Service Manual

ForceTriad™

Energy Platform

Part Number: 1037893
Preface

This manual and the equipment it describes are for use only by qualified medical professionals trained in the particular technique and surgical procedure to be performed. It is intended as a guide for servicing the Covidien ForceTriad energy platform only. Additional users information is available in the *ForceTriad Energy Platform User’s Guide*.

Equipment covered in this manual:
ForceTriad Energy Platform

The *ForceTriad Energy Platform Service Manual* consists of two parts - the text (part 1 of 2) and a schematics supplement (part 2 of 2), which contains the schematics.

**Part number:** 1035086

## Conventions Used in this Guide

<table>
<thead>
<tr>
<th><strong>Warning</strong></th>
<th>Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Caution</strong></td>
<td>Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.</td>
</tr>
<tr>
<td><strong>Notice</strong></td>
<td>Indicates a hazard which may result in product damage.</td>
</tr>
<tr>
<td><strong>Important</strong></td>
<td>Indicates an <em>operating tip or maintenance suggestion</em>.</td>
</tr>
</tbody>
</table>
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- **Cool-tip™ RFA Generator**: One year from date of shipment
- **Evident™ MWA Generator**: One year from date of shipment
- **LigaSure™ Vessel Sealing System**: One year from date of shipment
- **LigaSure™ Reusable Instruments**: One year from date of shipment
- **Mounting Fixtures (all models)**: One year from date of shipment
- **Footswitches (all models)**: One year from date of shipment
- **Valleylab™ Argon Gas Delivery Unit II**: One year from date of shipment
- **RapidVac™ Smoke Evacuator**: One year from date of shipment
- **LigaSure™ Sterile Single Use Items**: Sterility only as stated on packaging
- **Cool-tip™ Sterile Single Use Items**: Sterility only as stated on packaging
- **Sterile Single Use Items**: Sterility only as stated on packaging
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Chapter 1
Overview and General Features

This chapter provides an overview of the features and functions of the ForceTriad energy platform.

<table>
<thead>
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<th>Caution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read all warnings, cautions, and instructions provided with this system before use.</td>
</tr>
<tr>
<td>Read the instructions, warnings, and cautions provided with electrosurgical instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.</td>
</tr>
</tbody>
</table>
Introduction

The ForceTriad energy platform is designed to provide RF energy for monopolar and bipolar surgical applications and tissue-fusion applications. It features three touchscreen user interfaces, and has the ability to automatically detect handsets and to configure the energy platform accordingly. Safety and diagnostic functionality include automatic fail-safe functions.
List of Components

The ForceTriad energy platform is a self-contained unit, consisting of a main enclosure (cover and base) and a power cord. The main components are:

- Front panel components
- Rear panel components
- Internal components

Details about the interaction of the main components and PCBA descriptions are provided in Chapter 5, *Principles of Operation*.

System Conventions

Touchscreens

The ForceTriad energy platform features a user-friendly interface with three touchscreens that allow the user to control system functions. The active touchscreen or touchscreens illuminate, and the unavailable touchscreens dim.

Common Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Page Up/Page Down" /></td>
<td>Page Up/Page Down</td>
<td>Scrolls through blocks of options that cannot be displayed on a single screen.</td>
</tr>
<tr>
<td><img src="image" alt="Up/Down" /></td>
<td>Up/Down</td>
<td>Pressing once increases/decreases the associated value or moves highlighted selection up/down one line. Pressing and holding scrolls up/down.</td>
</tr>
</tbody>
</table>
### System Conventions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Arrow Right]</td>
<td><strong>Next/Back</strong></td>
<td>Progresses/regresses to the next screen.</td>
</tr>
<tr>
<td>![Arrow Left]</td>
<td><strong>Back Space</strong></td>
<td>Regresses one character.</td>
</tr>
<tr>
<td>![Speaker Mute]</td>
<td><strong>Bipolar Mute On/Off</strong></td>
<td>Turns on/off the audio tones produced by the system that indicate the increase or decrease of current during a bipolar procedure.</td>
</tr>
<tr>
<td>![Cross]</td>
<td><strong>Cancel</strong></td>
<td>Cancels current screen and returns to the previous screen.</td>
</tr>
<tr>
<td>![Check Mark]</td>
<td><strong>Enter</strong></td>
<td>Accepts and initiates current selections.</td>
</tr>
<tr>
<td>![System Tray]</td>
<td><strong>System Tray</strong></td>
<td>The system tray contains controls that allow you to access and adjust system settings including screen brightness and main-menu options as well as a connection indicator.</td>
</tr>
</tbody>
</table>
Power Modes

As a safety feature to prevent unexpected power delivery spikes, simultaneous activation of multiple instruments is not possible on the ForceTriad energy platform.

Monopolar Modes

The ForceTriad energy platform produces five different modes of power output.

Cut Modes

Pure cut provides a clean, precise cut in any tissue with little or no hemostasis.

Blend cut is a conventional blended waveform that provides slower cutting and additional hemostasis.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Brightness</strong></td>
<td>Each selection of this button adjusts the screen brightness to the next of the two available brightness settings. When maximum brightness is reached, next selection resets to the least bright setting.</td>
</tr>
<tr>
<td></td>
<td><strong>Wrench</strong></td>
<td>Selects access to the Main Menu, which provides user-selected options for language, appearance, and operation.</td>
</tr>
<tr>
<td></td>
<td><strong>Connection Indicator</strong></td>
<td>Indicates active communication with another system such as Valleylab Exchange Remote Software System or a third party system.</td>
</tr>
<tr>
<td></td>
<td><strong>Errors Disabled</strong></td>
<td>This icon on a yellow background overlays the screen when error warnings have been disabled using the service menu. The energy platform does not alarm or give error conditions when this symbol is activated. Touching the screen removes the icon for five seconds.</td>
</tr>
</tbody>
</table>

**Note:** Additional information on symbols may be found in Chapter 4, *Technical Specifications*. 
Valleylab Mode
Valleylab mode is a unique combination of hemostasis and dissection and allows the user to slow down for more hemostasis and speed up for faster dissection. Thermal spread is equal or superior to Cut or Blend modes.

Coag Modes
**Fulgurate** coagulates tissue by sparking from the active electrode, through air, to the patient tissue. Because sparks may spray unpredictably from the electrode during fulguration, using fulguration for delicate tissue or in confined areas can complicate surgery. Accidental sparking to adjacent areas can occur as tissue at the surgical site dries and becomes more resistant to current flow.

**Spray** delivers wider fulguration; penetration is shallower and the affected tissue area is larger than with the Fulgurate mode.

Bipolar Modes
Three bipolar modes are available: Low, Standard, and Macro bipolar.

**Low** delivers precision and fine control over the amount of desiccation.

**Standard** is a conventional bipolar output at low voltage.

**Macro** (Macro bipolar) may be used for bipolar cutting or rapid coagulation. Power remains constant over a wide range of tissue types.

Autobipolar
The autobipolar feature senses tissue impedance between the two bipolar electrodes, then uses the impedance information to automatically start or stop bipolar RF energy delivery. Optionally, the user may choose between footswitch start and auto start, or program a delay between auto start and RF activation.

**Note:** When using Autobipolar, the tissue in the grasp of the bipolar device must have an impedance within 20 Ω and 1,000 Ω. The activation impedance safety feature does not deliver RF power to the tissue if it is not within the specified range. This is a factory-set value that cannot be reset by the user.
LigaSure Mode

The LigaSure tissue-fusion mode can be used on arteries, veins, pulmonary vasculature, and lymphatics up to and including 7 mm in diameter and tissue bundles. This system provides precise energy delivery and electrode pressure to vessels for a controlled time period to achieve a complete and permanent fusion of the vessel lumen. The system has been designed to produce minimal sticking, charring, or thermal spread to adjacent tissue.

**Warning**

Do not attempt to fuse lung tissue with LigaSure mode or instruments.

LigaSure Instruments

The LigaSure instruments that complete the ForceTriad tissue-fusion system include multiple reusable and single-use instruments for open and laparoscopic procedures. Each reusable instrument requires a corresponding single-use electrode. The LigaSure function is available only when using LigaSure instruments.
Chapter 2

Patient and Operating Room Safety

The safe and effective use of electrosurgery depends to a large degree upon factors solely under the control of the operator. There is no substitute for a properly trained and vigilant surgical team. It is important that the operating instructions supplied with this or any electrosurgical equipment be read, understood, and followed.

Electrosurgery has been used safely in millions of procedures. Before starting any surgical procedure, the surgeon should be trained in the particular technique and surgical procedure to be performed, should be familiar with the medical literature related to the procedure and potential complications, and should be familiar with the risks versus the benefits of utilizing electrosurgery in the procedure.
General

Setting Up the System

**Warning**

**Electric Shock Hazard**  Connect the system power cord to a properly grounded power receptacle. Do not use power plug adapters.

**Fire Hazard**  Do not use extension cords.

**Patient Safety**  Use the energy platform only if the power-up self-test has been completed as described in this manual, otherwise inaccurate power outputs may result.

**Caution**

When using a smoke evacuator in conjunction with the ForceTriad energy platform, set the system volume control at a level that ensures that the activation tones can be heard.

Connect only Covidien-approved footswitches. Using footswitches from other manufacturers may cause equipment malfunction.

**Warning**

**Hazardous Electrical Output**  This equipment is for use only by trained, licensed physicians. Do not use electrosurgical equipment unless properly trained to use it in the specific procedure being undertaken. Use of this equipment without such training can result in serious, unintended patient injury, including bowel perforation and unintended, irreversible tissue necrosis.

Always use the lowest power setting that achieves the desired surgical effect. The active electrode should be utilized only for the minimum time necessary in order to lessen the possibility of unintended burn injury. Accidental and unintended burn injury has occurred during procedures in small surgical fields and on small appendages. Pediatric applications and/or procedures performed on small anatomic structures may require reduced power settings. The higher the current flow and the longer the current is applied, the greater the possibility of unintended thermal damage to tissue, especially during use on small structures.

Do not wrap the instrument cords or patient return electrode cords around metal objects. This may induce currents that could lead to shocks, fires, or injury to the patient or surgical team.

**Electric Shock Hazard**  Do not connect wet instruments to the energy platform. Ensure that all instruments and adapters are correctly connected and that no metal is exposed at any connection points.

Confirm proper power settings before proceeding with surgery. If the proper power settings are not known, set the power to a low setting and cautiously increase the power until the desired effect is achieved. If increased power settings are requested, check the patient return electrode and all instrument connections before major power setting adjustments.
While using electrosurgery, the patient should not be allowed to come into direct contact with grounded metal objects (e.g., surgical table frame, instrument table, etc.). If this is not possible during certain procedures (e.g., those in which noninsulated head frames are used), use extreme caution to maximize patient safety:

- Use the lowest power setting that achieves the desired effect.
- Place the patient return electrode as close to the surgical site as possible.
- Place dry gauze between the patient and the grounded object if possible.
- Continually monitor the contact point(s).
- Do not use metal needle monitoring electrodes.

Caution

Read all warnings, cautions, and instructions provided with this energy platform before using.

Read the instructions, warnings, and cautions provided with electrosurgical instruments before using. Specific instructions for electrosurgical instruments are not included in this manual.

For surgical procedures where the current could flow through delicate parts of the body, the use of bipolar techniques may be desirable in order to avoid unwanted coagulation.

Examine all instruments and connections to the system before using. Ensure that the instruments function as intended. Improper connection may result in arcs, sparks, instrument malfunction, or unintended surgical effects.

Do not turn the activation tone down to an inaudible level. The activation tone alerts the surgical team when the energy platform is delivering RF energy.

A non-functioning ForceTriad energy platform may cause interruption of surgery. A backup system should be available for use.

Studies have shown that smoke generated during electrosurgical procedures can be potentially harmful to patients and the surgical team. These studies recommend adequately ventilating the smoke by using a surgical smoke evacuator or other means.\(^a\)

Inadvertent activation may occur while installing, removing, or bending electrodes. Ensure that the instrument cord is not connected to the ForceTriad energy platform or that the system is OFF.

Notice

Connect the power cord to a properly grounded power receptacle having the correct voltage. Otherwise, product damage may result.
### Important

If required by local codes, connect the energy platform to the hospital equalization connector with an equipotential cable.

### Fire/Explosion Hazard

<table>
<thead>
<tr>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Danger: Explosion Hazard</strong> Do not use electrosurgery in the presence of flammable anesthetics.</td>
</tr>
</tbody>
</table>

| Fire Hazard | Do not place active instruments near or in contact with flammable materials (such as gauze or surgical drapes). Electrosurgical instruments that are activated or hot from use can cause a fire. When not in use, place electrosurgical instruments in a safety holster or safely away from patients, the surgical team, and flammable materials. |

| Fire Hazard | Sparking and heating associated with electrosurgery can be an ignition source. Keep gauze and sponges wet. Keep electrosurgical electrodes away from flammable materials and oxygen (O\(_2\)) enriched environments. Use of electrosurgery in O\(_2\) rich environments increases the risk of fire. Therefore, take measures to reduce the O\(_2\) concentration at the surgical site. Avoid enriched O\(_2\) and nitrous oxide (N\(_2\)O) atmospheres near the surgical site. Both O\(_2\) and N\(_2\)O support combustion and may result in fires and burns to patients or surgical personnel. If possible, stop supplemental oxygen at least one minute before and during use of electrosurgery. Do not activate the energy platform until flammable vapors from skin prep solutions and tinctures have dissipated. Avoid the accumulation of naturally occurring flammable gases that may accumulate in body cavities such as the bowel. Prevent pooling of flammable fluids and the accumulation of flammable or oxidizing gases or vapors under surgical drapes or near the surgical site. Tissue buildup (eschar) on the tip of an active electrode may create embers that pose a fire hazard, especially in oxygen enriched environments. Keep the electrode clean and free of all debris. Facial and other body hair is flammable. Water soluble surgical lubricating jelly may be used to cover hair close to the surgical site to decrease flammability. Verify that all anesthesia circuit connections are leak free before and during use of electrosurgery. |

| Fire Hazard During Oropharyngeal Surgery | Verify endotracheal tubes are leak free and that the cuff seals properly to prevent oxygen leaks. If an uncuffed tube is in use, pack the throat with wet sponges around the uncuffed tube, and be sure to keep sponges wet throughout the procedure. Question the need for 100% O\(_2\) during oropharyngeal or head and neck surgery. If necessary, scavenge excess O\(_2\) with separate suction. |
Energy Platform

**Warning**

Each instrument receptacle on this energy platform is designed to accept only one instrument at a time. Follow the instructions provided with electrosurgical instruments for proper connection and use.

**Caution**

Do not stack equipment on top of the energy platform or place the energy platform on top of electrical equipment. This is an unstable configuration and does not allow for adequate cooling.

Provide as much distance as possible between the energy platform and other electronic equipment (such as monitors). Do not cross or bundle electronic-device cords. This energy platform may cause interference with other electronic equipment.

Active Instruments

**Caution**

Read the instructions, warnings, and cautions provided with electrosurgical instruments before using. Specific instructions for electrosurgical instruments are not included in this manual.

Inspect instruments and cords for breaks, cracks, nicks, and other damage before every use. If damaged, do not use. Damaged instruments or cords may result in injury or electrical shock to the patient or surgical team.

Use only instruments that can withstand the maximum output (peak) voltage for each output mode as listed in Chapter 4, *Technical Specifications*. Using an instrument with a voltage rating that is lower than the maximum output voltage may result in injury to the patient or the operator, or damage to the instrument.

All Covidien instruments have voltage ratings that are greater than the maximum output voltages in the ForceTriad energy platform and are thus fully compatible.

Information on voltage ratings for non-Covidien instruments should be obtained from the instrument's manufacturer.
Pacemakers and ICDs

**Warning**
Use electrosurgery and tissue fusion with caution in the presence of internal or external pacemakers. Interference produced by the use of electrosurgical devices can cause a pacemaker to enter an asynchronous mode or can block the pacemaker effect entirely. Consult the pacemaker manufacturer or hospital cardiology department for further information when use of electrosurgery or tissue-fusion appliances is planned in patients with cardiac pacemakers.

If the patient has an implantable cardioverter defibrillator (ICD), contact the ICD manufacturer for instructions before performing an electrosurgical or tissue-fusion procedure. Electrosurgery or tissue fusion may cause multiple activations of ICDs.

After Surgery

**Warning**

**Electric Shock Hazard** Always turn off and unplug the energy platform before cleaning.

**Caution**

Do not reprocess, reuse or resterilize instruments labeled “disposable” or “single use only.”

**Notice**

Do not clean the energy platform with abrasive cleaning or disinfectant compounds, solvents, or other materials that could scratch the panels or damage the energy platform.
**Monopolar**

**Warning**

Simultaneously activating suction/irrigation and electrosurgical current may result in increased arcing at the electrode tip, burns to unintended tissues, or shocks and burns to the surgical team.

Some surgeons may elect to “buzz the hemostat” during surgical procedures. It is not recommended, and the hazards of such a practice probably cannot be eliminated. Burns to the surgeon's hands are possible. To minimize the risk take these precautions:

- Do not “buzz the hemostat” with a needle electrode.
- Do not lean on the patient, the table, or the retractors while buzzing the hemostat.
- Activate cut rather than coag. Cut has a lower voltage than coag.
- Firmly grasp as much of the hemostat as possible before activating the energy platform. This disperses the current over a larger area and minimizes the current concentration at the finger tips.
- “Buzz the hemostat” below hand level (as close as possible to the patient) to reduce the opportunity for current to follow alternate paths through the surgeon's hands.
- Use the lowest power setting possible for the minimum time necessary to achieve hemostasis.
- Activate the energy platform after the instrument makes contact with the hemostat. Do not arc to the hemostat.
- When using a coated- or nonstick-blade electrode, place the edge of the electrode against the hemostat or other metal instrument.

**Patient Return Electrodes**

**Warning**

Do not attempt to use patient return electrodes that disable the REM system. The ForceTriad energy platform REM system functions correctly only with contact quality monitoring (CQM) split-style patient return electrodes. Any other patient return electrode products may cause patient injury or product damage.

The safe use of monopolar electrosurgery requires proper placement of the patient return electrode. To avoid electrosurgical burns beneath the patient return electrode, follow all directions provided with the product.

Do not cut a patient return electrode to reduce its size. Patient burns due to high current density may result.

A patient return electrode is not necessary in bipolar or LigaSure procedures.

To avoid patient burns, ensure that the patient return electrode firmly and completely contacts the skin. Always check the patient return electrode periodically and after the patient is repositioned and during procedures involving long periods of activation.
Inadvertent Radio Frequency (RF) Burns

**Warning**
Use of duty cycles greater than 25% (10 seconds active followed by 30 seconds inactive) increases the risk that heat build-up under a return electrode may be high enough to injure the patient. Do not continuously activate for longer than one minute.

**Notice**
Capacitive pads and other non-CQM patient return electrodes may not work with the ForceTriad energy platform.

**Important**
A statement of compatibility from the CQM patient return electrode manufacturer should be obtained prior to the use of a non-Covidien CQM patient return electrode.

