External Communication Hamilton RS232 Block Protocol

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REVISION NOTES

For older revisions see older documents

1.10   2015-03-03   Adit Jain
Protocol Version 1.0.6
Kistler Michael:
- Wave Mode 2 and Mixed Mode 2 added for Platform G
- Parameter 0x4C Vti prox in insp added to group Special Monitored Parameters
- Parameter 0x4D Vti servo in insp added to group Special Monitored Parameters
Daniel Krähenbühl:
- 0x27 Added Increase Rapidly
- Added Protocol Version Format change information
Adit:
[SPEC.0011] Control Settings:
- 0x21 Mode has three new values in Platform C: (S)CMV(=3), SIMV(=4), Hi Flow O2(=20) in Platform C
- 0x2B Pause Time added for Platform C
- 0x3D Peak Flow added for Platform C
- 0x29 Tidal Volume is transmitted additionally for (S)CMV/SIMV in Platform C
- 0x3A Trigger has one new Value for Platform C: P Trigger(=1)
- 0x2D Pressure Trigger added for Platform C
- 0x85 Flow added for PlatformC
- 0x48 Tip added for PlatformC
[SPEC.0015] Monitored Parameters:
- 0x6E New Parameter added 'Pvent' for Platform C
- 0x6F New Parameter added 'Qvent' for Platform C
Robert Nawfal:
- Added HLI value for Platform C, not in Special monitored parameters, No NK raw value:
- [SPEC.0011] Monitored Parameters (Group Id 0x50)
- [SPEC.0015] Control Settings (Group Id 0x70)
- [SPEC.0018] Controller State (Group Id 0x52)
- [SPEC.0016] Alarm Limits Settings (Group Id 0x71)

1.11   2015-04-09   Adit Jain
- Removed PVent from PlatformC
- Changed ID of QVent from 0x6F => 0x6E
- Added FlowPattern for PlatformC

1.12   2015-04-27   Adit Jain
- EXM Review
- HiFlowO2 für PlatformG removed

1.13   2015-06-10   Frehner Christian
2015-05-26 Adit Kumar Jain
[SPEC.0011],[SPEC.0016]: PVI added for PlatformC
2015-06-10 Christian Frehner
Chapter 1.3 Scope updated
[SPEC.0007],[SPEC.0022]:
- Group Special Settings added for PlatformG
[SPEC.0012]:
- New PlatformG Id's 0x4E, 0x4F, 0x50, 0x51
[SPEC.0015]:
- Id 0x3A Trigger auto added for PlatformG
- ID's 0x79-0x80 obsolete (ASV+)
- New PlatformG Id's 0x84, 0x86, 0x87

1.14   2015-09-28   Costa Marco
2015-07-14   Krähenbühl Daniel
Support für C2 in Scope hinzugefügt
2015-07-27   Adit Kumar Jain
Added VT/IBW for PlatformC
2015-08-29 Adit Kumar Jain
-    Added Control Settings SpO2 Response (0x87)
-    Added Control Settings PulseDetectionSensitivity (0x89)
-    Added Control Settings PVI Averaging Mode (0x8A)
2015-09-01 M. Kistler
In Special Monitored Parameters Vti prox in insp(0x4C) and Vti servo in insp(0x4E) are also available in Platform C.
2015-09-09 M. Kistler
In Control Settings group Lower Oxygen limit (0x8B) added.
2015-09-18 Marco Costa
Quick Wean Parameters added (Group Quick Wean Settings)
Group Monitored Parameters: Parameters 0x68, 0x69 and 0x6A are available for PlatformC
No changes for PlatformG

1.15   2015-11-09   Pokorny Heinz
PlatfromG
[SPEC.0008]
Id 0x21 Mode Hi Flow O2 available
[SPEC.0015]
Id 0x85 Setting Flow available
[SPEC.0011]
Id 0x6F FlowServoMean added
No changes for PlatformC

1.16   2015-11-17   Costa Marco
[Spec 0006]
Ventilator status bits. Bit 0, 1 and 2: For Inspiration Hold these bits remain unchanged
[SPEC.0015]
Id 0x8B Lower Oxygen limit available for PlatformG

1.17   2016-01-19   Kistler Michael
 Parameter 0x24 Check flow sensor for water state added to group 0x53 Special State.
1.18   2016-07-07   Adit Jain
- Added Speaking Valve to Control Settings

CONTENTS

REQUIREMENTS

1 INTRODUCTION

1.1 Legal notice

Hamilton Medical AG expressly disclaims any obligation or undertaking to inform its stakeholders and third parties about possible changes to the protocol. Thus by making use of the protocol you agree that the protocol is provided "AS-IS" and with NO WARRANTIES and that Hamilton Medical AG shall not be LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES and assumes no responsibility or liability for any loss or damage suffered by any person as a result of the use or misuse of the protocol.

1.2 Purpose

This document contains the relevant information for external (outside Hamilton Medical) people about the *Hamilton RS232 Block Protocol* implemented in new Hamilton ventilators.

The *Hamilton RS232 Block Protocol* is a continuous sending data protocol for waves and parameters.

Main differentiation to the older Hamilton RS232 Protocol described in [1] :

	(new) RS232 Block Protocol	**(old) RS232 Protocol**
Scope	Platform C Platform G	Platform C Platform G Galileo Raphael Amadeus Veolar
Sending mode	Continuous sending (group-wise polling possible)	Polling (each parameter and waves)
Speed	Faster: - 38400 baud - 8 data bit	Slower: - 9600 baud - 7 data bit
Waves	**8** waves Higher resolution: Flow ➔ 0.1ml/s Volume ➔ 0.1ml	**4** waves Lower resolution: Flow ➔ 2.5ml/s Volume ➔ 2.5ml
Parameters	All relevant parameters	Parameters limited due to Id-Range

1.3 Scope

Hamilton Ventilators for Platform C and Platform G.

Availability of the Hamilton RS232 Block Protocol:

Protocol Version[1]	Document Version	Platform	Hamilton Ventilators	Ventilator SW Versions
1.0.0	1.0	Platform C	Hamilton-C1 / T1	not available
			Hamilton-C2	
			Hamilton-C3	
		Platform G	Hamilton-G5 / S1	VUP02.0x

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[1] see chapter 2.1

1.0.1	1.1	Platform C	Hamilton-C1 / T1	not available
			Hamilton-C2	
			Hamilton-C3	
		Platform G	Hamilton-G5 / S1	VUP02.1x
1.0.2	1.2	Platform C	Hamilton-C1 / T1	not available
			Hamilton-C2	
			Hamilton-C3	
		Platform G	Hamilton-G5 / S1	VUP02.2x
1.0.3	1.5	Platform C	Hamilton-C1 / T1	not available
			Hamilton-C2	
			Hamilton-C3	
		Platform G	Hamilton-G5 / S1	>= VUP02.3x
1.0.4	1.6	Platform C	Hamilton-C1 / T1	>= 2.1.0
			Hamilton-C2	>= 2.2.0 (from Mainboard PN 160383)
			Hamilton-C3	not available
		Platform G	Hamilton-G5 / S1	>= VUP02.4x
1.0.5	1.8	Platform C	Hamilton-C1 / T1	not available
			Hamilton-C2	
			Hamilton-C3	>= 1.1.0
		Platform G	Hamilton-G5 / S1	not available
1.0.6	1.10-1.17	Platform C	Hamilton-C1 / T1	TBD
			Hamilton-C2	
			Hamilton-C3	>= 2.0.0
		Platform G	Hamilton-G5 / S1	>= VUP02.6x
1.0.7	1.18	Platform C	Hamilton-C1 / T1	>= 2.2.0
			Hamilton-C2	TBD
			Hamilton-C3	
		Platform G	Hamilton-G5 / S1	TBD

1.4 Definitions and Acronyms

✗   not available
✓   available

Platform	Hamilton Ventilators
Platform C	Hamilton-C1 Hamilton-T1 Hamilton-C2[2] Hamilton-C3
Platform G	Hamilton-G5 Hamilton-S1

1.5 References

| Reference (Reference-No., Doc.-No., Title) |
| [1] 950021   External Communication Hamilton RS232 Protocol |

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[2] from Mainboard 160382

2 PROTOCOL SPECIFICATION

2.1 Protocol version

This document release describes the
Hamilton RS232 Block Protocol version:

1.0.7 (!)

(!) **Important notice**: When the Protocol Version changes from 1.0.9 to 1.1.0, the format will change from **X.X.X** to **<x>.<x>.<x>** (see [SPEC.0009] SW-Versions (Group Id 0x41) Parameter 0x21 – Protocol Version). Please make sure that compatibility is ensured for your future releases.

Version declaration:	<X>.<Y>.<Z>	Increasing rules
Main version:	<X>	Increases at major protocol changes
Release:	<Y>	Increases at minor protocol changes, compatibility not ensured
Revision:	<Z>	Increases, if protocol extended only (e.g. new parameter Id added) or typing corrections, but the protocol keeps compatibility

2.2 Data transmission configuration

The following communication parameters are used for data transmission to external Monitoring devices:

Parameter	Value	Remark
Baud rate	38400	
Data bits	8	
Stop bits	1	
Parity	No	Data integrity is verified by checksum
Handshake	No	

Transmission capacity:
- ➔ 3840 Bytes/s[3]
- ➔ **374 Bytes/100ms**[4]
- ➔ **184 Bytes/50ms**[5]

2.3 Used characters

control character	Hex	Decimal
<STX>	0x02	2
<ETX>	0x03	3
<HT>	0x09	9
<VT>	0x0B	11
<CR>	0x0D	13

- Transmitted data characters range 0x20 to 0xFF
- No data character lower then 0x20 is transmitted, to avoid conflicts with control characters

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[3] 10 bits used for transmission of one Byte (8 data bits, 1 start bit, 1 stop bit)

[4] 3840 Byte/s ➔ 384 Bytes/100ms; 10 Bytes reserve ➔ **374 Bytes/100ms**

[5] 3840 Byte/s ➔ 192 Bytes/50ms; 8 Bytes reserve ➔ **184 Bytes/50ms**

2.4   Protocol Introduction

The Hamilton RS232 Block Protocol operates with two Modes:
- **Wave Mode**
- **Mixed Mode**

Wave Mode:
In the Wave Mode, all available waves (maximal 8) are sent in high resolution (5ms or 10ms Sampling Rate). Therefore, every 50ms a data block with 10 or 5 samples per wave is transmitted.

Mixed Mode:
In the Mixed Mode, both waves and as parameters may be transmitted. To make sure there is enough space left to transmit the parameters, the waves are sent with a resolution of 20ms Sampling Rate. Therefore the samples are filtered (not averaged).
The Mixed Mode is configurable. The wave transmission may be activated or deactivated. On deactivated wave transmission, there is more space for sending parameter data. The parameters are combined as groups (see chap. 3). Each group may be configured, if and when it is transmitted (see chap. 2.8.1).
In the Mixed Mode, every 100ms a data block is transmitted except after "Stop Sending" (see chap. 4.1.1). The block size is variable, but limited to the maximum of **374 Bytes / 100ms**. Hence the receiver can prepare for the maximum block size. The real block size is not explicitly transmitted (due to overhead reduction). It is given by control characters (see chap. 2.8.3)
There may more than the maximum block size of data ready to be sent. The pending wave data is transmitted with each data block. The remaining space is filled with ready to send parameter data. The remaining pending parameter data are sent within the next 100ms data block(s).

