Boehringer Mannheim GmbH

Host Interface Manual
Miditron M

Version 3.1-1993

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1. Overview

This Manual contains information relating to the signal form and protocol (communication rules) for the connection of the Miditron system to an external computer (hereafter referred to as a Host) via asynchronous serial signal. The data exchange is semiduplex; the operation takes place in a point to point connection. The Miditron device is the master at all times.
Only ASCII symbols are transmitted according to DIN 66003 (hexadecimal values between 01 and 7F)
The activation of the host interface can and must only become effective after a power - off/on at the Miditron device.

DOWNLOAD :
The following effective data are received by the Miditron from the host computer :
Patient identification consisting of ten ASCII symbols, which characterise the test to be evaluated.
For security reasons, Miditron checks each Pat-ID received with the the Pat-ID´s received prior to it; if agreement is detected, then one just received is rejected Miditron internally.
After a certain time, a working list is stored in the device internally. Pat-IDs can also be shifted during measurements so long as there exist results internally for all Pat-IDs, or until the working list contains 270 Pad.IDs (300 strip limit minus a 10% for possible emergency tests).
After a specific time of no response, the Miditron start a time-window of non communication so called auto polling time, (length of the time-window depends on the device setting). After the auto polling time is elapsed, the Miditron keeps starting a new cycle of the down-load data request.
Should a download occur just when the customer activates an up-load process, then the Miditron memorises this and after completion of the down-load, automatically starts with the up-load.

UPLOAD :
The following data are output by the Miditron :
Date, time of measurement, evaluations obtained from the urine test strips, visually obtained evaluations, density values obtained by external means, patient identification numbers, and also the sequence numbers to facilitate co-ordination,as well as customer-specific text and settings .
We distinguish between short protocols (test strip evaluations only) and long protocol (incl. sediment evaluations), as well as between transmission of the results in code (concentration levels, up-load I), and in plain text (up-load II).
Coded evaluations required decoding at the host side. For this, the host must know the corresponding table "concentration level to value and unit". It can request it, if necessary. Also other device settings can be called, as for example customer-specific limits, arbitrary units and screening criteria; the so called operation control protocol (OPC) contain precisely this information.
The Miditron analyses the status of the communication. It measures the respond times of the host, and it checks the parity (optional), the LRC check bytes (optional), and the frame characteristic of the responses. No erroneous protocol is accepted.
An up-load in sequence mode after measurement is also possible as well as in Pat-ID mode. In case of a sequence mode evaluation, the data field of Pat-ID consist only spaces.
Alternative it is possible to activate an automaticly uploading in the time intervall of the choosen autopulling time (priority : downloading before uploading) .

2. Hardware Specification

2.1 Chip Description

The Miditron M-UART (universal asynchronous receiver/transmitter) is the SCN2681 chip. The interactive unit consist as an line driver the 1488 chip and as an line receiver the 1489 chip.

2.2 Pin description at the Miditron M socket

Socket : RS232C 9-pin (male)

Pin No.	Signal	Description	Direction
1	nc	non connected	
2	RxD	Receive Data	in
3	TxD	Transmit Data	out
4	nc	non connected	
5	SG	Signal Ground	--
6	nc	non connected	
7	RTS	Request to Send	out
8	CTS	Clear to Send	in
9	nc	non connected	

Comments:

From the Miditron M the RTS signal is not active (Mark) all the time.
This signal is only useful to check at the Host side if a physical connection is established.

2.3 Recommended cable connection

Miditron M (DTE)	plug 9 pin female	direction	plug 9 pin mail	plug 25 pin mail	HOST (DCE)
	pin 1		pin 1	pin	
RxD	pin 2	<--------	pin 2	pin 2	TxD
TxD	pin 3	--------->	pin 3	pin 3	RxD
	pin 4		pin 4	pin	
GND	pin 5	<------->	pin 5	pin 7	GND
	pin 6		pin 6	pin	
RTS	pin 7		pin 7	pin	
CTS	pin 8		pin 8	pin	
	pin 9		pin 9	pin	

3. Text format

Each transmitted protocol is transmitted as a block. Blocks of Host- and Miditron texts are structured according to the same scheme:

3.1	3.2	3.3	3.4	3.5	3.6
start character	frame field	data field	stop character	check sum	end character
1 byte	3 byte max	705 byte max.	1 byte	2 byte	1 byte

kinds of protocol's :