**Warning**
Electrodes and probes used with monitoring, stimulation, and imaging devices (or similar equipment) can provide a path for high frequency current even if the electrodes or probes are isolated at 50 Hz to 60 Hz, insulated, and/or battery operated.

Do not use needles as monitoring electrodes during electrosurgical procedures. Inadvertent electrosurgical burns may result.

To reduce the risk of an inadvertent electrosurgical burn at the electrode or probe site, place the electrode and/or probe as far away as possible from the electrosurgical site and/or patient return electrode. Protective impedances (resistors or RF inductors) installed in the monitoring leads may reduce the risk of such burns. Consult the hospital biomedical engineer for further information.

In some circumstances, the potential exists for alternate site burns at points of skin contact (e.g., between the arm and the side of the body). This occurs when electrosurgical current seeks a path to the patient return electrode that includes the skin-to-skin contact point. Current passing through small skin-to-skin contact points is concentrated and may cause a burn. This is true for ground referenced and isolated output electrosurgical energy systems.

To reduce the potential for alternate site burns, do one or more of the following:
- Avoid skin-to-skin contact points, such as fingers touching leg or knee touching knee when positioning the patient.
- Place insulation, such as dry gauze or towel, between contact points to ensure that contact does not occur.
- Position the patient return electrode to provide a direct current route between the surgical site and the return electrode which avoids skin-to-skin contact areas.
- In addition, place patient return electrodes according to the manufacturer’s instructions.
Laparoscopic Procedures

Warning

For laparoscopic procedures, be alert to these potential hazards:

• Laparoscopic surgery may result in gas embolism due to insufflation of gas in the abdomen.
• The electrode tip may remain hot enough to cause burns after the electrosurgical current is deactivated.
• Inadvertent activation or movement of the activated electrode outside of the field of vision may result in injury to the patient.
• Localized burns to the patient or physician may result from electrical currents carried through conductive objects (such as cannulas or scopes). Electrical current may be generated in conductive objects through direct contact with the active electrode, or by the active instrument (electrode or cable) being in close proximity to the conductive object.
• Do not use hybrid trocars that have a non-conductive locking anchor placed over a conductive sleeve. For the operative channel, use all metal or all plastic systems. At no time should electrical energy pass through hybrid systems. Capacitive coupling of RF current may cause unintended burns.
• When using laparoscopic instrumentation with metal cannulas, the potential exists for abdominal wall burns to occur due to direct electrode contact or capacitive coupling of RF current. This is most likely to occur in instances where the energy platform is activated for extended periods at high power levels inducing high current levels in the cannula.
• Ensure that the insulation of single-use and reusable laparoscopic instrumentation is intact and uncompromised. Compromised insulation may lead to inadvertent metal-to-metal sparking and neuromuscular stimulation and/or inadvertent sparking to adjacent tissue.
• Do not activate electrodes while in contact with other instruments as unintended tissue injury may occur.

Do not activate the energy platform in an open circuit condition. To reduce the chances of unintended burns, activate the energy platform only when the active electrode is near or touching the target tissue.

• Use the lowest power setting that achieves the desired surgical effect and use a low voltage waveform (Pure Cut, Blend, or Valleylab mode) to lessen the potential for the creation of capacitive currents.
• Carefully insert and withdraw active electrodes from cannulas to avoid possible injury to the patient or damage to the devices.

Covidien recommends against the use of laparoscopic surgery on pregnant patients.
Bipolar

Caution
Bipolar instruments must be connected to the bipolar instrument receptacle only. Improper connection may result in inadvertent system activation.

LigaSure

Warning
LigaSure instruments are intended for use ONLY with the ForceTriad energy platform and the LigaSure vessel sealing system. Use of these instruments with other Covidien generators or with generators produced by other manufacturers may not result in electrical output for which these instruments were designed and thus may not result in the desired clinical effect.

If the seal-complete tone has not sounded, an optimal seal may not have been achieved. Reactivate the RF energy until a seal-complete tone is heard.

The LigaSure tissue-fusion function has not been shown to be effective for tubal sterilization or tubal coagulation for sterilization procedures. Do not use this function for these procedures.

Use caution during surgical cases in which patients exhibit certain types of vascular pathology (atherosclerosis, aneurysmal vessels, etc.). For best results, apply the seal to unaffected vasculature.

Do not activate the energy platform in the LigaSure mode until the tissue-fusion instrument has been applied with the proper pressure. Activating the energy platform before this is done results in an improper seal and may increase thermal spread to tissue outside the surgical site.

Tissue fusion requires the application of RF energy and pressure from the instrument. Tissue to be sealed must be firmly grasped between the instrument jaw electrodes. Tissue in the jaw hinge or outside the instrument jaw will not be sealed even if thermal blanching occurs.

Do not use LigaSure instruments on vessels in excess of 7 mm in diameter.

LigaSure instruments that require single-use electrodes must be used with the correct electrode type. Use of these instruments with any other electrodes could result in injury to the patient or surgical team, or cause damage to the instrument.

Conductive fluids (e.g., blood or saline) in direct contact with LigaSure instruments or in close proximity may carry electrical current or heat, which may cause unintended surgical effects or burns.

Caution
Energy based devices, such as electrosurgical pencils or ultrasonic scalpels, that are associated with thermal spread should not be used to transect seals.

Avoid placing fingers in the handle ratchet mechanism. Injury to the user may result.
LigaSure in Laparoscopic Procedures

**Warning**

For laparoscopic procedures, be alert to these potential hazards:

- The external surfaces of the LigaSure instrument jaws may remain hot enough to cause burns after the RF current is deactivated.
- Inadvertent activation or movement of the activated LigaSure instrument outside of the field of vision may result in injury to the patient.
- Do not activate the instrument while the instrument jaws are in contact with, or in close proximity to, other instruments including metal cannulas, as localized burns to the patient or physician may occur.
- Do not activate the LigaSure function in an open circuit condition. Activate the energy platform only when the instrument is near or in direct contact with the target tissue to reduce the possibility of unintended burns.
- Carefully insert and withdraw LigaSure instruments from cannulas to avoid possible damage to the devices and/or injury to the patient.

**Servicing**

**Warning**

*Electric Shock Hazard* Do not remove the energy platform cover. Contact authorized personnel for service.

**Notice**

Refer to this system’s service manual for maintenance recommendations and function and output power verification procedures.

**Shunt Cords**

**Warning**

Some surgical instruments (e.g., colonoscopes) may allow substantial leakage current that could burn the surgeon. If the instrument manufacturer recommends the use of a shunt cord (s-cord) to direct the current back to the energy platform, you must also use a E0507-B adapter. To avoid a REM alarm, you must use a REM Polyhesive™ patient return electrode with the E0507-B adapter.
Conductive Fluid in the Surgical Site

**Warning**

When this energy platform is used in procedures where conductive fluid (saline or lactated Ringers) is introduced into the surgical site for distention or to conduct RF current, higher than normal currents (greater than one amp) may be produced. In this situation, use one or more adult-size return electrodes. Do not use return electrodes labeled for children, infants, babies, neonatal use, or pediatric use.

Use of duty cycles greater than 25% (10 seconds active followed by 30 seconds inactive) increases the risk that heat build-up under a return electrode may be high enough to injure the patient. Do not continuously activate for longer than one minute.
Chapter 3
System Setup

This chapter describes how to set up the energy platform, turn it on, and configure system settings.

<table>
<thead>
<tr>
<th>Caution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read all warnings, cautions, and instructions provided with this system before use.</td>
</tr>
</tbody>
</table>

Read the instructions, warnings, and cautions provided with electrosurgical instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.
Setup

Before Startup

1. Verify the system is off by pressing the power switch off (O).
2. Place the energy platform on a flat, stable surface such as a table, platform, boom system, or Covidien cart. Carts with conductive wheels are recommended. Refer to the procedures for your local institution or your local codes.
3. Plug the system power cord into the rear panel receptacle.
4. Plug the system power cord into a grounded power receptacle.
   
   Note: Do not plug into a power strip or extension cord.

Powering Up the ForceTriad Energy Platform

1. Turn on the system by pressing the power switch on (I). Observe the following during the power-up self-test:
   
   – The ForceTriad logo appears on all three screens.
   – A status bar indicates activity.
   – An hourglass icon indicates activity after the status bar disappears.
   – A tone sounds upon completion of self-test.
2. If the system does not pass the power-up self-test, refer to Chapter 7, Troubleshooting.
System Functions

Adjusting Display Brightness

The ForceTriad energy platform screens have two levels of brightness. Touch the brightness icon on the right side of the right touchscreen to adjust the display brightness.

The high and low brightness settings can be changed in Brightness Calibration as explained on page 6-19.

Activation Log

The Activation Log allows the user to view the last 1000 activations and REM alerts.

1. Touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen.
2. Touch Activation Log on the Main Menu. The activation log appears on the center touchscreen.
3. Touch the single up- or down-arrow to the right of the activation log to scroll through the log one line at a time.
4. Touch the green arrow button on the bottom-right corner of the Main Menu to return the ForceTriad energy platform to the previous setup configuration. The previous settings are displayed.

Service Display

Refer to Chapter 9, Maintenance and Repair for complete service instructions.

Restore

Select the Restore button on the Main Menu to restore the ForceTriad energy platform to the previous setup configuration. The touchscreens display the last settings entered prior to shutting the system off.
Setup

The Setup menu allows the user to change the language that the system touchscreens display, set the time and date, and access the features menu.

Language Setup

1. Touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen.
2. Touch Setup on the Main Menu. The Setup display appears in the left touchscreen.
3. Touch Language on the Setup menu. A list of languages appears in the left touchscreen.
4. Touch the single up- or down-arrow to the right of the list to scroll through the list one line at a time.
   or
   Touch the double up- or down-arrows to scroll through the list one page at a time.
5. Touch the desired language. A confirmation box appears and with a request for the user to confirm that a language change is desired.
6. To proceed with the language change, touch the green check-mark button. The language is activated and the confirmation box closes.
   or
   To reject the language change, touch the red ‘X’ button. The language setting returns to the previously selected language.
7. Touch the green arrow button to return to the Setup menu.
8. Touch the green arrow button below the Setup menu to return to the Main Menu.

Time and Date Setup

1. Touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen.
2. Touch Setup on the Main Menu. The Setup display appears in the left touchscreen.
3. Touch the Time and Date button in the Setup menu. The time and date display appears in the left touchscreen.
4. Touch the desired numeric field (minutes, seconds, month, day, or year) to select that field.
5. Touch the up or down arrows next to the time or date row to adjust the selected numeric field.
   Touch and hold the arrows to increase the number once per second. After four seconds, the numbers increase once per 100 milliseconds.
6. Touch the green check mark button to store the date and time information and return to the Setup menu.

or

Touch the red ‘X’ button to return the time and date to the previous settings and return to the Setup menu.

7. Touch the green arrow button below the Setup menu to return to the Main Menu.

Features Menu

The features menu displays software features and applications that can be enabled or disabled at the system level.

- **Autobipolar**—Configures automatic activation and cessation of energy from the Auto tab.

- **Mono 1 Footswitching**—Enables footswitching control of both handswitching and footswitching devices attached to the Monopolar 1 receptacle.

- **Other features or applications**—Other features and applications may be on this menu based on special configurations or purchased applications.

The default software settings for autobipolar mode and monopolar 1 footswitching are enabled or disabled at the system level from the Features menu. Once enabled, the feature is available on the affected screen and can be turned on and off.

Autobipolar and monopolar settings selected on the Features menu determine the options available from the Bipolar and Monopolar touch screens. The settings can be turned on and off locally from buttons available on the affected screens.

**Autobipolar**

Autobipolar mode on the Features menu enables and disables autobipolar function at the system level, controlling whether autobipolar function is available on the Bipolar tab of the center screen.

**Enable/Disable Autobipolar at the system level:**

1. Touch the wrench icon on the right side of the right touchscreen. The main-menu display appears in the left touchscreen.

2. Touch **Setup** on the Main Menu. The Setup display appears in the left touchscreen.

3. Touch **Features** in the Setup menu. Available options appear in the left touchscreen. The factory default for all features is disabled.

4. To enable, touch **AutoBipolar**. A check appears in the accompanying box.

   ![AutoBipolar](image)

   To disable, touch **AutoBipolar**. The check is cleared from the box.
5. Touch the green arrow buttons below the Features menu and Setup menu to return to the Main Menu.

When the AutoBipolar option is enabled, a green button is added to the Bipolar tab in the center screen.

![Diagram of the Bipolar tab]

1. Bipolar Tab (This label changes to Auto if autobipolar mode is turned on)
2. Autobipolar Mode Button (shows Autobipolar mode is enabled but not turned on)

**Turning Autobipolar Mode On and Off:**

Autobipolar mode can be turned on and off on the Bipolar tab if it is enabled from the Features menu.

**Note:** If enabled on the Features menu, the default setting for autobipolar mode is off.

To turn autobipolar mode on, touch the button on the Bipolar screen. The Bipolar tab changes to Auto, presenting the options and settings for autobipolar mode. For more information see the *ForceTriad Energy Platform User’s Guide*.

To turn autobipolar mode off, touch the Bipolar button on the Auto tab. The Auto tab changes to Bipolar.
Mono 1 Footswitching

The Monopolar 1 footswitching option on the Features menu enables and disables footswitching on the Monopolar 1 Std Mono and Valleylab tabs. The Accessories Port tab (Acc. Port) is not affected. If footswitching is enabled on the Features menu, it can then be turned on and off on the Std Mono and Valleylab tabs as well as on the “This feature is not enabled” touchscreen, as described in the following note.

Note: If footswitch use is attempted when Monopolar 1 footswitching has not been enabled at the system level from the features menu or at the local level from the mode tab, the following touchscreen appears and allows you to enable it quickly without using the Features menu or footswitching button in the procedures in the section.

You can enable Monopolar 1 footswitching by touching the button with the green check mark:

---

Enabling and Disabling Monopolar 1 Footswitching on the Features menu:

1. Touch the wrench icon on the right side of the right touchscreen. The main-menu display appears in the left touchscreen.
2. Touch Setup on the Main Menu. The Setup display appears in the left touchscreen.
3. Touch Features in the Setup menu. Available options appear in the left touchscreen. The default setting for all features is disabled.
4. To enable the feature, touch Mono 1. A check appears in the accompanying box.

To disable, touch Mono 1. The check is cleared from the box.

5. Touch the green arrow buttons below the features menu and Setup menu to return to the Main Menu.

When Monopolar 1 footswitching is enabled on the Features menu, the footswitching button with an “X” appears on the Std Mono and Valleylab tabs in the left screen.
Turning Monopolar 1 Footswitching On and Off:

Monopolar 1 footswitching can be turned on and off on the Std Mono and Valleylab tabs as needed if it is enabled on the Features menu. The

**Note:** If enabled on the Features menu, the default setting for Monopolar 1 footswitching is off, as indicated by the red “X” over the button.

To turn Monopolar 1 footswitching on, touch the footswitch button with the “X” on the Std Mono or Valleylab tab on the left touchscreen. The red “X” is removed from the button when turned on.

To turn Monopolar 1 footswitching off, touch the footswitch button on the Std Mono or Valleylab tabs on the left touchscreen. The red “X” appears on the button when turned off.
Demo Mode

**Warning**

Demo mode is intended for demonstration purposes only. Demo mode is not intended for clinical use.

Touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen.

**Enable Demo Mode**

1. On the Main Menu, the Demo mode button displays ‘Enter Demo’ if the system is not in Demo mode. Touch the Enter Demo mode button to begin Demo mode. The system operating displays appear in all the touchscreens with the words ‘DEMO MODE: Not for Clinical Use’ on all three screens.

**Note:** Touching the Demo mode screen removes it briefly from all touchscreens.

2. Proceed with practice or demonstration scenarios. While in Demo mode, the REM alarm and the dual instrument error alarm are deactivated but RF power is still delivered.

**Note:** In Demo mode the energy platform does not sense instrument type, so the appropriate tab must be selected manually for the connected instrument.

3. To exit Demo mode, either turn the system off and restart it, or follow the steps in the Exit Demo Mode section that follows.

**Exit Demo Mode**

1. Touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen.

2. On the Main Menu, the Demo mode button displays ‘Exit Demo’ if the system is in Demo mode. Touch the Exit Demo button on the Main Menu to exit the Demo mode. The system touchscreens display the last settings entered during the Demo mode.
Chapter 4
Technical Specifications

All specifications are nominal and subject to change without notice. A specification referred to as “Typical” is within ± 20% of a stated value at room temperature (77° F/25° C) and a nominal line input voltage.

Caution
Read all warnings, cautions, and instructions provided with this system before use.

Read the instructions, warnings, and cautions provided with electrosurgical instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.
Performance Characteristics

General

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<th>Output configuration</th>
<th>Isolated output</th>
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<td>Cooling</td>
<td>Natural convection and fan</td>
</tr>
<tr>
<td>Display</td>
<td>Three LCD touchscreens</td>
</tr>
<tr>
<td>Connector ports</td>
<td>LED illuminated Smart connector readers</td>
</tr>
</tbody>
</table>
| Mounting             | • ForceTriad energy platform cart (FT900), Universal Mounting cart (UC8009), and/or the UC8010 Overshelf  
                        • Operating room boom systems  
                        • Any stable, flat surface such as a table or cart top |

Dimensions and Weight

<table>
<thead>
<tr>
<th>Width</th>
<th>18” (45.7 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>20” (50.8 cm)</td>
</tr>
<tr>
<td>Height</td>
<td>10” (25.4 cm)</td>
</tr>
<tr>
<td>Weight</td>
<td>30 lb (13.6 kg)</td>
</tr>
</tbody>
</table>
## Operating Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature range</td>
<td>50° F to 104° F (+10°C to +40°C)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>30% to 75% non-condensing</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>700 millibars to 1060 millibars</td>
</tr>
<tr>
<td>Warm-up time</td>
<td>If transported or stored at temperatures outside the operating temperature range, allow one hour for the energy platform to reach room temperature before use.</td>
</tr>
</tbody>
</table>

## Transport and Storage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature range</td>
<td>-22° F to 149° F (-30°C to +65°C)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>25% to 85% (non-condensing)</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>500 millibars to 1060 millibars</td>
</tr>
<tr>
<td>Duration of storage</td>
<td>The ForceTriad energy platform may be stored indefinitely. If the energy platform is stored for over one year, the memory battery must be replaced.</td>
</tr>
</tbody>
</table>

## Internal Memory

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonvolatile, battery-backed RAM</td>
<td>Battery type: Lithium</td>
</tr>
<tr>
<td></td>
<td>Battery life: 120 mAh</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>256 KB</td>
</tr>
</tbody>
</table>
Activation Tone

The audio levels stated below are for activation tones (cut, Valleylab, coag, bipolar, and LigaSure modes) and alarm tones (REM and system alarms) at a distance of one meter.

