

Excel Medical Electronics, Inc.

BedMaster Operator's Manual

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1 Introduction

One of the dilemmas researchers and clinicians have is the ability to easily collect vital sign data from patients in a networked patient monitoring environment. Vendors typically have a proprietary protocol for communication with their own-networked devices in a closed architecture. Access to this data usually requires time-consuming manual record keeping using vendor-supplied patient monitoring software.

The BedMaster software program, developed by Excel Medical Electronics, Inc., allows the researcher and clinician access to patients' data in a GE Medical Systems *Information Technologies* Unity Network. By utilizing the ease of use and common controls of the Microsoft Windows operating system, BedMaster provides the user with data formatted in popular spreadsheet format.

The GE Medical Systems *Information Technologies* Unity Network is a hospital communication link for the efficient sharing of clinical information between cardiology, patient monitoring, hospital information, and laboratory equipment. The Unity network offers convenience and flexibility for acquiring, reviewing, and managing patient information.

The Unity Network is built using industry-standard equipment. Using IEEE 802.3 (Ethernet) cabling means that standard personal computers can be used with off-the-shelf hardware that is already familiar to hospital networking specialists.

Industry standard communication protocols are used throughout as well. The Unity Network uses protocols from the TCP/IP family. It's the same protocol family that is used to connect millions of computers across the Internet, and most often used to connect multi-vendor networks. This "industry standard" approach to networks allows the Unity Network to contain networks of patient monitors, printers, central stations, etc.

The BedMaster program uses this open architecture to acquire vital sign data from patient monitoring devices on the Unity Network.

2 Theory of Operation

The BedMaster program is a stand-alone program that runs under Microsoft Windows 95/98/NT/2000 operating systems. The personal computer executing the BedMaster program must have a network interface to an Ethernet LAN and have the TCP/IP stack loaded. The network card must have the same base IP address as the GE Medical Systems *Information Technologies* Unity Network that it is going to be connected. For example, if the Unity network has a base IP address of 126.x.x.x, the BedMaster personal computer must also have the IP Address set to a unique IP using 126.x.x.x.

All Unity Network patient monitoring devices broadcast information about that device on the network approximately every 15 to 30 seconds. This network "Census" contains information such as the care location, patient name, type of device, and IP address of the device. Each device on the Unity Network maintains an internal database of these devices and capabilities should they need to communicate with each other.

After initialization, the BedMaster program uses a main dialog screen to display all of the devices present on the Unity Network. BedMaster continually listens for each device broadcast and dynamically updates any changes in parameters or device availability. BedMaster has an internal database capable of maintaining and displaying information on 400 possible devices.

After a device is detected on the Unity Network, BedMaster allows configuration for data collection. A separate screen is displayed for each device located on the network. Each device can be configured for vital sign collection interval, file storage, parameter inclusion / exclusion, etc. If file storage is desired, BedMaster formats the requested vital sign information into TAB or

comma delimited format. These formats are native to popular spreadsheet programs such as Microsoft Excel and others.

3 BedMaster Installation

The BedMaster program uses Installshield for ease of installation. After installation, the BedMaster program will be located under Start->Programs->BedMaster.

Three directories are created on the C:\ drive with the installation process. The first is BedMaster. Under this main directory are two subdirectories, Bin and Data. The Bin directory contains the BedMaster executable and Operator's Manual in PDF format. Double clicking the BedMaster.exe will also invoke the program. The Data directory by default will contain data files from data that are gathered by the BedMaster program. In the configuration screen for each device, a default pathname and filename are provided for data storage.

4 BedMaster Network Setup

In order to run the BedMaster program, the personal computer must contain an Ethernet network adapter and the TCP/IP protocol stack in order to communicate on the Unity Network. The IP address of the personal computer must also be set to the same subnet and mask as the Unity Network. This is very important and failure to set this up properly will inhibit use of the BedMaster program.

It is recommended that the installer consult with the Unity Network Administrator and have the administrator assign a unique IP address for the personal computer running BedMaster.

Unity Networks are usually set up using the subnet of 126.0.X.X and a Network Mask of 255.0.0.0. One way to verify this is to look at a patient monitor that is connected to the Unity Network. Under "Monitor Setup", there

is a selection called "Service Mode". Under "Service Mode" there is a selection called "Set Internet Address". Entering this, the Internet address will be displayed. Do not modify this address. Note the four numbers separated by periods. This is the Address of the patient monitoring device on the Unity Network. The BedMaster must be configured to an IP address not used by any other device on the network.

To set up the network address under Microsoft Windows, select "Settings" from the "Start" button. Double click on the "Network" icon.

