COVIDIEN

Service Manual

Valleylab™ LS10

LS Series Single Channel Vessel Sealing Generator

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Service Manual

Valleylab™ LS10

LS Series Single Channel Vessel Sealing Generator

Preface

This manual and the equipment it describes are for use only by qualified personnel trained in the particular technique and surgical procedure to be performed. It is intended as a guide for servicing the Covidien Valleylab LS10, LS Series Single Channel Vessel Sealing Generator only. Additional information is available in the *Valleylab LS10, LS Series Single Channel Vessel Sealing Generator User's Guide*.

Additional technical information may be available from Covidien Technical Service.

For a complete list of service centers world wide, please refer to the Covidien web site: http://surgical.covidien.com/service-centers

Equipment covered in this manual:
Valleylab LS10, LS Series Single Channel Vessel Sealing Generator

Conventions Used in this Guide

Warning

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Precaution

Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

Notice

Indicates a hazard which may result in product damage.

Important

Indicates *an operating tip or maintenance suggestion.*

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The warranty periods for Covidien products are as follows:

Valleylab™ LS 10, LS Series Single Channel Vessel Sealing Generator	One year from date of shipment
All purchased or supplemental software programs or updates	90 days from delivery

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Chapter 1

Introduction

This chapter provides an overview of the features and functions of the Valleylab LS10, LS Series Single Channel Vessel Sealing Generator.

Precaution
Read all warnings, precautions, and instructions provided with this system before use.
Read the instructions, warnings, and precautions provided with LigaSure™ instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.

Overview and General Features

The generator is designed to provide a vessel sealing application. It features a simple interface and automatically detects LigaSure instruments and configures the generator accordingly. Safety and diagnostic functionality include automatic fail-safe functions.

The generator is a bipolar electrosurgical generator and works with LigaSure instruments as a system. Covidien offers a selection of LigaSure instruments that are fully compatible with this generator. The generator supports only compatible Covidien LigaSure instruments.

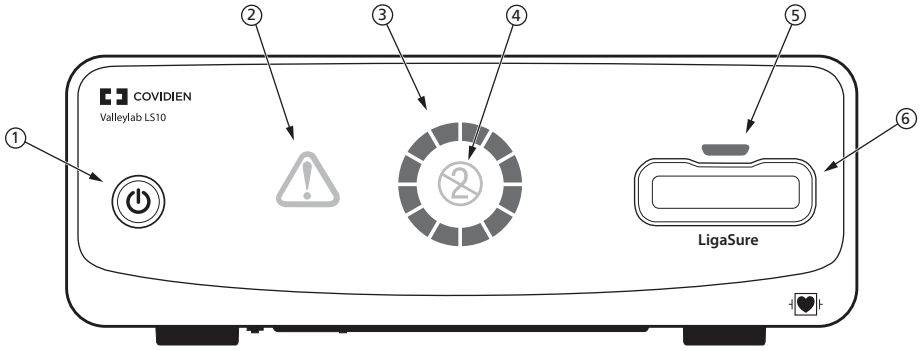
Indications for Use

The Valleylab LS10 is an electrosurgical generator containing LigaSure vessel sealing technology. The vessel sealing function is indicated for use in sealing (fusing) vessels up to, and including, 7 mm in diameter, tissue bundles, and lymphatics during general surgery including, but not limited to, surgical specialties such as urologic, vascular, thoracic, gynecologic, plastic and reconstructive, and colorectal.

Refer to each instrument's instructions for use (IFU) for additional indications, warnings, and specific contraindications.

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

Generator Front Panel



1. **Power button** - **Power on:** Push and release. **Power off:** Push and hold for 3 seconds.
2. **System error indicator** - Lights up as shown upon a system error in the generator. Restart the generator. If the error occurs again, contact local technical service or Covidien Technical Service.
3. **System status indicator** -

- White:

  In motion - System is performing a self test.

  Constant - Ready for use, insert LigaSure instrument.

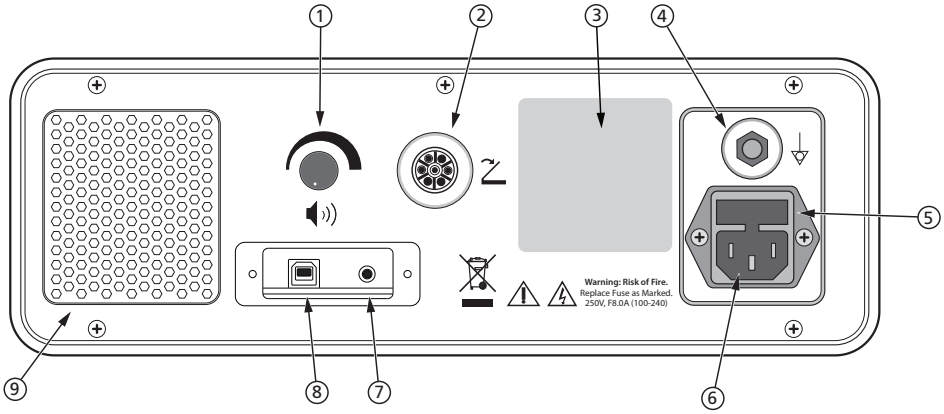
  Flashing - System in service mode, power cycle system for clinical use.

  Purple - Ready for sealing/seal cycle complete.

- Purple in motion - Sealing in process.
- Amber - Seal cycle incomplete alert. Inspect, regrasp, and reactivate sealing and complete the seal cycle.

4. **Usage limit indicator** - When illuminated, indicates the inserted device has already been used. It has not been recertified by the original manufacturer.
5. **Instrument status or switch stuck indicator** -
   Red - Instrument error or hand/footswitch stuck. Instrument may be invalid, damaged, or incompatible. Check that compatible LigaSure instrument is in proper working condition and no activation switches are depressed.
6. **Instrument port** - Connect LigaSure instruments when the system status indicator is white

Generator Back Panel



1. **Volume knob**
2. **Footswitch port**
3. **Serial label**
4. **Potential equalization conductor terminal**
5. **AC fuse**
6. **AC mains receptacle**
7. **ECG blanking connector**
8. **USB port**
9. **Vent**

LigaSure Mode

The LigaSure vessel sealing 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 is designed to produce minimal sticking, charring, and thermal spread to adjacent tissue.

Warning

Do not attempt to fuse lung tissue with LigaSure mode or instruments without first consulting the respective instructions for use to ensure the use is indicated.

LigaSure Instruments

The LigaSure instruments that complete the Valleylab vessel sealing system include reusable and single-use instruments for open and minimally-invasive procedures. Refer to each instrument's instruction for use (IFU) for additional indications, warnings, and specific contraindications. The LigaSure function is only available when using Covidien LigaSure instruments.

The footswitch will be disabled upon insertion for some LigaSure instruments. To determine which instrument this applies to, conduct the following:

1. Connect a LS0300 (purple) footswitch to the rear panel footswitch connector.
2. Insert a LigaSure instrument into the LigaSure receptacle on the front panel.
3. Attempt to activate the footswitch.
4. If there is an "invalid activation" tone, it may indicate a disabled footswitch for that particular instrument.

Chapter 2

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 (25° C/77° F) and a nominal line input voltage.

Precaution
Read all warnings, precautions, and instructions provided with this system before use.
Read the instructions, warnings, and precautions provided with electrosurgical instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.

Performance Characteristics

General

Output configuration	Isolated output, bipolar electrosurgical generator
Cooling	Natural and forced convection
Display	System Status Indicator - circle LED (12 blocks) shows system status System Error Indicator - triangle LED with exclamation mark Instrument Status Indicator - LED above the LigaSure receptacle Usage Limit Indicator - 2 with a line through it
Mounting	A Covidien cart (UC8009) or a stable, flat surface

Dimensions and Weight

Width	300 mm (11.81 inches)
Depth	377 mm (14.84 inches)
Height	105 mm (4.13 inches)
Weight	5 kg (11 lbs)

Operating Parameters

Ambient temperature range	+10° C to +40° C (50° F to 104° F)
Relative humidity	30% to 75% non-condensing
Atmospheric pressure	700 millibars to 1060 millibars
Warm-up time	If transported or stored at temperatures outside the operating temperature range, allow one hour for the system to reach room temperature before use.

Transport and Storage

Ambient-temperature range	-30° C to +65° C (-22° F to 149° F)
Relative humidity	25% to 85% (non-condensing)
Atmospheric pressure	500 millibars to 1060 millibars
Duration of storage	If the energy platform is stored for over one year complete a periodic safety check. Contact Covidien Service for information.

Duty Cycle

Under maximum-output settings and rated-load conditions (30 ohm load) the generator is suitable for activation times 5 seconds on, 15 seconds off, for one hour. With lesser settings and loads, you can activate the generator for greater durations without generating excessive internal temperatures.

Internal Battery

Battery for Real Time Clock	Battery type – 3 V lithium button cell Battery life – 5 years

Audio Volume

The stated audio levels are at a distance of one meter. Alert tones meet the requirements of IEC 60601-2-2.

Activation Tone

The audio levels stated below are for activation tones and alert tones at a distance of one meter.

Volume (adjustable)	45 dBA minimum
Frequency	Sealing in process – 440 Hz
Duration	Continuous while the system is activated

Alert Tone

Volume (not adjustable)	65 dBA minimum
Duration	Seal cycle incomplete alert – The LigaSure regrasp alert is four tones played for 150 ms each with no break between tones. The order and frequency of the tones is 784 Hz, 587 Hz, 784 Hz, 587 Hz High, low, high, low Seal cycle complete tone – Two tones played for175 ms each at 985 Hz with a 175 ms break between the tones System error tone – Three 200 ms tones separated by 300 ms for each error/system-alert event

USB Port

The software provides an asynchronous serial-communications interface for communicating with an externally-connected device. Equipment connected to the USB port shall comply with IEC 60950 safety of IT equipment. The USB data port is accessible behind the USB/ECG Blanking Port cover on the rear panel. This cover is removed using a tool to access the USB port.

USB B-type connector, enumerated with a serial/COM port with 115200 bps baud, 8 data bits, 1 stop bit, no flow control setting in the laptop.

Precaution

USB Port access should only be performed outside the surgical setting with no patient contact. Replace the port cover before surgical use.

Potential Equalization Conductor

A Potential Equalization Conductor providing a direct connection between the Valleylab Generator and the potential equalization busbar of the electrical installation.

Low-Frequency (50/60 Hz) Leakage Current (IEC 60601-2-2)

Enclosure source current, ground open	< 300 µA
Source current, patient leads, all outputs	Normal polarity, intact ground: < 10 µA Normal polarity, ground open: < 50 µA Reverse polarity, ground open: < 50 µA Mains voltage on applied part: < 50 µA
Sink current at high line, all inputs	< 50 µA

High-Frequency (RF) Leakage Current

LigaSure leakage		Measured with leads recommended by Covidien	Measured directly at the system terminals
	LigaSure (left tine)	< 116 mA	< 100 mA
	LigaSure (right tine)	< 116 mA	< 100 mA

Input Power

120 Volt	240 Volt
Maximum power at nominal line voltage: Idle: 35 VA Seal: 400 VA	Maximum power at nominal line voltage: Idle: 35 VA Seal: 400 VA
Full regulation range: 90 to 130 Vac	Full regulation range: 180 to 240 Vac
Operating Range: 100 to 120 Vac Mains current maximum: Idle: 389 mA_{rms} Seal: 4.44 A_{rms}	Operating Range: 210 to 240 Vac Mains current maximum: Idle: 194 mA_{rms} Seal: 2.22 A_{rms}
Mains line frequency range (nominal) 50 to 60 Hz	Mains line frequency range (nominal) 50 to 60 Hz
Fuses (2) – 5 mm x 20 mm 8 A, 250 V fast blow, high breaking capacity	Fuses (2) – 5 mm x 20 mm 8 A, 250 V fast blow, High breaking capacity
Power plug: 3-prong hospital-grade connector	Power plug: 3-prong locally-approved connector

Power Cord Specification

This system is factory equipped with a 220 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

210-240 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

Important

Contact your local Covidien representative for alternative internationally approved power-cord options.