<table>
<thead>
<tr>
<th>Volume (adjustable)</th>
<th>45 dBA to 65 dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td></td>
</tr>
<tr>
<td>Cut: 660 Hz</td>
<td></td>
</tr>
<tr>
<td>Valleylab: 800 Hz</td>
<td></td>
</tr>
<tr>
<td>Coag: 940 Hz</td>
<td></td>
</tr>
<tr>
<td>Bipolar: 940 Hz</td>
<td></td>
</tr>
<tr>
<td>LigaSure: 440 Hz</td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>Continuous while the system is activated</td>
</tr>
</tbody>
</table>

Alarm Tone

<table>
<thead>
<tr>
<th>Volume (not adjustable)</th>
<th>&gt;65 dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td></td>
</tr>
<tr>
<td>REM: 660 Hz</td>
<td></td>
</tr>
<tr>
<td>Reactivate/Regrasp, Check Instrument: Two tones:</td>
<td></td>
</tr>
<tr>
<td>High = 985 Hz, Low = 780 Hz</td>
<td></td>
</tr>
<tr>
<td>Seal Complete: 985 Hz</td>
<td></td>
</tr>
<tr>
<td>Error/System Alert: Beep tone = 1421 Hz</td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td></td>
</tr>
<tr>
<td>REM: Two 1/2 second tones separated by 1/2 second for each REM event</td>
<td></td>
</tr>
<tr>
<td>Reactivate/Regrasp: Four 175 ms tones — high, low, high, low</td>
<td></td>
</tr>
<tr>
<td>Check Instrument: Six 175 ms tones — high, low, high, low, high, low</td>
<td></td>
</tr>
<tr>
<td>Seal Complete: Two 175 ms tones separated by 175 ms for each seal-complete event</td>
<td></td>
</tr>
<tr>
<td>Error/System Alert: Three 250 ms tones separated by 250 ms for each Error/System Alert event</td>
<td></td>
</tr>
</tbody>
</table>
REM Contact Quality Monitor

<table>
<thead>
<tr>
<th>Interrogation frequency</th>
<th>80 kHz ± 10 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrogation current</td>
<td>&lt; 100 μA</td>
</tr>
<tr>
<td>Interrogation voltage</td>
<td>&lt; 12V RMS</td>
</tr>
</tbody>
</table>

Acceptable Resistance Range
REM resistance measurements are ± 10% during RF activation and ± 5% when RF output is not activated.

REM Polyhesive patient return electrode: 5 to 135 Ω or up to a 40% increase in the initial measured contact resistance (whichever is less).

If the measured resistance is outside the acceptable range(s) noted above, a REM fault condition occurs.

REM Alarm Activation
REM Polyhesive patient return electrode: When the measured resistance exceeds the standard range of safe resistance (below 5 Ω or above 135 Ω) or when the initial measured contact resistance increases by 40% (whichever is less), the REM alarm indicator enlarges and flashes red and yellow, a tone sounds twice, and RF output is disabled. The indicator remains illuminated red and yellow until you correct the condition causing the alarm. Then, the indicator illuminates green and RF output is enabled.

Autobipolar
The ForceTriad energy platform is equipped with an autobipolar feature that allows for automatic activation of bipolar energy.

**Note:** The autobipolar electrode function requires the use of the Reusable Footswitching Bipolar Cord E0020V, E0021S, E0022W, E360150, or E360150L.

**Warning**
Use of different Covidien cord models or cords from other manufacturers may not achieve proper electrical output for this device, thereby failing to produce the desired clinical effect. For example, Autobipolar activation/deactivation settings may not work properly using cords other than those specified by Covidien.
The autobipolar specifications are:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrogation frequency</td>
<td>80 kHz ± 10 kHz</td>
</tr>
<tr>
<td>Interrogation current</td>
<td>&lt; 100 μA</td>
</tr>
<tr>
<td>Interrogation voltage</td>
<td>&lt; 12V RMS</td>
</tr>
<tr>
<td>Activation impedance</td>
<td>20 Ω to 1000 Ω</td>
</tr>
<tr>
<td>Deactivation impedance</td>
<td>User selectable: 1,500 Ω, 1,800 Ω, 2,000 Ω or 2,200 Ω</td>
</tr>
<tr>
<td>Keying delay</td>
<td>User selectable in 500 ms increments from 0 sec to 2.5 sec</td>
</tr>
</tbody>
</table>

**Measurement Accuracy**

**Inactive**

± 5% of Full Scale activation impedance while keying inactive

**Active**

**Mode: BP Low**

<table>
<thead>
<tr>
<th>Load/Power</th>
<th>&lt; 30 W</th>
<th>≥ 30 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—500 Ω</td>
<td>± 20% or ±25 Ω (Whichever is greater)</td>
<td>± 20% or ±25 Ω (Whichever is greater)</td>
</tr>
<tr>
<td>501—1000 Ω</td>
<td>± 40%</td>
<td>± 20%</td>
</tr>
<tr>
<td>1001—2500 Ω</td>
<td>+100%/−50%</td>
<td>± 20%</td>
</tr>
<tr>
<td>&gt; 2500 Ω</td>
<td>Reads &gt; 2200 Ω</td>
<td>Reads &gt; 2200 Ω</td>
</tr>
</tbody>
</table>

**Mode: BP Standard**

<table>
<thead>
<tr>
<th>Load/Power</th>
<th>&lt; 50 W</th>
<th>≥ 50 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—500 Ω</td>
<td>± 20% or ±25 ohms (Whichever is greater)</td>
<td>± 20% or ±25 ohms (Whichever is greater)</td>
</tr>
<tr>
<td>501—1000 Ω</td>
<td>± 40%</td>
<td>± 20%</td>
</tr>
</tbody>
</table>
## Performance Characteristics

<table>
<thead>
<tr>
<th>Load/Power</th>
<th>Mode: BP Macro</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001—2500 Ω</td>
<td>+100%/-50%</td>
</tr>
<tr>
<td>&gt; 2500 Ω</td>
<td>Reads &gt; 2200 Ω</td>
</tr>
<tr>
<td>1—2500 Ω</td>
<td>± 20% or ±25 Ω (Whichever is greater)</td>
</tr>
<tr>
<td>&gt; 2500 Ω</td>
<td>Reads &gt; 2200 Ω</td>
</tr>
</tbody>
</table>
**Duty Cycle**

Under maximum power settings and rated load conditions, the ForceTriad energy platform is capable of operating a duty cycle of 25%, defined as 10 seconds active and 30 seconds inactive, in any mode for a period of 4 hours.

**Caution**

Use of duty cycles greater than 25% (10 seconds active followed by 30 seconds inactive) increases the risk that heat build-up under a return electrode may be high enough to injure the patient. Do not continuously activate for longer than one minute.

**Low Frequency (50/60 Hz) Leakage Current**

<table>
<thead>
<tr>
<th>Source current, patient leads, all outputs</th>
<th>Normal polarity, intact ground: &lt; 10 μA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal polarity, ground open: &lt; 50 μA</td>
</tr>
<tr>
<td></td>
<td>Reverse polarity, ground open: &lt;50 μA</td>
</tr>
<tr>
<td></td>
<td>Mains voltage on applied part: &lt; 50 μA</td>
</tr>
<tr>
<td>Enclosure source current, ground open</td>
<td>&lt; 300 μA</td>
</tr>
<tr>
<td>Sink current at high line, all inputs</td>
<td>&lt; 50 μA</td>
</tr>
</tbody>
</table>

**High Frequency (RF) Leakage Current**

<table>
<thead>
<tr>
<th>Measured with leads recommended by Covidien</th>
<th>Measured directly at the energy platform terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar RF leakage current</td>
<td>&lt; 59.2 mA rms</td>
</tr>
<tr>
<td></td>
<td>&lt; 59.2 mA rms</td>
</tr>
<tr>
<td>Monopolar RF leakage current</td>
<td>&lt; 150 mA rms</td>
</tr>
<tr>
<td></td>
<td>&lt; 100 mA rms</td>
</tr>
<tr>
<td>LigaSure leakage</td>
<td>&lt;132 mA rms</td>
</tr>
<tr>
<td></td>
<td>&lt; 100 mA rms</td>
</tr>
</tbody>
</table>
## Input Power

<table>
<thead>
<tr>
<th></th>
<th>100–120 Volt</th>
<th>220–240 Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum VA at nominal line voltage:</td>
<td>Idle: 52 VA</td>
<td>Idle: 52 VA</td>
</tr>
<tr>
<td></td>
<td>Bipolar: 450 VA</td>
<td>Bipolar: 450 VA</td>
</tr>
<tr>
<td></td>
<td>Cut: 924 VA</td>
<td>Cut: 924 VA</td>
</tr>
<tr>
<td></td>
<td>Coag: 530 VA</td>
<td>Coag: 530 VA</td>
</tr>
<tr>
<td>Input mains voltage, full regulation range:</td>
<td>90–132 Vac</td>
<td>208–264 Vac</td>
</tr>
<tr>
<td>Input mains voltage, operating range:</td>
<td>85–132 Vac</td>
<td>170–264 Vac</td>
</tr>
<tr>
<td>Mains current (maximum):</td>
<td>Idle: 0.4 A</td>
<td>Idle: 0.2 A</td>
</tr>
<tr>
<td></td>
<td>Bipolar: 2.0 A</td>
<td>Bipolar: 1.0 A</td>
</tr>
<tr>
<td></td>
<td>Cut: 7.0 A</td>
<td>Cut: 3.5 A</td>
</tr>
<tr>
<td></td>
<td>Coag: 4.0 A</td>
<td>Coag: 2.0 A</td>
</tr>
<tr>
<td></td>
<td>LigaSure: 5.0 A</td>
<td>LigaSure: 2.5 A</td>
</tr>
<tr>
<td>Mains line frequency range (nominal):</td>
<td>50 Hz to 60 Hz</td>
<td>50 Hz to 60 Hz</td>
</tr>
<tr>
<td>Fuses (2):</td>
<td>5 mm x 20 mm 8 A, 250 V fast blow</td>
<td>5 mm x 20 mm 8 A, 250 V fast blow</td>
</tr>
<tr>
<td>Power cord:</td>
<td>3-prong hospital grade connector</td>
<td>3-prong locally approved connector</td>
</tr>
</tbody>
</table>
Power Cord Specification

This unit was equipped from the factory with a 110 VAC hospital grade NEMA 5-15 power cord. Should the AC power cord need to be replaced to match another plug configuration, the replacement plug/cable/receptacle configuration must meet or exceed the following specifications:

**100-120 VAC**
- Cable - SJT16/3, IEC color code, maximum length 15 ft (5 m)
- Plug - minimum 10 A - 125 VAC
- Unit receptacle - IEC female, minimum 10 A - 125 VAC

**220-240 VAC**
- Cable - H05VVF3G1.0 VDE, maximum length 15 ft (5 m)
- Plug - minimum 6 A - 250 VAC
- Unit receptacle - IEC female, minimum 6 A - 250 VAC

Input Frequency

The ForceTriad energy platform operates within specification at all line input frequencies between 48 Hz and 62 Hz. The User does not need to reconfigure the ForceTriad energy platform for different line frequencies.

Input Current

The ForceTriad energy platform draws no more than 10 A at any line input voltage.

Backup Power

The ForceTriad energy platform retains all user programmed features, calibration, and statistical data when switched off and unplugged. The ForceTriad energy platform operates within specification when switched over to a supplied line power by hospital backup systems.

Equipotential Ground Connection

An equipotential ground connection is provided to allow connection of the ForceTriad energy platform to ground.
ECG Blanking

An ECG blanking port is provided to signal other devices that the ForceTriad energy platform is active. The receptacle is a 2.5 mm mono jack. It is electrically isolated from the internal ground referenced electronics with the shell electrically connected to the chassis for ESD protection.

Standards and IEC Classifications


ATTENTION

Consult accompanying documents

The energy platform output is floating (isolated) with respect to ground.

DANGER

Explosion risk if used with flammable anesthetics

To reduce the risk of electric shock, do not remove the cover. Refer servicing to qualified service personnel.

Unit produces non-ionizing radiation

Classified with respect to electrical shock, fire, and mechanical hazards only in accordance with UL60601-1 and CAN/CSA C22.2 No. 601.1

Classified with respect to electrical shock, fire, and mechanical hazards only in accordance with UL standard 60601-1; certified to CSA standard C22.2 No. 601.1.
Symbols

- **Monopolar instrument receptacle**
- **Monopolar footswitching receptacle**
- **Bipolar instrument receptacle**
- **LigaSure related receptacle or footswitch**
- **Color-coded LigaSure footswitch symbol for matching rear panel connector to front panel receptacle**
- **REM patient return electrode receptacle**
- **Volume adjustment for activation tones**
- **Equipotential grounding point**
- **Equipment should not disposed in trash**
Class I Equipment (IEC 60601-1)

Accessible conductive parts cannot become live in the event of a basic insulation failure because of the way in which they are connected to the protective earth conductor.

Type CF Equipment (IEC 60601-1)/Defibrillator Proof

This energy platform provides a high degree of protection against electric shock, particularly regarding allowable leakage currents. It is type CF isolated (floating) output and may be used for procedures involving the heart.

This energy platform complies with the ANSI/AAMI HF18 specifications for “defibrillator proof” designation and IEC 60601-2-2.

Liquid Spillage (IEC 60601-2-2 Clause 44.3)

The ForceTriad energy platform is constructed so that liquid spillage in normal use does not wet electrical insulation or other components which when wetted are likely to adversely affect the safety of the equipment.

Voltage Transients (Emergency Energy Platform Mains Transfer)

The ForceTriad energy platform continues to operate normally with no errors or system failures when transfer is made between line AC and an emergency energy platform voltage source. (IEC 60601-2-2 sub-clause 51.101 and AAMI HF18 sub-clause 4.2.2)
### Electromagnetic Compatibility (IEC 60601-1-2 and IEC 60601-2-2)

The ForceTriad energy platform complies with the appropriate IEC 60601-1-2 and 60601-2-2 specifications regarding electromagnetic compatibility.

<table>
<thead>
<tr>
<th>Notice</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ForceTriad energy platform should not be used adjacent to or stacked with equipment other than specified in the ForceTriad Energy Platform User Guide and Service Manual. If adjacent or stacked use is necessary, the ForceTriad energy platform should be observed to verify normal operation in the configuration in which it will be used.</td>
</tr>
<tr>
<td>The ForceTriad energy platform intentionally applies RF energy for diagnosis or treatment during activation. Observe other electronic medical equipment in the vicinity during the ForceTriad energy platform activation for any possible adverse electromagnetic effects. Ensure adequate separation of electronic medical equipment based on observed reactions.</td>
</tr>
<tr>
<td>The use of accessories, other than specified in the ForceTriad energy platform user guide and service manual, may result in increased emissions or decreased immunity of the ForceTriad energy platform.</td>
</tr>
</tbody>
</table>

The ForceTriad energy platform meets the following requirements:

- ESD Immunity (IEC 60601-1-2 Sub-Clause 36.202 and IEC 61000-4-2)
- Radiated Immunity (IEC 60601-1-2 sub-clause 36.202.2 and IEC 61000-4-3)
- Electrical Fast Transient/Burst (IEC 60601-1-2 sub-clause 36.202.3.1 and IEC 61000-4-4)
- Surge Immunity (IEC 60601-1-2 sub-clause 36.202.3.2 and IEC 61000-4-5)
- Emissions (IEC 60601-1-2 sub-clause 36.201.1, IEC 60601-2-2 sub-clause 36 and CISPR 11 Class A)
- Harmonic distortion (IEC 60601-1-2 sub-clause 36.201.3.1 and IEC 61000-3-2)
- Conducted disturbances (IEC 60601-1-2 sub-clause 36.202.6 and IEC 61000-4-6)
- Power frequency magnetic fields (IEC 60601-1-2 sub-clause 36.202.8.1 and IEC 61000-4-8)
- Voltage dips, short interruptions and variations (IEC 60601-1-2 sub-clause 36.202.7 and IEC 61000-4-11)
### Guidance and manufacturer's declaration - electromagnetic emissions

The ForceTriad energy platform is intended for use in the electromagnetic environment specified below. The customer or the user of the ForceTriad energy platform should ensure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Emissions test</th>
<th>Compliance</th>
<th>Electromagnetic environment - guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF emissions CISPR 11</td>
<td>Group 2</td>
<td>The ForceTriad energy platform must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.</td>
</tr>
<tr>
<td>RF emissions CISPR 11</td>
<td>Class A</td>
<td>The ForceTriad energy platform is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.</td>
</tr>
<tr>
<td>Harmonic emissions IEC 61000-3-2</td>
<td>Class A</td>
<td></td>
</tr>
<tr>
<td>Voltage fluctuations/ flicker emissions IEC61000-3-3</td>
<td>Complies</td>
<td></td>
</tr>
</tbody>
</table>
The ForceTriad energy platform is intended for use in the electromagnetic environment specified below. The customer or the user of the ForceTriad energy platform should ensure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Immunity test</th>
<th>IEC 60601 test level</th>
<th>Compliance level</th>
<th>Electromagnetic environment - guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge (ESD)</td>
<td>+/-6 kV contact</td>
<td>+/-6 kV contact</td>
<td>Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.</td>
</tr>
<tr>
<td>IEC 61000-4-2</td>
<td>+/-8 kV air</td>
<td>+/-8 kV air</td>
<td></td>
</tr>
<tr>
<td>Electrical fast transient/burst</td>
<td>+/-2 kV for power supply lines</td>
<td>+/-2 kV for power supply lines</td>
<td>Mains power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC 61000-4-4</td>
<td>+/-1 kV for input/ output lines</td>
<td>+/-1 kV for input/ output lines</td>
<td></td>
</tr>
<tr>
<td>Surge</td>
<td>+/-1 kV differential mode</td>
<td>+/-1 kV differential mode</td>
<td>Mains power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC 61000-4-5</td>
<td>+/-2 kV common mode</td>
<td>+/-2 kV common mode</td>
<td></td>
</tr>
<tr>
<td>Voltage dips, short interruptions and voltage variations on power supply input lines</td>
<td>&lt;5% Ut (&gt;95% dip in Ut) for 0,5 cycle</td>
<td>&lt;5% Ut (&gt;95% dip in Ut) for 0,5 cycle</td>
<td>Mains power quality should be that of a typical commercial or hospital environment. If the user of the ForceTriad energy platform requires continued operation during power mains interruptions, it is recommended that the ForceTriad energy platform be powered from an uninterruptible power supply or a battery.</td>
</tr>
<tr>
<td>IEC 61000-4-11</td>
<td>40% Ut (&gt;60% dip in Ut) for 5 cycles</td>
<td>40% Ut (&gt;60% dip in Ut) for 5 cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70% Ut (&gt;30% dip in Ut) for 25 cycles</td>
<td>70% Ut (&gt;30% dip in Ut) for 25 cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;5% Ut (&gt;95% dip in Ut) for 5 sec</td>
<td>&lt;5% Ut (&gt;95% dip in Ut) for 5 sec</td>
<td></td>
</tr>
<tr>
<td>Power frequency (50/60 Hz) magnetic field</td>
<td>3 A/m</td>
<td>3 A/m</td>
<td>Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC 61000-4-8</td>
<td>3 A/m</td>
<td>3 A/m</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Ut is the a.c. mains voltage prior to the application of the test level.
Guidance and manufacturer’s declaration - electromagnetic immunity

The ForceTriad energy platform is intended for use in the electromagnetic environment specified below. The customer or the user of the ForceTriad energy platform should assure that it is used in such an environment.