If a parameter group gets ready to send (e.g. due to timeout or new breath) while the group is being sent (part of the group is already transmitted), the sending of the group is completed and then transmitted once more.

Per default the protocol is in Mixed Mode, where the sending of the waves and the sending of each parameter group is deactivated (same condition as after stop sending -> see chap. 4.1.1)

A new activate command (Wave or Mixed Mode) is immediately active, i.e. a possible active sending of a parameter group from the previous command will not be finished.

2.5   Commands

Command	Code	Remark	PlatformG	PlatformC
Activate Wave Mode 1	0x30	Activates the high resolution wave sending.	✓	✓
Activate Mixed Mode 1	0x31	Activates the Mixed Mode sending and configures the sending behavior of waves 1 and parameter groups. With this command it is also possible to stop sending of any response block (see chap. 4.1.1).	✓	✓
Request Group	0x32	Single Request of all parameters from one group. This command does not have its own response block. The response is sent within the 100ms cycled data response blocks of the Mixed Mode (Command Code 0x31). ➔ This command is ignored during active Wave Mode	✓	✓
Activate Wave Mode 2	0x33	Activates the high resolution wave sending. Plethysmogram 2 is replaced with Qvent (internal flow)	✓	✓
Activate Mixed Mode 2	0x34	Activates the Mixed Mode sending and configures the sending behavior of waves 2 and parameter groups. With this command it is also possible to stop sending of any response block (see chap. 4.1.1).	✓	✓
<Reserved>	0xA0 .. 0xAF	Reserved for Hamilton internal use.	✓	✓

2.6   Common Transmission Format Rules

All transmission blocks, i.e. commands as well as the cycled response data blocks have following body:

Byte	Format	Remark
1	<STX>	Start character
2	Command Code	Identification of command and response data block
3..n	Data	ASCII characters from 0x20 to 0xFF (Decimal 32 to 255)
n+1	<ETX>	End character
n+2.. n+3	CRC checksum	CRC-8 Checksum (see chap. 2.6.1)
n+4	<CR>	Command respectively response data block ending

- Received commands in a wrong format or with invalid checksum are ignored.

2.6.1 CRC checksum

The checksum is calculated as CRC-8 with Polynomial $x^8 + x^7 + x^6 + x^4 + x^2 + 1$ (0xD5).

The checksum is calculated over all characters from <STX> to and including <ETX>.

The calculated 8 Bit checksum is transmitted as ASCII Hexadecimal with two Bytes.
Example:

Byte	Value	Remark
1	ASCII "C" (0x43)	Calculated CRC-8 checksum of decimal 198 (= 0xC6)
2	ASCII "6" (0x36)	

Hints for SW Developer:

At http://www.mikrocontroller.net/topic/155115 you will find a C-source code to calculate CRC8.

You can verify your CRC Routine by a CRC Calculator on the Web, e.g. with
http://www.zorc.breitbandkatze.de/crc.html with following CRC parameters:

CRC order (1..64)	*8*
CRC polynom (hex)	*D5*
Initial value (hex)	*0*
Final XOR value (hex)	*0*

Example to verify the CRC checksum
Data Sequence of "0x02 0x31 0x30 0x03" (from example 4.1.1)

Figure 1: Screenshot from http://www.zorc.breitbandkatze.de/crc.html

Hex values are entered with a "%" before the number.

2.7   Transmission Format: Wave Mode

2.7.1   [SPEC.0001] Command: Activate Wave Mode (Code 0x30):

Byte	Format	Remark
1	\<STX\>	
2	Command Code (0x30)	
3	\<ETX\>	
4..5	CRC checksum	
6	\<CR\>	

2.7.2   [SPEC.0002] Response Format Wave Mode (every 50ms):

Byte	Format	Remark
1	\<STX\>	
2	Command Code (0x30)	
3..4	Block Number	Cyclic consecutive number (00..99 / ASCII)[6]
5..8	Breath Number	Cyclic consecutive breath number (0000..9999 / ASCII)
9..10	Sampling Rate	Sampling Rate [ms] as ASCII characters. - Platform G: **05** (0x30, 0x35) - Platform C: **10** (0x31, 0x30)
11..27	Sample 1 (State and 8 Waves)	Details for one Sample see chap. 2.9
28..44	Sample 2 (State and 8 Waves)	
45..61	Sample 3 (State and 8 Waves)	Sampling Rate 5ms ➔ Sample 1..10
62..78	Sample 4 (State and 8 Waves)	Sampling Rate 10ms ➔ Sample 1..5
79..95	Sample 5 (State and 8 Waves)	
(96..112)	Sample 6 (State and 8 Waves)	
(113..129)	Sample 7 (State and 8 Waves)	
(130..146)	Sample 8 (State and 8 Waves)	
(147..163)	Sample 9 (State and 8 Waves)	
(164..180)	Sample 10 (State and 8 Waves)	
92 or 181	\<ETX\>	
93..94 or 182..183	CRC checksum	
95 or 184	\<CR\>	

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[6] The number will not be reset on switching between Wave and Mixed Mode.

2.8   Transmission Format: Mixed Mode

2.8.1   [SPEC.0003] Command: Activate Mixed Mode (Code 0x31):

Byte	Format	Remark
1	<STX>	
2	Command Code (0x31)	
3	Waves sending: 0 (0x30) ➔ Off 1 (0x31) ➔ On	On / Off for sending waves.
4..n	Parameter Group Configuration (5 Bytes each group)	Details for "Configuration for one group" see below. Each group not mentioned is handled as default: (Sending Off, Repeat Timer Off).
n+1	<ETX>	
n+2.. n+3	CRC checksum	
n+4	<CR>	

Configuration for one group:

Byte	Format	Remark
1	Group Id	Group Id according to chap. 3.2
2	Send State	Details for Send State see below.
3-5	Repeat Timer, 3 characters ASCII (0x30..0x39) 000 ➔ Timer Off (default) 001..999 ➔ Repeat Time [s]	A repeat timer may be set independent of the Send State. After each timeout, all parameters of this group are sent.

Send state:

ASCII Code	State	Remark
0 (0x30)	Send timed only (default)	The parameter sending of this group is defined by the Repeat Timer only.
1 (0x31)	Send once	All parameters of this group are sent once.
2 (0x32)	Send breath by breath	All parameters of this group are sent once, then repeating the sending breath by breath.
3 (0x33)	Send on change	All parameters of this group are sent once, then repeating the sending each time, if at least one parameter changes (except parameter 0x20, which is reserved for the breath number –> see chapter 3.3).

2.8.2   [SPEC.0004] Command: Request Group (Code 0x32):

Byte	Format	Remark
1	<STX>	
2	Command Code (0x32)	
3	Group Id	Group Id according to chap. 3.2
4	<ETX>	
5..6	CRC checksum	
7	<CR>	

2.8.3 [SPEC.0005] Response Format Mixed Mode (every 100ms):

Byte	Format	Remark
1	<STX>	
2	Command Code (0x31)	
3..4	Block Number	Cyclic consecutive number (00..99 / ASCII)[7]
(5..8)	Breath Number	Only if wave sending On. Cyclic consecutive breath number (0000..9999 / ASCII)
(9..10)	Sampling Rate	Only if wave sending On. Sampling Rate [ms] as ASCII characters. - Platform G: **20** (0x32, 0x30) - Platform C: **20** (0x32, 0x30)
(11..27)	Sample 1 (Status und 8 Waves)	Only if wave sending On.
(28..44)	Sample 2 (Status und 8 Waves)	Details for one Sample see chap. 2.9
(45..61)	Sample 3 (Status und 8 Waves)	
(62..78)	Sample 4 (Status und 8 Waves)	
(79..95)	Sample 5 (Status und 8 Waves)	
5 or 96	ASCII VT (Decimal 11, Hex 0B)	Waves End ➔ is also transmitted if wave sending Off
6..n or 97..n	Parameter Data Corresponding to the sending state of each group, this band is filled with parameter data.	Details "Data for each Parameter" see below. Maximum Block size = 374 Bytes Block end = 4 Bytes ➔ n max = 370
n+1	<ETX>	
n+2.. n+3	CRC checksum	
n+4	<CR>	

Data for each Parameter:

Byte	Format	Remark
1	Group Id	Group Id according to chap. 3.2
2	Param Id	Parameter identification within a group. Param Id according to chap. 3.4
3..n	Param Data, ASCII character from 0x20 to 0xFF	Param Data according to chap. 3.4
(n+1)	<VT>	<VT> is sent as delimiter, if further parameters following within the response block[8]

Group End ➔ Following sequence indicates that all parameters of a group have been sent:

Byte	Format	Remark
1	Group Id	Group Id according to chap. 3.2
2	0xFF	Parameter identification 0xFF is reserved as *Group End* indicator
(n+1)	<VT>	<VT> is sent as delimiter, if further parameters (of the next group) following within the response block[8]

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[7] The number will not be reset on switching between Wave and Mixed Mode.
[8] This means no <VT> will be sent directly before a <ETX>

Rules for sending of Parameter Data:

- Parameters are sent group by group.

- If a group cannot be fully transmitted within a response block (due to insufficient space), the next response block continues to sending the next parameters of this group.

- If a group is fully transmitted (after sending *Group End*), the next "to be transmitted" group are sent. There is no special sending priority within the groups.

- All transmitted parameters of a group corresponds to the parameters values at the time, when the group starts sending its first parameter.

- If a group becomes "to be transmitted" while their transmission is running, the sending of the group will be finished. The group keeps the state "to be transmitted", so it is sent again (after checking the other groups for transmission).

2.9   [SPEC.0006] Wave Data Details

2.9.1 Wave mode 1

Sending details for each sample:

Byte	Format	Remark
1	Ventilator status as follows: Bit 0 1 = mandatory inspiration Bit 1 1 = spont inspiration Bit 2 1 = patient trigger Bit 3 Reserve Bit 4 1 = Exhalation Bit 5 1 = Volume high resolution Bit 6 1 = Flow high resolution Bit 7 must be set high	**Bit 0, 1 and 2:** e.g. SIMV patient triggered mandatory breaths are sent as "mandatory inspiration" and "patient trigger" (at inspiration begin) **During exp-hold none of these bits are set.** **Bit 5:** High resolution bit is set if volume < 100ml. Otherwise bit is 0. **Bit 6:** High resolution bit is set if flow < 800ml/s. Otherwise bit is 0. **Bit 7:** Set to 1 to avoid conflict with control characters.
2 3	**p-Patient** low Byte **p-Patient** high Byte	Resolution per LSB: **[0.1 cmH$_2$O]**
4 5	**p-Optional** low Byte **p-Optional** high Byte	Resolution per LSB: **[0.1 cmH$_2$O]**
6 7	**Flow**[9] low Byte **Flow**[9] high Byte	Resolution per LSB (see Byte 1, Bit 6): ➔ Flow high resolution: **[0.1 ml/s]** ➔ Flow low resolution: **[1 ml/s]**
8 9	**Volume** low Byte **Volume** high Byte	Resolution per LSB (see Byte 1, Bit 5): ➔ Volume high resolution: **[0.1 ml]** ➔ Volume low resolution: **[1 ml]**
10 11	**PCO2** low Byte **PCO2** high Byte	Resolution per LSB: **[0.1 mmHg]** ➔ Only positive values
12 13	**FCO2** low Byte **FCO2** high Byte	Resolution per LSB: **[0.01 %]** ➔ Only positive values
14 15	**Plethysmogram 1** low Byte **Plethysmogram 1** high Byte	Resolution per LSB: : **[1]** ➔ Positive and negative values allowed
16 17	**Plethysmogram 2** low Byte **Plethysmogram 2** high Byte	Resolution per LSB: : **[1]** ➔ Positive and negative values allowed