Input Frequency

The system operates within specification at all line-input frequencies between 48 Hz and 62 Hz. The user does not need to reconfigure the system for different line frequencies.

Input Current

The generator draws no more than 8 A at input voltages between 100 V and 240 V.

Backup Power

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

ECG Blanking

An ECG blanking port is provided to signal other devices that the generator 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. The ECG blanking port is rated: 12 VDC @ 0.2A.

Standards and IEC Classifications

The Valleylab LS10 Generator meets all pertinent clauses of IEC 60601-1 second and 60601-2-2 third editions.

	The system 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 UL standard 60601-1; certified to CSA standard C22.2 No. 601.1.

Symbols

Catalogue number

Consult instructions for use

Manufacturer

Authorized representative in the European community

Date of manufacture

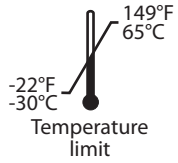
Footswitch

Alternating current

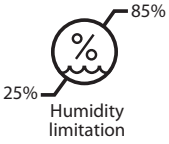
Potential equalization conductor terminal

SN — Serial number

LATEX — Not made with natural rubber latex



Temperature limitations



Humidity limitations

Rx ONLY — For sale by prescription only

ME20 — Russian GOST-R

CE 0123 — CE mark and notified body number

Volume adjustment for activation tones

Equipment should not be disposed in trash. Dispose of this product according to local regulation.

Class I Equipment (IEC 60601-1)

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

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

This generator 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 generator complies with IEC 60601-1:1988 + A1:1991 + A2:1995 and IEC 60601-1:2005 specifications for "defibrillator proof" designation and IEC 60601-2-2:2006 and IEC 60601-2-2:2009.

Liquid Spillage (IEC 60601-2-2:2006 Clause 44.3 and IEC 60601-2-2:2009 Clause 201.11.6.3)

The generator 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 System Mains Transfer)

The generator continues to operate normally with no errors or system failures when transfer is made between line AC and an emergency system-voltage source. (IEC 60601-1:1988 + A1:1991 + A2:1995 clause 49, IEC 60601-1:2005 clause 11.8, IEC 60601-2-2:2006 clause 51.101, and IEC 60601-2-2:2009 clause 201.11.8)

Electromagnetic Compatibility (IEC 60601-1-2 and IEC 60601-2-2)

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

Notice

The generator requires special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in the generator service manual.

Portable and mobile RF communications equipment can affect the generator. Refer to the EMC information provided in the *Valleylab LS10, LS Series Single Channel Vessel Sealing Generator Service Manual*.

Notice

The system should not be used adjacent to or stacked with equipment other than specified in the *Valleylab LS10, LS Series Single Channel Vessel Sealing Generator User's Guide* and *Service Manual*. If adjacent or stacked use is necessary, the system should be observed to verify normal operation in the configuration in which it will be used.

The system intentionally applies RF energy for diagnosis or treatment during activation. Observe other electronic medical equipment in the vicinity during the system activation for any possible adverse electromagnetic effects. Ensure adequate separation of electronic medical equipment based on observed reactions.

The use of accessories, other than specified in the *Valleylab LS10, LS Series Single Channel Vessel Sealing Generator User's Guide* and *Service Manual*, may result in increased emissions or decreased immunity of the system.

Other surgical equipment that generates RF energy may affect the generator. The generator should be observed to confirm normal operation when used simultaneously with other equipment. If an incomplete seal cycle occurs, reactivate the LigaSure instrument.

The generator 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)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Attention that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This product has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause

harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Warning

RFID function may be interfered with by other equipment even if that other equipment complies with CISPR emission requirements (required by clause 5.2.2.5 b in IEC 60601-1-2:2007.

Guidance and manufacturer's declaration - electromagnetic emissions

The Valleylab Generator is intended for use in the electromagnetic environment specified below. The customer or the user of the system should ensure that it is used in such an environment.

Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The Valleylab Single Channel Vessel Sealing Generator must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions CISPR 11	Class A	The Valleylab Single Channel Vessel Sealing Generator 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.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC61000-3-3	Complies	

The essential performance requirement per IEC 60601-1 does not apply to the generator. Basic Safety is the performance requirement used during immunity testing.

Guidance and manufacturer's declaration - electromagnetic immunity			
The generator is intended for use in the electromagnetic environment specified below. The customer or the user of the system should ensure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	+/-6 kV contact +/-8 kV air	+/-6 kV contact +/-8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	+/-2 kV for power supply lines +/-1 kV for input/output lines	+/-2 kV for power supply lines +/-1 kV for input/ output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	+/-1 kV differential mode +/-2 kV common mode	+/-1 kV differential mode +/-2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (>60% dip in U_T) for 5 cycles 70% U_T (>30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	<5% U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (>60% dip in U_T) for 5 cycles 70% U_T (>30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the generator requires continued operation during power mains interruptions, it is recommended that the system be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the a.c. mains voltage prior to the application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity			
The generator is intended for use in the electromagnetic environment specified below. The customer or the user of the system should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
			Portable and mobile RF communications equipment should be used no closer to any part of the generator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance
Conducted RF IEC 61000-4-6	3 V RMS 150 kHz to 80 MHz	7 V RMS	$d=1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	7 V/m	$d=1.2\sqrt{P}$ 80 MHz to 800 MHz $d=2.3\sqrt{P}$ 800 MHz to 2.5 GHz
			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). Field strengths from fixed RF transmitters[a], as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
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 generator is used exceeds the applicable RF compliance level above, the generator should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the generator.

b. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances between portable and mobile RF communication equipment and the generator

The generator is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the system can help prevent electromagnetic interferences by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the system as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter (W)	**Separation distance according to frequency of transmitter (m)**		
	150 kHz to 80 MHz d=1.2 x √P	**80 MHz to 800 MHz d=1.2 x √P**	**800 MHz to 2.5 GHz d=2.3 x √P**
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.2	1.2	2.3
10	3.7	3.7	7.4
100	12	12	23

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.

Accessories

The following accessories are for use with the Valleylab LS10 Generator.

Footswitches
Ligasure single pedal footswitch, LS0300 (purple)

Power	Cord Length
AC Cable 100–120 VAC, type SJT16/3	15 ft. or less
AC Cable 220–240 VAC, type H05WVVF3G1.0 VD	15 ft. or less

Equipotential	Cord Length
Equipotential Ground Cable, unshielded	15 ft. or less

Serial Port	Cord Length
USB A to B Cable	6.6 ft. or less

Output Characteristics

Maximum Output for LigaSure Mode

The accuracy of the measured RF power shall be within 20% of the actual real output power at the rated load or 12 W, whichever is greater for the range of 10 W to rated power.

Precaution

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.

Mode	Open Circuit Peak Voltage (max)	Open Circuit P–P Voltage (max)	Rated Load (max)	Power (max)	Short Circuit RMS Current (max)	Duty Cycle
LigaSure	250 V	500 V	30 Ω	270 W	5.5 A	N/A

Radio Frequency Identification (RFID) Module Specifications

The RFID module is located above the LigaSure port. The intended use of the RFID module is to identify the inserted LigaSure instrument and configure the generator with the data included in the RFID tag.

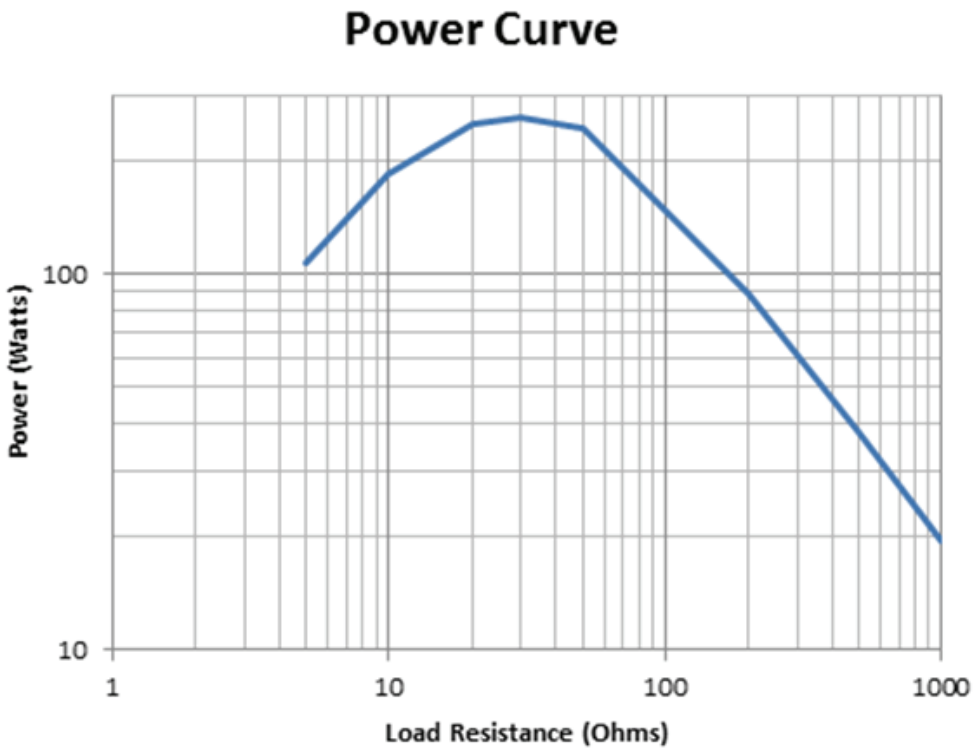
Contains Transmitter Module FCC ID: 2AAVI-JDK1901

Contains IC ID: 11355A-JDK1901

Radio Type	**RFID**
RF Output Power	**68.17 dBuV/m @ 3 meter**
Operating Frequency	**13.65 MHz**
Modulation	**Amplitude Shift Keying (ASK)**
Antenna Type	**PCB Inductive Loop**
Antenna Gain	**0 dBI**
Mode of Operation (Simplex/ Duplex)	**Duplex**

Output Power Versus Resistance Graphs

Output power versus impedance for LigaSure power



① Output power (watts)
② Load resistance (ohms)

Power Curve Limits [W]			
Load (ohms)	nominal	high	low
5	106.6	137.5	81.7
10	185.6	227.9	142.2
20	250.5	301.0	197.7
30	261.8	314.2	209.2
50	245.3	294.9	187.6
200	88.7	111.8	66.1
500	38.0	49.0	28.2
1000	19.5	25.3	14.5

Power Curve Limits [A]			
Load (ohms)	nominal	high	low
5	4.617	5.243	4.041
10	4.308	4.773	3.770
20	3.539	3.880	3.144
30	2.954	3.236	2.641
50	2.215	2.429	1.937
200	0.666	0.748	0.575
500	0.276	0.313	0.237
1000	0.140	0.159	0.120

Nominal power curve for an output power of 270 W at rated load with current/voltage limits per the power curve table.

Power curve represents the operational envelope, which varies.

Chapter 3

Setup, Tests, and Adjustments

This chapter describes how to set up, test, and calibrate the Valleylab LS10 Generator.

After unpacking or servicing the system, set up the system, perform any required calibration, and verify correct functionality.

This chapter contains tests that are specific for field testing. There are some tests which are performed in the manufacturing environment that are not field requirements. Those tests are not described in this manual.