<table>
<thead>
<tr>
<th>Immunity test</th>
<th>IEC 60601 test level</th>
<th>Compliance level</th>
<th>Electromagnetic environment - guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted RF</td>
<td>IEC 61000-4-6</td>
<td>3 Vrms</td>
<td>Portable and mobile RF communications equipment should be used no closer to any part of the ForceTriad energy platform, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</td>
</tr>
<tr>
<td></td>
<td>150 kHz to 80 MHz</td>
<td>3 V</td>
<td></td>
</tr>
<tr>
<td>Radiated RF</td>
<td>IEC 61000-4-3</td>
<td>3 V/m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80 MHz to 2.5 GHz</td>
<td>7 V/m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Recommended separation distance</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[d=0.5\sqrt{P}]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[d=0.5\sqrt{P} \text{ 80 MHz to 800 MHz}]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[d=\sqrt{P} \text{ 800 MHz to 2.5 GHz}]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Where ( P ) is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and ( d ) is the recommended separation distance in meters (m).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interference may occur in the vicinity of equipment marked with the following symbol: ( \text{({{1}})} )</td>
</tr>
</tbody>
</table>

Continued
| NOTE 1 | At a 80 MHz and 800 MHz, the higher frequency range applies. |
| NOTE 2 | These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people. |

**a.** Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ForceTriad energy platform is used exceeds the applicable RF compliance level above, the ForceTriad energy platform should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the ForceTriad energy platform.

**b.** Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 7 V/m.
The ForceTriad energy platform is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The Customer or the user of the ForceTriad energy platform can help prevent electromagnetic interferences by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ForceTriad energy platform as recommended below, according to the maximum output power of the communications equipment.

<table>
<thead>
<tr>
<th>Rated maximum output power of transmitter (W)</th>
<th>Separation distance according to frequency of transmitter (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150 kHz to 80 MHz</td>
</tr>
<tr>
<td></td>
<td>$d=0.5\sqrt{P}$</td>
</tr>
<tr>
<td>0.01</td>
<td>0.05 m</td>
</tr>
<tr>
<td>0.1</td>
<td>0.16 m</td>
</tr>
<tr>
<td>1</td>
<td>0.5 m</td>
</tr>
<tr>
<td>10</td>
<td>1.6 m</td>
</tr>
<tr>
<td>100</td>
<td>5 m</td>
</tr>
</tbody>
</table>

For transmitters rated at a maximum output power not listed above, the recommended separation distance $d$ in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

**NOTE 1** At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.  

**NOTE 2** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.
Output Characteristics

Maximum Output for Bipolar, Monopolar, and LigaSure Modes

Power readouts agree with actual power into rated load to within 15% or 5 watts, whichever is greater.

**Caution**

To avoid injury to the patient or surgical team, use only instruments rated for use at, or greater than, the maximum peak voltages listed below. For example, bipolar instruments must have voltage ratings of 250 V peak or greater, as shown in the “Open Circuit Peak Voltage (max)” column.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Open Circuit Peak Voltage (max)</th>
<th>Open Circuit P–P Voltage (max)</th>
<th>Rated Load (max)</th>
<th>Power (max)</th>
<th>Crest Factor*</th>
<th>Duty Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bipolar</strong></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Low</td>
<td>250 V</td>
<td>500 V</td>
<td>100 Ω</td>
<td>95 W</td>
<td>1.42</td>
<td>N/A</td>
</tr>
<tr>
<td>Standard</td>
<td>175 V</td>
<td>350 V</td>
<td>100 Ω</td>
<td>95 W</td>
<td>1.42</td>
<td>N/A</td>
</tr>
<tr>
<td>Macro</td>
<td>250 V</td>
<td>500 V</td>
<td>100 Ω</td>
<td>95 W</td>
<td>1.42</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Monopolar Cut</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut</td>
<td>1050 V</td>
<td>2100 V</td>
<td>300 Ω</td>
<td>300 W</td>
<td>1.42</td>
<td>N/A</td>
</tr>
<tr>
<td>Blend</td>
<td>1485 V</td>
<td>2970 V</td>
<td>300 Ω</td>
<td>200 W</td>
<td>2.7</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Valleylab (HWD)</strong></td>
<td>2365 V</td>
<td>4730 V</td>
<td>300 Ω</td>
<td>200 W</td>
<td>4.3</td>
<td>25%</td>
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<tr>
<td><strong>Monopolar Coag</strong></td>
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<tr>
<td>Fulgurate</td>
<td>3050 V</td>
<td>6100 V</td>
<td>500 Ω</td>
<td>120 W</td>
<td>5.55</td>
<td>6.5%</td>
</tr>
<tr>
<td>Spray</td>
<td>3625 V</td>
<td>7250 V</td>
<td>500 Ω</td>
<td>120 W</td>
<td>6.6</td>
<td>4.6%</td>
</tr>
<tr>
<td><strong>LigaSure</strong></td>
<td>287.5 V</td>
<td>575 V</td>
<td>20 Ω</td>
<td>350 W</td>
<td>1.42</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>LigaSure Test</strong></td>
<td>147.5 V</td>
<td>295 V</td>
<td>20 Ω</td>
<td>190 W</td>
<td>1.42</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* An indication of a waveform’s ability to coagulate bleeders without a cutting effect.
### Available Power Settings in Watts

#### Autobipolar (All Modes)

5 6 7 8 9 10  
11 12 13 14 15 16 17 18 19 20  
21 22 23 24 25 26 27 28 29 30  
31 32 33 34 35 36 37 38 39 40  
45 50 55 60 65 70 75 80 85 90  
95

#### Bipolar (All Modes)

1 2 3 4 5 6 7 8 9 10  
11 12 13 14 15 16 17 18 19 20  
21 22 23 24 25 26 27 28 29 30  
31 32 33 34 35 36 37 38 39 40  
45 50 55 60 65 70 75 80 85 90  
95
### Monopolar Cut

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### Monopolar Blend

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## Valleylab

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## Monopolar Coag

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</tbody>
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*ForceTriad Energy Platform Service Manual*
Output Waveforms

Tissue Sensing Technology, an automatic adjustment, controls all modes. As tissue resistance increases from zero, the energy platform outputs constant current followed by constant power followed by constant voltage. The maximum output voltage is controlled to reduce capacitive coupling and video interference and to minimize sparking.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Waveform Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bipolar</strong></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>472 kHz sinusoid continuous</td>
</tr>
<tr>
<td>Standard</td>
<td>472 kHz sinusoid continuous</td>
</tr>
<tr>
<td>Macro</td>
<td>472 kHz sinusoid continuous</td>
</tr>
<tr>
<td><strong>Monopolar Cut</strong></td>
<td></td>
</tr>
<tr>
<td>Cut</td>
<td>472 kHz sinusoid continuous</td>
</tr>
<tr>
<td>Blend</td>
<td>472 kHz bursts of sinusoid, recurring at 26.21 kHz intervals. 50% duty cycle.</td>
</tr>
<tr>
<td><strong>Valleylab</strong></td>
<td></td>
</tr>
<tr>
<td>Valleylab</td>
<td>472 kHz bursts of sinusoid, recurring at 28.3 kHz intervals. 25% duty cycle.</td>
</tr>
<tr>
<td><strong>Monopolar Coag</strong></td>
<td></td>
</tr>
<tr>
<td>Fulgurate</td>
<td>472 kHz damped sinusoidal bursts with a repetition frequency of 30.66 kHz. 6.5% duty cycle.</td>
</tr>
<tr>
<td>Spray</td>
<td>472 kHz damped sinusoidal bursts with a randomized repetition centered at 21.7 kHz. 4.6% duty cycle.</td>
</tr>
</tbody>
</table>
Output Power vs. Resistance Graphs

Monopolar Graphs

Pure Cut

Output power versus impedance for Pure cut power

Output power versus power setting for Pure cut power

1. Output power (watts)
2. Load Impedance (ohms)

1. Cut, Output power vs. Setting @ 300 Ω
2. Output power (watts)
3. Power Setting
Output Power vs. Resistance Graphs

**Peak voltage versus power setting for Pure cut power**

![Graph](image1)

1. Open Circuit Cut Peak Voltage vs. Power Setting
2. Peak Voltage
3. Power Setting

**Blend**

*Output power versus impedance for Blend power*

![Graph](image2)

1. Output power (watts)
2. Load Impedance (ohms)
Output power versus power setting for Blend power

1. Blend Output Power vs. Setting @ 300 Ω
2. Output power (watts)
3. Power Setting

Peak voltage versus power setting for Blend power

1. Open Circuit Blend Peak Voltage vs. Power Setting
2. Peak Voltage
3. Power Setting
Fulgurate

Output power versus impedance for Fulgurate power

Output power versus power setting for Fulgurate power

1. Fulgurate Output Power vs. Setting @ 500 Ω
2. Output power (watts)
3. Power Setting
**Peak voltage versus power setting for Fulgurate power**

- **1.** Open Circuit Fulgurate Peak Voltage vs. Power Setting
- **2.** Peak Voltage
- **3.** Power Setting

**Spray**

*Output power versus impedance for Spray power*

- **1.** Output power (watts)
- **2.** Load impedance (ohms)
Output Power vs. Resistance Graphs

Output power versus power setting for Spray power

Peak voltage versus power setting for Spray power

1. Spray Output Power vs. Setting @ 500 Ω
2. Output power (watts)
3. Power Setting

1. Open Circuit Spray Peak Voltage vs. Power Setting
2. Peak Voltage
3. Power Setting
Valleylab

*Output power versus impedance for Valleylab power*

Output power versus power setting for Valleylab power

1. Hemostasis with Division Output Power vs. Power Setting @ 300 Ω
2. Output power (watts)
3. Power Setting
Peak voltage versus power setting for Valleylab power

1. Open Circuit Valleylab Mode Peak Voltage vs. Power Setting
2. Peak Voltage
3. Power Setting
Bipolar Graphs

Bipolar Low

Output power versus impedance for Bipolar Low power

Output power versus power setting for Bipolar Low power

1. Output power (watts)
2. Load Impedance (ohms)
3. Bipolar Low Output Power vs. Setting @ 100 Ω
4. Output power (watts)
5. Power Setting


Technical Specifications

4-33
**Output Power vs. Resistance Graphs**

*Peak voltage versus power setting for Bipolar Low power*

![Graph 1](image1)

1. Open Circuit Bipolar Low Peak Voltage vs. Power Setting
2. Peak Voltage
3. Power Setting

**Bipolar Standard**

*Output power versus impedance for Bipolar Standard power*

![Graph 2](image2)

1. Output power (watts)
2. Load Impedance (ohms)
Output power versus power setting for Bipolar Standard power

Peak voltage versus power setting for Bipolar Standard power

**Note:** Maximum peak voltage in the Bipolar Standard mode occurs at 500 Ω, not open circuit.
Bipolar Macro

Output power versus impedance for Bipolar Macro power

- Output power (watts)
- Load Impedance (ohms)

Output power versus power setting for Bipolar Macro power

- Bipolar Macro Output Power vs. Setting @ 100 Ω
- Output power (watts)
- Power Setting
Peak voltage versus power setting for Bipolar Macro power

- 1. Open Circuit Bipolar Macro Peak Voltage vs. Power Setting
- 2. Peak Voltage
- 3. Power Setting
LigaSure

Output power versus impedance for LigaSure power

Peak voltage versus impedance for LigaSure power
Chapter 5
Principles of Operation

This chapter provides detailed information about how the ForceTriad energy platform functions and how the internal components interact.

This chapter includes the following information:

• A block diagram that illustrates how the energy platform functions
• A general description of how the energy platform works
• Detailed descriptions of the circuitry for the printed PCBAs
Block Diagram
Functional Overview

The ForceTriad energy platform is a combination of a full-featured general surgery electrosurgical unit and a LigaSure vessel sealing system. The monopolar and bipolar sections of the ForceTriad are isolated electrosurgical outputs that provide the appropriate power for cutting, desiccating, and fulgurating tissue during monopolar and bipolar surgery. The LigaSure section of the ForceTriad provides power for vessel sealing.

During monopolar electrosurgery, radio frequency (RF) current flows from the energy platform to an active electrode, which delivers the current to the patient. The resistance to the current, provided by the patient's tissue and/or the air between the active electrode and the tissue, produces the heat that is necessary for the surgical effect. The RF current flows from the active electrode, through the patient's body tissue to the return electrode, which recovers the current and returns it to the energy platform.

The LigaSure vessel sealing system provides precise energy delivery and electrode pressure to vessels for a controlled time period to achieve a complete and permanent fusion of the vessel lumen.

TissueFect™ Tissue Sensing Technology

The ForceTriad energy platform automatically senses resistance and adjusts the output voltage to maintain a consistent tissue effect across different tissue impedance. This adjustment is based on the selected mode, the power setting, and the level of tissue resistance.

REM Contact Quality Monitoring System

The ForceTriad energy platform uses the REM Contact Quality Monitoring system to monitor the quality of electrical contact between the patient return electrode and the patient. The REM system is designed to minimize the risk of burns at the return electrode site during monopolar electrosurgery.

When you connect a REM Polyhesive patient return electrode to the Patient Return Electrode receptacle, you activate the REM system. When you activate monopolar output, the energy platform connects the patient return electrode path. If you activate bipolar output while a return electrode is connected to the patient, the return electrode circuit is deactivated automatically to eliminate the possibility of current dispersal.

The REM system continuously measures resistance at the return electrode site and compares it to a standard range of safe resistance (between 5 and 135 Ω), thus minimizing intermittent false alarms that could result from small changes in resistance.

The REM system also adapts to individual patients by measuring the initial contact resistance (baseline resistance) between the patient and the patient return electrode. If the tissue impedance at the return electrode decreases during electrosurgery, the REM system resets the baseline resistance.
REM Alarm Activation

The REM Alarm indicator flashes red, a tone sounds, and the energy platform stops producing output power when either of the following occurs:

- The measured resistance is below 5 Ω or above 135 Ω, the limits of the standard range of safe resistance.
- An increase in contact resistance is greater than 40% from the initial measurement (baseline resistance).

The REM Alarm indicator remains illuminated red until you correct the condition causing the alarm. Then, the indicator illuminates green and RF output is enabled.

Electrodes Without the REM Safety Feature

Return electrodes without the REM safety feature cannot be used on the ForceTriad energy platform.

High Voltage DC (HVDC) Power Supply Principles of Operation

The HVDC power supply regulates an output DC voltage to a desired level that is proportional to a 0 to 5V analog logic signal called Voltage Control (ECON). The AC input range is 85 VAC to 264 VAC with line frequencies from 47Hz to 63Hz. The HVDC can be simplified into two sections, the AC section and DC section.

The AC section rectifies the AC input into the rectified +Bus and –Bus voltages. For line voltages of 150 VAC or less, the rectified AC voltage is doubled. The rectified voltage is monitored and is flagged if the voltage starts to drop too low or if the rectified voltage exceeds 400 VDC. As a safety feature, the HVDC shuts down when it exceeds 400 VDC. The AC section also incorporates a soft start circuit that reduces the inrush AC current at power up.

The DC section is a phase-shifted full-bridge typology and uses a Pulse Width Modulator (PWM) from Texas Instruments, part number UCC3895. For information on this particular typology, the data sheet (available at ti.com) for this part contains a full dialogue of the theory of operation. The DC section consists of limits that help protect the HVDC from fault conditions.

These limits include over voltage, over current, over power, and short circuit. Each limit sends a flag to the controller card if it is triggered and shuts down the HVDC. Another feature of the HVDC is an active discharge circuit; this circuit places a load across the output. This allows the output of the HVDC to discharge quickly no matter what the load attached to the HVDC.
RF Principles of Operation

The primary purpose of the ForceTriad RF PCBA is to convert the DC voltage coming from the HVDC PCBA into a 470 kHz RF signal that is sent to the Steering Relay PCBA to be distributed to the appropriate output.

A push-pull typology is used to accomplish this voltage conversion. Two gate drive signals that are 180° out of phase are used to drive the high voltage Field Effect Transistors (FETs), called T ON and T ON 180. The gate drive signals turn on each of the FETs at opposite times to deliver a waveform at the specified power requested from the user.

The RF PCBA is capable of several different outputs ranging from 5.5 Arms in LigaSure tissue fusion modes to over 7KVpp in coag modes. Relays throughout the RF PCBA switch in the appropriate tuning elements required to achieve these various outputs.

Primary and redundant sense circuits detect the RF output voltage and current. An accurate scaled down AC voltage representative of each of these is sent to the Controller PCBA, which in turn keeps the output at levels appropriate for the mode in use.

Four sense relays per circuit correspond to specific modes and switch in voltage dividers tuned to divide the output signals to levels that are manageable for the Controller card.

Three relays per voltage sense circuit divide down the output voltages from 425 Vpk - 5000 Vpk to around 1 Vpk, depending on the mode selected by the user. The current sensors use 1 relay per circuit; this relay kicks in for currents higher than 1Arms. The sensor signals are passed through a multiplier which uses a gain control signal from the controller card.

After this multiplier stage, the signal is filtered and routed to the controller card. RF voltage and current foldback circuits use the ranges selected on the sensors to determine if a limit has been hit. These circuits fold back the ECON signal going to the HVDC, reducing the DC output to the RF PCBA. This in turn reduces the RF output amplitude.

REM

The Return Electrode Monitor (REM) circuit monitors the resistance between the two return areas on a REM electrode using a 80 kHz signal generated by the controller card.

Autobipolar

The Autobipolar (ABP) circuit consists of an 80 kHz signal, also generated by the controller card. It is used to monitor the bipolar output impedance.

Leakage Current Monitor

The RF PCBA also features a leakage current monitor circuit, which measures the active and return of the energy platform and puts out a DC voltage that represents the difference between the two. If this voltage exceeds a limit, the RF is folded back to prevent excess leakage current.
Sensor Circuit

The sensor circuit provides RF output voltage and current monitoring to software in order to deliver the correct energy dosage during a surgical procedure. Two identical sensory circuit paths, composed of a primary and backup, are implemented to provide fail-safe mitigation in the event of circuit failure.

Because each primary and backup sensor circuit mirrors the other, the sensed output voltages, which are monitored by software, are equal when the sensory system maintains proper operation. In the event of primary or backup sense circuit failure, dissimilar outputs are present and software detection stops delivery of RF and notifies the user with an error message displayed on the front panel of the ForceTriad energy platform.