If the network adapter is already installed, a Network dialog box should appear listing all of the personal computer network settings.

Select the network adapter that will be connected to the Unity Network. Note that this adapter must be "bound" to the TCP/IP protocol. Press the Properties button to configure the network card.

See figure 4.1 Network Setup.

Figure 4.2 Illustrates the TCP/IP properties screen. Note that an IP address must be specified, as the Unity Network does not use DHCP servers. Again, it is recommended that the installer consult the Unity Network Administrator before assigning an IP address. This address must be unique for the BedMaster to operate properly. Also, note the Subnet Mask of 255.0.0.0.

After the data has been entered, press OK to continue. You will be prompted to reboot the personal computer if any changes were made to the settings.

In order to install the personal computer onto the unity network, a standard CAT-5 network cable should be used to connect the personal computer to the Unity Network through the network hub. The Unity Network Administrator can provide the location of the network hub.

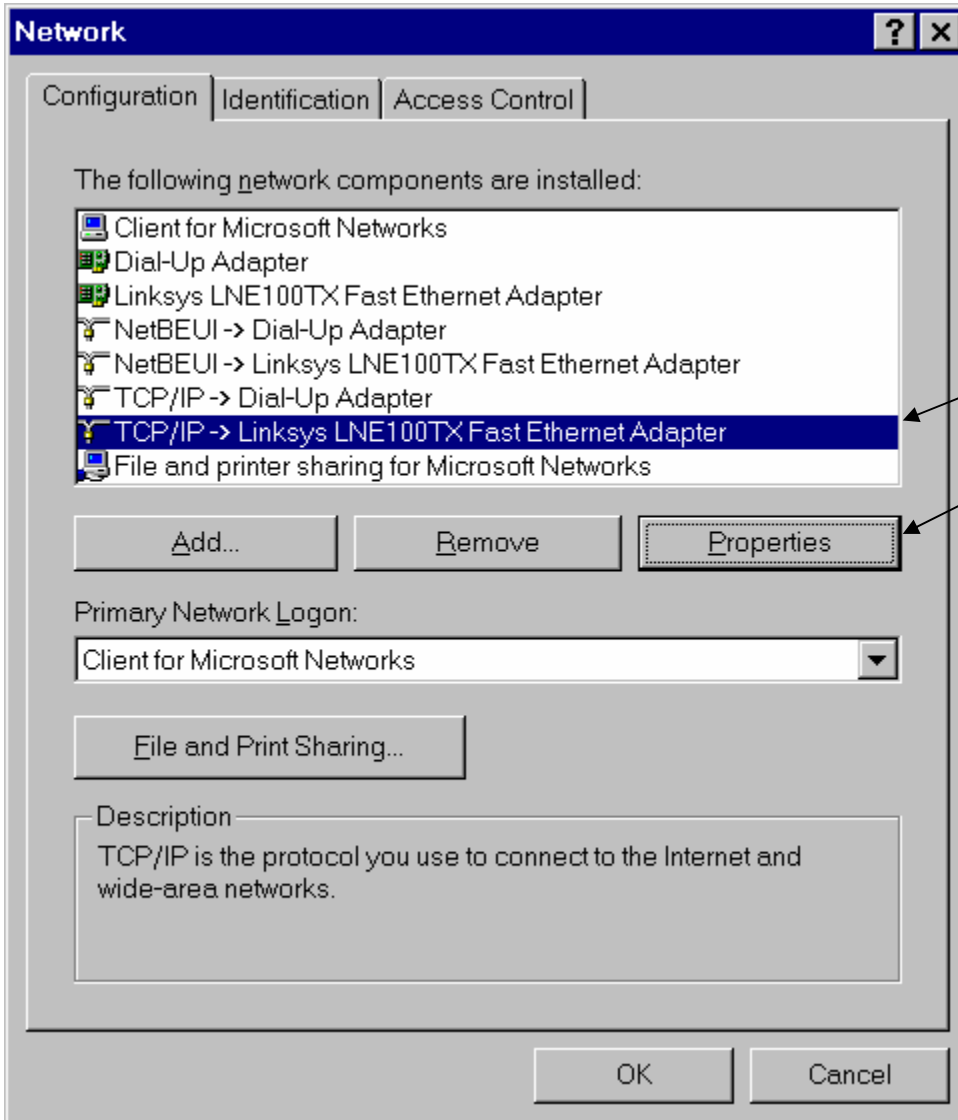


Figure 4.1 Network Setup

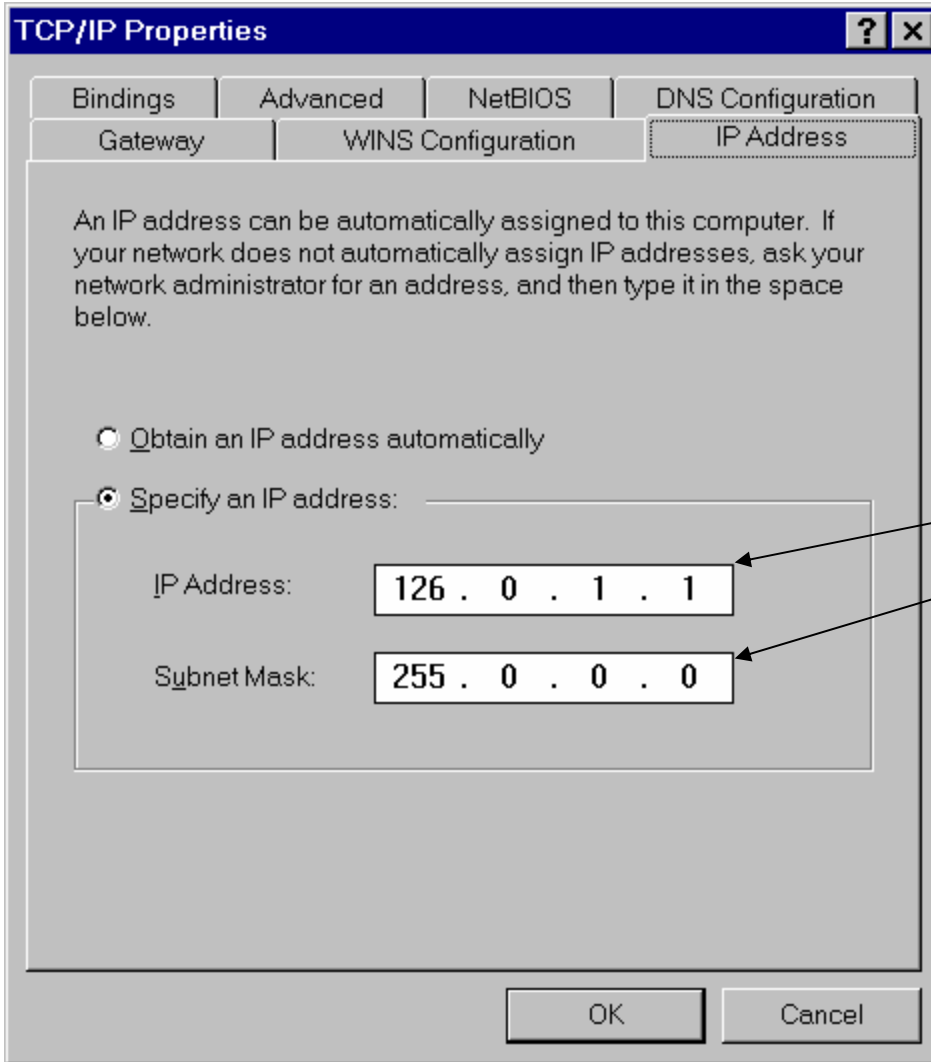


Figure 4.2 TCP/IP Properties

5 BedMaster Setup

After the BedMaster program has been installed and the personal computer network has been configured and connected, Unity Network devices should now be viewable.

Start the BedMaster program by pressing Start->Programs->BedMaster. The program will initialize and start. The main screen will initialize and look like figure 5.1. If the

BedMaster program initialized the network properly, the following two lines will be in the Vital Sign Status log.

Network Initialized...

Looking for Devices...

5.1 BedMaster Device Detection

The upper portion of the BedMaster main screen contains the device list of all detected devices on the Unity Network.

When devices are detected, the device list will be sorted by care unit and bed name.