First-Time Setup

The generator must be set up using the Valleylab Exchange Remote Software System. For instructions, refer to the *First-time Setup Guide* or *the Valleylab Exchange Remote Software System User's Guide*. The *First-time Setup Guide* and *Valleylab Exchange Remote Software System User's Guide* are available online at www.covidien.com/valleylabexchange.

Setting Up the Valleylab Single Channel Vessel Sealing Generator

Warning

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

Fire Hazard Do not use extension cords.

Precaution

Do not stack equipment on top of the system or place the system 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 system and other electronic equipment (such as monitors). An activated electrosurgical system may cause interference with them.

Notice

If required by local codes, connect the system 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. Place the system on a stable flat surface, such as a table, platform, or Covidien cart. 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 system for cooling. Normally, the top, sides, and rear panel are warm when the system is used continuously for extended periods of time.
2. According to the procedures used by your institution, connect an equipotential grounding cable to the grounding lug on the rear panel of the system. Then, connect the cable to earth ground.
3. Plug the system power cord into the rear panel receptacle.
4. Plug the system power cord into a grounded receptacle.

5. Turn on the system by pressing the power switch on (|). Verify the following:
   - The System Status Indicator located in the center of the front panel illuminates white, segment by segment, indicating activity.
   - A tone sounds upon completion of self-test.
6. **If the self-test is successful**, a tone sounds. Verify the following:
   - The System Status Indicator located in the center of the front panel illuminates white.

   or

   If the self-test is not successful, an alert tone sounds and a red System Error Indicator appears on the left side of the front panel. Refer to Chapter 5, *Troubleshooting*.

Valleylab Generator Service Mode

The service mode provides output checks, log retrieval, configuration data, and calibration data.

Calibration is not part of preventive maintenance. Calibration is required when components are replaced. Refer to Chapter 6, *Replacement Procedures* to determine the level of required calibration.

Notice

Measurements and calibration must be performed on a non-conductive surface. Do not use antistatic bench top mats. When performed on a conductive surface, calibration values may not be accurate.

After completing any calibration section, reboot the system to save the values from that calibration section.

Periodic Safety Check (Routine Maintenance)

Perform the following safety check once a year to verify that the system is functioning properly. Record the test results for reference in future tests. Copy the check sheet at the end of this chapter for use in recording the results. Keep the completed check sheet for future reference. If the system fails to meet any of the checks, refer to Chapter 5, *Troubleshooting*.

Warning

Electric Shock Hazard When taking measurements or troubleshooting the system, take appropriate precautions, such as using isolated tools and equipment, using the "one hand rule", etc.

Electric Shock Hazard Do not touch any exposed wiring or conductive surfaces while the system is disassembled and energized. Never wear a grounding strap when working on an energized system.

Precaution

The system contains electrostatic-sensitive components. When repairing the system, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized system. 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.

Full definitions of the periodic safety checks are found throughout this section of the manual. A summary of the periodic safety checks is:

- Inspect the system and accessories
- Inspect the internal components
- Test the system
- Confirm outputs
- Check leakage current and ground resistance

Recommended Test Equipment

- 100x isolated oscilloscope voltage probe (optional)
- 50 Ω, 250 W, 1% tolerance, non-inductive resistive loads
- Oscilloscope
- 200 Ω Resistor
- Current transformer - Volt per Amp equal to 0.10 with 10 MHz Bandwidth
- Covidien footswitch pedals (LigaSure)
- Low-frequency test circuit
- Modified LigaSure cable (The LigaSure test cable consists of 2 male 4 mm banana plugs connected to a full-length LigaSure cable. The cable requires no specific polarity connection during use and the banana plugs may be of any color.)
- 2 - 150 mm (6 inch) test cable, banana plug
- Functional LigaSure handswitching equipment
- True RMS voltmeter

True RMS Voltmeter Specifications

Requirement	Specification
Voltage (RMS)	2.0 to 700.0 mV(rms) (Resolution 0.1 mV(rms))
Voltage (Peak)	1000.0 mV (Resolution 0.1 mV)
Frequency	10 KH to 10 MHz
Accuracy	1% Reading
Max Input Voltage	3.3 Vp-p
Current (with 0.1:1 CT)	7000 mA(rms) (Resolution 1 mA)
Current (with 1:1 CT)	700.0 mA(rms) (Resolution 0.1 mA)
Crest Factor	1.4 to 500 (Resolution 0.1)
Input Impedance	50 Ω

Inspecting the System and Accessories

Equipment required:

- LigaSure instrument or test leads

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

Rear Panel

1. Check the rear-panel footswitch receptacle for obstructions or damage. Check for a secure fit by inserting the LigaSure LS0300 footswitch (purple) connector into the appropriate receptacle.
2. Remove the fuse and verify correct voltage and current rating. Refer to *Input Power* on page 2-6.
3. If any footswitch connector is damaged or unusable, return the system to Covidien Technical Service. For more information, see *Covidien Technical Service* on page 7-4.

Front Panel

To check the LigaSure receptacle for obstructions or damage, insert a LigaSure instrument to ensure a secure fit. If the receptacle is damaged, contact Covidien Technical Service (see page 7-4).

Footswitches

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

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 system and wall receptacle.

Inspecting the Internal Components

Equipment required:

- Phillips screwdriver

Precaution

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

1. Turn off the system and disconnect the power cord from the wall.
2. Remove the seven 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.
5. Replace the cover and secure the cover to the chassis using the seven screws.

Testing the System

Turning on the system initiates an internal self-test to verify the calibration. The self-test also checks the operation of the speaker, all indicators, and the displays. If the generator fails any of the following test steps, recalibrate the unit or contact Covidien Technical Service.

Warning

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

1. Turn on the system by pressing the front panel On (|) switch. Verify the following:
   - The System Status indicator located in the center of the front panel illuminates white, segment by segment, indicating activity.
   - A tone sounds upon completion of self-test.
2. If the self-test is successful, verify the following:
   - The System Status indicator located in the center of the front panel illuminates white.

     or

   If the self-test is not successful, an alert tone sounds and a red System Error indicator appears on the left side of the front panel. Refer to Chapter 5, *Troubleshooting*.

3. Insert a handswitching LigaSure instrument to the Front Panel receptacle. Verify the Instrument Status indicator LED above the receptacle becomes active, indicating the instrument has been detected.
4. Activate the generator using the handswitch.
5. Adjust the volume control on the rear panel to maximum volume and activate the generator.
6. If the unit does not activate, contact Covidien Technical Service.
7. Connect a LS0300 footswitch to the connector on the rear panel.
8. Activate the unit by depressing the footswitch.
9. If there is an invalid activation tone, it may indicate a disabled footswitch for that particular instrument. If the unit fails to activate or there is no audio indication, contact Covidien Technical Service.

Testing LigaSure Output

Information:

- A computer with USB connections is required to execute the Output Check.
- The Open Circuit Voltage test is performed as an internal check, external input to the generator is not required. While measuring and recording the maximum output voltage is not required, it is recommended.
- Please monitor the True RMS meter throughout this test because you will need to record the measurements from the meter while energy is being delivered.
- The pass/fail criteria, which includes the data sheet for the Output Check can be found in the service manual section called Preventative Maintenance Check Sheet.

1. Remove the USB port cover from the rear of the generator.

   - Press any key to stop activation at any time during this test.

   - Press <ESC> to return to the Main menu.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode. A list of service options appears on the screen.
7. From the VLLS10GEN>> prompt, select Test Options from the four options.
8. From the Test Functions>> prompt, select Check Output from the ten options.

9. At the Check Output>> prompt, using a modified LigaSure cable, connect a 50 Ω load and a True RMS Meter/Current transformer to measure output current. Verify that the measured output is within the limits described in the Preventative Maintenance Check Sheet.

10. Activate the generator by pressing the Space key.

11. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

12. At the prompt, enter output current recorded in the previous steps in milliamperes and press Enter. Record the output current in the Preventative Maintenance Check Sheet provided. Press any key to continue the test.

13. Disconnect the 50 Ω load and connect a 0 Ω (short circuit at the end of the cable) to the modified LigaSure cable. Connect a 0 Ω load and a True RMS Meter/Current transformer to measure output current. Verify that the measured output is within the limits described in the Preventative Maintenance Check Sheet.

14. Activate the generator by pressing Space.

15. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

16. At the prompt, enter output current recorded in the previous steps in milliamperes and press Enter. Record the output current in the Preventative Maintenance Check Sheet. Press any key to continue the test.

17. Using the modified LigaSure cable, disconnect the load and perform an open-circuit test (to perform the optional Peak Voltage measurement, connect the 100x isolated probe and oscilloscope to the ends of the cable).

18. Activate the generator by pressing Space.

19. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

20. If measured, verify that the output voltage meets the limits in the Preventative Maintenance Check Sheet.

21. The status of the internal checks performed during this procedure will be displayed on the terminal: Primary Power Accuracy test, Second Power Accuracy test, Power Compare test, Primary Current Accuracy test, Secondary Current Accuracy test, Current Compare test, Current Limit check, Voltage Limit test, Sensor Compare check, and Dosage check.

22. Verify that the terminal is displaying a pass of the Overall Test results.

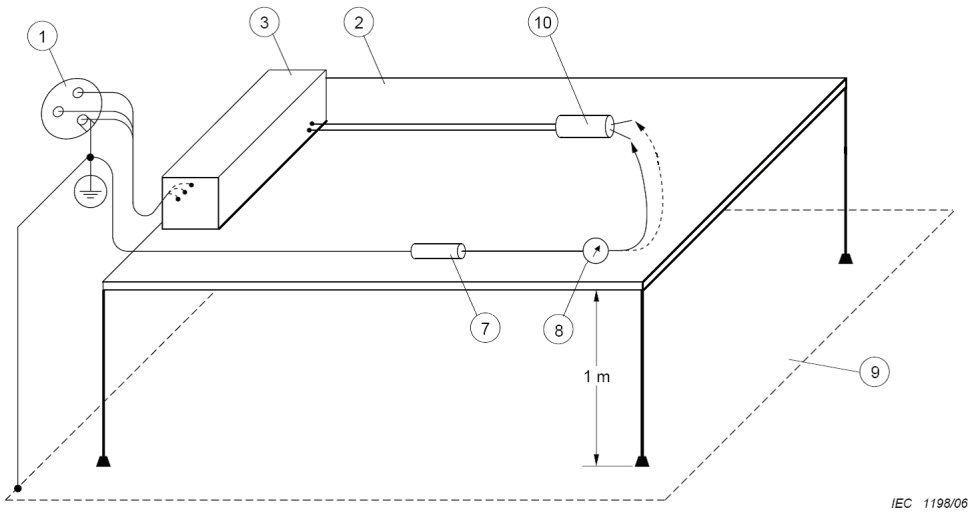
23. The output check is complete. Press <ESC> to return to the Main menu.

High Frequency Leakage

Key

1. SUPPLY MAINS
2. Table, made of insulating material
3. HF SURGICAL EQUIPMENT
7. Measuring resistance, 200 Ω
8. HF current meter
9. Earthed conductive plane
10. Activated BIPOLAR ELECTRODE

Measurement of HF LEAKAGE CURRENT from a BIPOLAR ELECTRODE



Important:

- A computer with USB connections is required to execute the RF High Frequency Leakage check.
- Please monitor the True RMS meter throughout this test because you will need to record the measurements from the meter while the energy was being delivered.
- The pass/fail criteria, which includes the data sheet for the RF Leakage check can be found in the service manual section called Preventative Maintenance Check Sheet/High-Frequency Leakage.

