Mortara

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Surveyor Central System

12-LEAD RESTING ELECTROCARDIOGRAPH

SERVICE MANUAL

CE 0459

Manufactured by Mortara Instrument, Inc., Milwaukee, Wisconsin U.S.A.

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

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1 General Information

Service Manual Purpose

The purpose of this manual is to supply information to authorized service personnel so they can properly maintain the Surveyor Central 3.x system. Information for peripheral devices, such as printers should be found in manuals supplied with equipment or by contacting original manufacturer. This manual is intended to function as the primary guide to preventive maintenance and electrical repairs considered field repairable for the Surveyor Central system.

Manufacturer's Responsibility

Mortara Instrument, Inc. is responsible for the effects on safety and performance of the device, as indicated by the CE label, only if article 2 of 93/42/EEC directive is applied, in particular:

- System installation and assembly operations, extensions, readjustments, modifications or repairs are carried out by personnel authorized by Mortara Instrument, Inc. only.
- The device is used in accordance with the instructions for use.
- The device is correctly maintained according to the standards authorized by Mortara Instrument, Inc. using original spare parts.
- The device is used with original accessories and supplies that are in compliance with the standard specifications described in this manual.
- 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 Mortara Instrument, Inc. authorized personnel must have access to this manual at any time.

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

Equipment Identification

Mortara Instrument, 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.

Copyright and Trademark Notices

Other Important Information

The information in this document is subject to change without notice.

Symbol Delineation

Warning: 	Means there is the possibility of personal injury to you or others.
Caution: 	Means there is the possibility of damage to the equipment.
Note:	Provides information to further assist in the use of the device.
	Refer to Operating Instructions
	Electrostatic sensitive devices
	Do not dispose as unsorted municipal waste. Per EC Directive 2002/96, requires separate handling for waste disposal according to national requirements.

User Safety Information

Safety Regulations

Surveyor Central and Surveyor Central Repeater are medical devices CE labelled, according to European directive 93/42/EEC (MDD), as a class IIb and class I medical devices respectively. Telemetry versions contain the radio receiver device "PCI-RF" produced by Mortara Instrument and marked CE according to European directive 99/5 R&TTE. Telemetry transmitters and antenna network components are produced by Mortara Instrument, and marked CE per the MDD directive. Various other accessories, like the monitor and printer are CE marked by the respective manufacturers according to the applicable European directives. See respective declarations of conformity for details.

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. The Surveyor Central complies with various safety and performance regulations as defined in the user manual.

The device is UL classified:

WITH RESPECT TO ELECTRIC SHOCK,
FIRE AND MECHANICAL HAZARDS ONLY IN ACCORDANCE
WITH UL2601-1, IEC60601-1, CAN/CSA CC22.2 No. 601.1,
AND
IEC60601-2-25

Warnings

- Before attempting to use the device for clinical applications, the operator must read and understand the contents of the user manual and any documents accompanying the device.
- The Surveyor Central was **not** designed to be used in the patient environment as defined in IEC 60601-1-1 (1.5 m from the patient's bed and 2.5 m from the floor). The use of an isolation transformer between mains and Surveyor Central is not a sufficient safety measure for use in the patient environment because of data connections (antenna network, data network) that might cause excessive leakage currents in some conditions. Any other equipment that has a physical connection between Surveyor Central, and that is in the patient environment, must have additional protection against electrical shock (e.g., a separation device between the equipment and Surveyor Central). In addition, it must be in compliance with UL 2601-1, IEC 60601-1 or equivalent safety standards.
- The Surveyor Central is not battery operated. For uninterrupted use, we recommend an appropriate uninterruptible power supply (UPS); note that, for uninterrupted use, the antenna network (telemetry) as well as any active network components (connection with laser printer and monitors) also need to be powered from the UPS. If power is interrupted, Surveyor Central will resume monitoring automatically with the same settings when power returns. Loss of stored data is possible if power is interrupted to the system that stores the data.

- 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 Mortara Instrument. Any other data path can lead to serious security risks and interruptions of monitoring. Any other devices must not be connected to the Surveyor data network.

- The Surveyor Central, as all medical equipment or systems, needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in the installation procedure in order to obtain a sufficient degree of immunity as well as not to create disturbance to other equipment. Refer to the specific EMC instructions in this manual.

- Cleaning must be performed with the device turned off. Let all parts dry well before turning the power back on.

- 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 device. The last operation must be performed by adequately trained and authorized personnel, and with the device turned off.

- Install the computer that generates the alarm sounds in such a way that the sound can be heard adequately in the appropriate areas. The speaker is installed on the front panel of the computer.

- 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.

- Prevent liquids from penetrating inside the equipment, components, and transmitters.

- The various manufacturers of accessories provide separate operator manuals (e.g., monitor, laser printer, X12+, T12, T12S, patient cables, electrodes). Read these manuals well and refer to them for specific functions. It is recommended to keep all manuals together.

- Every hardware or software modification has to be made by authorized and trained technical personnel.

- Technical and service documents are available upon request.

- Always turn the system off before connecting or disconnecting any cables.
- Do not use the equipment in places that are susceptible to explosion hazard or in the presence of flammable gases.
- Do not use the equipment in the presence of Magnetic Resonance Imaging (MRI) equipment and tomography equipment.
- Do not insert a bootable floppy disk or CD-ROM. Do not run any program from CD-ROM 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 device. 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 Mortara 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 which, by nature and way of use, can be more prone to failure.
- Installation and connection to data and antenna networks must be performed by properly trained personnel, authorized by Mortara Instrument, Inc.
- To maintain designed operator and patient safety, use only parts and accessories supplied with the device and available through Mortara Instrument, Inc.
- The device 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 device is optionally equipped with Mortara'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 Mortara 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.
- 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.

- 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 device 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 monitor supplied with the Surveyor Central has a separate power switch and power on indicator. If no image appears on the screen, check the monitor power indicator (normally illuminated in green). Alarm sounds are not affected by the status of the monitor.

- 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. 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.

- 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 paused for a period of time by a single patient only. The selection between disabling and pausing, as well as the pause 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.

The following warnings concern telemetry monitoring:

- The X12+, T12, and T12S transmitter applies a small DC current for active noise suppression in normal use, and an 8 or 16 Hz waveform during impedance check mode. Currents applied are below the thresholds specified in ANSI/AAMI ES1 “Safe current limits for electromedical apparatus.”

- The minimum amplitude for detecting QRS complexes is user selectable between 300 and 500 µV. 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 both detection leads. Therefore, the user is encouraged to select detection leads with an amplitude of at least 1 mV and set the minimum QRS amplitude at 500 µV.

- Electrostatic discharges may generate short interference on the ECG tracings.
- 2.4 GHz Telemetry: Transmitters with frequencies between 2400.96 and 2482.56 MHz may generate interference. In case of interference, please try with a different transmission channel (refer to the X12+, T12, or T12S transmitter user manual section that explains how to select transmission channels). Examples of these types of transmitters: leaking microwave ovens, radio therapy equipment, wireless LAN. Additionally, transmitters in frequency ranges close to 2.4 GHz and with high output power can disturb telemetry reception. Spectrum analyzer equipment is available from Mortara or other sources for troubleshooting interference.
- 600 MHz Telemetry: Transmitters with frequencies between 608 and 632 MHz may generate interference. In case of interference, try with a different transmission channel (refer to the X12+, T12, or T12S transmitter user manual section that explains how to select transmission channels). Examples of these types of transmitters: television transmitters, other telemetry devices. Also transmitters in frequency ranges close to 600 MHz and with very high output power can disturb telemetry reception. Spectrum analyzer equipment is available from Mortara or other sources for trouble shooting interference.
- 915 MHz Telemetry: Transmitters with frequencies between 904.76 MHz and 925.15 MHz may generate interference. In case of interference, please try with a different transmission channel (refer to the X12+, T12, or T12S transmitter user manual section that explains how to select transmission channels). Examples of these types of transmitters: leaking microwave ovens, radio therapy equipment, wireless LAN. Additionally, transmitters in frequency ranges close to 915 MHz and with high output power can disturb telemetry reception. Spectrum analyzer equipment is available from Mortara or other sources for troubleshooting interference.
- The system was not designed to be used with high frequency (HF) surgical devices.
- Electrodes used with this system must apply to IEC 60601-2-25, article 51.102 or ANSI/AAMI EC12, article 4.2.2.4 concerning defibrillation recover of the ECG trace.
- The use of the X12+, T12, or T12S transmitter is restricted in some countries; see the user manuals for details.
- Consult the X12+, T12, or T12S user manual for more information regarding the patient cable, electrode recommendations, cleaning, maintenance, channel frequencies, precautions to take during patient defibrillation, and other warnings.
- The use of the Surveyor Central with telemetry transmitters requires the presence of an antenna network, available from Mortara Instrument or its representative. Connection information and safety advice concerning the installation, use, and maintenance of the antenna network components has been included within this manual.

Caution: 

Periodic Safety Inspections

Follow the recommended maintenance schedule, including the manufacturer of the server/workstation. Periodically inspect all power cords, transmission cables, and computer cables for fraying, pinching and any other damage. Broken or frayed wires may cause interference, a loss of signal, and pose a shock hazard. Pay particular attention to points where wires enter connectors. Replace any cable that is suspect. Avoid sharp cable bends; protect cables on the floor from wheels of carts, cabinets and any pinching or floor traffic.

Sterilizing this Product

Do not sterilize this product or any accessories unless specifically directed by the manufacturer. Sterilization and sterilization environments can seriously damage many components and accessories.

Liquid Spills

Do not set beverages or other liquids on or near the Surveyor Central, and/or optional equipment.

General Cleaning Safety Precautions

- Never use solvents or flammable solutions to clean the workstation.

- Never immerse any parts in water or cleaning solutions. Apply any liquids to a clean cloth and then use the cloth on the component.

Product Life Expectancy

The Surveyor Central has an expected lifetime of 5 years, X12+, T12, and T12S transmitter of 3 years, patient cable of 6 months (continuous use), and antenna network components of 8 years. These times are estimated on the assumption that instruments are used according to manufacturer instructions and that maintenance is performed according to specifications included in this manual. Product lifetime starts from the date of manufacture. Use of devices beyond their specified life can compromise operator or patient safety.

Backup Copies

Backup and archive copies of your software are permitted.

Overload Protection

The Surveyor Central system has automatic overload protection with line-to-line protection of 1000 V without data loss.

