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1. Introduction

This document defines the serial transmission protocol between the CareFusion LTV or LTV2 series ventilators and the CareFusion LTM graphics monitor.

CAUTION

When connecting the Communication Port to any information technology other than the LTM™ Graphics Monitor, you must insure that connecting cable is optically isolated.

2. Hardware Protocol

2.1 Physical Connectors

RJ12 to RJ12, 6 positions, 6 conductors

Signals implemented:

Pin #	Signal	Description	I/O
1	SGND	Signal ground	NA
2	TxD	Transmit Data	O
3	RxD	Receive Data	I
4	CTS	Clear to Send	I
5	RTS	Request to Send	O
6	SGND	Signal ground	NA

Communication is unidirectional; the ventilator only uses TxD and SGND signals.

2.2 Electrical Levels

RS-232

2.3 Transmission

Type: Asynchronous
 Baud Rate: 60096
 Data Bits: 8
 Parity: None



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Stop Bits: 2

NOTE: To receive valid data on a PC or other device that only has standard bit rates, you need to use settings: 57,600 bps, 8 data bits, no parity, and 1 stop bit.



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3. Software Protocol

The following software protocol defines the transmission and reception of data between the LTV series ventilator and the graphics monitor. Communication is unidirectional. Data is transmitted from the ventilator and received by the graphics monitor.

All multi-byte data is transmitted in little Endian format.

3.1 Data size definitions

Data sizes for packet fields are defined as follows:

Table 1 – Data Sizes

uint8	1 byte unsigned
uint16	2 bytes unsigned
uint32	4 bytes unsigned
int16	2 bytes signed
int32	4 bytes signed

3.2 Packet Structure

Each packet of data transmitted shall have the same generic format defined as follows:

Table 2 – Packet Structure

Field	Size
Start	uint8
Length	uint8
Packet Type	uint8
Data	(variable)
CRC	uint8

The start byte is defined as 0xFA and is used as a synch byte to synchronize the data stream. The length field will specify how many bytes of data are to follow (packet type and data bytes).

3.3 LTV Power up self test

When the LTV is first powered on, it performs a set of diagnostic tests. The results of these tests are transmitted out the serial port before normal protocol packet transmission begins, regardless of the LTV's com setting. This allows a vent that fails any diagnostic test to give information about the failure before it halts.

The format of the diagnostic output is plain text, terminated with ASCII line-feed characters.

3.4 LTV Com-setting

To enable the LTV to send packets to the LTM, the LTV's com setting must be set to "MONITOR".

3.5 Protocol Changes

Any changes to the protocol definition are implemented by creating new packets and IDs in addition to the existing packets and IDs. The LTM shall accept all packets defined by this document. This allows the LTM to accept packets from all versions of LTV software in the field.



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As an example, suppose the settings packet needed to be changed. A new ID is created and the new settings packet is defined. The new packet ID and definition is now used on newly manufactured LTV/LTV2s. Since the LTM is easily field upgradeable, the new LTM software will accept old settings packets from existing LTVs already in the field, as well as new settings packets from newly manufactured LTV/LTV2s.

3.6 CRC computation

The 9-bit CRC divisor used for this protocol is 110000101.

To compute the packet CRC, first set the CRC byte to zero, and perform the exclusive-or division of the packet bytes by the 9-bit divisor, starting with the length byte and continuing up to and including the (zeroed) CRC byte. The remainder of this division is stored in the CRC byte and the packet is transmitted.

To verify the CRC on a received packet, perform the exclusive-or division of the packet bytes by the 9-bit divisor, starting with the length byte and continuing up to and including the CRC byte. If the remainder of this division is zero, then no error is detected.