1. Remove the USB port cover from the rear of the generator.

2. Connect the AC cable to the generator to power on the generator.

3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Test Function from the four options.
8. From the Test Functions>> prompt, select Check High Frequency Leakage from the ten options.
9. From the Check High Frequency Leakage>> prompt, using a modified LigaSure cable, connect a 200 Ω load and a True RMS Meter/Current transformer from the left tine of the LigaSure output to the equipotential ground connection on the rear panel.
10. Connect the LS0300 footswitch to the generator.
11. Disconnect the USB A to B cable and press footswitch to activate.
12. Release the footswitch and record the high frequency leakage current in the Preventative Maintenance Check Sheet. Disconnect the 200 Ω from the left tine and reconnect to the right tine (see setup diagram above).
13. Activate the generator by pressing the footswitch.
14. Release the footswitch and record the high frequency leakage current in the Preventative Maintenance Check Sheet.
15. The High Frequency Leakage is complete.

Safety Testing in Accordance with IEC601-1

Equipment required:

- Safety tester

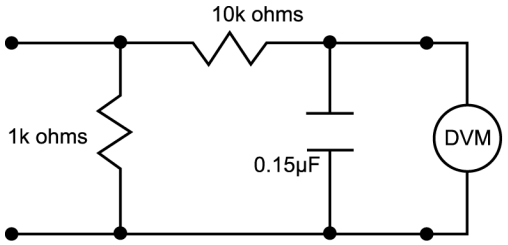
Note: Low-frequency tests are conducted at 10% above line voltage.

Checking Low-Frequency Leakage Current

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

Equipment required:

- DVM
- Leakage current tester



1 millivolt = 1 microamp

Leakage current test circuit regarding IEC 60601-1

Chassis or Earth Leakage

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the system.
3. Measure between the chassis and earth ground.
4. Determine the leakage current using the conventional 1 µA for each 1 mV.
5. Verify under normal conditions (ground closed, normal polarity) the leakage current is less than 300 µA. If the leakage current is greater than 300 µA, contact Covidien Technical Service (see page 7-4).
6. Verify single fault conditions (open neutral) the leakage current is less than or equal to 1000 µA. If the leakage current is greater than 1000 µA, contact Covidien Technical Service (see page 7-4).

Output Receptacle Source Current

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the system.
3. Measure between all the output receptacles and earth ground. Record the largest reading.
4. Determine the leakage current using the conventional 1 µA for each 1 mV.
5. Verify under normal conditions (ground closed, normal polarity) the leakage current is less than 10 µA. If the leakage current is greater than 10 µA, contact Covidien Technical Service (see page 7-4).
6. Verify single fault conditions (ground open) the leakage current is less than or equal to 50 µA. If the leakage current is greater than 50 µA, contact Covidien Technical Service (see page 7-4).

Output Receptacle Sink Current

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the system and connect the end of the leakage current test circuit to mains voltage through a 120 Ω, ¾ W resistor.
3. Connect the other side of the IEC leakage load to all of the output receptacles.
4. Determine the leakage current using the conventional 1 µA for each 1 mV.
5. Verify the leakage current is less than or equal to 50 µA. If the leakage current is greater than 50 µA, contact Covidien Technical Service (see page 7-4).

Ground Bond Testing

1. Connect the system to a ground bond tester.
2. Test between the equipotential ground lug on the rear of the system and the supplied Covidien power cord, or directly to the middle ground pin of the inlet receptacle.
3. Initiate the test according to IEC standards.
4. Specifications are 0.2 Ω using a Covidien-supplied power cord or 0.1 Ω connected directly to the middle pin of the inlet receptacle. If the specifications are not met during the ground bond testing, contact Covidien Technical Service (see page 7-4).

Docking to Valleylab Exchange

The Valleylab Exchange (VLEX) client is used for Remote Device Management on Covidien's generators. The Remote Device Management includes the following functionality:

- Download the latest version of the Valleylab Exchange Client for generators
- Retrieve the logs (pre-update error logs, pre-update event logs, post-update error logs, post-update event logs)
- Perform software updates on the generator
- Upload the logs collected along with the update results to the Enterprise server

Equipment required:

- USB A to B Cable
- Valleylab Exchange software

1. After completing service or preventive maintenance, the system should be docked to Valleylab Exchange to log any changes to the system in the master directory.
2. The *Valleylab Exchange Remote Software System User's Guide* is available online at www.covidien.com/valleylabexchange and contains instructions for docking to Valleylab Exchange. Follow the steps outlined in the guide for loading Valleylab Exchange software and docking the system to the Valleylab Exchange.

Preventive Maintenance Check Sheet

Unit Serial Number Date of Maintenance

Initial Inspection

Rear panel inspection	Accept Y or N
Front panel inspection	Accept Y or N
Footswitch inspection	Accept Y or N
Power cord inspection	Accept Y or N
Internal component inspection	Accept Y or N

System Self-Check

System self-check	Accept Y or N

Audio

Tone audible at high and low ranges	Accept Y or N

Testing LigaSure Output - 50 Ω

LigaSure	0 Ω	4.75A to 5.25A
	50 Ω	1.937A to 2.215A
	Open Circuit	250 V peak maximum

High-Frequency Leakage

		Left Tine	Right Tine
LigaSure Leakage	LigaSure (measured with leads recommended by Covidien)	<116 mA	<116 mA
	LigaSure (measured directly at the system terminals)	<100 mA	<100 mA

Safety Test in Accordance with IEC601-1

Earth Leakage	Normal Conditions	0 to 300 µA
	Open Neutral	0 to 1000 µA
Patient Leakage	Normal Conditions	0 to 10 µA
	Open Ground	0 to 50 µA
Sink Current (Mains to Applied Parts)	Normal Conditions	0 to 10 µA
	Open Ground	0 to 50 µA
Ground Bond Test		Accept Y, N, or N/A

Valleylab Exchange

Unit Docked to Valleylab Exchange	Accept Y, N, or N/A
USB Port Cover reinstalled	Y/N

Optional Service Applications

Power Curve Check

For data regarding power curve, refer to *Output Power Versus Resistance Graphs* on page 2-19.

Information:

- A computer with USB connections is required to execute the Power Curve check.
- Please monitor the True RMS meter throughout this test because you will need to record the measurements from the meter while the energy was being delivered.
- The pass/fail criteria, which includes the data sheet for the Power Curve check can be found in the Service Manual section called Output Characteristics.

1. Remove the USB port cover on the rear of the generator.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Test Functions from the four options.
8. From the Test Functions>> prompt, select Check Power Curve from the ten options.
9. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 5 Ω load and a True RMS Meter/Current transformer to measure output current. Verify that the measured output is within specification.
10. Activate the generator by pressing the Space key.
11. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.
12. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 10 Ω load and a True RMS Meter/Current transformer to measure output current. Verify that the measured output is within specification.
13. Activate the generator by pressing Space.
14. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.
15. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 20 Ω load and a True RMS Meter/Current transformer to measure output current. Verify that the measured output.

16. Activate the generator by pressing Space.

17. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

18. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 30 Ω and a True RMS Meter/Current transformer to verify that the measured output is within specification.

19. Activate the generator by pressing Space.

20. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

21. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 50 Ω and a True RMS Meter/Current transformer to verify that the measured output is within specification.

22. Activate the generator by pressing Space.

23. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

24. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 200 Ω and a True RMS Meter/Current transformer to verify that the measured output is within specification

25. Activate the generator by pressing Space.

26. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

27. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 500 Ω and a True RMS Meter/Current transformer to verify that the measured output is within specification.

28. Activate the generator by pressing Space.

29. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

30. At the Check Output Curve>> prompt, using a modified LigaSure cable, connect a 1000 Ω and a True RMS Meter/Current transformer to verify that the measured output is within specification.

31. Activate the generator by pressing Space.

32. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load.

33. Record the power curve data in the data sheet provided.

34. The Power Curve check is complete.

Sensor Calibration

Perform the Sensor Calibration if the generator fails the Output or Power Curve check.

1. Remove the USB port cover on the rear of the generator.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Test Functions from the four options.
8. From the Test Functions>> prompt, select Calibrate Sensors from the ten options.
9. At the Calibrate Sensors>> prompt, using test leads 150 mm (6 inch), connect a 20 Ω load and a True RMS Meter/Current transformer to measure output current. Press Esc to return the previous menu or to halt the test.
10. Activate the generator by pressing the Space key.
11. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load. Press any key to halt the test or to stop energy delivery.
12. At the prompt, enter the output current recorded in the previous step in milliamperes. Type the current into the terminal and press Enter.
13. Disconnect the 20 Ω load and connect a 10 Ω load.
14. Activate the generator by pressing the Space key.
15. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load. Press any key to halt the test or to stop energy delivery.
16. At the prompt, enter the output current recorded in the previous step in milliamperes. Type the current into the terminal and press Enter.
17. Disconnect the 10 Ω load and connect a 5 Ω load.
18. Activate the generator by pressing the Space key.
19. The generator is now delivering RF energy; follow the warnings/precautions at the start of this section. Record the current being delivered to the load. Press any key to halt the test or to stop energy delivery.
20. At the prompt, enter the output current recorded in the previous step in milliamperes. Type the current into the terminal and press Enter.

21. The sensor calibration is complete. Turn off the power to the generator to save the calibration parameters. Check the prompt to ensure the calibration was successful. If unsuccessful, contact Covidien Technical Service.

Instrument Information

1. Remove the USB port cover on the rear of the generator.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Test Functions from the four options.
8. From the Test Functions>> prompt, select Instrument Info from the ten options.
9. At the Instrument Info>> prompt the generator will scan (either barcode or RFID) the LigaSure instrument inserted into the instrument port and report the instrument's accessory ID, SKU, and name.

Check System Voltages

1. Remove the USB port cover on the rear of the generator.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Test Functions from the four options.
8. From the Test Functions>> prompt, select Voltages from the ten options.
9. At the Voltages>> prompt the generator will scan internal low voltage power supply values:
   3.3 V: 3.255
   1.8 V: 1.812
   5 V: 4.930
   48 V: 47.567

Sensor +5 V: 5.073
Sensor -5 V: -5.096.

The accuracy of the internal voltages is:
±3% @ 1.8 ± 0.09 VDC rail
±3% @ 3.3 ± 0.17 VDC rail
±4% @ 5.0 ± 0.25 VDC rail
±5% @ 48.0 ± 2.40 VDC rail
±5% @ RF 48.0 (+2.40/-2.60) VDC rail
±4% @ sensor power supply +5 (+0.25/-0.40) VDC rail
±11% @ sensor power supply -5 (+0.40/-0.25) VDC rail

Configuration Information

Information: While this method may be used to retrieve configuration information, it is recommended to connect the generator to the Valleylab Exchange for complete configuration information retrieval.

1. Remove the USB port cover on the rear of the generator.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.
6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Configuration from the four options.
8. At the Configuration>> prompt the generator displays Configuration data.

Retrieving Logs

Information: While this method may be used to retrieve partial logs, it is recommended to connect the generator to Valleylab Exchange for complete log retrieval.

1. Remove the USB port cover on the rear of the generator.
2. Connect the AC cable to the generator and power on the generator.
3. Connect one end of the USB A to B cable to the USB port on the rear panel of the generator (located behind the removable USB port cover).
4. Connect the other end of the USB A to B cable to a computer.
5. Launch the terminal emulation program on the computer. Configure the terminal emulation program to: baud rate of 115200 bps, 8 data bits, no parity, 1 stop bit and no flow control.

6. Hit Enter. This starts Generator Service mode.
7. From the VLLS10GEN>> prompt, select Logs.
8. From the Logs>> prompt, select Get Error Logs to get error logs or select Get Event Logs to get recent event logs or select to Exit.