Trans mitter	SC	FRC	FUC	SP	Pad ID	Seq Nr	Date	Time	Data	EC	CS	CR	SUM
Host	STX	SPE	A	SP	10 chr					ETX	CS 1,2	CR	18
Miditron	STX	SPE	B	SP	10 chr SP	5 num + SP	8 num + SP	5 num + SP	62 chr	ETX	CS 1,2	CR	102
Miditron	STX	SPE	B	SP	10 chr SP	5 num + SP	8 num + SP	5 num + SP	112 chr	ETX	CS 1,2	CR	152
Miditron	STX	SPE	C	SP	10 chr SP	5 num + SP	8 num + SP	5 num + SP	206 chr	ETX	CS 1,2	CR	246
Miditron	STX	SPE	D	SP	10 chr SP	5 num + SP	8 num + SP	5 num + SP	192 chr	ETX	CS 1,2	CR	230
Miditron	STX	SPE	E	SP	10 chr SP	5 num + SP	8 num + SP	5 num + SP	206 chr	ETX	CS 1,2	CR	246
Miditron	STX	SPE	F	SP	10 chr SP	5 num + SP	8 num + SP	5 num + SP	206 chr	ETX	CS 1,2	CR	246
Miditron	STX	ANY								ETX	CS 1,2	CR	6
Mid/Host	STX	REP								ETX	CS 1,2	CR	6
Miditron	STX	SPM								ETX	CS 1,2	CR	6
Host	STX	MOR								ETX	CS 1,2	CR	6
Host	STX	OPC	G-U	SP						ETX	CS 1,2	CR	8
Miditron	STX	OPC	G-Q	SP					523 chr	ETX	CS 1,2	CR	531
Miditron	STX	OPC	R-S	SP					705 chr	ETX	CS 1,2	CR	713
Miditron	STX	OPC	T	SP					72 chr	ETX	CS 1,2	CR	80
Miditron	STX	OPC	U	SP					79 chr	ETX	CS 1,2	CR	87
Miditron	STX	END								ETX	CS 1,2	CR	6

SC : start character
FRC : frame code
FUC : function code
SP : space
EC : end character
CS : check sum
CR : carriage return

3.1 Start character

Each transmitted text begins with the start character " STX " and it is 1 byte long.
The hex. code of " STX " is 02 hex and the ASCII character is ☺.

start character
1 byte
STX
02 hex
☺

3.2 Frame field

The frame field represents the purpose of text (contents of message) and consist the frame code, function code and space.

frame field		
frame code	**function code**	**space**
1 byte	1 byte	1 byte
SPE, SPM, ANY, REP, MOR, OPC, END	A...U	SP
(3B, 3C, 3E, 3F, 3E, 3D, 3A) hex	41 hex ... 55 hex	20 hex
; < > ? > = :	A...U	▪

("▪" means blank)

3.2.1 Frame code types :

frame code	HEX	ASCII	description
SPE	3B	;	start UP- or Down-Load
SPM	3C	<	readiness for UP-Load data transmission
ANY	3E	>	request and confirmation of Down-Load data
REP	3F	?	replay of last transmitted data
MOR	3E	>	request of more UP-Load data
OPC	3D	=	request of instrument setting data
END	3A	:	stop of UP-Load

3.2.2 Function code types:

function code	HEX	ASCII	description
A	41	A	only used by down-loading (request of samples)
B	42	B	Protocol I : Test strip results only (coded)
B	42	B	Protocol I : Test strip results + Sediment results (coded)
C	43	C	Protocol II/I : Test strip/Sediment results Part 1 (without Sediment)
D	44	D	Protocol II/II : Test strip/Sediment results Part 2 (Sedi + Appearance)
E	45	E	Protocol II : Test strip results only
F	46	F	Protocol II : Test strip results (no Sediment results existing)
G	47	G	OPC : request for ranges of SG
H	48	H	OPC : request for ranges of PH
I	49	I	OPC : request for ranges of LEU
J	4A	J	OPC : request for ranges of NIT
K	4B	K	OPC : request for ranges of PRO
L	4C	L	OPC : request for ranges of GLU
M	4D	M	OPC : request for ranges of KET
N	4E	N	OPC : request for ranges of UBG
O	4F	O	OPC : request for ranges of BIL
P	50	P	OPC : request for ranges of ERY
Q	51	Q	OPC : request for ranges (additional test field)
R	52	R	OPC : request for the first 15 sediment texts
S	53	S	OPC : request for the second 15 sediment texts
T	54	T	OPC : request for Screening criteria's
U	55	U	OPC : request for other instrument information and settings

3.3 Data field

The Data field consist the information of Pat. ID, Seq. No., date, time and results.