The actual implementation uses a table lookup. The following is the code used to generate the CRC lookup table. The generated table can be found in the file P:\LTV1000\Software\Source\CrcTable.h:

```
// build crc table
uint16 crc_table[256];
for (I=0; I<=255; I++) {
    crc_table[I] = I;
    for (j=1; j<=8; j++) {
        if (crc_table[I] & 0x80)
            crc_table[I] = (crc_table[I] << 1) ^ 0x0185;
        else crc_table[I] = (crc_table[I] << 1);
    }
    crc_table[I] = crc_table[I] & 0xff;
}
```

Following is a CRC computation example that uses the CRC lookup table:

```
// sample data message to transmit
uint8 data[] = {0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x00};

// compute crc on sample data message
crc_rem = 0;          // init crc rem
data[9] = 0;          // append zero byte to message
for (I=0; I < 10; I++) crc_rem = crc_table[crc_rem] ^ data[I];
data[9] = crc_rem;

// sample data message received with crc
uint8 data[] = {0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x2A};

// verify crc on sample data message
```



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```
crc_rem = 0;          // init crc rem
for (I=0; I < 10; I++) crc_rem = crc_table[crc_rem] ^ data[I];
if (crc_rem) printf("failed\n");
else          printf("passed\n");
```



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3.7 Packet Types

Packet Types are defined below. Each packet type has a unique identifier and a transmission rates. These are as follows:

Table 3 – Packet Types

Packet Type	Packet ID	Transmission Rate	Tolerance
Real time	0x01	10 ms	0 / +5 msec
Settings	0x02	*	0 / +1 sec
Monitors	0x03	**	0 / +1 sec
Alarms	0x04	***	0 / +1 sec
Settings2	0x05	*	0 / +1 sec
Alarms2	0x06	***	0 / +1 sec
Diagnostics	0x80	Manual activation	

*The entire Settings packet is sent according to the following:

- Once per second
- Any setting changes

**The entire Monitors packet is sent according to the following:

- MAP (once every 10 seconds)
- Peak Flow (start of exhalation)
- I/E hold computations (as they are computed during I/E hold maneuver, could be up to 4 times a second)
- Vcalc (once per second or when changed due to front panel settings)
- PIP (end of min-exhl)
- Vte, VE, total breath rate, spontaneous breath rate (start of inspiration, or when 20 seconds has elapsed since last Vte-VE-tbr-sbr update)
- I/E Ratio (start of inspiration)
- PEEP (start of inspiration)

***The entire Alarms (LTV only) or Alarms2 (LTV2 only) packet is sent according to the following:

- Once per second
- An alarm is displayed on the vent

The real time data has the highest priority. All other packet will be transmitted as time allows.

3.7.1 Real Time Data

The real time data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.



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Table 4 – Real Time Data

Field	Min	Max	Resolution	Size	Notes
Insp State	0	18		uint8	See Table 5
Prox Pres	-5	120	1/16 th cmH ₂ O	int16	
Xdcr Flow	- 200	200	1/16 th Lpm	int16	
Volume	0	3000	1 ml	int16	
Total				7 bytes	

Table 5 – Inspiratory state

0	Inspiratory hold
1	Inspiratory pause (not implemented)
2	Volume control exhalation
3	Pressure control exhalation
4	Pressure support exhalation
5	Spontaneous exhalation
6	Volume control exhalation, autozero
7	Pressure control exhalation, autozero
8	Pressure support exhalation, autozero
9	Spontaneous exhalation, autozero
10	Expiratory hold
11	Manual volume control inspiration
12	Volume control inspiration
13	Volume assist inspiration
14	Manual pressure control inspiration
15	Pressure control inspiration
16	Pressure assist inspiration
17	Pressure support inspiration
18	Spontaneous inspiration



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3.7.2 Settings Data

The settings data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.

Table 6 – Settings Data