2.9.2 Wave mode 2

Sending details for each sample:

Byte	Format	Remark
1	Ventilator status as follows: Bit 0 1 = mandatory inspiration Bit 1 1 = spont inspiration Bit 2 1 = patient trigger Bit 3 Reserve Bit 4 1 = Exhalation Bit 5 1 = Volume high resolution Bit 6 1 = Flow high resolution Bit 7 must be set high	***Bit 0, 1 and 2:*** e.g. SIMV patient triggered mandatory breaths are sent as "mandatory inspiration" and "patient trigger" (at inspiration begin) ***During exp-hold none of these bits are set.*** ***Bit 5:*** High resolution bit is set if volume < 100ml. Otherwise bit is 0. ***Bit 6:*** High resolution bit is set if flow < 800ml/s. Otherwise bit is 0. ***Bit 7:*** Set to 1 to avoid conflict with control characters.
2 3	**p-Patient** low Byte **p-Patient** high Byte	Resolution per LSB: [0.1 cmH$_2$O]
4 5	**p-Optional** low Byte **p-Optional** high Byte	Resolution per LSB: [0.1 cmH$_2$O]
6 7	**Flow**[9] low Byte **Flow**[9] high Byte	Resolution per LSB (see Byte 1, Bit 6): ➔ Flow high resolution: [0.1 ml/s] ➔ Flow low resolution: [1 ml/s]
8 9	**Volume** low Byte **Volume** high Byte	Resolution per LSB (see Byte 1, Bit 5): ➔ Volume high resolution: [0.1 ml] ➔ Volume low resolution: [1 ml]
10 11	**PCO2** low Byte **PCO2** high Byte	Resolution per LSB: [0.1 mmHg] ➔ Only positive values
12 13	**FCO2** low Byte **FCO2** high Byte	Resolution per LSB: [0.01 %] ➔ Only positive values
14 15	**Plethysmogram 1** low Byte **Plethysmogram 1** high Byte	Resolution per LSB: : [1] ➔ Positive and negative values allowed
16 17	**Internal Flow** low Byte **Internal Flow** high Byte	Resolution per LSB (see Byte 1, Bit 6): ➔ Qvent high resolution: [0.1 ml/s] ➔ Qvent low resolution: [1 ml/s]

2.9.3 General

The value of the parameter (Byte 2..17) is transmitted by 2 bytes with 14-bit resolution as follows:

Byte	MSB[10]	LSB						
Bit	7	6	5	4	3	2	1	0
low byte lower 7 bits	1	2^6	2^5	2^4	2^3	2^2	2^1	2^0
high byte higher 7 bits	1	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7

The value range of a single parameter is 14 bits or 16384. The parameter value has an 13 bit offset or 8192.

If there are no sample data available, the value **0xFF** is transmitted for both Bytes. Therefore the value 8191 is reserved for undefined values (OFF VALUE).

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9 Patient Flow

10 The MSB must be set to 1, to avoid conflict with control characters (Xon/Xoff etc).

Example:

Values of		
Parameters	Transmission	*Remark*
8191	16383	*OFF VALUE*
8190	16382	*Max positive*
0	8192	*Zero*
-8192	0	*Max negative*

This leads to following parameter value ranges:

Wave	**Value range[11]**	**Unit**	**Remark**
p-Patient	-819.2 to +819.0	[cmH2O]	
p-Optional	-819.2 to +819.0	[cmH2O]	
Flow	-8192 to +8190	[ml/s]	Resolution 0.1ml/s: from -799.9ml/s to +799.9ml/s Resolution 1ml/s: <= -800ml/s or >= +800ml/s
Volume	-8192 to +8190	[ml]	Resolution 0.1ml: from -99.9ml to +99.9ml Resolution 1ml: <= -100ml or >= +100ml
PCO2	-819.2 to +819.0	[mmHg]	
FCO2	-81.92 to +81.90	[%]	
Plethysmogram 1	-8192 to +8190	[1]	
Plethysmogram 2	-8192 to +8190	[1]	
Internal Flow	-8192 to +8190	[ml/s]	Resolution 0.1ml/s: from -799.9ml/s to +799.9ml/s Resolution 1ml/s: <= -800ml/s or >= +800ml/s

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[11] Theoretically possible value range. The actual values is in a smaller range and for some waves, the values are positive only (PCO2 and FCO2).

3   GROUP AND PARAMETER IDENTIFIER

3.1   Common parameter formats

Format	Remark
<x.x>	1 to 5 ASCII characters, indicating a Number (with or without '.'), with a variable number of numeric digits and any '.' position. The value "---" from the Hamilton ventilator indicates either the parameter is out of range or not available. Allowed characters: ASCII '0'..'9' (0x30 .. 0x39) ASCII '-' (0x2D) ASCII '.' (0x2E)
<x>	Same as <x.x> but always without '.'
X	Indicates a single numeric digit, ASCII '0'..'9' (0x30 .. 0x39).
<aaa>	Variable number of ASCII characters with a range of 0x20 .. 0xFF
<uuu>	Variable number of Unicode 16 Big Endian (UTF-16BE) characters. As a Unicode 16 Character has two Bytes with a range of 0x00 .. 0xFF, following coding will be used, to avoid conflicts with any control characters: → Due to its frequency of occurrences, 0x00, 0x03 and 0x04 have their own substitute sign. → If character **0x00** has to be transmitted, it will be represented by the character **0x22** ("). → If character **0x03** has to be transmitted, it will be represented by the character **0x23** (#). → If character **0x04** has to be transmitted, it will be represented by the character **0x24** ($). → If any other character **less or equal 0x19** has to be transmitted, it will be represented by two characters: **0x21** (!), followed by the **character + offset 0x30** (0). → If **0x22** (") has to be transmitted, it will be will be represented by two characters: **0x21** (!), followed by **0x22** ("). → If **0x23** (#) has to be transmitted, it will be will be represented by two characters: **0x21** (!), followed by **0x23** (#). → If **0x24** ($) has to be transmitted, it will be will be represented by two characters: **0x21** (!), followed by **0x24** ($). → If **0x21** (!) has to be transmitted, it will be transmitted **twice**. Examples: "0x00 0x55" will be transmitted as "0x22 0x55" "0x03 0x12" will be transmitted as "0x23 0x21 0x42" "0x04 0x24" will be transmitted as "0x24 0x21 0x24" "0x19 0x09" will be transmitted as "0x21 0x49 0x21 0x39" "0x22 0x23" will be transmitted as "0x21 0x22 0x21 0x23" "0x24 0x21" will be transmitted as "0x21 0x24 0x21 0x21" "0x20 0x25" will be transmitted as "0x20 0x25"

3.2 [SPEC.0007] Group Identifiers

Group Id	Group
0x40	Identifications
0x41	SW-Versions
0x42	Date and Time
0x50	Monitored Parameters
0x51	Special Monitored Parameters
0x52	Controller State
0x53	Special State
0x60	Active Alarms
0x61	Alarm List ASCII (US English)
0x62	Alarm List Unicode
0x70	Control Settings
0x71	Alarm Limits Settings
0x72	GUI Unit Settings
0x73	Quick Wean Settings
0x74	Special Settings
0xA0 .. 0xAF	<Reserved>[12]

3.3 Parameter "Breath Number" (0x20)

The parameter with the Id 0x20 is reserved as "Breath Number" which is a cyclic counter between 0 and 9999. The "Breath Number" will be transmitted with most groups (corresponding to chapter 3.4) and with wave data (see chapter 2.7.2 and 2.8.3) and maybe helpful for synchronization of the received data.

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[12] Hamilton internal use

3.4   Parameter Identifiers for each Group

Any received parameter Id which is not listed in this chapter (e.g. due to protocol enhancement) can be ignored.
Any not available parameter (✘) will not transmitted (platform depended).

3.4.1   [SPEC.0008] Identifications (Group Id 0x40)

Param Id	Item	Format	Platform G	Platform C	Id [1]
0x21	Instrument Model	<aaa>	e.g. "Hamilton-G5/S1"	e.g. "Hamilton-C2"	-
0x22	Serial Number	XXXXX	5-digit number	5-digit number	86
0x23	Patient Id	<aaa>	Patient identification (max 20 character)	✘	-
0x24	Ventilator Language	<aaa>	enUS = US English enGB = GB English de = German fr = French es = Spanish it = Italian nl = Dutch ja = Japanese pt = Portuguese pl = Polish ru = Russian hu = Hungarian zh = Chinese tr = Turkish cs = Czech sk = Slovak ko = Korean no = Norwegian sv = Swedish el = Greek da = Danish id = Indonesian bg = Bulgarian sr = Serbian fi = Finnish hr = Croatian	enUS = US English enGB = GB English de = German fr = French es = Spanish it = Italian nl = Dutch ja = Japanese pt = Portuguese pl = Polish ru = Russian hu = Hungarian zh = Chinese tr = Turkish cs = Czech sk = Slovak ko = Korean no = Norwegian sv = Swedish el = Greek da = Danish id = Indonesian sr = Serbian fi = Finnish ro = Romanian hr = Croatian	123

3.4.2   [SPEC.0009] SW-Versions (Group Id 0x41)

Param Id	Item	Format	Platform G	Platform C	Id [1]
0x21 [13]	Protocol Version	X.X.X From 1.1.0: <x>.<x>.<x> e.g. 1.1.19	Protocol version as defined in chapter 2.1	Protocol version as defined in chapter 2.1	127
0x22	Software Version 1	<aaa>	**IPP** Version as indicated in System Info: "IPPxx.xxx"	Version as indicated in System Info: "x.x.x"	124
0x23	Software	<aaa>	**VUP** Version as indicated	✘	126

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[13] When the Protocol Version changes from 1.0.9 to 1.1.0, the format will change from **X.X.X** to <x>.<x>.<x>. Please make sure that compatibility is ensured for your future releases.