Warranty

Mortara Instrument, Inc. warrants that Mortara products shall be free from defects in material and workmanship under normal use, service and maintenance for one year of such Product from Mortara or an authorized distributor or representative of Mortara. Normal use, service and maintenance means, operation and maintenance in accordance with appropriate instructions and/or information guides. This Warranty does not apply to damage to the Products caused by any or all of the following circumstances or conditions:

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

The remedy under this warranty is limited to the repair or replacement without charge for labor or materials, of any Products found upon examination by Mortara to have been defective. This remedy shall be conditioned upon receipt of notice by Mortara of any alleged defects promptly after discovery thereof within the warranty period. Mortara's obligations under the foregoing warranty will further be conditioned upon the assumption by the purchase of the Products (i) of all carrier charges with respect to any Products returned to Mortara's principal place or any other place as specifically designated by Mortara or an authorized distributor or representative of Mortara, and (ii) all risk of loss in transit. It is expressly agreed that the liability of Mortara is limited and that Mortara does not function as an insurer. A purchaser of a Product, by its acceptance and purchase thereof, acknowledges and agrees that Mortara is not liable for loss, harm or damage due directly or indirectly to an occurrence or consequence there from relating to the Products. If Mortara should be found liable to anyone under any theory (except the expressed warranty set forth herein) for loss, harm or damage, the liability of Mortara shall be limited to the lesser of the actual loss, harm or damage, or the original purchase price of the Product when sold.

Excluded from the limited warranty set forth above are consumable items such as, but not limited to; paper, batteries, electrodes, patient cables, lead wires, and magnetic storage mediums.

Except as set forth herein with respect to reimbursement of labor charges, a purchaser's sole exclusive remedy against Mortara for claims relating to the products for any and all losses and damages resulting from any cause shall be the repair or replacement of defective Products to the extent that the defect is noticed and Mortara is notified within the warranty period. In no event, including the claim for negligence, shall Mortara be liable for incidental, special or consequential damages, or for any other loss, damage or expense of any kind, including loss of profits, whether under tort, negligence or strict liability theories of law, or otherwise. This warranty is expressly in lieu of any other warranties, expressed or implied, including, but not limited to the implied warranty of merchant ability and the warranty of fitness for a particular purpose.

Duration and expiration of the Warranty

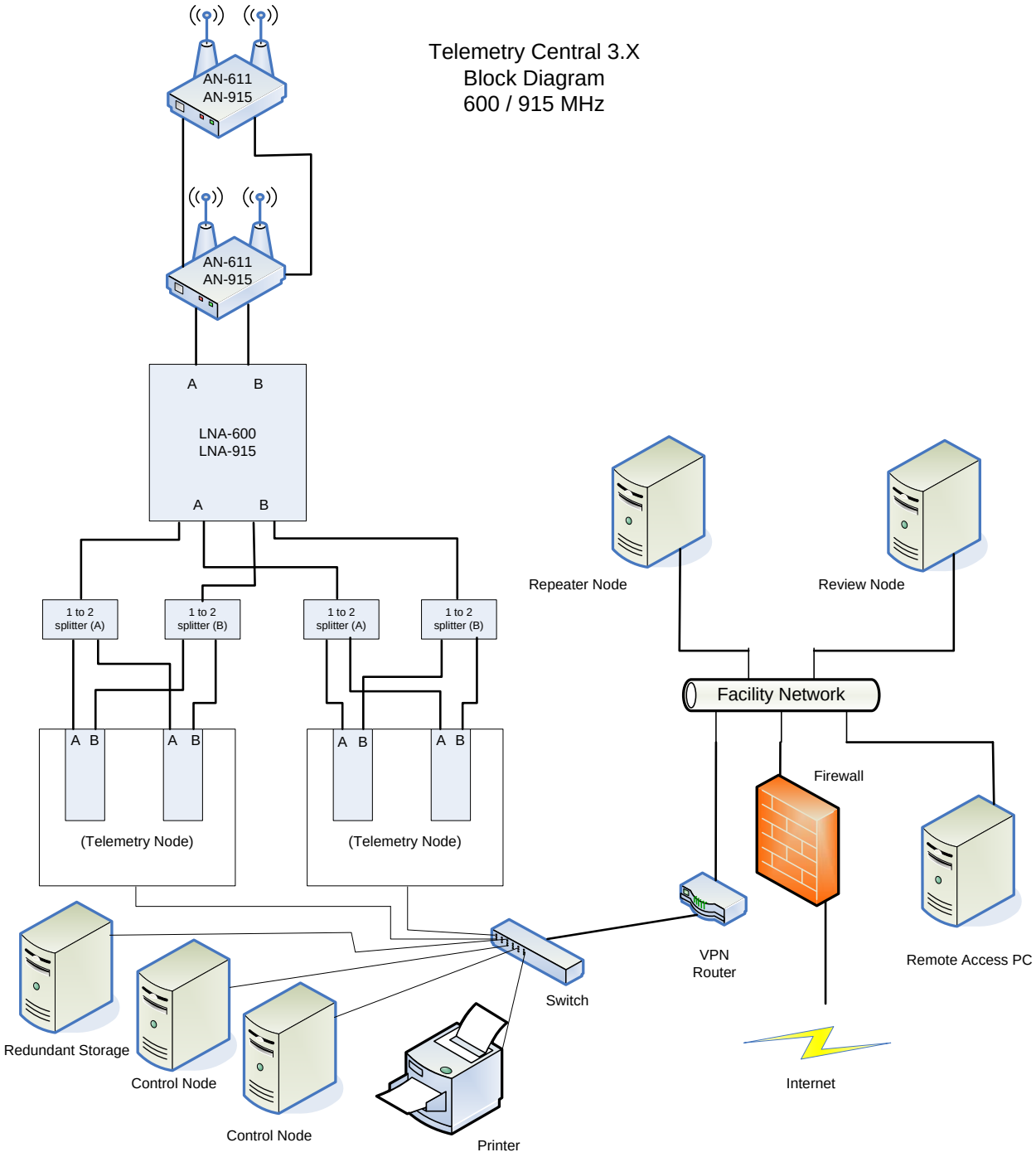
The Surveyor Central 3.x System carries a 90 day On-Site warranty and a 1 year Depot Repair warranty from the date of shipment from Mortara Instrument, Inc.

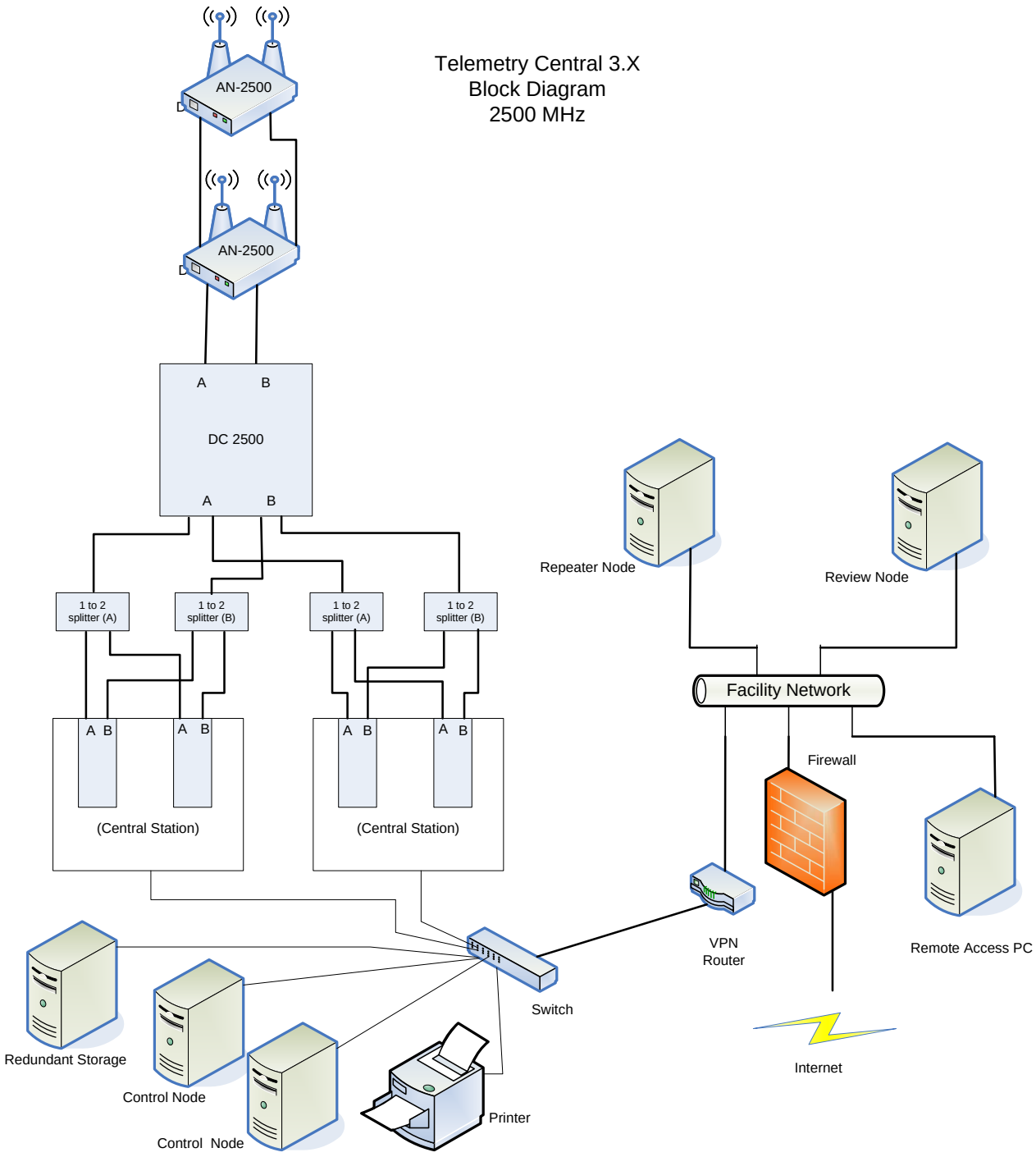
Warranty Tracking by Serial Number

Mortara Instrument tracks products by serial number for the purposes of warranty, configuration, and software version as related to repair, warranty expiration, etc. The serial number will be required for all warranty claims made to Mortara Instrument, Inc.

2 System Overview

This section provides a block diagram of the Surveyor Central system, identification of system components and Mortara part number information.




Telemetry Central 3.X
Block Diagram
2500 MHz
AN-2500
AN-2500
A
B
DC 2500
A
B
1 to 2 splitter (A)
1 to 2 splitter (B)
1 to 2 splitter (A)
1 to 2 splitter (B)
A B
A B
A B
A B
(Central Station)
(Central Station)
Repeater Node
Review Node
Facility Network
Firewall
VPN Router
Remote Access PC
Switch
Internet
Redundant Storage
Control Node
Control Node
Printer

The Surveyor Central 3.X System operates on a 608 MHz, 915 MHz, and/or 2500 MHz network. Receivers are typically mounted in the ceiling and receive patient telemetry data transmitted from the Mortara Instrument X12+, T12, and T12S units of appropriate frequency. This allows patient mobility within the confines of the antenna network. The distance from antenna to antenna is 15 meters (49.2 FT) for a non-plenum installation and up to 22 meters (66 FT) for a plenum installation. This allows for over-lapping coverage of the antennas and allows for greater mobility of the patients.

The system(s) shown in the block diagrams are example of a Surveyor Central system with the following requirements:

- Monitoring for up to 32 patients
- 2 - Telemetry receiving stations
- 2 – Control Nodes
- 1 – Network printer
- 1 - Redundant Storage server
- 1 - Antenna Network
- Remote VPN access
- 1 – Repeater Node
- 1 – Review Node

* System components and configuration will vary depending on customer requirements.

