UDM35
UDM40
USC

SERIAL COMMUNICATION PROTOCOL

Vers. 1 Rev. 1

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1 SERIAL COMMUNICATION PROTOCOL

1.1 INTRODUCTION

UDM and USC can be equipped with a RS485 serial interface. It is possible to connect up to 255 instruments using MODBUS protocol.

The command structure of the protocol allows the user to read and write from/in the µP RAM memory and the peripheral devices so that all the functions are completely transparent.
The communication parameters are in accordance with the following table:

Tab. 1-1

Interface	Baud rate (bps)	Parity	Stop bit
RS485	4800, 9600, 19200, 38400	None	1

NOTE: please refer to the instruction manual for any detail on the instrument programming.

The communication can be started only by the HOST unit, which sends the request frame. Each frame contains the following information:

- slave address: is a number from 1 to 255, which identifies the instrument connected to the network. Address 0 (zero) is accepted (in write frames only) by all the instruments, which will execute the relevant command but won't send any answer frame.
- command: it defines the command type (e.g. read function, write function etc.).
- data fields: these numbers define the operating parameters of the command (e.g. the address of the word, the value of the word to be written, etc.).
- CRC word: it allows detecting transmission errors that may occur. CRC calculation is carried out by the MASTER unit once it has defined address, command and data fields. When the frame is received by the SLAVE, it is stored in a temporary buffer. The CRC is calculated and then compared with the received one. If they correspond and the address is recognised by the SLAVE unit, the command is executed and an answer frame is sent.
  If the CRC is not correct, the frame is discarded and no answer is sent.

1.2 FUNCTIONS

UDM and USC accept the following three commands:

- Read words (code 03h or 04h)
- Write one word (code 06h)
- Diagnostic function (code 08h)

1.2.1 Function 03 or 04 (read words)

Request frame

Address	Function	Data address		n° of words		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	03h or 04h	MSB	LSB	MSB	LSB	MSB	LSB

NOTE:

- The maximum number of word is 13 (26 byte).
- The address 00 (zero) is not allowed (it generates no answer).

Answer frame

Address	Function	n° byte (=2 x n° word)	Values	CRC	
1 byte	1 byte	1 byte	n° byte (=2 x n° word)	2 byte	
From 1 to 255	03h or 04h	XX	…	MSB	LSB

1.2.2 Function 06 (write one word)

Request frame

Address	Function	Data address		Value		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	06h	MSB	LSB	MSB	LSB	MSB	LSB

Answer frame

Address	Function	Data address		Value		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	06h	MSB	LSB	MSB	LSB	MSB	LSB

NOTE:

- The answer frame is an echo of the request frame, which confirm the execution of the command.

1.2.3 Function 08 (diagnostic function)

Request frame

1.2.4 Address	**Function**	**Diagnostic code**		**Value**		**CRC**	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	08h	00h	00h	AAh	55h	MSB	LSB

Answer frame

1.2.5 Address	**Function**	**Diagnostic code**		**Value**		**CRC**	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	08h	00h	00h	AAh	55h	MSB	LSB

NOTE: the answer frame is an echo of the request frame, which confirm the execution of the

command.

IMPORTANT: if the address is 00 (zero) all the instruments connected to the network will execute the command but won't send an answer frame.
If the request frame contains an invalid function, the answer frame will be an "exception response".

Exception response

1.2.6 Address	Function	Diagnostic code		Value		CRC	
1 byte	1 byte	2 byte		2 byte		2 byte	
From 1 to 255	88h	00h	00h	AAh	55h	MSB	LSB

1.3 MEMORY AREA

UDM and USC manage two different memory areas addressed as follows.

Function 03h, 04h and 06h:

Memory area	Area
Internal RAM	From 3001h to 3006h
Data storage EEPROM	From E000h to E071h

1.4 UDM AND USC IDENTIFICATION CODE

Every Carlo Gavazzi instrument is identified by means of a code in order to recognise the type of the instrument via serial communication.
The UDM and USC family codes are:
- 1Ah LSX and LSE module
- 1Bh HSX module
- 1Ch TRX module.

These codes can be read with the following fixed frame:

Instrument code request frame (8 byte):

01h	04h	**00h**	**0Bh**	00h	01h	40h	08h

LSX or LSE code answer frame (7 byte):

01h	04h	02h	**00h**	**1Ah**	38h	FBh

HSX code answer frame (7 byte):

01h	04h	02h	**00h**	**1Bh**	F9h	3Bh

TRX code answer frame (7 byte):

01h	04h	02h	**00h**	**1Ch**	B8h	F9h

2 RAM VARIABLES MAP

2.1 VARIABLES MAP

Tab. 2-1

Word	ADDRESS	BYTE	VARIABLE
1	3001h	2	Measured value
2	3002h	2	Max value
3	3003h	2	Min value
4	3004h	2	Modules
5	3005h	2	I/O status
6	3006h	2	Firmware revision

NOTE:

- All the variables in this table are contiguous. It is possible to read the whole area with a single command sending, in the request frame, 3001h as data address and 0006h as number of words.
- The data are sent in 2-byte groups in the following order: MSB, LSB.

