



**Hillrom**<sup>TM</sup>

Welch Allyn<sup>®</sup>  
Surveyor<sup>TM</sup> Central  
User Manual



Manufactured by Welch Allyn, Inc. Skaneateles Falls, NY U.S.A.



**CAUTION:** Federal law restricts this device to sale by or on the order of a physician.

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Software V5.1

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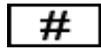
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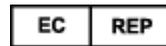
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901137 MONITORING CENTRAL STATION



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# 1. NOTICES

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## Manufacturer's Responsibility

Welch Allyn, Inc. is responsible for the effects on safety and performance of the device, only if:

- System installation and assembly operations, extensions, readjustments, modifications or repairs are carried out by personnel authorized by Welch Allyn, Inc. only.
- The device is used in accordance with the instructions for use.
- The device is correctly maintained according to the standards authorized by Welch Allyn, Inc. using original spare parts.
- The device is used with compatible accessories and supplies. Contact Welch Allyn or one of its affiliates for a current list of compatible accessories and supplies.
- The electrical installation of the relevant room complies with the requirements of appropriate regulations.

## Responsibility of the Customer

The user of this device is responsible for ensuring the implementation of a satisfactory maintenance schedule. Failure to do so may cause undue failure and possible health hazards. This manual must be kept in a safe place to prevent its deterioration and/or alteration. The user and Welch Allyn, Inc. authorized personnel must have access to this manual at any time.

The user of this device must periodically check the transmitters and monitors, their functionality and the integrity of their accessories.

## Equipment Identification

Welch Allyn, Inc. equipment is identified by serial and part numbers on the side, back, or bottom of the device. Care should be taken so that these numbers are not defaced.

The device product label is applied showing the unique identification numbers along with other important information printed on the label.

The serial number format is as follows:

YYYWWSSSSSS

YYY = First Y is always 1 followed by two-digit Year of manufacture

WW = Week of manufacture

SSSSSS = Sequence number of manufacture

The product label and UDI label (when applicable) are applied to work station.

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## Notice to EU Users and/or Patients

Any serious incident that has occurred in relation to the device, should be reported to the manufacturer and the competent authority of the Member State in which the user and/or patient is established.

## 2. WARRANTY INFORMATION

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### Your Welch Allyn Warranty

WELCH ALLYN, INC (hereafter referred to as “Welch Allyn”) warrants that components within Welch Allyn products (hereafter referred to as “Product/s”) will be free from defects in workmanship and materials for the number of years specified on documentation accompanying the product, or previously agreed to by the purchaser and Welch Allyn, or if not otherwise noted, for a period of twelve (12) months from the date of shipment.

Consumable, disposable or single use products such as, but not limited to, PAPER or ELECTRODES are warranted to be free from defects in workmanship and materials for a period of 90 days from the date of shipment or the date of first use, whichever is sooner.

Reusable product such as, but not limited to, BATTERIES, BLOOD PRESSURE CUFFS, BLOOD PRESSURE HOSES, TRANSDUCER CABLES, Y-CABLES, PATIENT CABLES, LEAD WIRES, MAGNETIC STORAGE MEDIUMS, CARRY CASES or MOUNTS, are warranted to be free from defects in workmanship and materials for a period of 90 days. This warranty does not apply to damage to the Product/s caused by any or all of the following circumstances or conditions:

- a) Freight damage;
- b) Parts and/or accessories of the Product/s not obtained from or approved by Welch Allyn;
- c) Misapplication, misuse, abuse, and/or failure to follow the Product/s instruction sheets and/or information guides;
- d) Accident; a disaster affecting the Product/s;
- e) Alterations and/or modifications to the Product/s not authorized by Welch Allyn;
- f) Other events outside of Welch Allyn’s reasonable control or not arising under normal operating conditions.

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### 3. SAFETY INFORMATION

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**WARNING:**

Means there is the possibility of personal injury to you or others.



**Caution:**

Means there is the possibility of damage to the device.

**Note:**

Provides information to further assist in the use of the device.

#### Safety Regulations

Surveyor Central cannot be classified as Medical Electrical Equipment according to the definition of safety standard IEC 60601-1. The Surveyor Central, together with all accessories that have a physical or logical connection with it, forms part of a Medical Electrical System.



#### WARNINGS

- This manual gives important information about the use and safety of this system. Deviating from operating procedures, misuse or misapplication of the system, or ignoring specifications and recommendations could result in increased risk of harm to users, patients and bystanders, or damage to the system.
- Users are expected to be licensed clinical professionals knowledgeable about medical procedures and patient care, and adequately trained in the use of this system. Before attempting to use this system for clinical applications, the operator must read and understand the contents of the user manual and other accompanying documents. Inadequate knowledge or training could result in increased risk of harm to users, patients and bystanders, or damage to the system. Contact Welch Allyn service for additional training options.
- The Surveyor Central is not designed to be used in the environment where the patient is undergoing a medical procedure as defined in IEC 60601-1 (1.5 m from the patient).
- The Surveyor Central is not battery operated. For uninterrupted use, an appropriate uninterruptible power supply (UPS) is required. The WiFi network (telemetry) as well as any active network components such as switch and firewall should also have the capability to remain operational in cases of general power outages. The Surveyor Central is designed to continue operation with the last stored settings after a power interruption, however, loss of stored data is possible if power is interrupted to the system that stores the data. When using a backup power source such as a UPS, periodically check it to ensure it is properly functioning per the manufacturer's recommendations and specifications.

- In order to be safely used, all accessories (such as monitors, printers, data network, etc.) must be compatible, and comply with all safety and EMC regulations that apply to them according to their intended use; for use in Europe, these accessories should be CE marked.
- The various parts of a Surveyor Central monitoring system (Telemetry receiver computers, control and display computers, storage computers, printers, or bedside monitors) are all connected through a specific Ethernet data network. This network must be installed according to all applicable standards and may only be logically or physically connected to the outside world through a specific routing device available from Welch Allyn. Any other data path can lead to serious security risks and interruptions of monitoring. Other devices must not be connected to the Surveyor data network.
- Connection of the Surveyor Network along with its associated transmitters and monitors to the IT Network in a healthcare delivery organization may carry risks to patients, operators as well as 3<sup>rd</sup> parties. Such risks must be carefully assessed and mitigated. The IEC 80001-1:2010 standard provides guidance to the healthcare delivery organization for carrying out such risk assessment and mitigation. Changes to the IT Network can also introduce new risks which should be carefully assessed and planned.
- In the case of a Surveyor Central system with additional control stations for display and control of the same patient channels in multiple locations, silencing or suspending of alarms will cause the alarm to be silenced or suspended at all the locations. Be certain that alarms are silenced or suspended by the clinician having direct responsibility for care of the given patient.
- Install all computer equipment with adequate space around ventilation vents. Clean and remove accumulated dust on ventilation openings, and also remove dust regularly from the inside of the system. The last operation must be performed by adequately trained and authorized personnel, and with the system turned off.
- Install the external USB connected speakers that generates the alarm sounds in such a way that the sound can be heard adequately in the appropriate areas. Do not unplug the USB speakers from the computer as this may cause the interruption of audible alarm.
- The Surveyor Central provides an alarm volume adjustment. Be sure to set the volume at a level that alarms can be heard above the ambient noise level in the environment of use. Setting alarm volumes too low can impede recognition of alarm signals.
- The hardware watchdog device is connected to the computer with a USB cable and has its own power supply. Mount it in such a way that the sound can be heard adequately in the appropriate areas. Test regularly by temporarily removing the USB plug while the central station power is turned on.
- The Surveyor Central must be connected to a properly grounded power terminal, and the electrical installation must comply with the local safety requirements for the environment where it is used.
- The Surveyor Central requires more than one mains outlet. Fix multi-socket outlets properly, do not leave them on the floor, and organize the cabling in such a way that normal work is not hampered and safety is not compromised.
- Regularly check all mains power cables for damage and proper connection. Do not use equipment with a damaged power cord.
- The Surveyor Central components are not waterproof. Avoid spillage of liquids from penetrating the system or submersion of components and transmitters into a liquid. In case of accidental spillage, turn device off and let dry thoroughly.
- The various manufacturers of accessories provide separate user manuals (e.g., monitor, laser printer, Surveyor S12/S19, Surveyor S4, patient cables, electrodes). Read these manuals well and refer to them for specific functions. It is recommended to keep all manuals together. Refer to these manuals for a list of approved accessories. When in doubt, contact Welch Allyn.

- Every hardware or software modification has to be made by Welch Allyn authorized and trained technical personnel.
- Do not disassemble the equipment as hazardous voltages may be present within. Contact Welch Allyn or an affiliated service representative for repairs.
- Technical and service documents are available upon request.
- Always turn the system off before connecting or disconnecting any cables.
- Do not use the system in places that are susceptible to explosion hazard or in the presence of flammable gases.
- Do not use the system in the presence of Magnetic Resonance Imaging (MRI) equipment and tomography equipment.
- Do not insert a bootable CD/DVD on the Surveyor Central computers. Do not run any program from CD/DVD or USB memory sticks. These I/O devices should only be used for export and import of patient ID formats, profiles and protocols.
- Surveyor Central computers contain a small lithium battery for maintaining clock and BIOS settings which should normally last the lifetime of the system. If the battery needs to be replaced, be sure that it is done by qualified personnel and with a battery of the same type.
- Surveyor Central software has been extensively tested and clinically validated. Several protection mechanisms against software errors have been built into the Surveyor Central; however, in the unlikely event of a failure of the software or the computer processor, the electronic (hardware) “watchdog” of the Surveyor Central sounds a continuous loud beep and the Central station has to be power-cycled to remove this. Please inform Welch Allyn service personnel for further troubleshooting should this continuous loud beeping occur.
- Surveyor Central hardware has been carefully selected for reliability; however, in mission critical situations, it might be advisable to have a backup system available at short notice. This also includes accessories such as patient transmitters and monitors which, by nature and way of use, can be more prone to failure.
- Installation and connection to data networks must be performed by properly trained personnel, authorized by Welch Allyn, Inc.
- To maintain designed operator and patient safety, use only parts and accessories supplied with the system and available through Welch Allyn, Inc.
- The equipment described in this manual has an expected lifetime of five years from the date of manufacture. Operation beyond this expected life may not meet specifications. This lifetime is only valid if devices are used according to the instructions in this manual and associated manuals provided with the equipment.
- The system captures and presents data reflecting a patient’s physiological condition that when reviewed by a trained physician or clinician can be useful in determining a diagnosis. However, the data should not be used as a sole means for determining a patient’s diagnosis. The system is optionally equipped with Welch Allyn’s VERITAS™ 12-lead resting ECG interpretation algorithm. When this option is enabled, the VERITAS ECG algorithm can provide an over-reading physician with a silent second opinion through diagnostic statements output on the ECG report. For additional information on the Welch Allyn VERITAS 12-lead resting ECG interpretation algorithm, please refer to the Physician’s Guide to ECG Interpretation.
- 12-lead ECGs acquired through Surveyor Central or attached monitors will normally use a modified lead system with the limb electrodes positioned on the torso. Although this is a generally accepted practice

(e.g., in stress testing), the different electrode positions can cause morphology changes on the ECG, thus influencing their interpretation. Most frequently seen differences are a vertical and rightward axis shift, minor changes of evidence of old inferior infarction and changes in the T-wave in the limb leads. All 12-lead ECGs printed with Surveyor Central have a warning message that alerts the physician that the ECG might have been acquired with torso positioned limb leads. It is recommended that you place the electrodes as close as possible to the normal limb positions avoiding the possibility of causing artifact. The right arm and left arm electrodes should be placed on the clavicles as close as possible to the arms. The left leg electrode should be placed as close as possible to the left leg without subjecting it to the possibility of motion artifact.

- The minimum amplitude for detecting QRS complexes is user selectable between 160, 300 and 500  $\mu\text{V}$ . A low value of this limit has the risk of detecting P waves as QRS complexes in the case of atrio-ventricular block; however, a high value might lead to false cardiac arrest alarms if the QRS amplitude is low in all leads. Therefore, the user is encouraged to select detection leads with amplitude of at least 1 mV and set the minimum QRS amplitude at 300  $\mu\text{V}$ .
- During periods of lead fail and when a reduced lead set is used for patient monitoring, 12-lead resting ECG interpretation cannot be reliably used in determining a diagnosis.
- When the 40 Hz filter is used, the frequency response requirement for diagnostic ECG equipment cannot be met. The 40 Hz filter significantly reduces high-frequency components of the ECG and pacemaker spike amplitudes, and is recommended only if high-frequency noise cannot be reduced by proper procedures.
- The quality of the signal produced by the system may be adversely affected by the use of other medical equipment connected to the patient including, but not limited to, defibrillators and ultrasound machines.
- If the system or one of its subsystems become inoperable during monitoring, a medium or low priority type alarm sounds and a message is displayed on the screen. In case of hardware or software failure that causes the sound generator or display subsystem to fail, the hardware watchdog unit generates a continuous beep. Periodic checks of the monitoring screen are recommended to ensure proper functioning.
- The LCD supplied with the Surveyor Central has a separate power switch and power-on indicator. If no image appears on the screen, check the LCD power indicator. Alarm sounds are not affected by the status of the LCD. Do not connect a sound-capable display monitor such as a LCD TV to the Surveyor Central.
- The on/off switch of the Surveyor Central is deactivated and can only be used for emergency power down by depressing it for a period greater than 4 seconds. Normal shutdown of the Surveyor Central should be done by using the password-protected configuration window.
- Do not use excessive force on any of the connection cables and handle all accessories with care.
- Various alarm conditions require operator set limits that vary per patient. For telemetry monitoring, Surveyor Central supports the selection of appropriate alarm profiles when a patient is admitted. The operator should check these settings after each patient admission to ensure whether the chosen alarm limits are appropriate for the individual patient. Inappropriate alarm limits render the alarm system useless.

- Saved profiles are only applicable to the type of cable and detection leads in use when the profile was defined. If another type of cable is used with a saved profile, the default detection leads will be utilized.
- In any single environment such as an intensive care unit or cardiac operating theater, a potential hazard can exist if different alarm preset values are used for the same or similar equipment.
- Portable and mobile RF communications equipment can affect medical electrical equipment or systems as well as the Surveyor Central and its accessories.
- Surveyor Central alarms can only be silenced and not reset. This means that visual representation of an alarm condition remains present after an operator silenced action until the alarm condition disappears (unless obscured by another, higher priority, alarm). The auditory alarm signal does not re-activate after a silence action if the alarm condition remains the same. As soon as the alarm condition of a silenced alarm goes away, the alarm can be reactivated.
- The Surveyor Central alarm system can be globally disabled or suspended for a period of time for a patient. The selection between disabling and suspending, as well as the suspension duration, can be set in the password-protected system configuration page. A clear visual indication of this condition is present in the patient window, and a reminder signal sounds every three minutes. Any technical alarms will be visually presented on the screen, regardless of the alarm disabled state. In this configuration the technical alarms will not be audible.
- The intended use of Surveyor Central Repeater is to repeat waveforms, parameters and system status of selected patients monitored by Surveyor Central in order to enhance workflow for medical personnel. Surveyor Central Repeater does not produce audible alarm signals and may not be used to substitute any alarm functions of Surveyor Central.
- This manual applies to the most recently manufactured system, with respect to software release and hardware configuration. Whenever used for software upgrades on previously installed equipment, some technical specifications or labels may not be respected, whereas functions and instructions for use of the system are always valid. This user manual reflects software version 5.1.0.
- This product complies with relevant electro-magnetic interference, mechanical safety, performance, and biocompatibility standards. However, the product cannot completely eliminate potential patient or user harm from the following:
  - Harm or device damage associated with electro-magnetic hazards,
  - Harm from mechanical hazards,
  - Harm from device, function, or parameter unavailability,
  - Harm from misuse error, such as inadequate cleaning.
- The device and IT Network the device is connected to should be securely configured and maintained per the IEC 80001 standard, or an equivalent network security standard or practice.

**The following warnings concern telemetry monitoring:**

- Electrostatic discharges may generate short interference on the ECG tracings.
- WiFi Telemetry: The Surveyor S4 utilizes standard WiFi telemetry per the IEEE 802.11g/n standard. The WiFi network supporting the Surveyor S4 and for use with the Surveyor Central must be installed and tested in accordance to Welch Allyn's guidance and network requirements. Also refer to Welch Allyn's Manufacturer Disclosure Statement for Medical Device Security (MDS2) documents for the Surveyor Central and Surveyor S4. Welch Allyn and/or 3<sup>rd</sup> party partners are available to perform network site surveys and audits to confirm the suitability of the facility's WiFi network for use with the S4 mobile monitor and

connection to the Surveyor Central and its SurveyorNetwork.

- The system was not designed to be used with high frequency (HF) surgical devices.
- Use of transmitters and monitors may be restricted in some countries; see the transmitter's and monitor's user manuals for details.
- Consult the Surveyor S12/S19 and Surveyor S4 user manuals for more information regarding the patient cable, electrode recommendations, cleaning, maintenance, channel frequencies, precautions to take during patient defibrillation, and other warnings.

The following warnings concern pulse oximetry (SpO<sub>2</sub>) telemetry monitoring:

- Pulse oximetry sensors must be checked a minimum of every 4 hours and moved to a new site as necessary.
- Pulse oximetry sensors are susceptible to high ambient light interference including ambient photodynamic therapy. Shield the sensor area as necessary.
- SpO<sub>2</sub> measurement may be adversely affected by dyes (e.g., methylene blue, indocyanine green, indigo, carmine, fluorescein) introduced into the bloodstream.
- Any condition that restricts blood flow such as the use of a blood pressure cuff or extremes in systemic vascular resistance may cause inability to determine accurate SpO<sub>2</sub> readings.
- Certain conditions such as physical movement (patient and imposed motion); diagnostic testing; low perfusion; electromagnetic interference; electrosurgical units; dysfunctional hemoglobin; and inappropriate positioning of the pulse oximeter sensor may result in pulse oximetry readings that are unreliable.
- SpO<sub>2</sub> signal inadequacy is indicated by error messages displayed on the LCD of the transmitter and by alarms generated at the Surveyor Central system for signals coming from the transmitter.
- The performance of the monitor may be compromised by excessive motion.
- Nail polish and/or artificial fingernails can affect the accuracy of pulse oximetry and should be removed.
- The pulse oximeter equipment is calibrated to display functional oxygen saturation.
- Functional SpO<sub>2</sub> testers (simulators) are useful to measure how accurately a particular monitor is reproducing the calibration curve but cannot be used to assess the accuracy of a type of probe or monitor. If there is independent demonstration that a particular calibration curve is accurate for the combination of a pulse oximeter monitor and a pulse oximeter probe, then a functional tester can measure the contribution of a monitor to the total error of a monitor/probe system. The functional tester can then measure how accurately a particular pulse oximeter monitor is reproducing that calibration curve.
- If no SpO<sub>2</sub> or pulse rate is present, alarm conditions are provided at the Surveyor Central system. There is no alarm condition provided at the transmitting device.
- For additional instructions and warnings, refer to the user manual of the transmitting device.

The following warnings concern heart rate for telemetry monitoring:

- Heart rate indication is usually not affected by ventricular or supraventricular arrhythmias or irregular heart rates. Heart rate is calculated over 16 beats at rates over 40 bpm and 4 beats at lower heart rates. This results in a response time of 9 seconds or less when the heart rate changes suddenly from 80 bpm to 40 or 120 bpm, as measured according to IEC 60601-2-27.
- High heart rate and low heart rate alarms cannot be disabled.

- Tall and peaked T-waves may affect QRS detection resulting in doubled heart rates. Surveyor Central rejects tall T-Waves less than or equal to 230% of a 1 mV QRS measured according to IEC60601-2-27.
- The heart rate meter correctly detects all beats of the alternating beat type waveforms considered in IEC 60601-2-27, Figure 201.101, patterns A1-A4, if the QRS amplitudes exceed the minimum detection threshold set by the user.
- Time to low heart rate, high heart rate and asystole, as measured according to IEC 60601-2-27, is less than 10 seconds.
- Heart rate indication is not reliable during episodes of ventricular fibrillation.
- The summarized performance of the QRS recognition and classification algorithm on standard databases, as defined by ANSI/AAMI EC 57, is as follows:

	MIT Database
Performance Measures	Welch Allyn
QRS Detection Sensitivity %	99.93
QRS Detection Positive Predictivity %	99.87
PVC Detection Sensitivity %	95.13
PVC Detection Positive Predictivity %	97.04
PVC Detection False Positive Rate %	0.220

	AHA Database
Performance Measures	Welch Allyn
QRS Detection Sensitivity %	99.78
QRS Detection Positive Predictivity %	99.91
PVC Detection Sensitivity %	93.15
PVC Detection Positive Predictivity %	98.40
PVC Detection False Positive Rate %	0.154

- Because of noise, artifact and the many different physiological manifestations of the ECG signal, it is inevitable that some beats are not detected or correctly classified by the system. The user is advised not to rely completely on automatic alarm systems for the monitoring of critical patients.
- Excessive patient movement could interfere with the operation of the system.
- Proper patient preparation is important to proper application of ECG electrodes and operation of the device.
- If the ECG amplifier input is out of normal operating range, the display will indicate a lead fail for the lead(s) where this condition is present and if the signal is being displayed or printed, the respective lead(s) will print out as square waves. A lead fail alarm is generated on the Surveyor Central.

The following warnings concern pacemaker patients for telemetry monitoring:

- Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon heart rate meter ALARM SIGNALS. Keep pacemaker PATIENTS under close surveillance. See this manual for disclosure of the pacemaker pulse rejection capability of this instrument.
- With the Surveyor S4 when used with the 4-wire, 5-wire or 10-wire ECG cable, all pacemaker spikes are rejected per the IEC 60601-2-27 standard (0.1 - 2 ms duration, 2 - 700 mV amplitude). Signals are recognized as pacemaker spikes when they have a slew rate over 4 V/s, as measured according to the IEC 60601-2-27 standard. Abnormally high or wide pacemaker spikes might be recognized as QRS if their

amplitude and pulse width exceed these values.

- With the Surveyor S4 when used with the 3-wire ECG cable, pacemaker spikes are not rejected consistently. For this reason, do not rely upon heart rate meter ALARM SIGNALS, when using a 3-wire cable.
- Welch Allyn does not claim, verify, or validate support for all available pacemakers.
- Consult the Surveyor S12/S19 User Manual for a description of its pacemaker spike rejection capabilities.
- The Pacemaker Rejection software can be deactivated by the user. This should not be done for patients with a pacemaker or suspected to have a pacemaker implanted because this can lead to a heart rate indication and failure to alarm for cardiac standstill.
- Other than the influence on beat detection as stated above, there is no known safety hazard if other equipment, such as pacemakers or other stimulators, is used simultaneously with the system.

## Notes

- Surveyor Central contains electronic records including ECG's which can be exported to other applications. The Surveyor Central system can be part of a system that is compliant with the electronic records requirements of part 11 of Title 21 of the Code of Federal Regulations; Electronic Records; Electronic Signatures (21CFR Part 11) as stipulated by the US Food and Drug Administration's (FDA). The user of the Surveyor Central system must ensure full compliance to this as required.
- The Surveyor Central system implements certain features such as username/passwords and audit trails. By design, the system is accessible and available for use upon power-up. The facility deploying and using the system is responsible for ensuring appropriate safeguards are put in place to protect patient health information (PHI). This includes a mixture of physical and IT-based mechanisms to secure PHI from unauthorized access. The Surveyor Central Station including printers generating reports must be placed in a physical location that is secure (e.g., nurse's station). Surveyor Review and Repeater stations may be placed in less secure locations but must implement proper username/password access policies as required.

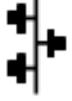
## 4. EQUIPMENT SYMBOLS AND MARKINGS



**WARNING** The warning statements in this manual identify conditions or practices that could lead to illness, injury, or death. In addition, when used on a patient applied part, this symbol indicates defibrillation protection is in the cables. Warning symbols will appear with a grey background in a black and white document.



**CAUTION** The caution statements in this manual identify conditions or practices that could result in damage to the equipment or other property, or loss of data.

 <p>Follow instructions/directions for use (DFU) -- mandatory action. A copy of the DFU is available on this website. A printed copy of the DFU can be ordered from Hillrom for delivery within 7 calendar days.</p>	 <p>Direct Current (DC) power input</p>
 <p>Indicates compliance to applicable European Union directives</p>	 <p>Universal Serial Bus (USB) port</p>
 <p>Do not dispose as unsorted municipal waste. Requires separate handling for waste disposal according to local requirements.</p>	 <p>Output terminal</p>
 <p>Network connection</p>	 <p>ON (Power)</p>
 <p>Model Identifier</p>	 <p>Reorder Number</p>
 <p>Medical Device</p>	 <p>Authorized representative in the European Community</p>
 <p>Manufacturer</p>	 <p>Global Trade Item Number</p>
 <p>Serial Number</p>	



Keep away from  
sunlight



This way up



Fragile



Keep dry



Temperature limit



Humidity limitation



Atmospheric pressure  
limitation

## 5. ELECTROMAGNETIC COMPATIBILITY

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The Surveyor Central Station is a patient monitoring central station using off-the-shelf ITE equipment such as workstation PC, server and peripheral equipment. All ITE equipment provided with Surveyor Central Station are compliant to the applicable Electromagnetic Compatibility Standards for Information Technology Equipment (ITE) including:

- EN 55032:2012 (equivalent to CISPR 32:2012) Class A or Class B for Emissions.
- EN 55024:2010 (equivalent to CISPR 24:2010 for Immunity).
- EN 61000-3-2:2014 for Harmonics.
- EN 61000-3-3:2013 for Flicker
- Federal Communication Commission (FCC), Code of Federal Regulations (CFR), Title 47, Part 15.



WARNING: The Surveyor Central is not designed to be used in the environment where the patient is undergoing a medical procedure as defined in IEC 60601-1. Therefore, to guarantee Electromagnetic compatibility do not place the Surveyor Central Station in the patient environment.



## 6. INTRODUCTION

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### Purpose

This user manual explains how to:

- Use and understand Surveyor™ Central, Surveyor Central Repeater, Surveyor Central Review and available options
- Enter, modify, and delete information
- Perform common operator tasks

**NOTE:** This manual may contain screen shots. Any screen shots are provided for reference only and are not intended to convey actual operating techniques. Consult the actual screen in the host language for specific wording.

### Audience

This manual is written for clinical professionals who are expected to have a working knowledge of medical procedures and terminology as required for monitoring cardiac patients.

### Intended Use

The Surveyor Central Station system is intended for monitoring of physiological signs, including cardiac and vital signs, for multiple patients within a medical facility. The system can receive, display and store data from up to a maximum of 64 multi-parameter patient monitors, mobile monitors, and/or telemetry systems. The system can support patient monitoring and telemetry monitoring modes simultaneously. Patient monitors can be Surveyor S12 or S19 patient monitoring systems. Ambulatory telemetry transmitter and mobile monitor sources can be Surveyor S4 systems.

In patient monitoring mode, the patient monitors provide primary monitoring functionality while the Surveyor Central Station system provides continuous secondary monitoring of patients including alarm reception and management, display and storage of parameters and waveforms including full-disclosure, automatic and on-demand generation of various printed reports using a network-attached printer.

In telemetry monitoring mode, the Surveyor Central Station provides primary monitoring of patients including display of values and waveforms, alarm generation and management, data storage, patient management and report printing functionality. Patients are monitored through telemetry, when moving in a defined area, of a variable size depending on layout and thickness of walls. In order to guarantee a proper signal transmission in each different situation, an antenna network can be installed according to customer needs.

The data and analysis provided by the Surveyor Central Station is reviewed, confirmed, and used by trained medical personnel in the diagnosis of patients with various conditions.

### Indications for Use

The Welch Allyn Surveyor Central Station is indicated for use in adult and pediatric patient populations.

- In a clinical setting, by qualified medical professionals, properly trained for patient monitoring and use of the system. Continuous analysis is provided for all patients. The personnel must be experienced in cardiovascular problematic situations and emergency procedures or pathologies related to cardiac involvements.
- Centralized monitoring through a network of patients in Coronary Care Units, Intensive Care Units, Ambulatory Care Units (Telemetry Units), Step-Down Units, Operating Rooms, Emergency Departments and Surgical Centers. Evaluation of adult and pediatric patients with symptoms suggesting arrhythmia. Detected arrhythmias create an audiovisual alarm according to the alarm profile.

- Chest Pain Evaluation.
- Evaluation of patients with pacemakers.
- Evaluation of a patient's response after resuming occupational or recreational activities (e.g., after M.I. or cardiac surgery.)
- Evaluation of monitored parameters documenting therapeutic interventions in individual patients or groups of patients.
- Clinical and epidemiological research studies.

## System Description

The Surveyor Central can perform telemetry monitoring using the Surveyor S4 integrated with the healthcare delivery organization's WiFi network infrastructure. The Surveyor Central is also designed to communicate with the Surveyor S12/S19 multi-parameter patient monitors.

Its intended functions include:

- Real-time, 3-wire (1-lead), 5-wire (7-lead) and 10-wire (12-lead) diagnostic ECG signal display
- Real-time SpO<sub>2</sub> plethysmographic waveform display
- Automatic monitoring of arrhythmias, SpO<sub>2</sub> values, and ST changes including one or more displayed waveform channels for each patient
- Visual and audible alarms of events, arrhythmias, and set parameters with adjustable priorities
- Averaged and reference QRS complexes
- Graphical trend review
- Single lead or any combination of leads up to 12 for ECG rhythm and report printing
- ECG signal and SpO<sub>2</sub> data storage with optional full-disclosure storage and review
- When the patient device is a Surveyor S12/S19 monitor, additional parameters may include non-invasive blood pressure (NIBP), impedance respiration, invasive pressures (P1-P4), Temperature (T1, T2), end-tidal and inspired CO<sub>2</sub>, and cardiac output (CO).

Through telemetry, patients using ambulatory transmitters are monitored while moving in a designated area. To guarantee proper signal transmission in various situations, install an antenna network as per facility requirements.

The Surveyor Central Station communicates with the Surveyor S12/S19 patient monitors through a Local Area Network (LAN) interface. The Surveyor Central network can distribute patient data to one or more Surveyor Central control stations in a single or dual display mode.

Each Surveyor Central receiving workstation will acquire data. Connect multiple Surveyor workstations to the same Surveyor Central network to allow real-time patient monitoring in a variety of different system configurations (see following page).

Control, viewing, receiving signals, and data storage are all possible on a single Surveyor Central workstation. Control, viewing, receiving signals, and



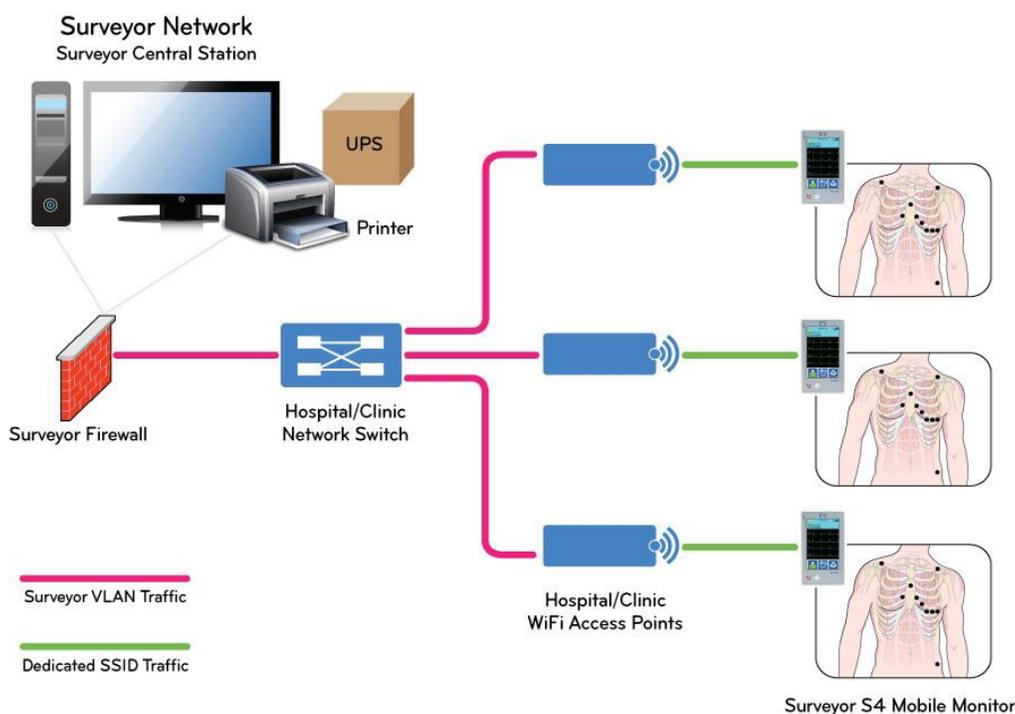
**Figure 1** – An example of Surveyor Central configured with dual displays.

data storage can also be achieved using separate workstations for each function—or a combination of functions—on the Surveyor Central network. Networked printers are used for automatic or manual printouts of 12-lead ECG, ECG rhythm, plethysmographic waveform with % SpO<sub>2</sub> and pulse rate, and reports.

An optional redundant storage server is available for increased storage capacity as well as storage to duplicate data disks when continuous and complete ECG capture is critical. This is valuable for institutions that collect ECG data for research purposes. This capability may also be important for other medical facilities.

The Surveyor Central system provides the means for users to manage patient records with associated patient demographics and assign each to a particular patient monitor or telemetry system for obtaining physiological information. Physiological data obtained from patient monitors and telemetry devices are viewable and stored continuously with a minimum storage timeframe of 72 hours. Alarm monitoring and management, including definition of alarm limits, as well as data trending and reporting are available. Full disclosure supports review of the data on a particular patient including review of 12-lead ECG waveforms and other data and waveforms for obtained parameters.

### Surveyor Central with WiFi telemetry



**Figure 2** - A Surveyor Central configuration with WiFi telemetry using Surveyor S4 mobile monitors.

### Surveyor Central with Multiple Control of Same Channels

Additional control stations are available for display and control of the same patient channels in multiple locations. Channel allocation for multiple control stations is defined during installation and setup.

### Surveyor Central USB-WATCHDOG

Surveyor Central is intended for continuous use. A Watchdog is externally connected to a USB port and emits a loud and continuous audible alarm in case of system failure. A Watchdog is a required and necessary part of every control workstation.



Figure 3 - Top and side view of the Surveyor Central USB watchdog device.

## Optional System Components

- **Single color displays:** A single 24" LCD display optimally supports up to 16 or a maximum total of 32 telemetry and patient monitoring slots.
- **Dual color displays:** A 24" dual LCD display optimally supports up to 32 or a maximum total of 64 telemetry and patient monitoring slots.
- **Single, touch-enabled color display:** A single 24" LCD display optimally supports up to 16 or a maximum of 32 telemetry and patient monitoring slots; with touchscreen function.
- **Keyboard/mouse switch:** Allows one keyboard and mouse to control up to 4 nodes, with their displays configured to seamlessly produce one large virtual desktop.
- **Surveyor Central control station:** A workstation with single or dual display on the Surveyor Central network for purposes of controlling and viewing a set of monitored channels at a designated location within the facility.
- **Surveyor Central receiving station:** A workstation connected to the healthcare delivery organization's WiFi network through a firewall router for the purposes of receiving transmitted signals from Surveyor S4. As required, the receiving station produces a set of channels for viewing or storage at another location on the Surveyor Central network.
- **Surveyor Central receiving and control station:** A workstation with single or dual display connected to the transmitters and monitors for purposes of receiving transmitted signals to produce, display, and control a set of monitoring channels. Data storage is accomplished at another location on the Surveyor Central network.
- **Redundant data storage:** Stores real-time data and simultaneously copies the data to a set of Redundant Array of Independent Disks (RAID) for increased storage capacity and data security in situations where complete data collection is critical. All system data storage for workstations on the Surveyor Central network is performed at this networked server when it is a component of the Surveyor Central.
- **Surveyor Central repeater station:** A display station where monitoring channels are repeated and can be displayed, printed, and reviewed. Alarms are visual only and are not audible or controlled at the repeater station.
- **Network printer (print server):** The printer must be plugged into the AC power outlet through the appropriate power cord that is in compliance with local regulations. Please refer to the printer manufacturer's user manual for information, warnings, commands, and intended use.

## System Software Options

- **Full disclosure for continuous data storage:** All patient monitoring data is available for review when this option is enabled. The storage amount is dynamic and relies on the number of channels utilized in relation to the size of the storage space. Each day of a patient's data is equal to approximately 0.5 GB. Divide number of storage days by number of monitored patients to calculate number of days for each monitored patient (i.e., 600 days of storage ÷ 10 monitored patients = 60 days per patient). This option also allows off-line archive to a network directory or DVD media. Data can be acquired by Welch Allyn's HSCRIBE™ Holter analysis system for further review, rhythm quantification, Holter reporting, and/or 12-lead ECG collection which can then be exported in XML or Unipro format. When this option is not enabled, one minute of ECG data surrounding each event or alarm is stored for review, ECG printing, and export.
- **Protocol manager:** Only available for Telemetry channels. Allows the clinician to design automatically-timed reminder events, automatically generate printed ECGs, and/or export resting 12-lead ECGs. This is particularly useful to clinicians that perform ECG data collection and must remember to execute certain functions at specific times. The application allows the clinician to program the times for such events to automatically occur. Several different protocols can be designed and the desired protocol can be selected during the patient monitoring sessions. Protocols can also be programmed in phases started by the Surveyor Central station user or by pressing the call button on the transmitter.
- **Extended arrhythmia and 12-lead ST monitoring:** In addition to standard lethal arrhythmia events and alarms, this option allows the clinician to automatically print and capture ventricular ectopy, rhythm patterns, and QRS changes as well as pacemaker failure events. This feature also allows averaged 12-lead ECG display for comparison of the reference ECG superimposed on the current ECG. The reference ECG is used for ST change alarms. Note that not all extended arrhythmias are available with S12/S19 patient monitors.
- **Resting ECG interpretation:** Enables global ECG measurement including QT/QTc calculation and 12-lead ECG interpretation utilizing Welch Allyn's VERITAS algorithm. 12-lead ECGs can be exported in Unipro format to a network directory or directly to Welch Allyn's E-SCRIBE™ data management system. This option is required to enable the ability to use and define E-SCRIBE custom ID formats. This feature is optional with telemetry only monitoring channels. This feature is always included with Surveyor S12/S19 patient monitoring or a mix of telemetry and S12/S19 patient monitoring.
- **Review station:** Enables patient data review in the Surveyor Central from the online database, as well as patient monitoring data archived from the database to external media. The (separate) Resting ECG Interpretation option is required to enable global measurement and 12-lead ECG interpretation on archived records.

The Surveyor Central review station screen layout is similar to the Surveyor Central review screen in dual-display modality and has the same functionality as the Surveyor Central review features including printouts and export.

When networked to the Surveyor Central database, it is possible to initiate archive of patient monitoring data. Please refer to section 13 of this manual for more detail.

## Surveyor S12 and S19 Patient Monitors

The Surveyor S12/S19 patient monitors are multiparameter patient monitors designed to acquire physiological waveforms and parameters, and to transmit this data to the Surveyor Central monitoring station.

Please refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183-51-ENG) for details.



**Figure 4** - Surveyor S19 Patient Monitor shown with optional printer and wall mount.

## Surveyor S4 Mobile Monitor

The Surveyor S4 is a small, lightweight mobile monitor with a touchscreen designed to acquire ECG and SpO<sub>2</sub>, and to transmit this data to the Surveyor Central monitoring station via an 802.11g/n wireless network.

Please refer to the Surveyor S4 User Manual (PN 9515-190-50-ENG) for details.



**Figure 5** - Surveyor S4 Mobile Monitor

## Surveyor Central with Wireless Access Points

Transmission from and to the Surveyor S4 is via the healthcare delivery organization's WiFi wireless network used for patient data transmission and other system-level communications. When configured with optional 10-wire ECG, the S4 provides continuous 12-lead ECG transmission. Refer to the diagram in this section.