Mortara Parts List

DESCRIPTION	MORTARA ITEM NUMBER
CENTRAL SYSTEM	SCSYS-XXX-XXXXX
CONTROL NODE	SCNODE-XXX-XXXXX
REDUNDANT STORAGE	SCNODE-XXX-XXXXX
TELEMETRY NODE	SCNODE-XXX-XXXXX
REVIEW NODE	SCREV-XXX-XXXXX
REPEATER NODE	SCREP-XXX-XXXXX
VPN ROUTER	9963-006-01
NETWORK PRINTER	9007-016
PCIRF BOARD	36025-001-70 (2500MHz 8 RCVR)
	36025-001-71 (2500MHz 4 RCVR)
	36025-001-60 (915MHz 8 RCVR)
	36025-001-61 (915MHz 4 RCVR)
	36025-002-50 (600MHz 8 RCVR)
	36025-002-51 (600MHz 4 RCVR)
DOWN CONVERTER	30012-004-50
LNA-611	30012-008-50
LNA-915	30012-005-50
2500 ANTENNA NETWORK	88169-005-50 (2500 MHz)
608 ANTENNA NETWORK	88169-007-50 (608 MHz)
915 ANTENNA NETWORK	88169-008-60 (915 MHz)
8 PORT SWITCH	4140-012-01
POWER SUPPLY	4101-008
50 OHM PLENUM COAX CABLE	3602-013 (2500 MHz)
	3602-010 (600 MHz / 915 MHz)
50 OHM COAX CABLE	3602-012
50 OHM TERMINATOR	3601-003
608/915 MHz 2:1 SPLITTER	9912-014
608/915 MHz 4:1 SPLITTER	9912-013
2500 MHz 4:1 SPLITTER	9912-020
2500 MHz 2:1 SPLITTER	9912-016
DC BLOCK	9912-009
N TO BNC ADAPTER	3601-004
CAT5E ETHERNET CABLE 10 ft	6400-008
REMOTE ACCESS PC	9906-036

Mortara Parts List (cont.)

DESCRIPTION	MORTARA ITEM NUMBER
PC Pentium Proc Raid 1+0	9991-002-06
(4x 146 GB) config	(HP 384156-999)
WORKSTATION PC	9906-036
Plenum Antenna Ceiling Enclosure	8480-026
X12+ Transmitter	X12PLUS-XXX-XXXXX
Patient Cable X12+ (US)	9293-017-50
Patient Cable X12+ (EC)	9293-017-51
Patient Cable X12+ (US) [Large Size]	9293-026-50
Patient Cable X12+ (EC) [Large Size]	9293-026-51
X12+ Battery Door	8346-003-50
Monitoring Hook-Up Kit	9294-009-50
X12+ Carrying Pouch with Belt and Neck Strap	8485-020-50
X12+ User Manual	9515-164-50-ENG
X12+ Short Form Instruction Card - English	9503-164-01-ENG
T12 Transmitter	T12-XXX-XXXXX
T12S Transmitter	T12S-XXX-XXXXX
Patient Cable T12/T12S (US)	9293-044-50
Patient Cable T12/T12S (EC)	9293-044-51
Patient Cable T12/T12S (US) [Large Size]	9293-044-60
Patient Cable T12/T12S (EC) [Large Size}	9293-044-61
Battery Door T12	8354-003-51
Battery Door T12S	8345-003-50
T12/T12S Carry Case	8485-025-50
T12 Short Form Instruction Card-English	9503-173-01 ENG
T12S Short Form Instruction Card-English	9503-173-02 ENG
T12(S) User Manual	9515-173-50 ENG

X12+/ T12x 2500 Channel Assignments

CH#	MHz	CH#	MHz	CH#	MHz	CH#	MHz	CH#	MHz	CH#	MHz
00	2400.96	30	2416.32	60	2431.68	90	2447.04	C0	2462.4	F0	2477.76
01	2401.28	31	2416.64	61	2432	91	2447.36	C1	2462.72	F1	2478.08
02	2401.6	32	2416.96	62	2432.32	92	2447.68	C2	2463.04	F2	2478.4
03	2401.92	33	2417.28	63	2432.64	93	2448	C3	2463.36	F3	2478.72
04	2402.24	34	2417.6	64	2432.96	94	2448.32	C4	2463.68	F4	2479.04
05	2402.56	35	2417.92	65	2433.28	95	2448.64	C5	2464	F5	2479.36
06	2402.88	36	2418.24	66	2433.6	96	2448.96	C6	2464.32	F6	2479.68
07	2403.2	37	2418.56	67	2433.92	97	2449.28	C7	2464.64	F7	2480
08	2403.52	38	2418.88	68	2434.24	98	2449.6	C8	2464.96	F8	2480.32
09	2403.84	39	2419.2	69	2434.56	99	2449.92	C9	2465.28	F9	2480.64
0A	2404.16	3A	2419.52	6A	2434.88	9A	2450.24	CA	2465.6	FA	2480.96
0B	2404.48	3B	2419.84	6B	2435.2	9B	2450.56	CB	2465.92	FB	2481.28
0C	2404.8	3C	2420.16	6C	2435.52	9C	2450.88	CC	2466.24	FC	2481.6
0D	2405.12	3D	2420.48	6D	2435.84	9D	2451.2	CD	2466.56	FD	2481.92
0E	2405.44	3E	2420.8	6E	2436.16	9E	2451.52	CE	2466.88	FE	2482.24
0F	2405.76	3F	2421.12	6F	2436.48	9F	2451.84	CF	2467.2	FF	2482.56
10	2406.08	40	2421.44	70	2436.8	A0	2452.16	D0	2467.52		
11	2406.4	41	2421.76	71	2437.12	A1	2452.48	D1	2467.84		
12	2406.72	42	2422.08	72	2437.44	A2	2452.8	D2	2468.16		
13	2407.04	43	2422.4	73	2437.76	A3	2453.12	D3	2468.48		
14	2407.36	44	2422.72	74	2438.08	A4	2453.44	D4	2468.8		
15	2407.68	45	2423.04	75	2438.4	A5	2453.76	D5	2469.12		
16	2408	46	2423.36	76	2438.72	A6	2454.08	D6	2469.44		
17	2408.32	47	2423.68	77	2439.04	A7	2454.4	D7	2469.76		
18	2408.64	48	2424	78	2439.36	A8	2454.72	D8	2470.08		
19	2408.96	49	2424.32	79	2439.68	A9	2455.04	D9	2470.4		
1A	2409.28	4A	2424.64	7A	2440	AA	2455.36	DA	2470.72		
1B	2409.6	4B	2424.96	7B	2440.32	AB	2455.68	DB	2471.04		
1C	2409.92	4C	2425.28	7C	2440.64	AC	2456	DC	2471.36		
1D	2410.24	4D	2425.6	7D	2440.96	AD	2456.32	DD	2471.68		
1E	2410.56	4E	2425.92	7E	2441.28	AE	2456.64	DE	2472		
1F	2410.88	4F	2426.24	7F	2441.6	AF	2456.96	DF	2472.32		
20	2411.2	50	2426.56	80	2441.92	B0	2457.28	E0	2472.64		
21	2411.52	51	2426.88	81	2442.24	B1	2457.6	E1	2472.96		
22	2411.84	52	2427.2	82	2442.56	B2	2457.92	E2	2473.28		
23	2412.16	53	2427.52	83	2442.88	B3	2458.24	E3	2473.6		
24	2412.48	54	2427.84	84	2443.2	B4	2458.56	E4	2473.92		
25	2412.8	55	2428.16	85	2443.52	B5	2458.88	E5	2474.24		
26	2413.12	56	2428.48	86	2443.84	B6	2459.2	E6	2474.56		
27	2413.44	57	2428.8	87	2444.16	B7	2459.52	E7	2474.88		
28	2413.76	58	2429.12	88	2444.48	B8	2459.84	E8	2475.2		
29	2414.08	59	2429.44	89	2444.8	B9	2460.16	E9	2475.52		
2A	2414.4	5A	2429.76	8A	2445.12	BA	2460.48	EA	2475.84		
2B	2414.72	5B	2430.08	8B	2445.44	BB	2460.8	EB	2476.16		
2C	2415.04	5C	2430.4	8C	2445.76	BC	2461.12	EC	2476.48		
2D	2415.36	5D	2430.72	8D	2446.08	BD	2461.44	ED	2476.8		
2E	2415.68	5E	2431.04	8E	2446.4	BE	2461.76	EE	2477.12		
2F	2416	5F	2431.36	8F	2446.72	BF	2462.08	EF	2477.44		

The above table shows the channel number assigned to each frequency for the 2500 MHz system.

2500MHz - Telemetry Channel Utilization									
DC BAND 1			DC BAND 2			DC BAND 3			DC BAND 4	
00			40			80			C0	
01	Txx		41	T17		81	T33		C1	T01
02			42			82			C2	
03			43			83			C3	
04			44			84			C4	
05	Txx		45	T18		85	T34		C5	T02
06			46			86			C6	
07			47			87			C7	
08			48			88			C8	
09	Txx		49	T19		89	T35		C9	T03
0A			4A			8A			CA	
0B			4B			8B			CB	
0C			4C			8C			CC	
0D	Txx		4D	T20		8D	T36		CD	T04
0E			4E			8E			CE	
0F			4F			8F			CF	
10			50			90			D0	
11	Txx		51	T21		91	T37		D1	T05
12			52			92			D2	
13			53			93			D3	
14			54			94			D4	
15	Txx		55	T22		95	T38		D5	T06
16			56			96			D6	
17			57			97			D7	
18			58			98			D8	
19	Txx		59	T23		99	T39		D9	T07
1A			5A			9A			DA	
1B			5B			9B			DB	
1C			5C			9C			DC	
1D	Txx		5D	T24		9D	T40		DD	T08
1E			5E			9E			DE	
1F			5F			9F			DF	
20			60			A0			E0	
21	Txx		61	T25		A1	T41		E1	T09
22			62			A2			E2	
23			63			A3			E3	
24			64			A4			E4	
25	Txx		65	T26		A5	T42		E5	T10
26			66			A6			E6	
27			67			A7			E7	
28			68			A8			E8	
29	Txx		69	T27		A9	T43		E9	T11
2A			6A			AA			EA	
2B			6B			AB			EB	

2C			6C			AC			EC	
2D	Txx		6D	T28		AD	T44		ED	T12
2E			6E			AE			EE	
2F			6F			AF			EF	
30			70			B0			F0	
31	Txx		71	T29		B1	T45		F1	T13
32			72			B2			F2	
33			73			B3			F3	
34			74			B4			F4	
35	Txx		75	T30		B5	T46		F5	T14
36			76			B6			F6	
37			77			B7			F7	
38			78			B8			F8	
39	Txx		79	T31		B9	T47		F9	T15
3A			7A			BA			FA	
3B			7B			BB			FB	
3C			7C			BC			FC	
3D	Txx		7D	T32		BD	T48		FD	T16
3E			7E			BE			FE	
3F			7F			BF			FF	

The above chart shows the transmitters assignments within the bands of the down converter. Whenever possible the transmitters should be spaced evenly apart (e.g. 4 channels apart). This is important to minimize the chances of interference between transmitters.