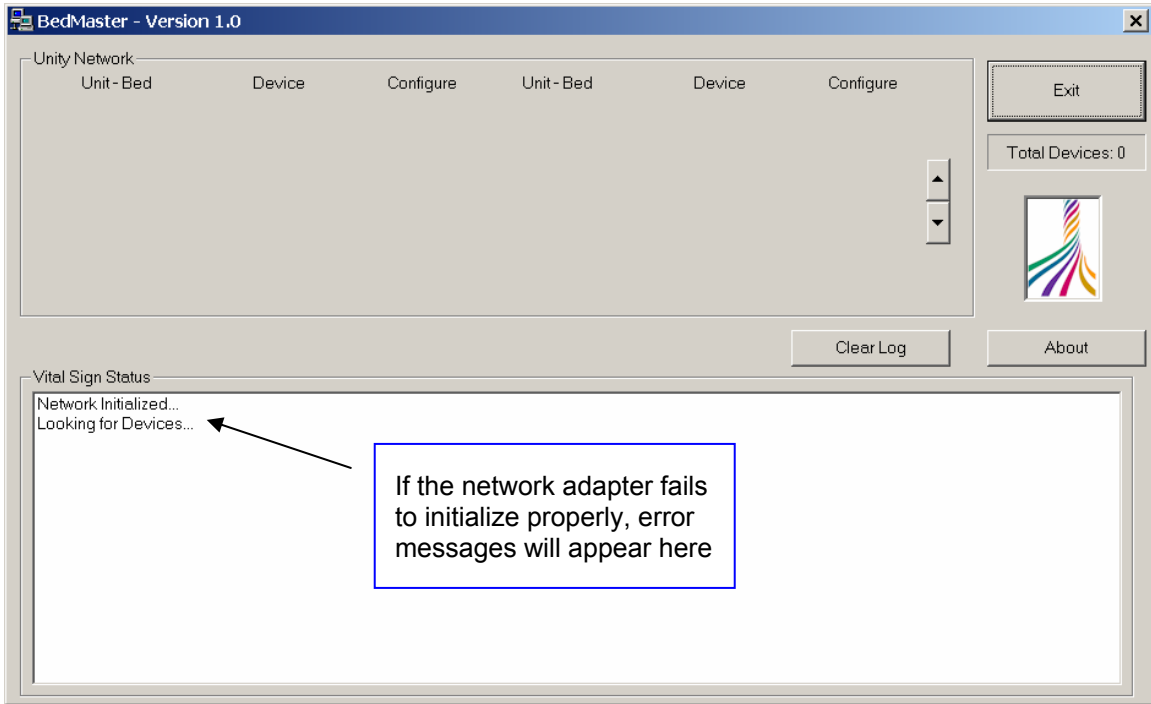


Figure 5.1 BedMaster Main Screen

The device list is updated approximately every two seconds to reflect any changes on the Unity Network. The up and down arrows on the right side of the display allow the operator to page through the device list. Sixteen devices will be displayed per page with the total device count being displayed under the Exit button. A "Clear Log" button is provided to allow the operator to clear all logged messages from the Vital Sign Status window.

Figure 5.2 shows a detected device on the Unity Network. When a device is detected, an entry is made in the Vital Sign Status log as well as on the device-listing portion of the screen. All devices are enumerated and sorted by care-unit and bed name. The device type (in this case a Tramscope) is displayed under the device heading. See

section seven for a listing of known devices. A configuration button appears with a red inset to indicate that the device has been detected but the device is not collecting vital sign data. Since the Unity Network is a dynamic network in that devices may be added or removed, a corresponding message will be displayed when a device is removed from the Unity Network. The device will also be removed from the device list and the list will be resorted. Any data that has been collected with file logging enabled will remain after the device has been removed.

To configure a device for vital sign collection, press the red button under the configure heading for the device you wish to configure. Figure 5.3 shows the setup screen for that device.