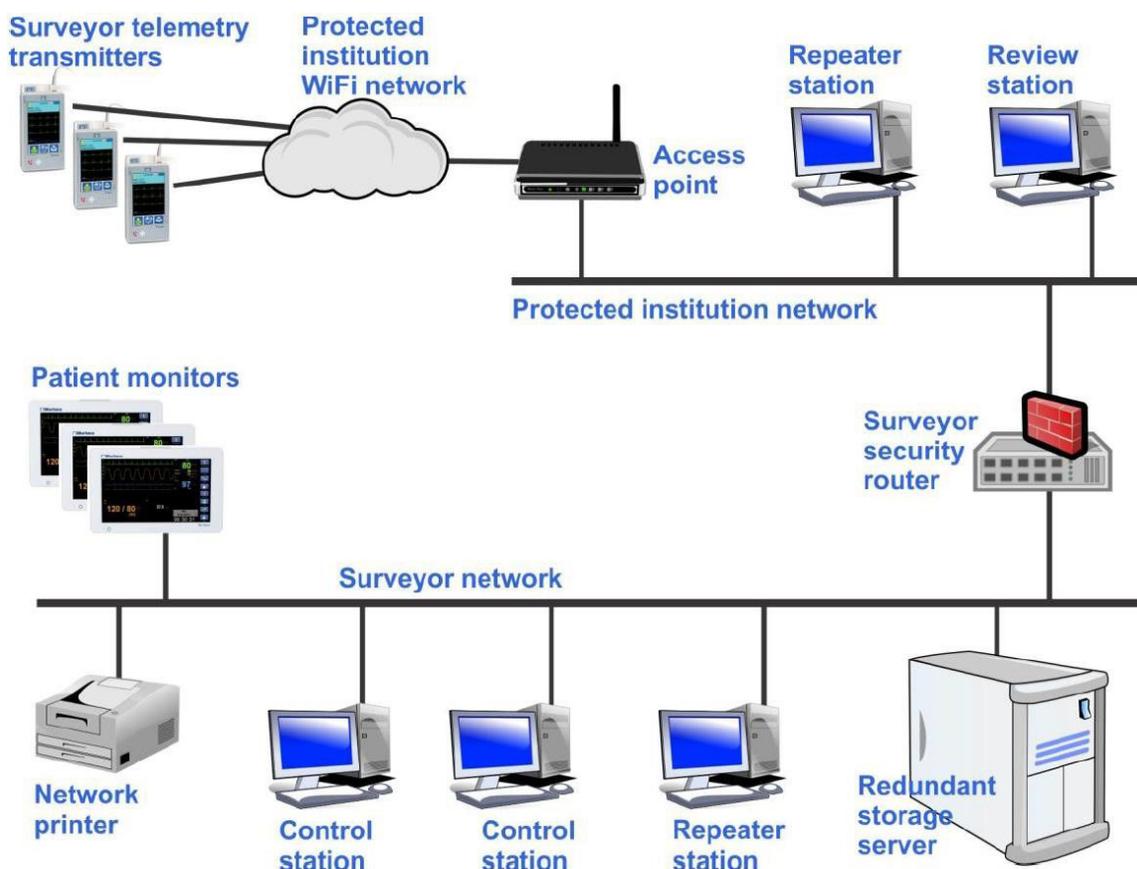
## Surveyor Central Network

The network for the Surveyor Central allows for the connection and exchange of data between the system components. Ethernet cable is used to connect all devices to the multi-port switch through an internal or external wall connection. All devices are outside of the patient area.



**WARNING:** Do not connect the Surveyor Central Network to computers, devices other than those specified by Welch Allyn, or the Internet, as system operation may be impaired. Consult Welch Allyn or one of its affiliates for information on devices that are approved for use on the Surveyor Central Network.

Surveyor Central's security router is used to isolate the system from the institution network. A secure firewall router is used for any repeater stations or review stations that are located outside of the Surveyor network. Other applications that access Surveyor Central such as Surveyor Import for Holter analysis and remote service support are networked in this way.



**Figure 6** - The Surveyor Central network.

The Surveyor Central repeater station is available as either a dedicated model or standalone software application.

- The dedicated model is installed within the Surveyor network and does not allow user access to any other Microsoft® Windows® programs. It will automatically start when the Surveyor Central is started, the same as any other dedicated node on the system.
- The repeater standalone application contains the same software and can be safely used on a computer on the institution network that meets the minimum specifications listed below and where there is access to the Surveyor securityrouter through LAN or WLAN connection.
  - Microsoft Windows 7 OS or Windows 10 (64-bit only)
  - Intel® 2<sup>nd</sup> Generation Core™ i3Processor
  - 4 GB RAM
  - 250 GB Hard Disk Drive
  - DVD/CD Drive (for software installation)
  - Fast Ethernet NIC
  - 1920 x 1080 Graphics Resolution

In addition, the repeater standalone application can be safely used on a suitable tablet PC's that meets the minimum specifications listed below and where there is access to the Surveyor security router.

- Microsoft Windows 7 OS or Windows 10 (64 bit only).

- Intel® Core i3 (7 gen) 7130U
- 4 GB RAM
- 128 GB SSD
- 10.1"
- 1440 × 900 Graphics Resolution

**NOTE:** In order to meet the declared Repeater standalone application performances, no more than two Repeater standalone applications, with eight patients under monitoring, must be connected to the same access point.

**NOTE:** In order to meet the declared Repeater standalone application performances, no more than nine Repeater standalone applications must be used at the same time.

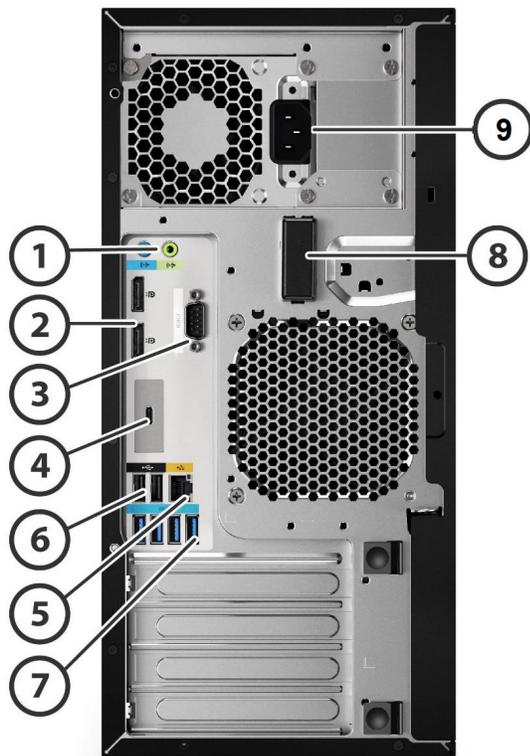
**NOTE:** When connected to Surveyor Central through WLAN connection, the Repeater standalone application performances depend on the customer WLAN connection and its traffic.

The Surveyor Central review station can be networked to the institution network with connection to the Surveyor security router when access to Surveyor Central's patient database is desired for remote review. The review station can also be installed as a stand-alone and used for review of archived patient monitoring records from media external to the Surveyor Central. Please refer to the Surveyor Central Review Station user manual (PN 9515-169-75-ENG) for more detail.

## Surveyor Central Connections

### Peripheral Workstation Component Interconnect

**NOTE:** Hardware and connections shown below are subject to change.



1	1 Audio Line In, 1 Audio Line Out, speaker connection (not used)
2	Display Connection (dual support)
3	Optional Serial Port (not used)
4	1 flex IO module for 2nd LAN/VGA/HDMI/DP/ USB-C 3.1 (not used)
5	Network printer connection or ethernet network connection
6/7	USB Port (USB external speaker connection, mouse and keyboard connection)
8	Optional WLAN/BT Antenna (not used)
9	AC Power



**WARNING:** Always make sure system is turned off before connecting or disconnecting any cable.

## Installation and Connections

Installation must be carried out by a Welch Allyn, Inc. authorized service representative in possession of current service and installation manuals. Surveyor Central requires specific settings based on the number and configuration of transmitters and monitors, the network layout, the type of printer, etc., as well as user preferences. The network laser printer requires specific settings and an installation driver. A package of cables, adapters, wire wraps, and labels are included with the system. Ensure these are available to installation personnel who will connect all accessories safely and in compliance with EMC and local safety requirements.

## Routine Maintenance and Cleaning Instructions

1. With the system turned off, clean all system components (computer, display, keyboard, mouse, printer, etc...), in accordance with their manufacturer's instructions.
2. Inspection and preventive maintenance by authorized personnel is recommended every six months.
3. Internal cleaning is recommended by means of a vacuum cleaner or similar device. Cleaning frequency depends on the environment.



**WARNING:** Use of unspecified cleaning/disinfecting agents, failure to follow recommended procedures, or contact with unspecified materials could result in increased risk of harm to users, patients and bystanders, or damage to the device. Improper cleaning products and processes can remove important symbols or markings and should not be used.



**WARNING:** Cleaning must be performed with the system turned off. Let all parts dry well before turning the power back on.

## Disposal of Waste Materials

Disposal must be in accordance with the following steps:

1. Follow cleaning and disinfection instructions per instructions in this user manual section.
2. Delete all existing data related to patients/hospital/clinic/doctor. Data backup may be performed prior to deletion.
3. Segregate material in preparation for the recycling process
  - Components are to be disassembled and recycled based on type of material
    - Plastic to be recycled as plastic waste
    - Metal to be recycled as Metals
      - Includes loose components containing more than 90% metal by weight
      - Includes screws and fasteners
    - Electronic components, including the power cord, to be disassembled and recycled as Waste of Electrical and Electronic Equipment (WEEE)
    - Batteries to be dismantled from the device and recycled as per WEEE

Users must adhere to all federal, state, regional, and/or local laws and regulations as it pertains to the safe disposal of medical devices and accessories. If in doubt, the user of the device shall first contact Hillrom Technical Support for guidance on safe disposal protocols.



## Privacy Information

The following information is meant to help the user decide which measures to take, taking into account both patient safety and the protection of personal information.

Surveyor Central allows the possibility to enter patient name as part of the demographic data. This name can be displayed on the screen of the system, depending on the configuration settings. The name is always displayed on all printouts.

Surveyor Central contains a temporary storage area of patient data (including patient name, if entered) meant for review in the context of immediate care, to which access is possible only through Surveyor Central components through the Surveyor data network. It is also possible to copy the data from a monitoring session (including patient name, if entered) to an off-line storage location or device. This data can only be read through specific Welch Allyn software for the purpose of reviewing this data, e.g., on a Holter analysis system or a Surveyor Central review station. It is the responsibility of the user organization to regulate access to these systems and software in compliance with local regulations.

## 7. USING THE SYSTEM

### Turning on the Surveyor Central Workstation

The ON/OFF switch is located on the front side of the CPU. When switch is depressed, the workstation will power on. To turn on LCD screen, locate the main switch (usually on the bottom border of the screen).

**NOTE:** The power-up sequence takes about 2 minutes and then the main display appears.

**NOTE:** Always keep the monitor ON/OFF switch in the ON position. If the monitor's indicator light is not illuminated, press the monitor ON/OFF switch. If the monitor indicator light is illuminated orange, red, or blinking and the monitor is still blank, check the cable connections between the monitor and the base. If an issue persists, contact Welch Allyn, Inc. technical support personnel.

### Display Screen

The Surveyor Central screen is divided into sub-screens, each showing a single patient. The number of traces that are shown depends on how the system is configured. This screen is called the "multi-patient display". An example is shown in Figure 7. In the multi-patient display, the entire screen displays real-time status of all connected patients including waveforms sent from monitors and/or telemetry transmitters.

**NOTE:** Normally, the waveform traces are drawn smoothly and continuously. Occasionally, you may observe a brief halt followed by the waveform catching up. This is usually due to momentary communication delays through the network between the Surveyor Central and the monitors/transmitters. The system is designed to work through such delays without data loss. However, if this occurs frequently, contact your network administrator or Welch Allyn to check the condition of the network.

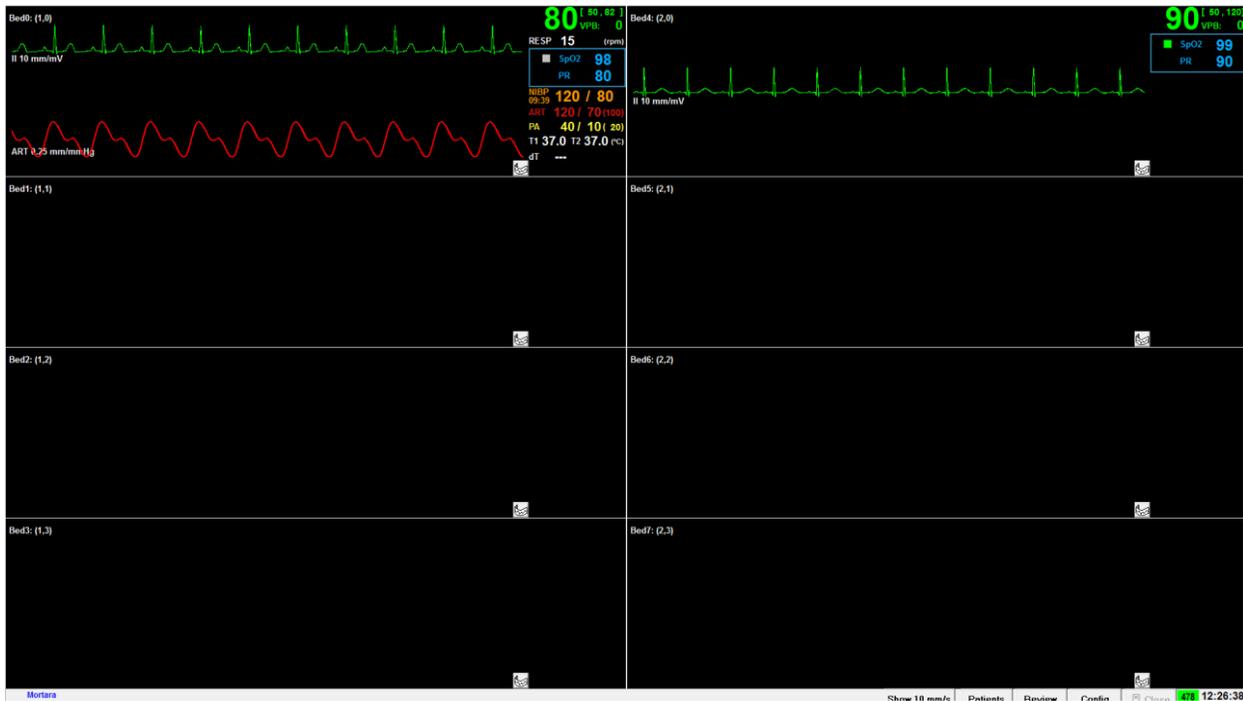


Figure 7 - The Surveyor Central multi-patient display screen.

## Moving the Cursor

The on-screen arrow is the mouse cursor used to activate all functions. For example, if you want to acknowledge and silence an alarm, move the cursor with the mouse over the Event/Alarm button (only visible if there is an alarm present) and left click the mouse button. It is not possible to acknowledge and silence alarms from a Surveyor Central repeater station, with the exception of protocol alarms.

## Multi-patient Display Buttons

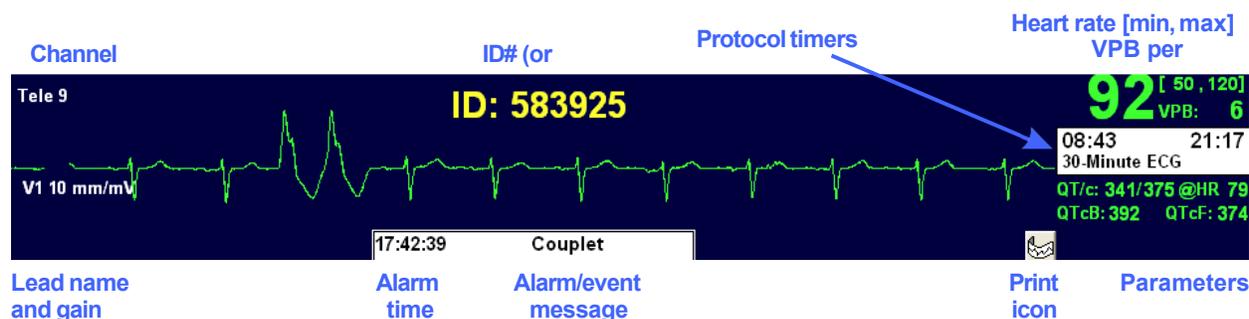
Buttons in the lower right area of the multi-patient display are active and can be selected by a left mouse click.

- **Show 10 mm/s** is used to toggle all monitored ECG waveforms between 25 mm/s and 10 mm/s speed for all patients.
- **Patients** will open a window that allows pre-admission entry of patient demographics. This window also shows the status of the current monitored patients. **Patients** is not active for the Surveyor Central repeater station.
- When using a Surveyor S12/S19 patient monitor, patient demographic information is communicated bidirectionally between the patient monitor and the Surveyor Central station — demographic information entered at the Surveyor Central station is sent to the patient monitor; demographic information entered at the patient monitor is sent to the Surveyor Central station.
- Patient data in the patients list can be added or edited allowing pre-admission by selecting **New** or **Modify** at the bottom of the display.
- The appropriate **ID Format** is also selected from the drop-down list in this window. When finished, select **OK** to save or **Cancel** to undo your changes.
- **Review** will open a multi-patient view of all of the current session events for all monitored patients. This allows you to filter, review, and edit all Events/Alarms. More detail will be explained later in this manual. Review is not available at the repeater station.
- **Config** will open a window that requires a password and will then present system configuration menus.

The number of available monitoring days in the database memory and current date and time are displayed in the area to the far right.

Feedback messages, when present, will appear in the lower left corner on the same status line. An informational message, such as a successful archive, will appear on a blue background. Error messages such as a print or archive failure will appear on a red background.

## Multi-patient display sub-screen fields



**Figure 8** - Detail view of a sub-screen within the multi-patient display.

A right click on the **print icon** shows a sub menu:

- Rhythm
- ST-Report
- Trends
- 12-lead
- 12-lead with Export
- Summary Report

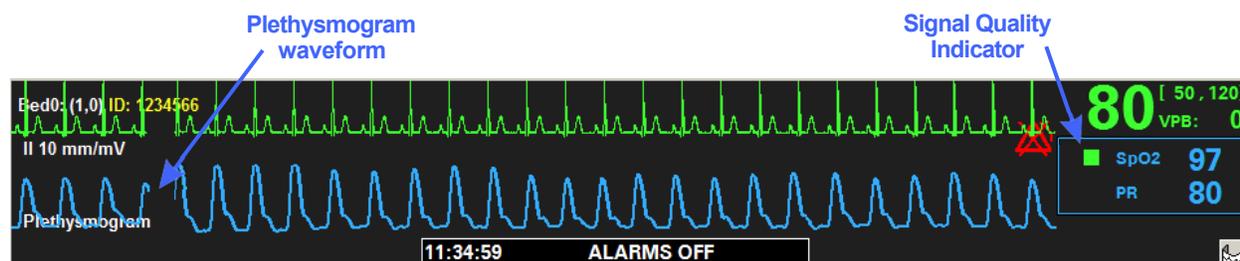
A left click on the **print icon** will generate a printout according to the user-defined default print setting



A red-crossed circle on the print icon indicates that alarm printouts have been disabled in the Alarm settings tab.

## SpO<sub>2</sub> display

When SpO<sub>2</sub> data is available, the sub-screen may also be configured to display the plethysmogram and/or a SpO<sub>2</sub> information block, as shown in the following example:



**Figure 9** - Detail view of a sub-screen showing telemetry from a Surveyor S4 with SpO<sub>2</sub>.

The plethysmogram is derived from the SpO<sub>2</sub> sensor placed on the patient, via the transmitting device. Its pulsatile characteristic reflects the flow of blood at the measurement site, but it is not a representation of arterial pressure. The plethysmogram is normalized so that its amplitude is continuously and automatically adjusted to fill the available display space. Consequently, the plethysmogram cannot be used to assess the strength of the signal; however, it is useful to visualize the impact of noise on the SpO<sub>2</sub> signal.

Within the SpO<sub>2</sub> parameter block, the following items are displayed:

- functional oxygen saturation in units of % SpO<sub>2</sub>,
- pulse rate in units of beats/minute, and
- a Signal Quality Indicator (SQI) appearing as a colored square.

## SpO<sub>2</sub> Signal Quality Indicator (SQI)

When used with a Surveyor S4, the SQI gives information about the condition of the signal being received by the sensor, as described in the table below. The S12/S19 and T12S do not support the SQI feature, and the SQI displays only a gray square.

SQI color	Description		
	S4	S12/S19	T12S
 Green	Good signal	Not applicable. Feature not available.	Not applicable. Feature not available.
 Yellow	Signal is weak and/or degraded by noise such as motion artifact. Percent SpO <sub>2</sub> and PR value displayed may potentially be inaccurate.		
 Red	The signal is missing or inadequate for SpO <sub>2</sub> to be calculated.		
 Gray	The SpO <sub>2</sub> is initializing.	No SQI information available.	No SQI information available.

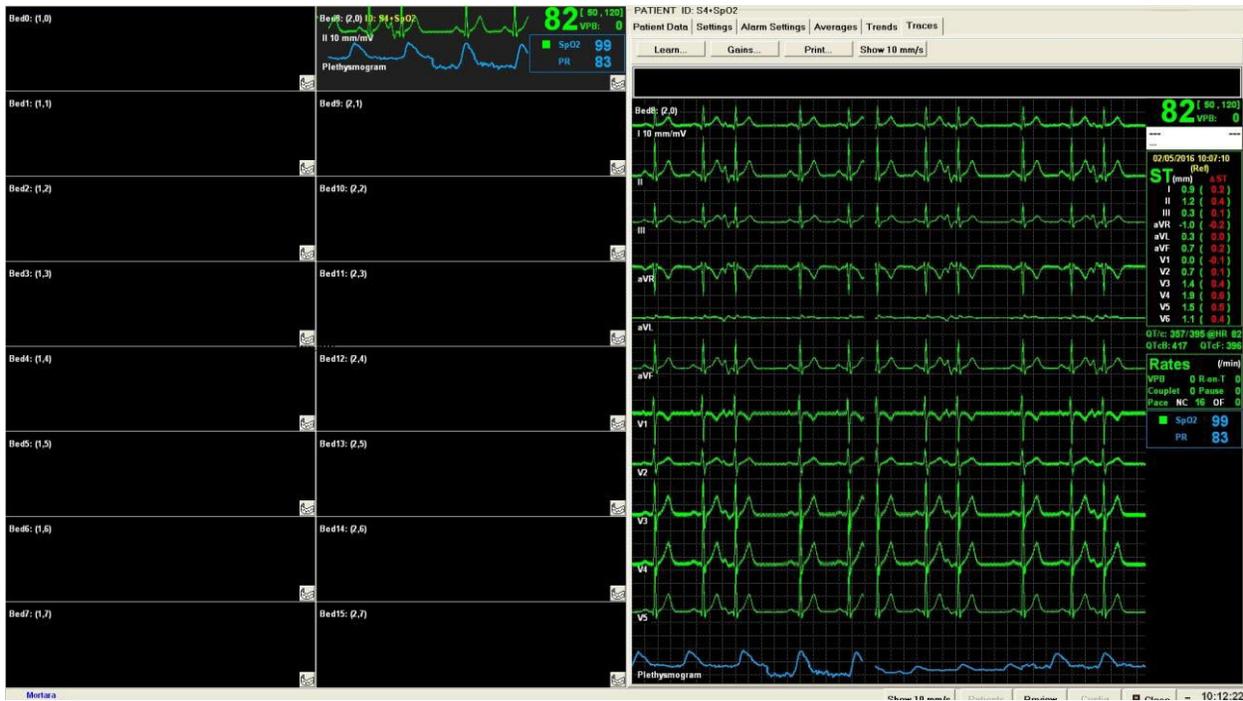
Refer to the Surveyor S4 User Manual, p/n 9515-190-51, for information on how to address signal quality issues. Additionally, technical alarm messages from the S4 may be displayed indicating certain conditions.

## Single-patient Display

A left click anywhere on a patient's sub-screen changes the background color, reduces the multi-patient display to half width, and opens the selected patient-related information on the right half of the screen in the Traces view.

Patient-related functions will be explained later in this manual. Click on **Close** to return to the multi-patient display screen.

### Selected telemetry patient sub-screen, Telemetry Traces view



**Figure 10** - The multi-patient display has been reduced to fit on the left screen, while a detail patient view from telemetry is shown on the right.

S12/S19 patient traces view

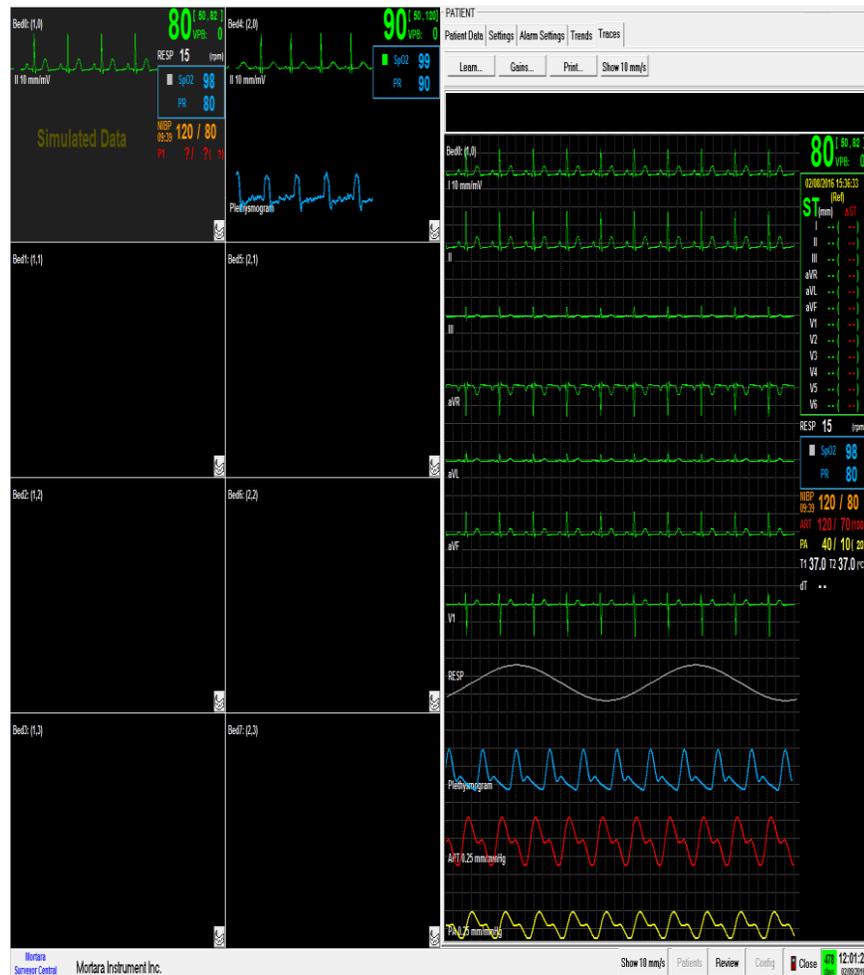


Figure 11 - The multi-patient display has been reduced to fit on the left screen, while a detail patient view from a Surveyor S12/S19 is shown on the right.

Single-patient display tabs

When a patient is selected and opened, there are six tabs that can be used for review. All tabs contain information for the selected patient. If another patient is selected, the information in the tabs will change to that of the selected patient. Patient ID (or name) and ambulatory transmitter channel number (if available) are displayed above the tabs.

**NOTE:** The Patient Data tab is not available at the Surveyor Central repeater station.



Figure 12 - Tab controls available in the single-patient display.

## Event/Alarm and Full-disclosure Review

A right click anywhere on a patient's sub-screen or a left click on Review changes the background color, reduces the multi-patient display to half width, and opens the selected patient's captured events/alarms and stored data on the right half of the screen. Review functions will be explained later in this manual. Click **Close** to return to the multi-patient display screen.



Figure 13 - Event/alarm and full-disclosure review screen.

## Beginning a 12-lead ECG monitoring session

Correct electrode placement and skin preparation are important for acquiring a successful ECG and performing a reliable monitoring session. Low-amplitude signals may be the result of poor skin-to-electrode contact. To ensure electrode adherence, hair must be removed with a razor and the skin must be clean and dry. Gently abrade the skin where the gel will be in contact to ensure good ECG signal conduction. Avoid muscular and loose, flabby areas to minimize movement and muscular artifact. Good quality, long-term monitoring electrodes are recommended.

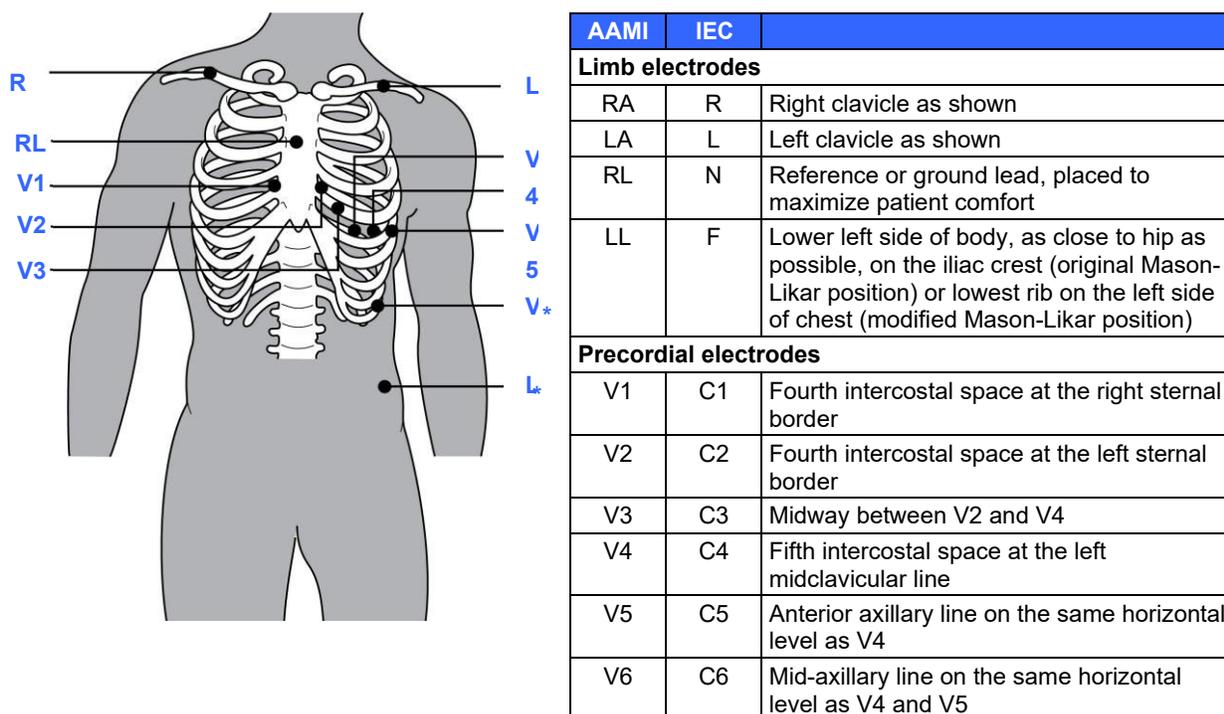


Figure 14 - Electrode placement.



**WARNING:** Placement of the Left Leg (LL)\* electrode in the original Mason-Likar position increases the similarity of the acquired ECG with a standard 12-lead ECG and is therefore recommended; however, clothing may interfere with this position and increase the amount of artifact. The modified position may decrease the sensitivity of inferior ECG leads and because axis shift with respect to the standard 12-lead ECG. Accurate skin preparation and suitable clothing are the most important factors in excessive artifact prevention.

**NOTE:** The Right Leg (RL) electrode may be positioned in any location least subject to motion artifact according to clinician preference and specific test requirements.

### To begin a 12-lead monitoring session:

1. Prep patient skin and attach monitoring electrodes and ECG cable to patient.
2. Ensure the Surveyor Central station is powered ON and displays patient monitoring slots.
  - When a Surveyor S12/S19 patient monitor is used:
    - Power ON the patient monitor or resume monitoring from a Standby mode.
    - Ensure the Network icon on the S12/S19 main display shows communication to the Surveyor Central station.
    - Refer to the Surveyor S12/S19 patient monitor user manual (PN9515-183-51-ENG).
  - When a Surveyor S4 is used:
    - Apply the sensors to the patient and connect sensor cables to the S4. Refer to the S4 user manual (PN 9515-190-51-ENG) for specific instructions.
    - Secure the S4 to the patient's body with the carrying pouch.
    - Turn the S4 ON by inserting batteries.
    - Ensure that the S4 establishes a connection to the Surveyor Central.
    - Check signal quality indicators on the S4, and re-prepare electrode sites or reposition sensors as needed.
    - On the multi-patient display of Surveyor Central, locate the slot that matches the S4 and view the waveforms.

**NOTE:** If you do not have a window set for the ambulatory transmitter, refer to the "System Configuration" section to setup receiver channels. Configurations for Surveyor S12/S19 and Surveyor S4 will be in place based on factory settings.

3. Click on window and the single-patient display will open with **Patient Data** tab active. Choose desired patient profile using the drop-down list box.

**NOTE:** Creating and saving patient profiles will be explained in the Settings section of this user manual.

4. Click **Start** to start a new monitoring session. From this moment on, monitoring has started, data is stored, and the alarm system is activated.

The system will ask you to select the best ECG detection leads. If you click **No** the system will use default lead settings (V1, V5 and II). When **Yes** is selected, real-time, 12-lead ECG traces will be displayed allowing you to change detection leads if necessary. Select **Learn** to make any changes. Refer to the "Traces" section for more detail about the **Learn** button. After reviewing or changing the 12-lead display settings, click on the **Patient Data** tab to return to the window that allows you to enter patient demographics.

**NOTE:** Refer to Veritas Advanced ECG Algorithms to learn more about the importance of selecting the best detection leads.

- Click **New** and type the patient information in the text entry fields.

**Figure 15** - The patient data screen.

**NOTE:** Age is calculated automatically when date of birth is entered (click on any other field to activate the calculation). Age can also be entered manually.

- When finished with all patient data operations, click **Confirm** in the lower portion of the display. A warning will ask if you are sure. Click **Yes**.

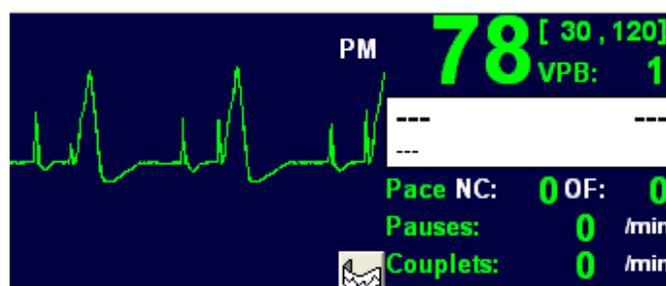
**NOTE:** Confirmation of the patient data connects the stored data with patient demographics, and makes the data available for review.

### ID Format

When ID Format option is present on your system, you can select from a drop-down list of user-created IDs. ID Formats in the list were imported by use of the configuration menu using the Management selection. ID formats are created in conjunction with Welch Allyn's E-Scribe system with the custom ID feature.

Patient data fields can be populated through the use of a bar code scanner. After scanning the bar code to populate the field, select **Confirm**. If the patient demographics were previously entered, all available data fields will be automatically filled. Note that the patient ID must be unique in order for this mechanism to work correctly. If there are more patients with the same patient ID registered, the data of the first found will be copied to these data fields. Patient data can be retrieved from the previously populated patients list by clicking **Import** and choosing from the list.

**WARNING:** For patients with pacemakers, the Pacemaker Present checkbox field should be enabled and the minimum rate of the pacemaker selected from the list.



**Figure 16** - Multi-patient display sub-screen for a pacemaker patient. PM indicates that pacemaker detection is enabled.

The **Notes** field can be used to store information about the patient that will be available in the patient data display for other clinicians. Text in this field does not appear on printouts.

**WARNING:** Adjust the alarm thresholds to patient conditions after monitoring has started. Incorrect alarm threshold settings are a frequent cause of false alarms and lower the attention level to the genuinely important alarms.

**NOTE:** Alarm settings cannot be changed in a Surveyor Central repeater station and are presented for informational purposes only.

**NOTE:** The Surveyor S12/S19 patient monitors control the alarm activation, sound state and priority of each generated alarm, regardless of the limits and/or other settings configured on Surveyor Central (even if conflicting with Surveyor Central settings). The Surveyor Central station obtains these settings from the patient monitor.

#### Reduced Lead-set Monitoring: Ambulatory Transmitter

When using an ambulatory transmitter, patients can be monitored using a reduced lead set either by not connecting all the electrode wires or using a reduced lead-set cable. When a reduced lead set is used, select the **5 electrodes** cable radio button in the patient data display.

**NOTE:** When the selection in the window above is changed, ECG waveforms are flat-lined for 1 second, heart rate is reset, and any pending ECG alarms are cleared.

**NOTE:** If you change from 10 to 5 electrodes, it is recommended to select the best leads for QRS-detection (see Learn menu in the Traces tab).

#### 5-wire Monitoring

Using R (RA), L (LA), F (LL), N (RL) and C1 (V1) electrodes will enable you to monitor leads I, II, III, aVR, aVL, aVF and V1. Select the **5 electrodes** radio button. The C1 (V1) electrode can be placed on any desired position on the thorax and will display and print as V1.

**NOTE:** When using an ambulatory transmitter, reduced lead monitoring or the selection of the 5 electrodes radio button will cause unused leads on the ECG printouts to be substituted by square waves.

**NOTE:** When using an ambulatory transmitter, reduced lead monitoring or the selection of the 5 electrodes radio button cannot be used when 12-lead ECG interpretation is required.

### 3-wire Monitoring

Using R (RA), L (LA), and F (LL), electrodes will enable you to monitor leads I, II, or III using the S4 mobile monitor or S12/S19 patient monitor when using it with a 3-wire cable.

**NOTE:** When using the S12/S19 patient monitor, the lead displayed on the Central Station is always indicated as Lead II regardless of the setting on the S12/S19 patient monitor.

Depending on the lead selected, the ECG waveform available will be displayed on the various panels as shown below with Lead II as an example here.



Figure 17 - An example of 3-wire monitoring.

## Protocol Manager

When Protocol Manager is included with your system, you are able to select from a list of user-created protocols. Protocols in the list were imported by use of the configuration menu using the Management selection. The protocols have been created from a separate application and are programmed to initiate automatic events and printouts once the protocol has been started. Select the protocol you wish to use for the current patient from the drop-down list located in the Patient Data tab. Protocols are saved with each individual profile and will be automatically selected by the profile. You can change to a different protocol at any time while monitoring a patient. Note that protocols are not available for use with the S12/S19 patient monitors.

### Using a Protocol

A protocol will initiate automatic events, reminders, and printouts once it is started. A new protocol can be selected when there is no other protocol in progress. There are two ways to start the protocol:

1. After the monitoring session has started, select the **Patient Data** tab and then select **Start Protocol** to begin.
2. Change the date and time values to the right of the **Start Protocol** button as desired and then select **Schedule start**. The protocol will automatically start at the scheduled time.

Once the protocol has been started, Protocol buttons will appear as shown:



Figure 18 - Protocol manager command buttons.

**Stop Protocol** can be selected to stop the protocol at any time. Once this is done, a "Protocol Aborted" message will appear on the patient display.

The date and time values can be set to correct the protocol phase start. The protocol phase that is currently in progress will be reset to a 00:00 start time and will begin at the set time. Select **Correct phase start** after you have adjusted the date and time values.

Additionally, "Protocol Times" can be selected for display (chosen in the "Settings" tab under "Parameters"). The time on the left shows that the protocol phase has progressed for 42 seconds and the next protocol step (Prepare for baseline) will occur in 18 seconds as shown to the right. Protocol messages will appear in the alarm/event area of the display according to protocol definitions.

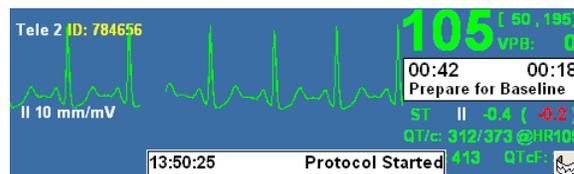


Figure 19 - Multi-display sub-screen with protocol active.

Protocols can be defined with phases (or groups of steps) for automatic functions. The ambulatory transmitter calls button--when configured within the protocol--or acknowledgement of the last protocol step of the previous phase causes the next phase to begin. An example would be of sequential patient treatments requiring a new series or type of automatic events.

The last step of any phase of a protocol is infinite in duration and will continue until you select **Stop Protocol** or move to the next phase by acknowledging the protocol alarm or pressing the ambulatory transmitter button.

## Ending a Monitoring Session: Telemetry

1. On the multi-patient display, click on desired patient window.
2. Select **Patient Data** tab.
3. Click on the **Stop** button.
4. A warning will ask if you are sure. Click **Yes**.

**NOTE:** If the monitoring slot has not been assigned to any patient, recorded data will be deleted!

5. This patient data will appear in the Patients list with a “Stopped” monitoring status.

## Restarting a Monitoring Session: Telemetry

1. On the multi-patient display, click desired patient window and the patient data window will open with patient data grayed out. Select Same Patient to resume monitoring the same patient in the same monitoring window.
2. Selection of **New Patient** will remove the previous patient monitoring session from the patient slot allowing you to start monitoring a new patient. The previous patient’s monitoring session will be available for review and will be shown in the patients listing with a “Stopped” status.
3. Previous stopped patient monitoring sessions can be imported into any available monitoring window when starting a new monitoring session. This allows you to move the patient to a different ambulatory transmitter and display window as desired. This also allows you to combine multiple monitoring sessions for the same patient.

**NOTE:** You can also start and stop monitoring sessions directly from the Surveyor S4 user interface.

## Discharge: Surveyor S12/S19 Patient Monitor

The Discharge function at the Surveyor S12/S19 patient monitor is communicated to the Surveyor Central station. When the patient is discharged at the patient monitor, the monitoring slot at the Surveyor Central station closes and all patient information, trends, alarms, and other setting information are being cleared for that device.