X12+/T12x-608 Channel Assignments

Includes reference to UHF TV channel occupying the same frequency range.

	TV37		TV38		TV39		TV40
CH#	MHz	CH#	MHz	CH#	MHz	CH#	MHz
00	608.48	40	614.48	80	620.48	C0	626.48
01	608.56	41	614.56	81	620.56	C1	626.56
02	608.64	42	614.64	82	620.64	C2	626.64
03	608.72	43	614.72	83	620.72	C3	626.72
04	608.8	44	614.8	84	620.8	C4	626.8
05	608.88	45	614.88	85	620.88	C5	626.88
06	608.96	46	614.96	86	620.96	C6	626.96
07	609.04	47	615.04	87	621.04	C7	627.04
08	609.12	48	615.12	88	621.12	C8	627.12
09	609.2	49	615.2	89	621.2	C9	627.2
0A	609.28	4A	615.28	8A	621.28	CA	627.28
0B	609.36	4B	615.36	8B	621.36	CB	627.36
0C	609.44	4C	615.44	8C	621.44	CC	627.44
0D	609.52	4D	615.52	8D	621.52	CD	627.52
0E	609.6	4E	615.6	8E	621.6	CE	627.6
0F	609.68	4F	615.68	8F	621.68	CF	627.68
10	609.76	50	615.76	90	621.76	D0	627.76
11	609.84	51	615.84	91	621.84	D1	627.84
12	609.92	52	615.92	92	621.92	D2	627.92
13	610	53	616	93	622	D3	628
14	610.08	54	616.08	94	622.08	D4	628.08
15	610.16	55	616.16	95	622.16	D5	628.16
16	610.24	56	616.24	96	622.24	D6	628.24
17	610.32	57	616.32	97	622.32	D7	628.32
18	610.4	58	616.4	98	622.4	D8	628.4
19	610.48	59	616.48	99	622.48	D9	628.48
1A	610.56	5A	616.56	9A	622.56	DA	628.56
1B	610.64	5B	616.64	9B	622.64	DB	628.64
1C	610.72	5C	616.72	9C	622.72	DC	628.72
1D	610.8	5D	616.8	9D	622.8	DD	628.8
1E	610.88	5E	616.88	9E	622.88	DE	628.88
1F	610.96	5F	616.96	9F	622.96	DF	628.96
20	611.04	60	617.04	A0	623.04	E0	629.04
21	611.12	61	617.12	A1	623.12	E1	629.12
22	611.2	62	617.2	A2	623.2	E2	629.2
23	611.28	63	617.28	A3	623.28	E3	629.28
24	611.36	64	617.36	A4	623.36	E4	629.36
25	611.44	65	617.44	A5	623.44	E5	629.44
26	611.52	66	617.52	A6	623.52	E6	629.52
27	611.6	67	617.6	A7	623.6	E7	629.6
28	611.68	68	617.68	A8	623.68	E8	629.68
29	611.76	69	617.76	A9	623.76	E9	629.76
2A	611.84	6A	617.84	AA	623.84	EA	629.84
2B	611.92	6B	617.92	AB	623.92	EB	629.92
2C	612	6C	618	AC	624	EC	630
2D	612.08	6D	618.08	AD	624.08	ED	630.08
2E	612.16	6E	618.16	AE	624.16	EE	630.16
2F	612.24	6F	618.24	AF	624.24	EF	630.24
30	612.32	70	618.32	B0	624.32	F0	630.32
31	612.4	71	618.4	B1	624.4	F1	630.4
32	612.48	72	618.48	B2	624.48	F2	630.48
33	612.56	73	618.56	B3	624.56	F3	630.56
34	612.64	74	618.64	B4	624.64	F4	630.64
35	612.72	75	618.72	B5	624.72	F5	630.72
36	612.8	76	618.8	B6	624.8	F6	630.8
37	612.88	77	618.88	B7	624.88	F7	630.88
38	612.96	78	618.96	B8	624.96	F8	630.96
39	613.04	79	619.04	B9	625.04	F9	631.04
3A	613.12	7A	619.12	BA	625.12	FA	631.12
3B	613.2	7B	619.2	BB	625.2	FB	631.2
3C	613.28	7C	619.28	BC	625.28	FC	631.28
3D	613.36	7D	619.36	BD	625.36	FD	631.36
3E	613.44	7E	619.44	BE	625.44	FE	631.44
3F	613.52	7F	619.52	BF	625.52	FF	631.52

This chart shows the channel assignments for the X12+/T12x 600 MHz transmitter. Only channels inside TV37, channels 00-3F are to be used. Whenever possible channel spacing of 4 channels should be observed, however it is possible to use every other channel for up to 32 channels maximum.

X12+/T12x-915 Channel Assignments

CH#	MHz	CH#	MHz	CH#		CH#	
00	904.76	40	909.88	80	915	C0	920.12
01	904.84	41	909.96	81	915.08	C1	920.2
02	904.92	42	910.04	82	915.16	C2	920.28
03	905	43	910.12	83	915.24	C3	920.36
04	905.08	44	910.2	84	915.32	C4	920.44
05	905.16	45	910.28	85	915.4	C5	920.52
06	905.24	46	910.36	86	915.48	C6	920.6
07	905.32	47	910.44	87	915.56	C7	920.68
08	905.4	48	910.52	88	915.64	C8	920.76
09	905.48	49	910.6	89	915.72	C9	920.84
0A	905.56	4A	910.68	8A	915.8	CA	920.92
0B	905.64	4B	910.76	8B	915.88	CB	921
0C	905.72	4C	910.84	8C	915.96	CC	921.08
0D	905.8	4D	910.92	8D	916.04	CD	921.16
0E	905.88	4E	911	8E	916.12	CE	921.24
0F	905.96	4F	911.08	8F	916.2	CF	921.32
10	906.04	50	911.16	90	916.28	D0	921.4
11	906.12	51	911.24	91	916.36	D1	921.48
12	906.2	52	911.32	92	916.44	D2	921.56
13	906.28	53	911.4	93	916.52	D3	921.64
14	906.36	54	911.48	94	916.6	D4	921.72
15	906.44	55	911.56	95	916.68	D5	921.8
16	906.52	56	911.64	96	916.76	D6	921.88
17	906.6	57	911.72	97	916.84	D7	921.96
18	906.68	58	911.8	98	916.92	D8	922.04
19	906.76	59	911.88	99	917	D9	922.12
1A	906.84	5A	911.96	9A	917.08	DA	922.2
1B	906.92	5B	912.04	9B	917.16	DB	922.28
1C	907	5C	912.12	9C	917.24	DC	922.36
1D	907.08	5D	912.2	9D	917.32	DD	922.44
1E	907.16	5E	912.28	9E	917.4	DE	922.52
1F	907.24	5F	912.36	9F	917.48	DF	922.6
20	907.32	60	912.44	A0	917.56	E0	922.68
21	907.4	61	912.52	A1	917.64	E1	922.76
22	907.48	62	912.6	A2	917.72	E2	922.84
23	907.56	63	912.68	A3	917.8	E3	922.92
24	907.64	64	912.76	A4	917.88	E4	923
25	907.72	65	912.84	A5	917.96	E5	923.08
26	907.8	66	912.92	A6	918.04	E6	923.16
27	907.88	67	913	A7	918.12	E7	923.24
28	907.96	68	913.08	A8	918.2	E8	923.32
29	908.04	69	913.16	A9	918.28	E9	923.4
2A	908.12	6A	913.24	AA	918.36	EA	923.48
2B	908.2	6B	913.32	AB	918.44	EB	923.56
2C	908.28	6C	913.4	AC	918.52	EC	923.64
2D	908.36	6D	913.48	AD	918.6	ED	923.72
2E	908.44	6E	913.56	AE	918.68	EE	923.8
2F	908.52	6F	913.64	AF	918.76	EF	923.88
30	908.6	70	913.72	B0	918.84	F0	923.96
31	908.68	71	913.8	B1	918.92	F1	924.04
32	908.76	72	913.88	B2	919	F2	924.12
33	908.84	73	913.96	B3	919.08	F3	924.2
34	908.92	74	914.04	B4	919.16	F4	924.28
35	909	75	914.12	B5	919.24	F5	924.36
36	909.08	76	914.2	B6	919.32	F6	924.44
37	909.16	77	914.28	B7	919.4	F7	924.52
38	909.24	78	914.36	B8	919.48	F8	924.6
39	909.32	79	914.44	B9	919.56	F9	924.68
3A	909.4	7A	914.52	BA	919.64	FA	924.76
3B	909.48	7B	914.6	BB	919.72	FB	924.84
3C	909.56	7C	914.68	BC	919.8	FC	924.92
3D	909.64	7D	914.76	BD	919.88	FD	925
3E	909.72	7E	914.84	BE	919.96	FE	925.08
3F	909.8	7F	914.92	BF	920.04	FF	925.16

3 Preventive Maintenance and Cleaning

Preventive Maintenance

Preventive maintenance is recommended to be performed on the Surveyor Central System once every 12 months.

Warning: Preventive maintenance is to be performed by Mortara authorized service personnel only. Prior to performing preventive maintenance, be sure the Surveyor Central system is not in active use and all of the clinical data on the system has been properly stored/archived.

Recommended Supplies

- Clean, lint-free cloth
- Cleaning solvent (isopropyl alcohol, 70% pure)
- DRY, low pressure, compressed air (30 psi)
- X12+ or T12 Transmitter
- AA Battery
- Patient Simulator
- Antenna Network Power Supply
- Covered Area Map
- UPS Batteries (if replacement is needed)

System / Network Verification

Node to node connectivity check:

From a Surveyor Central control node, communicate to the other nodes of the networked system by opening a command prompt and pinging each node's IP Address per the system network diagram.

Export and Archive Function:

Equipment needed: X12+/T12(S) transmitter, patient cable, patient simulator.

- Start a monitoring session on the Surveyor Central using the test transmitter and patient simulator.
- Once the system has had enough time to perform and display measurements on the system display, select 12-Lead+Exp from the Print Option menu.
- Verify the system has exported a digital copy of the ECG to either E-Scribe or the defined export location.
- Verify a hard copy was sent to the defined printer.
- Stop the monitoring session and select the option indicating that the monitoring session just stopped and archive the study from the "Patients" tab.
- Verify the archived data is present in the specified archive path.

Time Synchronization:

- Shutdown all nodes of the Surveyor Central system, except the storage server.
- On the storage server, expand the "Gaurdian" application.
- Right click anywhere in the guardian application screen and select "reboot".
- Once the server is booting up, verify that during the bootstrap process it states "Time Synchronized".

