsys, WL1, WL2 and WL3 whose engineering unit is Watt). The meter supports the sub-unit. See Table 1, Table 2, Table 3, Table 4 and Table 5.

1.2.3 Reset Function

This function code is used by the Master and to reset 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 Baud rate to a different value. 300, 2400 and 9600 BAUDs are available. The Slave confirms the correct received request by transmitting the E5h character with 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 Primary Data Request (SND_UD)

The Master unit can acquire only a partition of all data stored in the energy analyzers (EM210, EM26) 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. The slave confirms the request with the E5h character. From now on, each REQ_UD2 → RSP_UD will 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, 2Ah, only the Watt*10 measures will be obtained. With the string : 08h, FDh, 48h, 08h, 2Ah, all Volt*10 and Watt*10 measures 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 VIF1 #1	1 byte		See Table 8
Requested VIFE1 #1 (if present)	1 byte		
Requested VIFE1 #2 (if present)	1 byte		
Selector char	1 byte	08h	
Requested VIF2 #1	1 byte		See Table 8
Requested VIFE2 #1 (if present)	1 byte		
Requested VIFE2 #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	

1.2.6 Special Addresses

Primary test address = FEh is a test address, the slave always answers to the special address if no error is 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. VMUBM2US1B1A supports broadcast address only for SND_NKE command.

Address = FDh 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 Carlo Gavazzi instruments

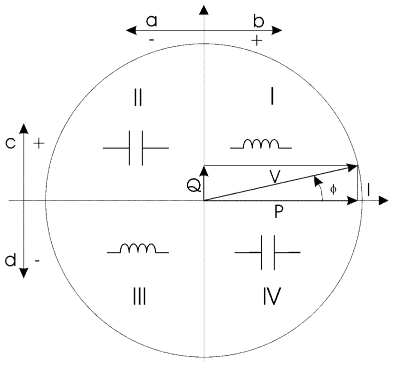
The variables are represented by integers or floating numbers, with 2's complement notation in case of "signed" format, using the following:

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	$-(1+[1\ -2^{-23}])x2^{127}$ .. 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.

2.1.1 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

2.2 Maximum and minimum electrical values

The maximum electrical input values are reported in relevant electrical data sheet. If the input is above the maximum value the display shows "EEE".

The overflow indication "EEE" is displayed when the MSB value of the relevant variable is 7FFFh.

2.3 Instantaneous variables and totalizers

(X = available)