## Standby: Surveyor S12/S19 Patient Monitor

The Surveyor S12/S19 patient monitor has a Standby mode used to temporarily suspend patient monitoring (patient returning to same monitor) or permanently discharge the patient (patient not returning to monitor). This function is performed while standing at the patient’s bedside monitor. When the S12/S19 is placed in the Standby mode, the Surveyor Central station will discontinue monitoring. The Surveyor Central station displays a Standby message in that patient’s monitoring slot to note that monitoring is not active for that patient device. Once the patient monitor resumes monitoring, the Surveyor Central station will resume monitoring.

## Resume Monitoring: Surveyor S12/S19 Patient Monitor

Once the Surveyor S12/S19 resumes monitoring after a Discharge or Standby mode, the Surveyor Central station will also resume monitoring.

## 8. SETTINGS

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The Settings tab allows you to define:

- ECG and other waveform traces, gain settings, and parameters for single and multi-patient displays
- 12 lead ECG, rhythm, trend, and report printouts
- ID or name highlight color
- Signal settings
- Number of ECG leads, ECG filtering, and amplitude for optimal beat detection
- Protocol to be used for current patient
- Profiles to be saved for future use

Once all the settings under this tab, Alarm Settings, and Trends are defined, save your preferences as a Profile with a unique name that can be selected when starting future patient monitoring sessions.

**NOTE:** HR (heart rate) is always selected and cannot be deselected under Parameters.

**NOTE:** Some features (e.g., Protocols and Plethysmogram) are optional and may not be available as selections in this window.

**NOTE:** Print settings, Signals and Protocol settings cannot be changed in a repeater station and are presented for informational purposes only. Profiles cannot be saved from a repeater station.

## Display settings

### Multi-patient

View multi-patient display selections on the previous page. Selections will appear grayed when the maximum number of choices is reached, and is dependent on display window height.

Trace and parameter selections for single-patient display are shown below.

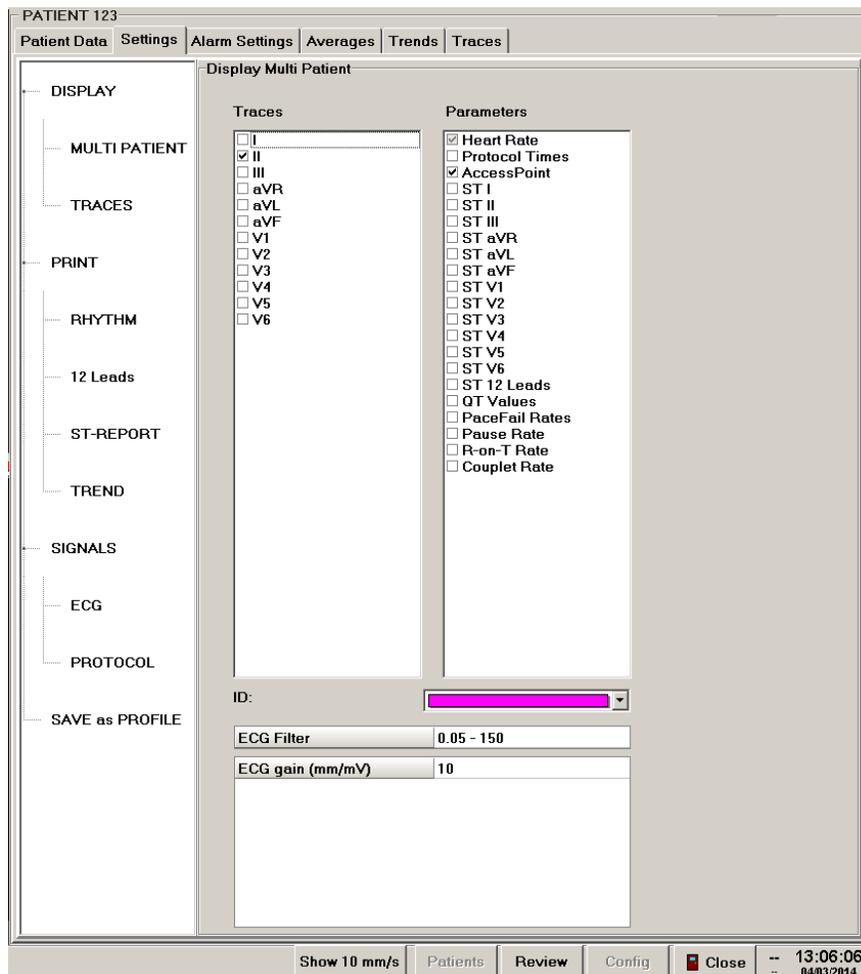


Figure 20 - Trace and parameter selection screen.

### Traces

ECG and plethysmogram waveform tracings can be selected for both multi-patient and traces (single patient) display. Selection of at least one trace is required.

### Parameters

Parameter labels and values can be selected for both multi-patient and traces (single patient) display. Parameters are displayed in the order that they appear in the Parameters column.

## ID

In multi-patient display, select the color highlighting for the ID or patient name from the drop-down list to the right of **ID**: The configuration menu determines which value (ID or name) will be shown in the multi-patient display.

## ECG Filter

In multi-patient display, choose a 0.05 – 40 Hz ECG filter or a 0.05 – 150 Hz ECG filter from a drop-down list after clicking on the value to the right of this selection. Filter setting has no effect on stored and exported data analyses.



**WARNING:** When the 40 Hz filter is used, the frequency response requirement for diagnostic ECG equipment cannot be met. The 40 Hz filter significantly reduces high-frequency components of the ECG and pacemaker spike amplitudes, and is recommended only if high-frequency noise cannot be reduced by proper procedures.

## ECG Gain (mm/mV)

In multi-patient display, select 5 mV, 10 mV, 20 mV, or 40 mV of gain for all ECG traces from a drop-down list after clicking on the value to the right of this selection. This setting affects displayed traces as well as rhythm printouts.

## Plethysmogram Gain

In multi-patient display, select 0.5 to decrease sensitivity by one half, 1 for normal sensitivity, or 2 to maximize the sensitivity for plethysmogram traces from a drop-down list after clicking on the value to the right of this selection. This setting affects displayed pleth traces as well as rhythm printouts.

## Invasive Pressure Waveform Gain

The Surveyor Central Station can display up to four invasive pressure waveforms and numerics dependent upon the S12/S19 configuration. To adjust the invasive pressure waveform, gain, in the multi-patient display select 0.1, 0.25, 0.5, 1, or 2 mm/mmHg for the selected invasive pressure.

## Capnography Waveform Gain

To adjust the Capnography waveform gain in the multi-patient display, select 0.1, 0.25, 0.5, 1, or 2 mm/mmHg

## Print settings

Allows you to define and customize each type of printout as explained below. Click on type of printout you want to define under the **PRINT** selection. Printout examples are shown in *Telemetry Monitoring Printout Examples*.

**NOTE:** Print settings cannot be modified on a Surveyor Repeater station.

## Rhythm

Checked boxes under **Traces** define waveform to be included on a 10-second printout. Desired parameter labels and values can be checked under **Parameters**. Change rhythm printout speed by clicking on the value to the right of **Speed (mm/s)**. A drop-down list allows you to choose 5, 10, 25, or 50 mm/s paper speed. Click on checkbox area to the right of **Print Grid** selection to enable or disable grid. Note that the grid is not printed at 5 mm/s or when grid is disabled for the printer in the configuration menu.

The Surveyor S12/S19 patient monitors can be configured to print its rhythm strip to the central station's printer. Refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183-51-ENG) for additional details.

Rhythm traces are printed with the timestamp centered in the middle of the page, as shown the by a vertical dotted line.

### 12-leads

12-lead printout format is selected from the drop-down list to the right of **Format**. Choose from **6x2** (6 leads in 2 columns), **4x3+1** (3 leads in 4 columns with 1 rhythm channel [II]), **4x3+3** (3 leads in 4 columns with 3 channels of rhythm [II, V1 and V5]), or **4x3+1+P** (3 leads in 4 columns with 1 rhythm channel [II] and plethysmogram waveform). Rhythm channels cannot be changed. Click on **Print Grid** checkbox to enable or disable grid. 1 to

4 copies can be selected when each 12-lead printout is chosen. Click on **Print Interpretation** and **Print Reasons** checkboxes to enable or disable interpretive statements on the 12-lead printouts.

12-lead ECG's are printed with the timestamp corresponding to the beginning of the acquisition of the ECG.

The Surveyor S12/S19 patient monitors will print its 12-lead report to the central station's printer. Refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183-51-ENG) for additional details.

### ST Report

Use the drop-down list to select trends to be printed on the report printout. The second trend in the rate-trend panel can be selected (the first trend is always HR), and both trends in the right panel can be selected from other parameters. Trend length (number of hours) can be defined in the **Trends** tab.

The Surveyor S12/S19 patient monitors can be configured to print a Trend report that includes the ST numerics to the central station's printer. Refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183-51-ENG) for additional details.

### Trend

Allows you to choose a single or two-page printout. The **ST Page** contains labels and trend values related to ST measurements in all leads; **Second Page** includes labels and trended values for all checked information in the lower portion of the display. Up to 14 trends can be selected.

The Surveyor S12/S19 patient monitors can be configured to print a Trend report to the central station's printer. Refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183-51-ENG) for additional details.

### Summary report

The Summary report provides a configurable report to tailor information to each specific patient's needs. The report includes the following information:

- Patient demographics
- Patient overview information, which includes average and summary information of parameters.
- List of alarms.
- Graphical parameter trends (optional).
- Tabular parameter trends (optional).
- Alarm snapshots (optional) – shows one tracing of an alarm condition; also shows a timeline of alarm occurrences.

Figure 21 - Summary Report settings.

To configure the content of the summary report:

1. Select the patient by clicking on their slot in the **Multi-Patient display**.
2. Select the **Settings** tab.
3. Select the **Summary Report** page.
4. Select the **Report Duration** from the drop down list.  
The system supports reports covering 4, 8, 12, and 24 hours.
5. Select the reporting interval for tabular trends from the **Tabular Trends Interval** dropdown. The System supports intervals of 1, 5, 15, 30, and 60 minutes.
6. Select whether or not to include graphical trends in the report using the **Graphic Trends** checkbox.
7. Select whether or not to include tabular trends in the report using the **Tabular Trends** checkbox.
8. Select whether or not to include alarm snapshots in the report using the **Alarm Snapshots** checkbox.
9. Select the parameters to include in trends from the selections in the **Trends** box.
10. Based on your selections, the system estimates the length of the printed report in the **Report Pages Num.** indicator.
11. Select the **Confirm** button.

To print a summary report:

1. Right-click on the **Print Icon** in the **Multi-Patient display**.
2. Select **Summary Report** from the drop down menu.

## Periodic print

The **Periodic Print** function is used to produce printed reports at predetermined time intervals.

Figure 22 - Settings for the **Periodic Print** function.

To enable periodic printing:

1. Select the patient by clicking on their slot in the **Multi-Patient display**.
2. Select the **Settings** tab.
3. Select the **Periodic Print** page.
4. Activate the periodic report function by checking the **Enable** control.
5. Select the reporting interval in the **Period** control. The system supports reporting intervals from 1 to 1,440 minutes (24 hours).
6. Select the type of report using the **Format** control.
7. Select **Confirm**.

To discontinue periodic printing:

1. Select the patient by clicking on their slot in the **Multi-Patient display**.
2. Select the **Settings** tab.
3. Select the **Periodic Print** page.
4. Clear the **Enabled** checkbox.
5. Select **Confirm**.

## Signal settings

### Analyze Pacers

The Surveyor S12/S19 patient monitors will send the pacemaker spikes to the central station if the Analyze Pacer setting is enabled at the patient monitor. Refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183- 51-ENG) for additional details.

When the Analyze Pacer function is enabled on a Surveyor S12/S19 patient monitor and the patient possesses an active pacemaker, the Surveyor Central will display an exaggerated tick mark at the point where a pacer pulse is detected on the ECG waveform. This pacer spike display may assist the clinician identification of pacer-initiated complexes.



**WARNING:** Maintain proper clinical assessment and close surveillance for patients with pacemakers during continuous ECG monitoring. Do not rely entirely on rate meters for these patients.

**NOTE:** For the S12/S19 patient monitors, the only available setting is the **Pacemaker present** selection.

**NOTE:** Signal settings cannot be modified on a Surveyor Repeater station.

### ECG

This screen provides adjustable settings related to the ECG.

PATIENT  
Patient Data Settings Alarm Settings Trends Traces

Signals ECG

Pacemaker present

Minimum pacer rate 60

Detection Lead 1 AUTO

Detection Lead 2 AUTO

Confirmation Lead AUTO

Min. QRS Amp. (uV) 300

Confirm Cancel

DISPLAY

MULTI PATIENT

TRACES

PRINT

RHYTHM

PERIODIC PRINT

SIGNALS

ECG

SAVE as PROFILE

**Figure 23** - ECG settings screen used with the Surveyor S4 mobile monitor.

When the monitored patient has a pacemaker, select **Pacemaker present** checkbox and select **Minimum pace rate** value from 40 to 100 beats per minute from the drop-down list. Note this selection is also present in the Patient Data tab.



**WARNING:** For patients with pacemakers, the Pacemaker Present checkbox field should be enabled and the minimum rate of the pacemaker selected from the list.

**NOTE:** When this selection is changed, ECG waveforms are flat-lined for one second, the HR is reset, and any pending ECG alarms are cleared.

**NOTE:** When changing from 10 to 5 electrodes, select the best leads for QRS-detection (see Learn menu in the Traces tab).

**NOTE:** 12-lead ECG interpretation may be affected by unattached lead wires, as with 5-electrode monitoring. Printing of 12-lead ECGs is not recommended.

**NOTE:** When using the S4 with LeadForm cable, a reduced lead set (5-wire) may also be selected on the device. Refer to the S4 User Manual. The S4 with shielded cable automatically detects the lead set used.

**Detection Lead 1** and **Detection Lead 2** are used for QRS beat detection. Choose leads that are of good quality and amplitude. **Confirmation Lead** is used to confirm the detected beat type. Choose a lead that is orthogonal or different than the detection leads.

Click on the value to the right of **Min. QRS Amp. ( $\mu\text{V}$ )** and adjust the Minimum QRS Amplitude in microvolts as 160, 300 or 500  $\mu\text{V}$  using the drop-down list. Note that this selection is also present in the LEARN button of the Traces tab.



**WARNING:** A low minimum QRS amplitude setting may cause the system to detect P-waves as QRS complexes and thus fail to detect an atrioventricular block. A high value increases the probability of Asystole alarms when all leads have a low QRS amplitude. 300  $\mu\text{V}$  is the factory default value.

Left click on **Confirm** to save all settings once your changes have been made.

## Protocol

Change a protocol in this settings selection. Choose desired protocol from the drop-down list. Note that this selection is also present in the Patient Data Tab. Left click on **Confirm** to save your change once the Protocol has been selected.

**NOTE:** Protocol settings cannot be saved from a Surveyor Repeater station.

## SAVE as PROFILE

**NOTE:** This feature applies to telemetry monitoring only and not the S12/S19 patient monitors.

Click on this selection to save all of your settings as a Profile that can be selected when you begin a new monitoring session. Saving your profile requires you to enter your system configuration password. After doing this, enter a name that will allow users to identify your defined settings. Note that the profile also contains all Alarm Settings and Trends settings. Make sure you check them before you save a profile, then left click on **Save**.

Prior to monitoring a new patient, you can choose your saved Profile from the drop-down list in the Patient Data tab.

## 9. ALARM SETTINGS

Alarms are generated for signals coming from the ambulatory transmitter and the Surveyor S12/S19 patient monitors. Alarm settings and other functions are managed through the Alarm Settings tab on the single-patient display. For a detailed description of alarm event criteria, refer to *Alarm Details*.

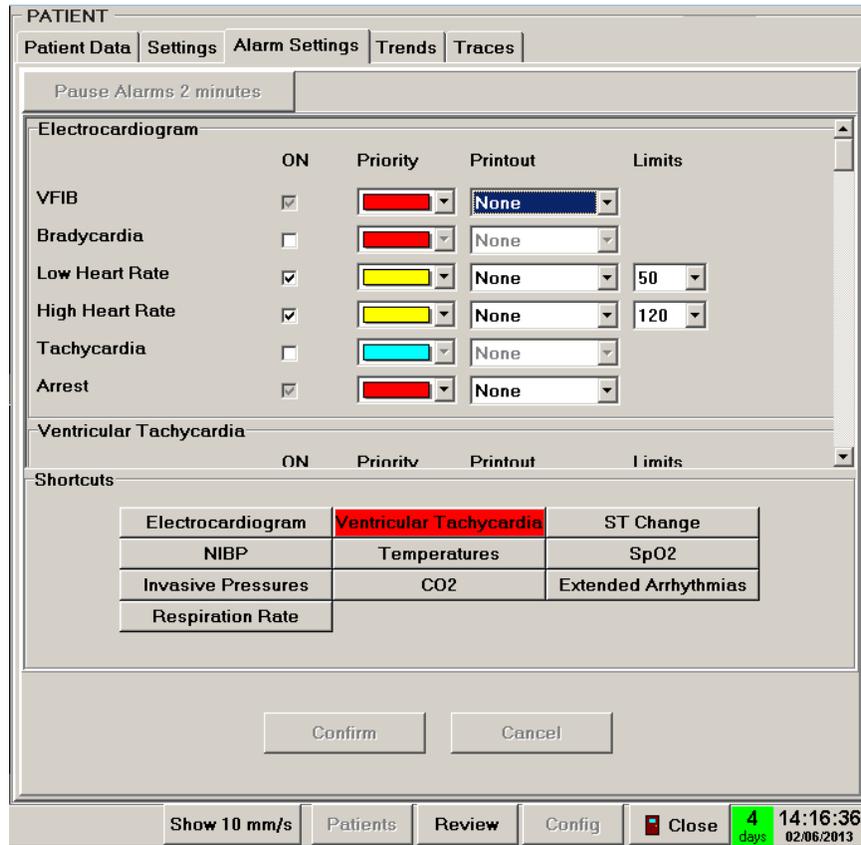


Figure 24 - The Alarm Settings screen.

**NOTE:** Alarm settings cannot be changed in a Surveyor Central repeater station and are presented for informational purposes only.

### Patient Monitor-Specific Alarm Interactions

With the exclusion of Surveyor Central station-generated events (e.g. Link Lost alarm), the Surveyor S12/S19 patient monitors control the alarm activation, sound state and priority of each generated alarm, regardless of the limits and/or other settings configured on Surveyor Central (even if conflicting with Surveyor Central settings). The Surveyor Central station obtains these settings from the patient monitor. If the parameter alarm is disabled at the patient monitor, the alarm is also disabled at the Surveyor Central station. Refer to the Surveyor S12/S19 patient monitor user manual (PN 9515-183-51-ENG) for additional details. After startup, any subsequent changes to the alarm settings on the Surveyor Central or the Surveyor S12/S19 patient monitors assigned to a particular bed will be bidirectionally communicated.

## Alarms and Events

### Alarm Hierarchy

Alarms on the Surveyor Central are divided into four priority levels: high (red), medium (yellow), low (cyan), and informational events (white) according to alarm importance. High, medium, and low alarm events are both audible and visual with different messages for each. Informational alarms are visual messages only.

COLOR	PRIORITY	VISUAL EXAMPLE	AUDIBLE
Red	High	18:05:50 VTACH 5,120	3 acute beeps – short pause – 2 acute beeps – 5 second pause
Yellow	Medium	18:00:08 ST Increase 2.0 V4	3 medium-tone beeps – 14 second pause
Cyan	Low	17:59:15 Irregular Rhythm	2 low-tone beeps – 19 second pause
White	Informational	17:57:09 ST Relearn	None

**NOTE:** Alarm priority is defined according to IEC 60601-1-8. The priority of some alarms can be changed by the operator on the basis of clinical need.

### Alarm Display

When an alarm is generated, a blinking message appears in the corresponding window showing the time alarm threshold was reached, the alarm message, and the alarm setting threshold. The time in front of the message is the time the alarm condition became true. When relevant, the alarm limit or ECG lead is also displayed. The message will continue to be displayed until the cause of the alarm disappears.

**NOTE:** The  icon is displayed in front of the alarm message to identify the control to acknowledge and silence the alarm.

**NOTE:** Alarm event times can differ from alarm presentation times due to overlapping higher priority alarms, or built-in presentation delays to avoid false alarms on short, clinically non-relevant events (e.g., a 60-second delay is used with an ST-change).

**NOTE:** There are no audible alarms on a Surveyor Central repeater station.

### How to Silence Alarms

Certain priority alarm events will also generate an audible signal along with the blinking message. Clicking on the message shows your acknowledgement and will silence the alarm though the message will stay on the screen to remind you that the cause of alarm is still present.

When a Surveyor S12/S19 patient monitor is used, the alarm silence is communicated bidirectionally between the patient monitor and the Surveyor Central station.

- Silencing an alarm at the Surveyor Central silences that alarm at the patient monitor.
- Silencing an alarm at the patient monitor silences that alarm at the Surveyor Central.

The alarm message and sound will remain for 20 seconds after the cause of an un-silenced clinical alarm disappears. This allows noticeable alarm presentation duration for conditions that last a short time. Technical and silenced alarm presentations disappear immediately after the cause goes away.

**NOTE:** Generic technical alarms (e.g., a printer paper-out condition) will appear on all patient windows involved. It is not necessary to silence all of these alarms separately. It is sufficient to left click on a single message to acknowledge the alarm on all patients.

**NOTE:** It is not possible to acknowledge and silence alarms from a Surveyor Central repeater station, with the exception of protocol alarms.

## Permanent and Non-Permanent Alarms

Clinical alarms can be permanent (latched) or non-permanent (non-latched). Permanent means that the audible alarm will continue until the operator acknowledges the message and silences the alarm. Non-permanent means that the audible alarm will disappear automatically shortly after the clinical condition is resolved.

Permanent or non-permanent is a global configuration setting for all ambulatory telemetry patients and cannot be changed for individual patients. High-priority alarms are always permanent and low-priority alarms are always non-permanent. The user can also choose to have the high-priority alarms permanently enabled, even if all the alarms are disabled. This is defined in the configuration menu.

**NOTE:** Ventricular tachycardia (VTACH) alarms are NOT latched; the sustained Ventricular Tachycardia Alarm (>15 seconds) IS always latched.

When a Surveyor S12/S19 patient monitor is used, acknowledging a permanent (latched) alarm is communicated bidirectionally between the patient monitor and the Surveyor Central.

- Acknowledging a permanent (latched) alarm at the Surveyor Central acknowledges that permanent (latched) alarm at the patient monitor.
- Acknowledging a permanent (latched) alarm at the patient monitor acknowledges that permanent (latched) alarm at the Surveyor Central.

## Overlapping Alarms

When several alarms occur within a short period of time and the system is busy displaying or printing a previous alarm printout, Surveyor Central will store the alarm events in memory and will automatically print them after the previous printout has finished. If more than one alarm is active, the auditory and visual indication of the highest priority alarm will be active. If more than one alarm with the same priority is active, the auditory and visual indication of the most recent alarm will be active.

For visual presentation, unacknowledged alarms have precedence over acknowledged alarms, depending on the priority. Note that up to three alarms are visualized simultaneously for a patient in the **Traces** tab.

## Alarm and Event Messages

Due to available screen space, some alarm and event messages are abbreviated. Longer messages are displayed on the **Review** event list and on printouts. Refer to *Alarm Details* for a list of all alarms, detailed alarm event criteria, and explanations.

## Suspended Alarms

Alarms can be temporarily suspended if the signal quality does not provide reliable alarms or when both detection leads are noisy or detached. For example, if the transmitter is out of range, a low priority **No Radio Signal** message appears on the screen. If the situation persists for more than 10 seconds, a medium priority **No ECG Monitoring** message appears on the screen and an audible alarm is generated. Alarms will be re-enabled when the signal returns to normal or when other technical alarms occur.

When the patient device is a Surveyor S12/S19 patient monitor, suspending an alarm is communicated bidirectionally between the patient monitor and the Surveyor Central.

- Suspending an alarm at the Surveyor Central suspends that alarm at the patient monitor.
- Suspending an alarm at the patient monitor suspends that alarm at the Surveyor Central.

## Alarm Re-activation

When an alarm is active, a new alarm of the same type will not register. For example, if a second Ventricular Tachycardia occurs while the first Ventricular Tachycardia alarm is still active, it will not register separately. This is specifically relevant when alarms are permanent or latching. Once the first alarm has ceased, the new same-type alarm will present itself immediately and will register as a separate event. In the case of alarms on numerical values (e.g., high HR), the parameter value has to go at least 5% below the threshold before the alarm cancels. Using high HR as an example, if the limit is set at 100 bpm, the alarm sounds at 100 bpm but will not cancel until HR returns to below 95 bpm. This mechanism is designed to prevent frequent alarm re-activation when parameter values are close to the limit.

## Disabling Alarms

In the **Alarm Settings** tab, you can disable/enable most of the alarm events using the toggle button: “Disable Alarms” / “Enable Alarms”.

Left click **Disable Alarms** to disable all alarms except for technical alarms. (Technical alarms continue to be presented visually, but do not generate a sound.) The multi-patient display will show an **ALARMS OFF** message and the time alarms were disabled. An alarms disabled symbol will also display to the right of the upper trace lead. A technical event will store in **Review** showing the time and date that the alarms were disabled.



**WARNING:** When an “ALARMS OFF” message is present, no clinical alarm will be generated or stored in Review. Re-enable alarms as soon as possible; use this function only when necessary.

**NOTE:** If Red Alarms Always Enabled is selected in the configuration menu, all high-priority alarms will not be disabled.

**NOTE:** When alarms are disabled for any channel, the system sounds a brief 4-tone reminder signal every three minutes. Contact a Welch Allyn representative to disable this reminder signal in your system.

When the patient device is a Surveyor S12/S19 patient monitor, disabling an alarm is communicated bidirectionally between the patient monitor and the Surveyor Central.

- Disabling an alarm at the Surveyor Central disables that alarm at the patient monitor.
- Disabling an alarm at the patient monitor disables that alarm at the Surveyor Central.

If a minute duration for **All Alarms Paused Duration (min)** is defined in the configuration menu, alarms will automatically become enabled after duration has been reached. This is indicated by the label of the Enable/Disable button (Pause alarms xx minutes) and by a count-down timer near the alarms disabled symbol in the patient window.



When a Permanent duration is selected in the configuration Global Alarm Settings menu, there is no timer and the alarms will remain off until enabled.

The same functionality occurs when **Start with Alarms Paused** is enabled. Alarms will be paused according to the set paused duration. This setting is useful to prevent any unwanted alarm events during the start of monitoring.

## Setting Alarm Event Automatic Printouts

Choose the layout of the automatic printout when an alarm event occurs, with or without export, in the Alarm Settings Tab. Left click on **Printout** to the right of the alarm label to open the drop-down list for rhythm, report, trends, and ECG format selections.

Choose desired printout and left click **Confirm** to save, or **Cancel** to undo your changes. Automatic printouts cannot be selected for technical alarms with the exception of the Patient call function of the transmitter. All automatic printouts for the patient can be disabled with the **Disable Alarm Printouts** or **Enable Alarm Printouts** toggle button, overriding the setting of the individual alarm. Automatic printouts can be set up at either the Surveyor Central or S12/S19 patient monitor.

When automatic alarm printouts are disabled on the Central Station for a given bed, the printer icon is displayed with a circle and crossed line on the lower right hand side of the multiscreen as shown below.



**Figure 25** - Sub-screen showing the crossed-out printer icon in the lower right corner, indicating that automatic alarm printouts are disabled.

## Changing Alarm Limits

When monitoring begins, alarm limits, priorities, and printouts are automatically assigned to the patient based on either the Profile chosen (new patient) or on the previous monitoring session (same patient). To change alarm limits, left click on the value to the right of the alarm limit you want to change. A drop-down list appears and related areas in the window are highlighted and become active. Click the desired limit and then left click **Confirm** to save, or **Cancel** to undo the change(s). Note that any limit that is changed remains highlighted until it is saved or cancelled.

New alarm limits become active after you have clicked on **Confirm**.

Use alarm group buttons (e.g., Electrocardiogram, etc.) in the lower portion of the Alarm Settings window to quickly move to related alarm settings.

**NOTE:** The alarm groups are the same as the alarm categories of the alarm event list in the Review tab. For a complete list of alarm group assignments, see *Alarm Details*.



**WARNING:** Inappropriate limit settings may render an alarm ineffective and cause serious danger to the patient. Choose limits appropriately and based on the individual patient.

## Changing Alarm Priority

To change an alarm priority, left click on the color value to the right of the alarm limit you want to change. A drop-down list appears and related areas in the window are highlighted and become active. Click on desired priority color (red, yellow, cyan or white) and then left click **Confirm** to save or **Cancel** to undo your change(s).

**NOTE:** Some alarm priorities cannot be changed by the operator, or only allow limited choices. This is by design and is intended to ensure patient safety.

When the patient device is a Surveyor S12/S19 patient monitor, the alarm priority settings are communicated bidirectionally between the patient monitor and the Surveyor Central.

- Adjusting an alarm priority at the central station adjusts that alarm priority at the patient monitor.
- Adjusting an alarm priority at the patient monitor adjusts that alarm priority at the Surveyor Central.

## Electrocardiogram Alarms: Heart Rate

Left click on the High Heart Rate and Low Heart Rate limit drop-down lists to select and change the beat per minute alarm limit.

Alarm type	Alarm trigger
Low Heart Rate	Alarm presents when HR bpm is lower than set limit
Bradycardia	Alarm presents when HR is 10 bpm below set Low HR limit
High Heart Rate	Alarm presents when HR bpm is higher than set limit
Tachycardia	Alarm presents when HR is 30 bpm above the High HR limit

**NOTE:** HR is calculated over an average of 16 beats when above 40 bpm and 4 beats when lower than 40 bpm.

**NOTE:** Low Heart Rate and High Heart Rate alarms cannot be disabled.

## Electrocardiogram Alarms: Heart Rate for S12/S19 Patient Monitoring

Bradycardia and Tachycardia limits are defined at the S12/S19 patient monitor. Refer to the S12/S19 User Manual.

## Electrocardiogram Alarms: Cardiac Arrest

To modify Cardiac Arrest limits for telemetry monitoring, locate the **Arrest** field and left click on the limit value to increase or decrease the number of seconds for the alarm limit. The set value reflects the number of seconds where no beats are detected before displaying a cardiac arrest alarm. There is no threshold limit for S12/S19 patient monitors.

## Ventricular Tachycardia Alarm

To modify ventricular tachycardia thresholds, move the cursor onto the **VTACH Length** or **VTACH Rate** field and use the drop-down list to increase or decrease the threshold. This alarm is generated by two events: 1) number of ectopic ventricular beats and 2) ventricular ectopic beats with a rate higher than the set limit. Only a simultaneous occurrence of these two events will trigger the alarm.

Limit type	Alarm setting criteria
VTACH Length	Number of successive ventricular ectopic beats
VTACH Rate	Rate of successive ventricular ectopic beats

**NOTE:** Thresholds set too low may cause false alarms due to noisy signal, in particular when patients are ambulatory in the case of many false alarms, it is advisable to increase the limit. If it is required to evaluate shorter ventricular runs, you can activate the Ventricular Run alarm in the Extended Arrhythmias section as a lower priority alarm and review them periodically.

**NOTE:** Ventricular arrhythmias with a rate lower than the VTACH Rate limit may cause a ventricular rhythm alarm; arrhythmias shorter than the VTACH Length limit may cause a ventricular run alarm. Both alarms can be enabled or disabled in the Extended Arrhythmia group.

**NOTE:** Ventricular tachycardia (VTACH) alarms are NOT latched. The sustained Ventricular Tachycardia Alarm (>15 seconds) IS always latched.

## ST Alarms

ST alarms can be disabled by individual lead check boxes in the ST Change group under the Alarm Settings tab.

**NOTE:** The alarm is initiated after a 1-minute duration of change that exceeds the threshold of the ST limit occurs.

**NOTE:** To redefine the reference level for ST alarm, press **New Ref** in the Averages tab or **Relearn + New ST Ref** in the Traces tab.

**NOTE:** The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes need to be determined by a clinician.

## Extended Arrhythmia Alarms

This optional group contains a number of extended, typically non-life threatening, arrhythmia events. In the default factory profile, all these alarms are disabled. Left click on the enable check box to enable each arrhythmia type individually. Some of these alarms may occur frequently; it is recommended that you do not set a priority that may obscure other, more serious alarms. Often an Informational (white) level alarm is enough to detect these types of arrhythmias in Review.

Pacemaker related alarms will not generate if the Pacemaker field in the Patient Data tab is not enabled. See *Alarm Details* for a complete list of extended arrhythmia alarms.

## Resting ECG

This optional group is available only when 12-lead ECG interpretation is present and allows the ability to have a low priority alarm signal when QTc values exceed the set millisecond limit, and are 70 seconds or more in duration.

This group is not available for S12/S19 patient monitors.

## SpO<sub>2</sub> Alarms

This optional alarm group is available when a transmitter with SpO<sub>2</sub> capability is used. Not all alarm types are supported on every transmitting device.

Alarm type	Alarm trigger
SpO <sub>2</sub> High	Medium-priority alarm presents when % SpO <sub>2</sub> is high than the set limit
SpO <sub>2</sub> Low	Medium-priority alarm presents when % SpO <sub>2</sub> is lower than set limit
Desaturation	High-priority alarm presents when % SpO <sub>2</sub> is 10% below set SpO <sub>2</sub> Low limit
Pulse rate low	Medium or low-priority alarm presents when SpO <sub>2</sub> pulse rate is below set limit
Pulse rate high	Medium or low-priority alarm presents when SpO <sub>2</sub> pulse rate is above set limit

**NOTE:** There is a SpO<sub>2</sub> alarm presentation delay as a result of processing and averaging of the incoming signals. Please refer to *Alarm Details*.

## Technical Alarms

Only technical alarms where the priority can be changed are in this list. For a complete list of alarms, refer to *Alarm Details*.

ECG leads off, or ECG noise may lead to suspension of beat detection. If the condition persists for more than 10 seconds, a specific technical alarm will appear (e.g., HR Not Available or No ECG Monitoring) with a medium (yellow) priority.

Short transmission interruptions and brief noisy episodes are a normal part of ambulatory telemetry monitoring and may happen frequently. It is not recommended to increase the priority of these alarms above the Informational (white) level, unless a high signal quality is very important to you. Note that the Patient Call alarm event is considered to be a technical alarm as well; therefore, it will only be visually presented (but not audible) when all alarms are disabled.

## Protocol Events

Protocol events are managed by the Protocol Manager. Alarm priorities and printout types are defined in separately generated protocol files. Any settings in this section will be ignored

# 10. AVERAGES

Clicking on the **Averages** tab in the single-patient display opens the averages page. Display **Reference** and **Markers** measurement points can be enabled or disabled as desired by a left click on the buttons. ST measurements are displayed in millimeters (mm) or microvolts ( $\mu\text{V}$ ); 1 mm corresponds to 100  $\mu\text{V}$ .

This screen allows you to **Print** a report, trends, rhythm, or a 12-lead ECG. Change display gain by clicking on the respective buttons.

In the screen below, current averages are displayed against the reference averages in a different color with measurement points enabled.

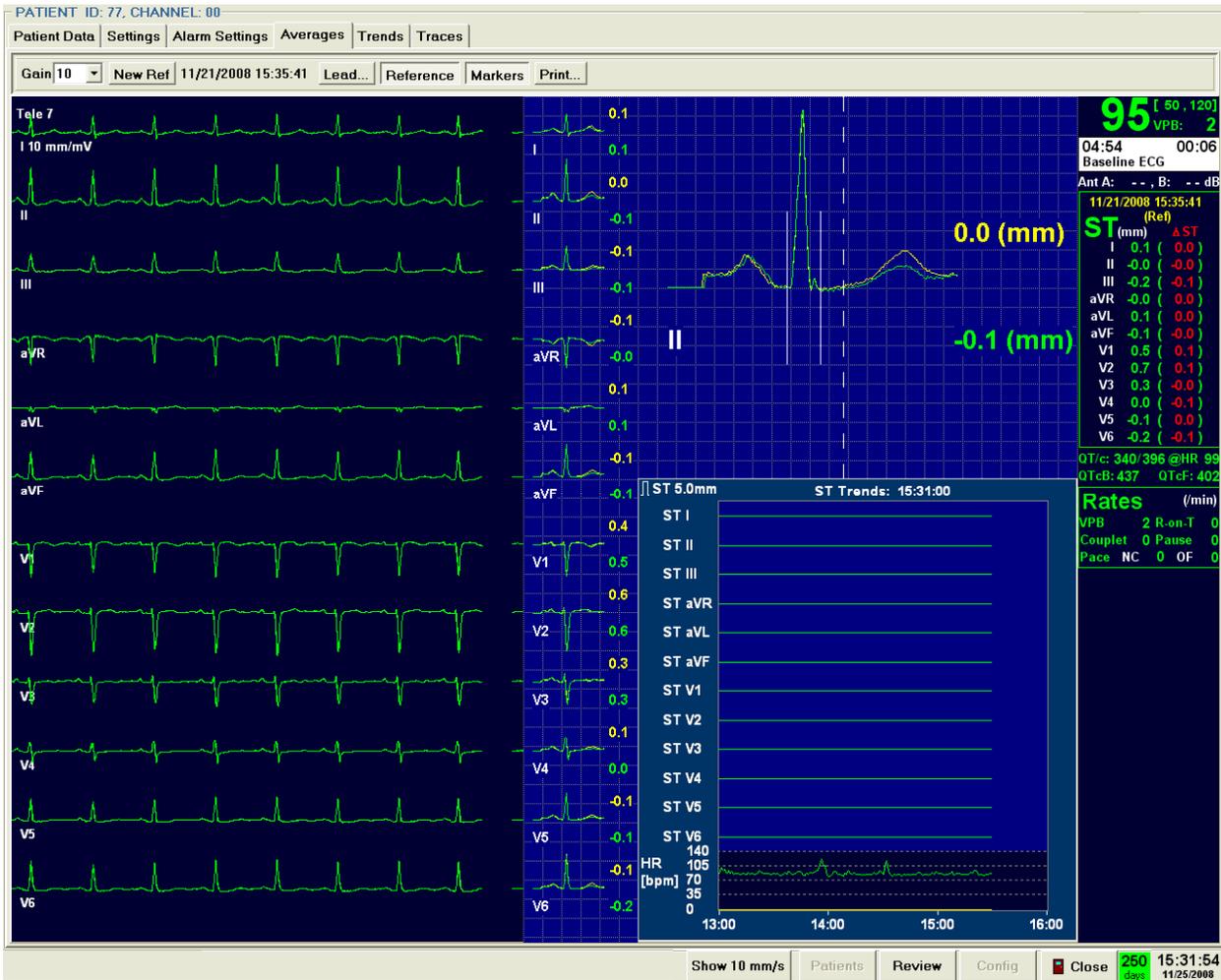


Figure 26 - The Averages screen.

## Reference

It is possible to display the reference average complex in yellow superimposed on the current complex in green together with the current ST values. This reference complex is used for ST change alarms and will be updated in the following cases:

- At the beginning of the monitoring session
- At a manual reset (New Ref button selected)

**NOTE:** The "New Ref" button is disabled in a Surveyor Central repeater station.

The display of the reference complex can be turned on and off by a left click on **Reference**. The time of the reference complexes is shown at the top center of the display and to the right of the ST (mm) measurement values highlighted in yellow. The lead of the enlarged complex can be chosen by pressing **Lead**. Choose between a fixed lead or choose **Dynamic** and let the system dynamically choose the lead with the biggest ST change with respect to the reference. The large complex is enlarged four times with respect to the normal ECG display; at 10 mm/mV gain this corresponds to 8 grid squares per mV. The display speed is 100 mm/s, so a grid square is 50 ms.

## Markers

The points in the QRS complex where measurements are made by the system can be displayed by clicking on Markers. Vertical bars of 1 mV height indicate the QRS onset (beginning) and offset (end) that were detected by the system. A vertical dotted line indicates the ST measurement point. This point is always relative to the QRS offset with a user-defined delay (typically 60 ms). The delay can be adjusted in the configuration menu.

**NOTE:** The segments of the vertical dashed lines where the ST measurements are taken have a length of 100 microvolts (1 mm with a normal gain of 10 mm/mV).

## ST Values

Each averaged QRS complex will show the current ST measurement value highlighted in green. If reference is enabled, the reference ST measurement value is displayed highlighted in yellow. Additionally, ST values are displayed to the right of each lead label highlighted in white. These values are continually updated and show the current ST segment value as negative or positive to the isoelectric line highlighted in green. The second set of values, highlighted in red, reflect the amount of ST change as compared to the reference ST value.

## Other Displayed Information

The information shown to the right of the averaged waveform is shown in the Traces display.

# 11. TRENDS

The Trends page will show a resolution of 3, 6, 12, or 24 hours of user-selected trend values and HR. Left click on the **Hours** drop-down list to choose your desired resolution; trend scale is calculated by the system automatically.

## Trend Select

**Trend Select** will open a drop-down list allowing you to choose the desired trends with up to three choices for Dual Trends display. HR trend will always be selected as a default for the Dual Trends view. Left click on **Trend Select** and then move the mouse cursor over the trend parameter selection you wish to edit. A drop-down list will appear allowing you to choose the desired parameter.