2.2 VARIABLES FORMAT

2.2.1 Measured, max and min values

The value of the m*easured*, max and m*in* are stored as a 2-byte (1 word) integer value with sign (2's complement).
The decimal point have to be set according to the *Decimal Point* word coding (see Tab. 3-10).

2.2.1.1 Reset of the Max and Min values

The value of max and min values can be reset by the following commands:

Max reset request frame (8 byte):

01h	06h	**30h**	**02h**	D8h	F1h	5Ch	8Fh

Min reset request frame (8 byte):

01h	06h	**30h**	**03h**	27h	0Fh	3Dh	3Fh

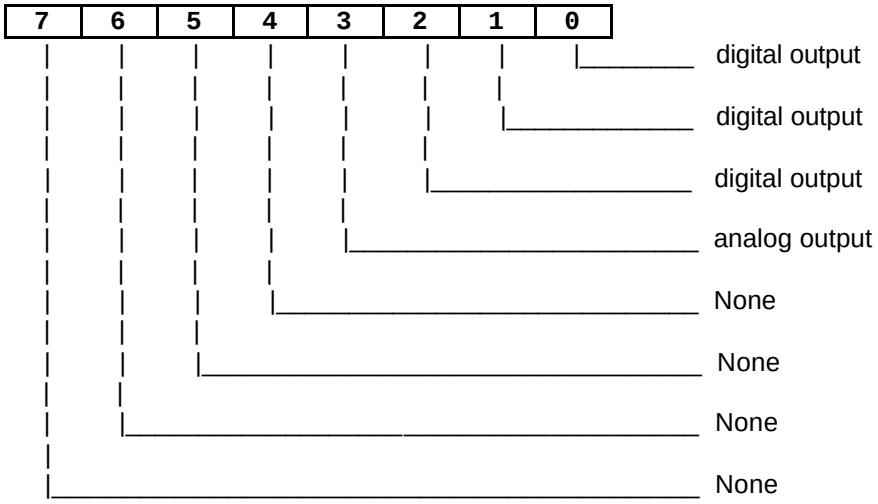
2.2.2 Configuration

The LSB value (bit 0 ÷ 7) of *"Modules"* variable specifies which modules are connected to the instrument (see Tab. 2-3).

Tab. 2-2

Bit Number	Module Type	Bit Value	Meaning
2,1,0	BO R1	0,0,0	Module not present
		0,0,1	Module present
2,1,0	BO R2	0,0,0	Module not present
		0,1,1	Module present
2,1,0	BO R4	0,0,0	Module not present
		1,1,1	Module present
3	BO AV	0	Module not present
		1	Module present

Variable bits:

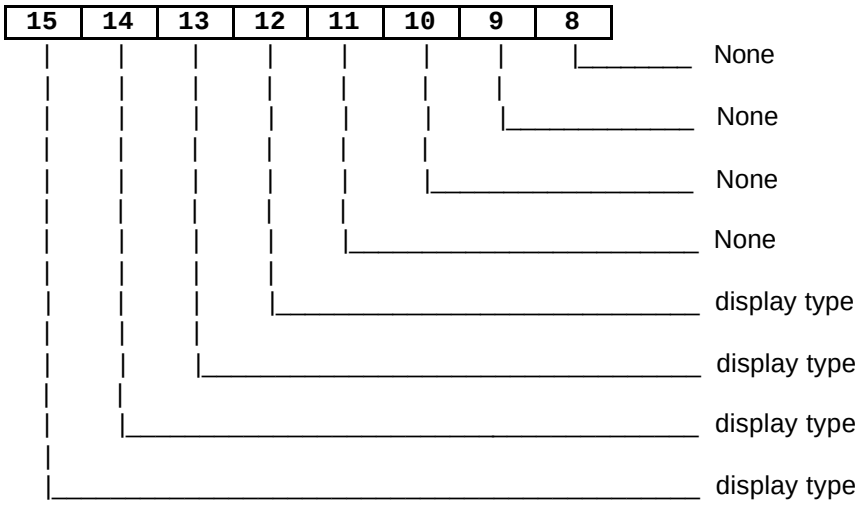


The MSB value (bit 8 ÷ 15) of "*Modules"* variable specifies which type of display is connected to the instrument (see Tab. 2-4).