Data Field				
Pat-ID	**Seq. No.**	**Date**	**Time**	**Results**
10/11 byte	6 byte	9 byte	6 byte	62 ... 705 byte
0...9 / + SP	0...9 + SP	0...9 + SP	0...9 + SP	0...9
(30...39/+20) hex	(30...39 +20) hex	(30...39 +20) hex	(30...39 +20) hex	(30...39) hex

3.3.1 Pat. ID

Upload:
The Patient ID contains 11 numeric character including a space witch are transmitted left hand oriented. If no Pat .ID given this field contains only spaces .
Download:
This is the only Information (without an additional space) witch is transmitted from Host.
Example : ***Pat.ID.: 978445***

Pat. ID										
9	7	8	4	4	5	SP	SP	SP	SP	SP

3.3.2 Sequence Number

The sequence number is generated on Miditron and transmitted to the host in case of upload.
Example : ***Sequenz number : 137***

Seq. No.					
SP	SP	1	3	7	SP

3.3.3 Date

This is the date of test strip measureing.
Example: ***17.07.92***

Date								
1	7	.	0	7	.	9	2	SP

3.3.4 Time

This is the time of test strip measuring.
Example: ***14:35***

Time					
1	4	:	3	5	SP

3.3.5 Results

The length and the information of the result field depends on the transmitted function code in the frame field (see also chapter 3.2.2).
Table of the different result field length :

function code	B	B	C	D	E	F	G...Q	R...S	T	U
length of result in byte (max.)	62	112	206	192	206	206	523	705	72	79

Examples of result fields :
(the character "|" means only a separation of contents and is not transmitted)

function code B :

(coded results)			example	
byte 37... 41	length : 5		▪1|▪6|▪|	(SG, 1.030)
byte 42... 46	length : 5		▪2|▪1|▪|	(PH, 6.0)
byte 47... 51	length : 5		▪3|▪0|▪|	(LEU, neg)
byte 52... 56	length : 5		▪4|▪0|▪|	(NIT, neg)
byte 57... 61	length : 5		▪5|▪1|▪|	(PRO, 0.25g/l)
byte 62... 66	length : 5		▪6|▪0|▪|	(GLU, norm)
byte 67... 71	length : 5		▪7|▪0|▪|	(KET, neg)
byte 72... 76	length : 5		▪8|▪0|▪|	(UBG, norm)
byte 77... 81	length : 5		▪9|▪0|▪|	(BIL, neg)
byte 82... 96	length : 5		10|▪0|▪|	(ERY, neg)
byte 87... 91	length : 5		11|▪▪|▪|	(NAG, ---)
byte 92... 98	length : 7		50|*|	(external SG) optional

* = only transmitted when available

function code B :

(coded results)			example	
byte 37... 41	length : 5		▪1|▪6|▪|	
byte 42... 46	length : 5		▪2|▪1|▪|	
byte 47... 51	length : 5		▪3|▪0|▪|	
byte 52... 56	length : 5		▪4|▪0|▪|	
byte 57... 61	length : 5		▪5|▪1|▪|	
byte 62... 66	length : 5		▪6|▪0|▪|	
byte 67... 71	length : 5		▪7|▪0|▪|	
byte 72... 76	length : 5		▪8|▪0|▪|	
byte 77... 81	length : 5		▪9|▪0|▪|	
byte 82... 96	length : 5		10|▪0|▪|	
byte 87... 91	length : 5		11|▪▪|▪|	
byte 92... 98	length : 5		12|▪4|▪|	(example of sediment result) optional

.