Each primary and backup sensory circuit consists of four processing elements to ensure that the correct RF is delivered. In the description that follows, the primary sensory path is identified for the voltage sense circuitry, with reference designation only provided to the backup circuit.

Backup circuit operation is identical to the primary circuit that is described here. RF current sense circuit process is symmetrical to the voltage sense description in that it also uses four processing elements. The only notable difference between voltage and current sensing is the different transfer gains required to adequately address the dynamic range of individual energy platform operating modes.

First: Transformer T6, along with resistors R110 and R119, provide RF output voltage monitoring by generating a proportionately scaled, secondary sense voltage, which is correlated to the delivered RF output voltage. Backup referenced components are T1, R95, and R111.

Second: Coupled to the secondary of transformer T6, a software controlled switched pad network is implemented to provide proper impedance scaling to address the dynamic sensory range required for all operating modes of the ForceTriad energy platform.

This pad impedance switched network is used to develop the proportionately scaled secondary sense voltage of T6. Resistors R103 and R107 provide the initial impedance termination, paralleled by resistor paired components R104 and R105, R94 and R106, and R85 and R100, which are switched independent on the selected energy platform Cut, Blend, and Coag operating modes respectively.

Paired resistor switching is accomplished by electronic switch components RL12, RL11, and RL10 respectively. Backup referenced terminating components are R89 and R93; paired components are R90 and R91, R88 and R92, and R81 and R84; and switch components are RL9, RL8, and RL7, which are used respectively.

Third: The Pad network output of T6 is then differentially fed to a gain control module, U18, which provides continuous gain control to normalize the sensed voltage output, independent of energy platform operating modes and delivered RF power levels.

Amplifier, U19, buffers the signal received from software which is used to precisely control the gain of U18, while amplifier U17 provides a scaled differential output voltage, a result of U18 gain processing. Backup referenced components are gain control module U40, buffer amp U31, and difference amp U30 respectively.
**Fourth:** The output of amplifier U17 is now delivered to the last stage for sensory signal processing. An anti-alias filter device, U16, receives the difference signal from U17. The last stage of sensor processing provides a benefit to the RF monitored output; it increases the accuracy of the delivered RF by minimizing noise to the sensed signals. Backup components U29, R190, and R216 are used.

**Steering Relay PCBA Principles of Operation**

To accommodate the need for high isolation between the patient and ground referenced voltages during use, the ForceTriad Steering Relay PCBA design incorporates several different types of relays designed for very high voltage standoff. In addition, cut-outs on the PCBA increase distances at strategic locations to help reduce creepage issues.

Multiple functions are performed by the Steering Relay PCBA. The main function is to route the 470 kHz from the RF PCBA to one of the six outputs. The outputs are as follows: Ligasure 1, Ligasure 2, Bipolar, Mono 1, Mono 2, and Footswitch Controlled outputs.

Because only one output can be active at any given time, the Steering Relay PCBA plays an important role in maintaining the isolation between all the outputs and their respective circuits. During mono and footswitch modes, a return path, called Mono return, is required.

Mono return is monitored with a Return Electrode Monitor (REM) circuit. This circuit monitors the resistance between the two return areas on a REM electrode. The actual REM circuit is on the RF PCBA, but this 80 kHz signal is routed through the Steering Relay PCBA to the Mono return.

Another signal that is routed from the RF PCBA to the Steering Relay PCBA is the Autobipolar (ABP) signal. This 80 kHz signal monitors the bipolar output impedance.

Another important function of the Steering Relay PCBA is hand-switching detection. The circuits used to detect hand-switching requests are powered from individual, highly isolated power supplies.

These power supplies use transformers that convert ground referenced +12 V to an isolated +8 V or +5 V, each referenced to its corresponding output. Five handswitching power supplies are available: Ligasure 1, Ligasure 2, Bipolar, Mono 1, and Mono 2. When an active hand switch signal is detected, the detection signal is transferred across an optocoupler and is sent to the microprocessor.

The final function of this PCBA is footswitch and bipolar sense. These circuits determine if an instrument is connected to any of the receptacles.
Circuit Descriptions for the Force Triad Display PCBA

Hotlink Transceiver U1

The Cypress Hotlink II transceiver U1 handles all communications between the Display PCBAs Field Programmable Gate Array (FPGA) U28 and the Controller PCBA. A single IC handles bi-directional communication.

Liquid Crystal Display (LCD) Driver Inside the FPGA U28

The LCD driver receives video data from the Controller PCBA and outputs it to the displays. Data is written into a 16-pixel deep First In/First Out (FIFO) when received from the serial link. Data is read out of the FIFO and presented to the displays at the pixel rate. For the ForceTriad energy platform, this yields a display refresh rate of ~46 Hz. In either case, the pixel rate must be derived from the receive clock to keep the display output in sync with the display data generation on the Controller PCBA and prevent overflowing or under flowing of the pixel FIFO.

Touchscreen Driver

Reading user input from the touchscreens is performed by the touchscreen driver. Three touchscreens are attached to the Display PCBA, each through its own 5-wire interface. The touchscreen driver polls each screen in turn to determine whether the user is pressing on it. If so, then the X and Y position of the touch are detected.

On the Force Triad Display PCBA, load switching FETs are used to drive voltages onto the four electrical drive connections, and the voltage on the sense connection is read by an Analog Digital Converter (ADC) U4. The drive circuitry normally drives +3.3 V to all four drive connections, while the sense connection is pulled weakly to ground.

The FPGA repeatedly reads the analog voltage on the sense line. As long as it is closer to ground than to +3.3 V, it registers a “no touch” read. If, however, the sense line is closer to +3.3 V than to ground, it initiates a read cycle. In the read cycle, the FPGA first applies +3.3 V to the X and (right side) drive connections and ground to the Y and L (left side) drive connections.

The voltage on the sense line is sampled to obtain the X position. Then, the Y and (top side) drive connection are driven to +3.3 V while the X and L (bottom side) drive connections are grounded. The sense line voltage is recorded as the Y position. This process is repeated for each of the three touchscreens.
LCD Brightness DAC Control

The brightness for each Quarter Video Graphics Array (QVGA) display can be controlled individually by feeding an analog value between 0 and 5V to its inverter. This is accomplished by use of a Digital/Analog Converter (DAC) U24. The LCD brightness DAC control block takes DAC values from the serial link and writes them to the DAC.

Barcode Driver

The Display PCBA supports communication with four barcode readers through a quad-Universal Asynchronous Receiver/Transmitter (UART) U14. One channel of the serial interface side of the UART is connected to each barcode reader, while the control side is connected to the display FPGA.

The barcode driver reads data bytes out of the UART as they are received from the barcode readers and sends them to the Controller PCBA. It also writes data and control bytes to the UART as specified by the Controller PCBA.

Power Supply

The power supply is dual DC to DC converter U16. The power supply has an input of 5 Volts and converts it down to 3.3 and 1.8 Volts outputs.

Footswitch/Audio PCBA Circuitry Description

Overview

The primary function of the audio circuitry is to receive commands from the Interface Control Logic (ICL) FPGA on the Controller PCBA via a serial, two-wire SMBus data link. The FPGA on this PCBA processes that data to determine three parameters; wave file, volume, and duration.

Based on these parameters, the FPGA accesses corresponding parallel data from flash memory, serializes it and passes it out to the DAC. Control data is also passed to the DAC that sets the volume level of the output amplifier stage. Footswitch data is collected and sent to the Controller PCBA as well.

Finally, the expansion port has an RS-232 and EKG/blanking relay interface that connects directly to the Controller PCBA and DAC controlled by this FPGA. The following diagram illustrates signal interconnect.
**Power Supplies**

This PCBA requires 2 power supplies: 5 V and 12 V. From those input voltages it also generates 2.5V, 3.3 V, and isolated supplies of +12 V, -12 V and +5 V. 5 V and 12 V are delivered to this PCBA via the RF PCBA connector.

The 2.5 V and 3.3 V supplies are regulated down from the 5 V supply on this PCBA. The 5 V rail should draw approximately 100 mA. The 12 V rail should draw approximately 500mA at full volume with no expansion port peripherals connected.

The 12 V supply is used by the audio amplifier, TPA1517, and also generates all of the isolated power supplies. The isolated power supply can source approximately 250 mA on each, +12 V ISO and -12 V ISO, and 500 mA on +5 V ISO.

**Communications**

All communications between the Controller PCBA and the Footswitch/Audio PCBA are conducted over a two-wire System Management Bus (SMBus). The master of this bus is the Controller PCBA.

**Audio Data**

Three commands can be received from the Controller PCBA; reset, parameter write and parameter read. The reset command resets all internal state machines inside the FPGA. It also immediately stops a running audio stream. The parameter commands allow the controller to write and read three internal parameters that control sending out audio data.

These parameters are wave file, duration, and volume.

The wave file parameter selects a particular wave file in the flash memory by selecting a base memory address from a look up table.

The duration parameter selects how many times to repeat the wave file. Since each wave file is a fixed length, that file can be repeated up to 30 times, or it can be told to be sent out continuously until another command is received.

Finally, the volume parameter simply selects a volume level between 0 (mute) and 1024 (highest volume, approximately 60 dBA).

When a command is received, the FPGA processes that command only once. For example, if a particular wave file is selected to be played twice, the FPGA plays that wave file twice and then stop until a new command is received. If a wave file is to be played continuously, it can be set via the duration field.

**Footswitch Data**

Footswitch data is polled in this FPGA and, when a footswitch register read is received from the ICL FPGA, the footswitch register data is sent to the ICL FPGA and then cleared. After being cleared, the FPGA immediately polls the footswitches for new footswitch activations. If an activation is detected, the FPGA holds a corresponding bit in the
footswitch register until it is read by the ICL FPGA, even if the footswitch is depressed before that event occurs.

**Expansion Port DAC Data**

The ICL FPGA sends DAC data to this FPGA, which is then serialized and sent out to the expansion port DACs. Four DAC registers can be written to in this FPGA; each corresponds to a RF statistic: power, current, voltage, and load impedance.

**DAC Amplifier**

The DAC is an Analog Device AD1854. It is controlled by two serial interfaces. One interface streams left and right channel audio data. The other interface sends control data to the DAC, including amplification settings. The volume parameter is passed directly to the DAC via this interface.

The amplifier is an Analog Device TPA1517. It is a 6-watt amplifier and runs off 12 volts. For both the DAC and the amplifier, only one of the two channels is used since the Footswitch/Audio PCBA only has one speaker.

**Isolated Footswitch and Expansion Port Circuitry**

The footswitch circuit provides an isolated footswitch detection circuit that passes footswitch data directly to this PCBA’s FPGA. The FPGA, as noted above, polls the footswitches for activations.

The expansion port has an EKG/blanking relay that is directly controlled by the Controller PCBA. The expansion port also has an RS-232 interface that links directly to the controller. And finally, it has a DAC that outputs analog data that corresponds to RF parameters.

**Host Processor**

The host has FLASH, SDRAM, and SRAM memory blocks. All memory devices are directly connected to the address and data bus. The SRAM is a battery-backed device that also supports the system’s real-time clock function. The host processor is also capable of external communication through two RS232 ports, an Ethernet port, and a USB port.
Digital Signal Processor (DSP) Controlled Data Converters

**DSP1**
The first Analog Devices ADSP-21161N DSP is the main control system processor. Its primary responsibility is control of the High Voltage Power Supply (HVPS) setting (via an on-board DAC), as well as the keying signal for the FR FETs (T_ON, T_ON_180).
It also reads a set of voltage and current sensors that complete the feedback loop of the control system. DSP1 has FLASH and SDRAM memories directly connected to its address and data bus.

**DSP2**
The second 21161 in the system is the dosage-error processor. It reads a redundant set of the same sensors that DSP1 reads. Through a direct-connect serial channel (or through the ICL), the two DSPs are able to compare sensor results. DSP2 has FLASH and SDRAM memories directly connected to its address and data bus.

**Interface Control Logic PLD**
The purpose of the ICL is to act as Hardware Abstraction Layer (HAL) for the processors. Those peripherals not directly connected to the processors are connected to the ICL. The ICL also provides a communication channel for the three processors via a tri-port RAM. The peripherals connected to the ICL are:
- Footswitch/Audio PCBA
- PCBA ID bus
- Display PCBA (LCDs, barcode readers, and touchscreens)
- Low Voltage Power Supply (LVPS) power fail circuit
- REM and HVPS sensor circuits
- RF relays

**Data Converters**
There are four high-speed Analog-to-Digital Converters (ADCs) on the PCBA for voltage and current sensor data. There is also one slow-speed ADC for reading REM voltage as well as the HVPS output. There are three Digital-to-Analog Converters (DACs) on the PCBA as well.
One DAC is not used. The other two DACs are used by the DSPs to drive the gain of their respective voltage and current sensors. The DSP1 DAC also drives the voltage level of the HVPS. The following figures show how the on-board and off-board data converters are connected.
External Peripherals

The Controller PCBA has ports for talking to external peripherals through the following protocols: RS232, USB 1.1, and Ethernet.
Chapter 6

Setup, Tests, and Adjustments

After unpacking or after servicing the ForceTriad energy platform, set it up and verify that it functions correctly.

If the energy platform does not satisfactorily complete the self-test, calibrate it to ensure its accuracy.
Setting Up the Energy Platform

**Warning**

**Electric Shock Hazard** Connect the energy platform power cord to a properly grounded receptacle. Do not use power plug adapters.

**Fire Hazard** Do not use extension cords.

**Caution**

Do not stack equipment on top of the energy platform or place the energy platform on top of electrical equipment. These configurations are unstable and/or do not allow for adequate cooling.

Provide as much distance as possible between the electrosurgical energy platform and other electronic equipment (such as monitors). An activated electrosurgical energy platform may cause interference with them.

**Notice**

If required by local codes, connect the energy platform to the hospital equalization connector with an equipotential cable.

Connect the power cord to a wall outlet having the correct voltage. Otherwise product damage may result.

1. Verify the energy platform is off by pressing the power switch off (O).

2. Place the energy platform on a stable flat surface, such as a table, platform, or Covidien cart. Carts with conductive wheels are recommended. For details, refer to the procedures for your institution or to local codes.

   Provide at least four to six inches of space from the sides and top of the energy platform for cooling. Normally, the top, sides, and rear panel are warm when the energy platform is used continuously for extended periods of time.

   Ensure that the energy platform rests securely on the cart or platform. The underside of the energy platform contains four rubber feet and additional holes that allow you to reposition the feet to ensure stability. Use a Phillips screwdriver to remove the rubber feet from the energy platform. Then, reinstall the feet in the preferred location.

3. According to the procedures used by your institution, connect an equipotential grounding cable to the grounding lug on the rear panel of the energy platform. Then, connect the cable to earth ground.

4. Plug the energy platform power cord into the rear panel receptacle.

5. Plug the energy platform power cord into a grounded receptacle.
Periodic Safety Check

6. Turn on the energy platform by pressing the power switch on (\(\)). Verify the following:
   – All visual indicators and displays on the front panel illuminate
   – Activation tones sound to verify that the speaker is working properly

7. If the self-test is successful, a tone sounds. Verify the following:
   – The three LCD touch screens illuminate and show the appropriate operating screen.
   – Each display shows a power setting of one watt.
   – The REM alarm indicator illuminates red.
   or
   If the self-test is not successful, an alarm tone sounds. An error screen appears on each of the LCD touchscreens. Note the information on this display and refer to Chapter 7, Troubleshooting.

Periodic Safety Check

Perform the following safety check once a year to verify that the energy platform is functioning properly. Record the test results for reference in future tests. If the energy platform fails to meet any of the checks, refer to Chapter 7, Troubleshooting.

**Warning**

<table>
<thead>
<tr>
<th>Electric Shock Hazard</th>
<th>When taking measurements or troubleshooting the energy platform, take appropriate precautions, such as using isolated tools and equipment, using the &quot;one hand rule, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Shock Hazard</td>
<td>Do not touch any exposed wiring or conductive surfaces while the energy platform is disassembled and energized. Never wear a grounding strap when working on an energized energy platform.</td>
</tr>
</tbody>
</table>

**Caution**

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

**Important**

When testing RF equipment, follow these test procedures to duplicate manufacturer test data. Keep test leads to the minimum length usable; lead inductance and stray capacitance can adversely affect readings. Carefully select suitable ground points to avoid ground loop error in measurements.

The accuracy of most RF instruments is approximately 1–5% of full scale. Using uncompensated scope probes causes large errors when measuring high voltage RF waveforms.
Periodic Safety Check

The summary of safety checks:

• Inspect the energy platform and accessories
• Inspect the internal components
• Test the energy platform
• Verify REM function
• Confirm outputs
• Check leakage current and ground resistance

Recommended Test Equipment

• Stylus pencil (for calibrating touch screen)
• 5, 10, 20, 30, 50, 100, 200, 300, 500, 1000, 2000, 5000 ohm, all 250 watt, 1% tolerance, noinductive (Dale NH-250, or equivalent)
• Current transformer - Pearson model 411, or equivalent
• True RMS voltmeter - Fluke 8920A, or equivalent
• Decade resistance box (for REM testing)
• REM plug
• Oscilloscope - Tektronix 2445, or equivalent
• X10 or X100 oscilloscope probes
• Digital voltmeter (3.5 digit minimum)
• Handswitching electrosurgical pencils
• Force TriVerse™ electrosurgical device (barcode)
• LigaSure instrument (dot code)
• Covidien footswitch pedals (bipolar, monopolar, LigaSure)
• Potentiometer adjustment tool
• Low frequency test circuit
Inspecting the Energy Platform and Accessories

Equipment required:
- Bipolar footswitch and monopolar footswitch
- Bipolar instrument cords or test leads
- Monopolar instrument cords or test leads
- LigaSure instrument or test leads

Turn off the energy platform, and disconnect the power cord from the wall receptacle.

Rear Panel

1. Check the rear panel footswitch receptacles for obstructions or damage. Check for a secure fit by inserting the bipolar, monopolar, LigaSure 1, and LigaSure 2 footswitch connector into the appropriate receptacle.

2. Remove the fuse and verify correct voltage and current rating. Refer to Performance Characteristics on page 4-2.

3. If any footswitch connector is damaged or unusable, return the energy platform to Covidien Technical Service. For more information, see Covidien Technical Service on page 9-4.

Front Panel

1. Check the Universal Footswitching Port (UFP) for obstructions or damage:
   - Check for a secure fit by inserting the UFP adapter into the receptacle.
   - Verify the accessory port tab (Acc. Port) on the Monopolar 1 screen becomes active, indicating the adapter has been detected.

   If the UFP port is damaged or unusable, return the energy platform to Covidien Technical Service. For more information, see Covidien Technical Service on page 9-4.

2. Check the Bipolar instrument receptacle for obstructions or damage:
   - Insert the bipolar instrument or cable into the receptacle to verify a secure fit.
   - Verify the Bipolar tab on the Monopolar 2 screen becomes active, indicating the instrument has been detected.