2.3.1 Table 1 – Instantaneous variables and totalizers of EM210 with THD measuring managed and enabled

Length (byte)	VARIABLE ENG. UNIT	EM21072D (NON MID)	EM21072V	Data Format	Notes	#SUB UNIT	VIF byte	VIFE byte
FRAME #1 (transmitted first)								
4	KWh (+) TOT	X	X	INT32	Engineering unit: Wh*100	0	1	-
4	Kvarh (+) TOT	X	X	INT32	Engineering unit: kVarh*0,1	0	1	2
4	KWh (-) TOT	X	X	INT32	Engineering unit: Wh*100	5	1	-
4	W ∑	X	X	INT32	Engineering unit: Watt*0.1	0	1	-
4	VAR ∑	X	X	INT32	Engineering unit: kVar*0.0001	0	1	2
4	VA ∑	X	X	INT32	Engineering unit: kVA*0.0001	0	1	2
2	PF ∑	X	X	INT16	Negative values correspond to exported active power; positive values correspond to imported active power. Engineering unit: dimensionless *0.001	0	1	2
FRAME #2								
4	V L-L ∑	X	X	INT32		4	1	1
4	V L-N ∑	X	X	INT32	Engineering unit: Volt*0.1	0	1	1
4	A L1	X	X	INT32		1	1	1
4	A L2	X	X	INT32	Engineering unit: Ampere*0.001	2	1	1
4	A L3	X	X	INT32		3	1	1
4	Hz	X	X	INT32	Engineering unit: Hz	0	1	1
FRAME #3								
4	W L1	X	X	INT32		1	1	-
4	W L2	X	X	INT32	Engineering unit: Watt*0.1	2	1	-
4	W L3	X	X	INT32		3	1	-
4	VAR L1	X	X	INT32		1	1	2
4	VAR L2	X	X	INT32	Engineering unit: kVar*0.0001	2	1	2
4	VAR L3	X	X	INT32		3	1	2
FRAME #4								
4	VA L1	X	X	INT32		1	1	2
4	VA L2	X	X	INT32	Engineering unit: kVA*0.0001	2	1	2
4	VA L3	X	X	INT32		3	1	2
2	PF L1	X	X	INT16	Negative values correspond to exported active power; positive values correspond to imported active power. dimensionless*0.001	1	1	2
2	PF L2	X	X	INT16		2	1	2
2	PF L3	X	X	INT16		3	1	2
FRAME #5								
4	V L1-L2	X	X	INT32		5	1	1
4	V L2-L3	X	X	INT32	Engineering unit: Volt*0.1	6	1	1
4	V L3-L1	X	X	INT32		7	1	1
4	V L1-N	X	X	INT32		1	1	1
4	V L2-N	X	X	INT32	Engineering unit: Volt*0.1	2	1	1
4	V L3-N	X	X	INT32		3	1	1
FRAME #6								
4	Run Hour + (if pos. power)	X	X	INT32	Engineering unit: Hour*0.01	0	1	1
4	Run Hour – (if neg. power)	X	X	INT32	Engineering unit: Hour*0.01	1	1	1
4	An	X	X	INT32	Engineering unit: Ampere*0.001	4	1	1
4	THD A1	X	X	INT32	Engineering unit: dimensionless * 0.01	1	1	2
4	THD A2	X	X	INT32	Engineering unit: dimensionless * 0.01	2	1	2
4	THD A3	X	X	INT32	Engineering unit: dimensionless * 0.01	3	1	2
FRAME #7								
4	THD VL1-N	X	X	INT32	Engineering unit: dimensionless * 0.01	4	1	2
4	THD VL2-N	X	X	INT32	Engineering unit: dimensionless * 0.01	5	1	2
4	THD VL3-N	X	X	INT32	Engineering unit: dimensionless * 0.01	6	1	2

4	THD VL1-L2	X	X	INT32	Engineering unit: dimensionless * 0.01	7	1	2
4	THD VL2-L3	X	X	INT32	Engineering unit: dimensionless * 0.01	8	1	2
4	THD VL3-L1	X	X	INT32	Engineering unit: dimensionless * 0.01	9	1	2
				FRAME #8				
2	Error flags	X	X	INT16	Error flags	0	1	1
4	VMUB firmware version	X	X	BCD		0	1	1

2.3.2 Table 2 – Instantaneous variables and totalizers of EM210 with THD measuring managed but not enabled

Length (byte)	VARIABLE ENG. UNIT	EM21072D	EM21072V	Data Format	Notes	#SUB UNIT	VIF byte	VIFE byte
				FRAME #1 (transmitted first)				
4	KWh (+) TOT	X	X	INT32	Engineering unit: Wh*100	0	1	-
4	Kvarh (+) TOT	X	X	INT32	Engineering unit: kVarh*0,1	0	1	2
4	KWh (-) TOT	X	X	INT32	Engineering unit: Wh*100	5	1	-
4	W ∑	X	X	INT32	Engineering unit: Watt*0.1	0	1	-
4	VAR ∑	X	X	INT32	Engineering unit: kVar*0.0001	0	1	2
4	VA ∑	X	X	INT32	Engineering unit: kVA*0.0001	0	1	2
2	PF ∑	X	X	INT16	Negative values correspond to exported active power; positive values correspond to imported active power. Engineering unit: dimensionless *0.001	0	1	2
				FRAME #2				
4	V L-L ∑	X	X	INT32	Engineering unit: Volt*0.1	4	1	1
4	V L-N ∑	X	X	INT32		0	1	1
4	A L1	X	X	INT32	Engineering unit: Ampere*0.001	1	1	1
4	A L2	X	X	INT32		2	1	1
4	A L3	X	X	INT32		3	1	1
4	Hz	X	X	INT32	Engineering unit: Hz	0	1	1
				FRAME #3				
4	W L1	X	X	INT32	Engineering unit: Watt*0.1	1	1	-
4	W L2	X	X	INT32		2	1	-
4	W L3	X	X	INT32		3	1	-
4	VAR L1	X	X	INT32	Engineering unit: kVar*0.0001	1	1	2
4	VAR L2	X	X	INT32		2	1	2
4	VAR L3	X	X	INT32		3	1	2
				FRAME #4				
4	VA L1	X	X	INT32	Engineering unit: kVA*0.0001	1	1	2
4	VA L2	X	X	INT32		2	1	2
4	VA L3	X	X	INT32		3	1	2
2	PF L1	X	X	INT16	Negative values correspond to exported active power; positive values correspond to imported active power. Engineering unit: dimensionless *0.001	1	1	2
2	PF L2	X	X	INT16		2	1	2
2	PF L3	X	X	INT16		3	1	2
				FRAME #5				
4	V L1-L2	X	X	INT32	Engineering unit: Volt*0.1	5	1	1
4	V L2-L3	X	X	INT32		6	1	1
4	V L3-L1	X	X	INT32		7	1	1
4	V L1-N	X	X	INT32	Engineering unit: Volt*0.1	1	1	1
4	V L2-N	X	X	INT32		2	1	1
4	V L3-N	X	X	INT32		3	1	1
				FRAME #6				
4	Run Hour + (if pos. power)	X	X	INT32	Engineering unit: Hour*0.01	0	1	1
4	Run Hour – (if neg. power)	X	X	INT32	Engineering unit: Hour*0.01	1	1	1
4	An	X	X	INT32	Engineering unit: Ampere*0.001	4	1	1
				FRAME #7				
2	Error flags	X	X	INT16	Error flags	0	1	1
4	VMUB firmware version	X	X	BCD		0	1	1