. (sediment results max.10x) only transmitted when available
.
byte 135...148 length : 4 41|▪4|▪| (example of sediment result) optional

function code C, E, F :

part I (test strip results) example

byte 37... 49 length : 13 SG|▪▪▪▪▪|▪|▪▪▪▪|▪|
byte 50... 60 length : 11 PH|9.0|▪|++++|▪|
byte 61... 80 length : 20 LEU|▪▪▪▪▪▪▪▪neg|▪|NEG|▪|
byte 81... 92 length : 12 NIT|pos|▪|▪▪▪▪|▪|
byte 93...112 length : 20 PRO|▪▪▪25▪mg/dl|▪|▪TR▪|▪|
byte 113...132 length : 20 GLU|▪▪▪50▪mg/dl|▪|▪▪+▪|▪|
byte 133...152 length : 20 KET|▪▪▪▪▪▪▪▪neg|▪|▪▪▪▪|▪|
byte 153...172 length : 20 UBG|▪▪▪▪▪▪▪norm|▪|NORM|▪|
byte 173...192 length : 20 BIL|▪▪▪▪▪▪▪▪neg|▪|▪NEG|▪|
byte 193...212 length : 20 ERY|▪▪▪▪▪▪▪▪neg|▪|▪▪-▪|▪|
byte 213...232 length : 20 NAG|▪▪▪▪▪▪▪▪▪▪▪|▪|▪▪▪▪|▪|
byte 233...242 length : 10 phySG|1.030| optional

function code D:

part II (sediment results) example

byte 37... 55 length : 19 ERY▪▪▪▪▪▪▪|++▪▪▪▪▪▪|▪|
byte 56... 74 length : 19 LEUCO▪▪▪▪▪|FEW▪▪▪▪▪|▪|
.
. (sediment results max. 10x) only tranmitted when aviable
.
byte 209...226 length : 19

3.4 OPC-function codes G...U (Operation Control)

example of OPC protocols "G...Q" Miditron/Host :

HOST

Byte No.	length	meaning	example
1	1	start character	STX
2	1	frame code	OPC
3	1	function code	G
4	1	space	SP
5	1	stop character	ETX
6...7	2	check sum	(LRC1 LRC2)
8	1	end character	CR

byte 24 to 31 max. 28 times repeated

Miditron

Byte No.	length	meaning	example
1	1	start character	STX
2	1	frame code	OPC
3	1	function code	G
4	1	space	SP
5	1	mark	*
6...13	8	date	12.07.92
14	1	space	SP
15...19	5	operator ID	123
20	1	space	(
21...23	3	parameter name	(SG
24...25	2	index of concentration level	(0
26	11	text of concentration level	((((((1.000
27...30	4	text of arbitray level	((- (
31	1	index of arbitray level	1
32	1	stop character	ETX
33...34	2	check sum	(LRC1, LRC2)
35	1	end character	CR

example of OPC protocols "R, S" Miditron :

		example
byte 01... 01	length : 1	(STX)
byte 02... 02	length : 1	=
byte 03... 03	length : 1	R
byte 04... 04	length : 1	▪
byte 05... 56	length :52	12|ERYTROZYT.|5-10▪▪▪▪|11-20▪▪▪|21-30▪▪▪|
		>30▪▪▪▪▪|▪▪▪▪▪▪▪▪|
.		
. 13 x		
.		
byte 733...784	length :52	26|▪▪▪▪▪▪▪▪▪▪|▪▪▪▪▪▪▪▪|▪▪▪▪▪▪▪▪|▪▪▪▪▪▪▪▪|▪▪▪▪▪▪▪▪|
		▪▪▪▪▪▪▪▪|
byte 785...785	length : 1	(ETX)
byte 786...786	length : 1	(LRC1)
byte 787...787	length : 1	(LRC2)
byte 788...788	length : 1	(CR)

example of OPC protocol "T" Miditron :

		example
byte 01... 01	length : 1	(STX)
byte 02... 02	length : 1	=
byte 03... 03	length : 1	T
byte 04... 04	length : 1	▪
byte 05... 12	length : 8	▪1|▪0|▪2|1|▪|
.		
. 13 x		
.		
byte 85... 92	length : 7	11|▪0|55|0|▪|
byte 93... 93	length : 1	(ETX)
byte 94... 94	length : 1	(LRC1)
byte 95... 95	length : 1	(LRC2)
byte 96... 96	length : 1	(CR)

example of OPC protocol "U" Miditron :

		example
byte 01... 01	length : 1	(STX)
byte 02... 02	length : 1	=
byte 03... 03	length : 1	U
byte 04... 04	length : 1	▪
byte 05... 31	length :27	BOEHRINGER▪MANNHEIM▪GmbH▪▪|▪|
byte 32... 83	length :52	0|4|1|2|0|1|2|1|0|4|1|2|▪|1|0|▪|▪2.3▪|▪1.30|▪7.4▪|▪|010|
		▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪|
byte 84... 84	length : 1	(ETX)
byte 85... 85	length : 1	(LRC1)

byte 86... 86 length : 1 (LRC2)
byte 87... 87 length : 1 (CR)