   If the receptacle is damaged, return the energy platform to Covidien Technical Service. For more information, see Covidien Technical Service on page 9-4.
3. Check the Monopolar 1 and Monopolar 2 instrument receptacles for obstructions or damage:
   • Insert a standard two-button or Force Triverse electrosurgical pencil into the both receptacles to verify a secure fit.
   • Verify the appropriate tab becomes active, indicating the instrument has been detected:
     – For the standard two-button electrosurgical pencil, the Standard Monopolar tab (Std Mono) becomes active.
     – For the Force Triverse electrosurgical pencil, the Valleylab tab becomes active.
   If either of the monopolar receptacles is damaged, contact Covidien Technical Service (see page 9-4).

4. Check the Patient Return Electrode receptacle for a broken pin or an obstruction.
   If the receptacle is damaged or obstructed, contact Covidien Technical Service (see page 9-4).

5. Check the LigaSure 1 and LigaSure 2 receptacles for obstructions or damage:
   • Insert a LigaSure instrument into the both receptacles to ensure a secure fit.
   • Verify the corresponding LigaSure control panel becomes active, indicating the instrument has been detected:
     – For the LigaSure 1 receptacle, the LigaSure 1 control panel becomes active.
     – For the LigaSure 2 receptacle, the LigaSure 2 control panel becomes active.
   If either receptacle is damaged or the “Invalid Instrument” message appears on either control panel, contact Covidien Technical Service (see page 9-4).

Footswitches
1. Remove the footswitch from the energy platform.
2. Inspect the connector for damage or corrosion.
3. Inspect the footswitch for damage.
4. Reconnect the footswitch to the energy platform.

Power Cord
1. Remove the power cord from the unit and ensure that it is unplugged from the wall receptacle.
2. Inspect the power cord for damage.
3. Reconnect the power cord to the energy platform and wall receptacle.
Inspecting the Internal Components

Equipment required:

- Phillips screwdriver

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

1. Turn off the energy platform.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover aside for reinstallation.
3. Verify that all connectors are firmly seated.
4. Inspect each PCBA for damaged components, wires, cracks, and corrosion:
   If you find evidence of damage on the Controller PCBA, Steering Relay PCBA, Display PCBA, Footswitch/Audio PCBA, HVDC Power Supply PCBA, or the RF PCBA, contact Covidien Technical Service (see page 9-4).
5. Reinstall the cover on the energy platform.

Testing the Energy Platform

Turning on the energy platform initiates an internal self-test to verify the calibration. The self-test also checks the operation of the speaker, all indicators, and the displays.

Warning

Use the energy platform only if the self-test has been completed as described. Otherwise, inaccurate power outputs may result.

1. Turn on the energy platform by pressing the front panel On (I) switch. Verify the following:
   - All visual indicators and displays on the front panel illuminate.
   - Activation tones sound to verify that the speaker is working properly.
2. If the self-test is successful, a tone sounds. Verify the following:
   – The three LCD touch screens illuminate and show the appropriate operating screen.
   – Each display shows a power setting of one watt.
   – The REM alarm indicator illuminates red.

   or

   If the self-test is not successful, an alarm tone sounds. An error screen appears on each of the LCD touchscreens. Note the information on this display and refer to Chapter 7, Troubleshooting.

Verifying REM Function

Equipment required:
- REM plug and resistance substitution box

1. Set the resistance substitution box to 120 Ω. Connect the resistance box to the energy platform and confirm that the REM indicator illuminates green.

2. Slowly increase the resistance and verify that the REM alarm sounds at 135 ± 5 Ω.

3. Decrease the resistance to 60 Ω and verify that the REM indicator illuminates green.

4. Increase the resistance to 100 Ω and verify that the REM alarm sounds.

5. Decrease the resistance to 30 Ω and verify that the REM indicator illuminates green.

6. Decrease the resistance to 10 Ω and verify that the REM indicator illuminates green.

7. Decrease the resistance to 3 Ω and verify that the REM alarm sounds.

Confirming Outputs

<table>
<thead>
<tr>
<th>Important</th>
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<tbody>
<tr>
<td>The output of any receptacle equipped with a barcode scanner may only be verified using an appropriate barcode or dot code accessory.</td>
</tr>
</tbody>
</table>

The energy platform must be in the Demo mode to confirm outputs.
The ForceTriad is designed to function only as Return Electrode Contact Quality Monitor (RECQM) equipped unit. To disable the RECQM circuit, see the following instructions for enabling the Demo mode.
Enable Demo Mode

1. To enter demo mode, touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen and the Demo mode button displays ‘Enter Demo’ if the system is not in Demo mode.

2. Touch the Enter Demo mode button to begin Demo mode. The touchscreens display the words ‘DEMO MODE: Not for Clinical Use’ on all three screens.

Note: While in Demo mode, the REM alarm and the dual instrument error alarm are deactivated, but RF power is still delivered. The energy platform does not sense the instrument type, so the appropriate tab must be selected manually for the connected instrument.

3. To exit Demo mode, either turn the system off and restart it, or follow the steps in the Exit Demo Mode section that follows.

Exit Demo Mode

1. Touch the wrench icon on the right side of the right touchscreen. The Main Menu display appears in the left touchscreen and the Demo mode button displays ‘Exit Demo’ if the system is in Demo mode.

2. Touch the Exit Demo button to exit Demo mode. The system touchscreens display the last settings entered during Demo mode.
Checking the Bipolar Output

1. Verify that the energy platform successfully completes the self-test as described in Testing the Energy Platform on page 6-7.

2. Connect the test equipment for bipolar output:
   a. Connect the two test cables to the Bipolar Instrument receptacle. Ensure the test cables depress both the sensing switches of the receptacle.
   b. Connect the 100-ohm power resistor across the output jacks at the end of the test cables.
   c. Connect the bipolar footswitch to the Bipolar Footswitch receptacle on the rear panel.

3. Press the Low button and set the bipolar power to 10 watts.

4. Test the output for the selected Bipolar mode:
   a. Press the footswitch pedal and, while activating the energy platform, note the output on the voltmeter.
   b. Release the footswitch pedal.


6. Press the Macro button and repeat step 4.

7. Verify that the energy platform output for each mode is 315 ± 24 mA rms.

   If the output is outside the specified range, calibrate the voltage and current as described in calibration steps 5, 6, and 9 starting on page 6-18 then repeat this procedure. If the output for one or more modes remains outside the specified range, contact Covidien Technical Service (see page 9-4).

Checking the Monopolar 1 and Monopolar 2 Output for Cut Modes

1. Verify that the energy platform successfully completes the self-test as described in Testing the Energy Platform on page 6-7.

2. Connect the test equipment for monopolar output:
   a. Connect a handswitching instrument in the Monopolar 1 Instrument receptacle.
   b. To complete the test circuit use a REM adapter or short the two pins together on the Patient Return Electrode.
   c. Connect the 300-ohm resistor across the output jacks at the end of the test cables.

3. Press the Pure button on the far left screen.

4. Press the Cut up (Δ) or down (∇) arrow buttons to set the cut power to 75 watts.

5. Test the monopolar cut output:
   a. Press the handswitch cut button and, while activating the energy platform, note the output on the voltmeter.
6. Press the **Blend** button and repeat step 5.

7. Verify that the energy platform output for each mode is $499 \pm 38$ mA rms.

   If the output is outside the specified range, calibrate the voltage and current as described in calibration steps 5, 6, and 9 on page 6-18 then repeat this procedure. If the output for one or more cut modes remains outside the specified range, contact Covidien Technical Service (see page 9-4).

8. Repeat steps 2 through 7 for Monopolar 2 output.

### Check the Monopolar 1 and Monopolar 2 Output for Coag Modes

1. Verify that the energy platform successfully completes the self-test as described in *Testing the Energy Platform* on page 6-7.

2. Connect the test equipment for monopolar output.
   
   a. Connect a handswitching instrument in the Monopolar 1 Instrument receptacle.
   
   b. Use a test cable to short the two pins on the Patient Return Electrode receptacle.
   
   c. Connect the second test cable from the voltmeter to both pins of the Patient Return Electrode receptacle.
   
   d. Connect the 500-ohm resistor across the output jacks at the end of the test cables.

3. Press the **Fulgurate** button.

4. Press the **Coag** up (Δ) or down (∇) arrow buttons to set the coag power to 30 watts.

5. Test the monopolar coag output.
   
   a. Press the handswitch coag button and, while activating the energy platform, note the output on the voltmeter.
   
   b. Release the handswitch button.
   
   c. Based on the voltmeter setting and the current transformer you are using, calculate and record the output current.

6. Press the **Spray** button and repeat step 5.

7. Verify that the system output for each mode is $245 \pm 19$ mA rms.

   If the output is outside the specified range, calibrate the voltage and current as described in calibration steps 1, 5, 6, and 9 on page 6-16 then repeat this procedure. If the output for one or more coag modes remains outside the specified range, contact Covidien Technical Service (see page 9-4).

8. Repeat steps 2 through 7 for Monopolar 2 output.
Checking the LigaSure 1 and LigaSure 2 Output

1. Verify the energy platform successfully completes the self-test as described in Testing the Energy Platform on page 6-7.

2. Connect the test equipment for LigaSure output.
   a. Connect the two test cables to the LigaSure 1 instrument receptacle.
   b. Connect the 30-ohm power resistor across the output jacks at the end of the test cables.

3. Setup the energy platform for testing LigaSure output.
   a. Select the ‘Wrench’ button on the right side of the right screen.
   b. Select the ‘Service’ button.
   c. Enter password ‘423213’ and select the ‘Enter’ button.
   d. Select the ‘Diagnostics’ button.
   e. Select the ‘Debug Mode’ button.
   f. Select the ‘LigaSure Test’ button from the drop down list (Mode Selection).
   g. Select ‘LigaSure 1 Port’ button from the drop down list (Port Selection).
   h. Select the ‘Closed Loop’ button.
   i. Set level to 5.5 Amps using the ‘Up’ button.

4. Test the LigaSure output.
   a. Select the ‘Start RF’ button.
   b. Note the output on the voltmeter.
   c. Depress the “Stop RF” button.
   d. Based on the voltmeter setting and the current transformer you are using, calculate and record the output current.

5. Verify that the system output is 2130 mA – 2880mA rms.
   If the output is outside the specified range, calibrate the voltage and current as described in calibration steps 5, 6, and 9 on page 6-18 then repeat this procedure. If the output for one or more modes remains outside the specified range, contact Covidien Technical Service (see page 9-4).

6. Repeat steps 2 through 7 for LigaSure 2 output.
Checking Low Frequency Leakage Current

Check the low frequency leakage current before returning the ForceTriad to clinical use.

**Equipment required:**
- DVM
- Leakage current tester

![Leakage current test circuit per IEC 60601-1](image)

Output Receptacles and REM Source Current

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the energy platform.
3. Measure between all the output receptacles (including the Patient Return Electrode receptacle) and earth ground. Record the largest reading.
4. Determine the leakage current using the conventional 1 microamp per 1 millivolt.
5. Verify under normal conditions (ground closed, normal polarity) the leakage current is less than 10 microamps. If the leakage current is greater than 10 microamps, contact Covidien Technical Service (see page 9-4).
6. Verify single fault conditions (ground open) the leakage current is less than or equal to 50 microamps. If the leakage current is greater then 50 microamps, contact Covidien Technical Service (see page 9-4).

Chassis or Earth Leakage

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the energy platform.
3. Measure between the chassis and earth ground.
4. Determine the leakage current using the conventional 1 microamp per 1 millivolt.
5. Verify under normal conditions (ground closed, normal polarity) the leakage current is less than 100 microamps. If the leakage current is greater than 100 microamps, contact Covidien Technical Service (see page 9-4).

6. Verify single fault conditions (ground open) the leakage current is less than or equal to 300 microamps. If the leakage current is greater than 300 microamps, contact Covidien Technical Service (see page 9-4).

**Output Receptacles and REM Sink Current**

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the energy platform and connect the end of the leakage current test circuit to mains voltage through a 120 kΩ resistor.
3. Connect the other side of the IEC leakage load to all of the output receptacles (including the Patient Return Electrode receptacle).
4. Determine the leakage current using the conventional 1 microamp per 1 millivolt.
5. Verify the leakage current is less than or equal to 20 microamps. If the leakage current is greater than 20 microamps, contact Covidien Technical Service (see page 9-4).

**Checking High Frequency Leakage Current**

Check the high frequency leakage current and ground resistance before returning the ForceTriad to clinical use. Check the leakage current:

- After calibrating the energy platform
- Every six months

**Equipment required:**

- 200 ohm, 250 watt, noninductive resistor
- Current transformer
- True RMS voltmeter (Fluke 8920 or equivalent)
- Bipolar and monopolar footswitches
- Leakage table - per IEC 601-2-2, Figure 104
Checking Monopolar High Frequency Leakage Current

1. Connect the 200-ohm load from the UFP to the true RMS voltmeter or equivalent to the equipotential ground lug on the rear of the energy platform.

2. Connect a monopolar footswitch to the Monopolar 1 footswitch receptacle on the rear panel.

3. Activate the footswitch in each Monopolar mode at the maximum control setting. Record the leakage current. If using the leakage table, leakage current should not exceed 150 mA for any mode.

4. If the high frequency leakage exceeds 150 mA, contact Covidien Technical Service (see page 9-4) for further instructions.

Checking Bipolar High Frequency Leakage Current

1. Remove the monopolar accessories and connect the 200-ohm load from one side of the bipolar output to the true RMS voltmeter or equivalent to the equipotential ground lug on the rear of the energy platform.

2. Connect a bipolar footswitch to the Bipolar footswitch receptacle on the rear panel.

3. Activate the footswitch in each mode at maximum control setting. Record the leakage current. It should not exceed 60 mA for any mode using either the leakage table or short lead configuration.

4. If the high frequency leakage exceeds 60 mA, contact Covidien Technical Service (see page 9-4) for further instructions.
Calibrating the ForceTriad Energy Platform

There are 11 calibration steps. During calibration you verify information specific to the ForceTriad energy platform, adjust the date, and adjust the clock. You also adjust the REM circuit and several values, or factors, that ensure the proper operation of the energy platform.

**Notice**

After completing any calibration step, proceed to the next step to save the values from the completed calibration step.

### Common Calibration Symbols

- **Wrench**
- **Enter**
- **Up/Down**
- **Page Up/Page Down**
- **Next/Back**
- **Cancel**

### Step 1 - LC Filter Tuning

1. Turn off the energy platform.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover aside for reinstallation.
3. Connect a cable through a Pearson current monitor from the REM port to the ground lug in the back of the energy platform.

4. Turn the energy platform on.
   a. Touch the wrench icon on the right side of the right screen.
   b. Select the ‘Service’ button.
   c. Enter password ‘423213’ and select the ‘Enter’ button.
   d. Select the ‘Diagnostics’ button.
   e. Select the ‘Debug Mode’ button.
   f. Select the ‘Mono Blend’ button from the drop down list (Mode Selection).
   g. Select the ‘Mono 1’ button from the drop down list (Port Selection).
   h. Select the ‘Open Loop’ button.
   i. Set level to 20% using the ‘Up’ button.
   j. Select the ‘Start RF’ button.

5. Adjust the inductor potentiometer (L2) located on the HVDC PCBA to get the lowest possible reading on the external True RMS meter.

6. Select the ‘Stop RF’ button when the optimal current value has been reached.

7. Turn the energy platform off.

8. Apply loctite, or equivalent, to the inductor potentiometer.

9. Reinstall the cover on the energy platform. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.

**Step 2 - Set Date and Time**

1. Turn the energy platform on.

2. Touch the wrench icon on the right side of the right screen.

3. Select the ‘Setup’ button.

4. Select the ‘Time and Date’ button.

5. Adjust time and date using up and down arrow keys and select the ‘Enter’ button.

6. Select the ‘Back’ button to return to the Main Menu.

**Step 3 - Touch Screen Calibration**

1. Select the ‘Service’ button.

2. Enter password ‘423213’ and select the ‘Enter’ button.

3. Select the ‘Maintenance’ button.

4. Select the ‘Calibrate’ button.

5. Use the up and down arrows to scroll through the calibration menu list and select the ‘Touch Screen’ button.
6. Using a stylus (or equivalent) gently touch the center of the cross hair targets. Complete all targets from left screen to right screen.

7. When the on-screen calibration instructions have been completed and saved, select the red “X” button to exit to the next calibration step.

**Step 4 - Scanner Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘Scanner’ button and select the green arrow to proceed. Allow the energy platform to perform an initial scanner calibration on all ports.

2. Follow the on-screen instructions and select the green arrow button to continue with calibration.

   **Note:** You will need a LigaSure instrument with a dot pattern on the connector. (A LigaSure instrument with a barcode on the connector will not work.)

3. When the on-screen calibration instructions have been completed and saved, select the red “X” button to exit to the next calibration step.

**Step 5 - Voltage Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘Voltage Calibration’ button.

2. Follow the on-screen instructions and select the ‘Next’ button to continue with calibration.

   **Note:** 1000 ohm and 5000 ohm resistors are required for voltage calibration.

3. When the on-screen calibration instructions have been completed and saved, select the red “X” button to exit to the next calibration step.

**Step 6 - Current Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘Current Calibration’ button.

2. Follow the on-screen instructions and select the ‘Right Arrow’ button to continue with calibration.

3. When the on-screen calibration instructions have been completed and saved, select the red “X” button to exit to the next calibration step.

**Step 7 - REM Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘REM Calibration’ button.

2. Follow the on-screen instructions and select the ‘Next’ button to continue with calibration.

3. When the on-screen calibration instructions have been completed and saved, select the red “X” button to exit to the next calibration step.

**Step 8 - Autobipolar Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘AutoBip Calibration’ button.
2. Follow the on-screen instructions and select the ‘Next’ button to continue with calibration.

3. When the on-screen calibration instructions have been completed and saved, select the red “X” button to exit to the next calibration step.

**Step 9 - RF Leakage Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘Leakage Calibration’ button.

2. Follow the on-screen instructions and select the ‘Next’ button to continue with calibration.

3. When the on-screen calibration instructions have been completed and saved, select the red “X” button to go to the next calibration step.

**Step 10 - Brightness Calibration**

1. Use the up and down arrows to scroll through the calibration menu list and select the ‘Brightness’ button.

2. Follow the on-screen instructions and select the ‘Next’ button to continue with brightness calibration.

3. When the on-screen calibration instructions for each of the three touchscreens have been completed and saved, select the ‘Next’ button to view the Brightness Calibration Parameters.

**Step 11 - Complete Calibration Process**

1. Select the red “X” button to return to the Calibration menu.

2. To save the calibration parameters, power cycle the ForceTriad energy platform.
Chapter 7
Troubleshooting

If the system is not functioning properly, use the information in this chapter to perform the following tasks:

- Identify and correct the malfunction
- If a system error was displayed, take the appropriate action to correct the condition.

Inspecting the ForceTriad Energy Platform

If the ForceTriad energy platform malfunctions, check for obvious conditions that may have caused the problem:

- Check the system for visible signs of physical damage.
- Verify that all accessory cords are properly connected.
- Check the power cord. Replace the power cord if you find exposed wires, cracks, frayed insulation, or a damaged connector.
- Open the fuse drawer and inspect the fuse housing and fuses for damage and corrosion. Verify that the fuses are firmly seated.