Field	Min	Max	Resolution	Size	Notes
Settings flags				UInt32	See Table 7
Spare flags				UInt16	Reserved
Dim flags				uint16	See Table 8
Blink flags				uint16	See Table 8
Year	1998	2098	1 year	uint16	(1998..2098)
Month	1	12	1 month	uint8	(1..12)
Date	1	31	1 day	uint8	(1..31)
Hour	0	23	1 hour	uint8	(0..23)
Min	0	59	1 minute	uint8	(0..59)
Sec	0	59	1 second	uint8	(0..59)
Software version				uint8[13]	12-char null terminated string
Breath Rate	0	80	1 bpm	uint8	(0..80)
Tidal Volume	50	2000	5 ml	uint16	(50..2000) by 5's
Pres Control	0	99	1 cmH ₂ O	uint8	(1..99)
Insp Time	3	99	0.1 sec	uint8	(0.3 .. 9.9) sec
Pres Support	0	60	1 cmH ₂ O	uint8	(0..60)
O ₂	21	100	1 %	uint8	(21..100)
Sensitivity	0	9	1 lpm	uint8	(0=off,1..9)
High Pres	5	100	1 cmH ₂ O	uint8	(5..100)
Low Pres	0	60	1 cmH ₂ O	uint8	(0..60)
Low Min Vol	0	99	0.1 liters	uint16	(0.0 .. 99.0)
Bits				uint16	See Table 9
Apnea interval	10	60	10 seconds	uint8	(10,20,30,40,50,60)
Pressure support flow termination	10	40	5%	uint8	(10,15,20,25,30,35,40)
Pressure support time termination	3	30	0.1 second	uint8	(0.3 .. 3.0)
Pressure control flow termination	0	40	5%	uint8	(0=off, 10, 15,20,25,30,35,40)
Alarm volume	60	85	5 db	uint8	(60,65,70,75,80,85)
High pressure delay	0=no delay	2=max x delay	1 breath	uint8	(0=no delay, 2=max)
Rise time profile	1	9		uint8	(1..9)
Bias flow	3	20	1 lpm	uint8	0 = off 10 (LTV only) 3-20 (LTV2 only)
Language				uint8	See Table 10
Date format	0	3		uint8	(0=mm/dd/yy 1=dd/mm/yy)



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Field	Min	Max	Resolution	Size	Notes
					2=yy/mm/dd)
Model				uint8	See Table 11
Flow valve cal	0	255	1 step	uint8	
Flow temp comp	0=off	1=on		uint8	(0=off 1=on)
Total				57 bytes	

Table 7 – Settings flags

Settings flags are used to indicate the data in the packet that has changed:

Bit	Field
0x00000001	Low Min Vol
0x00000002	Low Pres
0x00000004	High Pres
0x00000008	Sensitivity
0x00000010	O ₂
0x00000020	Pres Support
0x00000040	Insp Time
0x00000080	Pres Control
0x00000100	Tidal Volume
0x00000200	Breath Rate
0x00000400	Apnea interval
0x00000800	Pressure support flow termination
0x00001000	Pressure support time termination
0x00002000	Pressure control flow termination
0x00004000	Alarm volume
0x00008000	High pressure delay
0x00010000	Rise time profile
0x00020000	Bias flow (not implemented)
0x00040000	Language
0x00080000	Date format
0x00100000	Model
0x00200000	Flow valve cal
0x00400000	Flow temp comp
0x00800000	NPPV
0x01000000	Low O ₂ source
0x02000000	Control mode
0x04000000	Control method
0x08000000	Controls locked
0x10000000	Control unlock hard
0x20000000	Adaptive
0x40000000	PIP led
0x80000000	LPP alarm



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Table 8 – Blink flags / Dim flags

The blink flags indicate which displays on the ventilator are blinking (note that these flags are a subset of the settings flags):

The dim flags indicate which displays on the ventilator are dimmed. The dim flags are defined to be the same as the blink flags.

Bit	Field
0x0001	Low Min Vol
0x0002	Low Pres
0x0004	High Pres
0x0008	Sensitivity
0x0010	O ₂
0x0020	Pres Support
0x0040	Insp Time
0x0080	Pres Control
0x0100	Tidal Volume
0x0200	Breath Rate

Table 9 – Bits defs

The following fields are single bits packed into a single word:

Bit Field	Bit	Notes
NPPV Secondary	0x0001	(0=off 1=on) LTV series only
Low O ₂ source	0x0002	(0=off 1=on)
Control mode bit1 - lsb	0x0004	(0=assist/control, 1=SIMV/CPAP, 2=NPPV Primary) see Control mode bit2 below
Control method	0x0008	(0=vol control 1=pres control)
Controls locked	0x0010	(0=unlocked 1=locked)
Control unlock hard	0x0020	(0=unlock easy 1=unlock hard)
Leak Comp	0x0040	(0=leak comp off 1=leak comp on)
PIP led	0x0080	(0=pip led off 1=pip led on)
LPP alarm	0x0100	(0=lpp all breaths 1=lpp VC/PC only)
Control mode bit2 - msb	0x0200	see Control mode bit1 above

