



MODBUS Interface

PRODUCT DESCRIPTION: **CONTROL FOR MEDICAL REFRIGERATOR**
INTERNAL CODE: **0KFM50DA**

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1 Physical connectors

The MODBUS RTU interface is available through port RS232 found on connector M8 (terminals 1-GND, 2-RX, 3-TX)

2 Serial interface configuration

The serial interface must be configured as follows:

Speed	9600 bit/sec
Number of bits	8
Parity	No
Stop bits	1

3 MODBUS controller and functions address

The MODBUS address of the compressor is defined by the Compressor Number (0-32) parameter found in the menu Compressor Configuration. By setting the address on 0 si the MODBUS interface is disabled. The default address is 1.

The implemented MODBUS functions are:

- 3, "Read Holding Registers" for reading
- 6, "Preset Single Register", for the writing of a single register
- 16, "Preset Multiple Registers" for the writing of one or more registers

4 Addressing data

The charts on the next pages show the data that is accessible through the MODBUS interface. The controller data are subdivided into blocks according to their type. The number and name of the data group is shown at the beginning of each chart.

Below the heading of the chart concerning group 0.

Group 0: System Identification					
Word	Type	Perm	Sect	Description	Notes

For each MODBUS data are shown respectively:

- ^ Word, MODBUS register address (in hexadecimal)
- ^ Type, data type (list of possible types with description is at the end of the MODBUS data document)
- ^ Perm, permissions (R=read, W=Write)
- ^ Sz, number of bytes used by the object, that can eventually occupy more than one MODBUS register
- ^ Description , description of the object
- ^ Notes, notes on the interpretation of the object concerned

For example if you want to access the "Release Firmware" data found on block 0 (system identification) the MODBUS reading request (in the case of controller with address 1) will be, in hexadecimal,

0103000B0001F5C8 i.e.:



MODBUS Interface
CONTROL FOR FRIMED MEDICAL REFRIGERATOR

Version 7
07/03/14

Controller address	Function	Data address	Data length	CRC16
01	03	000B	0001	F5C8

It is possible to read the data of each block individually or with one single reading by specifying as length the sum of the lengths of the data of the block.

The reading of the whole block 0 for example will be:

Controller address	Function	Data address	Data length	CRC16
01	03	0000	000D	840F

Concerning the writing of a whole block with one single operation, the same operation is only possible if all the data of the block are writable.

In case of error due to:

- ^ non-supported function
- ^ incorrect data address
- ^ incorrect data length

the reply message will be a MODBUS exception.

5 References

The following document refers to:

1. Technical specificity of the product “TCF/Specifica/st frimed new rel.pdf”
2. Diagram of hardware “TCF/Specifica/Frimed Carico Scarico Dati.pdf”
3. MODBUS standard “http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b.pdf”

6 Description of registers

6.0 Group 0 System identification

Word	Type	Perm	Sect	Description	Notes
000A	uns16	R	2	HW_Hardware Model	0xF000: Frimed CONTROL FOR MEDICAL REFRIGERATOR
000B	uns16	R	2	FW_Firmware Release	Low byte= minor release, High byte = major release
000C	uns16	R	2	MB_MODBUS Interface Release	This description is valid for release 0

6.1 Group 1 State of machine and measurements

Word	Type	Perm	Sect	Description	Notes
0100	uns16	R	2	ST_State of machine	By values: 0 : BATTERY ON 1 : OFF 2 : DEFROSTING 3 : ALARM ACTIVE
0101	uns16	R	2	AL_Alarm code displayed	See appendix for alarm code table
0102	uns16	RW	2	OUT_Real state and digital exit	Managed as bit window: Reading 0x0002 RL1 0x0004 RL2 0x0008 RL3 0x0010 RL4 0x0020 RL5 0x0040 RL6 0x0080 RL1b In reading ILMAG version 0x0040 RL6
0103	uns16	R	2	IN_Digital entrances	Managed as bit window: 0x0004 IN1 0x0008 IN2
0104	sig16	R	2	T1_ S1 temperature	[0,1 °C]
0105	sig16	R	2	T2_ S2 temperature	[0,1 °C]
0106	sig16	R	2	T3_ S3 temperature	[0,1 °C]
0107	uns16	R	2	TS_Defrosting time	[s]
0108	uns32	R	4	S1_Condensor cleaning maintenance counter	[min]