Param Id	Item	Format	Platform G	Platform C	Id [1]
	Version 2		in System Info: "VUPxx.xxx"		
0x24	Software Version 3	<aaa>	**VRC** Version as indicated in System Info: "IPPxx.xxx"	✘	125
0x25	Software Version 4	<aaa>	CPC Version as indicated in System Info: "CPCxx.xx"	✘	
0x26	Reserved Version	X.X.X	Reserved for Hamilton internal use	Reserved for Hamilton internal use	-

3.4.3 [SPEC.0010] Date and Time (Group Id 0x42)

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x20	Breath Number	<x>	-	✓	✓	-
0x21	Time - second	XX	s	System clock [00 to 59]	System clock [00 to 59]	80
0x22	Time - minute	XX	min	System clock [00 to 59]	System clock [00 to 59]	81
0x23	Time – hour	XX	hr	System clock [00 to 23]	System clock [00 to 23]	82
0x24	Time – day	XX	d	System clock [01 to 31]	System clock [01 to 31]	83
0x25	Time - month	XX	m	System clock [01 to 12]	System clock [01 to 12]	84
0x26	Time - year	XXXX	y	System clock [1900 to 9999]	System clock [1900 to 9999]	85

3.4.4 [SPEC.0011] Monitored Parameters (Group Id 0x50)

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x20	Breath Number	<x>	-	✓	✓	-
0x21	P max	<x.x>	cmH_2O	Ppeak	Ppeak	66
0x22	P Plateau	<x.x>	$cm\ H_2O$	Pplateau	Pplateau	69
0x23	P mean	<x.x>	cmH_2O	Pmean	Pmean	67
0x24	PEEP/CPAP	<x.x>	cmH_2O	PEEP/CPAP	PEEP	68
0x25	P min	<x.x>	cmH_2O	Pminimum	✘	112
0x26	AutoPEEP	<x.x>	cmH_2O	AutoPEEP	AutoPEEP	103
0x27	P0.1	<x.x>	cmH_2O	P0.1	P0.1	115
0x28	PTP	<x.x>	cmH_2O*s	PTP	PTP	121
0x29	Insp. Flow	<x.x>	l/min	Insp Flow	Insp Flow	75
0x2A	Exp Flow	<x.x>	l/min	Exp Flow	Exp Flow	116
0x2B	Insp. Volume	<x.x>	ml	VTI	VTI	60
0x2C	Exp. Volume	<x.x>	ml	VTE	VTE	61
0x2D	VT Exp spont	<x.x>	ml	VTESpont	VTESpont	79
0x2E	Vexp/min	<x.x>	l/min	ExpMinVol	ExpMinVol	62
0x2F	MV Spont	<x.x>	l/min	MV Spont	MV Spont	-
0x30	f total	<x.x>	b/min	fTotal	fTotal	63
0x31	f spont	<x.x>	b/min	fSpont	fSpont	64
0x32	Insp. time	<x.x>	s	TI	TI	113
0x33	t Exp Pat	<x.x>	s	TE	TE	70
0x34	I:E ratio	1:<x.x> or <x.x>:1	-	I:E	I:E	65

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x35	R insp	<x.x>	cmH_2O /l/s	Rinsp	Rinsp	72
0x36	R exp	<x.x>	cmH_2O /l/s	Rexp	✘	73
0x37	Compliance	<x.x>	ml/cmH_2O	Cstat	Cstat	74
0x38	RCinsp	<x.x>	s	RCinsp	✘	118
0x39	RCexp	<x.x>	s	RCexp	RCexp	117
0x3A	RSB	<x.x>	1/(l*min)	RSB	RSB	-
0x3B	VT/IBW	<x.x>	ml/kg	VT/IBW[14]	VT/IBW[14]	-
0x3C	VLeak (%)	<x.x>	%	VLeak	VLeak	114
0x3D	VLeak (ml)	<x.x>	ml	VLeak	✘	-
0x3E	Oxygen	<x.x>	%	Oxygen	Oxygen	71
0x3F	WOB	<x.x>	J/l	WOBimp	✘	119
0x40	Pcuff	<x.x>	cmH2O	Pcuff	✘	-
0x41	P insp	<x.x>	cmH_2O	Pinsp	Pinsp	122
0x42	%fSpont	<x.x>	%	%fSpont	✘	-
0x43	VariIndex	<x.x>	%	VariIndex	✘	-
0x44	VDaw	<x.x>	ml	VDaw	VDaw	-
0x45	slopeCO2	<x.x>	%CO2/l	slopeCO2	slopeCO2	-
0x46	Vtalv	<x.x>	ml	Vtalv	Vtalv	-
0x47	V'alv	<x.x>	l/min	V'alv	V'alv	-
0x48	VDaw/VTE	<x.x>	%	VDaw/VTE	VDaw/VTE	-
0x49	PetCO2	<x.x>	mmHg	PetCO2	PetCO2	35
0x4A	FetCO2	<x.x>	%	FetCO2	FetCO2	-
0x4B	VeCO2	<x.x>	ml	VeCO2	VeCO2	-
0x4C	ViCO2	<x.x>	ml	ViCO2	ViCO2	-
0x4D	V'CO2	<x.x>	ml/min	V'CO2	V'CO2	-
0x4E	Pulse	<x.x>	1/min	pulse	Pulse	37
0x4F	SpO2	<x.x>	%	SpO2	SpO2	36
0x50	SpO2/FiO2	<x.x>	-	SpO2/FiO2	SpO2/FiO2	-
0x51	HLI	<x.x>	%	HLI	✘	38
0x52	QI-SpO2	<x.x>	%	QI-SpO2	SpO2 conf.	-
0x53	QI-HLI	<x.x>	%	QI-HLI	✘	-
0x54	Stress Index	<x.x>	%	✘	✘	
0x55	QI-Pulse	<x.x>	%	QI-Pulse	Pulse conf.	
0x56	Perfusion Index	<x.x>	%	PI (Masimo only, else "---")	PI (Masimo only, else "---")	
0x57	QI-Perfusion Index	<x.x>	%	QI-PI (Masimo only, else "---")	PI conf. (Masimo only, else "---")	
0x58	SpCO	<x.x>	%	SpCO (Masimo only, else "---")	SpCO (Masimo only, else "---")	
0x59	QI-SpCO	<x.x>	%	QI-SpCO (Masimo only, else "---")	SpCO conf. (Masimo only, else "---")	
0x5A	SpMet	<x.x>	%	SpMet (Masimo Rainbow only, else "---")	SpMet (Masimo Rainbow only, else "---")	

[14] Neonatal: VT/Weight

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x5B	QI-SpMet	<x.x>	%	QI-SpMet Masimo Rainbow only, else "---")	SpMet conf. Masimo Rainbow only, else "---")	
0x5C	SpHb_g	<x.x>	g/dl	SpHb_g (Masimo Rainbow only, else "---")	SpHb_g (Masimo Rainbow only, else "---")	
0x5D	SpHb_mmol	<x.x>	mmol/l	SpHb_mmol (Masimo Rainbow only, else "---")	SpHb_mmol (Masimo Rainbow only, else "---")	
0x5E	QI-SpHb	<x.x>	%	QI-SpHb (Masimo Rainbow only, else "---")	SpHb conf. (Masimo Rainbow only, else "---")	
0x5F	SpOC	<x.x>	ml/dl	SpOC (Masimo Rainbow only, else "---")	SpOC (Masimo Rainbow only, else "---")	
0x60	QI-SpOC	<x.x>	%	QI-SpOC (Masimo Rainbow only, else "---")	SpOC conf. (Masimo Rainbow only, else "---")	
0x61	Quick Wean: f increase	<x.x>	%	rate inc	✘	
0x62	Quick Wean: Pulse increase	<x.x>	%	pulse inc	✘	
0x63	PetCO2 kPa	<x.x>	kPa	PetCO2 kPa	PetCO2 kPa	
0x64	Patient Breathing Time	<x.x>	min	Patient Breathing Time	Ventilation Time	29
0x65	MV Leak	<x.x>	l/min	MVLeak	MVLeak	
0x66	HPC Temperatur Humidifier Monitoring	<x.x>	°C	T humidifier	T humidifier	
0x67	HPC Temperatur y-piece	<x.x>	°C	T y-piece	T y-piece	
0x68	Rate 10min average	<x.x>	1/min	Rate 10min average	Rate 10min average	
0x69	PetCO2 10min average	<x.x>	mmHg	PetCO2 10min average	PetCO2 10min average	
0x6A	PetCO2 10min average kPa	<x.x>	kPa	PetCO2 10min average kPa	PetCO2 10min average kPa	
0x6B	Pulse Rate 10min average	<x.x>	1/min	Pulse Rate 10min average	✘	
0x6C	Ptrans I	<x.x>	cmH2O	Ptrans I	✘	
0x6D	Ptrans E	<x.x>	cmH2O	Ptrans E	✘	
0x6E	Pleth Variability Index	<x.x>	%	✘	PVI (Masimo only, else "---")	

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x6F	Flow	<x.x>	l/min	Flow_servo_mean (Mode HiFlow only, else "---")	✗	

3.4.5 [SPEC.0012] Special Monitored Parameters (Group Id 0x51)

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x20	Breath Number	<x>	-	✓	✓	-
0x21	PetCO2 sensor	<x.x>	mmHg	PetCO2 sensor	✗	-
0x22	SpO2 raw 1	<x.x>	%	SpO2	✗	-
0x23	SpO2 raw 2	<x.x>	%	SpO2	✗	-
0x24	HLI raw 1	<x.x>	%	HLI	✗	-
0x25	HLI raw 2	<x.x>	%	HLI	✗	-
0x26	QI-SpO2 raw 1	<x.x>	%	QI-SpO2	✗	-
0x27	QI-SpO2 raw 2	<x.x>	%	QI-SpO2	✗	-
0x28	QI-HLI raw 1	<x.x>	%	QI-HLI	✗	-
0x29	QI-HLI raw 2	<x.x>	%	QI-HLI	✗	-
0x2A	Median VT per IBW [1]	<x.x>	ml/kg	Median VT/IBW [1]	✗	-
0x2B	Median VT per IBW [2]	<x.x>	ml/kg	Median VT/IBW [2]	✗	-
0x2C	Median Driving Press [1]	<x.x>	cmH2O	Median Driving Press [1]	✗	-
0x2D	Median Driving Press [2]	<x.x>	cmH2O	Median Driving Press [2]	✗	-
0x2E	Pulse raw left	<x.x>	1/min	Pulse raw left	✗	
0x2F	Pulse raw right	<x.x>	1/min	Pulse raw right	✗	
0x30	QI-Pulse raw left	<x.x>	%	QI-Pulse raw left	✗	
0x31	QI-Pulse raw right	<x.x>	%	QI-Pulse raw right	✗	
0x32	Perfusion Index raw left	<x.x>	%	PI raw left (Masimo only, else "---")	✗	
0x33	Perfusion Index raw right	<x.x>	%	PI raw right (Masimo only, else "---")	✗	
0x34	QI-Perfusion Index raw left	<x.x>	%	QI-PI raw left (Masimo only, else "---")	✗	
0x35	QI-Perfusion Index raw right	<x.x>	%	QI-PI raw right (Masimo only, else "---")	✗	
0x36	SpCO raw left	<x.x>	%	SpCO raw left (Masimo Rainbow only, else "---")	✗	
0x37	SpCO raw right	<x.x>	%	SpCO raw right (Masimo Rainbow only, else "---")	✗	
0x38	QI-SpCO raw left	<x.x>	%	QI-SpCO raw left (Masimo Rainbow only, else "---")	✗	
0x39	QI-SpCO raw right	<x.x>	%	QI-SpCO raw right (Masimo Rainbow only, else "---")	✗	
0x3A	SpMet raw left	<x.x>	%	SpMet raw left (Masimo Rainbow only, else "---")	✗	
0x3B	SpMet raw right	<x.x>	%	SpMet raw right (Masimo Rainbow only, else "---")	✗	
0x3C	QI-SpMet raw left	<x.x>	%	QI-SpMet raw left	✗	