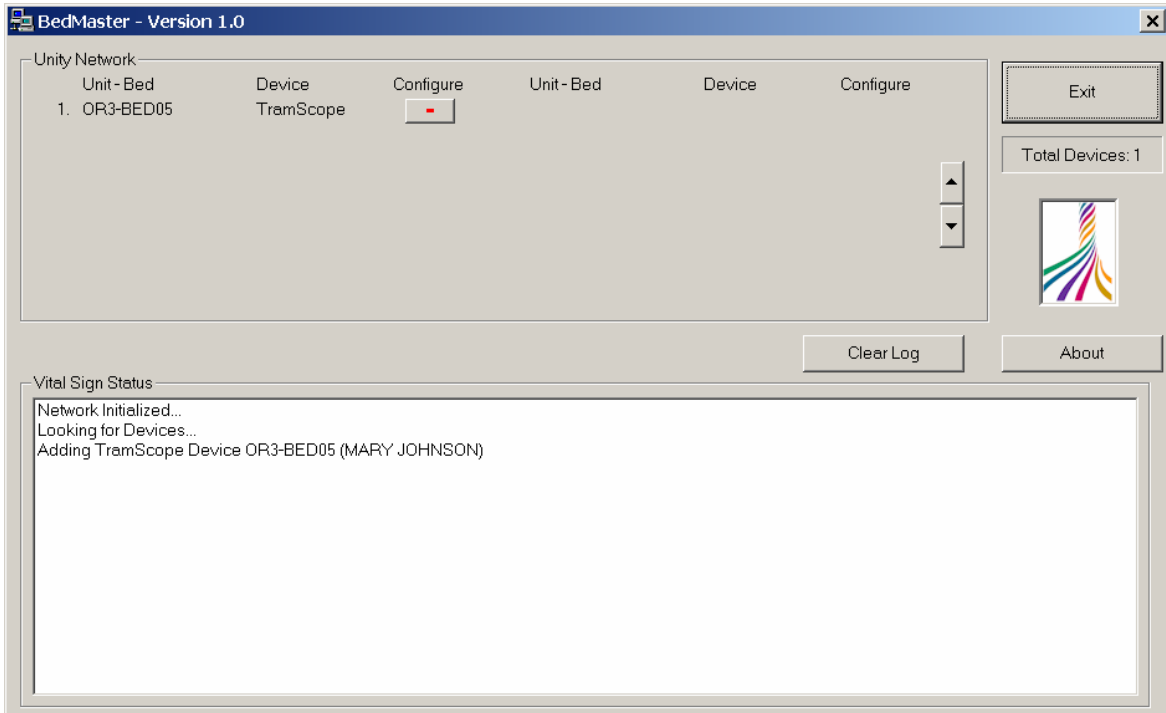


Figure 5.2 BedMaster Device Detection

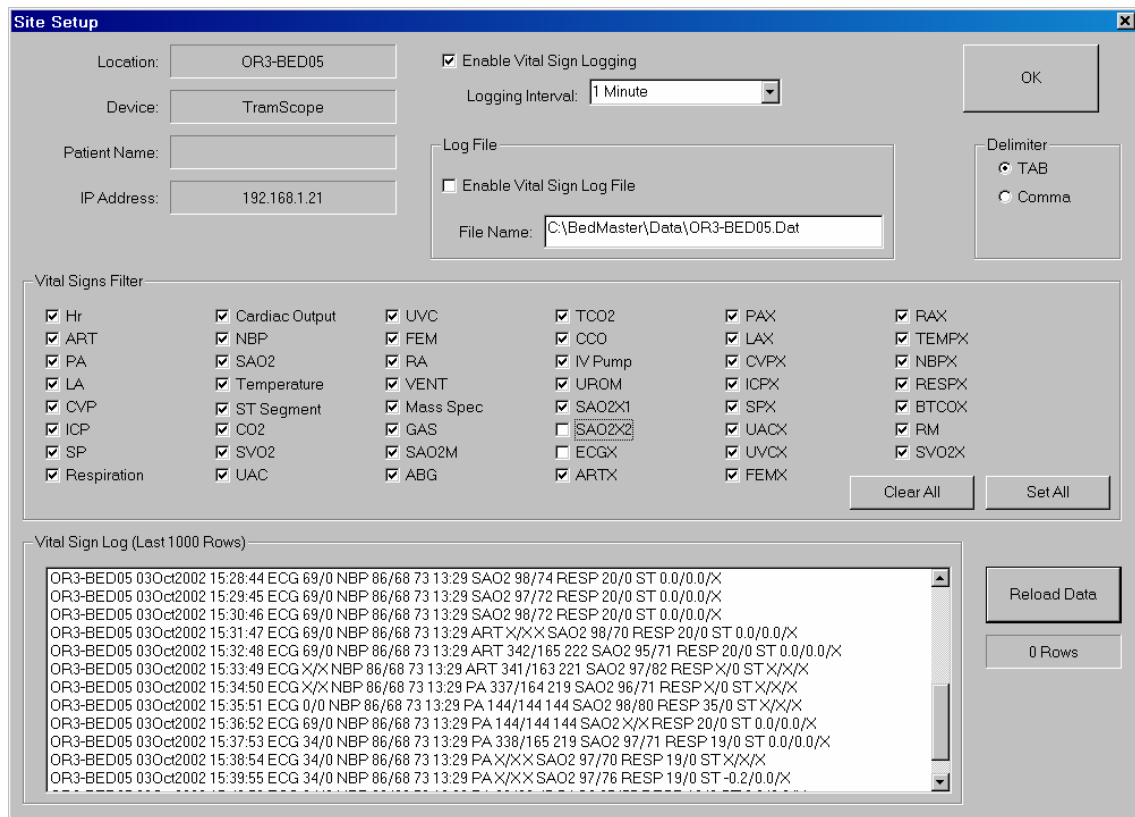


Figure 5.3 BedMaster Setup

5.2 BedMaster Configuration

The upper portion of the BedMaster setup screen shows the location of the device in care unit / bed name order, the type of device, the patients name, and the IP address of the device in the Unity Network.