2.3.3 Table 3 - Instantaneous variables and totalizers of EM210 with THD measuring not managed

Length (byte)	VARIABLE ENG. UNIT	EM21072D	EM21072V	Data Format	Notes	#SUB UNIT	VIF byte	VIFE byte
FRAME #1 (transmitted first)								
4	KWh (+) TOT	X	X	INT32	Engineering unit: Wh*100	0	1	-
4	Kvarh (+) TOT	X	X	INT32	Engineering unit: kVarh*0,1	0	1	2
4	KWh (-) TOT	X	X	INT32	Engineering unit: Wh*100	5	1	-
4	W ∑	X	X	INT32	Engineering unit: Watt*0.1	0	1	-
4	VAR ∑	X	X	INT32	Engineering unit: kVar*0.0001	0	1	2
4	VA ∑	X	X	INT32	Engineering unit: kVA*0.0001	0	1	2
2	PF ∑	X	X	INT16	Negative values correspond to exported active power; positive values correspond to imported active power. Engineering unit: dimensionless *0.001	0	1	2
FRAME #2								
4	V L-L ∑	X	X	INT32	Engineering unit: Volt*0.1	4	1	1
4	V L-N ∑	X	X	INT32		0	1	1
4	A L1	X	X	INT32	Engineering unit: Ampere*0.001	1	1	1
4	A L2	X	X	INT32		2	1	1
4	A L3	X	X	INT32		3	1	1
4	Hz	X	X	INT32	Engineering unit: Hz	0	1	1
FRAME #3								
4	W L1	X	X	INT32	Engineering unit: Watt*0.1	1	1	-
4	W L2	X	X	INT32		2	1	-
4	W L3	X	X	INT32		3	1	-
4	VAR L1	X	X	INT32	Engineering unit: kVar*0.0001	1	1	2
4	VAR L2	X	X	INT32		2	1	2
4	VAR L3	X	X	INT32		3	1	2
FRAME #4								
4	VA L1	X	X	INT32	Engineering unit: kVA*0.0001	1	1	2
4	VA L2	X	X	INT32		2	1	2
4	VA L3	X	X	INT32		3	1	2
2	PF L1	X	X	INT16	Negative values correspond to exported active power; positive values correspond to imported active power. Engineering unit: dimensionless *0.001	1	1	2
2	PF L2	X	X	INT16		2	1	2
2	PF L3	X	X	INT16		3	1	2
FRAME #5								
4	V L1-L2	X	X	INT32	Engineering unit: Volt*0.1	5	1	1
4	V L2-L3	X	X	INT32		6	1	1
4	V L3-L1	X	X	INT32		7	1	1
4	V L1-N	X	X	INT32	Engineering unit: Volt*0.1	1	1	1
4	V L2-N	X	X	INT32		2	1	1
4	V L3-N	X	X	INT32		3	1	1
FRAME #6								
2	Error flags	X	X	INT16	Error flags	0	1	1
4	VMUB firmware version	X	X	BCD		0	1	1