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
				(Masimo Rainbow only, else "---")		
0x3D	QI-SpMet raw right	<x.x>	%	QI-SpMet raw right (Masimo Rainbow only, else "---")	✘	
0x3E	SpHb_g raw left	<x.x>	g/dl	SpHb_g raw left (Masimo Rainbow only, else "---")	✘	
0x3F	SpHb_g raw right	<x.x>	g/dl	SpHb_g raw right (Masimo Rainbow only, else "---")	✘	
0x40	SpHb_mmol raw left	<x.x>	mmol/l	SpHb_mmol raw left (Masimo Rainbow only, else "---")	✘	
0x41	SpHb_mmol raw right	<x.x>	mmol/l	SpHb_mmol raw right (Masimo Rainbow only, else "---")	✘	
0x42	QI-SpHb raw left	<x.x>	%	QI-SpHb raw left (Masimo Rainbow only, else "---")	✘	
0x43	QI-SpHb raw right	<x.x>	%	QI-SpHb raw right (Masimo Rainbow only, else "---")	✘	
0x44	SpOC raw left	<x.x>	ml/dl	SpOC raw left (Masimo Rainbow only, else "---")	✘	
0x45	SpOC raw right	<x.x>	ml/dl	SpOC raw right (Masimo Rainbow only, else "---")	✘	
0x46	QI-SpOC raw left	<x.x>	%	QI-SpOC raw left (Masimo Rainbow only, else "---")	✘	
0x47	QI-SpOC raw right	<x.x>	%	QI-SpOC raw right (Masimo Rainbow only, else "---")	✘	
0x48	PetCO2 Sensor kPa	<x.x>	kPa	PetCO2 Sensor kPa	✘	
0x49	Single Breath PetCO2	<x.x>	mmHg	Single Breath PetCO2	✘	
0x4A	PetCO2 raw	<x.x>	mmHg	PetCO2 raw	✘	
0x4B	VA from Vdaw Calculation	<x.x>	ml	VA from Vdaw Calculation	✘	
0x4C	Vti prox in insp	<x.x>	ml	Vti prox in insp	VTIawStartInsp	
0x4D	Vti servo in insp	<x.x>	ml	Vti servo in insp	VTIventStartInsp	
0x4E	VTI raw	<x.x>	ml	✓	✘	
0x4F	VTE raw	<x.x>	ml	✓	✘	
0x50	Triggering type	<x>	-	✓ (internal bitmask)	✘	
0x51	Cycling type	<x>	-	✓ (internal bitmask)	✘	

3.4.6 [SPEC.0018] Controller State (Group Id 0x52)

Param Id	Item	Format	Units	Platform G	Platform C

Param Id	Item	Format	Units	Platform G	Platform C
0x20	Breath Number	<x>	-	✓	✓
0x21	SpO2 emergency Limit	<x.x>	%	✓	✓
0x22	SpO2 increase Limit	<x.x>	%	✓	✓
0x23	SpO2 decrease Limit	<x.x>	%	✓	✓
0x24	PEFIOS increase FiO2 Target	<x.x>	%	✓	✓
0x25	PEFIOS decrease FiO2 Target	<x.x>	%	✓	✓
0x26	HLI PEEP Limit	<x.x>	cmH2O	✓	✘
0x27	CO2 increase Limit	<x.x>	mmHg	✓	✓
0x28	CO2 decrease Limit	<x.x>	mmHg	✓	✓
0x29	fSpont increase Limit	<x.x>	b/min	✓	✓
0x2A	fSpont decrease Limit	<x.x>	b/min	✓	✓
0x2B	MV% min (Safety Limit)	<x.x>	%	✓	✓
0x2C	MV% max (Safety Limit)	<x.x>	%	✓	✓
0x2D	Push wean active (old quick weaning)	X	-	0 = Push wean not running 1 = Push wean running	✘
0x2E	Recruitment active	X	-	0 = Recruitment not running 1 = Recruitment running	0 = Recruitment not running 1 = Recruitment running
0x2F	Patient is active (PSS/active patient controller is used if MV% is auto)	X	-	0 = Patient not active 1 = Patient active	0 = Patient not active 1 = Patient active
0x30	PetCO2 for Vent Controller	<x.x>	mmHg	✓	✘
0x31	Vent Controller Status etCO2 Message	<x>	-	x = Message number	✘
0x32	Vent Controller Status fSpont Message	<x>	-	x = Message number	✘
0x33	Vent Controller Action MinVol Message	<x>	-	x = Message number	✘
0x34	Oxygenation Controller Status SpO2 Message	<x>	-	x = Message number	✘
0x35	PEEP Controller Action Message	<x>	-	x = Message number	✘
0x36	PEEP Controller Value Message	<x>	-	x = Message number	✘
0x37	PEEP Controller Value	<x>	-	x = Value	✘
0x38	FiO2 Controller Action Message	<x>	-	x = Message number	✘
0x39	FiO2 Controller Value Message	<x>	-	x = Message number	✘
0x3A	FiO2 Controller Value	<x>	-	x = Value	✘
0x3B	SBT running	X	---	0 = SBT not running 1 = SBT running	0 = SBT not running 1 = SBT running
0x3C	SpO2 Target Shift	<x.x>	%	SpO2 Target Shift	✓
0x3D	CO2 Target Shift mmHg	<x.x>	mmHg	CO2 Target Shift mbar	✓
0x3E	CO2 Target Shift kPa	<x.x>	kPa	CO2 Target Shift kPa	✓

Param Id	Item	Format	Units	Platform G	Platform C
0x3F	Vent Controller noalarm state	<x>	---	Controller inernal state	✗
0x40	Vent Controller PSS off state	<x>	---	Controller inernal state	✗
0x41	Vent Controller PSS on state	<x>	---	Controller inernal state	✗
0x42	Vent Controller PSS push wean state	<x>	---	Controller inernal state	✗
0x43	Vent Controller auto root state	<x>	---	Controller inernal state	✗
0x44	Vent Controller PSS/active patient controller is active	X	---	0 = PSS is not active 1 = PSS is active	0 = Patient is not active 1 = Patient is active
0x45	Oxygenation Controller state	<x>	---	Controller inernal state	✗
0x46	Oxygenation Controller Safety state	<x>	---	Controller inernal state	✗
0x47	Oxygenation Controller Safety active state	<x>	---	Controller inernal state	✗
0x48	Oxygenation Controller Safety noalarm state	<x>	---	Controller inernal state	✗
0x49	Oxygenation Controller PEEP state	<x>	---	Controller inernal state	✗
0x4A	Oxygenation Controller PEEP nofrc state	<x>	---	Controller inernal state	✗
0x4B	SBT start conditions not fullfilled	<x>	---	Controller SBT inernal bitmask	✗
0x4C	SBT abort condition fulfilled	<x>	---	Controller SBT inernal bitmask	✗
0x4D	SBT pause minute counter	<x>	min	SBT pause minute counter	✗
0x4E	Pause between two SBT's expired	X	---	0 = pause not expired 1 = pause expired	✗
0x4F	SBT can be started	X	---	0 = SBT can not be started 1 = SBT can not be started	✗
0x50	SBT enabled timeofday	X	---	0 = time of day allows no SBT 1 = pause between SBT's expired	✗
0x51	VDaw used by ASV Rate selector	<x.x>	ml	VDaw used by ASV Rate selector	✗
0x52	Next Oxygen	<x.x>	%	✗	✓
0x53	Next Oxygen Delay	<x>	s	✗	✓
0x54	Next PEEP	<x.x>	mmHg	✗	✓
0x55	Next PEEP Delay	<x>	s	✗	✓
0x56	Oxygen Frozen	X	---	✗	0 = false 1 = true
0x57	PEEP Frozen	X	---	✗	0 = false 1 = true
0x58	Percentage MV Frozen	X	---	✗	0 = false 1 = true
0x59	Recruitment Duration	<x>	s	✗	✓

Param Id	Item	Format	Units	Platform G	Platform C
0x5A	Recruitment Planned	X	---	✘	0 = false 1 = true
0x5B	Recruitment Preparing	X	---	✘	0 = false 1 = true
0x5C	Recruitment Running	X	---	✘	0 = false 1 = true
0x5D	Recruitment Running High Phase	X	---	✘	0 = false 1 = true
0x5E	Treatment Action Oxygenation	X	---	✘	0 = Treatment Action Invalid 1 = Treatment Action Increase Rapidly 2 = Treatment Action Increase 3= Treatment Action No Change 4 = Treatment Action Decrease
0x5F	Treatment Action Ventilation	X	---	✘	0 = Treatment Action Invalid 2 = Treatment Action Increase 3= Treatment Action No Change 4 = Treatment Action Decrease
0x60	Controller PEEP Limit Low	<x.x>	cmH$_2$O	✘	✔
0x61	Controller PEEP Limit High	<x.x>	cmH$_2$O	✘	✔
0x62	Manual Start Allowed	X	---	✘	0 = false 1 = true
0x63	Planned Next Start	<x>	s	✘	✔
0x64	Start Conditions Fulfilled Timer	<x>	s	✘	✔
0x65	Starting State	X	---	✘	0 = SBT Start Conditions Verifying 1 = SBT Start Conditions Fulfilled 2 = SBT Started

3.4.7 [SPEC.0020] Special State (Group Id 0x53)

Param Id	Item	Format	Units	Platform G	Platform C
0x20	Breath Number	<x>	-	✓	✓
0x21	P/V Tool Running	X	-	0 = not running 1 = running	0 = not running 1 = running
0x22	Bit Shift Pleth Wave Left	<x>	-	Bit Shift Pleth Wave Left	✗
0x23	Bit Shift Pleth Wave Right	<x>	-	Bit Shift Pleth Wave Right	✗
0x24	Check flow sensor for water state	<x>	-	0 = idle 1 = timeout 2 = initializing 3 = detecting 4 = plausibility	✗

3.4.8 [SPEC.0013] Active Alarms (Group Id 0x60)

Alarm texts are sent in the current ventilator language.

Param Id	Item	Format	Platform G	Platform C
0x20	Breath Number	<x>	✓	✓
0x21	Silence	X	0 = Off 1 = On	0 = Off 1 = On
0x22	Number of Active Alarms	XX	0..20	0..20
0x23 to 0x36[15]	Active Alarm	XXXX XXXXXX X <uuu>[16]	1. Alarm Time: ➔ HHMM (hour and minute) 2. Alarm identification: ➔ 6-digit number 3. Alarm priority ➔ 1 = low priority ➔ 2 = medium priority ➔ 3 = high priority 4. Alarm text ➔ Unicode text[17]	1. Alarm Time: ➔ HHMM (hour and minute) 2. Alarm identification: ➔ 6-digit number 3. Alarm priority ➔ 1 = low priority ➔ 2 = medium priority ➔ 3 = high priority 4. Alarm text ➔ Unicode text[17]

3.4.9 [SPEC.0014] Alarms List ASCII (US English) (Group Id 0x61)

This group allows getting a list of all alarms with specific alarm text defined for the ventilator. The list does not include the technical failures (high priority alarms), which have no specific alarm text.

All Alarm texts are sent as ASCII Text in US English.

Param Id	Item	Format	Platform G	Platform C
0x21 to 0xFE[18]	Alarm List	XXXXXX X <aaa>	*Per Alarm:* 1. Alarm identification: ➔ 6-digit number 2. Alarm priority ➔ 1 = low priority ➔ 2 = medium priority ➔ 3 = high priority	*Per Alarm:* 1. Alarm identification: ➔ 6-digit number 2. Alarm priority ➔ 1 = low priority ➔ 2 = medium priority ➔ 3 = high priority

---

[15] Only as much parameters will be transmitted, as active alarms are available (0 to 20)

[16] Example see chapter 4.2.1

[17] For technical failures always "*TF : <alarm number>*" (as Unicode)

[18] Only as much parameters will be transmitted, as alarms are available

Param Id	Item	Format	Platform G	Platform C
			3. Alarm text ➔ ASCII text	3. Alarm text ➔ ASCII text

3.4.10 [SPEC.0019] Alarm List Unicode (Group Id 0x62)

This group allows getting a list of all alarms with specific alarm text defined for the ventilator. The list does not include the technical failures (high priority alarms), which have no specific alarm text.