Table 10 – Languages

The following languages are currently defined:

0	ENGLISH
1	DEUTSCH (German)
2	ESPAÑOL (Spanish)
3	FRANCAIS (French)
4	ITALIANO (Italian)
5	PORTUGUES (Portuguese)



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6	DANSK (Danish)
7	SVENSKA (Swedish)
8	NORSK (Norwegian).
9	РУССКИЙ (Russian)
10	Türkçe (Turkish)
11	Suomi (Finnish)
12	Polski (Polish)

Table 11 – Models

The following models are currently defined:

0	LTV 1000
1	LTV900
2	LTV950
3	LTV800
4	LTV1200
5	LTV1150
6	LTV1100
7	LTV2100
8	LTV2150
9	LTV2200

3.7.3 Settings2 Data

The settings2 data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.

Table 12 – Settings2 Data

Field	Min	Max	Resolution	Size	Notes
Settings2 flags				UInt32	See Table 13
Serial Number				UInt8 [9]	Serial Number, 8 alpha-numeric characters + NULL termination
High f Alarm value	0	80	1 bpm	UInt8	5...80, 0 = Off
High PEEP Alarm value	0	40	1 cmH ₂ O	UInt8	3...40, 0 = Off (LTV 1200, 1150, and 1100 only: iPEEP + 3...20, 0=Off)
High f Alarm time	0	60	10 seconds	UInt8	(0..60)
SBT Status	0	1		UInt8	0 = Off, 1 = On
SBT Pressure Support	0	30	1 cmH ₂ O	UInt8	(0..30)
SBT FIO ₂	21	100	1 %	UInt8	(21..100)
SBT Minutes	15	120	5 minutes	UInt8	(15..120)
SBT High f	0	80	1 bpm	UInt8	(0=Off, 15-80)
SBT Low f	0	40	1 bpm	UInt8	(0=Off, 1-40)
SBT High f/Vt	0	900	5 f/Vt	UInt16	(0=Off, 70-900)
SBT Low f/Vt	0	90	5 f/Vt	UInt8	(0=Off, 5-90)



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O ₂ Flush Minutes	1	3	1 minutes	Uint8	(1..3)
iPEEP	0	20	1 cmH ₂ O	Uint8	(0..20)
Low PEEP Alarm value	0	20	1 cmH ₂ O	Uint8	LTV2 series or LTV 1200, 1150, and 1100 only: iPEEP – 3...20
SBT PEEP	0	20	1 cmH ₂ O	Uint8	(0..20)
High Minute Vol Alarm	0	99	0.1 liters	uint16	LTV2 series only (0.0 .. 99.0)
Total				31 bytes	

Table 13 – Settings2 Flags

Settings2 flags are used to indicate the data in the packet that has changed or is being sent:

0x00000001	Serial Number
0x00000002	High f Alarm value
0x00000004	High PEEP Alarm value
0x00000008	High f Alarm time
0x00000010	SBT Status
0x00000020	SBT Pressure Support
0x00000040	SBT FIO ₂
0x00000080	SBT Minutes
0x00000100	SBT High f
0x00000200	SBT Low f
0x00000400	SBT High f/Vt
0x00000800	SBT Low f/Vt
0x00001000	O ₂ Flush Minutes
0x00002000	iPEEP
0x00004000	Low PEEP Alarm value
0x00008000	SBT PEEP
0x00010000	High Minute Volume Alarm

3.7.4 Monitors

The monitored parameter data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.

Table 14 – Monitor Data

Field	Resolution	Size	Notes
Monitor flags		uint32	See Table 15
Cal error flags		uint16	See Table 16
PIP	1/16 th	int16	



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Field	Resolution	Size	Notes
	cmH ₂ O		
Peak flow	1/16 th Lpm	int16	
MAP	1/16 th cmH ₂ O	int16	
Total breath rate	Bpm	uint16	
Spontaneous breath rate	Bpm	uint16	
PEEP	1/16 th cmH ₂ O	int16	
Vte	ml	int16	
Ve	0.1 L	int16	
Itime	2 ms	uint16	
Etime	2 ms	uint16	
Vcalc	1/16 th Lpm	int16	
P Plat	Cm	int16	
P Alvdis	Cm	int16	
Cstatic	ml/Cm	int32	
P Exp	Cm	int16	
Auto PEEP	Cm	Int16	
RSBI	f/Vt	int16	
SBT Time	min	int8	
Total		43 bytes	

Table 15 – Monitor flags

Monitor flags are used to indicate the data in the packet that has changed:

Bit	Field
0x00000001	PIP
0x00000002	Peak flow
0x00000004	MAP
0x00000008	Total breath rate
0x00000010	Spontaneous breath rate
0x00000020	PEEP
0x00000040	Vte
0x00000080	Ve
0x00000100	Itime
0x00000200	Etime
0x00000400	Vcalc
0x00000800	P Plat dashes
0x00001000	P Plat
0x00002000	P Alvdis
0x00004000	Cstatic
0x00008000	P Exp



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0x00010000	Auto PEEP
0x00020000	RSBI
0x00040000	SBT Time Remaining

Table 16 – Cal error flags

Cal error flags are used to indicate the monitors that have cal errors. Only PIP, MAP, PEEP, Vte and Ve can have cal errors:

Bit	Field
0x0001	PIP
0x0004	MAP
0x0020	PEEP
0x0040	Vte
0x0080	Ve

3.7.4.1 Formatting PIP