5.3 Enabling Vital Sign Logging

To the right of the location information is the Enable Vital Sign Logging check box. This enables the BedMaster program to log vital signs at the logging interval specified in the drop down list box. Available logging intervals are 5 seconds, 15 seconds, 30 seconds, 1 minute, 5 minutes, 15 minutes, 30 minutes or 1 hour. Changing of the logging interval will automatically initiate a vital sign request from the selected device. If the user presses the OK button and returns to the BedMaster Main Screen, the red button will now be changed to blue indicating that the device is now being polled for vitals signs. All vital sign data will be displayed in the vital sign log on the setup screen and the vital sign status log on the main screen.

5.4 Vital Sign Logging

Under the “Log File” heading is a log file enable check box. Checking this box will cause the BedMaster program to log all vital sign data to disk using the path and filename specified in the file name edit box. By default, the path will be the data sub-directory located under the BedMaster directory. The care unit and bed name will constitute the filename. The operator may change this to any legal path and filename specification used by Microsoft Windows.

If the user presses the OK button and returns to the BedMaster Main Screen, the red or blue button will now be changed to green indicating that the device is now being polled for vitals signs and that the data is being stored to a file. All vital sign data will be displayed in the vital sign log on the setup screen and the vital sign status log on the main screen. Please note that the operator must check the Enable Vital Sign Log File check box to save data to a file. Figure 5.3 illustrates file enabled vital sign collection.

5.5 Delimiters

To the right of the “Log File” area is a delimiter specifier. This delimiter is added between parameter fields in the vital sign data stream to allow popular spreadsheet programs to align the data by rows and columns. By default, the TAB character is added between parameter fields, but may be changes to provide comma-delimited fields.

5.6 Vital Sign Filtering

In the middle of the screen is the Vital Signs Filter area. This area displays all of the known vital signs that can be monitored on the Unity Network. Each vital sign can be individually enabled or disabled by checking or un-checking the appropriate check box. By default, all check boxes are checked. Checking the check box will cause the vital sign to be displayed and or stored if it is available. Two buttons “Clear All” and “Set All” are available to set or clear all of the check boxes. Note that these are data filters and that the particular vital sign must be received from the device in order to be displayed.

5.7 Vital Sign Log

A vital sign log similar to the BedMaster main screen is located on the bottom of the BedMaster setup screen. The vital sign log file displays rows of collected data that was displayed and / or stored in a file. When entering the BedMaster setup screen, the BedMaster program reads in the file from the path and filename and loads it into the Vital Sign Log. Only the last 1000 rows are displayed as these files can become rather large if a short logging interval was selected and a long period of logging has taken place. A count of the actual rows of data in the file is displayed to the right of the log. A “Reload” button reloads the last 1000 rows into the log.

The format of the log is care unit / bed name / Admit Discharge status ((A) or (D)) optionally followed with the ID, followed by the date and time, followed by delimited vital sign parameter data.

6 BedMaster Vital Sign Parameter Description

The following table describes the vital sign parameters that can be displayed and stored using the BedMaster program. This table also represents the order that the vital sign parameters will be displayed. Unknown, out of range, or invalid data will be represented with an "X" when displayed. Interfaced parameters are parameters that are interfaced to the patient monitoring device by an Octacomm Interface device or other means.

Vital Sign	Description	Data Format	Notes
Hr	Heart Rate	ECG RR/P	ECG Rate / PVC's
ART	Arterial Pressure	ART S/D M	Systolic/Diastolic Mean pressures
PA	Pulmonary Artery	PA S/D M	Systolic/Diastolic Mean pressures
LA	Left Atrium	LA M	Mean Pressure
CVP	Central Venous Pressure	CVP M	Mean Pressure
ICP	Intra Cranial Pressure	ICP M	Mean Pressure
SP	Special Pressure	SP M	Mean Pressure
Respiration	Respiration Rate	RESP R/A	Rate / Apnea
Cardiac Output	Cardiac Output	CO X.X/X.X/X.X/X.X	Blood Temp / Cardiac Output / Inject Temp / Last Average Temp
NBP	Non-Invasive Blood Pressure	NBP S/D M HH:MM	Systolic / Diastolic Mean Hour: Minute
SAO ₂	Pulse Oximetry	SAO2 S/R	Saturation / Pulse Rate
Temperature	Temperature	TEMP X.X/X.X	Site 1 temp / Site 2 Temp
ST Segment	ST Segment	ST X.X/X.X/X.X	Inferior / lateral / anterior lead
CO ₂	CO ₂	CO2 X/X/X	End Tidal / Inspired / Rate
SVO ₂	SVO ₂	SVO2 S	Saturation
UAC	Umbilical Arterial Catheter	UAC S/D M	Systolic / Diastolic / Mean Pressures
UVC	Umbilical Venous Catheter	UVC M	Mean pressure
FEM	Femoral Artery	FEM S/D M	Systolic / Diastolic / Mean Pressures
RA	Right Atrium	RA M	Mean Pressure
VENT	Ventilator	VENT RR	Respiration Rate