Audible Alarm Testing

Equipment needed: X12+/T12(S) transmitter, patient cable, patient simulator.

Alarm Volume Testing

Select the Configuration Menu and enter a password to proceed. Click on the “Volumes” button and then select “Sound Level”. Note what the sound level is set to, so it can be returned to this setting after the volume testing is completed. Select the different volume options and click on the “Confirm” button to test the audible level of the alarm. Once the levels have been tested, return the level to its original setting.

Alarm Trigger Testing

Admit a patient on the control system for the appropriate channel that you have configured your test transmitter. Verify the “ECG Leads Off” alarm is set to ON for the admitted patient by selecting Alarm Settings, then Technical Alarms. If the setting is set to OFF, temporarily change the setting to ON to perform this test. Disconnect a lead from the patient simulator and verify that an alarm begins to sound at the appropriate sound level set in the previous step (be sure to reset the alarm control settings to where they were prior to performing this test).

UPS Test / Battery Replacement

Be sure patient monitoring is not in progress. Remove the mains plug from the UPS; the Central Station must continue to function for 5 minutes without losing power. If the system can not be powered by the UPS for a period of 5 minutes, the UPS may require repair or internal battery replacement.

Mortara recommends replacing the internal batteries on the UPS units provided by Mortara when the RED “Battery End of Life” indicator is illuminated or every 3 years.

System Cleaning

Equipment needed: Vacuum cleaner or compressed air

Open system PCs and remove accumulated dust and debris. Take particular care around cooling fans and inside media access slots. Clean the area the PC(s) and peripheral equipment reside in, to prevent dust and debris accumulation from occurring.

Inspection of PC cooling fans

Inspect CPU fan, and power supply fan. If they are running too slowly or are making any unusual noises during operation, they should be replaced. For improperly operating PC power supply fans, Mortara recommends replacing the entire power supply unit.

Maximizing the Airflow

Keep the system server/s and the workstation/s in an area where the airflow to the front and rear of the system is not obstructed.

- If possible, keep the unit off of surfaces where dust can gather.
- Keep the back of the unit at least 6 inches away from a wall or other obstruction.
- Keep the front of the unit clear of any obstruction that keeps air from entering the front of the system.
- Remove any dust on the front panel (vent area) and the rear fans with a small vacuum, compressed air, or a clean lint free cloth.

Antenna Network Maintenance

Equipment needed: Ladder, flashlight and digital multi-meter.

- Verify all connections of coax cables are secure.
- Verify both lights are illuminated on each antenna network unit. If either light is out it could be caused by either a faulty antenna network box (which would need to be replaced), or a disconnected coax cable between this antenna network box and the next unit in the chain.
- If both lights are out it could be caused by a faulty antenna network power supply(s). Refer to the section “Power Supply Testing and Verification” below for troubleshooting.
- Verify the lights are illuminated on either the LNA 611/915 or the 2500MHZ Down Converter (depending on the system configuration). In the case of the Down Converter the light will indicate the selected band which the Telemetry Central 3.X is set to receive. If these lights are not illuminated it could be caused by a faulty power supply or faulty unit which would need to be replaced.

Antenna Network Power Supply Testing and Verification

WARNING

This process must be followed or damage to the antenna network may result. This process requires the measuring of DC voltage and requires the use of voltmeter, proper care must be used when working around electricity or personal injury may result. If you are not familiar with the use of a voltmeter do not proceed with the test, find a qualified person to perform the test.

- To test the proper operation of any of the antenna network power supplies, obtain a spare identical power supply and temporarily plug it into one of the antenna networks which currently does not have a power supply attached, and the wall.
- Remove the antenna network power supply connector of the power supply to be tested from the antenna network.
- Using a voltmeter measure output of the power supply, the voltmeter should read 12 volts DC.
- If 12 volt DC power is not present the power supply must be replaced.
- After successful testing, re-connect the power supply to the antenna network.
- Continue this process for all power supplies in the antenna network. When completed testing all of the power supplies, remove the spare power supply from the antenna network.

Printer Maintenance and Servicing

Refer to the provided network printer manual for diagnostic testing, error logs, troubleshooting flow chart and prescribed maintenance.

Signal Strength Verification

Antenna Network Verification (covered area)

Equipment needed: ECG Simulator, X-12+/T12x Transmitter, and map of covered area.

- Turn on ECG simulator with transmitter and simulator connected.
- Set channel on one monitoring slot of Surveyor Telemetry Central System to match the selected transmitter channel and start monitoring.
- Refer to the original “covered area” map to determine which areas of the facility should display acceptable levels of signal strength.
- Document specific locations on the covered area map by location number (1 thru X) and locate the transmitter at these locations while monitoring the signal strength on the Surveyor Central system,
- Ensure there are no problems with low signal strength readings, or intermittent signal drop out for the locations defined on the covered area map. Signal strength readings should measure >-80db throughout the entire covered area.
- Document the signal strength readings for Antenna A and B on the PM report.

System Receiver Module Verification

After verifying one of the receiver modules meets specifications during the previous “Signal Strength Verification” testing, the test transmitter should be mapped to each of the separate receiver modules installed in the system hardware.

Each receiver module should be checked for proper operation, making sure that the signal strength level measures >-80db and the ECG waveforms do not show signs of distortion or drop out with the transmitter placed at location #1 from the previous test.

System Transmitter Verification

Turn on the ECG simulator and connect it to one transmitter at a time from location #1 defined in the previous tests. Start a monitoring session on the monitoring slot that matches the channel of the transmitter being tested and verify the ECG quality is clean with out dropout and has a signal strength >-80db.

Repeat this test for all system transmitters.

Mortara Instrument Inc.

Mortara Instrument, Inc.
7865 N. 86th Street
Milwaukee, WI. 53224

Phone (414) 354-1600
Fax (414) 354-4760

Surveyor Central Preventive Maintenance Report

System Serial #: _____

- □ System/Network Verification
  - □ Verify network connectivity from node to node
  - □ Test export and archive functions
  - □ Check Time Synchronization
- □ Audible Alarm Testing
- □ UPS Testing / UPS Battery Verification - Check if N/A ____
  - □ UPS Testing
  - □ UPS Battery Verification
    Replaced Date _____/_____/_____ or Not yet Required ____ (check)
- □ System PC(s) Inspection/Cleaning
- □ Antenna Network Maintenance
  - □ Coax Cable Check
  - □ Antenna Network Box Check
  - □ LNA/Down Converter Check
  - □ Antenna Network Power Supply Check
- □ System Printer(s) - Check if N/A ____
  - □ Functional Check
  - □ Printer Cleaning
- □ Signal Strength Verification
  - □ Antenna Network Verification (attach covered area map w/locations)

Transmitter Location	Antenna A Power	Antenna B Power
1		
2		
3		
4		
5		
6		

  - □ System Receiver Module Verification
  - □ System Transmitter Verification

Technician or Field Service Engineer: _____ Date: _____/_____/_____

4 Trouble Shooting

Surveyor Central 3.x

1. If Printouts seen with the following errors:

? **=** The generating process is not able to generate the parameter because of technical problems.
?? **=** The parameter is expected but has not been received.
??? **=** The received parameter is outside a valid range, or has been marked "invalid" by the generating process.
- - **=** Parameter is disabled by the generating process.

Possible solutions:

- Check to see that the transmitter is not out of range and is functional
- The parameter may be outside of a valid clinical range
- The parameter is disabled by the generating process (e.g. monitoring stopped or cardiac arrest)
- Try selecting a different time point and reprint needed printout
- Possible system error – Contact Mortara Technical Support

2. Telemetry Central does not print:

Possible solutions:

- Printman.exe not running on the storage system. If Printman is not running restart task in guardian, located on the storage node by right clicking on the Guardian screen, then select Start Application, and double click on Printman.

- Printer malfunction, troubleshoot printer, i.e, does printer print test page?

- If the printer is able to print a test page, verify the printer has the correct IP address assigned to the printer. The IP address is accessed in the printer by pressing the **MENU** button, use the up down arrow keys to highlight the desired option, select **CONFIGURE DEVICE, I/O, EMBEDDED JET DIRECT, TCP/IP, MANUAL SETTINGS, IP ADDRESS.** If the IP address is not correct, make changes to correct the address.

- Verify the printer, and all nodes are properly connected to a switch/router and power is connected to the switch and router. If the network cable is properly connected to the printer and the switch you will see an indicator light 'on' near the network cable connection.

- Verify IP Address is correctly installed in the System and the printer. To do this, Select Printer and Faxes in the Control Panel. Next right click on the printer and select properties. Inside of the properties selection, navigate to the Port tab and verify IP address located here matches the IP of the printer.

Local troubleshooting should be performed using the supplied manual and its 'Problem Solving' and 'Troubleshooting Flow Diagrams'. More information on the HP 4250 Printer: hp 4250 printer manual can be found on the internet.

3. Control Station displays "Storage Disabled":

Possible solutions:

- Verify that Storage Node is on
- If Storage node is on, check the processes running on storage node and make sure Storeman.exe is still running. If not, restart the process by right clicking on the Guardian screen and select Start application and then double click on Storeman
- If "Storage Disabled" is only displaying on certain monitoring slots and the data can be reviewed, this is a false message. The data is properly storing and only displaying the message because the sending process is not being properly acknowledged..
- Possible faulty connection of view station to Storage Node. Check connections to all computers, and switches. Network cable to storage server should go to the standard network port, and not the port labeled iLO

After checking all of the above and the Storage function is still not working properly:
Contact Mortara Instrument service department for assistance.

4. Watchdog Alarms:

- **"Odd" sound heard every few minutes:**
  Possible solutions:
  - Unit has the alarms disabled

  Note: When alarms are disabled no alarms will sound, this includes the arrest alarm, be careful when choosing to disable alarms. The customer assumes all risks for turning off alarms.

- **Rapid beeping tone emitted from system:**
  Possible solutions:
  1. Verify that there is power to the watchdog unit located on the side of the control station
  2. Check to make sure that all Guardian processes are running and has a green indication light next to it. If it has a red or orange indication dot by it, close and then restart that process

- **Rapid beeping tone emitted from system along with high pitched tone:**
  Possible solution:
  1. Check the USB cable connection between the watchdog and the control station.

5. Can not assign patient, review patient, perform resting interpretation:

Possible solution:

- Verify all Guardian processes are running and has the green indication light, if there is a red light by one of the processes, restart that process
- Possible problem with Time synchronization, refer to section below
- Incorrect IP address prevents these processes from running, contact Mortara Instrument service department for assistance.

6. No waveforms displayed, problems with printing, storage, and review:

Possible solution:

- Possible problem with the time synchronization.
- Try to close and then restart Timeman.exe. To close Timeman.exe, access the Task Manager by pressing Ctrl+Alt+Delete. Next, expand the Guardian application and right click on Timeman process. Then select "Close Process" and right click again and select "Start Application" and double click on Timeman. This will restart the Timeman application and resynchronize the time service.

7. Analysis, Full Disclosure, and Clinical Options not working:

Possible solution:

- Verify system has this feature enabled by Mortara
- Possibly the hash key has been changed. If this is changed all options are disabled, contact Mortara Instrument service department for assistance.