```

pip_cm = (pip_CMx16 + 8) >> 4;
if (cal error) display "cal error"
else if (pip_cm > 120) {
    if (language units are hPa) display ">118"
    else display ">120"
}
else if (pip_cm < 0) display "<0"
else {
    if (language units are hPa) format (pip_cm * 4017 >> 12) as "%3lu"
    else format pip_cm as "%3u"
}

```

3.7.4.2 Formatting Peak Flow

```

peak_flow_LPM = (peak_flow_LPMx16 + 8) >> 4;
peak_flow_LPM is not formatted on vent, format as desired

```

3.7.4.3 Formatting MAP

```

map_CM = map_CMx16 >> 4;
if (cal error) display "no cal"
else if (map_CM > 99) {
    if (language units are hPa) display ">97"
    else display ">99"
}
else if (map_CM < 0) {
    if (language units are hPa) format (map_CM * 4017 >> 12) as "%2lu"
    else format map_CM as "%2u"
}

```

3.7.4.4 Formatting Total Breath Rate

```

if (tbr_bpm > 250) display ">250"
else format tbr_bpm as "%3u"

```



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3.7.4.5 Formatting Spontaneous Breath Rate

sbr_bpm is not formatted on vent, format as desired

3.7.4.6 Formatting PEEP

```

peep_cm = (peep_CMx16 + 8) >> 4;
if (cal error) display "no cal"
if (peep_CMx16 > 99*16) {
    if (language units are hPa) display ">97"
    else display ">99"
}
else if (peep_CMx16 < 0*16) {
    if (language units are hPa) format (peep_cm * 4017 >> 12) as "%3ld"
    else format peep_cm as "%3d"
}
else if (peep_CMx16 < 1*16) display "0"
else {
    if (language units are hPa) format (peep_cm * 4017 >> 12) as "%2lu"
    else format peep_cm as "%2u"
}

```

3.7.4.7 Formatting Vte