## Dual Trends

The Dual Trends example for telemetry patient monitoring shown below has a set resolution of 3 hours where ectopic rate, ST II, and QTc Welch Allyn display selections were chosen. A trend duration of 3, 6, 12, or 24 hours can be selected from the drop-down list to the right of the Hours label.

### Upper Trend

HR and ventricular ectopic (ECT) beat per minute labels are shown in white.

HR trending is shown in green with green trend values on the left side. The ECT trending is shown in red with the scale values in red on the right.

### Lower Trend

ST lead II measurement and QTc ms labels are shown in white.

ST trending is shown in green with green scale values on the left side. QTc trending is shown in red with the scale values in red on the right.

### Minimum/Average/Maximum

Minimum, average, and maximum values for each selected trend parameter are shown for each 30-minute period over the last 3 hours in the lower portion of the display.

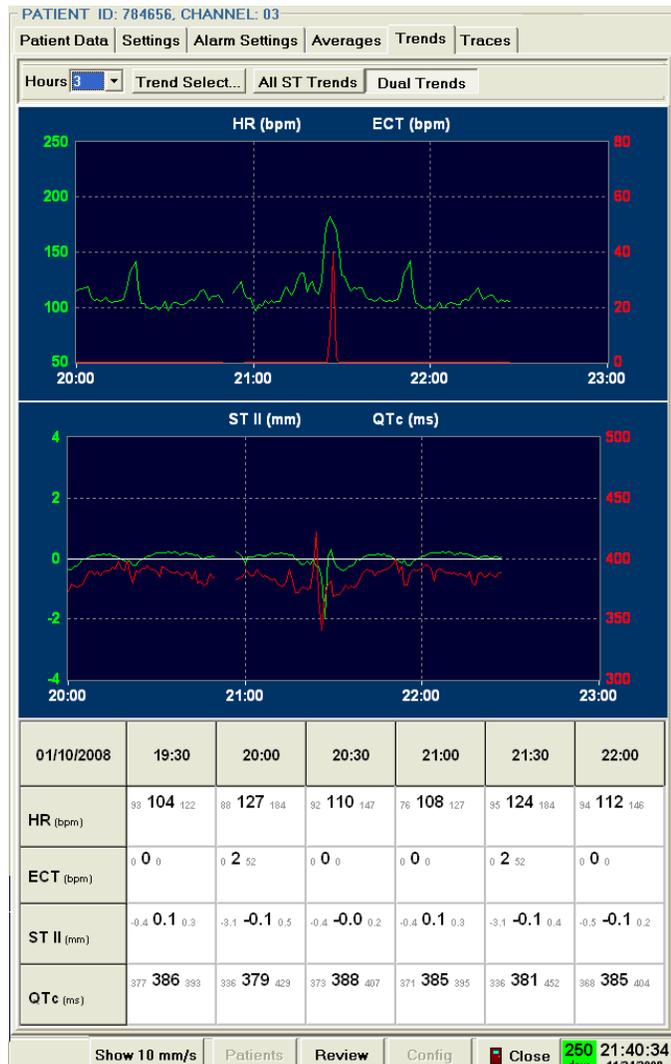


Figure 27 - The Trends screen.

The Dual Trends example for an S12/S19 patient monitoring slot shown below has a set resolution of 6 hours where respiration rate, P1 high and low mmHg values, and Temperature 1 display selections were chosen. The General Trend, parameter 2 list is displayed showing available selections.

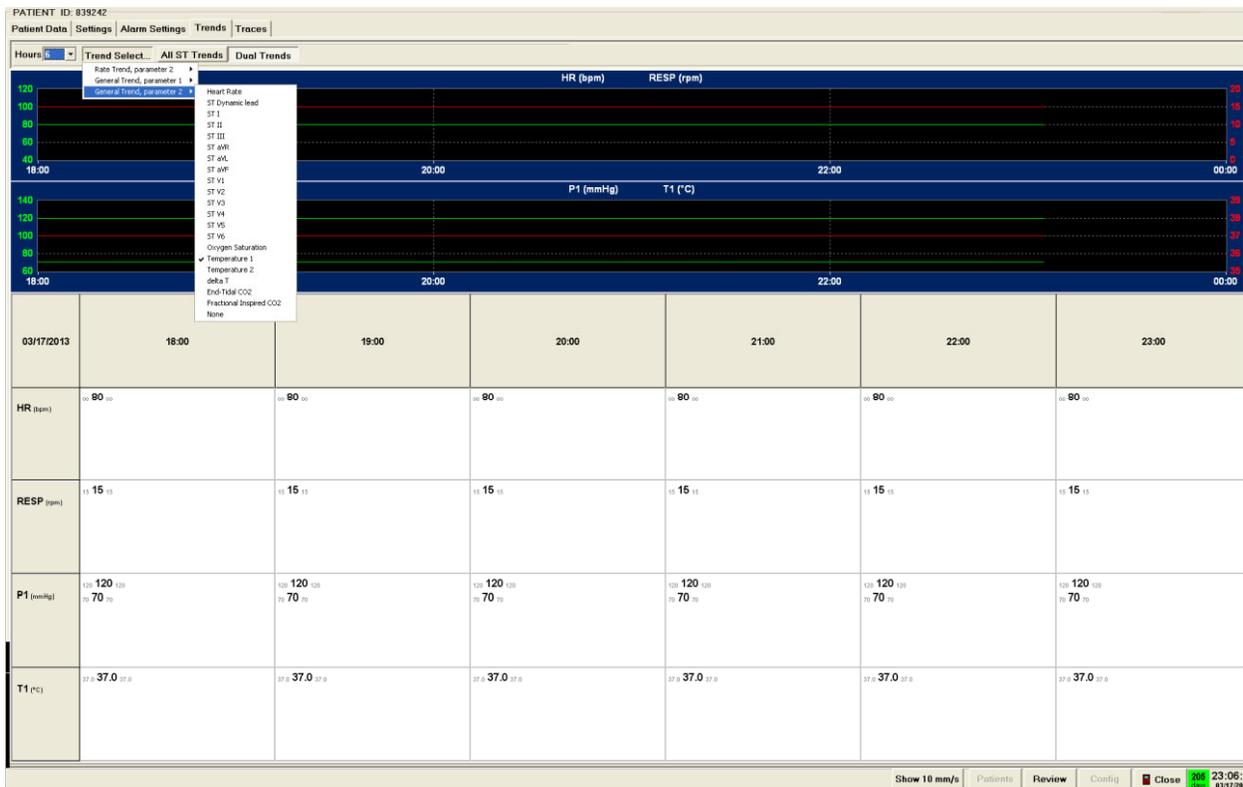


Figure 28 - Example of the Dual Trends screen.

## All ST Trends

In All ST Trends view, change trend resolution by clicking on the **Hours** drop-down list. Trend scale is calculated automatically by the system.

The time of the last trend value is highlighted in white at the top of the display. Trends are calculated every minute.

All 12-lead labels are displayed on the left side with their respective trend graph to the right.

HR trending is shown in green with white trend scale values on the left side.

Ventricular ectopic trending is shown in yellow on the same scale.

### Minimum/Average/Maximum

Minimum, average, and maximum values for each selected trend parameter are shown for each 30-minute period over the last 3 hours in the lower portion of this display.

**NOTE:** When monitoring is interrupted for a period of time, trend values are not present and appear as a break in the trend.

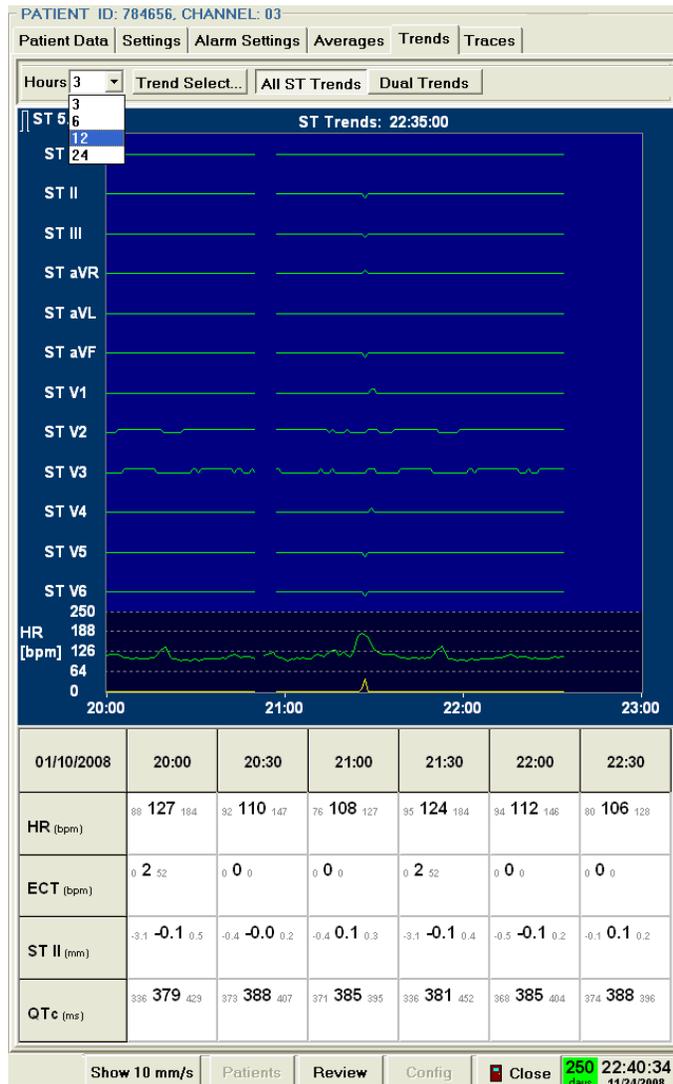


Figure 29 - All ST Trends screen.



## 12. TRACES

The Traces tab displays the real-time 12-lead ECG and plethysmogram when an ambulatory transmitter or mobile monitor is used. When a Surveyor S12/S19 patient monitor is used, the Traces tab displays the waveforms that are in use at the patient monitor. As in the multi-patient display, active alarm event messages are displayed and can be acknowledged in the Traces display. Up to three overlapping alarm events can be displayed simultaneously.

Parameter values and other information are displayed in the upper right area of the window. Displayed waveforms and parameters can be changed in the Settings Tab. **Print** can be selected to choose the type of printout from a list of choices.

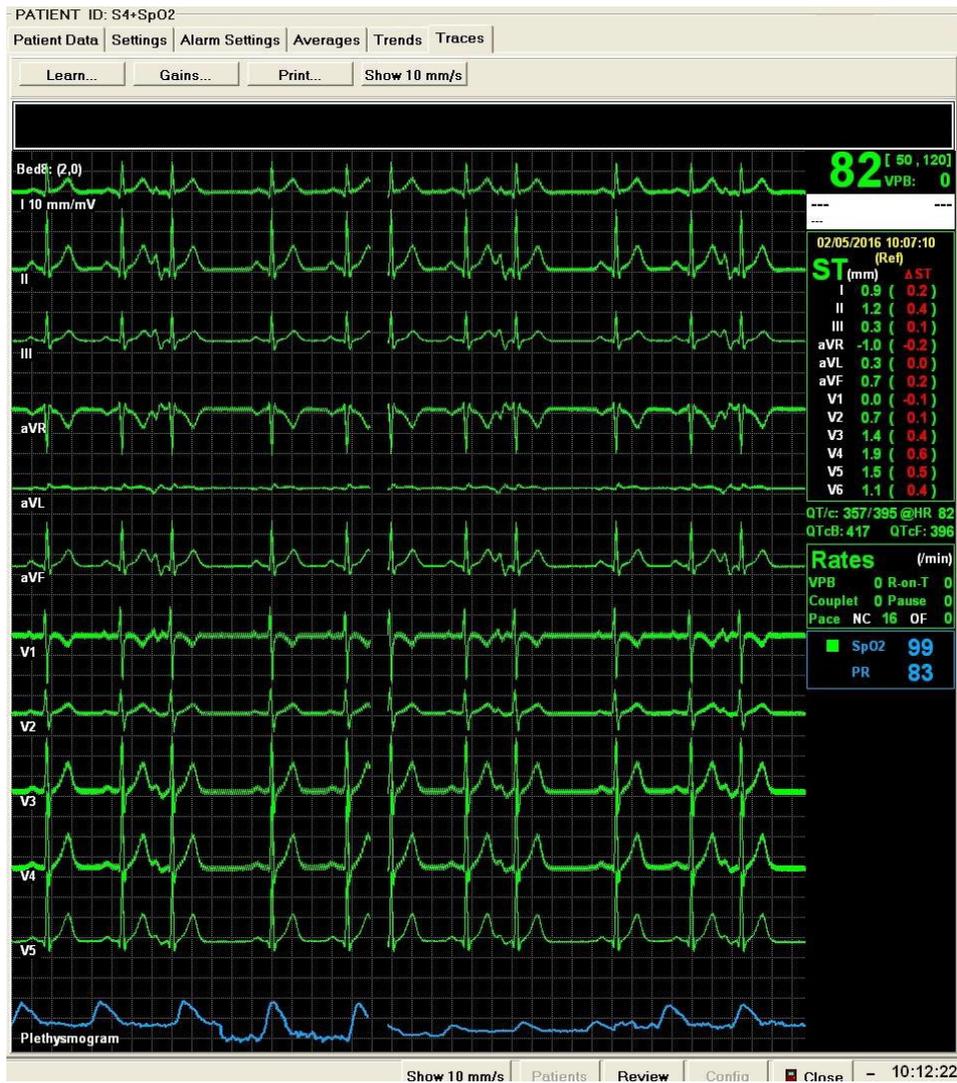


Figure 30 - The Traces screen.

The following displays 3-wire, single-lead monitoring with Lead III.

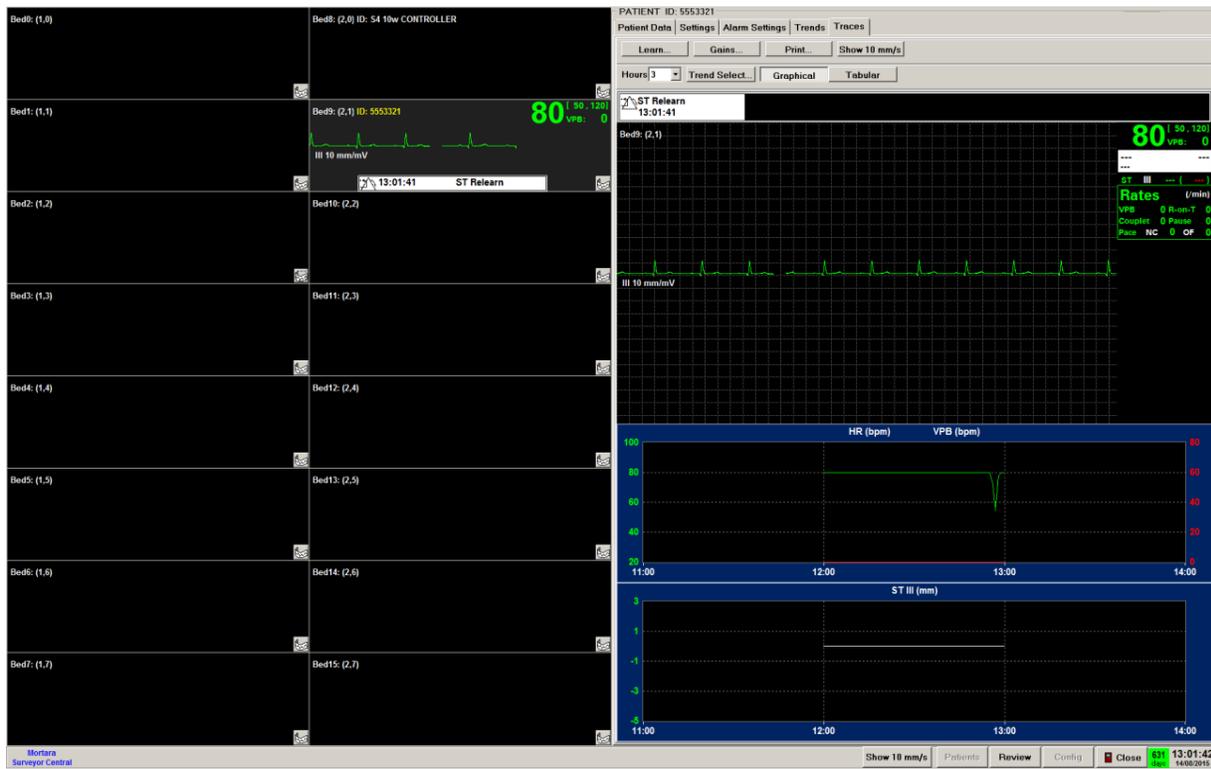


Figure 31 - The Trace screen showing a single lead trace.

## Protocol Timers

When a protocol is in progress, the minutes and seconds (mm:ss) from the start of the protocol is displayed on the left; minutes and seconds before the next step is displayed to the right. An upcoming protocol message is also displayed so the clinician will know what is going to occur next.

## Access Point

For Surveyor S4, the following items are displayed, and can be used for troubleshooting:

- MAC address or name of the WiFi Access Point through which the S4 is communicating  
**NOTE:** Descriptive names can be defined within the Surveyor Central system for each of the WiFi access points. Contact Welch Allyn Customer Service for assistance in setting up this feature.
- MAC address of the S4 device
- Signal to noise ratio in dB.
- WiFi channel occupied

## ST Values

ST values are displayed to the right of each lead label highlighted in white. These values are continually updated and show the current ST segment value as negative or positive to the isoelectric line highlighted in green. The second set of values, highlighted in red, reflect the amount of ST change as compared to the reference ST value.

## QT/c Values

Welch Allyn QT and QTc values are presented below ST values with HR (QT) and QTc calculations for Bazett and Fridericia when this option is available for telemetry monitoring. Note that the current HR value in the upper right corner and the QT HR value may differ slightly because the QT values are periodically calculated over 10 seconds of data.

## Arrhythmia Values

Ventricular premature beats (VPB), R-On-T, couplet, pause, pacemaker non-capture (NC), and failure to output (OF) values per minute are shown below the QT/c values. VPB is the only value available for S12/S19 patient monitoring at the Surveyor Central station.

## SpO<sub>2</sub> Values

SpO<sub>2</sub> percent and pulse rate (PR) values are displayed and continually updated when the T125 transmitter or S12/S19 monitors are used. Dashes (---) will be displayed in place of values when there is no valid signal.

## S12/S19 Numeric Parameter Values

The numeric parameter values are displayed according to checked items in the Traces Parameters under the Settings tab.

## Learn

In a case where the system incorrectly identifies the patient's normal beats, it may be necessary to relearn the rhythm. A Rhythm Relearn does not modify the reference for the ST change measurement.

**NOTE:** The **Learn** button is available for S12/S19 patient monitoring at the Surveyor Central station allowing the clinician to choose **Relearn + New ST Ref** only.

Although ST monitoring is always performed on all available leads, actual QRS detection is based on a reduced number of leads. If necessary, these leads can be changed in cases of low amplitude or poor signal quality. Use the Learn menu selections and choose the best leads from the drop-down list.

**Detection Lead 1** and **Detection Lead 2** are used for QRS beat detection. Choose leads that are of good quality and have the best amplitude.

**Confirmation Lead** is used to confirm the detected beat type. Choose a lead that is orthogonal or different than the detection leads.

A minimum peak-to-peak amplitude for QRS detection can be set as 160, 300, or 500  $\mu\text{V}$  (1.6, 3, or 5 mm with standard gain).

**NOTE:** The **Learn** button is disabled in a Surveyor Central repeater station.





**WARNING:** Careful setting of the correct leads for QRS detection is very important for optimal functioning of the VERITAS algorithm and ST monitoring, the prevention of false alarms, and the detection of true alarms. Refer to *Veritas Advanced ECG Algorithms* for details on the VERITAS algorithm and recommendations for choosing the best detection leads.



**WARNING:** A low minimum QRS amplitude setting may cause the system to detect P-waves as QRS complexes and thus fail to detect an atrioventricular block. A high value increases the probability of Asystole alarms when one or both detection leads has a low QRS amplitude. 300  $\mu\text{V}$  is the factory default value.

**NOTE:** Lead amplitudes used by the detection algorithm may differ slightly from printouts for technical reasons. The algorithm uses R (RA) as a reference instead of the Wilson terminal reference.

Choose **Relearn + New ST Ref** when you wish to perform an ST measurement reference relearn in addition to a rhythm relearn.

**NOTE:** Always exit the menu by clicking on **Rhythm Relearn** or **Relearn + New ST-Ref** after changing the detection leads or minimum QRS amplitude values.

Choose **Cancel** when you wish to exit the Learn window without making any changes.

## ECG Gains

Click **Gains** when you wish to change the displayed ECG gain in all leads to 5, 10, 20, or 40 mm/mV. This will change the gain in the single-patient display as well as the multi-patient display. This will also change the ECG gain in all printouts.

## Waveform gains

Click **Gains** when you wish to change the displayed waveform gain for each channel. This will change the gain in the single-patient display as well as the multi-patient display. This will also change the waveform gain in all printouts.

Respiratory (RESP) and Plethysmogram gains can be set to 0.5, 1, or 2.

P1, P2, P3, P4, ART, PA, RA, LA, CVP, ICP, and CO2 gains can be set to 0.1, 0.25, 0.5, 1, or 2 mm/mmHg.

## Show 10 mm/s

Show 10 mm/s is a toggle button that allows you to choose 25 mm/s display speed or 10 mm/s display speed in the Traces view. This selection will only affect the single-patient display and will not change the mm/s speed in the multi-patient display or on any printouts.

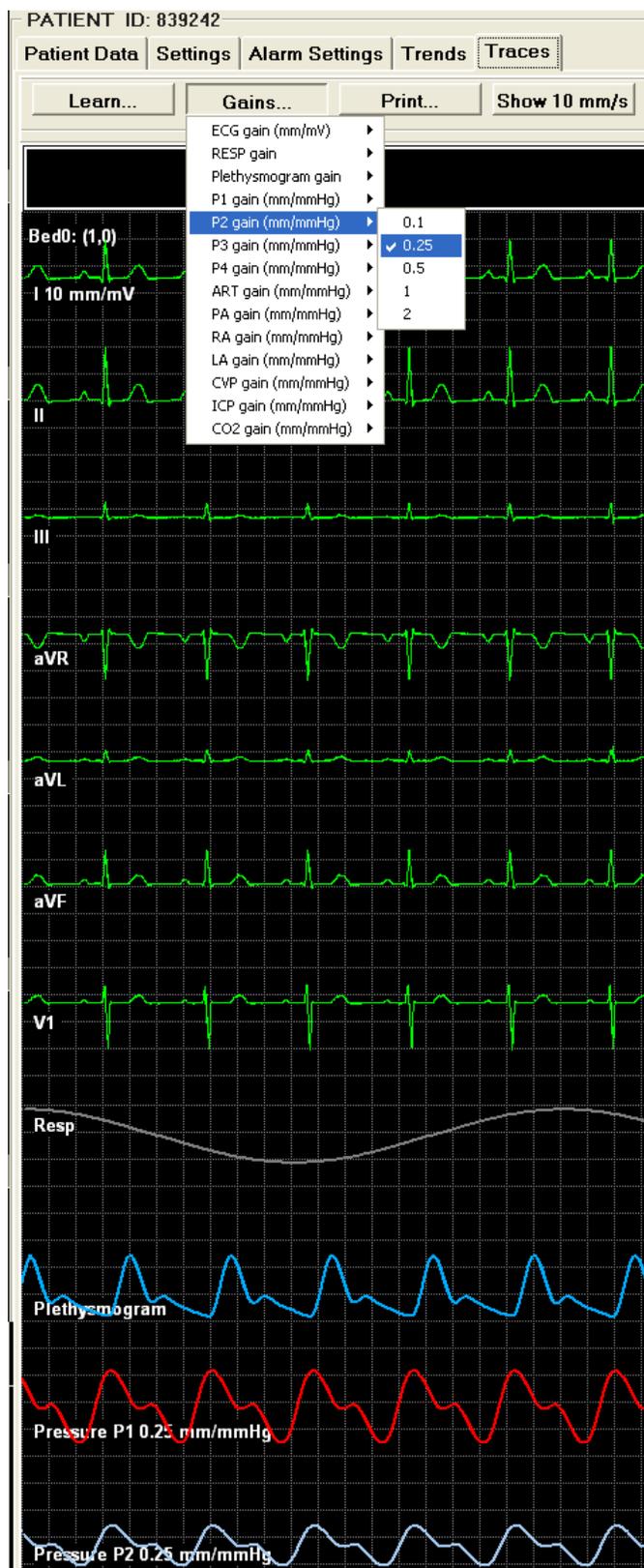


Figure 32 - The Waveform Gains screen.



# 13. REVIEW

Surveyor Central allows you to review all stored alarm events and ECG for all patients. The review window is on the right half of the screen when using a single monitor, or on the right display when using a dual monitor. Alarm events for all monitored patients are listed; click on any of the events to display ECG.

The review functionality can be also assessed through the Surveyor Review software. The Surveyor Review screen layout is similar to the Surveyor Central review screen in dual-display modality and has the same functionality as the Surveyor Central review features including printouts and export. Refer to the Surveyor Review Software section below for more details.

## Multi-patient Review

In the multi-patient display, left click on **Review** at the bottom right of the display. In the example shown, an episode of VTACH has been selected with a left click. The monitored patient's ID precedes the time and date of the event. 30 seconds of ECG lead II is shown in the Multi view. Parameters such as HR, VPB count, QT/c measurement, and ST measurement for the displayed ECG are shown in the bottom portion of the Review display. ST values are not displayed in this example because they are not calculated for ventricular beats.

All events with priorities that have not been acknowledged are shown in the alarm event listing for all patients in reverse chronological order. This window allows you to review all event alarms that have occurred for all of the currently monitored patient sessions. Left click on any alarm event and the ECG will be displayed.

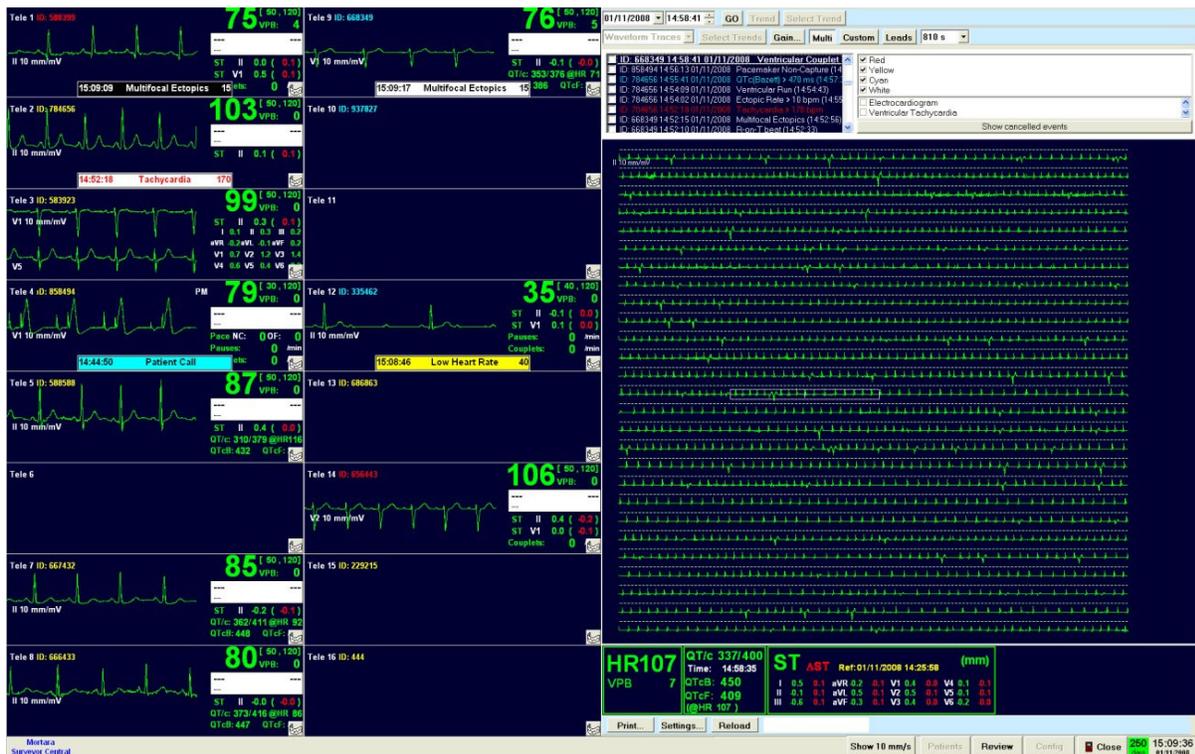


Figure 33 - The Multi-Patient Review screen.

The scroll bar at the right of the event list can be used to move to alarm events that are not currently in view. Navigation through the ECG and reviewing events, filtering events, acknowledging events, cancellation of events, and display selections are explained on the following pages.



**WARNING:** Only events that occurred within the last 30 minutes and that have never been acknowledged are shown in this screen. Go to Single Patient Review, explained on the next page, for review of acknowledged events and the events that have occurred earlier or in previous monitoring sessions.

**NOTE:** Multi-patient review is not available in a Surveyor Central repeater station.

### Single-patient Review

In single-patient display, left click on **Review** at the bottom right of the display or right click anywhere on the ECG of a patient's sub-screen in multi-patient display. Alternatively, highlight the patient and left click on **Review**. In the waveform traces view shown below, an event in the event list was selected with a left click. A 12-lead ECG is displayed at 25 mm/s speed. Parameters for the ECG are shown in the bottom portion of the display.

All event priorities for this patient are shown in the alarm event listing in reverse chronological order. This window allows you to review all event alarms that have occurred for this single patient. Left click on any alarm event and the ECG will be displayed.

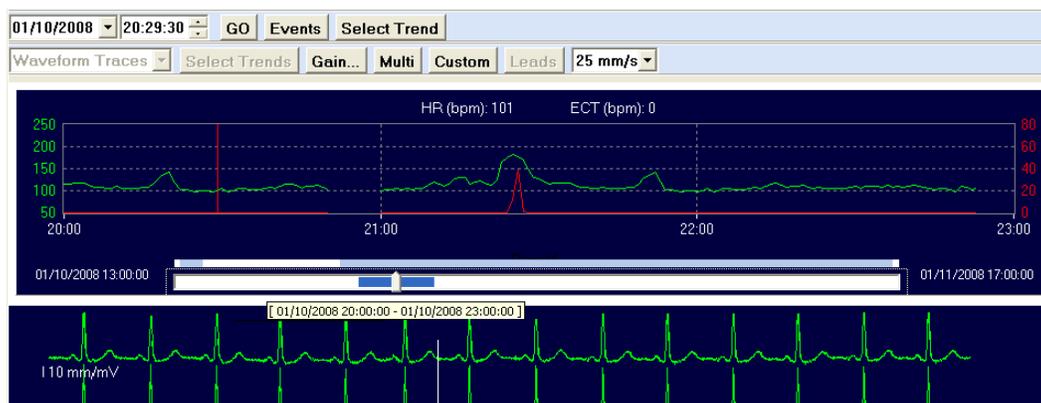
### Event review



Figure 34 - The Event Review screen.

## Trend Review

Left click on **Trend** to toggle between events review and trend review. The events listing is changed to a trend that allows you to navigate to any monitoring session. HR trending and values are shown in green and ECT (ectopy) is shown in red.



**Figure 35** - The Trend Review screen.

The start and end times of all monitoring sessions are shown to the right and left of the slider bar allowing you to navigate to any session time point. When the slider bar cursor is left clicked, the displayed dates and times will be shown.

A red vertical cursor will move when you left click anywhere in the trend and the ECG waveform at that time is immediately displayed. Blank areas in the trend and slider bar indicate periods when the monitoring was stopped and then restarted.

## Navigation to Day and Time

Displayed ECG waveform dates and times are shown in the upper left corner of the review display. Left click on the date and time values and change them to navigate to any point in the monitoring data. You can also have left click on the date drop-down list to open a calendar and choose a date.

To navigate to any time or day during the monitoring session(s), enter the time and date and then click **GO**.

## Select Trend for Waveform Traces Display

Click on **Select Trend** to change the displayed trend to durations of 3, 6, 12, or 24 hours and select various trend parameters.

## Navigation within the Review ECG

- Use **Home/End** keys to go the beginning or end of the monitoring period.
- Use **Page Down/Page Up** keys to go to the next/previous page of ECG.
- Use the mouse wheel to zoom in/out the number of seconds in the display.
- Right/left arrow keys move the displayed ECG a second at a time forward or backward.
- Up/down arrow keys move the displayed ECG set of traces to the previous/next line of traces.
- Left click on any beat in the display to center within the 12-second dashed box with the center on the beat you selected.
- Move the mouse cursor within the context of the Review ECG window and time and date at the bottom of the display will change to reflect the location of the ECG. Field is blank when the cursor is outside the Review ECG field.

## Gain

ECG gain can be adjusted in 5, 10, 20, or 40 mm/mV and will affect all ECG gain in review. Plethysmogram gain, when present, can be adjusted to 0.5, 1, or 2 times sensitivity and will affect all plethysmogram gain in review.

## Multi (Traces), 12-Lead and Custom Display

The **Multi** button is an on/off toggle that allows multiple traces for each ECG lead display. When depressed, the **Leads** and number of seconds drop-down lists allow customization of the ECG display. The number of seconds and the number of traces for each lead automatically adjust according to the number of leads selected. Close the **Leads** drop-down list by a left click.

When the **Multi** button is toggled off with a left click, an alternate view of the ECG can be selected. This view gives you only one single trace for each lead. You can select this view by left clicking again on the **Multi** button, toggling it off, or by left clicking on **12-lead/Custom**. Select either all 12 leads for display by left clicking **12-Lead** or select a subset of leads by left clicking **Custom**.

**Multi** is automatically toggled off when you left click on **12-Lead/Custom**. In single-trace view, display speed is expressed in mm/s and can be changed with the drop-down list. The number of leads in the custom display can be selected with **Leads**. The number of seconds displayed in this view is 6, 12, 30, or 60 seconds with dual monitors (half with a single monitor).

Select 5 mm grid display in the configuration menu. Note that the grid is never present at 5 mm/s display speed.

## Graphical Trends Review

With events displayed, you can switch between waveform traces, graphical trends, ST trends, and tabular trends using the drop-down list below date and time selections. In this view, Waveform Traces and Events Select Trend related buttons are not available.

This view allows you to choose durations of 3, 6, 12, or 24 hours and any combination of up to 8 trend parameters.

The first trend is HR only. This trend can be turned off by use of the None selection.



Figure 36 - The Graphical Trends Review screen.

## ST Trends Review

With events displayed, you can switch to ST trends using the drop-down list below date and time selections. In this view, Waveform Traces and Events Select Trend related buttons are not available. This view allows you to choose durations of 3, 6, 12, or 24 hours using the Select Trends button.

An ST trend for each of the ECG leads is displayed with a blue background. The HR trend is displayed in green and Ectopy is displayed at the bottom in yellow.

Location of the red vertical cursor determines the ST values in parenthesis that are shown to the right of the ST lead labels.

The values in parenthesis below HR indicate HR/ectopic beats per minute in relation to the red cursor location.

The HR trend scale values are shown to the right of the HR values (e.g., 250, 188, 126, 64, and 0).

The date and time shown in the middle lower portion of the display indicate mouse cursor position when it is moved over the graph.

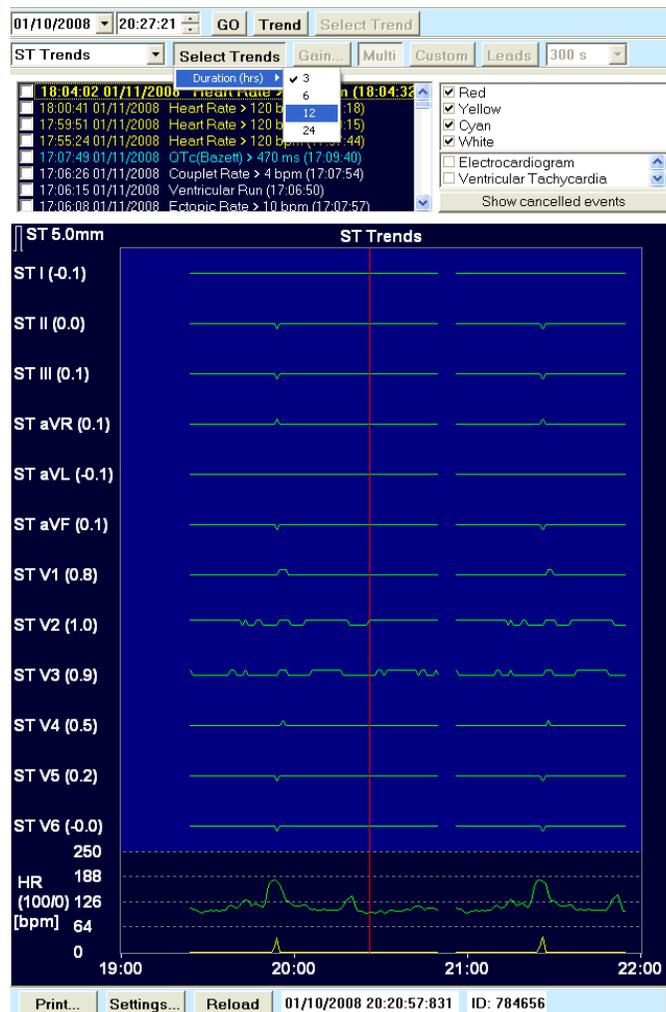


Figure 37 - The ST Trends Review screen.

## Tabular Trends Review

With Events displayed, you can switch to tabular trends using the drop-down list below date and time selections. In this view, Waveform Traces and Events Select Trend related buttons are not available.

This view allows you to choose durations of 3, 6, 12, or 24 hours and any combination of up to 8 trend parameters.

Trend column times will adjust as the durations are changed. This trend is 3 hours in duration and values are shown every 30 minutes.

Minimum, average, and maximum values for each time period are shown for each parameter.

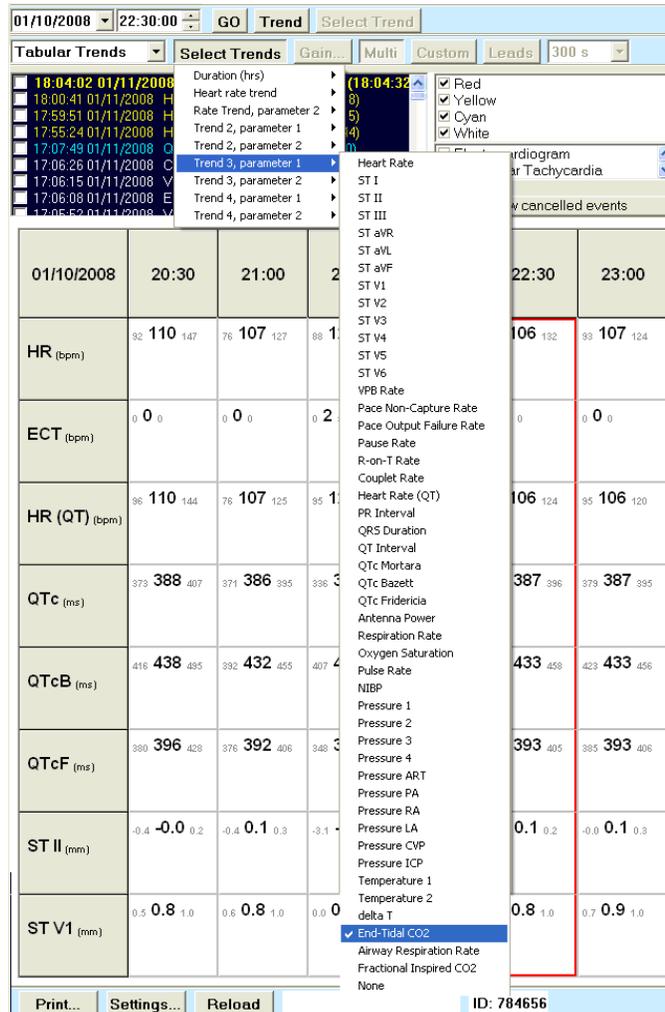


Figure 38 - The Tabular Trends Review screen.

## Print

Left click on **Print** in the lower area of the review display to open the available selections. When a 12-lead ECG is selected, the ECG located within the dashed box will be printed. In the review function, you can also print the ECG and trends as they are displayed on the screen. Patient demographics, displayed leads, and ST measurement values will appear on the waveform traces printouts. Note that the amount of data that is printed on the screen format differs slightly from the amount displayed, because dimensions of the screen differ from that of standard paper.

To print a Summary Report:

1. Click the **Print** button at the bottom of the review screen. A list of available reports pop up.
2. Select the **Summary Report** item.

## Settings

**Settings** allows you to change the printout defaults after monitoring has been stopped. When monitoring is in progress, you can change these settings through use of the Settings Tab. Settings can be changed for the 12-lead ECG, ST report, and Summary Report.