8. Forgotten Password:

Possible solutions:

- Try typing 'mortara' (all lower case) as password, if this does not work, contact Mortara Instrument service department for assistance, to reset password.

9. No Telemetry signal present, symptom related to only 1 patient window:

- **Square waves on display for 1 patient only.**

Possible solutions:

1. Make sure transmitter is turned on and tuned to the correct channel number.

2. Check received signal strength on this channel. If received strength is approx –120 dB verify monitoring slot and transmitter are set to the same channel. To verify this information click on the slot you suspect is bad, the channel number will be displayed on the top left corner of the patient window. The received signal strength selection will be located in Settings then Received Power. Once it is selected it will be displayed in monitoring slot window.

3. If possible try another known good transmitter tuned to the channel of the window to narrow it down to what is causing the problem. If the signal shows after the transmitter swap, then it is a defective transmitter. If the tracings still do not show, then it is more than likely a receiver module.

4. Check transmitter hookup, leads, electrodes, patient connector of cable. If signal strength is -110 dBm transmitter is out of range of nearest antenna network.

5. After verifying that the above solution did not correct the problem, one of the receiver cans on the PCIRF board can be the cause of the problem. If this is the case, please contact Mortara Tech support.

10. No Telemetry signal present, symptom related to all windows:

Possible solutions:

- Verify signal strength, if strength approx –180 PCIRF card driver not running, restart Telemetry node.
- If signal level is approx –120 dB, problem may be connected to the antenna network. Verify all LED's are illuminated on the Antenna Network Units, Down Converter/ LNA(611/915) depending on system configuration and verify cable connections.
- Be sure Down Converter if a 2500MHz system, is on the same band as the transmitters in use. (See channel utilization chart for customer). Disconnect the antenna network cables from the input of the Down Converter, install antennas on the inputs of the Down Converter, if the problem is gone the problem is related to the antenna network.
- If system is 608/915MHZ, disconnect cables from antenna network on LNA(611/915), install antennas on the PCIRF board(s), if the problem is gone, the problem is related to the antenna network.

11. Antenna Network:

- **Bad Coverage in 1 area:**

  Possible solutions:

  - Possible problem with a specific antenna network unit. Check unit has both LED's illuminated.

    This symptom can be caused by several failures.

  - If the area is related to the antenna, which is farthest from the Telemetry node, the problem could be either the antenna box or a cable leading to the next antenna in the chain.
  - If the area is related to an antenna elsewhere in the network, the problem is most likely due to the antenna network unit which services the area in question.

- **Large difference between signal A and signal B one window only:**

  Possible solution:

  - This problem may be related to a faulty receiver on a specific PCIRF board. Contact Mortara Technical Support for a Replacement board.

- **Large difference between signal A and signal B all windows:**

  Possible solution:
  - Check all coax cables to look for a problem related to a BNC connector.
  - Try to replace the Down Converter (2500 MHz systems) or LNA-611/915 (600 & 915 MHz systems).

- **Interference:**

  - Possible causes: Microwave ovens, Bluetooth devices, 2500 MHz wireless routers, cordless Phones, wireless temperature monitoring system, or radar therapy devices. It is the responsibility of the facility to narrow down the cause of the interference and isolate it.

12. IT Network:

On a Microsoft Windows XP® or 2003 Server® systems, run 'pathping' (like ping) between the Surveyor Central 3.x System devises to verify that no packet drop out exists. If a packet loss occurs, there is a network issue.

- **Fast Ethernet Switch Troubleshooting**

Possible Solution:

- If there is a problem with the switch, power cycle switch to restore connections
- If the Power LED or indicator is OFF:

1. Ensure the power cord is secure at both ends, and is not damaged.
2. Verify that the outlet has power.
3. Verify the cable is not damaged, pinched or frayed. Replace if this is the case.
4. Try using another power cord that is of an identical type.

- **LINK or Activity LED is OFF**

- The LINK LED is usually OFF when the device at the other end of the CAT 5 cable is OFF, disconnected, the CAT 5 cable is faulty, or the CAT 5 connector has oxidized and requires cleaning. The LINK LED at the switch, is illuminated when there is another device attached via a CAT 5 cable.

1. Make sure the CAT 5 cable connections are clean and properly connected.
2. Make sure both devices attached to the CAT 5 cable are powered on.
3. The CAT 5 cable is faulty. This may be apparent after checking the cable connections, or, if the LEDs on the end-node devices are both OFF.
4. The CAT 5 maximum cable length must not exceed 100 meters or 328 feet. If the CAT 5 cable exceeds 328 feet, performance may be diminished.
5. The devices attached to the cable, must be configured identically for 10 Mbps or 100 Mbps.

13. VPN Router setup:

Possible Solution:

- If any of the features below are not working correctly, the router may be the cause. A copy of the VPN router setup is stored on the storage PC, it is named CustomCyberConfig.sgc.

1. Unable to export to Unipro server.
2. Unable to Archive study data.
3. Unable to store 12 lead ECG's on the E-Scribe.
4. Time on Central System not in sync with the external time server.

Please contact Mortara Tech Support for assistance.

14. Power Up and Power Down Procedure:

- **To Power down Surveyor Central Telemetry System proceed as follow:**

    1. First, power off the Control Nodes (SCV1 & SCV2) normally located in Nurses Station:
        - Stop monitoring of all patients.
        - Select the **Config** tab at the bottom right hand corner of the screen.
        - Password is **mortara or Facility's password**.
        - Select **Shutdown Computer**.

    2. Next, power off the Telemetry Nodes (SCT1 & SCT2) normally located in IT closet:
        - Expand the **Guardian** Process.
        - Right click on Guardian window and a pop up asking for the password will appear, password is **mortara**, and select **Shutdown System.**

    3. The last step in shutting down the Surveyor Telemetry Central is to shut down the Storage Node (SCS1) also located in IT Closet:
        - Expand **Guardian**.
        - Right click on Guardian window and a pop up asking for the password will appear, password is **mortara**, and select **Shutdown System.**

- **To Power On Surveyor Telemetry Central System proceed as follow:**

    1. Power on the system in the following order **Storage Node (SCS1)**, then the **Telemetry Nodes (SCT1 & SCT2)** and finally the **Control Nodes (SCV1 & SCV2).**

Note: Powering off and on of the Surveyor Telemetry Central system has to be done in the exact orders as stated above. Failure to follow instructions will cause unwanted problems. Disregard the procedure if your Surveyor Telemetry Central System is a stand-a-lone system.

15. Repeater Node not working:

- **No Tracings seen on screen:**

    Check IP address:

    1. Right click on Repeater shortcut Icon and select Properties
    2. In the Shortcut Tab, verify the Target line lists the correct IP
    3. Verify that all processes running on Guardian has a green dot next to them

    Verify the channels are selected:
    1. Click on CONFIG and enter password.
    2. In the bed list make sure the beds you want are checked and view leads are selected.

16. Reviewer Node not working:

- Verify all network cables are connected
- Verify that all processes running on Guardian has a green dot next to them
- Verify dongle has correct permissions
- Check that the correct Data Source Type is selected
- Verify location of Data Source Type is correct
- If viewing Online Database, verify IP address is correct

17. No Plethysmograph tracing is displayed:

- Verify that Surveyor Telemetry System has software version 3.20
- In the Config menu, verify that the transmitter type in the Monitor Kind field is set to T12S.
- Verify that the transmitter used is a T12S
- Check SpO2 sensor finger clip/wrap and verify that the sensor indicator light is on
- Make sure that the Plethysomograph is selected in the Settings menu, under Display and 12-Lead. The system can only display 12 tracings total. Therefore, in order to display the plethysomograph, one of the other lead tracing will have to be unchecked and the plethysomograph selected

18. Error Logs:

- Each individual Surveyor System PC has it's own error logs. The error logs are located in C:\Central\Logs and they are date stamped with Debug.log being the most present copy
- Once error logs are retrieved from the location mentioned above, look through the correct error log at the time the error occurred. These files are a very important part in Mortara technical support's troubleshooting efforts
- Example Error Logs:

  The example listed below displays an issue with the time being out of sync:

  <11>Jan 7 08:23:21.843 192.168.10.111 SCV1T1 1332 timeman.exe 1900 E timeapp.cpp 467 TimeApp::timesync_loop Time overflow: Server Time '01/07/2009 14:22:24' (utc), Diff (srv-self) - 56875, limit 200 ms
  <13>Jan 7 08:23:24.483 192.168.10.111 SCV1T1 1352 soundman.exe 280 M medapp.cpp 985 MedicalApplication::set_running Bed (1,0) status: RUNNING
  <13>Jan 7 08:23:24.483 192.168.10.111 SCV1T1 1332 timeman.exe 1900 M medapp.cpp 985 MedicalApplication::set_running Bed (1,0) status: RUNNING
  <13>Jan 7 08:23:24.514 192.168.10.111 SCV1T1 1380 centralview.exe 1384 M medapp.cpp 985 MedicalApplication::set_running Bed (1,0) status: RUNNING
  <13>Jan 7 08:23:24.514 192.168.10.111 SCV1T1 1380 centralview.exe 1384 M centralbed.cpp 52 CentralBed::set_status MONITOR_RUNNING_BLIND
  <13>Jan 7 08:23:24.577 192.168.10.111 SCV1T1 1380 centralview.exe 1384 M centralbed.cpp 52 CentralBed::set_status MONITOR_RUNNING_BLIND
  <12>Jan 7 08:23:25.467 192.168.10.111 SCV1T1 1380 centralview.exe 1384 W mainscreen.cpp 466 TFormMain::cmd_ack_timeout_handle Cmd CMD_START_SESSION to: REPEATER not acknowledged
  <11>Jan 7 08:23:31.997 192.168.10.111 SCV1T1 1332 timeman.exe 1900 E timeapp.cpp 467 TimeApp::timesync_loop Time overflow: Server Time '01/07/2009 14:22:35' (utc), Diff (srv-self) - 56872, limit 200 ms
  <11>Jan 7 08:23:42.150 192.168.10.111 SCV1T1 1332 timeman.exe 1900 E timeapp.cpp 467 TimeApp::timesync_loop Time overflow: Server Time '01/07/2009 14:22:45' (utc), Diff (srv-self) - 56868, limit 200 ms

  The error logs will provide the date, time, IP address of the PC the logs were extracted from, Computer name, error identifier number, the process that generated the message, and the status of the message. Once the error logs are extracted, searching for key words such as: crash, restart, etc. will help in finding the cause of the error.

  If further investigation is needed, email a copy of the error logs to Mortara Tech Support with a brief description of the problem with the time and date that this error occurred.

Conformance Testing

Conformance testing is to be performed by Authorized Mortara Service Representatives to verify the device is functioning correctly after repair operations have been performed. Testing results should be documented on the test data record at the end of this section of the manual.