An internal component malfunction in the system can damage the fuses. You may need to replace the fuses if the energy platform fails the self test or stops functioning.
Responding to System Errors

Example

![Error Description](image)

- E277 is the error identification number.
- SELF_TESTS identifies the file name within the code where the error occurred.
- H identifies the processor in which the error occurred.
  (H = Host, 1 = Main Digital Signal Processor, 2 = Backup Digital Signal Processor)
- 0.0014 identifies the version of code.
- L1603 identifies the line of code at which the error occurred.

<table>
<thead>
<tr>
<th>Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>When contacting Covidien Service, include all screen information.</td>
</tr>
</tbody>
</table>

System Error Descriptions

When system errors occur, the system is no longer functional. Recycling power may clear the system error.

Non-Recoverable Error Descriptions

When non-recoverable errors occur, the system has limited functionality, but does not allow RF output. The system allows qualified service personnel to access the diagnostic service menu to aid in troubleshooting the unit. Software downloads can be performed and some limited capability is permitted within the main menus.

When the Diagnostic menu is selected, the user can choose to disable errors. When errors are disabled, the user has access to the full capability of the system and further non-recoverable errors do not limit this capability. However, because errors have occurred, the system may not function per specifications. The user can only enable errors by recycling power.

Some system and non-recoverable errors are corrected automatically by cycling power; however, most require some action by the user to correct the condition. When an error
occurs, record all screen information then cycle (turn off, then turn on) the energy platform. After correcting an error condition, verify the energy platform completes the self-test. If the error persists, contact Covidien Technical Service (see page 9-4).

The table below describes system errors that can be reported by the ForceTriad energy platform.

<table>
<thead>
<tr>
<th>System Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 2 ERR_SE_ICL_ERROR</td>
<td>Unable to communicate to hardware using the Host ICL registers</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 3 ERR_SE_APP_ROM_FAIL</td>
<td>DSP application ROM check failed at startup</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 4 ERR_SE_BOOT_ROM_FAIL</td>
<td>DSP boot ROM check failed at startup</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 5 ERR_SE_RAM_FAIL</td>
<td>DSP RAM check failed at startup</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 6 ERR_SE_RTOS_FAIL</td>
<td>Software error - A real time operating system failure. <strong>Example:</strong> During startup, the Host software failed to create a thread necessary for the system to function.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
## Responding to System Errors

<table>
<thead>
<tr>
<th>System Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 7</td>
<td><strong>ERR_SE_GEN_FAIL</strong> General system error failure</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> During startup, an error occurred while performing initialization or setup of some of the Host application software.</td>
<td></td>
</tr>
<tr>
<td>E 8</td>
<td><strong>ERR_SE_CRITICAL_DATA</strong> Software error - Critical data has been corrupted.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> The data store was not initialized.</td>
<td></td>
</tr>
<tr>
<td>E 9</td>
<td><strong>ERR_SE_ASSERT</strong> Software error - A software failure has occurred that has generated an assertion.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> A pointer that has not been assigned is about to be used.</td>
<td></td>
</tr>
<tr>
<td>E 10</td>
<td><strong>ERR_SE_INVALID_DATA</strong> Software error - A software failure occurred because of invalid data.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Invalid configuration data resulted in the inability of the user interface to function properly.</td>
<td></td>
</tr>
</tbody>
</table>
### System Error Identifications

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>E 11 ERR_SE_MACHINE_CHECK_EXCEPTION</td>
<td>A Host processor machine check exception has occurred. <strong>Example:</strong> The Host processor is trying to access an address location that does not exist.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 12 ERR_SE_DATA_STORAGE_EXCEPTION</td>
<td>A Host processor data storage exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 13 ERR_SE_ISI_EXCEPTION</td>
<td>A Host processor data storage exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 14 ERR_SE_ALIGNMENT_EXCEPTION</td>
<td>A Host processor alignment exception has occurred. <strong>Example:</strong> The operand of a load/store instruction is not word aligned.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 15 ERR_SE_PROGRAM_EXCEPTION</td>
<td>A Host processor program exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
Responding to System Errors

<table>
<thead>
<tr>
<th>System Error Identifications</th>
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</tr>
</thead>
<tbody>
<tr>
<td>E 16 ERR_SE_FP_UNAVAILABLE_EXCEPTION</td>
<td>A Host processor floating point unavailable exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>Example: Execution of a floating point instruction was attempted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E 17 ERR_SE_SYS_CALL_EXCEPTION</td>
<td>A Host processor system call exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>Example: A system call instruction (sc) has been executed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E 18 ERR_SE_TRACE_EXCEPTION</td>
<td>A Host processor trace exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>Example: When single step tracing is enabled, this exception is generated after the successful completion of each instruction. Instruction RFI is excluded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E 19 ERR_SE_FP_ASSIST_EXCEPTION</td>
<td>A HOST processor floating point assist exception has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 20 ERR_SE_MEM_ALLOC_FAIL</td>
<td>A memory allocation failure has occurred.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
### System Error Identifications

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 21</td>
<td>ERR_SE_UNKNOWN_EXCEPTION</td>
<td>The Host processor has generated an unknown exception. The exception vector is not a valid vector.</td>
</tr>
<tr>
<td>E22</td>
<td>ERR_SE_UNKNOWN_INTERRUPT</td>
<td>The Host processor has received an interrupt that is not initialized.</td>
</tr>
<tr>
<td>E 23</td>
<td>ERR_SE_STACK_OVERFLOW</td>
<td>A thread on the Host has overflowed its stack.</td>
</tr>
<tr>
<td>E24</td>
<td>ERR_SE_DMA_FAILURE</td>
<td>The iDMA is stuck.</td>
</tr>
<tr>
<td>E25</td>
<td>ERR_SE_UNHANDLED_INTERRUPT</td>
<td>The Host processor has received an interrupt but does not know how to handle it.</td>
</tr>
<tr>
<td>E26</td>
<td>ERR_SE_MAX_NUM_THREADS_REG</td>
<td>The Host code has attempted to register more threads than what is allowed.</td>
</tr>
</tbody>
</table>
### System Error Identifications

<table>
<thead>
<tr>
<th>System Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E27  ERR_SE_NULL_POINTER</td>
<td>The Host code has detected a pointer that has a NULL value.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
The following table describes all of the non-recoverable error identifications for the ForceTriad.

<table>
<thead>
<tr>
<th>Non-Recoverable Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
</table>
| E 257 ERR_NR_DOSAGE                   | General RF dosage error | 1. Turn off, then turn on the energy platform.  
2. Calibrate the energy platform.  
3. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 258 ERR_NR_MEM_ALLOC_FAIL           | Software error - Memory allocation failures | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 259 ERR_NR_INVALID_DATA            | Software error - Invalid data | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
|                                       | Examples: |  
• Invalid DSP Identifier  
• Invalid audio tone ID |
| E 260 ERR_NR_COM_ERROR               | Various communication errors | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
|                                       | Example: An error occurred in communications between a DSP and the Host. |
## Responding to System Errors

<table>
<thead>
<tr>
<th>Non-Recoverable Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
</table>
| E 261 ERR_NR_HW_ERROR                | Hardware setup/control error | 1. Turn off, then turn on the energy platform.  
2. Calibrate the energy platform.  
3. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 262 ERR_NR_ACT_DENIED              | Activation denied error | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 263 ERR_NR_INVALID_STATE           | Software error Invalid state | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 264 ERR_NR_UNSUPPORTED_CMD         | Software error - Unsupported command | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |

**Example:**

- **ERR_NR_HW_ERROR**: Unable to fully disable RF while attempting to deactivate.
- **ERR_NR_INVALID_STATE**: Invalid system state.
- **ERR_NR_UNSUPPORTED_CMD**: A Host thread has been sent a command from another thread that is undefined.
<table>
<thead>
<tr>
<th>Non-Recoverable Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 265 ERR_NR_ACCESS_FUNCTION</td>
<td>Software error - Access function error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td><strong>Examples:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- A thread is unable to interface with another thread to carry out a system function.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- A user interface object is unable to interface with another user interface object to complete a user interface function.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| E 266 ERR_NR_TIMEOUT_ERROR          | A timeout occurred. | 1. Reboot the unit and retry flashing.  
| Example:                           | The Host timed out waiting for flash download to a DSP. | 2. Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |

<p>| E 267 ERR_NR_GEN_ERROR              | General NR failure source unknown top level reporting | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| Example:                           | Activation has been denied during calibration |                    |</p>
<table>
<thead>
<tr>
<th>Non-Recoverable Error Identifications</th>
<th>Description</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 268  ERR_NR_SELF_TEST_ERROR</td>
<td>Self test error. After successful completion of the Host POST self tests, the status of all self tests is verified as passed as a double check. If at least one status indicates a failure, this error is reported.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 269  ERR_NR_DISPLAY_ERROR</td>
<td>Display error detected during the Host POST test.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 270  ERR_NR_AUDIBLE_ERROR</td>
<td>Audio self test error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
| E 271  ERR_NR_STUCK_BUTTON_ERROR     | Stuck Button self test error | 1. Ensure that footswitch pedals are not inadvertently activated during boot-up.  
2. Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
<p>| E 272  ERR_NR_CONTROL_KNOB_ERROR     | No longer used. | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |</p>
<table>
<thead>
<tr>
<th>Non-Recoverable Error Identifications</th>
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<tbody>
<tr>
<td>E 273 ERR_NR_INTER_PROC_COMM_ERROR</td>
<td>Inter-processor communication self test error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 274 ERR_NR_CRITICAL_DATA_ERROR</td>
<td>Critical data self test error</td>
<td>1. Turn off, then turn on the energy platform. 2. Calibrate the energy platform. 3. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 275 ERR_NR_MULTI_TASKING_ERROR</td>
<td>Multitasking self test error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 276 ERR_NR_ANALOG_SENSOR_ERROR</td>
<td>Analog Sensor self test error</td>
<td>1. Turn off, then turn on the energy platform. 2. Calibrate REM and autobipolar. 3. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 277 ERR_NR_RF_TEST1_ERROR</td>
<td>RF gen/shutdown self test #1 error</td>
<td>1. Turn off, then turn on the energy platform. 2. Calibrate voltage, current, leakage. 3. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>Non-Recoverable Error Identifications</td>
<td>Description</td>
<td>Recommended Action</td>
</tr>
<tr>
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<td>--------------------</td>
</tr>
</tbody>
</table>
| E 278  ERR_NR_RF_TEST2_ERROR         | RF gen/shutdown self test #2 error | 1. Calibrate voltage, current, leakage.  
                                      |             | 2. Replace the HVPS PCBA. |
| E 279  ERR_NR_RF_TEST3_ERROR         | RF gen/shutdown self test #3 error | 1. Calibrate voltage, current, leakage.  
                                      |             | 2. Replace the HVPS PCBA. |
| E 280  ERR_NR_TIMEBASE_ERROR         | Timebase comparison self test error | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 281  ERR_NR_SYS_WATCH_DOG_ERROR    | System watch dog self test error    | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 282  ERR_NR_ICL_PROG_ERROR         | ICL chip programmed self test error | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 283  ERR_NR_RAM_MEMORY_ERROR       | Ram memory self test error          | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 284  ERR_NR_FLASH_MEMORY_ERROR     | FLASH memory self test error        | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
### Non-Recoverable Error Identifications

<table>
<thead>
<tr>
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</thead>
</table>
| E 285      | ERR_NR_INVALID_CONFIG_DATA | Software error - Configuration data is not valid (checksum error)  
Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 286      | ERR_NR_NULL_PTR | Software error - Null pointer detected  
Example: DSP detected un-initialized data  
Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 287      | ERR_NR_AIE | Absolute integral error  
1. Turn off, then turn on the energy platform.  
2. Calibrate voltage, current, leakage.  
3. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 288      | ERR_NR_SENSOR_CLIP | DSP sensor clipping error  
Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 289      | ERR_NR_SENSORCOMPARE | DSP sensor comparison error  
1. Turn off, then turn on the energy platform.  
2. Calibrate voltage, current.  
3. If the error persists, contact Covidien Technical Service (see page 9-4). |
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<tr>
<td>E 290</td>
<td>VI data sampling error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 291</td>
<td>Communication watchdog error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 292</td>
<td>Software error - Generic DSP software failure</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 293</td>
<td>Error occurred writing to FLASH</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 294</td>
<td>Software error - Real time operating system error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 295</td>
<td>Error occurred storing data to NV store</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
## Non-Recoverable Error Identifications

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<td>E 296</td>
<td>ERR_NR_ICL_HB_ERROR ICL heartbeat error</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 297</td>
<td>ERR_NR_MSG_VIEWER_CTOR_FAIL Software error - Message viewer class construction failure</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E 298</td>
<td>ERR_NR_SYS_CTLR_REQ_FAIL Software error - System controller unexpectedly denied request to bring up main menus</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
| E 299      | ERR_NR_LKG_LIMIT DSP2 Leakage sensor compare error     | 1. Turn off, then turn on the energy platform.  
2. Calibrate leakage.  
3. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 300      | ERR_NR_BAD_SCANNER Scanner failed self test failure    | 1. Replace the barcode scanners.  
2. Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
## Responding to System Errors

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<tr>
<th>Non-Recoverable Error Identifications</th>
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</tr>
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</table>
| E 301 ERR_NR_LOW_BATTERY              | Battery self test failure | 1. Replace the battery.  
2. Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 302 ERR_NR_IO_ERROR                 | Memory-mapped I/O error | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| Example: The Host Memory-mapped register runtime self test verifies that the HVPS, steering relays, and RF enable registers are set properly for the currently running state. If not, this error is reported. |
| E 303 ERR_NR_DSP_VERIFY_ERROR         | DSP configuration verify failure | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 304 ERR_NR_SCREEN_STACK_ERROR      | Software error - Error in screen stack manipulation in AppScreenBase | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| Example: The user sees unexpected screen behavior. |
| E 305 ERR_NR_ROM_ERROR                | ROM self test failure | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
### Non-Recoverable Error Identifications

<table>
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<th>Recommended Action</th>
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</thead>
</table>
| E 306 | ICL communication link test failure | 1. Check the cable between the RF PCBA and the FTSW PCBA.  
2. Check the cable between the Controller PCBA and the Display PCBA.  
3. Program the FTSW FPGA.  
4. Program the Display FPGA.  
5. Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 307 | RF gen/shutdown self test #4 error | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 308 | The barcode reader uart has been changed and the loopback feature has been turned on. Any requests to the barcode reader will be sent back to the Host rather than to the barcode reader. | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
| E 309 | The Remote Control feature has been given an invalid window pointer. | Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4). |
### Responding to System Errors

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<thead>
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<th>Non-Recoverable Error Identifications</th>
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</tr>
</thead>
<tbody>
<tr>
<td>E310 ERR_NR_RDM_INVALID_FIELD_LIST</td>
<td>The Remote Control feature has been given an invalid field list.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
<tr>
<td>E311 ERR_NR_INVALID_RF_HDW_CONFIG</td>
<td>The Host has an invalid combination of hardware versions.</td>
<td>Turn off, then turn on the energy platform. If the error persists, contact Covidien Technical Service (see page 9-4).</td>
</tr>
</tbody>
</table>
Chapter 8
Replacement Procedures

Follow the procedures in this chapter when you need to replace the parts listed below:

- Fuses
- Battery
- Low Voltage Power Supply
- Footswitch/Audio PCBA
- Controller PCBA
- High Voltage DC PCBA
- Front Panel
- Steering Relay PCBA
- Display PCBA
- Barcode Scanner
- Output Receptacles

The parts used in these procedures are listed in Chapter 10, Service Parts.
Fuse Replacement

Equipment required:
- Small flathead screwdriver

<table>
<thead>
<tr>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fire Hazard</strong></td>
</tr>
</tbody>
</table>

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle and the rear panel of the energy platform for easier access to the adjacent fuse drawer.
2. To release the fuse drawer, insert a small flathead screwdriver into the slot on the drawer below the power cord receptacle then slide the drawer out.
3. Replace each fuse with one of the same type and rating.
4. Slide the fuse drawer into its slot until it snaps into place.
5. Connect the power cord to the rear panel.
Battery Replacement

Equipment required:
• Phillips screwdriver

Warning

**Electric Shock Hazards** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

Notice

Calibrate the energy platform after you install a new battery. Calibration values are lost when the battery is replaced. Refer to *Calibrating the ForceTriad Energy Platform* on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Locate the battery on the left side of the Controller PCBA.
4. Grasp the battery and remove it from the socket.
5. Install the new battery.
6. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Low Voltage Power Supply (LVPS) Replacement

Equipment required:

- Phillips screwdriver

Warning

Electric Shock Hazard  To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Locate the LVPS on the left rear of the unit and disconnect the cable assemblies from the LVPS.
4. Remove the three screws securing the LVPS to the chassis. Note that the lower right screw is non-conductive nylon.
5. Remove the LVPS.
6. Install the new LVPS in the correct orientation.
7. Replace the three screws, ensuring the nylon screw is installed in the lower right corner.
8. Reconnect the cable assemblies.
9. Position the cover above the chassis and slide it down. Install the four screw that secure the cover to the chassis.
Footswitch/Audio PCBA Replacement

Equipment required:

- Phillips screwdriver

**Warning**

**Electric Shock Hazard** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

**Caution**

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Locate the Footswitch/Audio PCBA on the right rear of the energy platform and disconnect the cable assemblies from the Footswitch/Audio PCBA.
4. Remove the two screws securing the Footswitch/Audio PCBA to the chassis. On the rear of the energy platform, remove the four screws securing the Monopolar and Bipolar Footswitch receptacles to the chassis.
5. Remove the Footswitch/Audio PCBA.
6. Install the new Footswitch/Audio PCBA.
7. Replace the two screws securing the Footswitch/Audio PCBA to the chassis. Replace the four screws securing the Monopolar and Bipolar Footswitch receptacles to the chassis.
8. Reconnect the cable assemblies.
9. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Controller PCBA Replacement

Equipment required:

- Phillips screwdriver

**Warning**

**Electric Shock Hazard** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

**Caution**

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

**Notice**

Calibrate the energy platform after you replace the Controller PCBA. Refer to Calibrating the ForceTriad Energy Platform on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Locate the Controller PCBA on the right side of the energy platform and disconnect the cable assemblies from the Controller PCBA.
4. Remove the single screw securing the Controller PCBA to the chassis.
5. Remove the Controller PCBA, taking care not to damage the RF PCBA connector.
6. Install the new Controller PCBA in the correct orientation, taking care to align the RF PCBA connector properly.
7. Replace the single screw securing the Controller PCBA to the chassis.
8. Reconnect the cable assemblies to the Controller PCBA.
9. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
High Voltage DC (HVDC) PCBA Replacement

Equipment required:
- Phillips screwdriver

**Warning**

**Electric Shock Hazard** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

**Caution**

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

**Notice**

Calibrate the energy platform after you install a new HVDC PCBA. Refer to *Calibrating the ForceTriad Energy Platform* on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Locate the HVDC PCBA on the left side of the energy platform and disconnect the cable assemblies from the HVDC PCBA.
4. Remove the single screw securing the HVDC PCBA to the chassis. This screw is inserted from the chassis side of the assembly.
5. Remove the HVDC PCBA, taking care not to damage the RF PCBA connector.
6. Install the new HVDC PCBA in the correct orientation, taking care to align the RF PCBA connector properly.
7. Replace the single screw securing the HVDC PCBA to the chassis.
8. Reconnect the cable assemblies to the HVDC PCBA.
9. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Front Panel Replacement

Equipment required:
- Phillips screwdriver

Warning

Electric Shock Hazard To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

Notice

Calibrate the energy platform after you install a new Front Panel. Refer to Calibrating the ForceTriad Energy Platform on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove the three screws attaching the Front Panel assembly to the top rail of the chassis. Remove the four screws at the sides of the Front Panel attaching it to the chassis.
4. Disconnect cable assemblies:
   a. Steering Relay PCBA to RF PCBA
   b. Display PCBA to Controller PCBA
   c. Power Switch to Power Receptacle
5. Rotate the top of the Front Panel assembly downwards until the Steering Relay PCBA clears the chassis top rail. Lift the Front Panel assembly away from the chassis.
6. Install the new Front Panel:
   a. Hold the assembly at an angle with the top away from the energy platform.
   b. Set the bottom of the Front Panel assembly into the chassis, taking care to line up the alignment tabs.
   c. Rotate the Front Panel assembly towards the chassis, ensuring the fan cables are not pinched.
   d. Slide the top of the Steering Relay PCBA under the top rail of the chassis until the screw holes align.
7. Replace the three screws securing the Front Panel assembly to the chassis top rail. Reinstall the four screws attaching the Front Panel to the chassis.