Chapter 4

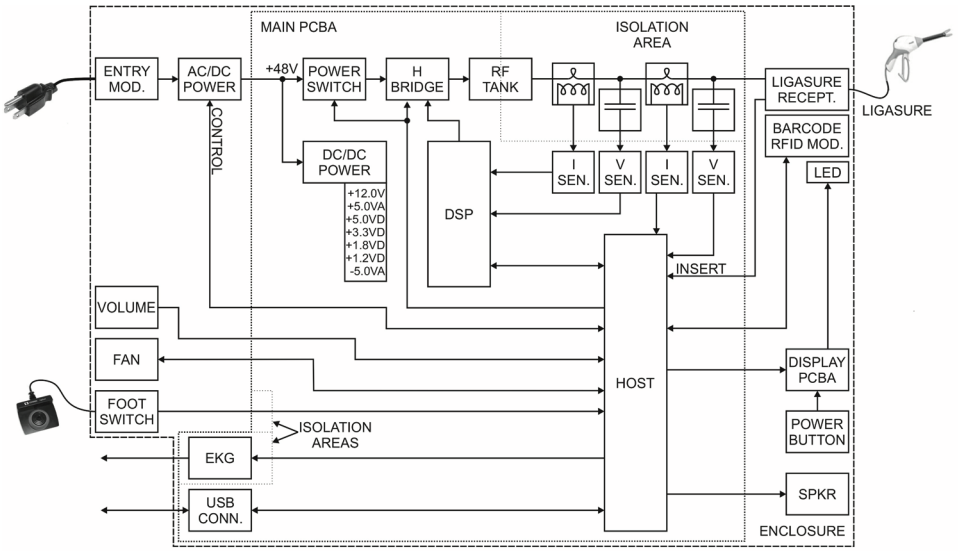
Principles of Operation

This chapter provides detailed information about how the Valleylab LS10 Generator functions and how the internal components interact.

This chapter includes the following information:

- A block diagram that illustrates how the system functions
- A general description of how the system works
- Detailed descriptions of the circuitry for the PCBAs

Block Diagram



Functional Overview

The Valleylab LS10, LS Series Single Channel Vessel Sealing Generator is a LigaSure vessel sealing system. The LigaSure system provides power for vessel sealing. 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.

RF Tank Circuitry

The primary purpose of the RF tank circuitry is to convert the +48 DC volts coming from the commercial power supply into a 400kHz RF signal that is sent to the LigaSure receptacle output. A full H-bridge topology drives the tank circuitry and is used to accomplish this voltage conversion. The RF transformer that is a part of the tank circuitry both steps up the voltage and provides isolation.

The four gate drive signals driving the H-bridge come from the DSP. A full cycle of the H-bridge output is:

1) High on the "left" side, low on the "right" side

2) Dead time, high on both "left" and "right" side

3) Low on the "left" side, high on the "right" side

4) Dead time, low on both "left" and "right" side

This cycle repeats at a 400kHz rate. The two on times are identical in length and the two off times are identical in length.

The power delivered to the LigaSure receptacle is changed by varying the ratio of the on time to the off time. This ratio is referred to as the "phase" of the driving signals. The phase varies between 10° and 160°. In order to keep both the FET devices on one side of the H-bridge from being on at the same time, there is a minimum amount of dead time guaranteed by the DSP.

Voltage and Current Sensing

There are two independent and identical voltage and current sensors. One voltage and one current sensor feed the DSP and the other pair of sensors feed the Host processor. The voltage and current sensors feeding the DSP are each digitized and read by the DSP. Having both the voltage and the current allows the DSP to compute the power being delivered to the tissue, the impedance of the tissue, and the phase between the voltage and the current. The tissue impedance is used by the algorithms in the DSP to control the power being delivered to the tissue.

The voltage and current sensors that feed the Host processor first go through an analog multiplier The single output of the multiplier represents the power being delivered to the tissue.

The voltage sensor is a highly accurate capacitor that couples the RF voltage into a filter. The current sensor is a Rogowski coil that generates a voltage across a resistor. That voltage is coupled into another filter. Each of the filters consists of a low pass filter, a high pass filter, and an integrator.

VMAD

The Host voltage sensor is a Mean Absolute Deviation circuit used to detect an over-voltage and is sampled by the Host ADC. The maximum allowed voltage is calibrated during manufacturing and is checked by the Host processor during RF activations. If an over-voltage condition is detected due to a single fault, a non-recoverable error is generated.

IMAD

The Host current sensor is a Mean Absolute Deviation circuit sampled by the Host ADC and an RMS value is calculated from this waveform. The RMS value is compared to the DSP in order to detect if the primary sensor chain is inaccurate. If the two RMS values do not agree for a period of time, then a non-recoverable error is generated.

DSP

The main function of the DSP is to control the amount of energy being delivered to the tissue. The delivery algorithms in the DSP determine the desired amount of energy based on the tissue's impedance and time. The DSP determines the actual amount of energy being delivered to the tissue by sensing the voltage and the current. The DSP adjusts the phase of the H-bridge driving signals to vary the delivered power and drive the delivered power towards the desired energy level. In the event of an error, the DSP can disable the drive to the H-bridge to shut down RF energy.

Host Processor

The Host processor provides an independent monitor of the power delivery. The Host processor compares the output of the analog multiplier with the power level reported by the DSP over the SPI interface between the two processors. If there is too much difference between these two levels for a long enough period of time, the Host will send a message to the DSP to stop the delivery of energy and the Host will also disable the RF circuitry. The disabling of the RF circuitry is controlled by a single signal that both turns off the +48 volts feeding the RF tank circuitry and the signal turns off the logic signals driving the H-bridge.

The Host processor also interfaces to all of the peripheral devices in the system. These are explained in the following sections.

Speaker

The main feedback to the operator is through the audio generated by the generator. The Host processor drives an audio DAC, which drives a speaker amplifier, and then a speaker. The Host processor generates different tones to indicate the initiation of a sealing cycle, the successful end of a sealing cycle, and error conditions such as a re-grasp event.

Volume Control

The volume control is mounted on the rear of the chassis. It is a potentiometer and is sampled by the ADC in the Host processor. This value is used by the Host Processor to control the level of the audio driving the speaker.

Display PCB

The display PCBA is visible through the front of the generator. All of the tri-color LEDs used on the display PCBA have red, green, and blue LEDs in them. Each of the red, green, and blue LEDs can be turned on or off independently. This allows each location to display seven different colors as well as being off.

In the center of the front panel there is a circle with 12 tri-color LEDs. In the center of this circle is a smaller circle with white LEDs. The outer circle of LEDs shows the progress of a seal cycle by lighting the LEDs sequentially around the circle, similar to a clock face. Different colors are used to indicate error conditions. The center white LEDs are used as a reusable instrument status indicator.

To the left side of the front panel is a triangle with an exclamation point in it. This triangle is lit by red LEDs. When lit it indicates an error condition.

Above the LigaSure receptacle is a single tri-color LED. It indicates when an instrument is inserted and is recognized by the generator.

Power Button

The power button is on the far left of the front panel. When the power button is pressed for approximately 3 seconds the generator will turn off. A short press of the button will turn the generator on.

Insertion Detection

A part of the LigaSure receptacle contains a switch that is activated whenever an instrument is inserted into the LigaSure receptacle. This insertion is detected by the Host processor. The Host processor then determines the type of instrument that was inserted by using the barcode and RFID module.

Since the insertion detection switch is located near the RF energy signals in the LigaSure receptacle, the switch detection circuitry is isolated from the Host processor. These detection signals cross the isolation boundary via a high voltage isolation module.

Barcode/RFID Module

The Barcode/RFID (Vibe) module is a single assembly containing both a Barcode (Aztec) scanner and a RFID scanner. It is responsible for detecting LigaSure Device type. The Host processor communicates with the Barcode/RFID module bi-directionally over an RS-422 link. The Host processor can request the Barcode/RFID module to read a barcode, read an RFID, or to write an RFID. Both the barcode and the RFID contain information about the instrument.

Instrument Handswitch

The Host processor needs to detect the activation of a hand switch on an instrument. Since the hand switch is connected to the RF energy signals in the instrument, the switch detection circuitry is isolated from the Host processor. These detection signals cross the isolation boundary via a high voltage isolation module.

Footswitch

The Host processor needs to detect the activation of the foot switch when using certain instruments. Since the foot switch is in contact with the user, the switch detection circuitry is isolated from the Host processor.

Fan

The Host processor can both control the speed of the fan and sense the speed of the fan. The air flow of the fan is first directed over the H-bridge FETs, their drivers, and their heat sinks. The air flow proceeds to the RF inductor and the RF transformer. Other than the commercial AC/DC power supply, these components comprise the main source of heat generation in the generator.

ECG Blanking

The ECG blanking port is controlled by the Host processor. It is activated before RF energy is applied to tissue and deactivated after the cessation of energy application. It can be used to protect ECG equipment if that equipment is connected to the patient, or it can be used to control an evacuation fan. The relay contacts will handle up to 12 volts, AC/DC, and up to 0.2 amps.

USB Port

The USB port is configured as a serial port into the Host processor. The Host processor can communicate over this port to any PC that has its own USB port configured as a serial port. There is a USB to serial port converter on the generator PCBA. The Host processor interfaces to this converter over a normal serial port.

AC to DC Power Supply

The AC/DC power supply is a purchased part. It converts normal power to 48 volts DC and can supply up to 8.3 amps. Without fan cooling, this supply cannot continuously supply the 8.3 amps but the generator only draws that amount of current for short periods of time.

Power Entry Module

The power entry module is located on the rear of the generator. It provides the connection for a modular power cord. The module also contains the power fuses for the generator.

Chapter 5

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 an error was recorded, take the appropriate action to correct the condition

Additional technical information may be available through Covidien Technical Service.

Precaution
Read all warnings, precautions, and instructions provided with this system before use.
Read the instructions, warnings, and precautions provided with electrosurgical instruments before use. Specific instructions for electrosurgical instruments are not included in this manual.

General Troubleshooting Guidelines

If the Valleylab LS10 generator malfunctions, check for obvious conditions that may have caused the problem:

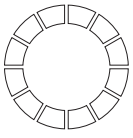
- Check the system for visible signs of physical damage.
- Make sure the fuse drawer is tightly closed.
- Verify that all cords are connected and attached properly.
- If the problem is still unclear, turn the generator off, wait a minute or two, then turn it back on.

If the malfunction persists, the system may require service. Contact the institution's biomedical-engineering department. Covidien Technical Service may be contacted in the ways indicated.

System Alerts and Troubleshooting

Most system alerts require some action on your part to correct the condition; however, some are corrected automatically. Use the following list to determine how to correct an alert condition. After correcting the alert condition, verify that the system completes the self-test as described in.

Indicators	Description	Actions
Amber color system status indicator and four-pulse tone delivered 	Seal cycle incomplete	Refer to Chapter 5, *Correcting Malfunctions, Incomplete seal cycle alert* section
Red instrument status indicator and three-pulse tone delivered 	Invalid instrument or a stuck handswitch or footswitch	Check the handswitch and make sure it is released. If the problem remains, remove the instrument and observe the instrument status indicator. If it remains red, the footswitch is depressed. Check the footswitch. If it turns off, the LigaSure handswitch is stuck or an invalid instrument is inserted. Replace with a new LigaSure instrument.

Indicators	Description	Actions
Red system error indicator illuminated and three-pulse tone delivered 	System error	Power cycle the generator. If error recurs, system fault is present. Contact Covidien Technical Service as indicated on page 7-4.
No audio tone upon attempted activation of footswitch	Footswitch fault may be present	Confirm instrument is fully inserted in receptacle by removing and reinserting LigaSure connector. Confirm the footswitch plug is fully inserted by reconnecting the plug to ensure pin alignment.
Single pulse tone delivered when footswitch pressed, no energy delivered	Footswitch activation disabled for connected LigaSure instrument	Replace instrument with a footswitch-compatible LigaSure instrument or use handswitch functionality to activate energy.
Usage limit indicator illuminated 	Inserted device has already been used	Replace with certified Covidien LigaSure instrument.
White color system status indicator illuminated and flashing 	System in service mode	Cycle the power to exit service mode.