To configure the contents of a Summary report:

1. Click the **Settings** button at the bottom of the review screen.  
A list of report configuration settings pops up. The following items apply to the Summary report:

Item	Description	Options
Summary Report: Report Duration	Selects the coverage period for the report.	4 hours 8 hours 12 hours 24 hours
Summary Report: Tabular trends interval	Selects the reporting interval used for the tabular trends section of the report.	1 minute 5 minutes 15 minutes 30 minutes 60 minutes
Summary Report: Graphical Trends	Selects whether or not to include a graphical trends displays in the report.	Enabled/disabled
Summary Report: Tabular Trends	Selects whether or not to include a tabular trend display in the report.	Enabled/disabled
Summary Report: Alarm Snapshots	Selects whether or not to include alarm snapshots in the report.	Enabled/disabled

2. Click on the desired configuration item.
3. Click on the desired setting for the configuration item.
4. Repeat the above steps for each configuration change to be made.

## Reload

Left click on **Reload** at the bottom of the review display to update or refresh any alarm events or trends that occurred since you entered the review display. Neither the alarm events list nor trends will update or show new information until you select this button.

## Alarm Events List

### Multi-patient Alarm Events List

Only alarm events that occurred in the last 30 minutes and have not been acknowledged are displayed. To acknowledge an event, left click the checkbox preceding it. Once you **Reload** or **Close** and then reopen the multi-patient review, the acknowledged event will not be shown. To cancel an event, left click the event and press **Delete**. Before you close review, **select Show cancelled events** to display only deleted events. **Return** to go back to the event list.

To undo a deletion, left click the event and press the **Insert** key. This must be done before you close the review screen. Deleted events cannot be undone once the review screen is closed.

### Single-patient Alarm Events List

In single-patient review display, all acknowledged and unacknowledged events are displayed and can be deleted the same as in multi-patient review display. Cancellation is possible for both acknowledged and unacknowledged alarm events.

## Alarm Events Filtering

You can filter the alarm events list by selecting or deselecting the check boxes to the right of the listing. Additionally, you can filter to view related groups of alarm events for:

- Electrocardiogram
- Ventricular Tachycardia
- ST Change
- Protocol Events
- Extended Arrhythmias
- Resting ECG
- NIBP
- Technical Alarms
- External Events
- Temperatures
- SpO<sub>2</sub>
- Invasive Pressures
- CO<sub>2</sub>
- Respiration Rate
- Technical Alarms
- All Alarms Off

Any combination of alarm priority types and related groups can be selected.

**NOTE:** Selected alarm event types and groups remain selected each time the review window is closed and reopened.

## Surveyor Review Software

### Description

Surveyor Review allows clinicians to review online patient monitoring data from a Surveyor Central system database or archived data that has been written to external media or a networked location. The Resting ECG Interpretation option is required to enable global measurement and 12-lead ECG interpretation.

The Surveyor Review station screen layout is similar to the Surveyor Central system review screen in its dual-display modality and has the same review features and functionality including printout and 12-lead ECG export (when the Resting ECG Interpretation option is present).

When the Surveyor Review station is networked to the Surveyor Central system database, it is possible to initiate archive of patient monitoring data, delete records, and/or modify patient demographic information.

### System configurations

The Surveyor Review is provided in one of two configurations:

- **Node** – The Surveyor Review is provided pre-installed on a computer workstation.
- **Kit** – The Surveyor Review is provided in the form of a CD that can be installed on a customer-supplied computer workstation meeting the following specifications:

<b>Operating System:</b>	Windows 7 Professional 64-bit, Windows 8.1 64-bit, or Windows 10 Professional 64-bit
<b>CPU :</b>	Performance equivalent to an Intel Core i3, or higher
<b>RAM:</b>	2 GB (minimum)
<b>Video:</b>	1280 × 1024 resolution (minimum)
<b>Disk space:</b>	1 GB on the C: drive (minimum)
<b>USB ports:</b>	1 free V2.0 (minimum)

### Required Equipment

#### Surveyor Review Kit

- Surveyor Review installation CD
- Surveyor Review dongle (enables associated features)
- Surveyor Review user manual (includes installation and operational instructions)

#### Computer(s) to run Surveyor Review application software

**NOTE:** It is not possible to use the Surveyor Central system network printer for Surveyor Review printout.

#### Online access (for when a Surveyor Review station is networked to Surveyor Central)

- Welch Allyn Surveyor Security router installed and configured by an authorized Welch Allyn representative

### Application installation (Kit configuration only)

**NOTE:** Prior to installing Surveyor Review, any copy-protection dongle must be removed from the computer.

Insert the Surveyor Review program CD in your drive. If the Auto Play function is enabled, installation will start automatically. If not enabled, left click on the desktop **My Computer** icon, browse to the CD/DVD drive, and left click on Setup Executable. The Review program and dongle driver will install automatically at C:\SCSYSApps\Review\Bin. When complete, follow the on-screen instructions.

1. Select the application language.
2. Configure the initial data parameters.
  - a. Live database IP [enter IP address with which the Surveyor Central database server is visible or make no changes when you plan to review archived data only. The IP address is typically the public IP address of the Surveyor firewall. Ask the network administrator when in doubt.].

**NOTE:** *The version of Surveyor Review being installed must match that of the Surveyor Central.*

- b. Archive [enter path or click on the button (...) to browse to the location].

**NOTE:** Surveyor Central archive data at V3.00 or later.

- c. Click on the radio button that represents the database source.
3. Select **Run Review Configurator Now**, then **Finish**.
4. Define the print settings in the Print Settings tab.
5. Click on the Miscellaneous tab to define the 12-lead ECG export path and to choose ID or Name to be displayed in the Patients Surveyor Review station listing.
6. Select **Save and Exit** when finished.

**NOTE:** Saved settings can be changed within the Surveyor Review program.

The install program will automatically create a shortcut on the computer desktop to the Surveyor Review program.

Links to the Surveyor Review configurator, dongle update utility, and uninstaller shortcut will be created in the Windows Start menu within the Surveyor Central applications group.

Insert the Surveyor Review dongle in an available USB port. Only one dongle can be used at a time; if running Welch Allyn's HSCRIBE™ Holter analysis software at version 4.xx on the same computer, ask a Welch Allyn representative to upgrade the HSCRIBE dongle to enable the Surveyor Review program features.

## Surveyor Review Specifications

### Computer

Operating System:	Windows 7 Professional or Windows 10
CPU :	Performance equivalent to an Intel Core i3, or higher
RAM:	2 GB (minimum)
Video:	1280 x1024 resolution (minimum)
Disk space:	1 GB on the C: drive (minimum)
USB ports:	1 free V2.0 (minimum)

### Environmental Conditions

Transporting and Operating:	Depends on the computer in which the device is installed
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### Screen

Supported screen resolutions:	Horizontal from 1024 to 3500 pixel Vertical from 720 to 1500 pixel
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Traces per patient:	Up to 12 simultaneously
Display velocity:	5, 10, 25, or 50 mm/s
ECG sensitivity:	5, 10, 20, or 40 mm/mV
Trends:	Up to 8 tabular or graphic
Trend duration:	3, 6, 12, and 24 hour
Full disclosure:	Up to 4 traces
Full disclosure duration:	Depending on screen resolution, number of traces, and display velocity; typically more than 1 hour
Review method:	By event or by graphical trend

### Printer

Compatibility:	Windows compatible printer; fully tested with HP M601n laser printer and PCL5 drivers
Printout types:	Rhythm, 12-lead ECG, ST report, trends, Summary Report
12-lead ECG formats:	6×2, 3×4+1, 3×4+3 at 25 or 50 mm/s
Rhythm speeds:	5, 10, 25, 50 mm/s
Paper types:	A4 and letter
Resolution:	1200 × 1200 dpi
Print speed:	55 ppm max

## Using Surveyor Review Software

### Selecting data for review

Open the Surveyor Review program to display a patient list as shown in the example below. (This program example is setup to review archived patient data on a networked drive.)

Sort the list by any of the column headers (i.e., Last Name, ID, Date of Birth, etc.). The selected sort field is indicated by a triangular symbol. To sort in reverse order, click on the same column header again. To sort by two headers, click on the first choice then press and hold the shift key and simultaneously click on the second sort column. Then click on **Reload**.

The screenshot shows the Mortara Surveyor Review software window. At the top, there is a 'Bar code' field with a 'Confirm' button. Below this is a table with the following columns: Last name (with a dropdown arrow), First Name, ID, Date of Birth, Start Time, Stop Time, ID Format, and Status. The table contains 10 rows of patient data. At the bottom of the window, there are buttons for 'Patient Data', 'Review', 'Reload', and 'Close'. A status bar at the very bottom shows 'Data Source Type: Archived Data' and 'Archive Path: F:\Telemetry Monitoring System\3.10.1132' with a 'Browse' button.

Last name ▼	First Name	ID	Date of Birth	Start Time	Stop Time	ID Format	Status
White		839233532	18/05/1969	14/03/2008 17:19:06	16/03/2008 18:51:26	Acme_Clinical_Research	Archived
TIF		689458	14/02/1974	14/03/2008 17:23:55	16/03/2008 18:51:59	Heart_Institute	Archived
Schubheis		786235834	15/10/1975	14/03/2008 17:19:00	16/03/2008 18:51:14	Acme_Clinical_Research	Archived
PAC		382998	11/11/1941	14/03/2008 17:23:13	16/03/2008 18:51:48	Heart_Institute	Archived
HAH		838295	02/02/1972	14/03/2008 17:19:18	16/03/2008 18:51:33	Heart_Institute	Archived
Gray		332433255	01/04/1971	14/03/2008 17:18:43	16/03/2008 18:51:21	Acme_Clinical_Research	Archived
BIB		385829	04/04/1974	14/03/2008 17:23:07	16/03/2008 18:51:41	Heart_Institute	Archived
ARA		382934	15/05/1965	14/03/2008 17:18:11	16/03/2008 18:51:05	Heart_Institute	Archived

Figure 1 - Patient list.

To review a patient's demographic information, highlight the desired patient and left click on **Patient Data**. The Patient Data window will open. To exit this window and return to the patient list, click on **Close**.

To review a patient's ECG data, double click the desired patient or highlight the desired patient and left click on **Review**. To return to the patient list, click on **Patients**.

If using a bar code scanner, scan the patient's bar code to automatically highlight the patient. Click on the **Bar code** field, scan the code, and left click on **Confirm**.

Left click on **Reload** at the bottom of the display to update or refresh any changes that have occurred to the patient listing. Left click on **Close** or click on the red **X** in the upper right corner to exit the program.

The following selections allow you to change configuration settings:

- ✓ **Data Source Type** Choose between Archived Data and Online Database (when networked to a Surveyor Central system).
- ✓ **Archived Data** Displays the “archive path”; manually enter or use the Browse button to navigate to the archived data location.
- ✓ **Online Database** Displays “online server address”; enter the IP address of the Surveyor Central system database. The IP address is typically the public IP address of the Surveyor firewall.

When using Surveyor Review in the online database configuration, access is defined by the Surveyor Central system administrator in the password-protected configuration (Config) menu. The Surveyor Central system administrator will select each user’s authorized ID formats and set applicable permissions.

The Patient Data button is replaced by the following permitted selections:

Selecting **New** will open a window.

Select ID format from the drop-down list and enter the patient demographics. Left click **OK** to save any changes and return to the patient list. Select **Cancel** to return without saving any changes.

Use **Modify** to open a patient’s demographics window to add to or change any of the demographic information. Left click **OK** to save any changes and return to the patient list. Select **Cancel** to return without saving any changes.

**Delete** will remove new patient information that has been added, as well as patient data with a “Stopped” or “Archived” status from the database. Once deleted, the data cannot be retrieved. Delete is inactive if a patient with a current status of “Monitoring” is highlighted. Surveyor Review can be setup to require the configuration password in order to delete a patient. See a Welch Allyn representative to activate this function.

**Archive** sends all closed monitoring sessions of a highlighted patient to the destination defined in the system. If a patient that is currently being monitored is highlighted, only the stopped monitoring sessions will be archived.

**NOTE:** Archived data cannot be restored to the Surveyor Central system. Archived data is typically used for acquisition at a Surveyor Central Review station, or an Hscribe system that has the Surveyor data analysis option.

## Review screen

Surveyor Review allows you to review all stored events and ECG data for any patient in the patient list.

In the example below, the selected patient’s ECG data is shown in Waveform Traces view with a 12-lead ECG displayed at 25 mm/s speed. Parameters for the ECG are given in the bottom portion of the screen. Events are listed in the upper portion of the screen in reverse chronological order. Left click on any event to display the ECG.

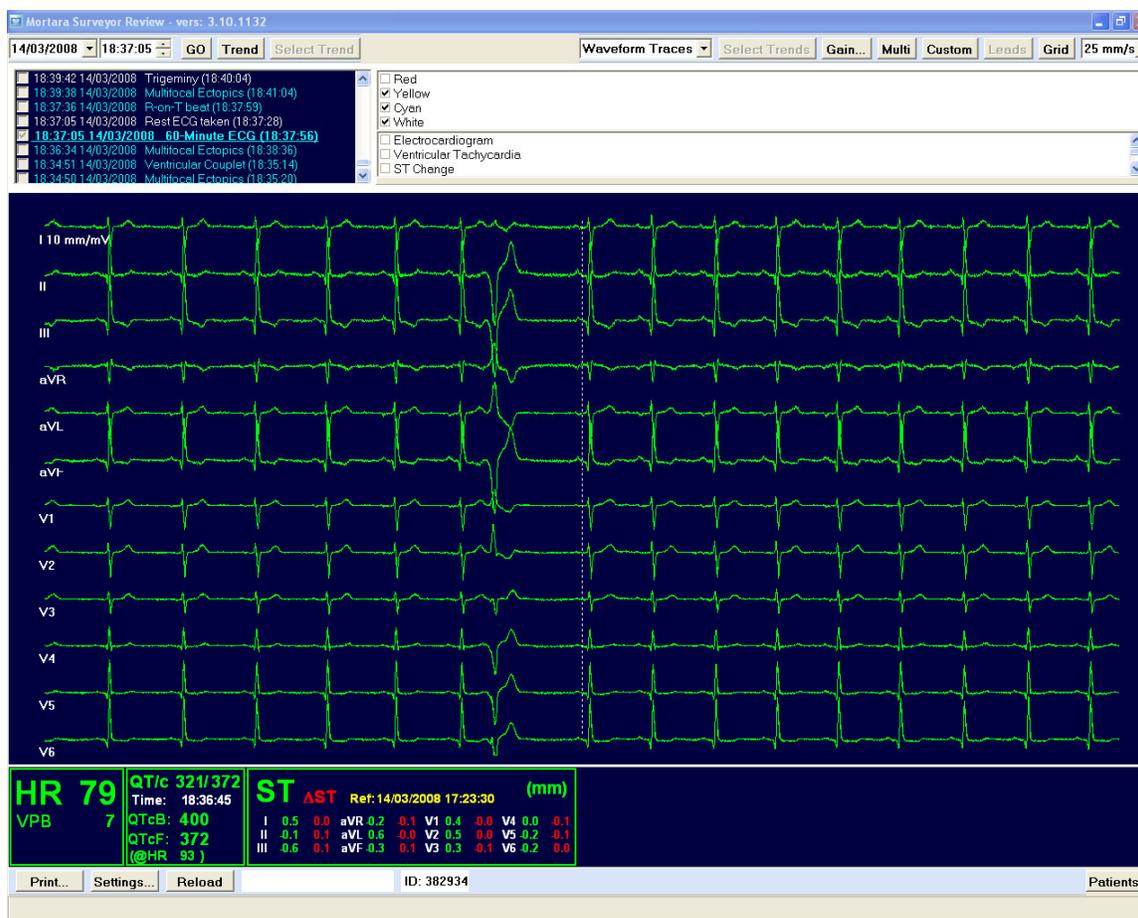


Figure 2 - Waveform traces view.

## Event Review

Filter the events list by selecting or deselecting the check boxes to the right of the listing. Additionally, you can filter to view related groups of events. Any combination of event priority types and related groups can be selected.

### Event Type Hierarchy

- Red = High
- Yellow = Medium
- Cyan = Low
- White = Informational

### Event Groups

- Electrocardiogram
- Ventricular Tachycardia
- ST Change
- Protocol Events
- Extended Arrhythmias
- Resting ECG
- Technical Alarms
- All Alarms Off

**NOTE:** Some of the groups available for filter selections (e.g., ECG Derived Respiration (EDR), NIBP, SpO<sub>2</sub>, Temperatures, Invasive Pressures and CO<sub>2</sub>) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

**NOTE:** Selected event types and groups remain selected each time the review window is closed and reopened.

## Trend Review

Left click on **Trend** to toggle between Event review and Trend review. In Trend review, the events listing changes to a trend allowing navigation to any monitoring session. HR trending and values are shown in green and VPB (ventricular ectopy) is shown in red. Left click on **Select Trend** to change the duration and parameters.

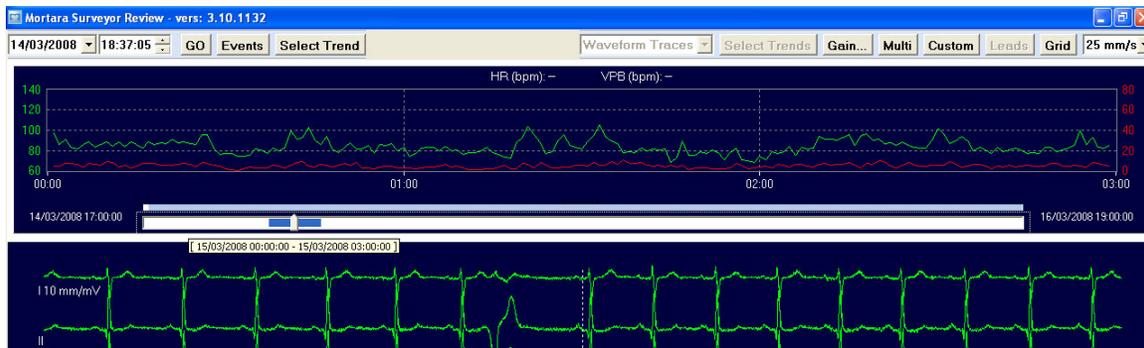


Figure 3 - Trend review screen.

The start and end times of all monitoring sessions are shown to the right and left of the slider bar allowing navigation to any session time point. Left click the slider bar cursor to display the date and time for its current position.

Left click anywhere in the trend and the ECG waveform at that time is immediately displayed. Blank areas in the trend and slider bar indicate periods when the monitoring was stopped and then restarted.

## Navigation to Day and Time

Displayed ECG waveform dates and times are shown in the upper left corner of the display. Left click on the date and time values and change them to navigate to any point in the monitoring data. You can also left click on the date drop-down list to open a calendar and choose a date.

To navigate to any time or day during the monitoring session(s), enter the time and date and then click **GO**.

## Select Trend for Waveform Traces Display

Click on **Select Trend** to change the displayed trend to durations of 3, 6, 12, or 24 hours and select various trend parameters.

**NOTE:** Some selections (e.g. Oxygen Saturation, NIBP, and End-Tidal CO<sub>2</sub>) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

## Navigation within the Review ECG

- Use **Home/End** keys to go the beginning or end of the monitoring period.
- Use **Page Down/Page Up** keys to go to the next/previous page of ECG.
- Use the mouse wheel to **zoom in/out** the number of seconds in the display.
- **Right/left arrow keys** move the displayed ECG a second at a time forward or backward.
- **Up/down arrow keys** move the displayed ECG set of traces to the previous/next line of traces.

- Left click any beat in the display to center within the 12-second dashed box with the center on the beat you selected.
- Move the mouse cursor within the context of the Review ECG window and time and date at the bottom of the display will change to reflect the location of the ECG. Field is blank when the cursor is outside the Review ECG field.

## Gain

ECG gain can be adjusted in 5, 10, 20, or 40 mm/mV and will affect all ECG gain in review.

**NOTE:** Some selections (e.g., EDR gain, Plethysmogram gain, ART gain, PA gain, etc.) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

## Multi (Traces), 12-Lead and Custom Display

The **Multi** button is an on/off toggle to display multiple traces for each ECG lead. When toggled on, the **Leads** and number of seconds drop-down lists allow customization of the ECG display. The number of seconds and the number of traces for each lead automatically adjust according to the number of leads selected. Close the **Leads** drop-down list by a left click.

**NOTE:** Some selections (e.g., EDR, Plethysmogram, Pressure ART, etc.) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

When the **Multi** button is toggled off, an alternate view of the ECG can be selected. This view gives you only one single trace for each lead. Select this view by toggling **Multi** off, or by left clicking on the **12-Lead/Custom** toggle. Select either all 12 leads for display by left clicking **12-Lead** or select a subset of leads by left clicking **Custom**.

**Multi** is automatically toggled off when you left click on the **12-Lead/Custom** toggle key. In single-trace view, display speed is expressed in mm/s and can be changed with the drop-down list. The number of leads in the custom display can be selected with **Leads**. The number of seconds displayed in this view adjusts according to the number of leads selected and can be changed by clicking on the **Seconds** value drop-down list.

Select **Grid** in the configuration menu to display a grid. Note that the grid is never shown at 5 mm/s display speed or greater than 600 seconds in the multi view.

## Graphical Trends Review

With events displayed, switch between Waveform Traces, Graphical Trends, ST Trends, and Tabular Trends. In this view, Waveform Traces and Events Select Trend related buttons are not available.

This view allows you to choose durations of 3, 6, 12, or 24 hours and any combination of up to 8 trend parameters.

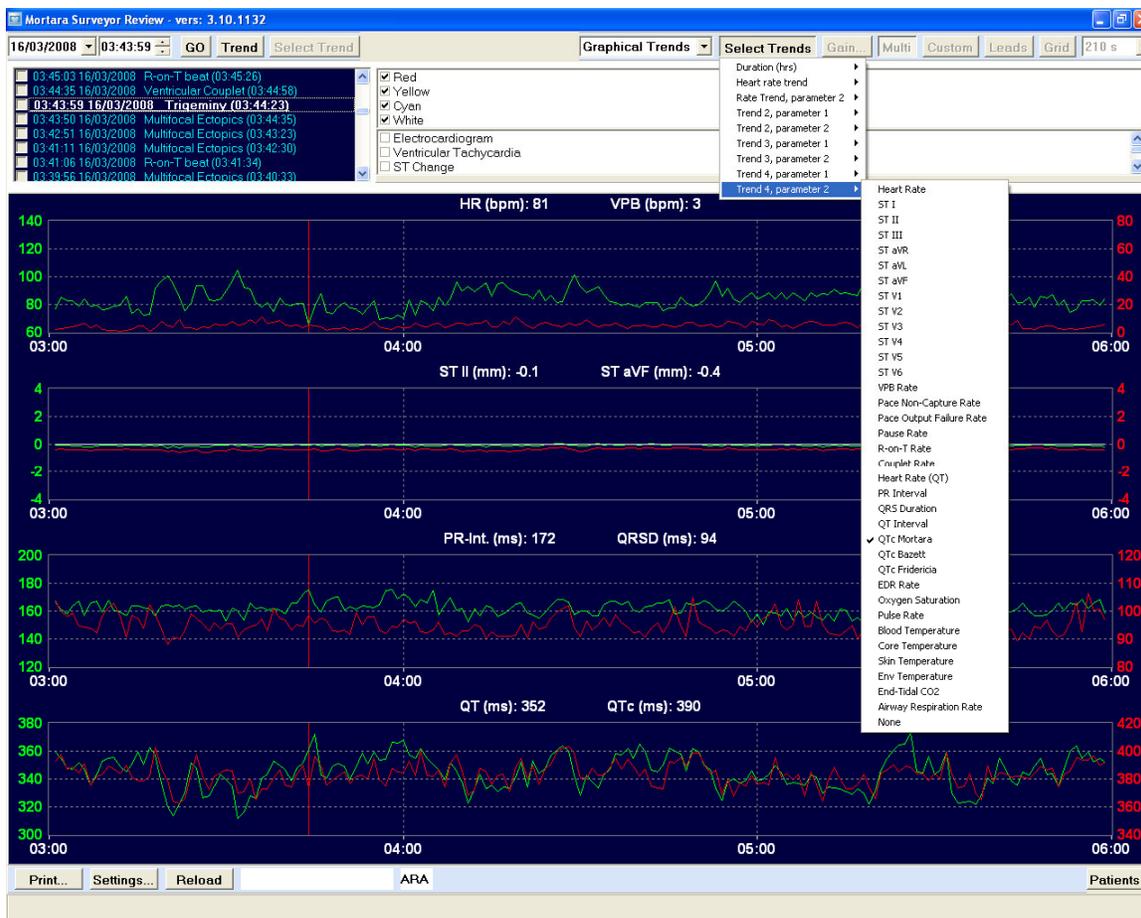


Figure 4 - Graphical trends review screen.

The first trend is HR and VPB per minute. Trends can also be turned off by use of the **None** selection.

**NOTE:** Some parameter selections shown (e.g., EDR Rate, Oxygen Saturation, Pulse Rate, NIBP, Pressure ART, etc.) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

### ST Trends Review

With events displayed, switch between Waveform Traces, Graphical Trends, ST Trends, and Tabular Trends. In this view, Waveform Traces and Events Select Trend related buttons are not available.

This view allows you to choose durations of 3, 6, 12, or 24 hours using the Select Trends button.

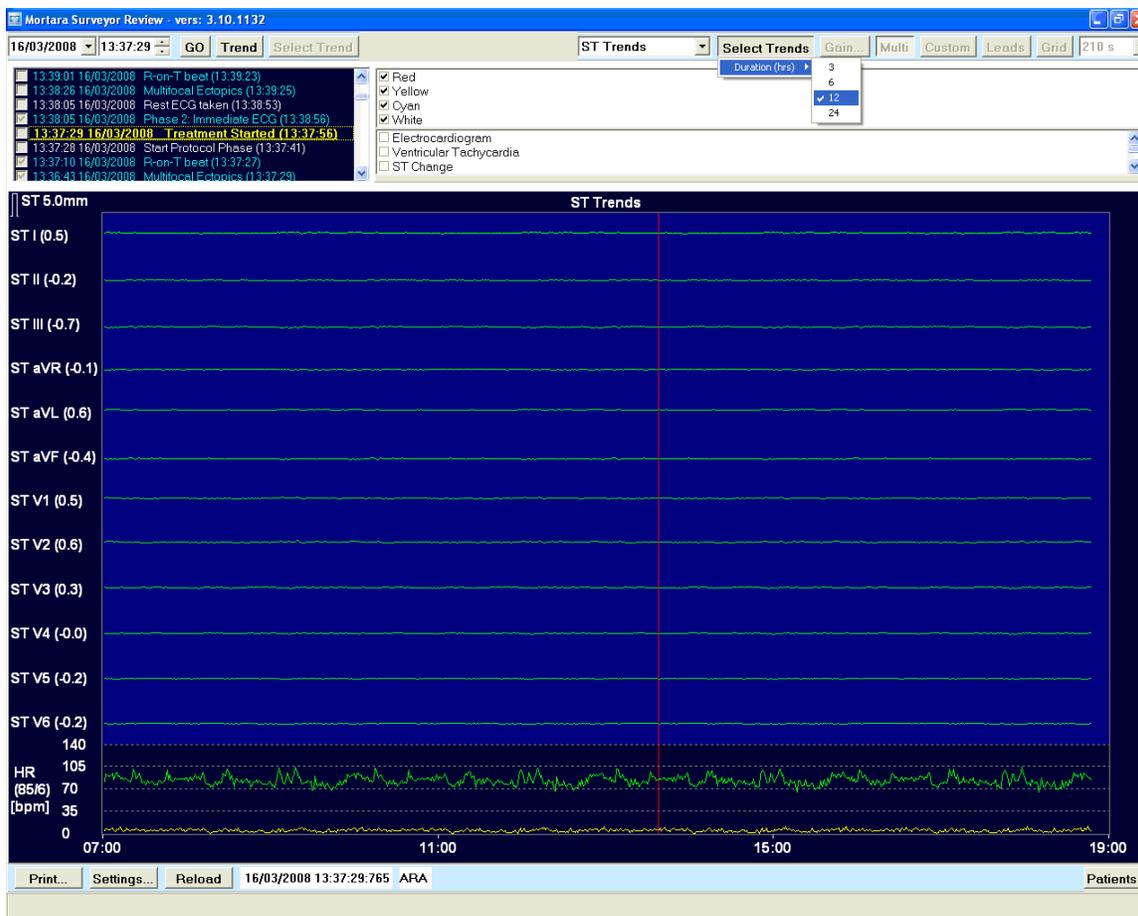


Figure 5 - ST Trends Review screen.

An ST trend for each of the ECG leads is displayed with a blue background. The HR trend is displayed in green and ectopy is displayed at the bottom in yellow.

Location of the red vertical cursor determines the ST values in parenthesis that are shown to the right of the ST lead labels.

The values in parenthesis below HR indicate *HR/ectopic beats per minute* in relation to the red cursor

location. The HR trend scale values are shown to the right of the HR values (e.g., 140, 105, 70, 35 and 0).

The date and time shown in the middle lower portion of the display will indicate mouse cursor position when it is moved over the graph.

## Tabular Trends Review

With events displayed, switch between Waveform Traces, Graphical Trends, ST Trends, and Tabular Trends. In this view, Waveform Traces and Events Select Trend related buttons are not available.

This view allows you to choose durations of 3, 6, 12, or 24 hours and any combination of up to 8 trend parameters.

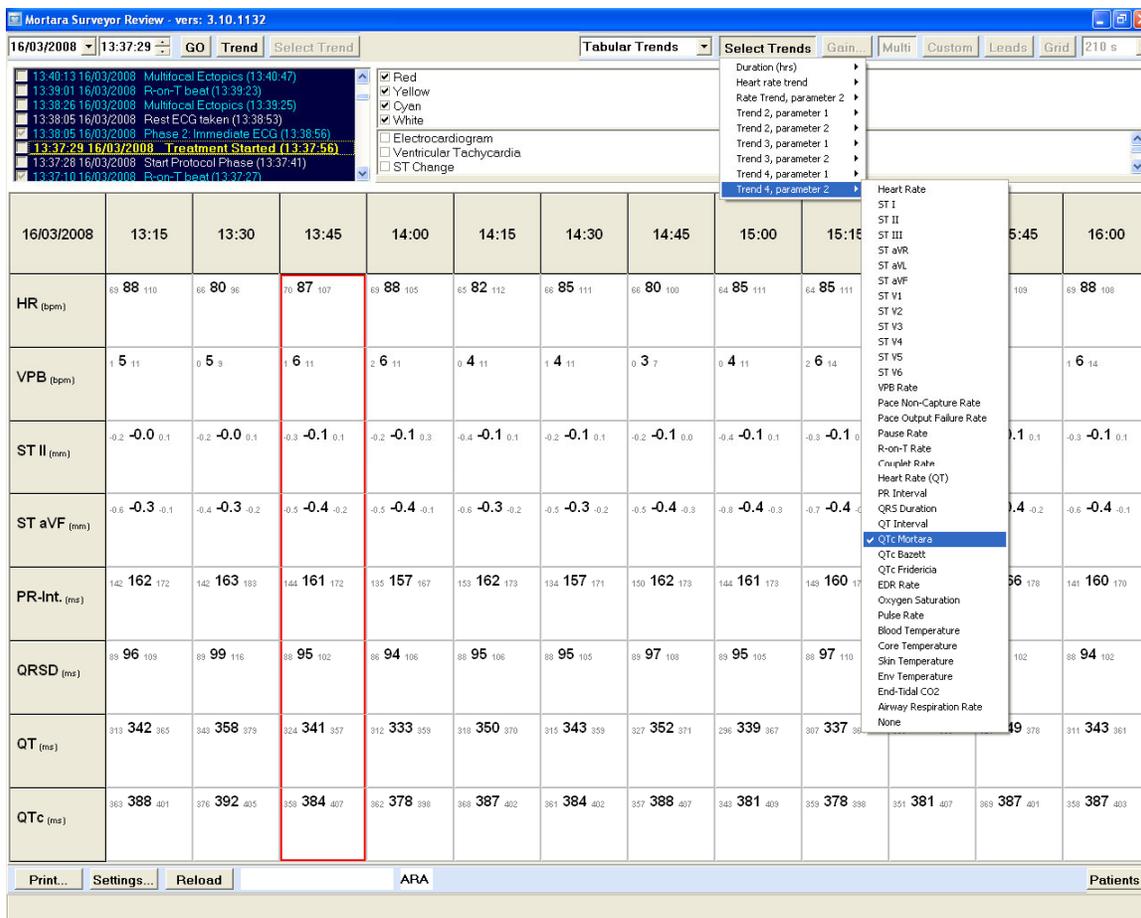


Figure 6 - Tabular Trends screen.

Trend column times will adjust as the durations are changed. This trend is 3 hours in duration and values are shown for each 15 minutes.

Minimum, average, and maximum values for each time period are shown for each parameter.

**NOTE:** Some parameter selections shown (e.g., EDR Rate, Oxygen Saturation, Pulse Rate, NIBP, Pressure ART, etc.) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

Print

Left click on **Print** in the lower area of the display to open the available selections. When a 12-lead ECG is selected, the ECG located within the dashed box will be printed. You can also print the ECG and trends as they are displayed on the screen. Patient demographics, displayed leads, and ST measurement values will appear on the waveform traces printouts. Note that the amount of data that is printed on the screen format differs slightly from the amount displayed, because dimensions of the screen differ from that of standard paper.

**NOTE:** The Surveyor Review Resting ECG Interpretation option is required to enable global measurement and 12-lead ECG interpretation.

## Settings

**Settings** allows you to change the printout defaults. Settings can be changed for 12-lead ECG, ST report, and Summary Report printouts.

**NOTE:** Some parameters available for ST-Report trend selections (e.g., Oxygen Saturation, NIBP, Pressure ART, etc.) are non-ECG parameter items and may not be available when reviewing telemetry only monitoring data.

## Summary report

The Summary report provides a configurable report to tailor information to each specific patient's needs. The report includes the following information:

- Patient demographics
- Patient overview information, which includes average and summary information of parameters.
- List of alarms.
- Graphical parameter trends (optional).
- Tabular parameter trends (optional).
- Alarm snapshots (optional) – shows one tracing of an alarm condition; also shows a timeline of alarm occurrences.

To configure the contents of a Summary report:

1. Click the **Settings** button at the bottom of the review screen.  
A list of report configuration settings pops up. The following items apply to the Summary report:

Item	Description	Options
Summary Report: Report Duration	Selects the coverage period for the report.	4 hours 8 hours 12 hours 24 hours
Summary Report: Tabular trends interval	Selects the reporting interval used for the tabular trends section of the report.	1 minute 5 minutes 15 minutes 30 minutes 60 minutes
Summary Report: Graphical Trends	Selects whether or not to include a graphical trends displays in the report.	Enabled/disabled
Summary Report: Tabular Trends	Selects whether or not to include a tabular trend display in the report.	Enabled/disabled
Summary Report: Alarm Snapshots	Selects whether or not to include alarm snapshots in the report.	Enabled/disabled

2. Click on the desired configuration item.

3. Click on the desired setting for the configuration item.
4. Repeat the above steps for each configuration change to be made.

To print a Summary Report:

1. Click the **Print** button at the bottom of the review screen. A list of available reports pop up.
2. Select the **Summary Report** item.

### Reload (Patient Review)

Left click on **Reload** to update or refresh any events or trends that occurred since you entered the review display when you are connected to the Surveyor Central online database. Neither the events list nor trends will update or show new information until you select this button.



## 14. PATIENTS

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Use **Patients** to view the status of all monitoring sessions in progress and those that have been stopped. New patient demographics can be entered to allow quick and easy import for when the monitoring session is started. Monitoring sessions that have been archived will show in the Status column. The **Patients** button is disabled in the Surveyor Central repeater station.

Once selected, a window will open. Sort the list by any of the column headers such as Last Name, ID, Date of Birth, Start Time, Stop Time, ID Format, or Status. The sort field is indicated by a triangular symbol. To sort in reverse order, click the column header again. To sort by two headers, click on the first choice then press and hold the shift key and simultaneously click on the second sort column.

Using Bar code, you can automatically highlight a patient by scanning the bar code with your bar code reader. To do this, click on the bar code field, scan the code, and left click on **Confirm**.

You can click anywhere on a patient line to highlight and select it. Buttons at the bottom of the display window allow you to:

- Add **New** patient demographics to allow import of information when a monitoring session is started.
- **Modify** existing patients; add information or edit changes to the demographics. Double click on a patient and this modality will open automatically.
- **Delete** patient data or demographics from the Surveyor Central database.
- **Archive** monitoring sessions to a defined location on your network.

**NOTE:** Change column widths by dragging the header border left or right. If you size a column too small and it disappears, click on the edge and drag it over the border of the next column. This will reset all column widths to their default size.

**NOTE:** Delete is inactive when status is "Monitoring."

### New

Selecting **New** will open a window.

Select ID format from the drop-down list and enter the patient demographics. Left click **OK** to save your changes and return to the patient list. If **Cancel** is selected, you will return without any saved changes.

### Modify

**Modify** can be used to open a patient's demographics window to add to or change any of the demographic information. Left click **OK** to save your changes and return to the patient list. If **Cancel** is selected, you will return without any saved changes.

### Delete

**Delete** will remove **New** patient information that has been added, as well as patient data with a "Stopped" or "Archived" status from the database. Once done, the data cannot be retrieved. **Delete** is inactive if you have highlighted a patient that currently has a status of "Monitoring".

The system may be setup to require the configuration password in order to delete a patient. If you require this function, please ask a Welch Allyn representative.

## Archive

**Archive** will send all closed monitoring sessions of a highlighted patient to the destination defined in your system. If you highlight a patient that is currently being monitored, only the stopped monitoring sessions will be archived.

To archive all data up to the current time, go to the **Patient Data** Tab. Select **Stop** and then select **Same Patient** to immediately restart a new monitoring session. Go back to the patients list and select **Archive**.



**WARNING:** Protection of archived information sent to an off-line storage location is the responsibility of the customer who will provide correct storage and handling of data including regulation of access to this information.

**NOTE:** Archived data cannot be restored to your Surveyor Central. Archived data is typically used for acquisition at a Welch Allyn Surveyor Central review station, or an H-Scribe analysis system that has the Surveyor data analysis option.

## Session Management

### Moving a Patient

Through the patients list you can move a monitoring session to any other monitoring window on your system (i.e., move a patient from slot #14 to slot #2 or to any other networked control station):

1. From Patient Data window select the **Stop** monitoring button.
2. Click on a patient slot that is not currently being used (patient data window opens).
3. If the slot had previously been used by another patient, click on **New Patient**.
4. Click on **Start**.
5. Click on **Import** (patients list opens).
6. Highlight patient with the "Stopped" status.
7. Click on **OK**.

The previous closed session data is moved together with the patient to the new telemetry channel window.



**WARNING:** Alarm settings in the new monitoring session will be those of the chosen profile. Previous alarm settings for the patient are lost.

**NOTE:** Each window has a specific device or telemetry channel associated with it. Don't forget to exchange the device. If you don't, you may display data from a different patient.

### Multiple Sessions

In cases where the patient will return for multiple monitoring sessions, the same steps can be used for each session. This allows you to keep all the sessions together and you can review data and events in one location. Archive the data together as desired or when the last session has been completed.

## Blind Monitoring Sessions

When a **New** monitoring session is started, a “blind” session is opened. The blind session has no patient data associated with it; therefore, when you stop the monitoring session the data is LOST and there is no way to review it. For this reason, a warning message will prompt that “All data will be deleted. Are you sure?” when you choose the **Stop** monitoring button.

**NOTE:** Once a monitoring session has been assigned to a patient, it is not possible to assign it to another patient.

## Review

To review stored events or full-disclosure data for a single patient from the Patients menu, highlight the desired patient row and left click on **Review**.



## 15. SYSTEM CONFIGURATION

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Most system configuration parameters can be changed through the configuration screen. Some parameters can only be changed by Welch Allyn, Inc. authorized personnel. These parameters include number of patients visible on the screen, colors, text strings, storage configuration, control, data processing, maintenance services, IP addresses, configuration of networked nodes, etc.

System configuration is entered through **Config** in the bottom right portion of the display.

Your current system software version and the Surveyor Central serial number are displayed when the **Config** button is selected.

Further access into the configuration menu requires a password to ensure your system's security.



**CAUTION:** User actions can interrupt monitoring, destroy data, or change alarm modality. Use Config only if properly instructed and authorized.

**NOTE:** The password to access the configuration screen will be assigned to you by a Welch Allyn, Inc. representative.

The configuration screen is divided into several groups of functions.

- Beds
- Printers
- Volumes
- Alarms
- Display
- Signal Processing
- Passwords
- Management
- Users Setup

These functions are explained on the following pages.

All modifications made within the configuration menu will become active when **Confirm** is selected. All modifications will be cancelled, and the configuration that was in effect when you entered the screen will be reloaded when **Cancel** is selected.

**NOTE:** Each configuration group must be confirmed individually prior to selection of the next group item. If this is not done, your changes will not be saved.

**NOTE:** Beds, Display and Signals are the only functions available in a Surveyor Central repeater station.

### Beds

The **Default** column identifies factory set system configurations. The two numbers in parenthesis (1, 2) identify the receiver used and the unit ID number. This column is used by Welch Allyn maintenance personnel and cannot be changed.