Tab. 2-3

Bit				Meaning
15	14	13	12	
0	0	0	0	UDM35
1	0	0	0	UDM40
1	1	0	0	USC

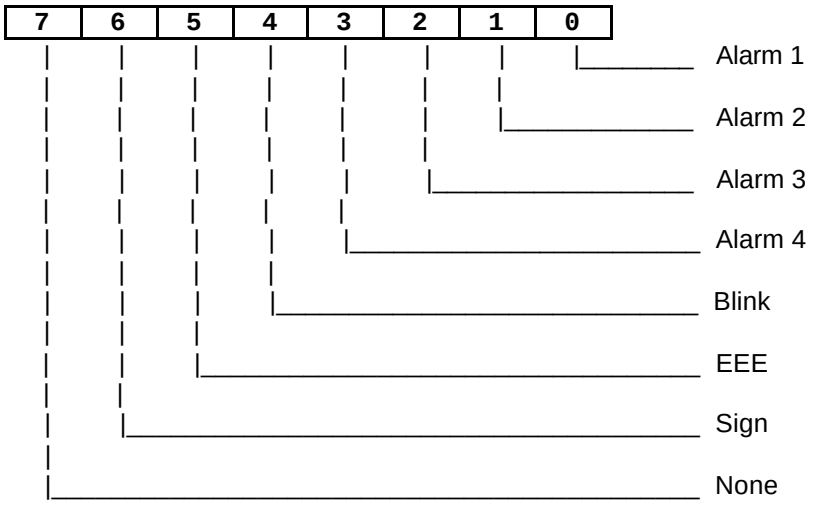
Variable bits:



2.2.3 Alarms Status

The LSB value of *I/O status* variable specifies the status of the alarms and the over range condition (see Tab. 2-5).

Variable bits:



Tab. 2-4

Bit	Value	Meaning
0	0	Alarm 1 = OFF
	1	Alarm 1 = ON
1	0	Alarm 2 = OFF
	1	Alarm 2 = ON
2	0	Alarm 3 = OFF
	1	Alarm 3 = ON
3	0	Alarm 4 = OFF
	1	Alarm 4 = ON
4	0	Blink = OFF
	1	Blink = ON
5	0	EEE = OFF
	1	EEE = ON
6	0	Sign = OFF
	1	Sign = ON
7	X	Not used

***Example 1*: reading of all the variables stored in RAM**

All variables request frame (8 byte):

01h	04h	30h	01h	00h	06h	CRC	CRC

All variables answer frame (17 byte):

01h	04h	0Ch	01h	00h	07h	07h	00h	03h	00h	03h	00h	0Eh	00h	00h	CRC	CRC
A	B	C	F	G	H	I	L	M	N	O	P	Q	R	S	T	U

Decimal point request frame (8 byte):

01h	04h	E0h	08h	00h	01h	CRC	CRC

Decimal point answer frame (7 byte):

01h	04h	02h	00h	01h	CRC	CRC
A	B	C	D	E	T	U

D,E: Decimal point value: 0001h (1 decimal)
F,G: Measure value: 0100h (0256 decimal)
H,I: MAX value: 0707h (1799 decimal)
L,M: Min value: 0003h (3 decimal)
N,O: Modules value: 0003h (0000 0000 0000 0011)
P,Q: I/O state value: 000Eh (0000 0000 0000 1110)
R,S: Firmware Rev. value: 0000h (0 decimal)

Variable value (Measure): 25.6
Variable value (MAX): 179.9
Variable value (Min): 0.3
Display type: UDM35
Module type: Two relay module
Alarm state: Alarm 1 = OFF
Alarm 2 = ON
Alarm 3 = ON
Alarm 4 = ON
Blink: OFF
EEE: OFF
Sign: OFF
Firmware rev.: 0

3 EEPROM VARIABLES MAP

3.1 LSX / LSE / HSX configuration map

ADD.	VARIABLE	
E000h	Password	See Tab. 3.1
E001h	Range	See Tab. 3.2
E002h	Measure Type	See Tab. 3.3
E003h	Integration Time	See Tab. 3.4
E004h	Display Selection	See Tab. 3.7
E005h	Display Color	See Tab. 3.8
E006h	Electric Low	See Tab. 3.11/12
E007h	Electric High	See Tab. 3.11/12
E008h	Decimal Point	See Tab. 3.10
E009h	Display Low	See Tab. 3.11/12
E00Ah	Display High	See Tab. 3.11/12
E00Bh	Linearisation Mode	See Tab. 3.15
E00Ch	Linearisation Points	See Tab. 3.15
E00Dh	IN point 1	See Tab. 3.15
E00Eh	OUT point 1	See Tab. 3.15
E00Fh	IN point 2	See Tab. 3.15
E010h	OUT point 2	See Tab. 3.15
E011h	IN point 3	See Tab. 3.15
E012h	OUT point 3	See Tab. 3.15
E013h	IN point 4	See Tab. 3.15
E014h	OUT point 4	See Tab. 3.15
E015h	IN point 5	See Tab. 3.15
E016h	OUT point 5	See Tab. 3.15
E017h	IN point 6	See Tab. 3.15
E018h	OUT point 6	See Tab. 3.15
E019h	IN point 7	See Tab. 3.15
E01Ah	OUT point 7	See Tab. 3.15
E01Bh	IN point 8	See Tab. 3.15
E01Ch	OUT point 8	See Tab. 3.15
E01Dh	IN point 9	See Tab. 3.15
E01Eh	OUT point 9	See Tab. 3.15
E01Fh	IN point 10	See Tab. 3.15
E020h	OUT point 10	See Tab. 3.15
E021h	IN point 11	See Tab. 3.15
E022h	OUT point 11	See Tab. 3.15
E023h	IN point 12	See Tab. 3.15
E024h	OUT point 12	See Tab. 3.15
E025h	IN point 13	See Tab. 3.15
E026h	OUT point 13	See Tab. 3.15
E027h	IN point 14	See Tab. 3.15
E028h	OUT point 14	See Tab. 3.15
E029h	IN point 15	See Tab. 3.15
E02Ah	OUT point 15	See Tab. 3.15
E02Bh	IN point 16	See Tab. 3.15
E02Ch	OUT point 16	See Tab. 3.15
E02Dh	Set-point Low 1	See Tab. 3.16