3.5 LRC calculation

The LRC test bytes are in the natur of a longitudinal redundance check. It is so called a "length parity" over the bits of the data protocol. The procedure is simple: byte for byte of the protocol are linked bit by bit with XOR. The resulting byte is split into two bytes (for the purpose of avoiding the occurrence of transmission controls), and are attached to the protocol.

LRC-byte = byte 1 XOR byte 2 XOR byte3 ... XOR byte last

LRC1-byte = high-nibble (moved by 4 bits) of the LRC byte OR 30 *hex*
LRC2-byte = low-nibble of the LRC byte OR 30 *hex*

example:

byte no.	bit no.	bit no.	bit no.	bit no.	bit no.	bit no.	bit no.	bit no.
	8	7	6	5	4	3	2	1
1	0	1	1	0	0	0	1	0
2	0	0	0	0	0	0	1	1
3	0	0	1	1	0	1	1	0
4	0	0	1	1	1	0	1	0
5	0	0	1	1	1	1	1	0
LRC byte	0	1	0	1	0	0	1	1
high nibble	0	1	0	1				
low nibble					0	0	1	1

LRC1-byte =	0	0	1	1	0	0	0	0	30 *hex*
OR	0	0	0	0	0	1	0	1	high-nibble
	0	0	1	1	0	1	0	1	

LRC2-byte =	0	0	1	1	0	0	0	0	30 *hex*
OR	0	0	0	0	0	0	1	1	low-nibble
	0	0	1	1	0	0	1	1	

All bytes starting with STX to ETX are taken into account for the calculation of the LRC.
Is the parity check deactivated the instead of the LRC check bytes there will be transmitted LRC1=LRC2=20*hex*=blank !

4. Signal Description

4.1 Setting of Miditron Host-interface

item	specification	default
parity	even, odd, none	none
baud rate	1200, 2400, 4800, 9600	9600
stop bits	1, 2	1
bits / char.	7, 8	8
protocol	encoded, long form	encoded
check sum	on, off	off
auto polling interval in minutes	0.5, 1, 3, 5	0.5

Remark: Autopulling ab 3.0 o.5 min. !!!

4.2 Signal discrimination

Signal	Binary	Level	RS232 Voltage
Mark (OFF)	logic "1"	low	<= - 3V
Space (ON)	logic "0"	high	< +3V

4.3 Signal timing

4.3.1 Down Load

a)

Miditron :

STX	Frame	ETX	LRC1	LRC2	CR

|20 ms| |20 ms| |20 ms| |20 ms| |20 ms| **max. delay-time (byte to byte)**

b)

response time Host : 15 sec. max. then autopulling pause.

c)

Host :

STX	Frame	F-Code	Space	ID No	ETX	LRC1	LRC2	CR

|<----------max. transmitting time : **1.5 sec.**----------|

d)

Miditron :

STX	Frame	ETX	LRC1	LRC2	CR

|20 ms| |20 ms| |20 ms| |20 ms| |20 ms| **max. delay-time (byte to byte)**

4.3.2 Up Load

a)

Miditron:

STX	Frame	ETX	LRC1	LRC2	CR

|20 ms| |20 ms| |20 ms| |20 ms| |20 ms| **max. delay-time (byte to byte)**

b)

response time Host : 15 sec. max.

repeat Miditron string (a) max. 3 times then stop Up-Load

c)

Host :

STX	Frame	(F-Code)	(Space)	ETX	LRC1	LRC2	CR

|<----------max. transmitting time : **1.5 sec.**----------|

d)

Miditron:

STX	Frame	F-Code	Space	...|| Data ||...	ETX	LRC1	LRC2	CR

|20 ms| |20 ms| |20 ms| ..... **max. delay-time (byte to byte)**