```

if (cal error) display "no cal"
else if (tv_ml > 4000) display ">4000"
else if (tv_ml < 0) display "----"
else format tv_ml as "%4u"

```

3.7.4.8 Formatting Ve

```

if (cal error) display "no cal"
else if (Ve_Lx10 > 999) display ">99.9"
else if (Ve_Lx10 < 0) display "< 0"
else format Ve_Lx10 as "%4.1D"

```

3.7.4.9 Formatting I/E Ratio

```

if (Itime < Etime) {
    if ((Etime/Itime) < 10) Etime = ((Etime * 10 + (Itime >> 1)) / Itime);
    else Etime = ((Etime + (Itime >> 1)) * 10 / Itime);
    if (Etime < 100) format Etime as "1:%3.1D"
    else if (Etime > 999) display ">1:99"
    else format Etime/10 as "1:%u"
}
else {
    if ((Itime / Etime) < 10) Itime = ((Itime * 10 + (Etime >> 1)) / Etime);
    else Itime = ((Itime + (Etime >> 1)) * 10 / Etime);
    if (Itime < 100) format Itime as "%3.1D:1"
    else if (Itime > 999) display ">99:1"
    else format Itime/10 as "%2u:1"
}

```

3.7.4.10 Formatting Vcalc

```

format ((vcalc_LMPx16 + 8) >> 4) as "%3d"

```




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3.7.4.11 Formatting P Plat dashes

```
Display "P Plat ---"
```

3.7.4.12 Formatting P Plat

```
Format PPlat_CM as "%4ld"
```

3.7.4.13 Formatting P Alvdis

```
if (PAlvDis_CM >= 1000) display "P Alvdis ---"
else
    format PAlvDis_CM as "%4ld"
```

3.7.4.14 Formatting Cstatic

```
if (CStatic >= 10000) display "C Static ---"
else
    format CStatic as "%4ld"
```

3.7.4.15 Formatting P Exp