All Alarm texts are sent as Unicode in the current ventilator language.

Param Id	Item	Format	Platform G	Platform C
0x21 to 0xFE[19]	Alarm List	XXXXXX X <uuu>	*Per Alarm:* 1. Alarm identification: ➔ 6-digit number 2. Alarm priority ➔ 1 = low priority ➔ 2 = medium priority ➔ 3 = high priority 3. Alarm text ➔ Unicode text	*Per Alarm:* 1. Alarm identification: ➔ 6-digit number 2. Alarm priority ➔ 1 = low priority ➔ 2 = medium priority ➔ 3 = high priority 3. Alarm text ➔ Unicode text

3.4.11 [SPEC.0015] Control Settings (Group Id 0x70)

Param Id	Item	Format [20]	Units	Platform G	Platform C	Id [1]
0x20	Breath Number	<x>	-	✓	✓	-
0x21	Mode Id	X *or* XX	-	1 = Ambient 3 = (S)CMV 4 = SIMV 5 = SPONT 6 = P-SIMV 7 = P-CMV 8 = APV$_{SIMV}$ 9 = APV$_{CMV}$ 10 = ASV 11 = DuoPAP 12 = APRV 13 = NIV 14 = NIV-ST 15 = nCPAP-PS 16 = VS 20 = Hi Flow O2	1 = Ambient 2 = Safety 3 = (S)CMV 4 = SIMV 5 = SPONT 6 = PSIMV+ 7 = PCV+ 8 = SIMV+/ APV$_{SIMV}$ 9 = (S)CMV+/ APV$_{CMV}$ 10 = ASV 11 = DuoPAP 12 = APRV 13 = NIV 14 = NIV-ST 15 = nCPAP-PS 17 = nCPAP-PC 18 = nCPAP 19 = INTELLiVENT 20 = Hi Flow O2	40
0x22	Mode Name	<aaa>	-	ASCII name of the mode	ASCII name of the mode	
0x23	Apnea Backup Ventilation[21]	X	-	0 = Backup Off 1 = Backup On	0 = Backup Off 1 = Backup On	

---

[19] Only as much parameters will be transmitted, as alarms are available

[20] Rule: a lot of Control with format <x.x> are mode dependent available or not. For every not available Control Settings, the value "---" (0x2D, 0x2D, 0x2D) is transmitted.

Param Id	Item	Format 20	Units	Platform G	Platform C	Id [1]
0x24	Standby	X	-	0 = Standby Off 1 = Standby On	0 = Standby Off 1 = Standby On	
0x25	Ventilation Controller	X	-	0 = Off 1 = Decrease 2 = Increase 3 = Maintain 4 = Freeze 5 = PSS increase 6 = PSS decrease 7 = PSS stable	✖	
0x26	PEEP/CPAP Controller	X	-	0 = Off 1 = Decrease 2 = Increase 3 = Maintain 4 = Freeze	✖	
0x27	FiO2 Controller	X	-	0 = Off 1 = Decrease 2 = Increase 3 = Maintain 4 = Freeze 8 = Fine Control 9 = Decrease above PEFIOS 10 = Increase rapidly	✖	
0x28	Rate	<x.x>	b/min	Rate	Rate	41 and 42
0x29	Tidal Volume	<x.x>	ml	- VT setting	- VT setting	43
0x2A	Insp. Time	<x.x>	%	✓	✖	44
0x2B	Pause Time	<x.x>	%	✓	✓	45
0x2C	Flow Pattern	X		0 = not available in actual mode 2 = square 3 = 50% decelerating 4 = decelerating 8 = sine	0 = not available in actual mode 2 = square 3 = 50% decelerating 4 = decelerating 8 = sine	46
0x2D	Pressure Trigger	<x.x>	cmH$_2$O[22]	P Trigger setting	P Trigger setting	47
0x2E	PEEP/ CPAP	<x.x>	cmH$_2$O	PEEP setting	PEEP setting	48
0x2F	Plow	<x.x>	cmH$_2$O	**APRV Mode:** - Plow setting	**APRV Mode:** - Plow setting	
0x30	Pressure Support	<x.x>	cmH$_2$O	P support setting	P support setting	49
0x31	Oxygen	<x.x>	%	FiO2 setting	FiO2 setting	50
0x32	ASV$_{MV}$	<x.x>	l/min	**ASV Mode:** - ASV$_{MV}$	**ASV Mode:** - ASV$_{MV}$	51
0x33	Plimit(ASV)	<x.x>	cmH$_2$O	**ASV Mode:** P ASV Limit	**ASV Mode:** P ASV Limit	-

[21] On when the device ventilates in the Backup Mode

[22] Relative value below PEEP

Param Id	Item	Format 20	Units	Platform G	Platform C	Id [1]
0x34	VT Set Point	<x.x>	ml	**ASV Mode:** VTsp	**ASV Mode:** VTsp	-
0x35	RR Set Point	<x.x>	b/min	**ASV Mode:** RRsp	**ASV Mode:** RRsp	-
0x36	RRimv	<x.x>	b/min	**ASV Mode:** RRimv	**ASV Mode:** RRimv	-
0x37	Pinsp	<x.x>	cmH$_2$O	Pinsp	Pinsp	122
0x38	P Control	<x.x>	cmH$_2$O	P control setting	P control setting	87
0x39	Phigh	<x.x>	cmH$_2$O	**DuoPAP, APRV Mode:** Phigh setting	**DuoPAP, APRV Mode:** Phigh setting	-
0x3A	Trigger	X	-	0 = Flow Trigger 1 = P Trigger 2 = Off 3 = Trigger auto	0 = Flow Trigger 1 = P Trigger 2 = Off	104
0x3B	Flowtrigger	<x.x>	l/min	✓	✓	-
0x3C	I:E	1:<x.x> *or* <x.x>:1	-	✓	✓	105
0x3D	Peak Flow	<x.x>	l/min	✓	✓	106
0x3E	Paw or Paux	X	-	Paw = 0 Paux = 1	always 0	107
0x3F	ETS	<x.x>	%	✓	✓	108
0x40	Ramp	<x.x>	Ms	✓	✓	109
0x41	Body Wt (IBW)	<x.x>	Kg	✓	✓	110
0x42	% Min Vol	<x.x>	%	%MinVol	✓	111
0x43	Tlow	<x.x>	s	✓	✓	-
0x44	VT/kg	<x.x>	ml/Kg	✓	✓	-
0x45	Thigh	<x.x>	s	✓	✓	-
0x46	TIMax	<x.x>	s	✓	✓	-
0x47	Ti	<x.x>	s	✓	✓	-
0x48	Tip	<x.x>	s	✓	✓	-
0x49	Patient Gender	X	-	0 = Any (Neonatal) 1 = Male 2 = Female	0 = Any (Neonatal) 1 = Male 2 = Female	-
0x4A	Patient Group	X	-	1 = Adult 2 = Pediatric 3 = Neonatal	1 = Adult 3 = Neonatal	-
0x4B	Patient height	<x.x>	cm	Patient height	Patient height	-
0x4C	ARDS	X	-	0 = ARDS Off 1 = ARDS On	0 = ARDS Off 1 = ARDS On	-
0x4D	COPD	X	-	0 = COPD Off 1 = COPD On	0 = COPD Off 1 = COPD On	-
0x4E	Brain injury	X	-	0 = Brain injury Off 1 = Brain injury On	0 = Brain injury Off 1 = Brain injury On	-
0x4F	Hemod. unstable (obsolete)	X	-	✗	✗	-
0x50	Pneumo Thorax (obsolete)	X	-	✗	✗	-
0x51	Quick Wean	X	-	0 = Disable 1 = Conditional (old quick weaning only) 2 = Automatic / Always	0 = Disable 2 = Automatic	-
0x52	Gas Source	X	-	1 = Air 2 = Heliox	1 = Air	-

Param Id	Item	Format 20	Units	Platform G	Platform C	Id [1]
0x53	TRC	X	-	0 = Disable TRC 1 = ET tube 2 = Trach tube	0 = Disable TRC 1 = ET tube 2 = Trach tube	-
0x54	Tube diameter	<x.x>	mm	Tube size	Tube size	-
0x55	Compensation	<x.x>	%	Compensate	Compensate	-
0x56	Baseflow	<x.x>	l/min	✗	✗	-
0x57	Sigh activation	X	-	0 = Sigh Off 1 = Sigh On	0 = Sigh Off 1 = Sigh On	-
0x58	Automatic Recruitment Maneuver	X	-	0 = Disabled 1 = Always 2 = Passive Pt	0 = No recruitment 2 = Passive pt	-
0x59	Upper PEEP limit	<x.x>	cmH$_2$O	✓	✓	-
0x5A	Lower PEEP limit	<x.x>	cmH$_2$O	✓	✓	-
0x5B	HLI activation	X	-	0 = HLI activated Off 1 = HLI activated On	✗	-
0x5C	Cuff Pressure Control	X	-	0 = Off 1 = Manual 2 = Auto 3 = Deflate	✗	-
0x5D	Cuff manual Pressure	<x.x>	cmH$_2$O	Cuff Pressure	✗	-
0x5E	Cuff automatic Rel. Pressure	<x.x>	cmH$_2$O	Rel. Pressure	✗	-
0x5F	Cuff automatic Max. Pressure	<x.x>	cmH$_2$O	Max. Pressure	✗	-
0x60	Cuff automatic Min. Pressure	<x.x>	cmH$_2$O	Min. Pressure	✗	-
0x61	CO2 Supp (CO2 Controller)	<x.x>	-	CO2 Supp (0..100)	✗	-
0x62	PetCO2sp (Vent Controller)	<x.x>	mmHg	PetCO2sp	✗	-
0x63	Dyshaemoglobin (obsolete)	X	-	✗	✗	-
0x64	SpO2 Sensor Type	X	-	0 = Nihon Kohden 1 = Masimo	0 = Nihon Kohden 1 = Masimo	
0x65	SpO2 Line frequency	X or "---"	-	0 = 50Hz 1 = 60Hz (Masimo only, else "---")	0 = 50Hz 1 = 60Hz (Masimo only, else "---")	
0x66	SpHb averaging	X or "---"	-	0 = Long 1 = Medium 2 = Short (Masimo only, else "---")	0 = Long 1 = Medium 2 = Short (Masimo only, else "---")	
0x67	SpHb mode	X or "---"	-	0 = Arterial 1 = Venous (Masimo Rainbow only, else "---")	0 = Arterial 1 = Venous (Masimo Rainbow only, else "---")	
0x68	SpHb precision	X or "---"	-	0 = 0.1 1 = 0.5 2 = 1 (Masimo Rainbow only, else "---")	0 = 0.1 1 = 0.5 2 = 1 (Masimo Rainbow only, else "---")	
0x69	SpHb unit	X or "---	-	0 = g/dl	0 = g/dl	