E02Eh	Set-point High 1	See Tab. 3.16
E02Fh	Set-point 1	See Tab. 3.16
E030h	Hysteresis 1	See Tab. 3.16
E031h	OFF Delay 1	See Tab. 3.16
E032h	ON Delay 1	See Tab. 3.16
E033h	Relay Status 1	See Tab. 3.17
E034h	Alarm Type 1	See Tab. 3.18
E035h	ON Color 1	See Tab. 3.19
E036h	Set-point Low 2	See Tab. 3.16
E037h	Set-point High 2	See Tab. 3.16
E038h	Set-point 2	See Tab. 3.16
E039h	Hysteresis 2	See Tab. 3.16
E03Ah	OFF Delay 2	See Tab. 3.16
E03Bh	ON Delay 2	See Tab. 3.16
E03Ch	Relay Status 2	See Tab. 3.17
E03Dh	Alarm Type 2	See Tab. 3.18
E03Eh	ON Color 2	See Tab. 3.19
E03Fh	Set-point Low 3	See Tab. 3.16
E040h	Set-point High 3	See Tab. 3.16
E041h	Set-point 3	See Tab. 3.16
E042h	Hysteresis 3	See Tab. 3.16
E043h	OFF Delay 3	See Tab. 3.16
E044h	ON Delay 3	See Tab. 3.16
E045h	Relay Status 3	See Tab. 3.17
E046h	Alarm Type 3	See Tab. 3.18
E047h	ON Color 3	See Tab. 3.19
E048h	Set-point Low 4	See Tab. 3.16
E049h	Set-point High 4	See Tab. 3.16
E04Ah	Set-point 4	See Tab. 3.16
E04Bh	Hysteresis 4	See Tab. 3.16
E04Ch	OFF Delay 4	See Tab. 3.16
E04Dh	ON Delay 4	See Tab. 3.16
E04Eh	Relay Status 4	See Tab. 3.17
E04Fh	Alarm Type 4	See Tab. 3.18
E050h	ON Color 4	See Tab. 3.19
E051h	Filter scale	See Tab. 3.20
E052h	Filter Coefficient	See Tab. 3.20
E053h	Analog Electic Low	See Tab. 3.22
E054h	Analog Electric High	See Tab. 3.22
E055h	Analog Type	See Tab. 3.21
E056h	Serial Port Address	See Tab. 3.24
E057h	Serial Port Baudrate	See Tab. 3.23
E058h	AUX Command	See Tab. 3.25

3.2 TRX configuration map

ADD.	VARIABLE	
E000h	Password	See Tab. 3.1
E001h	Range	See Tab. 3.5
E002h	Probe	See Tab. 3.5
E003h	CJC Mode	See Tab. 3.6
E004h	Display Selection	See Tab. 3.7
E005h	Display Color	See Tab. 3.8
E006h	Electric Low	See Tab. 3.13/14
E007h	Electric High	See Tab. 3.13/14
E008h	Decimal Point	See Tab. 3.10
E009h	Display Low	See Tab. 3.13/14
E00Ah	Display High	See Tab. 3.13/14
E02Dh	Set-point Low 1	See Tab. 3.16
E02Eh	Set-point High 1	See Tab. 3.16
E02Fh	Set-point 1	See Tab. 3.16
E030h	Hysteresis 1	See Tab. 3.16
E031h	OFF Delay 1	See Tab. 3.16
E032h	ON Delay 1	See Tab. 3.16
E033h	Relay Status 1	See Tab. 3.17
E034h	Alarm Type 1	See Tab. 3.18
E035h	ON Color 1	See Tab. 3.19
E036h	Set-point Low 2	See Tab. 3.16
E037h	Set-point High 2	See Tab. 3.16
E038h	Set-point 2	See Tab. 3.16
E039h	Hysteresis 2	See Tab. 3.16
E03Ah	OFF Delay 2	See Tab. 3.16
E03Bh	ON Delay 2	See Tab. 3.16
E03Ch	Relay Status 2	See Tab. 3.17
E03Dh	Alarm Type 2	See Tab. 3.18
E03Eh	ON Color 2	See Tab. 3.19
E03Fh	Set-point Low 3	See Tab. 3.16
E040h	Set-point High 3	See Tab. 3.16
E041h	Set-point 3	See Tab. 3.16
E042h	Hysteresis 3	See Tab. 3.16
E043h	OFF Delay 3	See Tab. 3.16
E044h	ON Delay 3	See Tab. 3.16
E045h	Relay Status 3	See Tab. 3.17
E046h	Alarm Type 3	See Tab. 3.18
E047h	ON Color 3	See Tab. 3.19
E048h	Set-point Low 4	See Tab. 3.16
E049h	Set-point High 4	See Tab. 3.16
E04Ah	Set-point 4	See Tab. 3.16
E04Bh	Hysteresis 4	See Tab. 3.16
E04Ch	OFF Delay 4	See Tab. 3.16
E04Dh	ON Delay 4	See Tab. 3.16
E04Eh	Relay Status 4	See Tab. 3.17
E04Fh	Alarm Type 4	See Tab. 3.18
E050h	ON Color 4	See Tab. 3.19
E051h	Filter scale	See Tab. 3.20
E052h	Filter Coefficient	See Tab. 3.20
E053h	Analog Electic Low	See Tab. 3.22
E054h	Analog Electric High	See Tab. 3.22