System Functions

Logs

The logs list the activities on the generator such as activation counts, instrument insertion, and other events.

Service Mode

Service mode functionality requires an external PC and terminal emulation program. When the system is in service mode, the system status indicator will illuminate white and flash. Cycle power to exit service mode.

Correcting Malfunctions

If a solution is not readily apparent, use the table below to help identify and correct specific malfunctions. After the malfunction is corrected, power cycle the generator, confirm the self-test completes, and returns to ready state.

Situation	Possible Cause	Solution
Abnormal neuromuscular stimulation *(stop surgery immediately)*	Metal-to-metal sparking	Check all connections to the generator and LigaSure instrument and cords for damage.
	Abnormal 50 Hz-60 Hz leakage currents	Contact your biomedical-engineering department or a Covidien Technical Service representative for assistance.
Generator does not respond when turned on	Disconnected power cord or faulty wall outlet	Check power cord connections (generator and wall outlet). Connect the power cord to a functional outlet.
	Faulty power cord	Replace the power cord.
	Fuse drawer is open or fuses are blown.	Replace the blown fuse(s). Close the fuse drawer. Refer to the service manual.
	Internal component malfunction	Use a backup generator. Contact the biomedical-engineering department or a Covidien Technical Service representative for assistance.

Situation	Possible Cause	Solution
System is on, but did not complete the self-test; system status indicator does not achieve system ready for use status (constant white)	Software malfunction	Turn off, then turn on the generator.
	Internal component malfunction	Use a backup generator. Contact the biomedical-engineering department or a Covidien Technical Service representative for assistance.
Generator is on and instrument is activated, but system does not deliver energy	Malfunctioning footswitch or handswitching instrument	Check and reconnect instrument and/or footswitch connection. Power cycle the generator. Replace the instrument if it continues to malfunction.
	Internal component malfunction	Use a backup generator. Contact the biomedical engineering department or a Covidien Technical Service representative for assistance.
Incomplete seal cycle alert front panel will illuminate with a solid amber light, a four-pulse tone sounds, and RF output is disabled	Excessive tissue/eschar on jaws	Clean jaws with a wet gauze pad.
	Electrodes have come loose from the instrument jaws Electrode pins may have been compromised or bent during assembly of the instrument and may need to be replaced	Re-insert the electrode into the instrument jaws making sure that all the electrode pins are firmly seated. If not resolved, replace the LigaSure instrument.
	Metal or other foreign object is grasped within jaws	Avoid grasping objects, such as staples, clips, or encapsulated sutures in the jaws of the instrument.
	Tissue grasped within jaws is too thin	Open the jaws and confirm that a sufficient amount of tissue is inside the jaws. If necessary, increase the amount of tissue and repeat the procedure.
	Pooled fluids around instrument tip	Minimize or remove excess fluids.

Situation	Possible Cause	Solution
	The seal cycle was interrupted before completion. The handswitch or footswitch was released before the end tone activated. Additional time and energy are needed to complete the seal cycle	Reactivate the seal cycle without removing or repositioning the instrument.
Continuous patient or video monitor interference	Faulty power cord or display cables	Check and replace power cord and display cables for the monitor and power cord for the generator.
	Electrical equipment is grounded to different objects rather than a common ground. The generator may respond to the resulting voltage differences between grounded objects.	Plug all electrical equipment into line power at the same location. Contact your biomedical-engineering department or a Covidien Technical Service representative for assistance.
	Malfunctioning monitor	Replace the monitor.
Interference with other devices only when the generator is activated	Metal-to-metal sparking	Check all connections to the generator and LigaSure instrument and cords for damage.
	Electrically inconsistent ground wires in the operating room	Verify that all ground wires are as short as possible and go to the same grounded metal.
	If interference continues when the generator is activated, the monitor is responding to radiated frequencies.	Ask the biomedical-engineering department to check with the manufacturer of the monitor. Some manufacturers offer RF choke filters for use in monitor leads. The filters reduce interference when the generator is activated.

Situation	Possible Cause	Solution
Pacemaker interference	Intermittent connections or metal-to-metal sparking	Check the active electrode cord connections. It may be necessary to re-program the pacemaker. Always monitor patients with pacemakers during surgery and keep a defibrillator available. Consult the pacemaker manufacturer or hospital cardiology department for further information when use of the LigaSure system is planned in patients with cardiac pacemakers.
Internal Cardiac Defibrillator (ICD) activation	ICD is activated by generator	Stop the procedure and contact the ICD manufacturer for instructions.

Error and Event Code Strings

The generator records both errors and events. Errors indicate that the system is unstable and in a state where all system functions are disabled. An event occurs when the system needs to record an informational event or recoverable warning. Certain events may be logged for Covidien informational purposes. It is important that these events not be interpreted as errors or failure conditions that require any action on the part of service personnel.

Recorded errors and events may be downloaded/viewed using the Chapter 3, *Retrieving Logs* section or by docking the system to the Valleylab Exchange Chapter 3, *Docking to Valleylab Exchange*.

Some errors are corrected automatically by cycling power. When an error occurs, cycle (turn off, then turn on) the system. After correcting an error condition, verify the system completes the self-test. If the error persists, use the troubleshooting guide in this section to further analyze the issue. Should you be unable to correct the issue, contact Covidien Technical Service.

Error Text String	Failure cause	Correction action
None	System error.	Power cycle. Return for service if it persists.
DSP Assert	System error.	Power cycle. Return for service if it persists.
DSP RAM Failure	RAM is corrupted – possible hardware failure of RAM.	Power cycle. Return for service if it persists.
DSP Stack Underflow Failure	System error.	Power cycle. Return for service if it persists.
DSP Stack Overflow Failure	System error.	Power cycle. Return for service if it persists.
DSP Software Default Case	System error.	Power cycle. Return for service if it persists.
DSP Invalid Service Sub-State	System error.	Reprogram DSP and Host software.
DSP Software Registration Failure	System error.	Power cycle. Return for service if it persists.
DSP Unexpected Interrupt	System error.	Power cycle. Return for service if it persists.
DSP Foreground Execution Failure	System error.	Power cycle. Return for service if it persists.
DSP SPI Comm Failure	System or SPI communication error.	Power cycle to clear. Move generator away from other devices generating EMI. Return for service if it persists.
DSP SPI Transmit Failure	System error.	Power cycle. Return for service if it persists.
DSP V ADC Offset	Excess bias on sensor. Possible hardware failure or unit needs calibration.	Recalibrate unit. Return for service if it persists.
DSP I ADC Offset	Excess bias on sensor. Possible hardware failure or unit needs calibration.	Recalibrate unit. Return for service if it persists.
DSP V ADC Saturation	High voltage present. Possible hardware failure.	Power cycle. Return for service if it persists.
DSP I ADC Saturation	High current present. Possible hardware failure.	Power cycle. Return for service if it persists.
DSP PWM Output Mismatch	System error.	Power cycle. Return for service if it persists.
DSP Missed SPI Frames Failure	System or SPI communication error.	Power cycle to clear. Move generator away from other devices generating EMI. Return for service if it persists.
DSP Timer Accuracy Failure	DSP Crystal failure.	Power cycle. Return for service if it persists.

DSP SPI Retry Logic Failure	System or SPI communication error.	Power cycle to clear. Move generator away from other devices generating EMI. Return for service if it persists.
DSP Event Queue Full	System error.	Power cycle. Return for service if it persists.
DSP Critical Data Inverse Wrong	System error or corrupt memory due to hardware failure.	Power cycle. Return for service if it persists.
DSP Critical Data Range	System error or corrupt memory due to hardware failure.	Power cycle. Return for service if it persists.
DSP Bad CRC	System error or corrupt memory due to hardware failure.	Power cycle. Return for service if it persists.
DSP Watchdog Timeout	System error or corrupt memory due to hardware failure.	Power cycle. Return for service if it persists.
DSP Invalid Software Upgrade State	System error.	Power cycle. Return for service if it persists.
DSP Illegal IPC Command	System error or corrupt memory due to hardware failure.	Power cycle. Reprogram Host and DSP software. Return for service if it persists.
DSP ADC Load Error	System error or corrupt memory due to hardware failure.	Power cycle. Return for service if it persists.
DSP Verifiable Data CRC Failure	System error or corrupt memory due to hardware failure.	Power cycle. Return for service if it persists.
DSP EndZ Offset Out of Range	Incorrect endz value sent from the Host. Host software failure.	Power cycle. Return for service if it persists.
DSP Host Error	System error.	Power cycle. Return for service if it persists.
DSP Event Pool Full	System error.	Power cycle. Return for service if it persists.
DSP Event Pool Empty	System error.	Power cycle. Return for service if it persists.
DSP SPI TX Queue Empty	System error.	Power cycle. Return for service if it persists.
DSP SPI TX Queue Full	System error.	Power cycle. Return for service if it persists.
DSP Application Flash Failure	Failure to read/write to DSP external flash. Possible hardware failure.	Power cycle. Return for service if it persists.

DSP Backup Flash Failure	Failure to read/write to DSP external flash. Possible hardware failure.	Power cycle. Return for service if it persists.
DSP SPI Comm Timeout	System or SPI communication error.	Power cycle to clear. Move generator away from other devices generating EMI. Return for service if it persists.
DSP Comm Buffer Overun	System error.	Power cycle. Return for service if it persists.
DSP Snprintf Overflow	System error.	Power cycle. Return for service if it persists.
DSP SPI RX SW FIFO Overflow	System or SPI communication error.	Power cycle. Return for service if it persists.
DSP SPI RX HW FIFO Overflow	System or SPI communication error.	Power cycle. Return for service if it persists.
DSP Irms Limit Exceeded	Current exceeding 5.5A for more than 450 milliseconds. Possible hardware failure or unit needs calibration.	Output check. Recalibrate sensors. Return for service if it persists.
DSP Target Sensor Mismatch Low	Possible hardware failure or unit needs calibration.	Output check. Recalibrate sensors. Return for service if it persists.
DSP Target Sensor Mismatch High	Possible hardware failure or unit needs calibration.	Output check. Recalibrate sensors. Return for service if it persists.
DSP PWM MEP Calibration Failure	Hardware failure.	Power cycle. Return for service if it persists.
DSP Voltage Peak Saturation	High voltage present. Possible hardware failure.	Output check. Recalibrate sensors. Return for service if it persists.
DSP Current Peak Saturation	High current present. Possible hardware failure.	Output check. Recalibrate sensors. Return for service if it persists.
DSP RF Single Fault	Hardware failure or unit needs calibration.	Output check. Recalibrate sensors. Return for service if it persists.
DSP RF Single Fault Min Phase	Hardware failure or unit needs calibration.	Output check. Recalibrate sensors. Return for service if it persists.
DSP System Timer Corrupted	Hardware failure.	Power cycle. Return for service if it persists.
DSP RS232 TX Queue Empty	System error.	Power cycle. Return for service if it persists.
DSP RS232 TX Queue Full	System error.	Power cycle. Return for service if it persists.
DSP RS232 TX Timeout	System error.	Power cycle. Return for service if it persists.
Host Image CRC Failure	System error.	Power cycle. Return for service if it persists.