This window allows you to define the **Name** of the telemetry transmitter displayed in the patient display window. Enter any name that will allow clinicians to identify the transmitter with the monitoring slot. It is recommended you clearly label all transmitters to prevent any mix up of patients and waveforms. Recorded data cannot be moved to another patient after monitoring has been started.

The **Type** column tells the system that all channels will receive data from a telemetry transmitter, or monitor. This column is factory defined and is not editable.

The last column has no function.

It is not possible to change channel numbers for monitor slots.

Once your changes have been made, left click **Confirm** to save your settings.

### Beds menu at a Surveyor Central Repeater Station

It is not possible to change bed names and telemetry channels.

Using the **Show** column check boxes in this menu, select the channels that are repeated at the repeater station screen.

### Printers

**Station List** was configured upon installation and reflects the computer names of your Surveyor Central. In the **First Printer** column, select the name of the network printer from the drop-down list where you want your 12-lead ECGs, rhythm strips, trends, etc. to print.

Define a **Second Printer** and all printouts will print to both devices simultaneously.

The **System Printer List** shows all printers defined for your system. Select **Paper Size** (A4 or letter) in the column to the right. To **Print Grid** on your printouts, select the check box. Note that grid is not printed on 5 mm/s rhythm strips.

In the lower portion, set the **Speed (mm/s)** you want for **12-lead ECG** printouts to 25 mm/s or 50 mm/s. With 50 mm/s, the 12-lead ECG will print on two separate pages.

Once your changes have been made, left click **Confirm** to save your settings.

### Volumes

**Day Alarms and Warnings:** It may be desirable to select higher volumes for alarms and warnings during the daytime hours.

**Night Alarms and Warnings:** It may be desirable to select lower volumes for alarms and warnings during the night time hours so resting patients are not disturbed.

Left click on the time in the **Start** column to change the time that begins your Daytime hours. Use the scroll arrows for hours, minutes, and seconds or use the keyboard to enter the desired military time. To change the time your Night time hours, begin, repeat these steps.

Choose the **Sound Level** for day and night. To hear an example of the volume, use the **Test Volume** drop-down list to hear each type of sound level.

In order to have low priority alarms sound, ensure that **Sound Low Priority Alarms** is checked. Uncheck this item to not have low priority alarms annunciate.



**CAUTION:** Setting a low level for the volumes may cause an alarm to be missed. Ensure volumes are appropriate for your situation.

Once your changes have been made, left click **Confirm** to save your settings.

## Alarms

Latch all yellow alarms by selecting the **All Yellow Alarms Latched** check box.

### Permanent (Latched) and Non-permanent (Non-latched) Alarms

Permanent (latching) means the audible alarm continues until the operator clicks or acknowledges the message to silence the alarm. Non-permanent (non-latching) means the alarm sound will disappear automatically shortly after the clinical condition is resolved.

**NOTE:** Yellow latched alarms will prevent yellow priority protocol steps from advancing without first acknowledging the yellow messages.

Permanent or non-permanent is a global configuration setting for all telemetry patients and cannot be changed for any individual. High-priority alarms are always permanent, except the Ventricular Tachycardia alarm; low-priority alarms are always non-permanent. When the check box **Red Alarms Always Enabled** is selected, all of the alarms marked as high priority will not be disabled when a clinician chooses to “Disable all alarms” (ALARMS OFF message is displayed) for an individual patient in the Alarm Settings tab.

When a minute duration (from 1 to 30 minutes) for **All Alarms Paused Duration (min)** has been selected, disabled alarms (ALARMS OFF message is displayed) will automatically become enabled after duration has been reached. A count-down timer will also appear in the patient sub-screen.



**CAUTION:** Transient alarm conditions may not be noticed if “Alarms Latched” is OFF especially if the automatic alarm printout is also disabled.

Check **Start with Alarms Paused** to start each monitoring session with all alarms paused, and to manually enable the alarms. This prevents unwanted alarm events while the monitoring is being started and the ST and ECG learning process is in progress. This setting is not possible if the duration is set to “Permanent”.

Once your changes have been made, left click **Confirm** to save your settings.

## Display

**Patient identified by** allows you to select the demographics that will show on the multi-patient and single-patient displays. Select either **ID** or **Name** from the drop-down list.

The default printout type for all monitored patients is defined by left clicking the print icon in the monitoring window. Choose Rhythm, Report, Trends, 12-lead, or 12-lead with Export depending on the available options in the **Default print type** drop-down list.

To show **Grid on MultiPatient screen**, left click the check box to the right of this selection.

To show **Grid on real time Traces screen**, left click the check box to the right of this selection.

To show **Grid on Review screen**, left click the check box to the right of this selection.

Once your changes have been made, left click **Confirm** to save your settings.

### Display menu at a Surveyor Central Repeater Station

The first check box of this menu has a different meaning at the repeater station. When Show Patient ID has been selected, the repeater station will show the patient identifier (name or ID) in the patient windows same as Surveyor Central.

## Signal Processing

ST delay (ms) is the time after the J-point (end QRS) where the ST measurement is made. It can be selected from the drop-down list and set anywhere from 10 ms to 200 ms, in 10 ms increments.

**NOTE:** Stop and restart patient monitoring to update the measurement point if ST delay is changed during the monitoring session.

Ensure that **AC Power Frequency (Hz)** is set to your local power frequency. To change setting, click on the drop-down list and select either 50 Hz or 60 Hz.

Once your changes have been made, left click **Confirm** to save your settings.

**NOTE:** The ST settings cannot be changed in a repeater station and are presented for informational purposes only.

## Passwords

Password settings allows you to change the existing configuration access password. Left click within the blank **Enter new password** field and type any desired password.

Retype the new password in the blank **Confirm new password** field. If it does not match, you will be prompted to retype the new password in both fields again.

Note you will be asked for the same password if you want to save a monitoring profile or delete a patient (if your system is set up for password-protected delete).

Once your changes have been made, left click **Confirm** to save your settings.

## Management

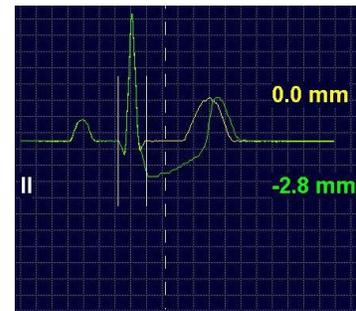
**Management Functions** will show buttons allowing you to **Import** and **Export** custom **ID Formats** from an E-Scribe system, and **Protocols** created through the Protocol Manager external application tools. The buttons are inactive if you do not have these options on your system.

Profiles that have been saved can also be exported to another networked Surveyor Central node.

## Import/Export

To Import or Export ID Formats, Import or Export Protocols, or Export Profiles, left click any of the buttons shown.

A window will prompt you to browse for the source (Import) or destination (Export) folder or networked location. Left click on folder or drive letter, then click **OK** and the data will automatically be imported or exported to the proper location.



**Figure 39** - ST delay is set to 60 ms after the J-point where ST measurement will be taken.



**Figure 40** - The Management Functions screen.

## Delete Saved Profiles, ID Formats, and Protocols

Delete saved profiles, protocols, or ID formats through the Delete drop-down lists.

Left click in the field to the right of Delete Profile, Delete ID Format, or Delete Protocol and a drop-down list will appear. Select the item you wish to remove from your system.

Once your changes have been made, left click **Confirm** to save your settings.

## User Setup

Settings in this window set up permissions for review station users that have online database access through the institution network and the Surveyor network security router.

### Review Users

Selection of User setup opens a window.

To add a new review user, type the user and domain names setup on the network and then click

**Add**. You can select any user and click on Delete to remove access.

### User-Authorized ID Formats

With user name highlighted, select ID Formats for the user from the drop-down list. User will only be allowed to access patient data with ID Formats chosen here.

You can also select ID Formats to remove access for the user.

### User Permissions for the ID Format

Choose the permissions allowed for the selected user by a left click on the check box next to the features desired.

- Create/Modify
- Delete
- Archive
- Review

Once all of the review users are configured, left click on **Save Changes** to save the settings.

Please refer to the Surveyor Central Review Station user manual (PN 9515-169-75-ENG) for more details about using the Review Station.

## Shutdown or Reboot Node

Surveyor Central workstations can be turned off or rebooted by selecting **Shutdown Node** or **Reboot Node** in the configuration window. Upon selection, you will be prompted for confirmation.

To cancel the shutdown or reboot, left click **No**.

To continue, left click **Yes** and the shutdown process will begin.

After a node reboot, workstations will automatically restart after the reset.

After a node shutdown, turn the Surveyor Central node back on by pressing the ON/OFF switch on the front side of the workstation. System will restart within a few minutes; any patient monitoring that was in progress will continue.



## 16. TROUBLESHOOTING FOR THE CLINICIAN

The following chart contains information to assist the clinician with troubleshooting by providing possible solutions. Whenever the suggested solutions do not resolve the issue, contact Welch Allyn technical support for assistance.

Trouble	Possible cause and solution
<b>Noisy ECG signal</b>	<ul style="list-style-type: none"> <li>• Check that patient is relaxed. Tension can cause muscular interference.</li> <li>• Check that all electrodes are securely attached to the patient's skin.</li> <li>• Check that there is no clothing rubbing or pulling on the lead wires or electrodes.</li> </ul>
<b>No ECG is displayed</b>	<ul style="list-style-type: none"> <li>• Check that "New patient" or "Same Patient" is selected in the Patient Data tab to begin monitoring.</li> <li>• Check that transmitter channel matches the window telemetry channel that has been set.</li> <li>• Check the telemetry transmitters are not outside the range of the WiFi network</li> </ul>
<b>Parameter values show question marks (? , ??, ???) or dashes (---)</b>	<ul style="list-style-type: none"> <li>• Check that transmitter is not out of range and is functional.</li> <li>• The parameter may be outside of a valid clinical range.</li> <li>• The parameter is disabled by the generating process (e.g., monitoring stopped or cardiac arrest).</li> <li>• The generating process is not able to generate the parameter because of technical problems.</li> </ul>
<b>Alarm: "Alarm Engine Error" and no ECG waveforms</b>	<ul style="list-style-type: none"> <li>• Waveform generating device has been turned off or disconnected from the network. Identify the faulty unit(s) and check whether they are functioning properly. Check to see that the network connection is present.</li> </ul>
<b>Faulty Alarms or Arrhythmias</b>	<ul style="list-style-type: none"> <li>• Check status of the patient.</li> <li>• Check that all electrodes are attached.</li> <li>• Check the QRS morphology to see if there is a change. If yes, select "Learn..." in the Traces tab and then select <b>Rhythm Relearn</b>. Note that selecting "<b>Relearn + New ST Ref</b>" will also reset the ST measurement reference.</li> <li>• Select Traces to display all 12 ECG leads. Determine best leads for detection, and then select Learn. Change detection lead 1 and/or detection lead 2 to leads that display the best amplitude and then select <b>Relearn Rhythm</b>.</li> <li>• Alarm thresholds may be set too low during periods of noisy signals.</li> <li>• QRS detection can be set to 300 <math>\mu</math>V when all leads have very low amplitude resulting in frequent false cardiac arrest alarms.</li> </ul>

Trouble	Possible cause and solution
<b>Absent ST segment values</b>	<ul style="list-style-type: none"> <li>• System is in process of learning ST and requires at least 16 normal beats.</li> <li>• The patient's rhythm is paced (P) or ventricular (V) or VFIB. ST analysis is not performed on these beats.</li> <li>• ST analysis is in process of "Relearn". The clinician has selected the Learn... button or the Relearn + New ST Ref button. An ST Relearn also occurs when there has been a change in the QRS morphology and a new dominant rhythm is learned.</li> <li>• A lead is in fail or both detection leads are in fail or there is radio signal interference. Check lead connections and any possible cause of RF interference.</li> </ul>
<b>Square Waves are showing on the display</b>	<ul style="list-style-type: none"> <li>• Check to see if a reduced lead set is being used for monitoring the patient. Unused leads appear as square waves.</li> <li>• Lead wires are disconnected. Attach the lead wire to the electrode.</li> <li>• Check to see if the "5 electrode cable" has been selected in the Patient Data window.</li> <li>• Check to see if a transmitter lead check is in progress.</li> <li>• Check surrounding area for any possible cause of RF interference.</li> <li>• Check to see that the connections between the ECG cable and the transmitter are secure.</li> </ul>
<b>SpO<sub>2</sub> signal is inadequate</b>	<ul style="list-style-type: none"> <li>• Check the SpO<sub>2</sub> sensor to ensure it is correctly positioned according to accompanying instructions.</li> <li>• SpO<sub>2</sub> sensors are susceptible to high ambient light. Shield the sensor when this could be the cause.</li> <li>• Excessive motion can affect the SpO<sub>2</sub> signal quality. Check the patient to see if this is the cause.</li> <li>• Check to see that the connections between the sensor cable and the transmitter are secure.</li> <li>• Check sensor and cables to ensure there are no cracks or breakage.</li> </ul>
<b>Faulty SpO<sub>2</sub> Alarms</b>	<ul style="list-style-type: none"> <li>• Check status of the patient.</li> <li>• Check that SpO<sub>2</sub> sensor is attached and correctly positioned according to accompanying instructions.</li> <li>• Check that the transmitter is turned on and in range.</li> <li>• Display the plethysmogram waveform to check signal quality.</li> <li>• Compare the SpO<sub>2</sub> pulse rate to the ECG heart rate values. Similar values are a good indication of adequate signal quality.</li> <li>• Check SpO<sub>2</sub> alarm threshold settings. Increase or decrease the limits according to patient condition status.</li> </ul>

The following table specifically applies to connectivity issues when using the Surveyor monitors:

Trouble	Possible cause and solution
<b>No Data from Monitor</b>	<ul style="list-style-type: none"> <li>• Confirm network connections on both the Surveyor monitor and Surveyor Central</li> <li>• Confirm Communication Settings on the Surveyor monitor including assigned network address information, central station name or address as well as port number.</li> <li>• Confirm that the proper bed and unit ID has been established</li> <li>• Confirm that the Surveyor monitor is actively monitoring a patient and not turned off or in standby mode.</li> </ul>
<b>Missing Parameter or Waveforms</b>	<ul style="list-style-type: none"> <li>• Confirm that the desired parameters and waveforms are available on the selected Surveyor monitor configuration</li> <li>• Confirm that patient cables and sensors are properly attached to the patient and monitor and that the parameter and waveforms are displayed on the Surveyor monitor display</li> <li>• Ensure that the Surveyor Central has been properly configured to display the parameters and traces</li> </ul>
<b>Missing ECG Traces</b>	<ul style="list-style-type: none"> <li>• Ensure that the proper ECG lead cable is utilized and enabled. The Surveyor monitor has options for 3 or 5 lead cable, as well as 10-lead ECG. When the 10-lead ECG cable is attached and enabled in the settings, this will be the default source for ECG signals</li> </ul>
<b>Drawing of waveforms sent from an S4 is jittery</b>	<ul style="list-style-type: none"> <li>• This may occur when there is a slight difference (less than 1 s) between the time kept on the S4's internal clock and that of the Surveyor Central. This condition is automatically corrected within 30 min of starting the S4, after which the waveforms should be drawn smoothly.</li> </ul>

The following table specifically applies to Surveyor Review Software:

Trouble	Possible Cause and Solution
Surveyor Review station does not connect to the Surveyor Central system (error message!!)	<ul style="list-style-type: none"> <li>• IP address for the Surveyor Central (= public address of firewall) is wrong or unreachable. Check the IP address ("Ping" should be used).</li> <li>• The firewall has not been installed correctly. Check that the used ports are open.</li> <li>• Surveyor Central is off or not connected to network. Consult your network administrator or Welch Allyn service personnel.</li> </ul>
Surveyor Review user is not allowed to review, delete, archive, or modify patient data on the Surveyor Central system (error message!!)	<ul style="list-style-type: none"> <li>• Check to see if the user has permissions (set by the Surveyor Central system administrator).</li> <li>• Define the user in the authorized list of Review users in the Surveyor Central configuration settings.</li> </ul>
Nothing happens when the Surveyor Review user clicks on an entry in the patient list.	<ul style="list-style-type: none"> <li>• The clock setting on the Surveyor Review station computer is one hour or more behind the Surveyor Central system.</li> <li>• Correct the clock time on the Surveyor Review computer.</li> </ul>

<p>Archived data that resides in a network folder cannot be accessed from the Surveyor Review station.</p>	<ul style="list-style-type: none"> <li>· The Surveyor Review computer is not in a Windows domain.</li> <li>· Use a computer that is in a Windows domain or copy the archived data onto a local drive.</li> </ul>
<p>12-lead resting ECG interpretation is present on ECGs printed from Surveyor Central archive but not present when printing a 12-lead ECG from an online Surveyor Central system.</p>	<ul style="list-style-type: none"> <li>· The Surveyor Central system does not have the 12- lead resting ECG interpretation option installed. The Surveyor Review interpretation option is valid for archived data only.</li> <li>· For online Surveyor Central database access, the option settings of the Surveyor Central take precedence.</li> <li>· An upgrade to the 12-lead VERITAS interpretation option on the Surveyor Central system is required.</li> </ul>
<p>Surveyor Review software locks up during installation.</p>	<ul style="list-style-type: none"> <li>· Check to see if a dongle is present. All dongles must be removed prior to software installation.</li> <li>· End the program "Haspdinst.exe" through the Windows task manager program.</li> <li>· Uninstall Surveyor Review through the Start -&gt; Programs -&gt; Surveyor Central Applications -&gt; Uninstall menus.</li> <li>· Repeat the installation steps.</li> </ul>

## 17. VERITAS ADVANCED ECG ALGORITHMS

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Computerized arrhythmia monitoring is a valuable tool in many situations; however, it is important that the user understands its limits so as to optimize performance and minimize false alarms.

Performance can be improved significantly by understanding the limits of the algorithm and its correct use. The most important parameters that affect performance are:

1. Signal quality
2. QRS-amplitude and form
3. T-amplitude and form
4. P-amplitude and form
5. Alarm limits

Welch Allyn's VERITAS algorithm uses 2 leads for QRS detection; a third lead is used for additional information to improve discrimination between ventricular and supraventricular morphology of the detected QRS. All available leads are used for the measurement of the ST level. Choosing the right detection leads is an important way of improving performance in difficult cases, and in particular for ambulatory patients.

### How to Optimize Performance

#### 1. Optimize signal quality.

Poor signal quality is always the most important cause for poor arrhythmia detection and false alarms, in particular for high HR and ventricular runs. There are measures that can be taken to improve signal quality:

- Skin preparation is very important. Degrease the skin and use skin-prep tools to remove resistive skin layers. Use the impedance measurement tool on the transmitter to check the electrode skin contact.
- Use good quality electrodes. Store them well in their original closed package and in the specified environmental conditions. Change applied electrodes every 24 hours as applied electrodes will dry out resulting in ECG baseline wander.
- Choose the right locations on the body to apply electrodes:
  - Do not apply them on muscles and areas that are often touched or handled. Refer to relevant figures in the user manual.
  - Pay particular attention to the LA/L and RA/R electrodes, which can pick up muscle noise from the shoulder or pelvic muscles. The LL/F electrode is also notorious: the best place is on the iliac crest, but sometimes the trouser or waist band can interfere and cause many artifacts. In that case, it may be best to move the position of the LL/F electrode to the lower ribcage.
  - It is important to realize that the 12-lead ECG can be significantly altered when the LL/F electrode is applied higher. The inferior part of the heart is not represented well; important ST changes in the inferior leads might be completely missed.
- Prevent pulling of the wires on the electrodes. Although the LeadForm ECG cable is ergonomically formed, pulling of electrodes can still occur. Position the transmitter properly and use a well-made pouch. When necessary, tape the electrodes or wires.
- Regularly check the ECG cable and lead wires. Replace any cable that is visibly damaged or stiff. Gently tug on all electrode-wire connections to check any broken wire that might make intermittent contact.
- If a lead remains particularly noisy, do not choose that lead as a detection lead (see below).

#### 2. Select the right detection leads.

Selecting the right leads for the detection algorithm is always important, but particularly so in patients with wide QRS complexes (bundle branch blocks, hypertrophic hearts, ventricular pacemakers). Wide QRS complexes are more difficult to detect by the algorithm, lower the threshold for false detections of P- and T-waves, and increase the probability of false ventricular fibrillation calls. The following general rules should be applied when selecting detection leads (in order of decreasing importance):

- Do not choose leads that are very noisy due to poor electrodecontact.
- Choose leads with adequate QRS amplitude (it is recommended 1 mV at least, although QRS complexes as low as 0.3 mV are detected). If all leads are of low amplitude causing false cardiac arrest calls, select the leads with the highest amplitude and set the QRS threshold to 0.16mV.
- Choose leads with a tall R-wave, which is not biphasic or even more irregular. This is particularly important when the QRS complex is wide.
- Do not choose leads with a tall, pointed T-wave. Sometimes it is tempting to choose, for example, V2 or V3 as a detection lead because of the high QRS amplitude; however, these leads also often present a tall T-wave. This might cause double detections and false high HRalarms.
- Do not choose leads with a large or pointed P-wave. Similar to the tall T-waves, these can cause double detections.
- Select the appropriate setting for “Pacemaker present”.



**WARNING:** Always select “Pacemaker present” when the patient has a pacemaker. Failure to do so can result in false QRS detection of the pacemaker spike and prevents the detection of pacemaker malfunction.

- The third lead, or “Confirmation Lead”, is less important for QRS detection. Choose a lead that is anatomically different from the detection leads (for example, if V2 and V4 are chosen as detection leads, do not use V3 as confirmation lead, but choose lead III). The default detection leads are V1 and V5, with Lead II as confirmation lead.

### 3. Adjust the alarm thresholds to patient conditions.

Incorrect alarm threshold settings are a frequent cause of false alarms and lower the attention level to the genuinely important alarms. It is important to choose the right thresholds for a particular patient and condition.

Examples are:

- Increase ST change thresholds for patients with a wide QRS or a pacemaker rhythm. ST levels vary in those conditions and are more difficult to measure.
- Do not choose a high HR limit that is too close to the normal HR of the patient. In particular, for patients with an irregular heart rate (e.g., atrial fibrillation) and for mobile patients the addition of some noisy beats might cause the alarm to occur frequently.
- Increase the minimum run length for the ventricular tachycardia alarm for ambulatory patients with a noisy signal. Noisy beats are easily mistaken for ventricular beats especially when preceded by a false detection. For patients with known short runs, it may not be useful to alarm on all of them as the clinician may become desensitized to the alarms. If you want to review whether the patient has short runs, activate the “Ventricular Run” alarm instead, with a low priority (e.g. white), and use the Review tab to quickly scan through them periodically. This will greatly reduce the number of false high priority alarms and reduce “alarm fatigue”.

## 18. ALARM DETAILS

This section concerns alarm settings for telemetry monitored patients and provides further and more detailed information on system criteria regarding alarms. The table below lists all telemetry monitoring alarms and their principle characteristics. Column definitions are:

<b>Message</b>	The alarm message displayed on the multi-patient screen, listed in alphabetical order
<b>Group</b>	The group to which the alarm belongs as used in the Alarm Settings page and the Review filter settings
<b>Description</b>	Detailed description of the cause of the alarm
<b>Factory Default Priority</b>	Priority set in the factory default alarm profile: Information (white), Low (Cyan), Medium (Yellow) or High (Red)
<b>Min. Limit</b>	Minimum value of possible limit settings, if applicable
<b>Max. Limit</b>	Maximum value of possible limit settings, if applicable
<b>Factory Default Limit</b>	Alarm limit set in the factory default profile
<b>Delay (s)</b>	Delay in seconds after which the alarm is presented. This delay presents the sum of signal filter delays, algorithm detection delays, delays inserted to prevent false alarms and any other processing delays. These values have been measured in reasonable worst-case conditions. Wherever applicable, the measuring methods mentioned in the ANSI/AAMI standard EC 13 have been used.

**Note:** Refer to the Surveyor S12/S19 patient monitor user manual for the list of alarms generated by these patient monitors which are bidirectionally communicated and managed by the Surveyor Central.

Message	Group	Description	Factory Default Priority	Range limits (resolution)	Factory Default Limit	Delay (s)
Alarms Engine Error	None	The alarm handler cannot be reached; no alarms will be generated. Cannot be silenced.	Medium			20
ALARMS OFF	All Alarms Off	All alarms are off or suspended	Information			-
Asystole	Electrocardiogram	Cardiac Arrest	High	2 – 8 sec (step 1 sec)	4 sec	Limit+2
Bigeminy	Extended Arrhythmias	A beat sequence of N, V, N, V, N, V has been detected	Information			3
Bradycardia	Electrocardiogram	Heart rate is more than 10 bpm below the Low Heart Rate limit*	High	10 bpm less than Low HR limit		8
Couplet	Extended Arrhythmias	2 successive ventricular beats	Information			4
Desaturation (S4)	SpO <sub>2</sub>	SpO <sub>2</sub> % is 10% below the Low SpO <sub>2</sub> set limit defined by the user	High	10% less than SpO <sub>2</sub> Low limit		18
Dominant Rhythm Change	Extended Arrhythmias	Very low correlation between the current beat and the incoming beats	Information			28
ECG Leads Off	Technical Alarms	One or more electrode is disconnected	Low			6
ECG Noise	Technical Alarms	ECG detection leads are noisy	Information			3
HD Full, No Storage	Technical Alarms	Data storage is disabled because the hard disk is full	Low			-
High Couplet Rate	Extended Arrhythmias	The number of ventricular couplets has reach the beat per minute limit	Information	2 – 30 bpm (step 2 bpm)	4 bpm	4

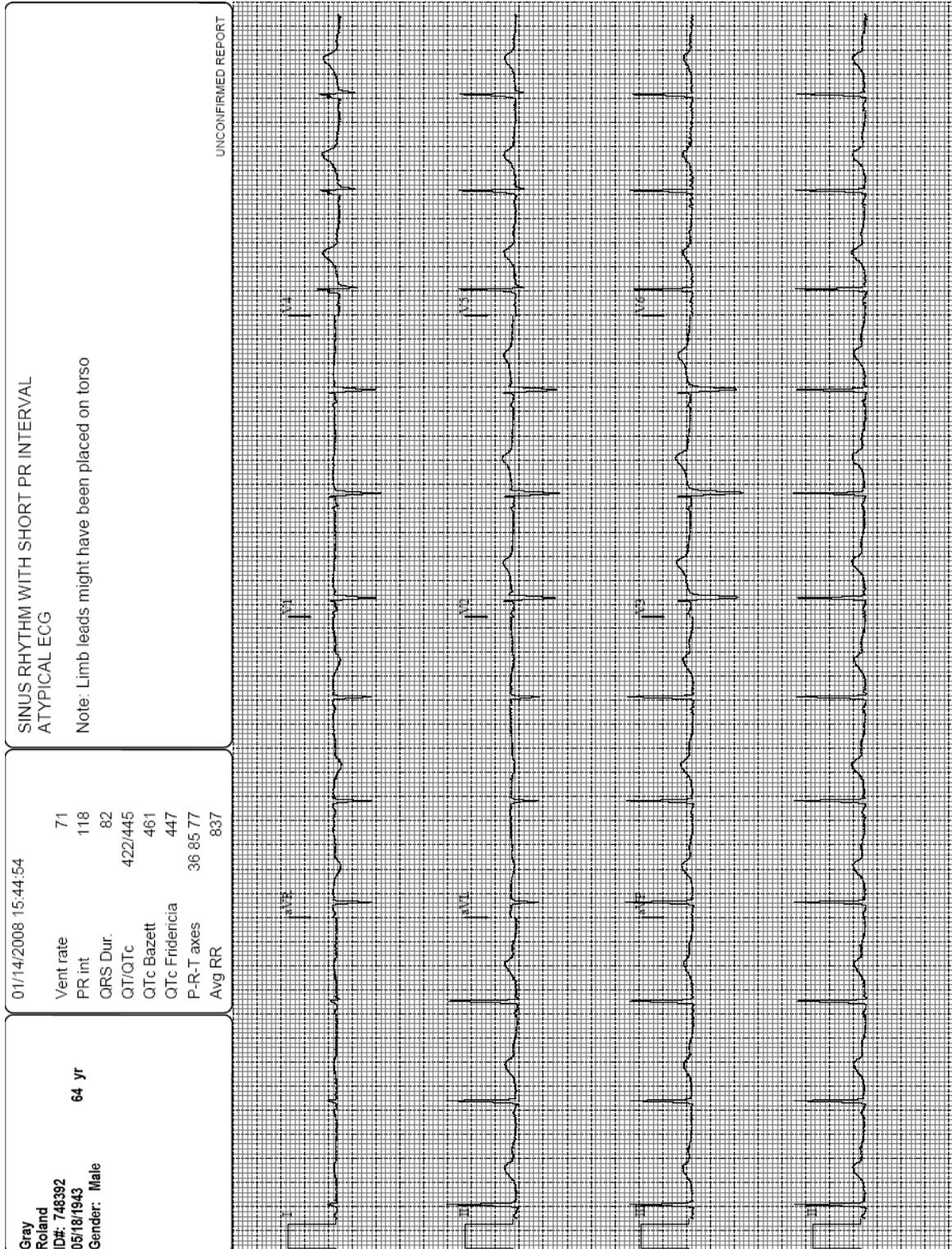
Message	Group	Description	Factory Default Priority	Range limits (resolution)	Factory Default Limit	Delay (s)
High Ectopic Rate	Extended Arrhythmias	Ventricular beats are above the beat per minute limit. Ectopic rate is not calculated during ventricular rhythm and ventricular fibrillation	Information	2 – 50 bpm (step 2 bpm)	10 bpm	3
High Failure Rate	Extended Arrhythmias	Pacemaker output failures have reached the limit	Information	2 – 30 bpm (step 2 bpm)	4 bpm	5
High Heart Rate	Electrocardiogram	Heart rate is above the maximum limit	Medium	50 – 250 bpm (step 1 bpm)	120 bpm	10
High Non-Capture Rate	Extended Arrhythmias	Pacemaker non-capture rate has exceeded the limit	Information	2 – 30 bpm (step 2 bpm)	4 bpm	5
High Pause Rate	Extended Arrhythmias	Missing QRS complexes have reached the limit	Information	2 – 30 bpm (step 2 bpm)	4 bpm	4
High R-on-T Rate	Extended Arrhythmias	The number of ventricular R-on-T beats have reached the limit	Information	2 – 50 bpm (step 2 bpm)	2 bpm	3
HR Not Available	Technical Alarms	Heart rate is not received by the system for a period of time	Medium			12
Impedance Test	Technical Alarms	Transmitter impedance check is in progress	Information			2
Invalid Channel	Technical Alarms	Telemetry channel setting is incompatible	Low			-
Irregular Rhythm	Extended Arrhythmias	The rhythm of the ECG is irregular for more than a minute	Information			23
Low Battery	Technical Alarms	The transmitter battery is low	Information			32
Low Heart Rate	Electrocardiogram	Heart rate is below the minimum limit	Medium	20 – 150 bpm (step 1 bpm)	50 bpm	10
Low QRS Voltage	Extended Arrhythmias	QRS voltage is below 1.5 times that of the detection threshold	Information			4
Low Storage, Deleting...	Technical Alarms	No storage is available, system is deleting old stopped sessions	Low			-
Low System Battery	Technical Alarms	The system battery is low and the node is shutting down (UPS related)	Information			1
Missing QRS	Extended Arrhythmias	R-R interval is greater than or equal to 180% of the average R-R interval	Information			4
Multifocal Ectopics	Extended Arrhythmias	Ventricular beats with different morphologies have been detected within the last "limit" beats	Information	3 – 31 bpm (step 1 bpm)	15 bpm	3
New ST Reference	ST Change	A new ST reference has been set	Information			-
No AC Power	Technical Alarms	System is running on battery power (UPS related)	Information			6
No ECG Monitoring	Technical Alarms	Valid ECG signal has not been detected for a period of time	Medium			12
No Radio Signal	Technical Alarms	The transmitter is out of range or switched off	Information			2
Pacemaker Non-Capture	Extended Arrhythmias	No QRS complex is detected within 300 ms after a pacemaker spike	Information			5
Pacemaker Output Failure	Extended Arrhythmias	No QRS complex or Paced beat has been detected for the time equivalent to the set pacemaker rate	Information			5

Message	Group	Description	Factory Default Priority	Range limits (resolution)	Factory Default Limit	Delay (s)
Patient Call	Technical Alarms	A transmitter button has been pressed	Information			2
Printer Error	Technical Alarms	The network printer is in error (e.g. out of paper)	Low			16
Printer Offline	Technical Alarms	The network printer is off line	Low			16
Protocol Aborted	Protocol Events	The protocol has been cancelled	Information			-
Protocol Completed	Protocol Events	The protocol has completed	Information			-
(Protocol Event)	Protocol Events	User customized message indicating an event for the Protocol in progress	Low			1
(Protocol Phase) End	Protocol Events	The last event from the in progress protocol phase; latching alarm	Low			1
Pulse Rate High (S4)	SpO <sub>2</sub>	Pulse rate is above the maximum limit	Low	50 – 250 bpm (step 5 bpm)	120 bpm	23
Pulse Rate Low (S4)	SpO <sub>2</sub>	Pulse rate is below the minimum limit	Low	20 – 100 bpm (step 2 bpm)	50 bpm	23
QTc High	Resting ECG	QTc (Welch Allyn correction) above limit	Low	300 – 600 ms (step 10 ms)	500 ms	70
QTc-Bazett High	Resting ECG	QTc (Bazett correction) above limit	Low	300 – 600 ms (step 10 ms)	500 ms	70
QTc-Fridericia High	Resting ECG	QTc (Fridericia correction) above limit	Low	300 – 600 ms (step 10 ms)	500 ms	70
Radio Interference	Technical Alarms	The telemetry receiver is receiving signals from another source	Information			2
Receiver Error	Technical Alarms	Receiver initialization failed (presents a number from 1 to 6 for service)	Low			-
Repairing Database	Technical Alarms	Database is corrupt and is being repaired. No storage during repair.	Low			-
Rest ECG Taken	Resting ECG	A Resting ECG has been taken	Information			-
Rhythm Relearn	Electrocardiogram	The system is learning the rhythm type (dominant QRS type)	Information			-
R-on-T Beat	Extended Arrhythmias	Detected Ventricular beats occur earlier than half of the previous R-R interval	Information			3
SpO <sub>2</sub> Check Sensor (S4 only)	Technical Alarms	The probe is no longer applied to the patient.	Low			12
SpO <sub>2</sub> Communication Error	Technical Alarms	A technical fault has been detected in the S4.	Low			40
SpO <sub>2</sub> High (S4)	SpO <sub>2</sub>	% SpO <sub>2</sub> is above the set limit	Medium	52 – 100% (step 1%)	100%	18
SpO <sub>2</sub> Low (S4)	SpO <sub>2</sub>	% SpO <sub>2</sub> is below the set limit	Medium	50 – 98% (step 1%)	90%	18
SpO <sub>2</sub> Low Quality	Technical Alarms	The SpO <sub>2</sub> signal is weak or noisy.	Information (from S4) Low (other devices)			10
SpO <sub>2</sub> Noise	Technical Alarms	The SpO <sub>2</sub> signal is degraded by noise and/or motion artifact, so that % SpO <sub>2</sub> and PR cannot be calculated.	Low			30

Message	Group	Description	Factory Default Priority	Range limits (resolution)	Factory Default Limit	Delay (s)
SpO <sub>2</sub> Not Available	Technical Alarms	No valid SpO <sub>2</sub> signal is available and there is no probe fault detected; probe may not be applied to the patient	Low			30
SpO <sub>2</sub> Pulse Search	Technical Alarms	Searching for valid SpO <sub>2</sub> signal	Information			11
SpO <sub>2</sub> No Sensor	Technical Alarms	SpO <sub>2</sub> sensor has been detached from the monitor/transmitter NOTE: When used with the S4, acknowledging this alarm suspends SpO <sub>2</sub> monitoring.	Low			7
SpO <sub>2</sub> Sensor Error	Technical Alarms	A technical fault in the sensor has been detected.	Low			15
ST Decrease	ST Change	ST decrease with respect to the ST reference level above the limit in one lead or greater than 70% of the limit in more than one lead simultaneously	Medium	1.0 – 9.0 mm (step 0.5 mm)	2.0 mm	80
ST Increase	ST Change	ST increase with respect to the ST reference level above the limit in one lead or greater than 70% of the limit in more than one lead simultaneously	Medium	1.0 – 9.0 mm (step 0.5 mm)	2.0 mm	80
ST Relearn	ST Change	The system is initializing the ST level measurement	Information			-
Storage Disabled	Technical Alarms	Data storage is disabled because the storage system is unavailable	Low			-
Storage Space <24 hr	Technical Alarms	Less than 24 hours of storage space is available on the storage disk	Low			-
Sustained VTACH	Ventricular Tachycardia	Sustained Ventricular Tachycardia with a duration of more than 15 sec	High		15 sec	18
Synchronizing Clock	Technical Alarms	The local clock is not in synch with the time server and the system is synchronizing	Information			-
Tachycardia	Electrocardiogram	Heart rate is more than 30 bpm above the High Heart Rate limit	High	30 bpm more than High HR limit		8
Trigeminy	Extended Arrhythmias	A beat sequence of N, N, V, N, V, N, N, V has been detected	Information			3
Ventricular Rhythm	Extended Arrhythmias	3 or more successive ventricular beats with rate below the VTACH rate limit and no VTACH alarm	Information			3
Ventricular Run	Extended Arrhythmias	3 or more successive ventricular beats with rate above the VTACH rate limit have been detected and no VTACH alarm <b>Note:</b> If the total run is less than VRUNLENGTH beats it will not be reported until it ends.	Information			VTACH length beats + 2 s
VFIB	Electrocardiogram	Ventricular Fibrillation	High			8
VTACH	Ventricular Tachycardia	Ventricular Tachycardia with a duration of more than the number of beats limit and above the rate limit.	Medium	3 – 100 beats (step 1 beat) 100 – 200 bpm (step 1 bpm)	10 beats, 120 bpm	8

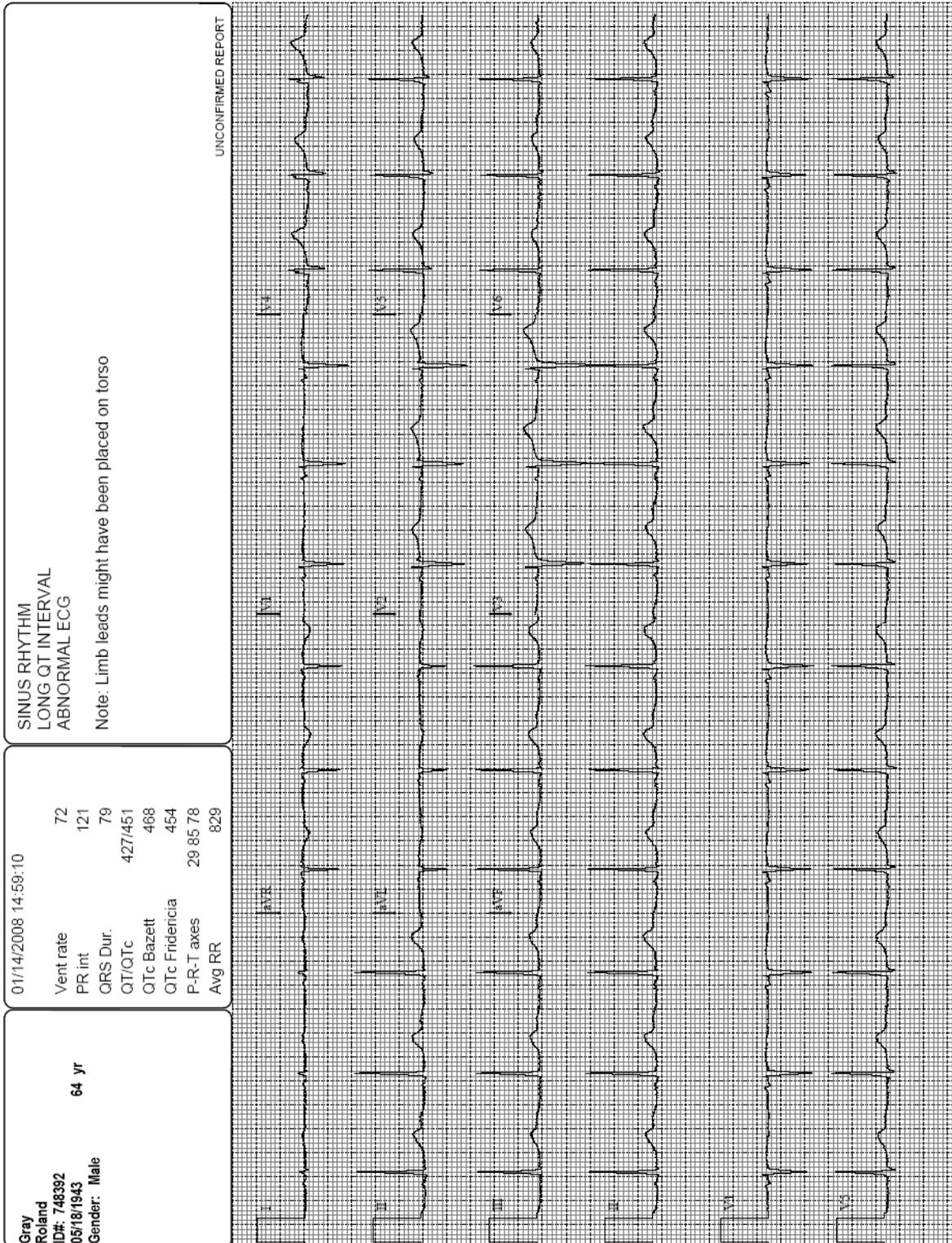
# 19. TELEMETRY MONITORING PRINTOUT EXAMPLES