E055h	Analog Type	See Tab. 3.21
E056h	Serial Port Address	See Tab. 3.24
E057h	Serial Port Baudrate	See Tab. 3.23
E058h	AUX Command	See Tab. 3.25
E06Bh	Automatic Compensation	See Tab. 3.6
E06Ch	Manual Compensation	See Tab. 3.6

3.3 EEPROM CONFIGURATION DATA FORMAT

3.3.1 Password

Tab. 3-1

Value	Description
0000 ÷ 4999	Full Access Protection
5000 ÷ 9999	Set-Point direct access, other parameters protected

3.3.2 Input Selection

3.3.2.1 LSX / LSE / HSX

Tab. 3-2: Range Selection

	MODE	
	LSX - LSE	HSX
Range	Full Scale	Full Scale
0	200uA	200mA
1	2mA	2A
2	20mA	5A
3	200mV	20V
4	2V	200V
5	20V	500V

Tab. 3-3: Measure Type

Value	Description
0	TRMS
1	AVERAGE

Tab. 3-4: Integration Time

Value	Description	Format
-	Automatic	
100.0 ÷ 999.9	Manual	sec

3.3.2.2 TRX

Tab. 3-5: Range and Probe Selection

Value	Probe	0	1	2
Range				
0		TC J	PT 100*	20 Ω
1		TC J	PT 100**	200 Ω
2		TC K	PT 250**	2K Ω
3		TC E	PT 500**	20K Ω
4		TC S	PT 1000**	200K Ω
5		TC T	Ni 100	200K Ω

NOTE:

(*) measuring range: from –200°C to +850°C.
(**) measuring range: from –200°C to +200°C.

Tab. 3-6: CJC Mode

Value	Description
0	Automatic
1	Manual, from 0 to 50°C (*)

NOTE:

(*) According to "Manual Compensation" parameter

3.3.3 Display

Tab. 3-7: Display selection

Value	Description
0	3 ½ digit
1	3 digit + 0

NOTE:

- Available only for UDM35

Tab. 3-8: Display Colour

Value	Description
0	RED
1	ORANGE
2	GREEN

NOTE:

- Available only for UDM40

3.3.4 Scaling

Tab. 3-9: Electric and display limits

	Min Value	Max Value
Electric Low	b.s.	f.s.
Electric High	b.s.	f.s.
Decimal Point	0	3
Display Low	b.s.	f.s.
Display High	b.s.	f.s.

NOTE:
f.s. means full scale; b.s. means beginning of the scale.

Tab. 3-10: Displayed decimal point

Value	Description
0	1111
1	111.1
2	11.11
3	1.111

3.3.4.1 LSX, LSE and HSX

Tab. 3-11: UDM40 limits

		Electric Low		Electric High		Display Low		Display High	
		b.s.	f.s.	b.s.	f.s.	b.s.	f.s.	b.s.	f.s.
	UDM40					(*)	(*)	(*)	(*)
LSX LSE	200uA	0.0	200.0	0.0	200.0	-9999	9999	-9999	9999
	2mA	0.000	2.000	0.000	2.000	-9999	9999	-9999	9999
	20mA	0.00	20.00	0.00	20.00	-9999	9999	-9999	9999
	200mV	0.0	200.0	0.0	200.0	-9999	9999	-9999	9999
	2V	0.000	2.000	0.000	2.000	-9999	9999	-9999	9999
	20V	0.00	20.00	0.00	20.00	-9999	9999	-9999	9999
HSX	200mA	0.0	200.0	0.0	200.0	-9999	9999	-9999	9999
	2A	0.000	2.000	0.000	2.000	-9999	9999	-9999	9999
	5A	0.000	5.000	0.000	5.000	-9999	9999	-9999	9999
	20V	0.00	20.00	0.00	20.00	-9999	9999	-9999	9999
	200V	0.0	200.0	0.0	200.0	-9999	9999	-9999	9999
	500V	0.0	500.0	0.0	500.0	-9999	9999	-9999	9999