8. Reconnect cable assemblies:
   a. Steering Relay PCBA to RF PCBA
   b. Display PCBA to Controller PCBA
   c. Power Switch to Power Receptacle

9. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
RF PCBA Replacement

Equipment required:
- Phillips screwdriver

Warning

**Electric Shock Hazard** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

Notice

Calibrate the energy platform after you install a new RF PCBA. Refer to *Calibrating the ForceTriad Energy Platform* on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove the following components:
   a. Controller PCBA; see *Controller PCBA Replacement* on page 8-6.
   b. HVDC PCBA; see *High Voltage DC (HVDC) PCBA Replacement* on page 8-7.
   c. Front Panel assembly; see *Front Panel Replacement* on page 8-8.
4. Disconnect cable assemblies:
   a. Footswitch/Audio PCBA to RF PCBA
   b. LVPS PCBA to RF PCBA
   c. Fan and Temperature Sensor
5. Remove the nine screws securing the RF PCBA to the chassis.
6. Remove the RF PCBA by lifting and sliding forward.
7. Install the new RF PCBA by lowering and sliding backwards.
8. Reinstall the nine screws securing the RF PCBA to the chassis.
9. Reconnect cable assemblies:
   a. Footswitch/Audio PCBA to RF PCBA
   b. LVPS PCBA to RF PCBA
c. Fan and Temperature Sensor

10. Reinstall components:
   a. Front Panel assembly; see Front Panel Replacement on page 8-8.
   b. HVDC PCBA; see High Voltage DC (HVDC) PCBA Replacement on page 8-7.
   c. Controller PCBA; see Controller PCBA Replacement on page 8-6.

11. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Steering Relay PCBA Replacement

Equipment required:
- Phillips screwdriver

Warning
Electric Shock Hazard To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution
The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

Notice
Calibrate the energy platform after you install a new Steering/Relay PCBA. Refer to Calibrating the ForceTriad Energy Platform on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove the Front Panel assembly; see Front Panel Replacement on page 8-8. Place the Front Panel assembly on a non-scratch surface to protect the touch screens.
4. With the top of the Front Panel facing away, disconnect the following:
   a. Barcode scanner cables
   b. Zero Insertion Force (ZIF) connectors, then the shield ground connectors
   c. Steering Relay PCBA to Display PCBA cable assembly
5. Remove the four screws securing the Steering Relay PCBA to the side brackets. Remove the three screws attaching the bracket to the top of the Steering Relay PCBA.
6. Carefully lift the Steering Relay PCBA off of the Front Panel until sufficient space to disconnect the cable assemblies is available. Disconnect the cable assemblies attaching the Steering Relay PCBA to the output receptacles. Finish removing the Steering Relay PCBA.
7. Install the new Steering Relay PCBA:
   a. Position the Steering Relay PCBA above the Front Panel in the correct orientation.
   b. Reconnect the cable assemblies attaching the Steering Relay PCBA to the output receptacles.
   c. Reconnect the cable assembly connecting the Steering Relay PCBA to the Display PCBA.
d. Verify that the Barcode Scanner cable assemblies are not trapped between the two assemblies.

e. Lower the Steering Relay PCBA onto the Front Panel making sure the Barcode Scanner assemblies align with the slots in the Steering Relay PCBA.

8. Reinstall the four screws securing the Steering Relay PCBA to the Front Panel side brackets.

9. Reconnect the four Barcode scanner cable assemblies taking care to fully insert and align the ZIF cables. Verify the shield ground connectors are completely connected.

10. Reinstall the top bracket using three screws, verifying the Barcode Scanner cable assemblies are captured in the proper slots.

11. Reinstall the Front Panel assembly; see Front Panel Replacement on page 8-8.

12. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Display PCBA Replacement

Equipment required:
• Phillips screwdriver

Warning
Electric Shock Hazard To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution
The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove the Front Panel assembly; see Front Panel Replacement on page 8-8. Place the Front Panel assembly on a non-scratch surface to protect the touch screens.
4. Remove the Steering Relay PCBA; see Steering Relay PCBA Replacement on page 8-12.
5. Remove the four screws in the center of the Display PCBA securing it to the Front Panel. Carefully lift the Display PCBA out of the Front Panel.
6. Install the new Display PCBA by carefully lowering it into the Front Panel in the correct orientation.
7. Replace the four screws securing the Display PCBA to the Front Panel.
8. Reinstall the Steering Relay PCBA; see Steering Relay PCBA Replacement on page 8-12.
9. Reinstall the Front Panel assembly; see Front Panel Replacement on page 8-8.
10. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Barcode Scanner Replacement

Equipment required:

- Phillips screwdriver

Warning

**Electric Shock Hazard** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

Notice

Calibrate the energy platform after you install a new Barcode Scanner. Refer to *Calibrating the ForceTriad Energy Platform* on page 6-16 for instructions.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove the Front Panel assembly; see *Front Panel Replacement* on page 8-8. Place the Front Panel assembly on a non-scratch surface to protect the touch screens.
4. Remove the Steering Relay PCBA; see *Steering Relay PCBA Replacement* on page 8-12.
5. Remove the two screws at the bottom of the Barcode Scanner assembly. Slide the Barcode Scanner and shield out of the receptacle assembly.
6. Slide the new Barcode Scanner into the shield, ensuring the shield ground tab mates correctly.
7. Slide the Barcode Scanner and shield into the receptacle assembly. Reattach the two screws securing the Barcode Scanner to the receptacle assembly.
8. Reinstall the Steering Relay PCBA; see *Steering Relay PCBA Replacement* on page 8-12.
9. Reinstall the Front Panel; see *Front Panel Replacement* on page 8-8.
10. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Output Receptacle Replacement

Equipment required:
• Phillips screwdriver

Warning

**Electric Shock Hazard** To allow stored energy to dissipate after power is disconnected, wait at least five minutes before replacing parts.

Caution

The energy platform contains electrostatic-sensitive components. When repairing the energy platform, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized energy platform. Handle PCBAs by their non-conductive edges. Use an antistatic container for transport of electrostatic-sensitive components and PCBAs.

1. Turn off the energy platform. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove the Front Panel assembly; see *Front Panel Replacement* on page 8-8. Place the Front Panel assembly on a non-scratch surface to protect the touch screens.
4. Remove the Steering Relay PCBA; see *Steering Relay PCBA Replacement* on page 8-12.

**Monopolar 1 Receptacle**

a. Remove the three screws securing the Monopolar 1 receptacle to the Front Panel.
b. Remove the Monopolar 1 cable assembly from the receptacle.
c. Install the new Monopolar 1 receptacle in the Front Panel using the three screws.
d. Install the Monopolar 1 cable assembly.

**Monopolar 2 Receptacle**

a. Remove the three screws securing the Monopolar 2 receptacle to the Front Panel.
b. Remove the Monopolar 2 cable assembly from the receptacle.
c. Install the new Monopolar 2 receptacle in the Front Panel using the three screws.
d. Install the Monopolar 2 cable assembly.

**LigaSure 1 Receptacle**

a. Remove the three screws securing the LigaSure 1 receptacle to the Front Panel.
b. Remove the LigaSure 1 cable assembly from the receptacle.
c. Install the new LigaSure 1 receptacle in the Front Panel using the three screws.

d. Install the LigaSure 1 cable assembly.

LigaSure 2 Receptacle
a. Remove the three screws securing the LigaSure 2 receptacle to the Front Panel.
b. Remove the LigaSure 2 cable assembly from the receptacle.
c. Install the new LigaSure 2 receptacle in the Front Panel using the three screws.
d. Install the LigaSure 2 cable assembly.

Universal Footswitching Port
a. Remove the four screws securing the Universal Footswitching Port to the Front Panel.
b. Remove the Universal Footswitching Port cable assembly from the receptacle.
c. Install the new Universal Footswitching Port in the Front Panel using the four screws.
d. Install the Universal Footswitching Port cable assembly.

Bipolar Receptacle
a. Remove the three screws securing the Bipolar receptacle to the Front Panel.
b. Remove the Bipolar receptacle cable assembly from the receptacle.
c. Install the new Bipolar receptacle in the Front Panel using the three screws.
d. Install the Bipolar receptacle cable assembly.

REM Receptacle
a. Remove the two screws securing the REM receptacle to the Front Panel. Note the length of each screw. Remove the REM retaining bracket.
b. Install the new REM receptacle in the Front Panel. Replace the REM retaining bracket. Secure the REM receptacle and bracket using the two screws.

5. Reinstall the Steering Relay PCBA; see Steering Relay PCBA Replacement on page 8-12.

6. Reinstall the Front Panel assembly; see Front Panel Replacement on page 8-8.

7. Position the cover above the chassis and slide it down. Install the four screws that secure the cover to the chassis.
Chapter 9
Maintenance and Repair

This chapter presents the following information:

- The manufacturer’s responsibility
- Routine maintenance
- Returning the energy platform for service
- Service centers

Caution
Read all warnings, cautions, and instructions provided with this system before use.

Read the instructions, warnings, and cautions provided with electrosurgical instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.
Responsibility of the Manufacturer

Covidien is responsible for the safety, reliability, and performance of the energy platform only if all of the following conditions have been met:

- Installation and setup procedures in this manual are followed.
- Assembly, operation, readjustments, modifications, or repairs are carried out by persons authorized by Covidien.
- The electrical installation of the relevant room complies with local codes and regulatory requirements, such as IEC and BSI.
- The equipment is used in accordance with the instructions for use.

For warranty information, refer to the Limited Warranty in this manual.

Routine Maintenance

When should the energy platform be checked or serviced?

Covidien recommends that the energy platform be inspected by qualified service personnel at least once a year. This inspection should include adjusting the system to factory specifications.

When should the power cord be checked or replaced?

Check the power cord each time you use the energy platform or at the intervals recommended by your institution. Replace the power cord if you find exposed wires, cracks, frayed edges, or a damaged connector.

When should the fuses be replaced?

An internal component malfunction can damage the fuses. You may need to replace the fuses if the system fails the self-test or if the energy platform stops functioning, even though it is receiving power from a wall outlet. Refer to Fuse Replacement on page 8-2 for instructions.
Cleaning

**Warning**

**Electric Shock Hazard** Always turn off and unplug the energy platform before cleaning.

**Notice**

Do not clean the energy platform with abrasive cleaning or disinfectant compounds, solvents, or other materials that could scratch the panels or damage the energy platform.

1. Turn off the system and unplug the power cord from the wall outlet.
2. Thoroughly wipe all surfaces of the energy platform and power cord with a damp cloth and mild cleaning solution or disinfectant. The energy platform will withstand the effects of cleaning over time without degrading the enclosure or display quality.

**Product Service**

Covidien recommends that authorized Covidien personnel service the ForceTriad energy platform, however some service operations can be performed by qualified biomeds.

**Returning the Energy Platform for Service**

Before you return the energy platform, call your Covidien sales representative for assistance. If you are instructed to send the energy platform to Covidien, do the following:

1. Obtain a return authorization number.
   - Call the Covidien Technical Service (see page 9-4) to obtain a Return Authorization Number. Have the following information ready when you call:
     - Hospital/clinic name/customer number
     - Your telephone number
     - Department/address, city, state, and zip code
     - Model number
     - Serial number
     - Description of the problem
     - Type of repair to be done
2. Clean the energy platform.
   - See the Cleaning section above.
3. Ship the energy platform.
   a. Attach a tag to the energy platform that includes the return authorization number and the information (hospital, phone number, etc.) listed in step 1.
   b. Be sure the energy platform is completely dry before you pack it for shipment. Package it in its original shipping container, if available.
   c. Ship the energy platform, prepaid, to the Covidien Service Center.

Adjustment to Factory Specification (Calibration)

Covidien recommends that only Covidien-authorized personnel calibrate the ForceTriad energy platform. The energy platform incorporates automatic calibration where possible to reduce the required equipment and manual steps.

Software Upgrades

Software upgrades must be performed by authorized personnel only.

Covidien Technical Service

For service, you may contact Covidien Technical Service or your ForceTriad sales representative. Contact a Covidien technical service representative by telephone, email, or through the Internet:

- USA and Canada: 1-800-255-8522 Option 2
- International: 1-303-530-2300
- Email: valleylab.technicalservice@covidien.com
- Internet: www.forcetriad.com

For a complete list of service centers worldwide, please refer to the Covidien web site: http://www.valleylab.com/valleylab/international/service-world.html
Chapter 10

Service Parts

Replacement parts for the ForceTriad energy platform are listed in this chapter. If the part number is not listed for a specific item, a replacement for that item is not available.

All components must be replaced with parts of identical construction and value. Replacement ratings and tolerances must be equal to or better than the original. Covidien does not recommend field replacement of surface mount components.

Ordering Replacement Parts

Parts may be ordered from the Covidien Service Center for your location. When ordering replacement parts, include this information:

- Model number (located on the rear panel of the energy platform)
- Serial number (located on the rear panel of the energy platform)
- Part number (for the part you are ordering)
- Modification number, if applicable.

If you do not know the part number or if you wish to order spare parts, contact Covidien Technical Service (see page 9-4).
Chassis Assembly (continued)
## Chassis Assembly Parts List

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## Front Panel Parts List

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## Display LCD PCBA

### Display LCD PCBA Parts List

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## Steering Relay PCBA

### Steering Relay PCBA Parts List

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Receptacles
Receptacles Parts List

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RF PCBA
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<td>2</td>
<td>BATRY SNAPCHAT TIMEKEEPER SRAM</td>
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### Cable Assemblies

#### Cable Assemblies Parts List

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<tr>
<th>Reference Designator</th>
<th>Description</th>
<th>Part Number</th>
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<tr>
<td>16</td>
<td>ASSY CABLE ETHERNET</td>
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<td>CABLE LCD-INVERTER FORCETRIAD</td>
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<td>CABLE AC SWITCH HVPS FORCETRIAD</td>
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<td>ASSY CABLE DISPLAY POWER</td>
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<td>CABLE RIBBON SCANNER FORCETRIAD</td>
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<td>ASSY CABLE PANEL-SWITCH FORCETRIAD</td>
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<td>36</td>
<td>CABLE RF FOOTSWITCH FORCETRIAD</td>
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<td>CABLE RETURN FORCETRIAD</td>
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<td>CABLE RF-LVPS FORCETRIAD</td>
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<td>ASSY CABLE CHASSIS-GND FORCETRIAD</td>
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<td>CABLE MONO OUT FORCETRIAD</td>
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<td>ASSY CABLE FORCETRIAD AUTO-BIPOLAR</td>
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<td>ASSY CABLE FORCETRIAD FILTER-AC SW</td>
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Schematics Supplement

This supplement contains the assembly drawings and schematics for the printed circuit board assemblies listed below:

- HVDC PCBA
- RF PCBA
- Steering Relay PCBA
- Display PCBA
- Footswitch/Audio PCBA
- Controller PCBA
Display PCBA

HOTLINK

HOTLINK TO FPGA

Display PCBA Sheet 1 of 4
ALL 232INV AND AIM/NWAKE LINES ARE PULLED UP INSIDE THE FPGA
DISPLAY

PWR/GND
Footswitch/Audio PCBA

VOLUME CONTROL

ISOLATED PLANE

R90 Prevents AUDIO_VOL from reaching 5V.

J14 is a 7-pin Wire-to-Board connector that connects the 7-pin Ligasure Footswitch Connector, AMP 211398-1, to this board. Pin of J14 goes to Pin 1 of the footswitch connector.

70mV Hysteresis

R25 1.4K
R26 2.15K
C30 0.01UF 2000V

TP10 5015
TP11 5015
TP12 5015
TP13 5015
TP15 DNP
TP16 CW
3 1
2R14 BOURNS, PCW1D-B24-BAB502 5K

R4 1.4K
R5 2.15K
C22 0.01UF
C9 0.01UF 2000V

R15 1.4K
R16 2.15K
C51 0.01UF
C52 0.01UF 2000V

R17 1.4K
R18 2.15K
C53 0.01UF
C54 0.01UF 2000V

R19 1.4K
R20 2.15K
C58 0.01UF
C59 0.01UF 2000V

2 - 3 + 1U23-B LT1804IDD

FB8 FERRITE 3A 100 OHM 1206 SMD HI1206N101R-00
FB4
FB9
FB10
FB11
FB12
FB13
FB15

D7
D8 DALLAS SEMICONDUCTOR, DS9502
D10
D11
D12

1 VDD1
3 VIA4 VIB5 VIC6 VID 7 NC
2 GND18 GND1 9 GND2 15 GND2 10 VE2 11 VOD 12 VOC 13 VOB 14 VOA

U6 ADuM1400BRW

C17 0.1UF
C20 0.1UF

TP27 1.221V 4 IN_A-
5 IN_A+
6 IN_B-
7 IN_B+
10 IN_C-
11 IN_C+
12 IN_D-
13 IN_D+
16 VDD2
3
V+ 14 HYST
8 REF
9 V-

U10 LINEAR TECH, LTC1445CS

C126 0.1UF
C128 0.1UF
C12 0.1UF
R9 2.15K
R12 16.9k
R13 2.4M

Footswitch/Audio PCBA Sheet 1 of 5