## 12-lead ECG with Interpretation, 4x3+1 Format with Grid



Hospital

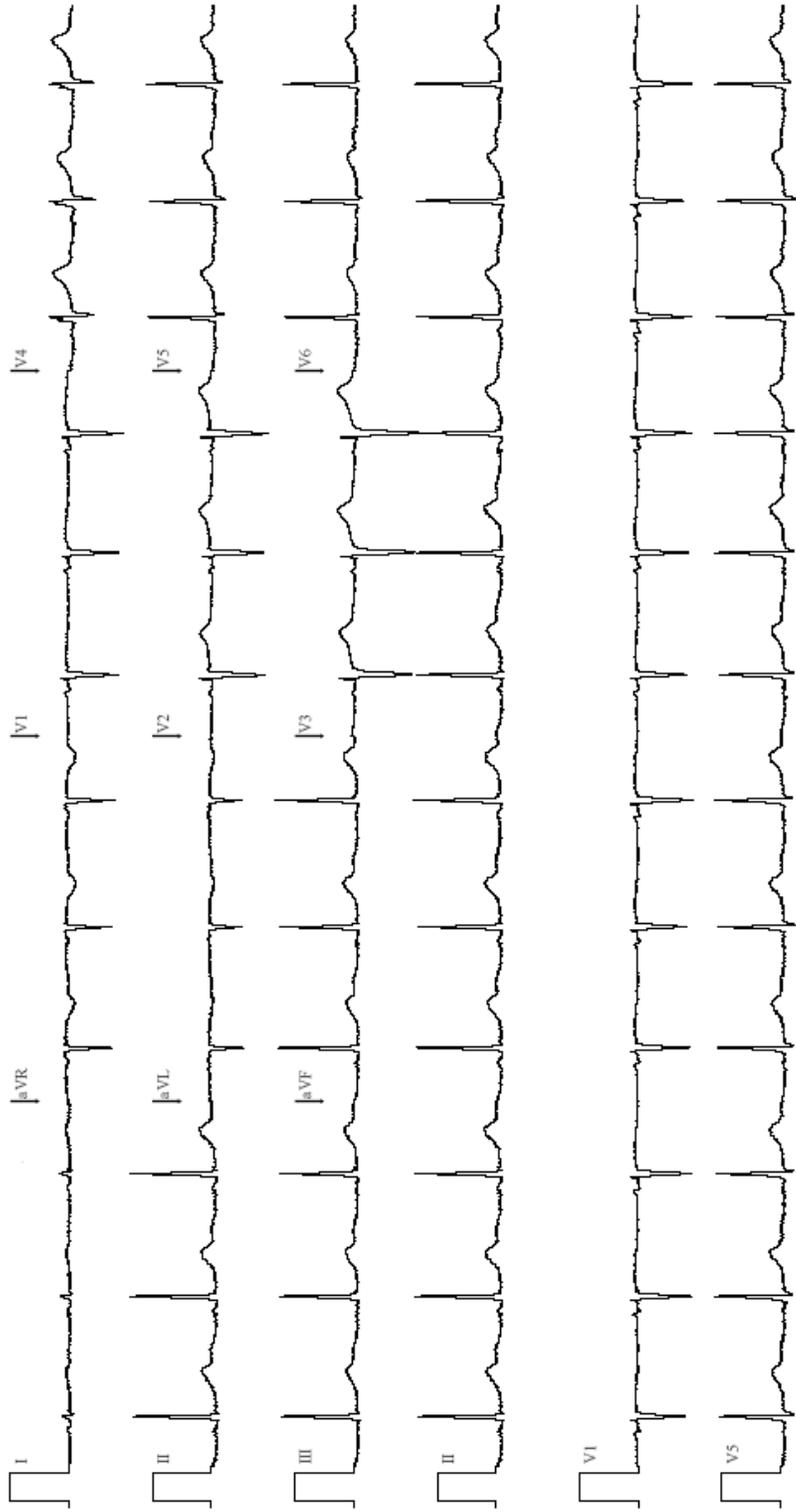
12-lead ECG with Interpretation, 4x3+3 Format with Grid



Hospital

## 12-lead ECG without Interpretation and Grid, 4x3+3 Format

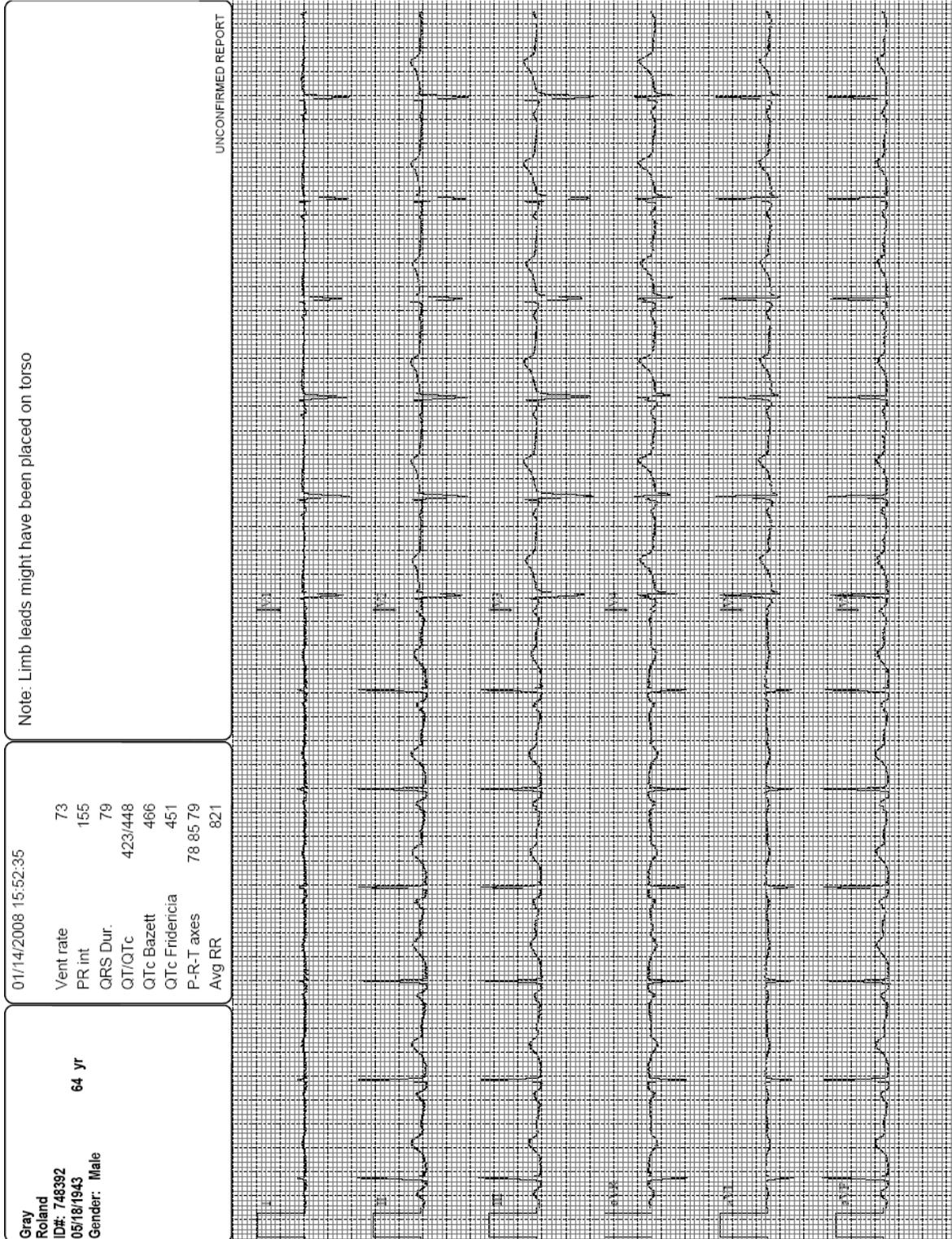
Gray Roland ID#: 748392 05/18/1943 Gender: Male	64 yr	01/14/2008 14:59:10 Vent rate 72 PR int 121 QRS Dur. 79 QT/QTc 427/451 QTc Bazett 468 QTc Fridericia 454 P-R-T axes 29 85 78 Avg RR 829	Note: Limb leads might have been placed on torso	UNCONFIRMED REPORT
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ECG: 10 mm/mV, 25 mm/s, Site#0, Tele 8, [0.05 - 150]

Hospital

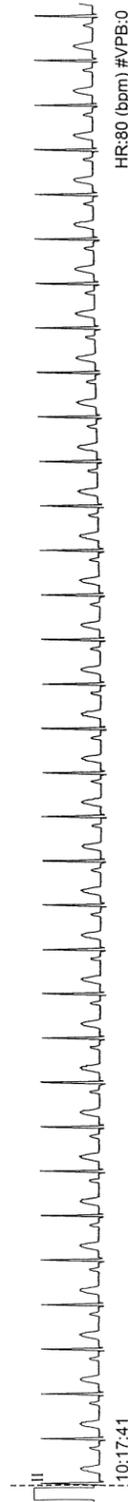
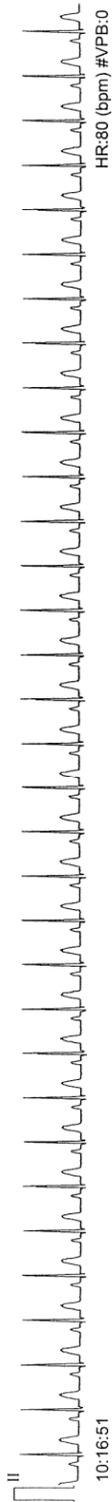
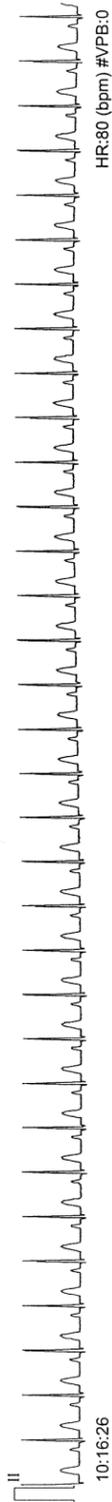
12-lead ECG without Interpretation, 6x2 Format with Grid



Hospital

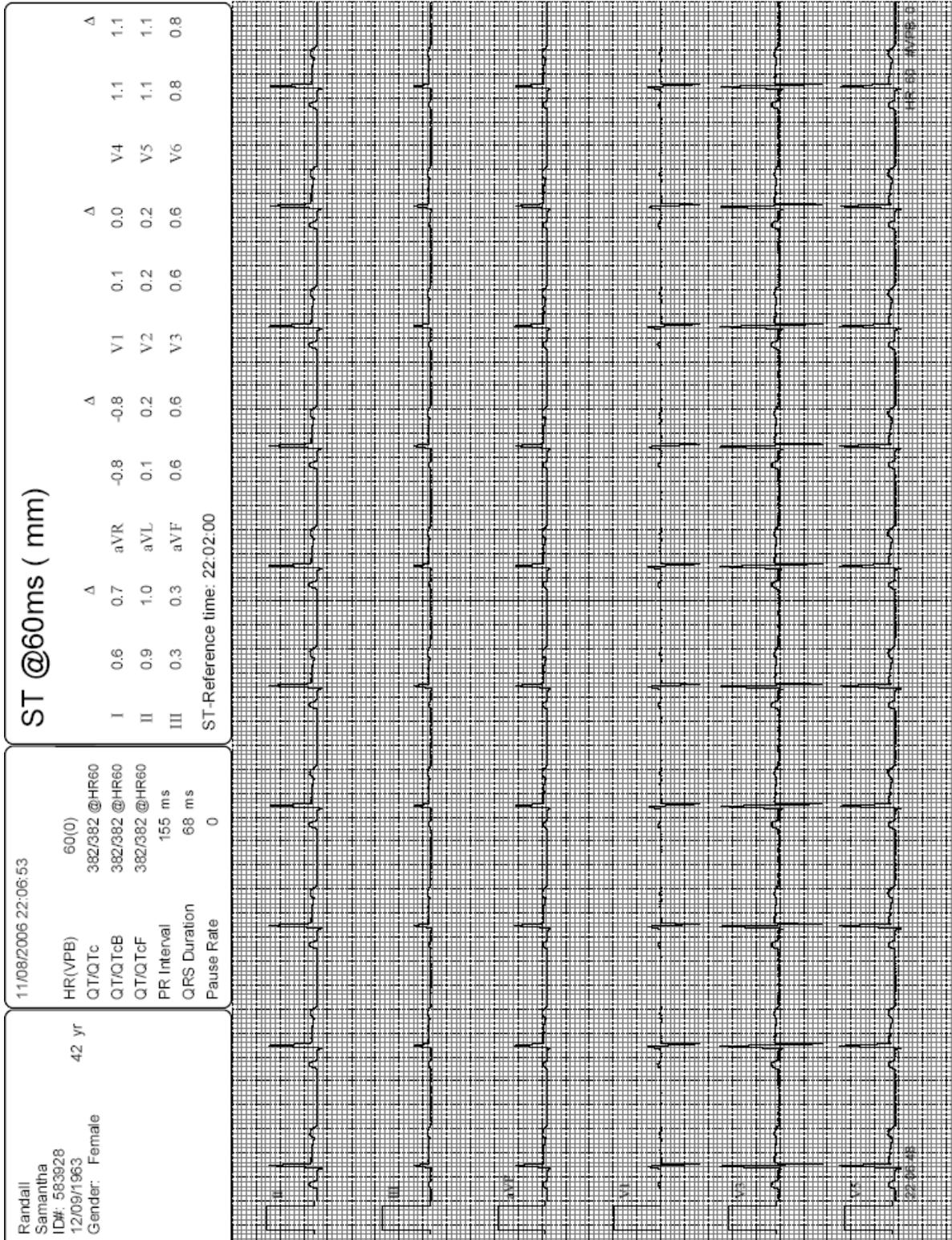
### Single lead ECG, no grid

<b>Doe</b> John ID#: Patient 01/01/1981 Gender: Male Height: 178 Weight: 70		<b>15/12/2015 10:17:41</b> HR(VPB) 80(0) (bpm) Pace Non-Capture 0 (/min) Pace Output Failure 0 (/min) Pause Rate 0 (/min) R-on-T Rate 0 (/min) Couplet Rate 0 (/min)	
34 yr		HR (bpm)	
		VPB (bpm)	
		0 20 40 60 80	
		07:30 08:00 08:30 09:00 09:30 10:00	



ECG: 10 mm/mV, 10 mm/s, Site#0, Bed# (2,0), [0.05 - 150]

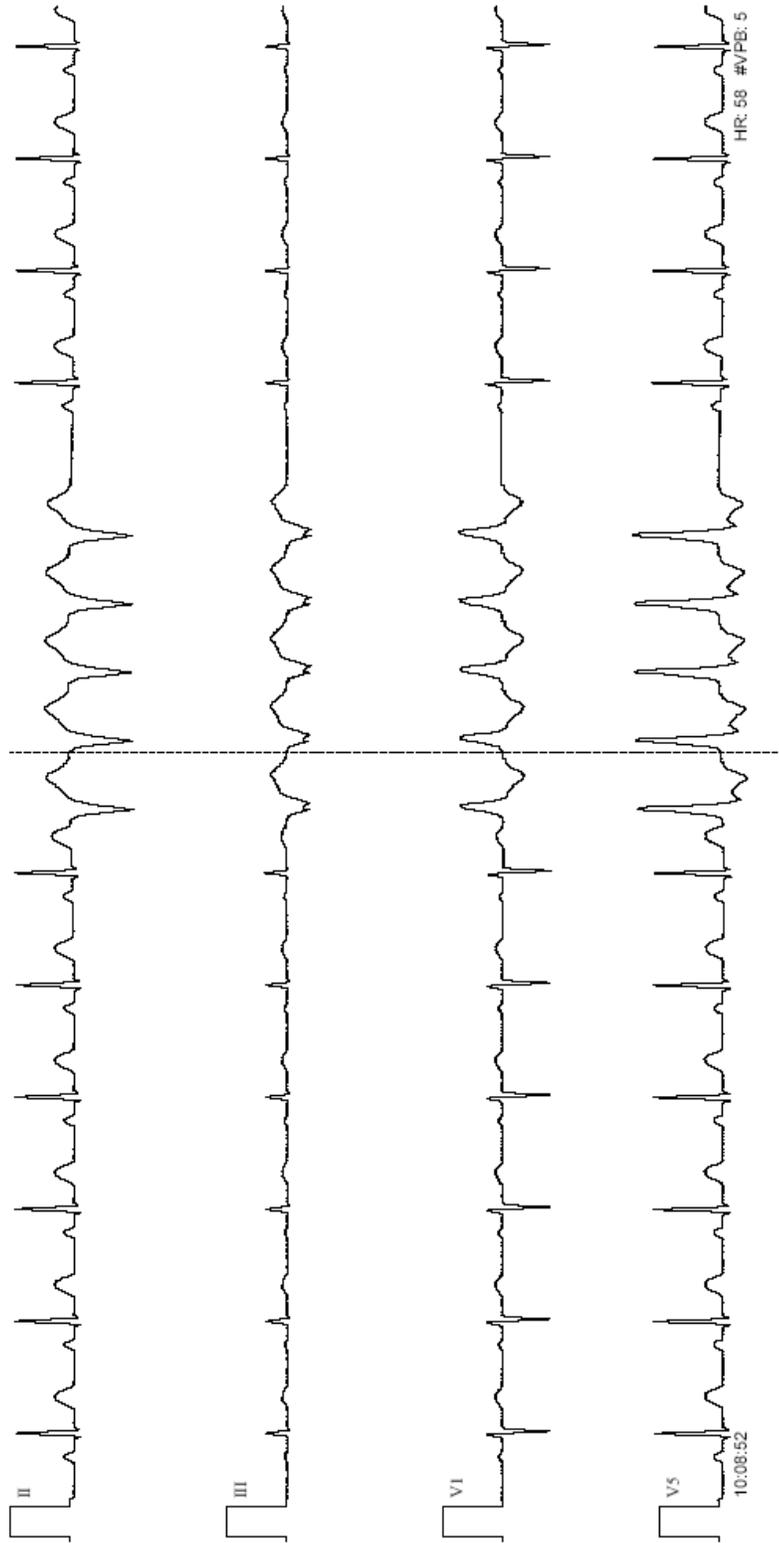
Rhythm (user-defined leads and parameters) with Grid



St. Mary's Hospital  
ECG: 10 mm/mV, 25 mm/s, Site# 0, Tele 1: (1,0), [0.05 - 150]

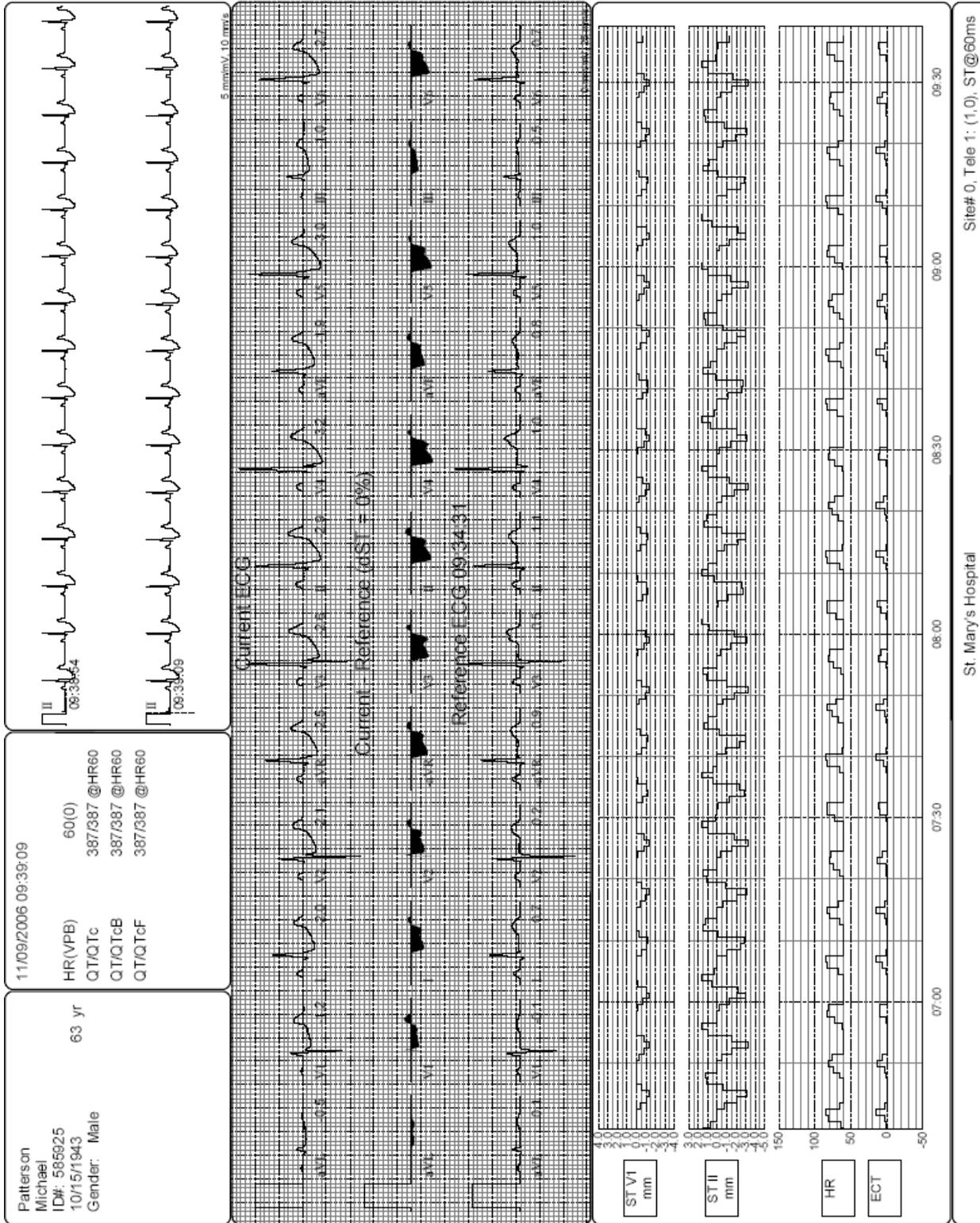
Rhythm (user-defined leads and parameters) without Grid

Patterson Michael ID#: 585925 10/15/1943 Gender: Male	11/09/2006 10:08:57 HR(VPB) 82(5) QT/QTc 365/400 @HR80 QT/QTcB 365/421 @HR80 QT/QTcF 365/401 @HR80 PR Interval 159 ms QRS Duration 84 ms	<b>ST @60ms ( mm)</b> <table border="1"> <thead> <tr> <th></th> <th>I</th> <th>II</th> <th>III</th> <th>aVR</th> <th>aVL</th> <th>aVF</th> <th>V1</th> <th>V2</th> <th>V3</th> <th>V4</th> <th>V5</th> <th>V6</th> <th>Δ</th> </tr> </thead> <tbody> <tr> <td>Δ</td> <td>-0.1</td> <td>-0.0</td> <td>0.0</td> <td>0.1</td> <td>-0.1</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>2.5</td> <td>0.0</td> <td>3.4</td> <td>0.0</td> <td>0.0</td> </tr> <tr> <td>Δ</td> <td></td> <td>4.1</td> </tr> <tr> <td>Δ</td> <td></td> <td>3.8</td> </tr> <tr> <td>Δ</td> <td></td> <td>3.5</td> </tr> </tbody> </table> ST-Reference time: 09:39:28		I	II	III	aVR	aVL	aVF	V1	V2	V3	V4	V5	V6	Δ	Δ	-0.1	-0.0	0.0	0.1	-0.1	0.0	0.0	0.0	2.5	0.0	3.4	0.0	0.0	Δ													4.1	Δ													3.8	Δ													3.5
	I	II	III	aVR	aVL	aVF	V1	V2	V3	V4	V5	V6	Δ																																																											
Δ	-0.1	-0.0	0.0	0.1	-0.1	0.0	0.0	0.0	2.5	0.0	3.4	0.0	0.0																																																											
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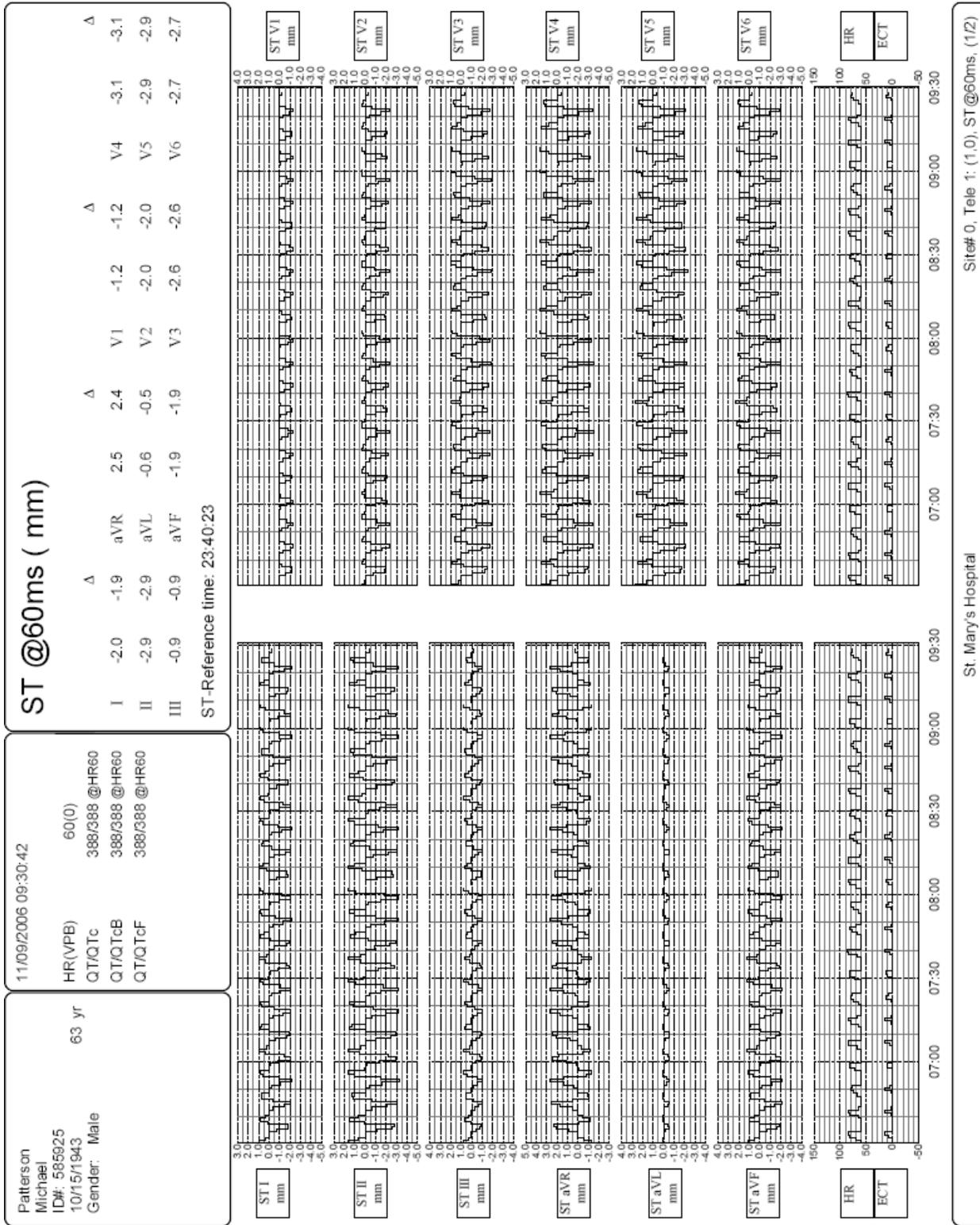


St. Mary's Hospital ECG: 10 mm/mV, 25 mm/s, Site# 0, Tele 1: (1,0), [0.05 - 150]

ST Report: 20 seconds of current ECG, Averaged ST of current ECG compared to reference ECG, ST trend for 3 hours, HR, and Ectopy

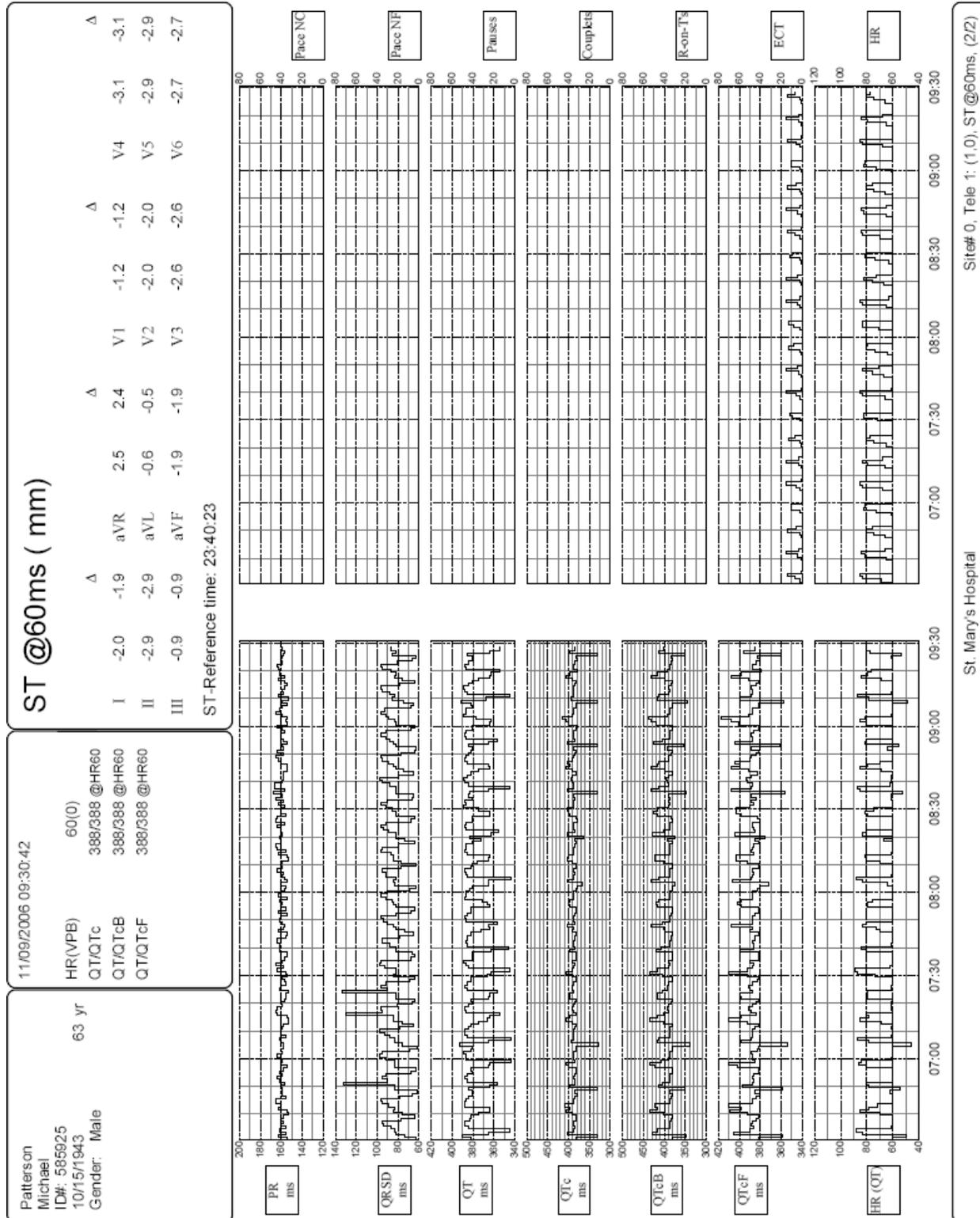


Trend – Page 1: ST change, HR, and Ectopy



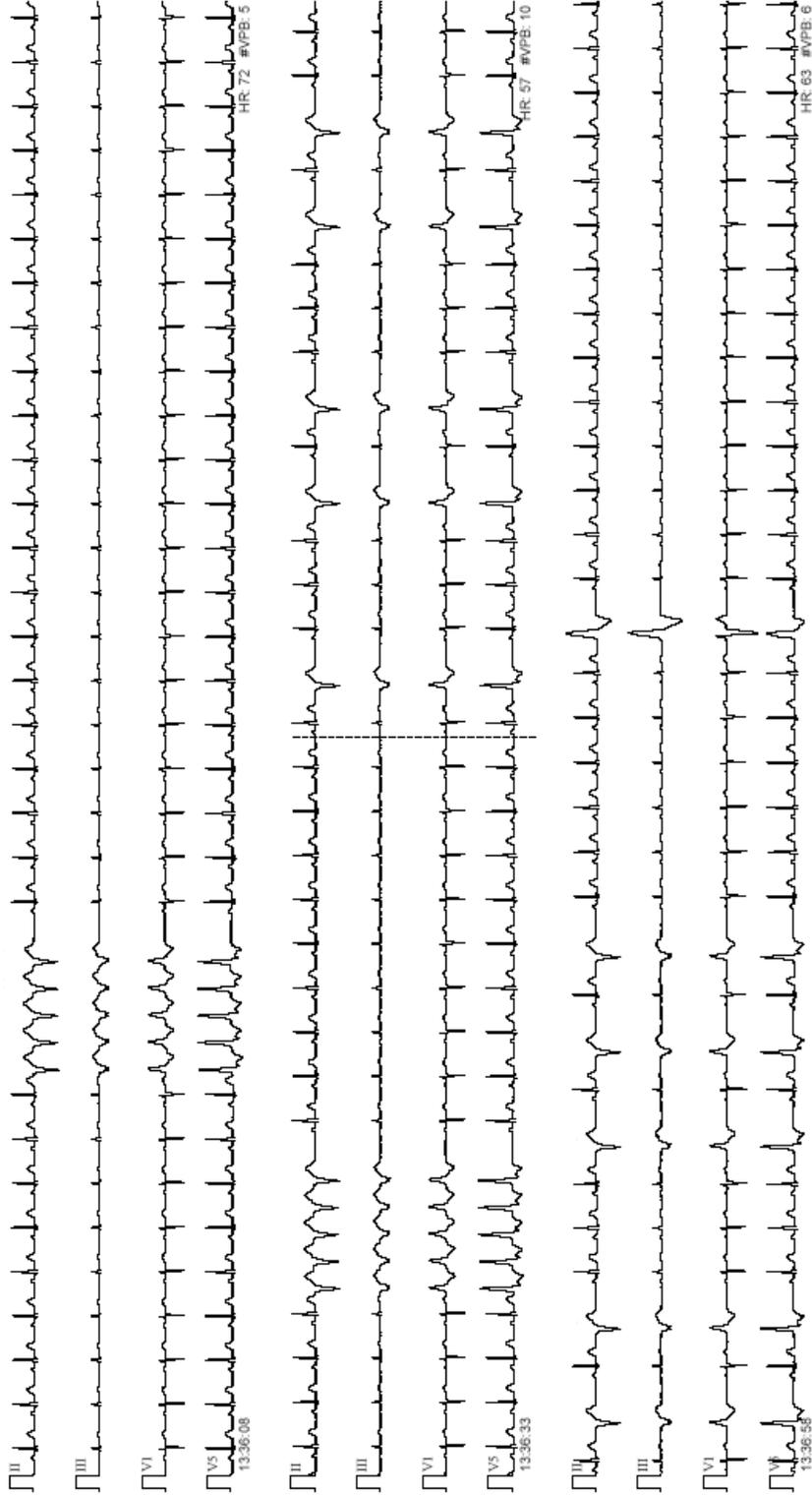
Trend – Page 2: ST change HR, Ectopy, Intervals, QT and QTc

(Note: Page 2 trends are user selected)



Review Screen Print, sample 1: 180 seconds of leads II, III, V1, and V5

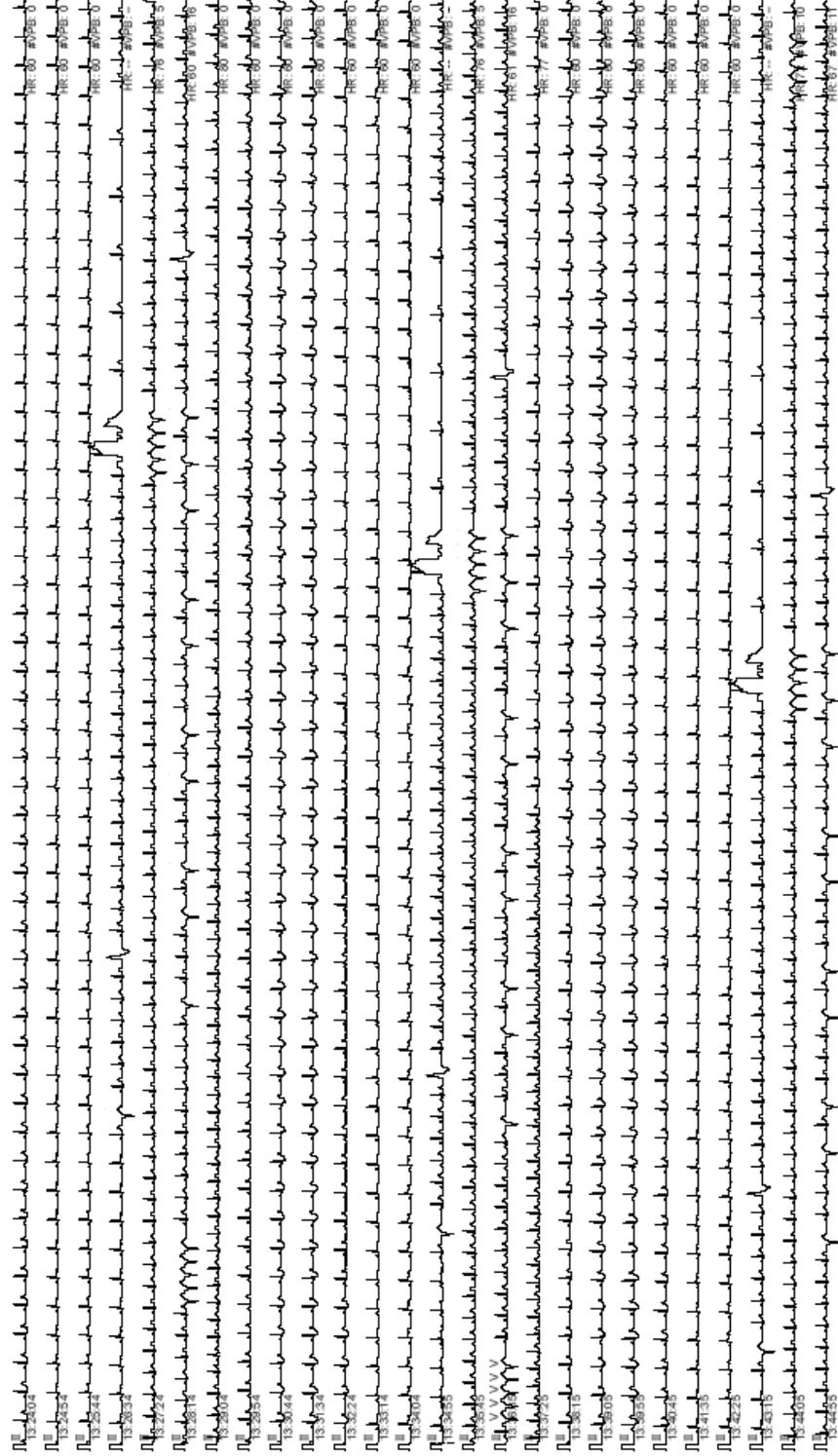
Wolff Jonathan ID#: 382952 05/18/1943 Gender: Male	11/06/2006 13:36:46 HR(VPB) 89(10) QT/QTc 362/412 @HR93 QT/QTcB 362/450 @HR93 QT/QTcF 362/418 @HR93	<b>ST @60ms ( mm)</b> <table border="1"> <thead> <tr> <th></th> <th><math>\Delta</math></th> <th>aVR</th> <th>0.1</th> <th>V1</th> <th><math>\Delta</math></th> <th>V4</th> <th><math>\Delta</math></th> </tr> </thead> <tbody> <tr> <td>I</td> <td>-0.1</td> <td>-0.0</td> <td>0.1</td> <td>0.1</td> <td>0.0</td> <td>0.1</td> <td>0.0</td> </tr> <tr> <td>II</td> <td>-0.0</td> <td>-0.0</td> <td>-0.1</td> <td>-0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> </tr> <tr> <td>III</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>-0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> </tr> </tbody> </table> ST-Reference time: 11:15:44		$\Delta$	aVR	0.1	V1	$\Delta$	V4	$\Delta$	I	-0.1	-0.0	0.1	0.1	0.0	0.1	0.0	II	-0.0	-0.0	-0.1	-0.0	0.0	0.0	0.0	III	0.0	0.0	0.0	-0.0	0.0	0.0	0.0
	$\Delta$	aVR	0.1	V1	$\Delta$	V4	$\Delta$																											
I	-0.1	-0.0	0.1	0.1	0.0	0.1	0.0																											
II	-0.0	-0.0	-0.1	-0.0	0.0	0.0	0.0																											
III	0.0	0.0	0.0	-0.0	0.0	0.0	0.0																											