Host Assert	Host Flash is corrupted. Possible hardware failure, or bad software download image.	Power cycle. Reprogram Host and DSP software. Return for service if it persists.
Host Software Default Case	System error.	Power cycle. Return for service if it persists
Host Stack Corrupted	Software execution failure or incompatible versions of Host and DSP code.	Power cycle. Return for service if it persists.
Host State Pointer Corrupt	System error.	Power cycle. Return for service if it persists.
Host State Owner Corrupt	System error.	Power cycle. Return for service if it persists.
Host Thread Failure	System error.	Power cycle. Return for service if it persists.
Host Message Queue Overflow	System error.	Power cycle. Return for service if it persists.
Host Thread Create Fail	System error.	Power cycle. Return for service if it persists.
Host Queue Create Fail	System error.	Power cycle. Return for service if it persists.
Host Hardware Fail	Hardware failure.	Power cycle. Return for service if it persists.
Host SPI Communications Failure	System or SPI communication error.	Power cycle. Reprogram Host and DSP software. Return for service if it persists.
Host Digital POT Calibration Failed	Hardware failure.	Power cycle. Return for service if it persists.
Host Watchdog Timeout	System error, possibly due to hardware failures.	Power cycle. Return for service if it persists.
Host Sensor Miscompare	Hardware failure or unit needs calibration	Output check. Recalibrate sensors. Return for service if it persists.
Host POST Wait for SPI	Power on self test failed. DSP did not initialize and run properly. Possible hardware failure.	Power cycle. Reprogram Host and DSP software. Return for service if it persists.
Host POST Wait for Complete	Power on self test failed. DSP did not initialize and run properly. Possible hardware failure.	Power cycle. Reprogram Host and DSP software. Return for service if it persists.
Host POST Hot Swap Ready	Power on self test failed. High voltage not available.	Power cycle. Return for service if it persists.
Host unit needs calibration	Unit is not calibrated.	Output check. Recalibrate sensors. Return for service if it persists.
Host Voltage Out Of Range	Hardware failure.	Power cycle. Return for service if it persists.

Host RF State Mismatch	System error.	Power cycle. Return for service if it persists.
Host Instrument Info Corrupt	System error.	Power cycle. Return for service if it persists.
Host Bad Fan	Hardware failure.	Power cycle. Return for service if it persists.
Host Receive Invalid IPC evnet	System error or incompatible versions of Host and DSP code.	Power cycle. Reprogram Host and DSP software. Return for service if it persists.
Host Seal Deactivation	System error.	Power cycle. Return for service if it persists.
Host Country Not Set	Unit not configured correctly. Need to dock and configure.	Dock to VLEX and set country code. Return for service if it persists.
Host Region Not Set	Unit not configured correctly. Need to dock and configure.	Dock to VLEX and set country code. Return for service if it persists.
Host VIBE Init Failed	Scanner hardware failure.	Power cycle. Return for service if it persists.
Host Rtc Failure	Hardware failure.	Dock to VLEX and set time. Change battery. Return for service if it persists.
Host Energy Without Activation	System error, hardware failure, or unit needs calibration.	Perform Output check. Recalibrate sensors. Return for service if it persists.
Host Control Core Fail	System error.	Power cycle. Return for service if it persists.
Host Send Message Fail	System error.	Power cycle. Return for service if it persists.
Host Receptacle Switch Failure	Receptacle hardware failure.	Power cycle. Return for service if it persists.
Host Thread Init Fail	System error.	Power cycle. Return for service if it persists.
Host Over-voltage	High voltage. Hardware failure or unit needs calibration	Perform Output check. Recalibrate sensors. Return for service if it persists.
Host critical Data Sonsor Cal check Fail	Hardware failure (NV store).	Power cycle. Return for service if it persists.
Host Critical Data Aduio table check Fail	Hardware failure (NV store).	Power cycle. Return for service if it persists.
Host Configuration Check Fail	Hardware failure (NV store) or improper configuration setup.	Power cycle. Return for service if it persists.
Host Config Mgmt Primary and Backup Fail	Hardware failure (NV store).	Power cycle. Return for service if it persists.
Host EBD Session Message Registration Fail	System error.	Power cycle. Check compatibility of VLEX and VLLS10

Host Dosage Power Exceeded	High power. Hardware failure or unit needs calibration	Perform Output check. Recalibrate sensors. Return for service if it persists.
Host Check SPI Ready Fail	Hardware failure, or DSP software not executing.	Power cycle. Return for service if it persists.
hand Switch Stuck	Handswitch button is stuck.	Release button. Try new instrument. Return for service if it persists.
foot switch stuck	Footswitch is stuck.	Release footswitch button. Try new footswitch. Return for service if it persists.
Invalid Activation	System error.	Power cycle. Return for service if it persists.
Invalid Instrument Inserted	Instrument inserted that is not compatible with the VLLS10.	Use valid instrument.
Host POST Successful	POST cycle completed successfully	Event is for information only. No corrective action needed.
Host POST Failed	Power On Self Test has failed	Power cycle unit. Return for service if an error occurs.
Host Digital POT Calibration	Digital potentiometer auto calibrated on startup	Event is for information only. No corrective action needed.
Host RTC OF Bit Set	System error.	Power cycle. Return for service if it persists.
Device Info UID MSB	Information only	Event is for information only. No corrective action needed.
Device Info UID LSB	Information only	Event is for information only. No corrective action needed.
Device Info Schema	Information only	Event is for information only. No corrective action needed.
Device Info Tag Data Ver	Information only	Event is for information only. No corrective action needed.
Device Info SKU MSB	Information only	Event is for information only. No corrective action needed.
Device Info SKU LSB	Information only	Event is for information only. No corrective action needed.
Device Info Device Type	Information only	Event is for information only. No corrective action needed.
Device Info UMU And UMPU	Information only	Event is for information only. No corrective action needed.
Device Country Setting	Information only	Event is for information only. No corrective action needed.
Device New Timestamp	Information only	Event is for information only. No corrective action needed.
Device Data Error Invalid UL Data CRC	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.

Device Data Error Invalid L Data CRC	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.
Device Data Error Invalid Signature	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.
Device Data Error Invalid Public Key	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.
Device Data Error Invalid Device Type	Incompatible Instrument inserted.	Replace Instrument. Return for service if persists.
Device Usage Not Allowed By Tag	Incompatible Instrument inserted.	Replace Instrument. Return for service if persists.
Device Usage Not Allowed By Tracklist	Incompatible Instrument inserted.	Replace Instrument. Return for service if persists.
Device is not compatible with generator	Incompatible Instrument inserted.	Replace Instrument. Return for service if persists.
Instrument Inserted	Information only	Event is for information only. No corrective action needed.
Instrument Removed	Information only	Event is for information only. No corrective action needed.
Hand Switch Pressed	Information only	Event is for information only. No corrective action needed.
Hand Switch Released	Information only	Event is for information only. No corrective action needed.
Foot Switch Pressed	Information only	Event is for information only. No corrective action needed.
Foot Switch Released	Information only	Event is for information only. No corrective action needed.
Barcode instrument identified	Information only	Event is for information only. No corrective action needed.
Foot Switch Single Fault	Information only	Replace footswitch. Return for service if event persists.
RF On	Information only	Event is for information only. No corrective action needed.
Seal Complete	Information only	Event is for information only. No corrective action needed.
Seal Regrasp	Information only	Event is for information only. No corrective action needed.
Seal Reactive	Information only	Event is for information only. No corrective action needed.
Large Phase Step	System error.	Return for service.
DSP Primary Restored	Information only	Event is for information only. No corrective action needed.
DSP Second Restored	Information only	Event is for information only. No corrective action needed.
DSP Activation Denied	Information only	Event is for information only. No corrective action needed.

Host Power Down	Information only	Event is for information only. No corrective action needed.
Host Power Drop Off	Information only	Event is for information only. No corrective action needed.
Host Software Upgrade Complete	Information only	Event is for information only. No corrective action needed.
Host Software Upgrade Fail	Software upgrade failed.	Retry software upgrade.
Host Application Secondary Image Corrupt	System error.	Event is for information only. No corrective action needed.
Host Boot Primary Image Corrupt	System error.	Event is for information only. No corrective action needed.
DSP Software Upgrade Complete	System error.	Event is for information only. No corrective action needed.
DSP Software Upgrade Fail	Software upgrade failed.	Retry software upgrade.
DSP Calibration Complete	Primary sensor calibration passed	Event is for information only. No corrective action needed
Max Phase Check Complete	Maximum phase calibration passed	Event is for information only. No corrective action needed
Max Phase Check Fail	Maximum phase calibration failed	Return for service.
Host current calibration success	Current calibration passed	Event is for information only. No corrective action needed
Host current calibration fail	Current calibration failed	Retry sensor calibration. Return for service if it persists.
Host VPeak Calibration success	Voltage peak calibration passed	Event is for information only. No corrective action needed
Host VPeak Calibration fail	Voltage peak calibration failed	Retry maximum output calibration. Return for service if it persists.
Host NVStore Primary configuration data fail	System error.	Power cycle. Return for service if it persists.
Host Secondary configuration data fail	System error.	Power cycle. Return for service if it persists.
Host Config Mgmt Primary NV read fail	System error.	Power cycle. Return for service if it persists.
Host EBD transport receiver overflow	System error.	Power cycle. Return for service if it persists.
Host EBD session dropped message	System error.	Power cycle. Return for service if it persists.
Host EBD session receiver overflow	System error.	Power cycle. Return for service if it persists.

Event Text String	Reason for entry	Corrective action
hand Switch Stuck	Handswitch button is stuck.	Release button. Try new instrument. Return for service if it persists.
foot switch stuck	Footswitch is stuck.	Release footswitch button. Try new footswitch. Return for service if it persists.
Invalid Activation	System error.	Power cycle. Return for service if it persists.
Invalid Instrument Inserted	Instrument inserted that is not compatible with the VLLS10.	Use valid instrument.
Host POST Successful	POST cycle completed successfully	Event is for information only. No corrective action needed.
Host POST Failed	POST has failed	Power cycle unit. Return for service if error re-occurs.
Host Digital POT Calibration	Digital potentiometer auto calibrated on startup	Event is for information only. No corrective action needed, return for service if it persists.
Host RTC OF Bit Set	System error.	Power cycle. Return for service if it persists.
Device Info UID MSB	Information only	Event is for information only. No corrective action needed.
Device Info UID LSB	Information only	Event is for information only. No corrective action needed.
Device Info Schema	Information only	Event is for information only. No corrective action needed.
Device Info Tag Data Ver	Information only	Event is for information only. No corrective action needed.
Device Info SKU MSB	Information only	Event is for information only. No corrective action needed.
Device Info SKU LSB	Information only	Event is for information only. No corrective action needed.
Device Info Device Type	Information only	Event is for information only. No corrective action needed.
Device Info UMU And UMPU	Information only	Event is for information only. No corrective action needed.
Device Country Setting	Information only	Event is for information only. No corrective action needed.
Device New Timestamp	Information only	Event is for information only. No corrective action needed.
Device Data Error Invalid UL Data CRC	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.
Device Data Error Invalid L Data CRC	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.
Device Data Error Invalid Signature	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.
Device Data Error Invalid Public Key	Invalid RFID data read.	Replace with valid instrument. Return for service if persists.