Tab. 3-12: UDM35 limits

		Electric Low		Electric High		Display Low		Display High	
		b.s.	f.s.	b.s.	f.s.	b.s.	f.s.	b.s.	f.s.
	UDM35					(*)	(*)	(*)	(*)
LSX	200uA	0.0	199.9	0.0	199.9	-1999	1999	-1999	1999
LSE	2mA	0.000	1.999	0.000	1.999	-1999	1999	-1999	1999
	20mA	0.00	19.99	0.00	19.99	-1999	1999	-1999	1999
	200mV	0.0	199.9	0.0	199.9	-1999	1999	-1999	1999
	2V	0.000	1.999	0.000	1.999	-1999	1999	-1999	1999
	20V	0.00	19.99	0.00	19.99	-1999	1999	-1999	1999
HSX	200mA	0.0	199.9	0.0	199.9	-1999	1999	-1999	1999
	2A	0.000	1.999	0.000	1.999	-1999	1999	-1999	1999
	5A	0	500	0	500	-1999	1999	-1999	1999
	20V	0.00	19.99	0.00	19.99	-1999	1999	-1999	1999
	200V	0.0	199.9	0.0	199.9	-1999	1999	-1999	1999
	500V	0	500	0	500	-1999	1999	-1999	1999

NOTE:

(*) b.s. and f.s. values of these columns are indicated without the decimal point information.

3.3.4.2 TRX

Tab. 3-13: UDM40 limits

	Electric Low		Electric High		Display Low		Display High	
	b.s.	f.s.	b.s.	f.s.	b.s.	f.s.	b.s.	f.s.
UDM40					(*)	(*)	(*)	(*)
TC J	-50	760	-50	760	-9999	9999	-9999	9999
TC K	-200	1260	-200	1260	-9999	9999	-9999	9999
TC E	-200	1000	-200	1000	-9999	9999	-9999	9999
TC S	350	1750	350	1750	-9999	9999	-9999	9999
TC T	-200	400	-200	400	-9999	9999	-9999	9999
PT100	-200	850	-200	850	-9999	9999	-9999	9999
PT100	-200.0	200.0	-200.0	200.0	-9999	9999	-9999	9999
PT250	-200.0	200.0	-200.0	200.0	-9999	9999	-9999	9999
PT500	-200.0	200.0	-200.0	200.0	-9999	9999	-9999	9999
PT1000	-200.0	200.0	-200.0	200.0	-9999	9999	-9999	9999
Ni100	-60	180	-60	180	-9999	9999	-9999	9999
R 20	0.00	20.00	0.00	20.00	-9999	9999	-9999	9999
R 200	0.0	200.0	0.0	200.0	-9999	9999	-9999	9999
R 2K	0.000	2.000	0.000	2.000	-9999	9999	-9999	9999
R 20K	0.00	20.00	0.00	20.00	-9999	9999	-9999	9999
R 200K	0.0	200.0	0.0	200.0	-9999	9999	-9999	9999

Tab. 3-14: UDM35 limits

	Electric Low		Electric High		Display Low		Display High	
	b.s.	f.s.	b.s.	f.s.	b.s.	f.s.	b.s.	f.s.
UDM35					(*)	(*)	(*)	(*)
TC J	-50	760	-50	760	-1999	1999	-1999	1999
TC K	-200	1260	-200	1260	-1999	1999	-1999	1999
TC E	-200	1000	-200	1000	-1999	1999	-1999	1999
TC S	350	1750	350	1750	-1999	1999	-1999	1999
TC T	-200	400	-200	400	-1999	1999	-1999	1999
PT100	-199	850	-199	850	-1999	1999	-1999	1999
PT100	-199.9	199.9	-199.9	199.9	-1999	1999	-1999	1999
PT250	-199.9	199.9	-199.9	199.9	-1999	1999	-1999	1999
PT500	-199.9	199.9	-199.9	199.9	-1999	1999	-1999	1999
PT1000	-199.9	199.9	-199.9	199.9	-1999	1999	-1999	1999
Ni100	-60	180	-60	180	-1999	1999	-1999	1999
R 20	0.00	19.99	0.00	19.99	-1999	1999	-1999	1999
R 200	0.0	199.9	0.0	199.9	-1999	1999	-1999	1999
R 2K	0.000	1.999	0.000	1.999	-1999	1999	-1999	1999
R 20K	0.00	19.99	0.00	19.99	-1999	1999	-1999	1999
R 200K	0.0	199.9	0.0	199.9	-1999	1999	-1999	1999

NOTE:

(*) b.s. and f.s. values of these columns are indicated without the decimal point information.

3.3.5 **Linearisation**

Tab. 3-15

Value	Description
0	None
1	Yes

?