Vital Sign	Description	Data Format	Notes
VENT	Ventilator	VENT PEEP	Peep
VENT	Ventilator	VENT MV	MV
VENT	Ventilator	VENT FIO2	FIO2
VENT	Ventilator	VENT TV	TV
VENT	Ventilator	VENT PIP	PIP
VENT	Ventilator	VENT PPLAT	PPLAT
VENT	Ventilator	VENT MAWP	MAWP
VENT	Ventilator	VENT SENS	SENS
Mass Spec	Mass Spectrometry	MSPEC1 (X)E/I MSPEC2 (X)E/I	(Parameter Code) Expired / Inspired 0 = Nitrogen 2 = Nitrous 4 = Halothane 6 = Isoflurane/Forane 8 = Etherane/Enflurane 10 = Desflurane/Suprane 12 = Sevoflurane 14 = Helium 16 = Argon 18 = Oxygen 255 = invalid code
GAS	Gas Parameters	XXX X.XX/X.XX	N ₂ Expired / Inspired N ₂ O Expired / Inspired HAL Expired / Inspired ISO Expired / Inspired ETH Expired / Inspired DES Expired / Inspired SEV Expired / Inspired SEL Expired / Inspired ARG Expired / Inspired O ₂ Expired / Inspired
SAO ₂ M		SAO2M S/R	Saturation / Pulse Rate
ABG	Arterial Blood Gas	ABG X.XX/X/X/X	pH / PCO ₂ / PO ₂ / HCO ₃

Vital Sign	Description	Data Format	Notes
TCO ₂	Transcutaneous CO ₂ /O ₂	TCO2 X/X/X.X	TPCO ₂ / TPO ₂ / Temperature
CCO	Continuous Cardiac Output	CCO X.X/X.X/X.X	Cardiac Output / Cardiac Index / Blood Temperature
IV Pump	IV Pump (Interfaced)	IVPUMP X/X.X/X.X	Total Volume / Primary Rate / Secondary Rate
UROM	Urometer (Interfaced)	UROM X.X/X	Temperature / Volume
SAO ₂ X1	Pulse Ox (Interfaced)	SAO2X1 S/R	Saturation / Pulse Rate
SAO ₂ X2	Pulse Ox (Interfaced)	SAO2X2 S/R	Saturation / Pulse Rate
ECGX	Heart Rate (Interfaced)	ECG XX/X	ECG rate / PVC's
ARTX	Arterial Pressure (Interfaced)	ARTX S/D M	Systolic / Diastolic Mean pressures
PAX	Pulmonary Artery Pressure (Interfaced)	PAX S/D M	Systolic / Diastolic Mean pressures
LAX	Left Atrium Pressure (Interfaced)	LAX M	Mean Pressure
CVPX	Central Venous Pressure (Interfaced)	CVPX M	Mean Pressure
ICPX	Intra Cranial Pressure (Interfaced)	ICPX M	Mean Pressure
SPX	Special Pressure (Interfaced)	SPX M	Mean Pressure
UACX	Umbilical Arterial Catheter (Interfaced)	UAC S/D M	Systolic / Diastolic / Mean Pressures
UVCX	Umbilical Venous Catheter (Interfaced)	UVC M	Mean pressure
FEMX	Femoral Artery (Interfaced)	FEMX S/D M	Systolic / Diastolic / Mean Pressures
RAX	Right Atrium (Interfaced)	RAX M	Mean Pressure
TEMPX	Temperature (Interfaced)	TEMPX X.X/X.X	Site 1 temp / Site 2 Temp