Param Id	Item	Format 20	Units	Platform G	Platform C	Id [1]
		"		1= mmol/l (Masimo Rainbow only, else "---")	1= mmol/l (Masimo Rainbow only, else "---")	
0x6A	SpO2 alarm delay	X	-	0 = 0 sec. 1 = 5 sec. 2 = 10 sec. 3 = 15 sec.	0 = 0 sec. 1 = 5 sec. 2 = 10 sec. 3 = 15 sec.	
0x6B	SpO2 averaging time	X or "---"	-	0 = 2 sec. 1 = 4 sec. 2 = 8 sec. 3 = 10 sec. 4 = 12 sec. 5 = 14 sec. 6 = 16 sec. (Masimo only, else "---")	0 = 2 sec. 1 = 4 sec. 2 = 8 sec. 3 = 10 sec. 4 = 12 sec. 5 = 14 sec. 6 = 16 sec. (Masimo only, else "---")	
0x6C	SpO2 Sensitivity mode	X or "---"	-	0 = Maximal 1 = Normal 2 = APOD (Masimo only, else "---")	0 = Maximal 1 = Normal 2 = APOD (Masimo only, else "---")	
0x6D	SpO2 FastSat	X or "---"	-	0 = FastSat Off 1 = FastSat On (Masimo only, else "---")	0 = FastSat Off 1 = FastSat On (Masimo only, else "---")	
0x6E	Vent Controller manual status	X	-	0 = auto 1 = manual	0 = auto 1 = manual	
0x6F	PEEP Controller manual status	X	-	0 = auto 1 = manual	0 = auto 1 = manual	
0x70	FiO2 Controller manual status	X	-	0 = auto 1 = manual	0 = auto 1 = manual	
0x71	Humidifier Connected	X	-	0 = HPC not connected 1 = HPC connected	✘	
0x72	Humidifier Power	X	-	0 = HPC Power Off 1 = HPC Power On	✘	
0x73	Humidifier Standby	X	-	0 = HPC Standby Off 1 = HPC Standby On	✘	
0x74	Humidifier NIV	X	-	0 = HPC NIV Off 1 = HPC NIV On	✘	
0x75	Humidifier Auto	X	-	0 = HPC Auto Off 1 = HPC Auto On	✘	
0x76	Humidifier Exp. Temp increase	X	-	0 = HPC exp. T incr. Off1 = HPC exp. T incr. On	✘	
0x77	Humidifier Set temp	<x.x>	°C	Humidifier Set temp	✘	
0x78	Humidifier Humidity (obsolete)	<x>	-	✘	✘	
0x79	ASV+ aktiv (obsolete)	X	-	✘	✘	
0x7A	ASV+ VT/IBW	<x.x>	ml/kg	✘	✘	

Param Id	Item	Format 20	Units	Platform G	Platform C	Id [1]
	(obsolete)					
0x7B	ASV+ VT Max enabled (obsolete)	X	-	✗	✗	
0x7C	ASV+ Psup MV0 (obsolete)	<x.x>	cmH2O	✗	✗	
0x7D	ASV+ Psup MV100 (obsolete)	<x.x>	cmH2O	✗	✗	
0x7E	ASV+ Psup MV200 (obsolete)	<x.x>	cmH2O	✗	✗	
0x7F	ASV+ Psup MV350 (obsolete)	<x.x>	cmH2O	✗	✗	
0x80	ASV+ Ti Max (obsolete)	<x.x>	s	✗	✗	
0x81	Use Measured Vdaw	X	-	0 = Use Off 1 = Use On	✗	
0x82	Use Measured Vdaw Continuously	X	-	0 = Use Off 1 = Use On	✗	
0x83	Humid T gradient	<x.x>	°C	Humid T gradient	✗	
0x84	Apnea Backup Setting	X	-	0 = Backup Off 1 = Backup On	0 = Backup Off 1 = Backup On	
0x85	Flow	<x>	l/min	✓	✓	
0x86	ASV Version	X	-	0 = ASV 1 = ASV 1.1	✗	
0x87	ETS Auto	X or "---"	-	0 = ETS auto off 1 = ETS auto on	✗	
0x88	SpO2 Response	X or "---"	-	✗	0 = Slow 1 = Normal 2 = Fast 3 = Extra Fast	
0x89	Pulse Detection Sensitivity	X or "---"	-	✗	0 = Low 1 = Normal 2 = High	
0x8A	PVI Averaging Mode	X or "---"	-	✗	0 = Normal 1 = Fast	
0x8B	Lower Oxygen limit	<x.x>	%	✓	✓	
0X8C	SpeakingValve	X	-	✗	0 = Off 1 = On	

3.4.12 [SPEC.0016] Alarm Limits Settings (Group Id 0x71)

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
0x20	Breath Number	<x>	-	✓	✓	-
0x21	Low Pressure	<x.x>	cmH₂O	✓	✓	-
0x22	High Pressure	<x.x>	cmH₂O	✓	✓	53
0x23	Low Exp Min Vol	<x.x>	l/min	✓	✓	54
0x24	High Exp Min Vol	<x.x>	l/min	✓	✓	55
0x25	Low Rate	<x.x>	b/min	✓	✓	-
0x26	High Rate	<x.x>	b/min	✓	✓	52
0x27	VT low	<x.x>	ml	✓	✓	-
0x28	VT high	<x.x>	ml	✓	✓	-
0x29	Leak	<x.x>	%	✓	✗	-
0x2A	Apnea time	<x.x>	s	✓	✓	-
0x2B	Low PetCO2	<x.x>	mmHg	✓	✓	-
0x2C	High PetCO2	<x.x>	mmHg	✓	✓	-
0x2D	Low SpO2	<x.x>	%	✓	✓	-
0x2E	High SpO2	<x.x>	%	✓	✓	-
0x2F	Low Oxygen	<x.x>	%	✓	✓	56
0x30	High Oxygen	<x.x>	%	✓	✓	57
0x31	High HLI	<x.x>	%	✓	✗	-
0x32	Low Pulse	<x.x>	1/min	✓	✓	
0x33	High Pulse	<x.x>	1/min	✓	✓	
0x34	Low PI	<x.x>	%	Low PI (Masimo only, else "---")	Low PI (Masimo only, else "---")	
0x35	High PI	<x.x>	%	High PI (Masimo only, else "---")	High PI (Masimo only, else "---")	
0x36	Low SpCO	<x.x>	%	Low SpCO (Masimo Rainbow only, else "---")	Low SpCO (Masimo Rainbow only, else "---")	
0x37	High SpCO	<x.x>	%	High SpCO (Masimo Rainbow only, else "---")	High SpCO (Masimo Rainbow only, else "---")	
0x38	Low SpMet	<x.x>	%	Low SpMet (Masimo Rainbow only, else "---")	Low SpMet (Masimo Rainbow only, else "---")	
0x39	High SpMet	<x.x>	%	High SpMet (Masimo Rainbow only, else "---")	High SpMet (Masimo Rainbow only, else "---")	
0x3A	Low SpHb_g	<x.x>	g/dl	Low SpHb_g (Masimo Rainbow only, else "---")	Low SpHb_g (Masimo Rainbow only, else "---")	
0x3B	High SpHb_g	<x.x>	g/dl	High SpHb_g (Masimo Rainbow only, else "---")	High SpHb_g (Masimo Rainbow only,	
0x3C	Low SpHb_mmol	<x.x>	mmol/l	Low SpHb_mmol (Masimo Rainbow only, else "---")	Low SpHb_mmol (Masimo	

Param Id	Item	Format	Units	Platform G	Platform C	Id [1]
					Rainbow only, else "---")	
0x3D	High SpHb_mmol	<x.x>	mmol/l	High SpHb_mmol (Masimo Rainbow only, else "---")	High SpHb_mmol (Masimo Rainbow only, else "---")	
0x3E	Low PetCO2 kPa	<x.x>	kPa	✓	✓	
0x3F	High PetCO2 kPa	<x.x>	kPa	✓	✓	
0x40	Oxygen setting high	<x.x>	%	(O2-Controller active only, else "---")	(O2-Controller active only, else "---")	
0x41	Low PVI	<x.x>	%	✗	Low PVI (Masimo only, else "---")	
0x42	High PVI	<x.x>	%	✗	High PVI (Masimo only, else "---")	

3.4.13 [SPEC.0017] GUI Unit Settings (Group Id 0x72)

The parameters in this group show, in which unit the graphical user interface of the ventilator displays its values. However, the protocol transmits the monitoring (see chap. 3.4.4 and 3.4.5), control settings (see chap. 3.4.11) and alarm setting (see chap. 3.4.12) data always as specified for each parameter, and not in the ventilator GUI unit.

Param Id	Item	Format	Platform G	Platform C
0x20	Breath Number	<x>	✓	✓
0x21	Unit pressure	X	1 = cmH2O	1 = cmH2O 2 = mbar 3 = hPa
0x22	Unit CO2 pressure	X	1 = mmHg 2 = Torr 3 = kPa	1 = mmHg 2 = Torr 3 = kPa
0x23	Unit length	X	1 = cm 2 = inch	1 = cm 2 = inch

3.4.14 [SPEC.0021] Quick Wean Settings (Group Id 0x73)

Param Id	Item	Format	Units	Platform G	Platform C
0x20	Breath Number	<x>		✓	✓
0x21	Quick Wean	X	---	0 = Disable 1 = Conditional (old quick weaning only) 2 = Automatic / Always	0 = Disable 2 = Automatic
0x22	To start SBT Adult - PEEP	<x.x>	cmH2O	✓	✓
0x23	To start SBT Adult - Oxygen	<x.x>	%	✓	✓
0x24	To start SBT Adult - VTE/IBW	<x.x>	ml/kg	✓	✓
0x25	To start SBT Adult - Delay time / Tolerance time	<x.x>	s	✓	✓

Param Id	Item	Format	Units	Platform G	Platform C
0x26	To start SBT Adult - RSBi	<x.x>	1/(l*min)	✓	✗
0x27	SBT settings Adult - PEEP	<x.x>	cmH2O	✓	✓
0x28	SBT settings Adult - %MinVol	<x.x>	%	✓	✓
0x29	To abort SBT Adult - Rate inc	<x.x>	%	✓	✓
0x2A	To abort SBT Adult - Oxygen	<x.x>	%	✓	✓
0x2B	To abort SBT Adult - PetCO2 inc	<x.x>	mmHg	✓	✓
0x2C	To abort SBT Adult - PetCO2 inc kPa	<x.x>	kPa	✓	✓
0x2D	To abort SBT Adult - Tolerance time	<x.x>	s	✓	✓
0x2E	To abort SBT Adult - Max Duration	<x.x>	min	✓	✓
0x2F	To start SBT Pediatric - PEEP	<x.x>	cmH2O	✓	✓
0x30	To start SBT Pediatric - Oxygen	<x.x>	%	✓	✓
0x31	To start SBT Pediatric - VTE/IBW	<x.x>	ml/kg	✓	✓
0x32	To start SBT Pediatric - Delay time / Tolerance time	<x.x>	s	✓	✓
0x33	SBT settings Pediatric - PEEP	<x.x>	cmH2O	✓	✓
0x34	SBT settings Pediatric - %MinVol	<x.x>	%	✓	✓
0x35	To abort SBT Pediatric - Rate inc	<x.x>	%	✓	✓
0x36	To abort SBT Pediatric - Oxygen	<x.x>	%	✓	✓
0x37	To abort SBT Pediatric - PetCO2 inc	<x.x>	mmHg	✓	✓
0x38	To abort SBT Pediatric - PetCO2 inc kPa	<x.x>	kPa	✓	✓
0x39	To abort SBT Pediatric - Tolerance time	<x.x>	s	✓	✓
0x3A	To abort SBT Pediatric - Max Duration	<x.x>	min	✓	✓
0x3B	SBT Configuration - Before starting SBT	<x.x>	min	✓	✓
0x3C	SBT Configuration - Between 2 SBT's	<x.x>	min	✓	✓
0x3D	SBT Configuration - Rate	<x.x>	1/min	✓	✓
0x3E	SBT Configuration - Pressure	<x.x>	mbar	✓	✓
0x3F	SBT Configuration – Pinsp Low	<x.x>	mbar	✓	✗
0x40	SBT Timing - Start allowed after time of day	<x.x>	min	✓	✓
0x41	SBT Timing - Start allowed before time of day	<x.x>	min	✓	✓
0x42	Auto SBT	X or "---"	-	✗	0 = Auto SBT Off 1 = Auto SBT On