010A	uns32	R	4	S2_General control maintenance counter	[min]
010C	uns32	R	4	S3_Security maintenance counter	[min]
010E	uns16	R	2	AA=Active alarms (for the correspondence of the bits with the alarms see appendix for code table)	Managed as bit window: 0x0001 AL00 network missing 0x0002 AL01 Broken S1 probe 0x0004 AL02 Broken S2 probe etc...

6.2 Group 2 Parameters

Word	Type	Perm	Sect	Description	Notes
0200	sig16	RW	2	C01_TN/BT-2	[0.1 °C], for the range see ref. 1
0201	sig16	RW	2	C02_TN/BT-3	[0.1 °C], for the range see ref. 1
0202	sig16	RW	2	C03_TN/BT-1	[0.1 °C], for the range see ref. 1
0203	sig16	RW	2	C04_TN/BT-4	[0.1 °C], for the range see ref. 1
0204	sig16	RW	2	C05_COMPRESSORE-1	[min], for the range see ref. 1
0205	sig16	RW	2	C06_COMPRESSORE-2	[0.1 °C], for the range see ref. 1
0206	sig16	RW	2	C07_COMPRESSORE-3	0 compressor always ON 1 under evap probe
0207	sig16	RW	2	C08_TIMER-1	[min], for the range see ref. 1
0208	sig16	RW	2	C09_TIMER-2	[min], for the range see ref. 1
0209	sig16	RW	2	C10_TIMER-3	[min], for the range see ref. 1
020A	sig16	RW	2	C11_DEFROST-1	[h], for the range see ref. 1
020B	sig16	RW	2	C12_DEFROST-2	[min], for the range see ref. 1
020C	sig16	RW	2	C13_DEFROST-3	[0.1 °C], for the range see ref. 1
020D	sig16	RW	2	C14_DEFROST-4	[min], for the range see ref. 1
020E	sig16	RW	2	C15_DEFROST-5	[min], for the range see ref. 1
020F	sig16	RW	2	C16_DEFROST-6	0 Def 1 °C
0210	sig16	RW	2	C17_OFFSET SONDE-1	[0.1 °C], for the range see ref. 1
0211	sig16	RW	2	C18_OFFSET SONDE-2	[0.1 °C], for the range see ref. 1
0212	sig16	RW	2	C19_OFFSET SONDE-3	[0.1 °C], for the range see ref. 1
0213	sig16	RW	2	C20_SET ALLARMI-1	[min], for the range see ref. 1
0214	sig16	RW	2	C21_SET ALLARMI-2	[min], for the range see ref. 1
0215	sig16	RW	2	C22_SET ALLARMI-3	[0.1 °C], for the range see ref. 1
0216	sig16	RW	2	C23_SET ALLARMI-4	[0.1 °C], for the range see ref. 1