Due to the complexity of the Surveyor Central System, not all sections of the conformance testing procedure may be required to verify conformance of a particular repair activity. Based upon the repair performed, the repair technician may deem various sections as “non-applicable” since they were not related to the functions associated with the repair; in such cases the decision to exclude a section shall be documented on the test data record provided.

System/Network

Node to node connectivity check:

From a Surveyor Central control node, communicate to the other nodes of the networked system by opening a command prompt and pinging each node’s IP Address per the system network diagram.

Export and Archive Function:

Equipment needed: X12+/T12(S) transmitter, patient cable, patient simulator.

- Start a monitoring session on the Surveyor Central using the test transmitter and patient simulator.
- Once the system has had enough time to perform and display measurements on the system display, select 12-Lead+Exp from the Print Option menu.
- Verify the system has exported a digital copy of the ECG to either E-Scribe or the defined export location.
- Verify a hard copy was sent to the defined printer.
- Stop the monitoring session and select the option indicating that the monitoring session just stopped and archive the study from the “Patients” tab.
- Verify the archived data is present in the specified archive path.

Time Synchronization:

- Shutdown all nodes of the Surveyor Central system, except the storage server.
- On the storage server, expand the “Gaurdian” application.
- Right click anywhere in the guardian application screen and select “reboot”.
- Once the server is booting up, verify that during the bootstrap process it states “Time Synchronized”.

Audible Alarm Testing

Equipment needed: X12+/T12(S) transmitter, patient cable, patient simulator.

Alarm Volume Testing

Select the Configuration Menu and enter a password to proceed. Click on the “Volumes” button and then select “Sound Level”. Note what the sound level is set to, so it can be returned to this setting after the volume testing is completed. Select the different volume options and click on the “Confirm” button to test the audible level of the alarm. Once the levels have been tested, return the level to its original setting.

Alarm Trigger Testing

Admit a patient on the control system for the appropriate channel that you have configured your test transmitter. Verify the “ECG Leads Off” alarm is set to ON for the admitted patient by selecting Alarm Settings, then Technical Alarms. If the setting is set to OFF, temporarily change the setting to ON to perform this test. Disconnect a lead from the patient simulator and verify that an alarm begins to sound at the appropriate sound level set in the previous step (be sure to reset the alarm control settings to where they were prior to performing this test).

UPS (Uninterruptable Power Supply)

Be sure patient monitoring is not in progress. Remove the mains plug from the UPS; the Central Station must continue to function for 5 minutes without losing power. If the system can not be powered by the UPS for a period of 5 minutes, the UPS may require repair or internal battery replacement.

Mortara recommends replacing the internal batteries on the UPS units provided by Mortara when the RED “Battery End of Life” indicator is illuminated or every 3 years.

Antenna Network

Equipment needed: Ladder, flashlight and digital multi-meter.

Verify all connections of coax cables are secure.

Verify both lights are illuminated on each antenna network unit. If either light is out it could be caused by either a faulty antenna network box (which would need to be replaced), or a disconnected coax cable between this antenna network box and the next unit in the chain.

If both lights are out it could be caused by a faulty antenna network power supply(s). Refer to the section “Power Supply Testing and Verification” below for troubleshooting.

Verify the lights are illuminated on either the LNA 611/915 or the 2500MHZ Down Converter (depending on the system configuration). In the case of the Down Converter the light will indicate the selected band which the Telemetry Central 3.X is set to receive. If these lights are not illuminated it could be caused by a faulty power supply or faulty unit which would need to be replaced.

Antenna Network Power Supply Testing and Verification

WARNING

This process must be followed or damage to the antenna network may result. This process requires the measuring of DC voltage and requires the use of voltmeter, proper care must be used when working around electricity or personal injury may result. If you are not familiar with the use of a voltmeter do not proceed with the test, find a qualified person to perform the test.

- To test the proper operation of any of the antenna network power supplies, obtain a spare identical power supply and temporarily plug it into one of the antenna networks which currently does not have a power supply attached, and the wall.
- Remove the antenna network power supply connector of the power supply to be tested from the antenna network.
- Using a voltmeter measure output of the power supply, the voltmeter should read 12 volts DC.
- If 12 volt DC power is not present the power supply must be replaced.
- After successful testing, re-connect the power supply to the antenna network.
- Continue this process for all power supplies in the antenna network. When completed testing all of the power supplies, remove the spare power supply from the antenna network.

Antenna Network Verification (covered area)

Equipment needed: ECG Simulator, X-12+/T12x Transmitter, and map of covered area.

- Turn on ECG simulator with transmitter and simulator connected.
- Set channel on one monitoring slot of Surveyor Telemetry Central System to match the selected transmitter channel and start monitoring.
- Refer to the original “covered area” map to determine which areas of the facility should display acceptable levels of signal strength.
- Document specific locations on the covered area map by location number (1 thru X) and locate the transmitter at these locations while monitoring the signal strength on the Surveyor Central system,
- Ensure there are no problems with low signal strength readings, or intermittent signal drop out for the locations defined on the covered area map. Signal strength readings should measure >-80db throughout the entire covered area.
- Document the signal strength readings for Antenna A and B on the PM report.

System Printer(s)

Refer to the provided network printer manual for diagnostic testing, error logs, troubleshooting flow chart and prescribed maintenance.

Receiver Module(s)

After verifying one of the receiver modules meets specifications during the previous “Signal Strength Verification” testing, the test transmitter should be mapped to each of the separate receiver modules installed in the system hardware.

Each receiver module should be checked for proper operation, making sure that the signal strength level measures >-80db and the ECG waveforms do not show signs of distortion or drop out with the transmitter placed at location #1 from the previous test.

Transmitter(s)

Turn on the ECG simulator and connect it to one transmitter at a time from location #1 defined in the previous tests. Start a monitoring session on the monitoring slot that matches the channel of the transmitter being tested and verify the ECG quality is clean with out dropout and has a signal strength >-80db.

Repeat this test for all system transmitters.

Surveyor CentraConformance Testing

System Serial #: _____

System/Network _____ Pass/Fail/NA

Verify network connectivity from node to node
Test export and archive functions
Check Time Synchronization (where applicable)

Audible Alarm Testing _____ Pass/Fail/NA

UPS (Uninterruptable Power Supply) _____ Pass/Fail/NA

- □ UPS Testing
- □ UPS Battery Verification

Replaced Date _____/_____/_____ or Not yet Required ____ (check)

Antenna Network _____ Pass/Fail/NA

- □ Coax Cable(s)
- □ Antenna Network Box(s)
- □ LNA/Down Converter

Antenna Network Power Supply(s) _____ Pass/Fail/NA

Antenna Network Verification (attach covered area map w/locations) _____ Pass/Fail/NA

Transmitter Location	Antenna A Power	Antenna B Power
1		
2		
3		
4		
5		
6		

System Printer(s) _____
Pass/Fail/NA

- □ Functional Check
- □ Printer Cleaning

System Receiver Module(s) _____ Pass/Fail/NA

System Transmitter(s) _____ Pass/Fail/NA

Performed by: _____ Date: _____/_____/_____

5 System Specifications

Surveyor Central System Specifications

Safety and essential performance standards:

Workstations, Printer, Monitor:	UL-listed, Comply with FCC part 15, class B, CE-labeled according to EU directives 73/23 (Low Voltage) and 89/336 (Electromagnetic Compatibility)
Transmitter:	UL-listed, complies with FCC part 15 (2500 MHz, 608 MHz and 915 MHz), CE labeled according to EU directives 93/42 (Medical Device) and 99/5 (Radio and Telecommunications Terminal Equipment), complies with ANSI/AAMI EC11 and ANSI/AAMI EC13 Complies with IEC 60601-1 (CF, Internal power), IEC 60601-2-25, IEC 60601-2-27 (where applicable) Complies with IEC 60601-1-2, ETS 300-440, ETS 300-683 T12S only: Complies with ISO 9919 Classified as IPX2 per IEC60529
Antenna network, receivers:	UL-listed, Comply with FCC part 15 (2500 MHz, 608 MHz and 915 MHz) CE labeled according to EU directives 93/42 (Medical Device) and 99/5 (Radio and Telecommunications Terminal Equipment) (2500 MHz network) Complies with IEC 60950, IEC 60601-1-1 and IEC 60601-1-2 Complies with ETS 300 440, ETS 301 489
System:	International versions are CE labeled according to EU directives 93/42 (Medical Device) and 99/5 (Radio and Telecommunications Terminal Equipment) (2500 MHz network) Complies with IEC 60601-1-1, 60601-1-2, 60601-1-4, 60601-1-8 Complies with ANSI/AAMI EC11 (applicable parts) and ANSI/AAMI EC13 Complies with ISO 9919 (together with T12S transmitter only) Note: Also complies with the equivalent European Union standards (EN60…..)

ECG

12-lead ECG acquisition:	I, II, III, avR, avL, avF, V1, V2, V3, V4, V5, V6
Acquisition:	10,000 samples/s for pacemaker detection, reduced to 500 samples/s
Resolution:	2.5 µV.
Dynamic range/offset tolerance:	± 340mV
Input dynamic:	680 mV
Common Mode Reduction Ratio:	100dB, up to 180 dB with digital filter at 50 or 60Hz (ANSII/AAMI EC 13)
Frequency response:	Diagnostic ECG-standard ANSII/AAMI EC11 and ECG monitoring standard ANSII/AAMI EC13

Input impedance:	47MΩ
Electrodes:	Compatible with ANSII/AAMI EC12
Defibrillator protection:	Only when used with Mortara Instrument ECG cables
Beat detection:	Sensitivity 99.90%, positive predictivity 99.88% (AHA/MIT data base)
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
ST level measurement:	Range: -2500 – 2500 μV (-25 – 25 mm) Resolution: 10 μV (0.1 mm) Measurement error: Mean 6 μV, Standard Deviation 60 μV as measured according to ANSI/AAMI EC57 on the ESC-ST database
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 presentation:	Internal speaker 5 volume settings between 60 and 87 dBA

SpO_2
(optional - requires T12S)

Pulse Oximetry Transmitted: (optional)	Plethysmographic waveform, oxygen saturation percent (SpO_2%), pulse rate, and probe status spot check during hookup; continuous acquisition and transmission during monitoring
SpO_2% Accuracy**:	70% - 100% SpO_2: $E_{RMS} = \pm 2.2\%$
SpO_2 Pulse Rate Accuracy**:	45 – 210 BPM: $E_{RMS} = \pm 2\%$
SpO_2 Measurement wavelength:	Red: 660nm at 3.5 to 4.5 mW nominal Infrared: 905nm at 3.5 to 4.5 mW nominal

****** *Verified by clinical tests where measured values of the sensors were compared with arterial CO-oximetry in adult subjects over the specified SpO_2 range. Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within the E_{RMS} of the value measured by a CO-oximeter.*