Point	Range of values
IN 1	From b.s to f.s (*)
OUT 1	From b.s to f.s (*)
IN 2	From b.s to f.s (*)
OUT 2	From b.s to f.s (*)
…	…
…	…
IN 16	From b.s to f.s (*)
OUT 16	From b.s to f.s (*)

NOTE:

Available only for LSX, LSE and HSX models.

(*) According to “Scaling” paragraph values.

The number of linearisation points is the value of “Linearisation Points” variable, stored in address E00Ch: its min value is 2 and its max value is 16.

3.3.6 Set Points

Tab. 3-16: Limits and delay

Variable name	Min value	Max value
Set Point Low	b.s.(*)	f.s.(*)
Set Point High	b.s.(*)	f.s.(*)
Set Point	Set Point Low	Set Point High
Hysteresis	0	(**)
OFF delay	0	255 seconds
ON delay	0	255 seconds

NOTE:

(*) See “Scaling” paragraph for available values.

(**) The Max value of “Hysteresis” can be obtained as difference between “Display High” and “Display Low”.

Tab. 3-17: Digital Output

Value	Description
0	Normally de-energised
1	Normally energised

Tab. 3-18: Alarm Type

Value	Description
0	OFF
1	DOWN
2	UP
3	Disable DOWN
4	UP + Latch
5	DOWN + Latch

Tab. 3-19: Alarm Colour

Value	Description
0	RED
1	ORANGE
2	GREEN
3	NONE

3.3.7 Filter

Tab. 3-20

Variable name	Min Value	MAX Value
Filter Scale	0(**)	(*)(**)
Filter Coefficient	1	32

NOTE:

(*) The Max value of "Filter Scale" can be obtained as difference between "Display High" and "Display Low".

(**) Range inside which the filter is working, indicated in digits.

3.3.8 Analog Output

Tab. 3-21: Analog Type

Value	Description
0	Output Voltage
1	Output Current

Tab. 3-22: Analog Output

Type	Range
Voltage	0.0 ÷ 100.0% (*)
Current	0.0 ÷ 100.0% (*)

Note: (*) 100% means 10V for voltage outputs and 20mA for current outputs.

3.3.9 Serial Port

Tab. 3-23: Baurate value

Value	Description
0	4800
1	9600
2	19200
3	38400

Tab. 3-24: Address range

Value
0 ÷ 255

3.3.10 Auxiliary Commands

Tab. 3-25

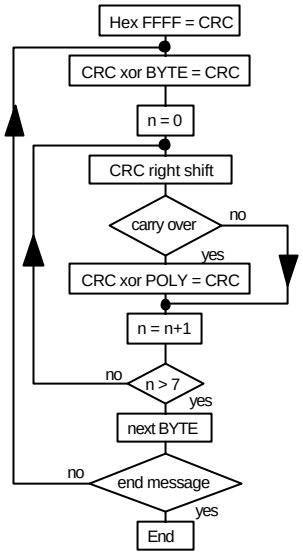
Value	Description
0	C1: display hold
1	C2: keypad disabling
2	C3: latch reset

4 CRC CALCULATION ALGORITHM

CRC is calculated according to the relevant flow diagram (see below). An explanatory example will follow.

***Example 25*: calculation of CRC starting from frame 0207h**

CRC Inizialization	1111	1111	1111	1111	
Load first byte			0000	0010	
Execute XOR with the first byte of the frame	1111	1111	1111	1101	
Execute 1st right Shift	0111	1111	1111	1110	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1101	1111	1111	1111	
Execute 2nd right Shift	0110	1111	1111	1111	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1100	1111	1111	1110	
Execute 3rd right Shift	0110	0111	1111	1111	**0**
Execute 4th right Shift	0011	0011	1111	1111	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1001	0011	1111	1110	
Execute 5th right Shift	0100	1001	1111	1111	**0**
Execute 6th right Shift	0010	0100	1111	1111	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1000	0100	1111	1110	
Execute 7th right Shift	0100	0010	0111	1111	**0**
Execute 8th right Shift	0010	0001	0011	1111	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1000	0001	0011	1110	
Load the second byte of the frame			0000	0111	
Execute XOR with the second byte of the frame	1000	0001	0011	1001	
Execute 1st right Shift	0100	0000	1001	1100	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1110	0000	1001	1101	
Execute 2nd right Shift	0111	0000	0100	1110	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1101	0000	0100	1111	
Execute 3rd right Shift	0110	1000	0010	0111	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1100	1000	0010	0110	
Execute 4th right Shift	0110	0100	0001	0011	**0**
Execute 5° right Shift	0011	0010	0000	1001	**1**
Carry = 1 , load polynomial	1010	0000	0000	0001	
Execute XOR with the polynomial	1001	0010	0000	1000	
Execute 6th right Shift	0100	1001	0000	0100	**0**
Execute 7th right Shift	0010	0100	1000	0010	**0**
Execute 8th right Shift	0001	0010	0100	0001	**0**
CRC Result	**0001**	**0010**	**0100**	**0001**	
	12h		**41h**		