0217	sig16	RW	2	C24_ALARM SET-5	[0.1 °C], for the range see ref. 1
0218	sig16	RW	2	C25_ALARM SET-6	[min], for the range see ref. 1
0219	sig16	RW	2	C26_VENTILATOR SET-1	[0.1 °C], for the range see ref. 1
021A	sig16	RW	2	C27_VENTILATOR SET-2	[0.1 °C], for the range see ref. 1
021B	sig16	RW	2	C28_MAINTENANCE-1	[h], for the range see ref. 1
021C	sig16	RW	2	C29_MAINTENANCE-2	[h], for the range see ref. 1
021D	sig16	RW	2	C30_MAINTENANCE-3	[h], for the range see ref. 1
021E	uns16	RW	2	T01_LANGUAGE	0 – Italian 1 – English 2 – French 3 – German 4 – Spanish 5 - Portuguese
021F	uns16	RW	2	T02_°C/°F	0- °C 1- °F
0220	uns16	RW	2	T03_BATTERY	0 – No 1 - Yes
0221	uns16	RW	2	T04_GSM	0 – No 1 - Yes
0222	uns16	RW	2	T05_ETHERNET	0-No 1-32 Tcp address
0223	uns16	RW	2	T06_REFRIGERATOR TYPE	0 – TN 1 - BT
0224	uns16	RW	2	T07_DEFROSTING EXECUTION	1 – Hot gas 2 – Resistance 3 – In time 4 – Ventilator 5 - No
0225	uns16	RW	2	T08_END DEFROSTING	1 – In time 2 - S2
0226	uns16	RW	2	T09_S2 PRESENT	0 – No 1 - Yes
0227	uns16	RW	2	T10_WORK OF S2	1 – Defrosting 2 - Work
0228	uns16	RW	2	T11_S3 PRESENT	0 – No 1 - Yes
0229	uns16	RW	2	T12_SECURITY	0 – No 1 - Yes
022A	uns16	RW	2	T13_FUSE	0 – 99,9 A
022B	uns16	RW	2	T15_KG GAS	0 – 9,999 Kg.
022C	byte[8]	R	8	TM_DATE AND TIME	Since the first element of the array:

					0 - SECONDS 1 - MINUTES 2 - HOURS, 3 - DAY OF WEEK (1=MONDAY) 4 - DAY OF MONTH 5 - MONTH 6 - YEAR (00-99, 00=2000) 7- Empty
230	uns16	R	2	DST_Automatic adjustment summer/winter time	0 disabled 1 enabled

6.3 Group 3 Strings

Word	Type	Perm	Sect	Description	Notes
0300	ch[16]	RW	16	MD_SERIAL NUMBER	String '\0' over
0308	ch[16]	RW	16	MD_MODEL	String '\0' over
0310	ch[16]	RW	16	ID_COMPANY NAME	String '\0' over
0318	ch[16]	RW	16	DL_DATA LOGGER	String '\0' over/Valid characters first 8
0320	ch[16]	RW	16	G1_GSM PHONE	String '\0' over
0328	ch[4]	RW	4	G2_N. PIN	
032A	ch[16]	RW	16	G3_PHONE NUMBER-1	String '\0' over
0332	ch[16]	RW	16	G4_PHONE NUMBER-2	String '\0' over
033A	ch[16]	RW	16	G5_PHONE NUMBER-3	String '\0' over
0342	ch[8]	RW	8	T14_GAS TYPE	String '\0' over

6.4 Group 4 Password

Word	Type	Perm	Sect	Description	Notes
0400	ch[3]	RW	4	L1_PASSWORD LIV1	The first 3 characters are valid
0402	ch[4]	RW	4	L2_PASSWORD LIV2	
0404	ch[4]	RW	4	L3_PASSWORD LIV3	

6.5 Group 5 Alarm history

Word	Type	Perm	Sect	Description	Notes
0500	alm	R	8	AL00_Alarm history record	Posit.0 – more recent
0504	alm	R	8	AL01_Alarm history record	Posit.1
0508	alm	R	8	AL02_Alarm history record	Posit.2