Vital Sign	Description	Data Format	Notes
NBPX	Non-Invasive Blood Pressure (Interfaced)	NBPX S/D M HH:MM	Systolic / Diastolic Mean Hour: Minute
RESPX	Respiration Rate (Interfaced)	RESPX R/A	Rate / Apnea
BTCOX	Blood Temp / Cardiac Output (Interfaced)	BTCOX X.X/X.X/X.X/X.X	Blood Temp / Cardiac Output / Inject Temp / Last Average Temp
RM	Respiratory Mechanics	RM X.X/X.X	Perfusion / Minute Volume
SVO ₂ X	SVO ₂ (Interfaced)	SVO2X S	Saturation
ICG	Impedance Cardiac Output	ICG X.X/X.X/X	Cardiac Index / Cardiac Output / TFC
ICG(E)	ICG Extended	ICG(E) X/X/X	HR / MAP / PEP
ICG1	Impedance Cardiac Output	ICG1 X/X/X	SV / SI / VI
ICG1(E)	ICG1 Extended	ICG1(E) X/X.XX/X/X	DO2I / LCWI / LVET / LSWI
ICG2	Impedance Cardiac Output	ICG2 X/X/X	SVR / SVRI / ACI
BIS	BIS	BIS X/X/X	BIS / SR / SQI
BIS(E)	BIS Extended	BIS(E) X/X.X/X	EMG / SEF / AMP
EEG	EEG	EEG X.X/X.X/X.X	Channel 1 Values: SEF / MF / SR
EEG(E)	EEG Extended	EEG(E) X.X/X.X/X.X/X.X/X.X	Channel 1 Values: AMP / EMG / Delta / Theta / Alpha / Beta
EEG1	EEG1	EEG1 X.X/X.X/X.X	Channel 2 Values: SEF / MF / SR
EEG1(E)	EEG1 Extended	EEG1(E) X.X/X.X/X.X/X.X/X.X	Channel 2 Values: AMP / EMG / Delta / Theta / Alpha / Beta
EEG2	EEG2	EEG2 X.X/X.X/X.X	Channel 3 Values: SEF / MF / SR
EEG2(E)	EEG2 Extended	EEG2(E) X.X/X.X/X.X/X.X/X.X	Channel 3 Values: AMP / EMG / Delta / Theta / Alpha / Beta
EEG3	EEG3	EEG3 X.X/X.X/X.X	Channel 4 Values: SEF / MF / SR

Vital Sign	Description	Data Format	Notes
EEG3(E)	EEG3 Extended	EEG3(E) X.X/X.X/X.X/X.X/X.X/X.X	Channel 4 Values: AMP / EMG / Delta / Theta / Alpha / Beta
EEG4	EEG4	EEG4 X.X/X.X/X.X	Channel 1 & 2 Pair Values: SEF / MF / SR
EEG4(E)	EEG4 Extended	EEG4(E) X.X/X.X/X.X/X.X/X.X/X.X	Channel 1 & 2 Pair Values: AMP / EMG / Delta / Theta / Alpha / Beta
EEG5	EEG5	EEG5 X.X/X.X/X.X	Channel 3 & 4 Pair Values: SEF / MF / SR
EEG5(E)	EEG5 Extended	EEG5(E) X.X/X.X/X.X/X.X/X.X/X.X	Channel 3 & 4 Pair Values: AMP / EMG / Delta / Theta / Alpha / Beta
ID	Patient ID	Comes from Monitor Patient Name Field.	NOTE: This field is defaulted to off. Recommended use of this field is to encode a patient id rather than use a name to protect patient privacy.

7 Unity Network Devices

The following is list of Unity Network Devices.

- Tramscope
- Central
- Eagle
- 2in DDW
- 4in DDW
- Laser Prt
- Full Disclosure
- MRT2
- Time Master
- Muse
- Telemetry Bed
- 7015
- 7020
- 7025
- 7030
- Download Server
- Download Server2
- Telemetry Combo
- Message Display
- Telemetry Tower
- Holter
- TTX Master
- Eagle 3000
- Admit Master
- LZP Server
- RX 12SL
- HL7 Admit Server

- HL7 Lab Server
- QMI QS
- Octacomm
- Location List Server
- Octacomm ID
- Union Station
- Access Server
- Patient Transfer
- Network Printer
- PID Register Server
- Cardio Pager
- CP RX
- CIC
- HIS Server
- Prism Telemetry
- VOA Server
- Aegis SIM
- Aegis POX
- Aegis IBP
- Aegis ECG
- Aegis ECGL
- Aegis TCO
- Aegis NBP
- Aegis ETCO2
- AEGIS AUTO

8 Error Messages

The BedMaster program logs error messages to the BedMaster Main Screen log. Error messages are primarily network error messages from improper or missing network software components and file error messages opening or writing to vital sign files. Since all networking is done using TCP/IP and UDP protocols, data are guaranteed to arrive correctly, thereby minimizing errors.

9 Minimum Requirements

The following are the recommended minimum requirements for the BedMaster program.

- Windows 95/98/NT/2000 Operating System
- 100 MHz 486 Processor
- 100 Mb Free Hard Drive space
- 32 Mb of RAM
- CD-ROM drive
- 1 Network Interface

10 Evaluation Versions

Evaluation versions of BedMaster are fully functional versions except that vital sign logging is limited to five rows per device. All other features are available to give the operator a full evaluation of the BedMaster Program.