Ventricular Run 13:36:46 11/06/2006 St. Mary's Hospital ECG: 4 mm/mV, 10 mm/s, Site# 0, Bed# 4: (1,4), [0.05 - 150]

Review Screen Print, sample 2: 780 seconds of lead II only

Randall Samantha ID#: 583928 12/09/1963 Gender: Female	11/06/2006 13:34:55 HR(VPB) 60(0) QT/QTc 380/380 @HR60 QT/QTcB 380/380 @HR60 QT/QTcF 380/380 @HR60 PR Interval 164 ms QRS Duration 66 ms Pause Rate 0	<b>ST @60ms ( mm)</b> <table border="1"> <thead> <tr> <th></th> <th><math>\Delta</math></th> <th>0.6</th> <th>0.7</th> <th>aVR</th> <th>-0.8</th> <th><math>\Delta</math></th> <th>0.0</th> <th>0.0</th> <th>V1</th> <th>0.0</th> <th><math>\Delta</math></th> <th>0.0</th> <th>V4</th> <th>1.1</th> <th><math>\Delta</math></th> <th>1.1</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>0.6</td> <td>0.7</td> <td>aVR</td> <td>-0.8</td> <td><math>\Delta</math></td> <td>0.0</td> <td>0.0</td> <td>V1</td> <td>0.0</td> <td><math>\Delta</math></td> <td>0.0</td> <td>0.0</td> <td>V4</td> <td>1.1</td> <td><math>\Delta</math></td> <td>1.1</td> </tr> <tr> <td>II</td> <td>1.1</td> <td>1.1</td> <td>aVL</td> <td>0.1</td> <td>0.1</td> <td>V2</td> <td>0.2</td> <td>0.3</td> <td>V5</td> <td>1.0</td> <td>1.1</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>III</td> <td>0.5</td> <td>0.5</td> <td>aVF</td> <td>0.8</td> <td>0.8</td> <td>V3</td> <td>0.6</td> <td>0.5</td> <td>V6</td> <td>1.6</td> <td>0.8</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> ST-Reference time: 11:15:43		$\Delta$	0.6	0.7	aVR	-0.8	$\Delta$	0.0	0.0	V1	0.0	$\Delta$	0.0	V4	1.1	$\Delta$	1.1	I	0.6	0.7	aVR	-0.8	$\Delta$	0.0	0.0	V1	0.0	$\Delta$	0.0	0.0	V4	1.1	$\Delta$	1.1	II	1.1	1.1	aVL	0.1	0.1	V2	0.2	0.3	V5	1.0	1.1						III	0.5	0.5	aVF	0.8	0.8	V3	0.6	0.5	V6	1.6	0.8					
	$\Delta$	0.6	0.7	aVR	-0.8	$\Delta$	0.0	0.0	V1	0.0	$\Delta$	0.0	V4	1.1	$\Delta$	1.1																																																						
I	0.6	0.7	aVR	-0.8	$\Delta$	0.0	0.0	V1	0.0	$\Delta$	0.0	0.0	V4	1.1	$\Delta$	1.1																																																						
II	1.1	1.1	aVL	0.1	0.1	V2	0.2	0.3	V5	1.0	1.1																																																											
III	0.5	0.5	aVF	0.8	0.8	V3	0.6	0.5	V6	1.6	0.8																																																											



VTACH > 5, 120 (beats/bpm) 09:30:34 11/06/2006 St. Mary's Hospital ECC: 2 mm/mV, 5 mm/s, Site# 0, Tele 1: (1,0), [0.05 - 150]

Review Screen Print; sample 3: 12-Lead ECG at 10 mm/s

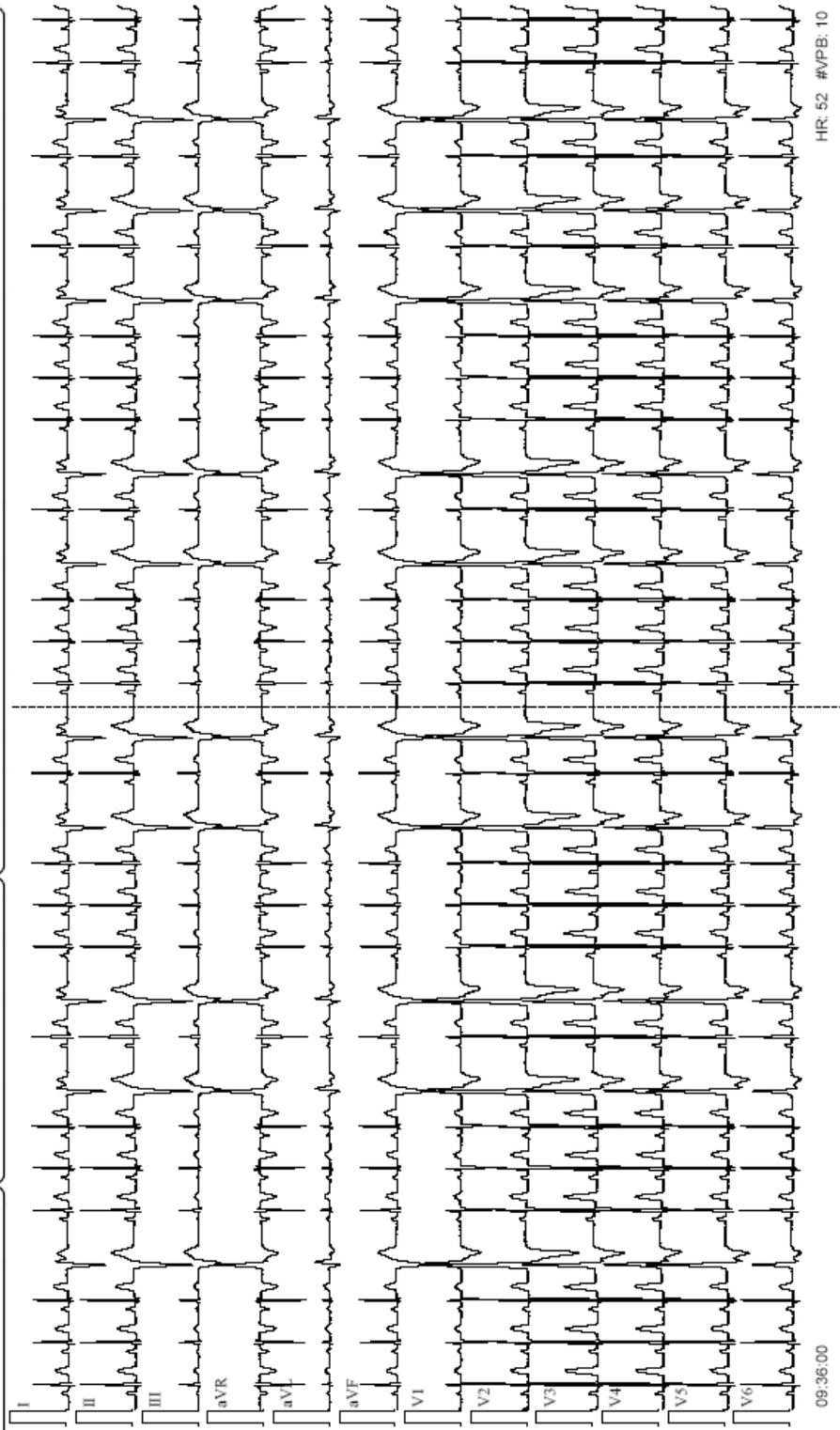
**ST @60ms ( mm)**

	I	II	III	aVR	aVL	aVF	V1	V2	V3	V4	V5	V6	Δ
Δ	-0.1	-0.0	0.0	-0.7	-1.1	-0.4	0.9	-0.1	-0.8	0.1	0.0	-0.5	0.0
Δ													-1.0
Δ													-1.0
Δ													-0.7

ST-Reference time: 09:34:31

11/09/2006 09:36:13	77(14)
HR(VPB)	363/394 @HR76
QT/QTc	363/411 @HR76
QT/QTcB	363/394 @HR76
QT/QTcF	

Patterson  
 Michael  
 ID#: 585925  
 10/15/1943  
 Gender: Male  
 63 yr



HR: 52 #VPB: 10

09:36:00

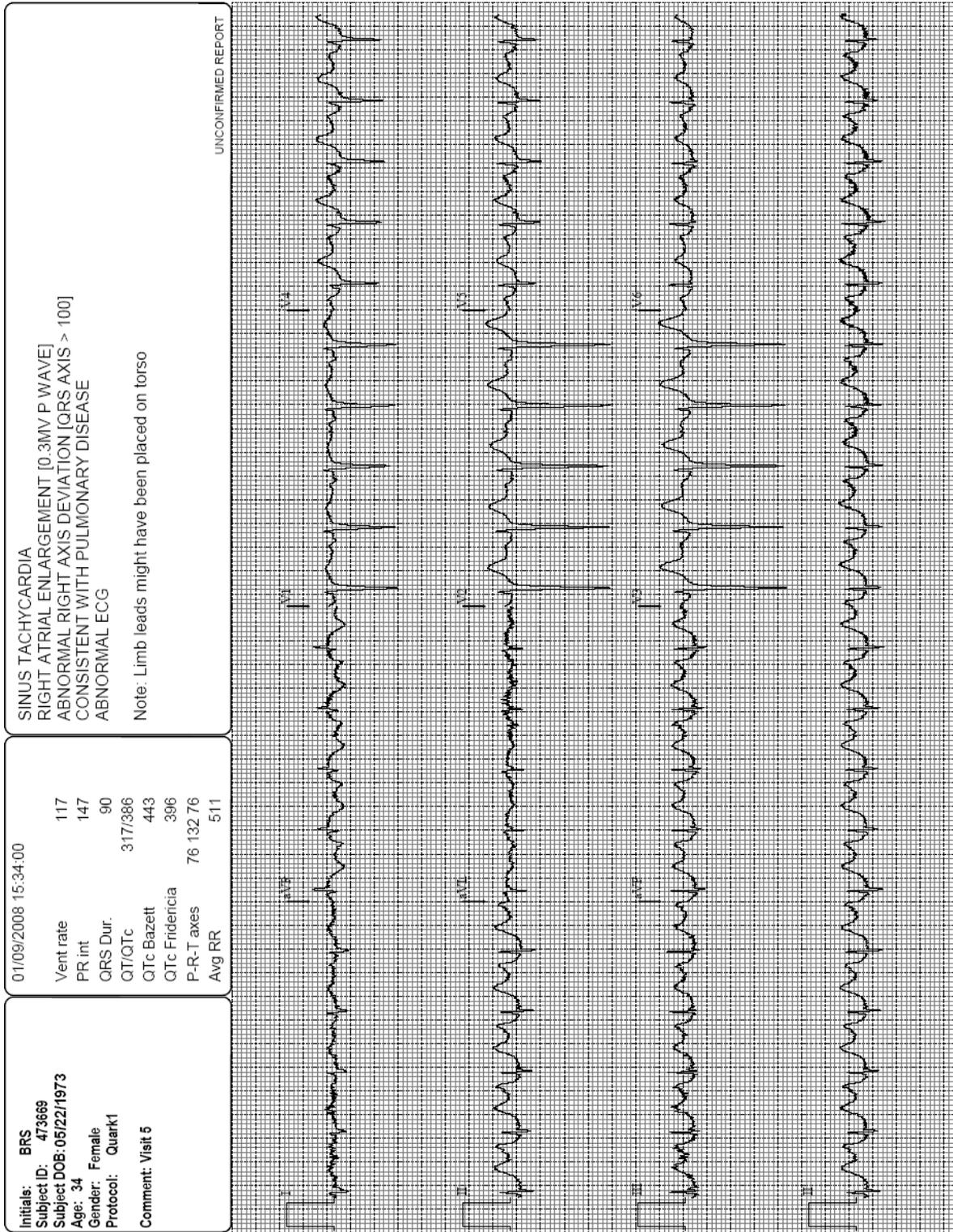
ECG: 10 mm/mV, 10 mm/s, Site# 0, Tele 1: (1,0), [0.05 - 150]

St. Mary's Hospital

Heart Rate < 50 bpm 09:34:57 11/09/2006

Automatic Protocol Printout

12-lead ECG with Interpretation: 4x3+1 Format with Grid (Time Point #2)



ECG: 10 mm/mV, 25 mm/s, Site#9, Tele 3, [0.05 - 150]

Research Site 1

Time Point #2

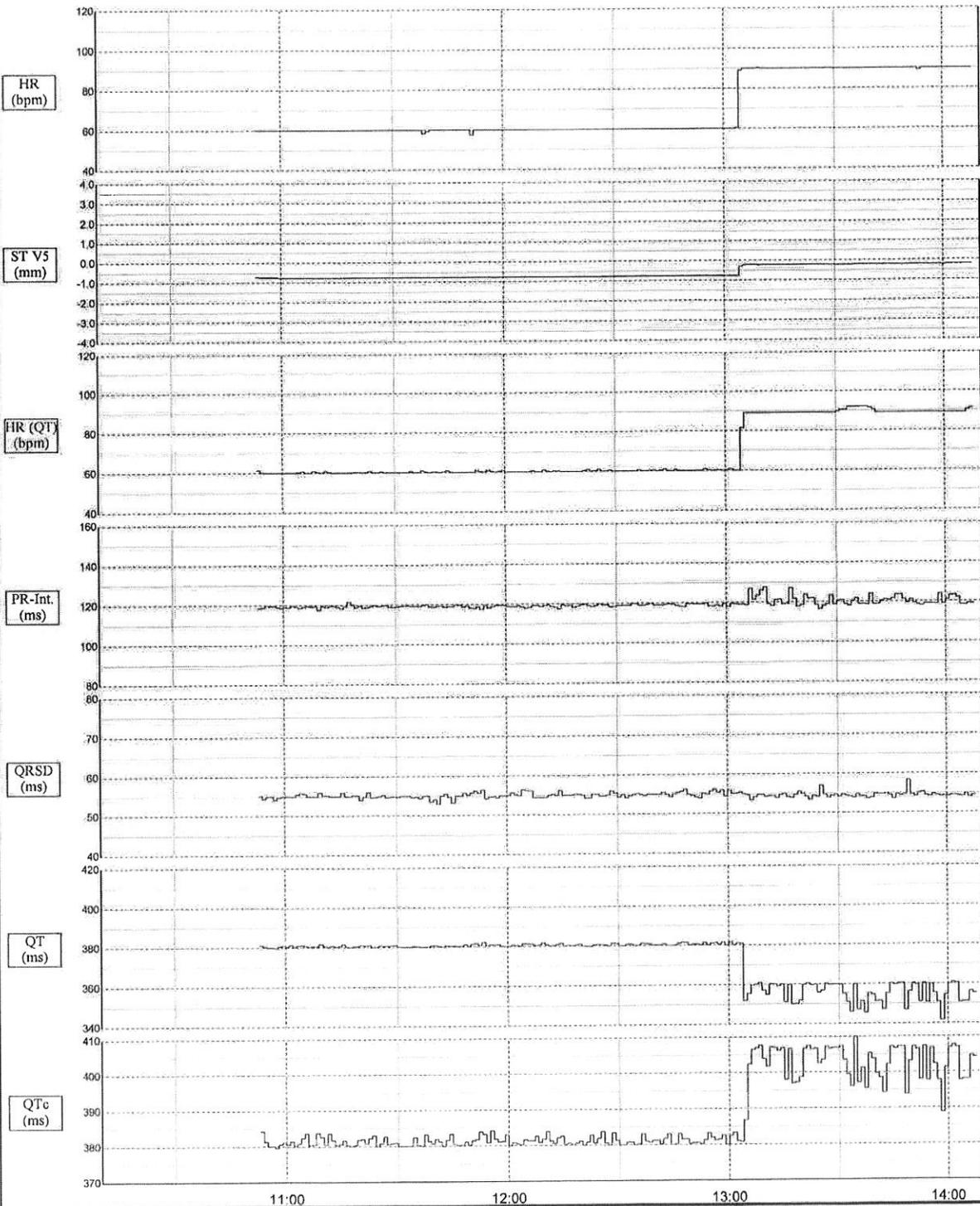
End of Shift Report

08/19/2016 14:10:15		SUMMARY REPORT		(1/5)
Smith Tony ID#: 987654567 10/12/1976 Gender: Male Height: Weight:	39 yr	Patient: Site#0, Bed8: (2,0)	Report start time: 08/19/2016 10:10:15 to 14:10:15	Report duration: 4 hours
<b>OVERVIEW</b>				
HR Avg[min:max]	70 [41:94] (bpm)	Oxygen Saturation Avg[min:max]	96 [82:99] (%)	
VPB Rate Avg[min:max]	0 [0:0] (bpm)	Pulse Rate Avg[min:max]	71 [36:94] (/min)	
QTc Linear Avg[min:max]	388 [379:411] @HR70			
QTc Bazett Avg[min:max]	399 [379:448]			
QTc Fridericia Avg[min:max]	390 [379:417]			
<b>ALARMS LIST</b>				
<b>DATE</b>	<b>START</b>	<b>END</b>	<b>ALARM MESSAGE</b>	
08/19/2016	14:08:52	00:00:00	SpO2 < 90	
08/19/2016	11:52:09	11:52:33	Heart Rate < 50 bpm	
08/19/2016	11:39:50	11:40:14	Heart Rate < 50 bpm	
08/19/2016	10:56:18	10:56:44	SpO2 < 90	
			Mortara Instrument Inc.	
			Site#0, Bed8: (2,0)	

08/19/2016 14:10:15

(2/5)

TRENDS

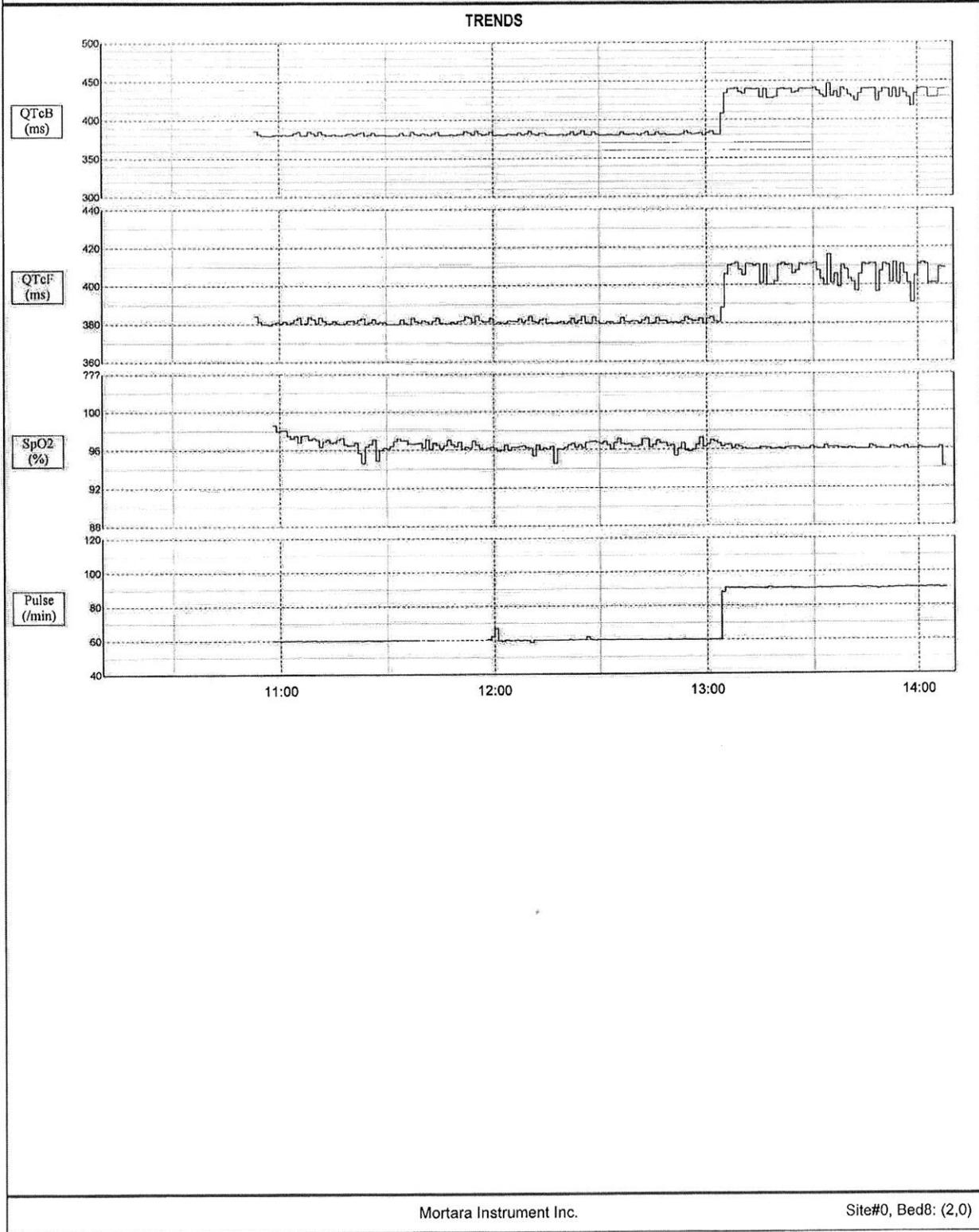


Mortara Instrument Inc.

Site#0, Bed8: (2,0)

08/19/2016 14:10:15

(3/5)



Mortara Instrument Inc.

Site#0, Bed8: (2,0)

08/19/2016 14:10:15 (4/5)

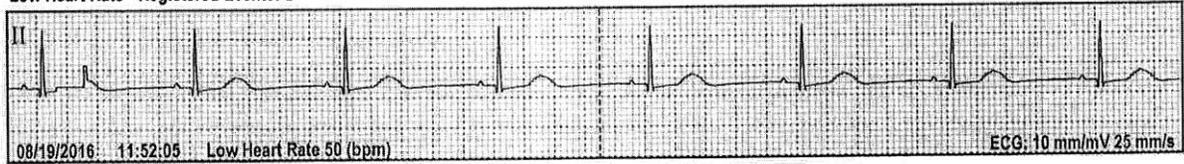
08/19/2016	Heart Rate (bpm)	ST V5 (mm)	Heart Rate (QT) (bpm)	PR Interval (ms)	QRS Duration (ms)	QT Interval (ms)	QTc Linear (ms)	QTc Bazett (ms)	QTc Fridericia (ms)	Oxygen Saturation (%)	Pulse Rate (/min)
10:15	--	--	--	--	--	--	--	--	--	--	--
10:20	--	--	--	--	--	--	--	--	--	--	--
10:25	--	--	--	--	--	--	--	--	--	--	--
10:30	--	--	--	--	--	--	--	--	--	--	--
10:35	--	--	--	--	--	--	--	--	--	--	--
10:40	--	--	--	--	--	--	--	--	--	--	--
10:45	--	--	--	--	--	--	--	--	--	--	--
10:50	--	--	--	--	--	--	--	--	--	--	--
10:55	60	-0.7	61	119	55	381	384	386	384	--	--
11:00	60	-0.8	60	119	55	380	380	380	380	99	60
11:05	60	-0.8	60	119	55	381	381	381	381	98	60
11:10	60	-0.8	60	119	55	381	382	383	382	97	60
11:15	60	-0.8	60	119	55	381	382	382	382	97	60
11:20	60	-0.8	60	120	55	380	380	380	380	97	60
11:25	60	-0.8	60	119	55	381	382	382	382	96	60
11:30	60	-0.8	60	119	55	381	381	381	381	96	60
11:35	60	-0.8	60	119	55	380	380	380	380	97	60
11:40	60	-0.8	60	119	55	380	381	382	381	97	60
11:45	60	-0.8	60	119	54	380	381	381	381	97	60
11:50	60	-0.8	60	119	55	380	381	381	381	97	--
11:55	59	-0.8	60	118	56	381	382	382	382	96	--
12:00	60	-0.8	60	119	55	381	382	382	382	96	60
12:05	60	-0.8	60	119	55	380	381	381	381	96	62
12:10	60	-0.8	60	119	56	381	381	382	381	96	60
12:15	60	-0.8	60	119	55	381	382	382	382	96	60
12:20	60	-0.8	60	119	55	381	381	381	381	96	60
12:25	60	-0.8	60	119	55	380	381	381	381	96	60
12:30	60	-0.8	60	119	55	381	382	382	382	97	60
12:35	60	-0.8	60	119	55	381	381	381	381	97	60
12:40	60	-0.8	60	119	55	381	381	381	381	97	60
12:45	60	-0.8	60	119	55	380	382	382	382	97	60
12:50	60	-0.8	60	119	55	381	381	381	381	97	60
12:55	60	-0.8	60	119	55	381	381	381	381	96	60
13:00	60	-0.8	60	119	56	381	382	383	382	96	60
13:05	60	-0.8	60	119	55	381	382	382	382	97	60
13:10	90	-0.2	87	122	54	357	402	433	405	96	90
13:15	90	-0.2	89	122	54	358	405	438	409	96	90
13:20	90	-0.2	89	122	55	354	401	433	405	96	90
13:25	90	-0.2	89	121	55	358	405	438	409	96	90
13:30	90	-0.2	89	119	55	358	405	438	409	96	90
13:35	90	-0.2	90	119	55	354	403	436	407	96	90
13:40	90	-0.2	92	120	54	352	402	437	406	96	90
13:45	90	-0.2	90	121	55	352	400	432	403	96	90
13:50	90	-0.2	89	122	54	357	404	437	408	96	90
13:55	90	-0.2	89	119	56	357	404	437	408	96	90
14:00	90	-0.2	89	120	54	352	399	430	402	96	91
14:05	90	-0.2	89	122	54	357	404	437	408	96	91
14:10	90	-0.2	90	119	54	353	401	434	405	96	90

08/19/2016 14:10:15

(5/5)

ALARM SNAPSHOTS

Low Heart Rate - Registered Events: 2



10:20 11:00 11:40 12:20 13:00 13:40



## 20. TECHNICAL SPECIFICATIONS

### Specifications

#### System

Mode of Operation	Continuous
-------------------	------------

**NOTE:** Refer to the Surveyor S12/S19 patient monitor user manual, part number 9515-183-51-ENG, for the specification of its parameters communicated to and managed by the Surveyor Central including associated ranges and accuracy.

#### ECG

ECG acquisition:	10-wire (12-lead): I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6 5-wire (7-lead): I, II, III, aVR, aVL, aVF, V 3-wire (1-lead): I, II or III
Acquisition:	40,000 s/s (Surveyor S4) for pacemaker detection, reduced to 500 samples/s
Resolution:	2.5 $\mu$ V.
Dynamic range/offset tolerance:	$\pm$ 340 mV
Input dynamic:	680 mV
Common Mode Rejection Ratio:	100 dB, up to 180 dB with digital filter at 50 or 60 Hz (ANSI/AAMI EC 13)
Frequency response:	Diagnostic ECG-standard IEC 60601-2-25 and ECG monitoring standard IEC 60601-2-27
Input impedance:	200 M $\Omega$ (Surveyor S4)
Defibrillator protection:	Only when used with Welch Allyn ECG cables
Beat detection:	Sensitivity 99.90%, positive predictivity 99.88% (AHA/MIT database)
Beat recognition:	Normal, ventricular, paced, unknown
Heart rate measurement:	Range: 30-300 bpm; Resolution: 1 bpm Measurement error (RMS) as measured according to ANSI/AAMI EC57: 2.8% AHA database, 1.7% MIT database
HR Averaging	If the heart rate from the last four R to R intervals is greater than 48 beats per minute, the average heart rate is determined by averaging the last 16 R to R intervals. If the heart rate from the last four R to R intervals is less than or equal to 48 beats per minute, then this rate is used. Paced beats and PVCs are included in the heart rate calculation.
ST level measurement:	Range: -2500 to +2500 $\mu$ V (-25 to +25 mm) Resolution: 10 $\mu$ V (0.1 mm) Measurement error: Mean 8.5 $\mu$ V, Standard Deviation 66 $\mu$ V as measured according to ANSI/AAMI EC57 on the ESC-ST database

**NOTE:** For SpO<sub>2</sub> specifications of the Surveyor S4, refer to the Surveyor S4 User Manual, p/n 9515-190-51.

## Alarms

Number Alarms level:	4 (high, medium, low, and information only)
Visual alarm presentation:	Color-coded text message by priority (red, yellow, cyan, white) Blinking, for active alarm Stationary when alarm condition still present but silenced by operator
Audible alarm sound pressure level:	External USB connected speakers 5 volume settings SPL ranges (measured according to IEC 60601-1-8 :2012): USB Speaker Logitech S-150: High priority alarms: 58.4 dBA to 68.01 dBA Medium priority alarms: 60.41 dBA to 65.58 dBA

## Alarms groups

Electrocardiogram:	Arrest: .....High priority, limits 2-8 seconds VFIB:.....High priority
Heart Rate:	Bradycardia: .....High/Medium/Low priority, low HR – 10 bpm Low Heart Rate: .....Medium priority, limit 20-100 bpm High heart rate: .....Medium priority, limit 50-250 bpm Tachycardia: .....High/Medium/Low priority, high heart rate + 30 bpm
Ventricular Tachycardia:	VTACH: .....High priority, 3 – 20 beat run length (user selectable), 100 – 200 beats/min (user selectable) Sustained VTACH:.....High priority, > 15 second duration
ST Change:	ST Increase: .....Medium/Low priority ST Decrease: .....Medium/Low priority User-selectable limits 100-900µV (1 – 9 mm) change User-selectable ST delay, post J-point (10- 200 ms)
Extended Arrhythmias for telemetry patient monitoring:	<b>Medium, low/On or Off (user selectable)</b> Trigeminy, Bigeminy, High Ectopic Rate, R-on-T Rate, High R-on-T Rate, Multifocal Ectopics, Couplet, High Couplet Rate, Ventricular Rhythm, Dominant Rhythm Change, Missing QRS, High Pause Rate, Irregular Rhythm, Low QRS Voltage, Pacemaker Output Failure, High Output Failure Rate, Pacemaker Non-Capture, High Non- Capture Rate
Extended Arrhythmias for S12/S19 patient monitoring:	<b>Medium, low, or information only/On or Off (user selectable)</b> Ventricular Run, Ventricular Rhythm, Couplet, High Ectopic Rate, Bigeminy, Missing QRS, Irregular Rhythm, Pacemaker Non-Capture
Resting ECG for telemetry monitoring: (optional - requires 12-lead Interpretation)	<b>Low or information only priority/On or Off (user selectable)</b> QTc High: .....300-600 ms QTc-Bazett High: .....300-600 ms QTc-Fridericia High: .....300-600 ms
Telemetry SpO <sub>2</sub> : (optional - requires T12S)	<b>Medium/On or Off (user selectable)</b> SpO <sub>2</sub> Low: .....Medium priority, 50-98% saturation Desaturation: .....High priority, 10% below SpO <sub>2</sub> low limit Pulse rate low: .....Medium or Low priority, 20-100 pulse rate Pulse rate high: .....Medium or Low priority, 50-250 pulse rate
Technical Alarms – General	Printer error (low priority) No AC Power (low priority) Printer off-line (low priority) Storage space < 24hr (low priority) Deleting old sessions (low priority) Hard disk full (low priority) Storage system unreachable (low priority) Repairing database (low priority)

Technical Alarms for telemetry	<p>ECG Lead Off (low/information only priority)  ECG Noise (low/information only priority)  Patient Call (medium/low/information only priority)  No Radio Signal (low/information only priority)  Radio Interference (low/information only priority)</p> <p>Battery Low (information only)  Electrode impedance test (information only)  12-lead ECG taken (information only)  Synchronizing clocks (information only)  System battery power low (information only)  No Heart rate (medium priority)  ECG monitoring disabled (medium priority)  Alarm engine fault (medium priority)</p>
Technical Alarms for patient monitoring	<p>Network Connection Lost (low priority)  SpO2 Hardware Failure (low priority)  SpO2 Unplugged (low priority)  SpO2 Artifact (low priority)  NIBP Artifact (low priority)  NIBP Blocked Line (medium priority)  NIBP Open Line (low priority)  NIBP Timeout on Measurement (low priority)  NIBP Measurement Failure (low priority)  Temperature Unplugged (low priority)  Temperature Too High (low priority)  Temperature Hardware Failure (low priority)  Respiration Leads Off (low priority)  Respiration Artifact (low priority)  Respiration Too High (low priority)  CO2 Hardware Failure (low priority)  CO2 Unplugged (low priority)  CO2 Occluded Line (low priority)  CO2 Too High (low priority)  FICO2 Too High (low priority)  Pressure Unplugged (low priority)  Pressure Hardware Failure (low priority)  Pressure Needs Calibration (low priority)  Pressure Needs Zero (low priority)  Pressure Artifact (low priority)  Pressure Too Low (low priority)  Pressure Pulse Rate Too Low (low priority)  Pressure Too High (low priority)  Pressure Weak Signal (low priority)  Arrhythmia Disabled (low priority)  Check Leads (low priority)  Heart Rate Artifact (low priority)  Monitor Low Battery (low priority)  Art Line Open (high priority)</p>
Protocol events: (optional)	<p><b>Information only:</b>  Protocol completed, Protocol aborted</p> <p><b>Medium, low or information only/On or Off (user selectable):</b>  Step change, Phase change (user-selectable texts)</p>
ALARMS OFF:	<b>Information only with audible reminder (user selectable)</b>

## Storage

Period:	Approximately up to 1200 days with redundant server
Continuous:	12-lead ECG at 500 Samples/s @ 2.5 $\mu$ V LSB (optional)
12 lead average waveform:	every 5 s: 500 Samples/s @ 2.5 $\mu$ V LSB (optional)
Trends:	Heart rate, Ventricular rate, R-on-T rate, Couplet rate, Pause rate, Pacemaker Non-capture and Output Failure rates, PR-interval, QRS duration, QT interval QTc interval (Bazett + Fridericia), SpO <sub>2</sub> , ST
Alarms:	Physiological alarms, clinical alarms, protocol events, 12-lead ECG printout events
RR-intervals:	2 ms resolution

## Configuration

Storage Configurations:	<ol style="list-style-type: none"> <li>1) Storage on local workstation</li> <li>2) Storage on redundant (RAID1+0) server</li> </ol>
Component Configurations:	<ol style="list-style-type: none"> <li>1) Receiving workstation with support for up to 16 channels</li> <li>2) Control workstation with support for up to 48 channels</li> <li>3) Control and receive on one workstation</li> <li>4) Control, receive, and storage on one workstation</li> <li>5) Storage on redundant (RAID1+0) network server</li> </ol>
Maximum number of telemetry channels per system:	Up to 128 channels per Surveyor Central system (more than one Surveyor Central system is required above 64 patients),

**NOTE:** Surveyor Central components are designed to share an independent physical network. Connection to an external network is through an optional VPN security router.

## Network

Digital local area network:	IEEE 802.3, 100 Base T
Network protocol:	IP
Data exchange protocol:	UDP and TCP
Distance Switch-station:	Max 100 m
Cable:	8 wire twisted pair Cat 5
Connectors:	RJ-45
Router Firewall support:	ICSA Firewall, ICSA VPN, EAL4, 240 Mb/s throughput
Router VPN support :	VPN server, 40 Mb/s throughput
Router ports:	4 RJ-45 internal, 100 Base-T 1 RJ-45 external, 100 Base-T
Router IP addressing:	Fixed or DHCP

## Size

Central Workstation:	35,6 cm x 16,9 cm x 43,5 mm (14.0 x 6.7 x 17.1 in)
Redundant Network Server:	8.73 x 44.55 x 67.94 cm (3.44 x 17.54 x 26.75 inches) (Gen10 Server)
Monitor:	56 x 28 x 38 to 49 cm (22 x 11 x 15 to 19 inches) unpacked with stand
Printer	40 x 45 x 42 cm (16 x 18 x 17 inches)
Keyboard:	46 x 4 x 17 cm (18 x 1.5 x 6.7 inches)
Mouse:	13 x 6.4 x 3.8 cm (5 x 2.5 x 1.5 inches)
External Speakers:	15.8 x 6.8 x 6.4 cm (6.22 x 2.68 x 2.52 inches)

## Weight

Central Workstation:	8.2 kg (18.03 lb)
Redundant Network Server:	24.5 kg (54 lb) Maximum (Fully Loaded Configuration) (Gen10 Server)
Monitor:	6.8 kg (15lbs.)
Printer	23.6 kg (52 lbs.)
Keyboard:	1 kg (2.2 lbs.)
Mouse:	128 grams (4.5 oz.)
External Speakers:	0.4 kg (1.41 oz)

## Screen

Resolution with possible and recommended maximum number of monitoring slots per display:	19" Single Display 1280x1024 dots: 16 slots possible/ 8 slots recommended 24" Single Display 1920x1200 dots: 24 slots possible/ 16 slots recommended 19" Dual Display 1280x1024 dots: 32 slots possible/ 16 slots recommended 24" Dual Display 1920x1200 dots: 48 slots possible/ 32 slots recommended
Traces per Patient:	Up to 12 on single-patient window, up to 2 on multiple-patient window
Parameters per Patient:	Up to 20 (user selectable)
Sweep traces:	10 or 25 mm/sec
ECG sensitivity:	5, 10, 20 or 40 mm/mV
Size:	19" or 24" LCD in single or dual display modes

## Printer

Technology:	Black and white laser jet, networked
Printout types:	Rhythm, 12-lead ECG, ST report, Trends, End-of-Shift Report
12-lead ECG formats:	6x2, 3x4+1, 3x4+1+P, 3x4+3 @ 25 or 50 mm/s
Rhythm speeds:	5, 10, 25, 50 mm/s
Paper types:	A4 and Letter
Resolution:	1200 x 1200 dpi
Print speed:	55 ppm max

## Electrical characteristics

Uninterrupted Power Supply:	Recommended for each workstation and server location
Power Supply	<p>HP Z240 Workstation: 280 W</p> <p>HP Z2 G4 Workstation: 500W</p> <p>HPE ProLiant DL380 Gen10 Server:800 W</p> <p>HPE ML350P Gen9 Server: 500W(2) 24" LCD Displays: 44 W</p> <p>USB Watchdog: 10 W</p> <p>Router: 15 W</p>
Workstation UPS:	<p>Required UPS USB HID (Human Interface device) compliant.</p> <ul style="list-style-type: none"> <li>Recommended specifications (HP Z2 G4 Workstation)</li> </ul> <p>UPS rated for 800 VA (or greater) and with a runtime of at least 10 minutes at a 700 W or 760 VA load.</p> <ul style="list-style-type: none"> <li>Recommended specifications (HP Z240 Workstation):</li> </ul> <p>UPS rated for 500 VA (or greater) and with a runtime of at least 10 minutes at a 420 W or 465 VA load.</p>
Server UPS:	<p>Required UPS USB HID (Human Interface device) compliant.</p> <ul style="list-style-type: none"> <li>Recommended specifications (Gen10 Server or later):</li> </ul> <p>UPS rated for 1200 VA (or greater) and with a runtime of at least 10 minutes at a 1020W or 1160 VA load.</p> <ul style="list-style-type: none"> <li>Recommended specifications (Gen 9 Server):</li> </ul> <p>UPS rated for 800 VA (or greater) and with a runtime of at least 10 minutes at a 700 W or 760 VA load.</p>
Number of outlets needed:	2 or 3, per workstation, depending on system configuration
Voltage:	100-240 V
Rated Input Current	Redundant (RAID1+0) 7.1 Amps (at 120 VAC) to 3.5 Amps (at 240 VAC) per Power Supply

## Redundant (RAID) Server Environmental Conditions

BTU Rating:	3067 BTU/hr (At 100 V ac), 2958 BTU/hr (At 200 V ac), 2949 BTU/hr (At 240 V ac) w/ 800 W power supply (Gen10 Server)
Transporting:	-30° to +60°C 10% to 90% humidity w/o condensation Maximum altitude of 9144 m (30,000 ft.). Maximum allowable altitude change rate is 457 m/min (1500 ft./min) (Gen10 Server)
Operating:	+10° to +35°C 8% to 90% humidity w/o condensation Maximum altitude of 3050 m (10,000 ft.). This value may be limited by the type and number of options installed. Maximum allowable altitude change rate is 457 m/min (1500 ft./min). (Gen10 Server)

## Workstation Computer Environmental Conditions

BTU Rating:	Typical: 444 btu/hr (112 kcal/hr) Maximum: 1484 btu/hr (374 kcal/hr)
Transporting:	-30° to +60°C 10% to 90% humidity w/o condensation Maximum altitude 9,144 m (30,000 feet)
Operating:	+5° to +35°C 8% to 85% humidity w/o condensation Maximum altitude 3,000 m (10,000 feet)