POLY = crc calculation polynominal: A001h

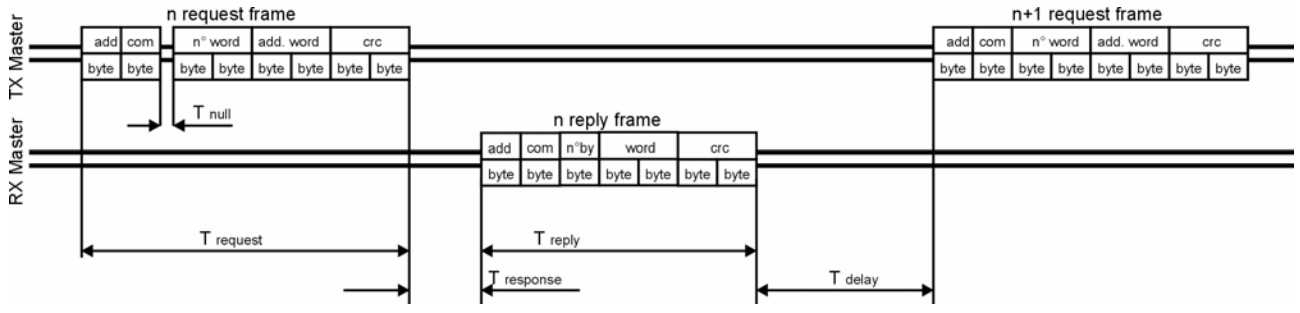
NOTE: the byte 41h is sent first (even if it's the LSB), then byte 12h is sent.

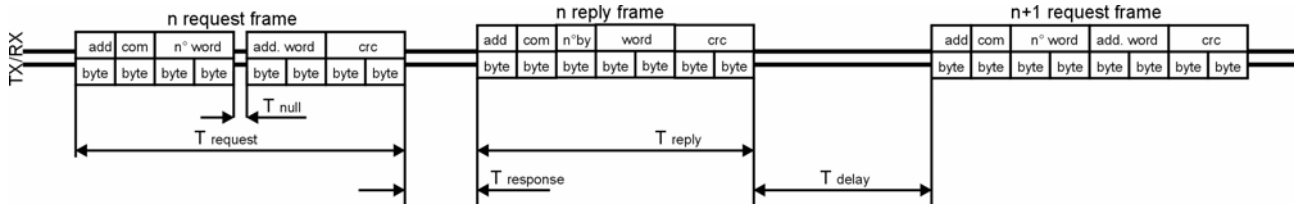
5 HARDWARE SPECIFICATIONS

5.1 RS485 INTERFACE

General technical specifications	
Baud rate	4800, 9600, 19200, 38400bps
Data format	8 data / 1 stop bit / no parity
Address	1 to 255
Broadcast	Yes (address 0 with function 06)
Standard functions	04, 03: Read function (max 13 words)
	06: Write function (max 1 word)
Special functions	08: Test device
Identification code	26,27,28 (1Ah,1Bh,1Ch)
Synchr. Time-out	3 chars
Physical interface	MAX1482
RX termination	Jumper in BO SX module
Available connections	4-wire (RS485 half duplex interface)

Timing characteristics for 4-wire an 2-wire communication	msec
T response: max answering time	600ms
T response: typical answering time	60ms
T delay1: minimum time for a new query on the same address	3 char
T delay2: minimum time for a new query on a different address	3 char
T null: maximum interruption time on the request frame	3 char





APPLICATION NOTES

1. If the instrument does not answer within the “max answering time”, it is necessary to repeat the query. If the instrument does not answer after 3 consecutive queries, it must be considered as

not connected, faulty or having a different address. The same consideration is valid in case of CRC errors or incomplete frames.

2. By entering the programming mode (by pressing the “S” key) the communication is interrupted. Any data received during the programming mode are ignored.
3. To avoid reflections or couplings between the communication wires it is suggested to terminate the last instrument of the network and of the host. If some problems persist, bias the host transmission. It is advisable to terminate the network also in case of short point to point connections.
4. If the connection is longer than 1000 m a signal amplifier has to be used.
5. To calculate the time required to scan all the instruments of a network, the following formulae are to be used:

$$Trequest = \frac{N^\circ bit}{Baud\_rate} * 8$$

$$Treply = \frac{N^\circ bit}{Baud\_rate} * N^\circ char$$

$$TS = T\_request + T\_response + T\_reply + T\_delay1$$

$$TA = TS * N^\circ request$$

$$TM = (TS + Tdelay2) * N^\circ instruments$$

N° bit	10 (no parity), 11 (even or odd parity)
N° char	5 + number of Words*2 (function 04), 8 (function 06)
N° word	Number of words to be read in the same request
TS	Reading execution time
Tdelay1	Minimum time for a new query on the same address
TA	Instrument data acquisition time
TM	Total network scanning time
N° instruments	Number of instruments connected in the network
Tdelay2	Minimum time for a new query on a different address