2.3.4 Table 4 – Instantaneous variables and totalizers of EM26 set to application “C”, “F”, “G” or “H”

Length (byte)	VARIABLE ENG. UNIT	EM26	Data Format	Notes	#SUB UNIT	VIF byte	VIFE byte
FRAME #1 (transmitted first)							
4	KWh (+) TOT	X	INT32	Engineering unit: Wh*100	0	1	-
4	Kvarh (+) TOT	X	INT32	Engineering unit: kVarh*0,1	0	1	2
4	KWh (-) TOT	X	INT32	Engineering unit: Wh*100	5	1	-
4	Kvarh (-) TOT	X	INT32	Engineering unit: kVarh*0,1	5	1	2
4	W ∑	X	INT32	Engineering unit: Watt*0.1	0	1	-
4	VAR ∑	X	INT32	Engineering unit: kVar*0.0001	0	1	2
4	VA ∑	X	INT32	Engineering unit: kVA*0.0001	0	1	2
2	PF ∑	X	INT16	Negative values correspond to lead (C), positive value correspond to lag (L). Engineering unit: dimensionless*0.001	0	1	2
FRAME #2							
4	V L-L ∑	X	INT32	Engineering unit: Volt*0.1	4	1	1
4	V L-N ∑	X	INT32		0	1	1

4	A L1	X	INT32		1	1	1
4	A L2	X	INT32	Engineering unit: Ampere*0.001	2	1	1
4	A L3	X	INT32		3	1	1
2	Hz	X	INT16	Engineering unit: Hz*0.1	0	1	1
			FRAME #3				
4	W L1	X	INT32		1	1	-
4	W L2	X	INT32	Engineering unit: Watt*0.1	2	1	-
4	W L3	X	INT32		3	1	-
4	VAR L1	X	INT32		1	1	2
4	VAR L2	X	INT32	Engineering unit: kVar*0.0001	2	1	2
4	VAR L3	X	INT32		3	1	2
			FRAME #4				
4	VA L1	X	INT32		1	1	2
4	VA L2	X	INT32	Engineering unit: kVA*0.0001	2	1	2
4	VA L3	X	INT32		3	1	2
2	PF L1	X	INT16	Negative values correspond to lead (C), positive value correspond to lag (L). Engineering unit: dimensionless*0.001	1	1	2
2	PF L2	X	INT16		2	1	2
2	PF L3	X	INT16		3	1	2
			FRAME #5				
4	V L1-L2	X	INT32		5	1	1
4	V L2-L3	X	INT32	Engineering unit: Volt*0.1	6	1	1
4	V L3-L1	X	INT32		7	1	1
4	V L1-N	X	INT32		1	1	1
4	V L2-N	X	INT32	Engineering unit: Volt*0.1	2	1	1
4	V L3-N	X	INT32		3	1	1
			FRAME #6				
4	KWh (+) PAR	X	INT32	Engineering unit: Wh*100	4	1	-
4	Kvarh (+) PAR	X	INT32	Engineering unit: kVarh*0,1	4	1	2
4	KWh (+) L1	X	INT32	Engineering unit: Wh*100	1	1	-
4	KWh (+) L2	X	INT32	Engineering unit: Wh*100	2	1	-
4	KWh (+) L3	X	INT32	Engineering unit: Wh*100	3	1	-
			FRAME #7				
4	DMD W ∑	X	INT32	Engineering unit: Watt*0.1	4	1	-
4	DMD W ∑ max	X	INT32	Engineering unit: Watt*0.1	5	1	-
4	DMD VA ∑	X	INT32	Engineering unit: kVA*0.0001	4	1	2
4	DMD VA ∑ max	X	INT32	Engineering unit: kVA*0.0001	5	1	2
4	DMD A max	X	INT32	Engineering unit: Ampere*0.001	4	1	1
4	Run Hour (if pos. or neg power)	X	INT32	Engineering unit: Hour*0.01	2	1	1
			FRAME #8				
2	THD A1	X	INT16	Engineering unit: dimensionless * 0.1	1	1	2
2	THD A2	X	INT16	Engineering unit: dimensionless * 0.1	2	1	2
2	THD A3	X	INT16	Engineering unit: dimensionless * 0.1	3	1	2
2	THD VL1-N	X	INT16	Engineering unit: dimensionless * 0.1	4	1	2
2	THD VL2-N	X	INT16	Engineering unit: dimensionless * 0.1	5	1	2
2	THD VL3-N	X	INT16	Engineering unit: dimensionless * 0.1	6	1	2
2	THD VL1-L2	X	INT16	Engineering unit: dimensionless * 0.1	7	1	2
2	THD VL2-L3	X	INT16	Engineering unit: dimensionless * 0.1	8	1	2
2	THD VL3-L1	X	INT16	Engineering unit: dimensionless * 0.1	9	1	2
			FRAME #9				
4	KWh (+) T1	X	INT32	Engineering unit: Wh*100	6	1	-
4	KWh (+) T2	X	INT32	Engineering unit: Wh*100	7	1	-
4	KWh (+) T3	X	INT32	Engineering unit: Wh*100	8	1	-
4	KWh (+) T4	X	INT32	Engineering unit: Wh*100	9	1	-
4	Counter 1	X	INT32	Engineering unit: Cumulation counter (*)	0	1	2
4	Counter 2	X	INT32	Engineering unit: Cumulation counter (*)	1	1	2
4	Counter 3	X	INT32	Engineering unit: Cumulation counter (*)	2	1	2
			FRAME #10				
4	Kvarh (+) T1	X	INT32	Engineering unit: kVarh*0,1	6	1	2
4	Kvarh (+) T2	X	INT32	Engineering unit: kVarh*0,1	7	1	2
4	Kvarh (+) T3	X	INT32	Engineering unit: kVarh*0,1	8	1	2
4	Kvarh (+) T4	X	INT32	Engineering unit: kVarh*0,1	9	1	2
			FRAME #11				
2	Error flags	X	INT16	Error flags	0	1	1