050C	alm	R	8	AL03_ Alarm history record	Posit.3
0510	alm	R	8	AL04_ Alarm history record	Posit.4
0514	alm	R	8	AL05_ Alarm history record	Posit.5
0518	alm	R	8	AL06_ Alarm history record	Posit.6
051C	alm	R	8	AL07_ Alarm history record	Posit.7
0520	alm	R	8	AL08_ Alarm history record	Posit.8
0524	alm	R	8	AL09_ Alarm history record	Posit.9
0528	alm	R	8	AL10_ Alarm history record	Posit.10
052C	alm	R	8	AL11_ Alarm history record	Posit.11
0530	alm	R	8	AL12_ Alarm history record	Posit.12
0534	alm	R	8	AL13_ Alarm history record	Posit.13
0538	alm	R	8	AL14_ Alarm history record	Posit.14
053C	alm	R	8	AL15_ Alarm history record	Posit.15
0540	alm	R	8	AL16_ Alarm history record	Posit.16
0544	alm	R	8	AL17_ Alarm history record	Posit.17
0548	alm	R	8	AL18_ Alarm history record	Posit.18
054C	alm	R	8	AL19_ Alarm history record	Posit.19 - oldest

The alarm data type codifies date, time and alarm. Alarm=0 corresponds to an unused history record. It consists of an array of 8 bytes in which the elements starting from the first represent respectively: alarm code (See table), day (1-31), month (1-12), year (0=2000-99=2099), time (0-23), minutes (0-59), gap (2 byte).

6.6 Group 6 Recording reading, begin download

6.7 Group 7 Recording reading, continue download

6.8 Group 8 Recording reading, reread

Word	Type	Perm	Sect	Description	Notes
0600	uns32	R	4	PTR_Reading pointer	Pointer to the data currently read
0602	rec[N]	R	L	REC0..REC9_Reading 10 records, from beginning of recording	In the case of number of recordings lower than 10 the answer is shorter

0700	uns32	R	4	PTR_Reading pointer	Pointer to the data currently read
0702	rec[N]	R	L	REC0..REC9_Reading following 10 records	In the case of number of recordings lower than 10 the answer is shorter

0800	uns32	R	4	PTR_Reading pointer	Pointer to the data currently read
0802	rec[N]	R	L	REC0..REC9_Reding last 10 records	In the case of number of recordings lower than 10 the answer is shorter

The reading (performed with the 0x03 function) will always request the total length $L=120+4$ bytes corresponding to $N=10$ records and according to what the registers requests from 0600hex, 0700hex or 0800hex will be managed respectively as: reading of records at beginning of memory, reading of following records or rereading last records.

In the case of less available data, those available are restored in the response and the third byte of the response, containing the number of byte of the data part, will be set consequently. Subsequent readings past the end of the data always return to length zero.

The reading pointer is available to manage the rereading of the data in case of failed response and allows to identify a record block that has already been read.

The recordings all have the same dimension of 12 bytes and are of the following type:

```
typedef struct {
    T_time    time;
    byte      alarm; // if 0 there are no alarms
    sig16     T1; // [0.1 °C]
    sig16     T2; // [0.1 °C]
    sig16     T3; // [0.1 °C]
} record;
```

The timestamp of the record is time that memorises date and hour according to the following structure:

```
typedef struct {
    uns32     minute:6;
    uns32     hour:5;
    uns32     day:5;
    uns32     month:4;
    uns32     year:7;
} T_time;
```