Alarm Groups

Electrocardiogram:	Arrest:.....High priority, limits 2-8 seconds VFIB:.....High priority Bradycardia: .....High priority, low HR – 20 bpm Low Heart Rate: .....Medium priority, limit 20-100 bpm High heart rate: .....Medium priority, limit 50-250 bpm Tachycardia: .....High priority, high heart rate + 50 bpm
Ventricular Tachycardia:	VTACH:.....Medium/high priority (user selectable), 3 – 20 beat run length (user selectable), 100 – 200 beats/min (user selectable) Sustained VTACH:....High priority, > 30 second duration
ST Change:	ST Increase:.....Medium priority ST Decrease:.....Medium priority User-selectable limits 100-900μV (1 – 9 mm) change User-selectable ST delay, post J-point (0-200 ms)
Extended Arrhythmias: (optional)	**Medium, low, or information only/On or Off (user selectable)** Trigeminy, Bigeminy, High Ectopic Rate, R-on-T Rate, Multifocal Ectopics, Couplet, High Couplet Rate, Ventricular Run, 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
Resting ECG: (optional - requires 12-lead Interpretation)	**Low or information only priority/On or Off (user selectable)** QTc High:.....300-500 msec QTc-Bazett High: .....300-500 msec QTc-Fridericia High: .....300-500 msec
SpO_2: (optional - requires T12S)	**High, medium or low priority/On or Off (user selectable)** SpO_2 Low: .....Medium priority, 70-98% saturation Desaturation:.....High priority, 10% below SpO_2 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:	**Information only**: Battery Low, Electrode impedance test, 12-lead ECG taken, Synchronizing clocks, No AC-Power, System battery power low **Low priority:** Printer error, Printer off-line, Storage space < 24hr, Deleting old sessions, Hard disk full, Storage system unreachable, Repairing database **Low or information only (user selectable):** ECG Leads Off, ECG Noise, No Radio Signal, Radio Interference. **Medium, low, or information only/On or Off (user selectable):** Patient Call **Medium priority:** No Heart rate, ECG monitoring disabled, Alarm engine fault
Protocol events: (optional)	**Information only**: Protocol completed, Protocol aborted **Medium, low or information only/On or Off (user selectable):** Step change, Phase change (user-selectable texts)
ALARMS OFF:	**Information only with audible reminder (user selectable)**

Storage

Period:	0 to 600 days (optional)
Continuous:	12 lead ECG at 500 Samples/s @ 2.5 μV LSB (optional)
12 lead average waveform:	every 5 s: 500 Samples/s @ 2.5 μV 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_2, 12-lead ST
Alarms:	Physiological alarms, clinical alarms, protocol events, 12-lead ECG printout events
RR-intervals and beat labels:	2 ms resolution

Configuration

Storage Configurations:	1) Storage on local workstation 2) Storage on redundant (RAID1+0) server
Component Configurations:	1) Receiving workstation with support for up to 16 channels 2) Control workstation with support for up to 32 channels 3) Control and receive on one workstation 4) Control, receive, and storage on one workstation 5) Storage on redundant (RAID1+0) network server
Maximum number of telemetry channels per system:	Up to 128 channels per Surveyor Central system (depending on frequency band, 2500 MHz, 608 MHz or 915 MHz; more than one storage station 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 e TCP
Distance Switch-station:	Max 100 m
Cable:	8 wire twisted pair Cat 5
Connectors:	RJ-45
Router Firewall support:	ICSA certified, 120 Mb/s throughput
Router VPN support :	VPN server, 30 Mb/s throughput
Router ports:	4 RJ-45 internal, 100Base-T 1 RJ-45 external, 100 Base-T,
Router IP addressing:	Fixed or DHCP

Size

Central Workstation:	45 x 17 x 46 cm (18 x 7 x 18 inches) cables overall ≈ 10 cm (4 inches)
Redundant Network Server:	47 x 26 x 66 cm (18.5 x 10.25 x 26 inches) cables overall ≈ 10 cm (4 inches)
Monitor:	20 x 42 x 43 cm (8 x 16.5 x 17 inches) cables overall ≈ 10 cm (4 inches)
Printer	41 x 55 x 104 cm (16.2 x 21.5 x 41.1 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)

Weight

Central Workstation:	16 Kg (35 lbs.)
Redundant Network Server:	27.24 Kg (60 lbs.)
Monitor:	3 Kg (6.5 lbs.)
Printer	20.4 Kg (45 lbs)
Keyboard:	1 Kg (2.2 lbs.)
Mouse:	128 grams (4.5 oz.)

Screen

Resolution and Optimal Number of Traces per monitor:	19 “ Single Display 1280x1024 dots: 16 traces are optimal 24 “ Single Display 1920x1200 dots: 24 traces are optimal 19” Dual Display 1280x1024 dots: 32 traces are optimal
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” LCD in single or dual display mode, 24” display in single-display mode

Printer

Technology:	Black and white laser jet, networked
Printout types:	Rhythm, 12-lead ECG, ST report, Trends
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
Workstation UPS:	VA rating:900; wattage rating: 460W*
Server UPS:	VA rating:2200;wattage rating: 1980W*
	*Provides power for a minimum of 10 minutes after power outage in typical use
Number of outlets needed:	2 or 3, per workstation, depending on system configuration
Voltage:	100-240 V
Power:	Workstation computer: rated 460W, typical 215W* Redundant (RAID1+0) server rated 1050W, typical 550W" Monitor 37W* (19" LCD) Printer: 800 W printing, 20 W stand-by *Approximation: actual values depend on system configuration
In-rush current (3 ms):	Redundant (RAID1+0) Server: 70A@230V, 35A@115V

Redundant (RAID) Server Environmental Conditions

BTU Rating:	3,500 BTU/hr max, 1,600 BTU/hr typical
Transporting:	-40° to +60°C 10% to 90% humidity w/o condensation 500 hPa to 1060 hPa pressure Maximum altitude 9,144 m (30,000 feet)
Operating:	+10° to +35°C 10% to 90% humidity w/o condensation 700 hPa to 1060 hPa pressure Maximum Altitude 3,048 m (10,000 feet)

Workstation Computer Environmental Conditions

BTU Rating:	2,400 BTU/hr max, 740 BTU/hr typical
Transporting:	-40° to +60°C 10% to 90% humidity w/o condensation 500 hPa to 1060 hPa pressure Maximum altitude 9,144 m (30,000 feet)
Operating:	+10° to +35°C 10% to 85% humidity w/o condensation 700 hPa to 1060 hPa pressure Maximum altitude 3,048 m (10,000 feet)

2500 MHz Antenna Network

Distance between 2 amplifiers:	15 meters (49.2 feet)
Amplifier/Splitter: Dimensions:	AN-2500+ range 2401 to 2483 MHz amplification: 10dB power input: 12V DC max, 310 mA connector D.5.5mm, central pin + (positive) 13.5 cm x 13.5 cm x 5 cm (5.3 x 5.3 x 2 inches) 325 grams (11.5 oz.)
Down converter DC-2500: Dimensions:	Output range: 900 – 930 MHz, with 4 input bands. Channels on bands 1 to 4: 1: 0 to 3F (2.4 – 2.421 GHz) 2: 40 to 7F (2.421 – 2.442 GHz) 3: 80 to BF (2.442 – 2.462 GHz) 4: A0 to FF (2.462 – 2.484 GHz) Power input: 12 V DC, max; 500 mA Connector D.5.5mm, central pin + (positive) 13.5 cm x 13.5 cm x 5 cm (5.3” x 5.3” x 2”) 325 grams (11.5 oz.)
Cable:	Low Loss Coaxial Cable: BELDEN #9310 / Times Microwave LMR200, attenuation: ≈ 10dB /15 meters @ 2.45 GHz; or Times Microwave LMR400, attenuation: ≈ 10dB /45 meters @ 2.45 GHz Plenum Rated Coaxial Cable for 2500 MHz networks: Times Microwave LMR-195-LLPL, attenuation: ≈ 10dB /15 meters
Power requirements:	One power supply every 5 amplifiers Power supply current: 0.6 A Nominal voltage: 100-240 V

915 MHz Antenna Network (ITU region 2 only)

Distance between 2 amplifiers:	20 meters (66 feet)
Amplifier/Splitter: Dimensions:	AN-915 range 904.76 to 925.15 MHz amplification: 10dB power input: 12V DC max, 310 mA connector D.5.5mm, central pin + (positive) 13.5 cm x 13.5 cm x 5 cm (5.3 x 5.3 x 2 inches) 325 grams (11.5 oz.)
Low Noise Amplifier LNA-915 : Dimensions:	Power input: 12 V DC, max; 500 mA Connector D.5.5mm, central pin + (positive) 13.5 cm x 13.5 cm x 5 cm (5.3” x 5.3” x 2”) 325 grams (11.5 oz.)
Cable:	Plenum Rated Coaxial Cable for 915 MHz networks: BELDEN #82907, attenuation: ≈ 9.5 dB / 20 meters @ 915 MHz
Power requirements:	One power supply every 5 amplifiers Power supply current: 0.6 A Nominal voltage: 100-240 V

608 MHz Antenna Network (US and Canada Only)

Distance between 2 amplifiers:	20 meters (66 feet)
Amplifier/Splitter: Dimensions:	AN-611 range 608.48 MHz to 613.52 MHz amplification: 10dB power supply: 12V DC, 60 mA connector D.5.5mm, central pin positive 13.5 cm x 13.5 cm x 5 cm (5.3” x 5.3” x 2”) 325 grams (11.5 oz.)
Low Noise Amplifier LNA-611: Dimensions:	Power input: 12 V DC, max; 500 mA Connector D.5.5mm, central pin + (positive) 13.5 cm x 13.5 cm x 5 cm (5.3” x 5.3” x 2”) 325 grams (11.5 oz.)
Cable:	Plenum Rated Coaxial Cable for 608 MHz networks: BELDEN #82907 attenuation: ≈ 8 dB /20 meters @ 608 MHz
Power requirements:	One power supply every 5 amplifiers Power supply current: 0.6 A Nominal voltage: 100-240 V

608 MHz, 915 MHz and 2500 MHz Antenna Network Environmental Conditions

Transporting:	-20° to +60°C 10% to 90% humidity w/o condensation 500 hPa to 1060 hPa pressure
Operating:	+10° to +40°C 30% to 75% humidity w/o condensation 700 hPa to 1060 hPa pressure

6 System Restoration

Disaster Recovery Procedure

1. Turn the system on and then insert the Recovery DVD into the CDRW/DVD+RW drive. A message will appear on the screen giving you two options to choose from. Press the letter "**R**" on the keyboard for the Recovery Process.

2. After some time, the PC Recovery Wizard will appear. Make sure the option "Recover the PC to a specific point in time" is selected and then click on **Next**.

3. Under Description, click on "Initial Recovery Point" and then click on **Next**.

4. In the Smart PC Recovery screen, select the option "Recover PC without preserving new and updated files" and then click on **Next**.

5. Click on **Yes** to begin the Recovery Process. The drive will first be formatted, and then the Recovery Point will be copied.

6. Once the Recovery Process is complete, click on **Restart** and then remove the Recovery DVD from the drive. The system will then reboot.

7. Finally, copy the directories and files from the Configuration CD provided upon installation. Run the executables of the PC that is being recovered.