4	VMUB firmware version	X	BCD		0	1	1

(*): Engineering unit could be *0.1, *0.01 or *0.001 depending on counter configuration

2.3.5 Table 5 - Instantaneous variables and totalizers of EM26 set to application "A", "B", "D" or "E"

Length (byte)	VARIABLE ENG. UNIT	EM26	Data Format	Notes	#SUB UNIT	VIF byte	VIFE byte
			FRAME #1 (transmitted first)				
4	KWh (+) TOT	X	INT32	Engineering unit: Wh*100	0	1	-
4	Kvarh (+) TOT	X	INT32	Engineering unit: kVarh*0,1	0	1	2
4	KWh (-) TOT	X	INT32	Engineering unit: Wh*100	5	1	-
4	Kvarh (-) TOT	X	INT32	Engineering unit: kVarh*0,1	5	1	2
4	W ∑	X	INT32	Engineering unit: Watt*0.1	0	1	-
4	VAR ∑	X	INT32	Engineering unit: kVar*0.0001	0	1	2
4	VA ∑	X	INT32	Engineering unit: kVA*0.0001	0	1	2
2	PF ∑	X	INT16	Negative values correspond to lead (C), positive value correspond to lag (L). Engineering unit: dimensionless*0.001	0	1	2
			FRAME #2				
4	V L-L ∑	X	INT32	Engineering unit: Volt*0.1	4	1	1
4	V L-N ∑	X	INT32		0	1	1
4	A L1	X	INT32	Engineering unit: Ampere*0.001	1	1	1
4	A L2	X	INT32		2	1	1
4	A L3	X	INT32		3	1	1
2	Hz	X	INT16	Engineering unit: Hz*0.1	0	1	1
			FRAME #3				
4	W L1	X	INT32	Engineering unit: Watt*0.1	1	1	-
4	W L2	X	INT32		2	1	-
4	W L3	X	INT32		3	1	-
4	VAR L1	X	INT32	Engineering unit: kVar*0.0001	1	1	2
4	VAR L2	X	INT32		2	1	2
4	VAR L3	X	INT32		3	1	2
			FRAME #4				
4	VA L1	X	INT32	Engineering unit: kVA*0.0001	1	1	2
4	VA L2	X	INT32		2	1	2
4	VA L3	X	INT32		3	1	2
2	PF L1	X	INT16	Negative values correspond to lead (C), positive value correspond to lag (L). Engineering unit: dimensionless*0.001	1	1	2
2	PF L2	X	INT16		2	1	2
2	PF L3	X	INT16		3	1	2
			FRAME #5				
4	V L1-L2	X	INT32	Engineering unit: Volt*0.1	5	1	1
4	V L2-L3	X	INT32		6	1	1
4	V L3-L1	X	INT32		7	1	1
4	V L1-N	X	INT32	Engineering unit: Volt*0.1	1	1	1
4	V L2-N	X	INT32		2	1	1
4	V L3-N	X	INT32		3	1	1
			FRAME #6				
4	KWh (+) PAR	X	INT32	Engineering unit: Wh*100	4	1	-
4	Kvarh (+) PAR	X	INT32	Engineering unit: kVarh*0,1	4	1	2
4	KWh (+) L1	X	INT32	Engineering unit: Wh*100	1	1	-
4	KWh (+) L2	X	INT32	Engineering unit: Wh*100	2	1	-
4	KWh (+) L3	X	INT32	Engineering unit: Wh*100	3	1	-
			FRAME #7				
4	DMD W ∑	X	INT32	Engineering unit: Watt*0.1	4	1	-
4	DMD W ∑ max	X	INT32	Engineering unit: Watt*0.1	5	1	-
4	DMD VA ∑	X	INT32	Engineering unit: kVA*0.0001	4	1	2
4	DMD VA ∑ max	X	INT32	Engineering unit: kVA*0.0001	5	1	2
4	DMD A max	X	INT32	Engineering unit: Ampere*0.001	4	1	1
4	Run Hour (if pos. or neg power)	X	INT32	Engineering unit: Hour*0.01	2	1	1
			FRAME #8				
2	THD A1	X	INT16	Engineering unit: dimensionless * 0.1	1	1	2