6.9 Group 0E Ethernet peripheral configuration

Word	Type	Perm	Sect	Description	Notes
0x0E00	uns16	W	2	State/alarms Ethernet module	Managed as bit window: 0x0001 Missing/wrong answer of the control on MODBUS RTU RS232/RS485 for t>5s 0x0002 Link down Ethernet side for t>5s 0x0004 Missing/wrong answer of SERVER for t>5s (if P05 different from empty string) 0x0008 Missing/invalid answer of DHCP server for t>10s 0x0010 Impossibility to solve names through DNS1 and DNS2 for t>10s 0x0020 Missing answer of SMTP server for t>10s 0x0040 Invalid email address 0x0080 Wrong IP configuration (check parameters from P01 to P03)
0x0E01	uns32	W	4	Current IP address	Corresponds to parameter 8-2-2 if DHCP disabled, otherwise it is the assigned dynamic address
0x0E03	uns16	W	2	Frame count MODBUS TCP/IP in	
0x0E04	uns16	W	2	Frame count MODBUS RTU out	
0x0E05	uns16	W	2	Frame count MODBUS RTU in	
0x0E06	uns16	W	2	Frame count MODBUS TCP/IP out	
0x0E07	uns16	R	2	Ethernet management: indicates the activity requested from the Ethernet module The data is placed on zero as soon as the operation has been completed	0 no operation (idle) 1 rereading parameters and reconfiguration (controller → Ethernet module) 2 writing parameters (Ethernet module → controller)
0x0E08	uns16	RW	2	8-2-1 DHCP habilitation	0 disabled, 1 enabled
0x0E09	uns32	RW	4	8-2-2 IP address	IP address A.B.C.D where A is the most significant byte
0x0E0B	uns32	RW	4	8-2-3 Netmask	Netmask A.B.C.D where A is the most significant byte
0x0E0D	uns32	RW	4	8-2-4 Gateway IP address	Like 0x0E01
0x0E0F	uns32	RW	4	8-2-5 DNS1 IP address	Like 0x0E01
0x0E11	uns32	RW	4	8-2-6 DNS2 IP address	Like 0x0E01
0x0E13	ch[40]	RW	40	8-2-7 WEB server	String '\0' ended with numerical notation IP address (ex. A.B.C.D)

					or symbolical to be solved with DNS (ex. smtp.myprovider.com)
0x0E27	ch[40]	RW	40	8-2-8 SMTP server	Like 0x0E13
0x0E3B	ch[40]	RW	40	8-2-9 EMAIL address 1	Like 0x0E13
0x0E4F	ch[40]	RW	40	8-2-10 EMAIL address 2	Like 0x0E13
0x0E63	ch[40]	RW	40	8-2-11 EMAIL address 3	Like 0x0E13
0x0E77	ch[40]	RW	40	8.2.12 MODULE identif.	Like 0x0E13

7 Appendix

7.0 Alarm codes

1	AL00	Missing grid
2	AL01	S1 probe broken
3	AL02	S2 probe broken
4	AL03	Defrosting alarm
5	AL04	Freezing alarm
6	AL05	High temperature alarm
7	AL06	S3 probe broken
8	Door	Door open
9	AL70	Battery alarm
10	AL71	Battery power supply
11	ErPar	Error parameter incongruity
12	DefPar	Error parameter memory
13	Full Memory	Recording memory full
14	Clock	Broken clock
15	AM1	Condenser cleaning
16	AM2	General control
17	AM3	Safety

7.1 Data types

Type	Description	Range	Notes
ch	ASCII Characters (8 bit)		1 byte
byte	Unsigned char (8 bit)	0..255	1 byte
uns16	Unsigned word (16 bit)	0..65535	2 bytes (h-l)
sig16	Signed integer (16bit)	-32768..32767	2 bytes (h-l)
uns32	Unsigned Long Int (32bit)	0..4294967295	4 bytes (h..l)
sig32	Signed Long Int (32bit)	-2147483648..2147483647	4 bytes (h..l)
float	Floating point (32 bit)	-3.4e+38, 3.4e+38	4 bytes coded as: ANSI/IEEE Std754-1985 From the most significant bit: - sign of mantissa - 8 bit for exponent - 23 bit for mantissa

8 Revision index

Rev.	Data	Description	Elaborated	Verified	Approved
0	02/04/12	Emission	M.Felici		
1	06/07/12	Ethernet block revision	M.Felici		
2	18/07/12	General revision	D.Dondarini		
3	19/07/12	Block E0 serial setting elimination	D.Dondarini		
4	01/08/12	Ethernet block address revision	M.Felici		
5	02/08/12	Correct address of Gas type object	M.Felici		
6	22/05/13	Revision of alarm codes and history	D.Dondarini		
7	07/03/14	Data Logger parameter inserted	D.Dondarini		