```
format Pexp_CM as "%4ld"
```

3.7.4.16 Formatting Auto Peep

```
if (AutoPeep_CM >= 1000) display "Autopeep ---"
else
    format AutoPeep_CM as "%4ld"
```

3.7.5 Alarms

The Alarms data is only applicable when the data source is the LTV series ventilator.

Table 17 – Alarm Data

The alarms data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.

Field	Min	Max	Resolution	Size	Notes
Displayed alarm				uint8	See Table 18
Apnea breath rate			1 bpm	uint16	Used by Apnea bpm alarm
Current Alarms Flags				uint32	See Table 18
Total				7bytes	

Table 18 – Alarm index codes.

Displayed Alarm / Priority Index	Alarm	Current Alarms Flags
0	No alarm	0x00000001
1	Vent check	0x00000002
2	Apnea bpm	0x00000004
3	Apnea	0x00000008
4	Disconnect	0x00000010
5	Internal battery empty	0x00000020
6	Internal battery low	0x00000040



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Displayed Alarm / Priority Index	Alarm	Current Alarms Flags
7	External power lost	0x00000080
8	External power low	0x00000100
9	O ₂ pressure low	0x00000200
10	O ₂ pressure high	0x00000400
11	Defaults	0x00000800
12	No cal data	0x00001000
13	Hardware fault	0x00002000
14	Reset	0x00004000
15	High pressure	0x00008000
16	Low minute volume	0x00010000
17	Low peak pressure	0x00020000
18	Transducer fault	0x00040000
19	Defaults Set	0x00080000
20	High PEEP	0x00100000
21	High rate	0x00200000
22	SBT High f	0x00400000
23	SBT Low f	0x00800000
24	SBT High f/Vt	0x01000000
25	SBT Low f/Vt	0x02000000
26	SBT OFF	0x04000000
27	Low PEEP	0x08000000

3.7.6 Alarms2

The Alarms2 data is only applicable when the data source is the LTV2 series ventilator. This packet is a variable length packet depending on how many alarms are active, inactive, or not triggered. An active alarm is an alarm conditions are currently met. An inactive alarm is an alarm that was active at one time, but the alarm conditions have gone away. An alarm that has not triggered is an alarm that has been reset by the operator or had not occurred at all. These 'not triggered' alarms are not sent in this packet. The alarms will be sent in priority order, highest priority first, lowest priority last.

NOTE: Display Alarm 1 and Display Priority 1 will always be sent. If no alarms are currently active, the Display Alarm 1 value will be 0, 'No alarm' from Table 20 – Alarm2 index codes and Display Priority 1 value will be 0, 'No Alarm' from Table 21 – Alarm2 State/Priority codes.

NOTE: The LTM will not accept packets longer than 60 total bytes so the LTV2 will limit this packet to that size at most by removing the lowest priority alarms until it fits.

Table 19 – Alarm2 Data

The alarms data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.

Field	Min	Max	Resolution	Size	Notes
Apnea breath rate			1 bpm	uint16	Used by Apnea bpm alarm
Display Alarm 1				uint8	See Table 20
Display Priority 1				uint8	See Table 21



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Display Alarm 2				uint8	See Table 20
Display Priority 2				uint8	See Table 21
...				uint8	See Table 20
...				uint8	See Table 21
Display Alarm NN				uint8	See Table 20
Display Priority NN				uint8	See Table 21
Total				variable	

Table 20 – Alarm2 index codes

Displayed Alarm	Alarm
0	No alarm
1	Vent Check
2	Apnea bpm
3	Apnea
4	Check Circuit
5	Internal Battery Temperature Critical
6	Internal Battery Temperature High
7	Internal Battery Temperature Low
8	Removable Battery Temperature Critical
9	Removable Battery Temperature High
10	Removable Battery Temperature Low
11	Internal Battery Empty
12	Internal Battery Fault
13	Removable Battery Empty
14	Oxygen Pressure Low
15	High Pressure
16	Low Minute Volume
17	Low Peak Pressure
18	Internal Battery Low
19	Removable Battery Fault
20	High Minute Volume
21	Removable Battery Low
22	Oxygen Pressure High
23	Defaults
24	No Calibration Data
25	Hardware Fault
26	Transducer Fault
27	High PEEP
28	High Breath Rate
29	Low PEEP
30	Reset
31	Removable Battery Removed
32	Defaults Set
33	External Power Lost
34	External Power Low
35	SBT High Breath Rate



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Displayed Alarm	Alarm
36	SBT Low Breath Rate
37	SBT High f/Vt
38	SBT Low f/Vt
39	SBT Off
40	Query Inactivity

Table 21 – Alarm2 State/Priority codes

Displayed Alarm	Alarm	Notes
0	No Alarm	Alarm has not occurred
1	Inactive	Alarm has occurred but the conditions have gone away.
2	Low Priority	Active as a Low Priority Alarm
3	Medium Priority	Active as a Medium Priority Alarm
4	High Priority	Active as a High Priority Alarm

3.7.7 Diagnostics

Table 22 – Diagnostic Function codes

The LTV simulator can send Diagnostics packets to the LTM. The LTV ventilator cannot send these packets. The diagnostic data packets shall contain the data as specified in the table below. The order listed defines the order transmitted.

Field	Min	Max	Resolution	Size	Notes
FC				uint8	See Table 23
Idata				int16	Signed data
Udata				uint16	Unsigned data

Table 23 – Function codes.

FC	Function	Idata	Udata
0	No function	n/a	n/a
1	Fill LTM event log with all possible alarms	n/a	n/a
2	Erase LTM event log	n/a	n/a
3	PCMCIA voltage test	1 = Slot A 2 = Slot B	0 = All voltages off. 3 = Vcc and Vpp are both 3.3 volts 5 = Vcc and Vpp are both 5 volts 12 = Vcc is 5 volts and Vpp is 12 volts Note: always issue a 0 command between new voltage commands



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