2	THD A2	X	INT16	Engineering unit: dimensionless * 0.1	2	1	2
2	THD A3	X	INT16	Engineering unit: dimensionless * 0.1	3	1	2
2	THD VL1-N	X	INT16	Engineering unit: dimensionless * 0.1	4	1	2
2	THD VL2-N	X	INT16	Engineering unit: dimensionless * 0.1	5	1	2
2	THD VL3-N	X	INT16	Engineering unit: dimensionless * 0.1	6	1	2
2	THD VL1-L2	X	INT16	Engineering unit: dimensionless * 0.1	7	1	2
2	THD VL2-L3	X	INT16	Engineering unit: dimensionless * 0.1	8	1	2
2	THD VL3-L1	X	INT16	Engineering unit: dimensionless * 0.1	9	1	2
FRAME #9							
2	Error flags	X	INT16	Error flags	0	1	1
4	VMUB firmware version	X	BCD		0	1	1

2.3.6 Table 6 – Connected analyser recognized but not managed

Length (byte)	VARIABLE ENG. UNIT	EM270	EM271	EM280	Data Format	Notes	#SUB UNIT	VIF byte	VIFE byte
FRAME #1									
2	Error flags	X	X	X	BOOLEAN (16bit)	See Table 7	0	1	1
4	VMUB firmware version	X	X	X	BCD (8digit)		0	1	1

2.3.7 Table 7 – Error flags meaning

Error Flags value [binary]	Meaning
0000000000000000b	No error (analyzer recognized and managed)
0000000000000010b	Analyzer recognized but not managed

2.3.8 Table 8 – 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	
THD*0.01(dimensionless)	11111101b = FDh	10111010b = BAh	01110100b = 74h	
THD*0.1(dimensionless)	11111101b = FDh	10111010b = BAh	01110101b = 75h	
Hz * 0.1	11111011b = FBh	00101110b = 2Eh	-	
Hz	11111011b = FBh	00101111b = 2Fh	-	
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	
Cumulation counter *0.001	11111101b = FDh	11100001b = E1h	01110011b = 73h	
Cumulation counter *0.01	11111101b = FDh	11100001b = E1h	01110100b = 74h	
Cumulation counter *0.1	11111101b = FDh	11100001b = E1h	01110101b = 75h	
Error flags	11111101b = FDh	00010111b = 17h	-	
VMUB firmware version	11111101b = FDh	00001111b = 0Fh	-	

Colours:

(yellow)	= Primary M-Bus Codes
(green)	= Extension of Primary M-Bus Codes

2.3.9 Table 9 - Record errors

To report errors belonging just to a special record, the slave adds to the defective record a VIFE containing the type of occurred error.
VMUBM2US1B1A manages overflow errors.

VIFE	Type of record error
00010110b = 16h	Data overflow

Colours:

= Extension of Primary M-Bus Codes

3 REVISIONS