3.4.15 [SPEC.0022] Special Settings (Group Id 0x74)

Param Id	Item	Format	Units	Platform G	Platform C[23]
0x20	Breath Number	<x>		✓	✗
0x21	Trigger Setting 01 (internal use)	<x.x>	---	✓	✗
0x22	Trigger Setting 02 (internal use)	<x.x>	---	✓	✗
0x23	Trigger Setting 03 (internal use)	<x.x>	---	✓	✗
0x24	Trigger Setting 04 (internal use)	<x.x>	---	✓	✗
0x25	Trigger Setting 05 (internal use)	<x.x>	---	✓	✗
0x26	Trigger Setting 06 (internal use)	<x.x>	---	✓	✗
0x27	Trigger Setting 07 (internal use)	<x.x>	---	✓	✗
0x28	Trigger Setting 08 (internal use)	<x.x>	---	✓	✗
0x29	Trigger Setting 09 (internal use)	<x.x>	---	✓	✗
0x2A	Trigger Setting 10 (internal use)	<x.x>	---	✓	✗

---

[23] Group 0x74 will be ignored in PlatformC

Param Id	Item	Format	Units	Platform G	Platform C[23]
0x2B	Trigger Setting 11 (internal use)	<x.x>	---	✓	✗
0x2C	Trigger Setting 12 (internal use)	<x.x>	---	✓	✗
0x2D	Trigger Configuration 01 (internal use)	<x.x>	---	✓	✗
0x2E	Trigger Configuration 02 (internal use)	<x.x>	---	✓	✗
0x2F	Trigger Configuration 03 (internal use)	<x.x>	---	✓	✗
0x30	Trigger Configuration 04 (internal use)	<x.x>	---	✓	✗
0x31	Trigger Configuration 05 (internal use)	<x.x>	---	✓	✗
0x32	Trigger Configuration 06 (internal use)	<x.x>	---	✓	✗
0x33	Trigger Configuration 07 (internal use)	<x.x>	---	✓	✗
0x34	Trigger Configuration 08 (internal use)	<x.x>	---	✓	✗
0x35	Trigger Configuration 09 (internal use)	<x.x>	---	✓	✗
0x36	Trigger Configuration 10 (internal use)	<x.x>	---	✓	✗
0x37	Trigger Configuration 11 (internal use)	<x.x>	---	✓	✗
0x38	Trigger Configuration 12 (internal use)	<x.x>	---	✓	✗
0x39	Trigger Configuration 13 (internal use)	<x.x>	---	✓	✗
0x3A	Trigger Configuration 14 (internal use)	<x.x>	---	✓	✗

4 EXAMPLES

4.1 Examples for command: Activate Mixed Mode (Code 0x31)

4.1.1 Stop sending

Scenario:
- no waves sending
- no parameter groups sending

Following command leads to this scenario:

Byte	Value	Remark
1	<STX>	
2	0x31	Command Code
3	0x30	Waves sending **Off** No parameter groups sending
4	<ETX>	
5	8 (0x38)	CRC checksum (0x8D)
6	D (0x44)	
7	<CR>	

4.1.2 Timed Monitored Parameters only

Scenario:
- no waves sending
- sending the group *Monitored Parameters* once, and repeat this every two minutes
- no other parameter groups sending

Following command leads to this scenario:

Byte	Value	Remark
1	<STX>	
2	0x31	Command Code
3	0x30	Waves sending **Off**
4	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
5	1 (0x31)	Send State: Send once
6	1 (0x31)	Repeat Timer: Repeat Time 120s
7	2 (0x32)	
8	0 (0x30)	
9	<ETX>	
10	9 (0x39)	CRC checksum (0x91)
11	1 (0x31)	
12	<CR>	

4.1.3 Waves and diverse Parameters

Scenario:
- send 8 waves with 20ms resolution (every 100ms: 5 samples per wave)
- group *Identifications*: send once, repeat on change only
- group *SW-Versions*: send once, no repetition
- group *Date and Time*: send every minute, start after first minute
- group *Monitored Parameters*: send once, repeat breath by breath only
- group *Active Alarms*: send once, repeat on change only
- group *Control Settings*: send once, repeat on change and every 3 minutes
- group *Alarm Limits Settings*: send once, repeat on change only
- other groups do not send at all (*Special Monitored Parameters , Alarm List, GUI Unit Settings*)

Following command leads to this scenario:

Byte	Value	Remark
1	<STX>	
2	0x31	Command Code
3	0x31	Waves sending **On**
4	0x40	Group Id: *Identifications* (see chap. 3.2)
5	3 (0x33)	Send State: Send on change
6	0 (0x30)	
7	0 (0x30)	Repeat Timer **Off**
8	0 (0x30)	
9	0x41	Group Id: *SW-Versions* (see chap. 3.2)
10	1 (0x31)	Send State: Send once
11	0 (0x30)	
12	0 (0x30)	Repeat Timer **Off**
13	0 (0x30)	
14	0x42	Group Id: *Date and Time* (see chap. 3.2)
15	0 (0x30)	Send State: Send timed only
16	0 (0x30)	
17	6 (0x36)	Repeat Timer: Repeat Time 60s (1 minute)
18	0 (0x30)	
19	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
20	2 (0x32)	Send State: Send breath by breath
21	0 (0x30)	
22	0 (0x30)	Repeat Timer **Off**
23	0 (0x30)	
24	0x60	Group Id: *Active Alarms* (see chap. 3.2)
25	3 (0x33)	Send State: Send on change
26	0 (0x30)	
27	0 (0x30)	Repeat Timer **Off**
28	0 (0x30)	
29	0x70	Group Id: *Control Settings* (see chap. 3.2)
30	3 (0x33)	Send State: Send on change
31	1 (0x31)	
32	8 (0x38)	Repeat Timer: Repeat Time 180s (3 minutes)
33	0 (0x30)	
34	0x71	Group Id: *Alarm Limits Settings* (see chap. 3.2)
35	3 (0x33)	Send State: Send on change
36	0 (0x30)	
37	0 (0x30)	Repeat Timer **Off**
38	0 (0x30)	
39	<ETX>	
40	B (0x42)	CRC checksum (0xB9)
41	9 (0x39)	
42	<CR>	

4.2 Examples for response Mixed Mode (Code 0x31)

4.2.1 Response Active Alarms (Group Id 0x60)

Scenario:
- no waves sending
- block number 17
- breath number 52
- silence is off
- 2 alarms active: one high priority alarm (5022) with time 07:52 and one low priority alarm (3001) with time 08:01

The corresponding 100ms Mixed Mode Response Block:

Byte	Value	Remark
1	<STX>	
2	0x31	Command Code
3	1 (0x31)	Block Number
4	7 (0x37)	
5	<VT>	Waves End (wave sending is Off)
6	0x60	Group Id: *Active Alarms* (see chap. 3.4.8)
7	0x20	Param Id: **Breath Number**
8	5 (0x35)	Breath Number
9	2 (0x32)	
10	<VT>	Delimiter for Param Id
11	0x60	Group Id: *Active Alarms*
12	0x21	Param Id: **Silence**
13	0 (0x30)	Silence off
14	<VT>	Delimiter for Param Id
15	0x60	Group Id: *Active Alarms*
16	0x22	Param Id: **Number of Active Alarms**
17	0 (0x30)	Number of alarms
18	2 (0x32)	
19	<VT>	Delimiter for Param Id
20	0x60	Group Id: *Active Alarms*
21	0x23	Param Id: **Active Alarm 1**
22	0 (0x30)	Alarm Time 1 (=0752)
23	7 (0x37)	
24	5 (0x35)	
25	2 (0x32)	
26	0 (0x30)	Alarm Id 1 (=005022)
27	0 (0x30)	
28	5 (0x35)	
29	0 (0x30)	
30	2 (0x32)	
31	2 (0x32)	
32	3 (0x33)	Alarm priority 1 (high)
33..n	(0x20..0xFF)	Alarm Text 1 (as Unicode)
n+1	<VT>	Delimiter for Param Id
n+2	0x60	Group Id: *Active Alarms*
n+3	0x24	Param Id: **Active Alarm 2**
n+4	0 (0x30)	Alarm Time 2 (=0801)
n+5	8 (0x38)	
n+6	0 (0x30)	
n+7	1 (0x31)	
n+8	0 (0x30)	Alarm Id 2 (=003001)

Byte	Value	Remark
n+9	0 (0x30)	
n+10	3 (0x33)	
n+11	0 (0x30)	
n+12	0 (0x30)	
n+13	1 (0x31)	
n+14	1 (0x31)	Alarm priority 2 (low)
n+15..m	(0x20..0xFF)	Alarm Text 2 (as Unicode)
m+1	<VT>	Delimiter for Param Id
m+2	0x60	Group Id: *Active Alarms*
m+3[24]	0xFF	***Group End* indicator**
m+4	<ETX>	
m+5.. m+6	CRC checksum	
m+7	<CR>	

4.3 Examples for command: Request Group (Code 0x32)

4.3.1 Monitored Parameters only

Scenario:
- sending the group *Monitored Parameters* once
- no other parameter groups sending

Following command request leads to this scenario:

Byte	Value	Remark
1	<STX>	
2	0x32	Command Code
3	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
4	<ETX>	
5	D (0x44)	CRC checksum (0xD7)
6	7 (0x37)	
7	<CR>	

4.4 Examples for response Request Group (Code 0x32)

4.4.1 Response Monitored Parameters only (Group Id 0x50)

Scenario:
- block number 3
- breath number 12
- P max = 20 cmH20
- P Plateau = 19 cmH20
- …

The corresponding 100ms Mixed Mode Response Block:

Byte	Value	Remark
1	<STX>	
2	**0x31**	Command Code (see chap.2.5)
3	0 (0x30)	Block Number
4	3 (0x33)	
5	<VT>	Delimiter for Param Id
6	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
7	0x20	Param Id: ***Breath Number***

---

[24] No <VT> after 0xFF due to following <ETX>

Byte	Value	Remark
8	1 (0x31)	Breath Number
9	2 (0x32)	
10	<VT>	Delimiter for Param Id
11	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
12	0x21	Param Id: *P max*
13	2 (0x32)	P max = 20 cmH$_2$0
14	0 (0x30)	
15	<VT>	Delimiter for Param Id
16	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
17	0x22	Param Id: *P Plateau*
18	1 (0x31)	P Plateau = 19 cmH$_2$0
19	9 (0x39)	
20	<VT>	Delimiter for Param Id

…

Next Parameter (see chap.3.4.4)

…

n+1	<VT>	Delimiter for Param Id
n+2	0x50	Group Id: *Monitored Parameters* (see chap. 3.2)
n+3[25]	0xFF	*Group End* indicator
n+4	<ETX>	
n+5.. n+6	CRC checksum	
n+7	<CR>	

---

[25] No <VT> after 0xFF due to following <ETX>