Device Data Error Invalid Device Type	Incompatible Instrument inserted.	Replace with valid instrument. Return for service if persists.
Device Usage Not Allowed By Tag	Incompatible Instrument inserted.	Replace with valid instrument. Return for service if persists.
Device Usage Not Allowed By Tracklist	Incompatible Instrument inserted.	Replace with valid instrument. Return for service if persists.
Device is not compatible with generator	Incompatible Instrument inserted.	Replace with valid instrument. Return for service if persists.
Instrument Inserted	Normal operation.	Event is for information only. No corrective action needed.
Instrument Removed	Normal operation.	Event is for information only. No corrective action needed.
Hand Switch Pressed	Normal operation.	Event is for information only. No corrective action needed.
Hand Switch Released	Normal operation.	Event is for information only. No corrective action needed.
Foot Switch Pressed	Normal operation.	Event is for information only. No corrective action needed.
Foot Switch Released	Normal operation.	Event is for information only. No corrective action needed.
Barcode instrument identified	Normal operation.	Event is for information only. No corrective action needed.
Foot Switch Single Fault	Accessory failure.	Replace footswitch. Return for service if event persists.
RF On	Normal operation.	Event is for information only. No corrective action needed.
Seal Complete	Normal operation.	Event is for information only. No corrective action needed.
Seal Regrasp	Normal operation.	Event is for information only. No corrective action needed.
Seal Reactive	Normal operation.	Event is for information only. No corrective action needed.
Large Phase Step	System error.	Return for service.
DSP Primary Restored	System error.	Event is for information only. No corrective action needed.
DSP Second Restored	System error.	Event is for information only. No corrective action needed.
DSP Activation Denied	System error.	Event is for information only. No corrective action needed
Host Power Down	System error.	Event is for information only. No corrective action needed
Host Power Drop Off	System error.	Event is for information only. No corrective action needed
Host Software Upgrade Complete	Software upgrade successful.	Event is for information only. No corrective action needed

Host Software Upgrade Fail	Software upgrade failed.	Retry software upgrade. Return for service if it persists.
Host Application Secondary Image Corrupt	System error.	Event is for information only. No corrective action needed, return for service if it persists.
Host Boot Primary Image Corrupt	System error.	Event is for information only. No corrective action needed, return for service if it persists.
DSP Software Upgrade Complete	Software upgrade successful.	Event is for information only. No corrective action needed
DSP Software Upgrade Fail	Software upgrade failed.	Retry software upgrade. Return for service if it persists.
DSP Calibration Complete	Primary sensor calibration passed	Event is for information only. No corrective action needed
Max Phase Check Complete	Maximum phase calibration passed	Event is for information only. No corrective action needed
Max Phase Check Fail	Maximum phase calibration failed	Return for service if it persists.
Host current calibration success	Current calibration passed	Event is for information only. No corrective action needed
Host current calibration fail	Current calibration failed	Retry sensor calibration. Return for service if it persists.
Host VPeak Calibration success	Voltage peak calibration passed	Event is for information only. No corrective action needed
Host VPeak Calibration fail	Voltage peak calibration failed	Retry maximum output calibration. Return for service if it persists.
Host NVStore Primary configuration data fail	System error.	Power cycle unit. Return for service if error re-occurs.
Host Secondary configuration data fail	System error.	Power cycle unit. Return for service if error re-occurs.
Host Config Mgmt Primary NV read fail	System error.	Power cycle unit. Return for service if error re-occurs.
Host EBD transport receiver overflow	System error.	Power cycle unit. Return for service if error re-occurs.
Host EBD session dropped message	System error.	Power cycle unit. Return for service if error re-occurs.
Host EBD session receiver overflow	System error.	Power cycle unit. Return for service if error re-occurs.

Chapter 6

Replacement Procedures

Follow the procedures in this chapter if replacement becomes necessary for the components listed in this chapter.

Replacement Procedures

Warning

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

Precaution

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

Notice

Perform all the steps including the recalibration listed below. Failure to recalibrate the system after replacing components may result in the system becoming inoperable.

To service many of the components of the system, it is necessary to remove the front panel of the system. The steps listed here are referenced throughout the procedures for servicing other components.

Replacement Parts

Component	Service Level Required
Front Panel Assy	Routine Maintenance
PCBA Display	Routine Maintenance
PCBA PROG MAIN	Calibration, VLEX, Routine Maintenance, Power Curve Check
Battery - Lithium COIN 3V 16 mm	VLEX, Routine Maintenance
ASSY/RFID/Barcode Vibe	VLEX, Routine Maintenance
Power Supply	Calibration, Routine Maintenance, Power Curve Check
ASSY RECEPTACLE LIGASURE	Routine Maintenance

Component	Service Level Required
Speaker Assy	Routine Maintenance
Fan with Cable	Routine Maintenance
Power Entry with Cable	Routine Maintenance
Display Cable Board	Routine Maintenance
ASSY Cable Power Supply to Main PCBA	Routine Maintenance
Control Cable Main bd to PS	Routine Maintenance
Volume Control Cable	Routine Maintenance
Footswitch Cable	Routine Maintenance
Power Cords	Routine Maintenance
Rubber foot for chassis	N/A
Fuse 250VAC 8A RoHS LITTLEFUSE	Routine Maintenance
USB Cover	N/A

Removing the Front Panel

1. Turn off the system. Disconnect the power cord from the wall receptacle.
2. Remove the four screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect cable assemblies:
   - **a.** Display cable, at P1 of display PCBA on front panel assembly
   - **b.** Barcode/RFID module cable, at P26 on main PCBA
   - **c.** LigaSure cable, at P1 of main PCBA
   - **d.** Insert detect cable, at P29 on main PCBA
4. Remove the 5 screws that secure the panel to the housing (one on either side and three on the bottom).
5. Slide the front panel away from the chassis.

Reinstalling the Front Panel

1. Slide the front panel assembly on to the front of the chassis, making sure that the round protrusions in the left and right alignment tabs of the chassis fall into the lower tab holes on the front panel assembly.
2. Install the two screws of either side of the assembly, as well as the three screws on the bottom of the assembly.
3. Reconnect cable assemblies:
   a. Display cable from P23 on main PCBA to P1 on display PCBA on front panel assembly
   b. Barcode/RFID module cable from assembly on front panel to P26 on main PCBA
   c. LigaSure cable to P1 on main PCBA
   d. Insert detect cable to P26 on main PCBA
4. Place the top cover onto the chassis and secure with 4 screws.
5. See the section Replacement Parts on page 6-2 for the Service Level required after replacement of this assembly.

PCBA Display Replacement

1. Remove the front panel assembly.
2. Remove the flex cable at J1 connector.
3. Remove the 7 screws that secure the display PCBA to the front panel.
4. Lift the Display PCBA away from the front panel assembly.
5. Place the replacement display PCBA on the front panel assembly, making sure the power button on the replacement display PCBA is inserted into the spring of the power button on the front panel without interference.
6. Secure the replacement display PCBA to the front panel assembly using the 7 screws and a torque screwdriver set to 0.7Nm+/-10%.
7. Secure the flex cable into the J1 connector.
8. Re-install the front panel assembly.

ASSY RFID/Barcode Module Replacement

1. Remove the front panel assembly.
2. Remove the three screws that secure the module to the front panel assembly.
3. Lift the RFID/Barcode module away from the assembly.
4. Install the replacement RFID/Barcode module in place of the removed RFID/Barcode module. Secure using the 3 previously removed screws and the Phillips screwdriver set to 0.7Nm+/-10%.

5. Reinstall the front panel assembly.

ASSY Receptacle LigaSure Replacement

1. Remove the front panel assembly.
2. Remove the three screws that secure the RFID/Barcode module to the front panel assembly.
3. Lift the RFID/Barcode module and LigaSure Receptacle away from the front panel assembly.
4. Locate the replacement LigaSure receptacle in place of the removed one.
5. Locate the RFID/Barcode module on top of the LigaSure Receptacle aligning the three screw holes.
6. Secure the RFID/Barcode module and LigaSure receptacle to the front panel assembly using the 3 previously removed screws and the Phillips screwdriver set to 0.7Nm+/-10%.
7. Reinstall the front panel assembly.

ASSY Cable to Power Supply to Main PCBA Replacement

1. Remove the front panel assembly.
2. Using the screwdriver, loosen the two screws securing the power supply cable to the power supply and disconnect the cable from the power supply.
3. Remove the other end of the cable from P30 on the main PCBA.
4. Insert the replacement power supply cable to the 2 screws on the power supply, making sure that the red wire is seated behind the top screw. Secure using the Phillips screwdriver set to 1.0Nm+/-10%.
5. Secure the other end of the cable to P30 on the main PCBA.
6. Reinstall the front panel assembly.

Control Cable Main PCBA to Power Supply Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the power supply control cable from the power supply at J3.
4. Disconnect the power supply control cable from the main PCBA at P31.
5. Connect the replacement power supply control cable to the locations listed in the above 3 steps.

6. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Fuse 250 VAC 8A RoHS Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle and allow several minutes for any voltages to discharge.
2. Place the screwdriver blade just behind the inside upper lip of the power entry connector and push the driver shaft against the bottom chassis to remove the fuses and fuse holder portion of the power entry assembly.
3. Replace both fuses with 250 VAC, 8A fuses.
4. Push the fuse holder back into the power entry assembly until it is flush with the assembly.

Battery - Lithium COIN 3V 16 mm Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle and allow several minutes for any voltages to discharge.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Place the small screwdriver blade or dental pick tool under the battery at the cutout slot of the battery receptacle housing (aligned with top battery retaining tab). While prying the battery up using the screwdriver or pick, slide battery out of the retainer using your thumbnail.
4. Using only an approved battery and observing the + polarity is facing up, insert the replacement battery into the receptacle housing.
5. Dock to Valleylab Exchange to set the Real Time clock.
6. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Rubber Foot for Chassis Replacement

1. Remove the rubber feet using the screwdriver.
2. Install thread sealant on to the screws of the replacement rubber feet.
3. Using the screwdriver, install the replacement rubber feet to the bottom chassis. Tighten to 0.3Nm ±10%.

USB Cover Replacement

1. To access the ECG blanking connector, open the latch door on the USB cover.
2. To access the USB connector, remove the 2 screws and remove the cover.

3. To replace the USB cover, remove the 2 screws and remove the USB cover.
4. Place the new cover over the cutout, making certain that the 2 screws holes line up with the holes in the chassis.
5. Reinstall the 2 screws.

Power Cord Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle and allow several minutes for any voltages to discharge.
2. Remove the power cord from the power entry receptacle.
3. Locate the replacement power cord and insert it into the power entry receptacle.

Power Entry with Cable Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Using the screwdriver, remove the Power Entry with cable wires from the power supply. View looking forward from the back panel, left to right, red, blue, and green.
4. Using the ratchet and 10 mm socket, remove the nut and lock washer holding the green ground wire to the lug of the rear panel.
5. Using the screwdriver, remove the 2 screws holding the Power Entry with cable to the rear panel and remove the power entry cable from the back panel.
6. Insert the replacement Power Entry with cable through the back panel cutout. Secure the Power Entry with cable to the back panel using the screwdriver and the 2 screws previously removed.
7. Using the screwdriver, secure the Power Entry with cable wires to the power supply at TB1. View looking forward from the back panel, left to right, red, blue, and green. Tighten to 1.0Nm ±10%.
8. Using the ratchet and 10 mm socket attach the green ground wire to the back panel lug with the nut and lock washer.
9. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Power Supply Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the power supply cable from P30 on the main PCBA.

4. Disconnect the power supply control cable from J3 on the power supply.
5. Using the screwdriver, remove the Power Entry with cable wires from the power supply. View looking forward from the back panel, left to right, red, blue, and green.
6. Remove the 4 screws holding the power supply to the chassis and lift the module out of the chassis.
7. Remove the 6 screws holding the chassis mounting bracket to the power supply and remove the bracket.
8. using the screwdriver, loosen the 2 screws securing the power supply cable to the power supply and remove the cable.
9. Obtain the replacement power supply and attach the chassis mounting bracket using the six screws from step 7. Tighten to 0.7Nm ±10%.
10. Insert the replacement power supply cable to the 2 screws on the power supply making certain that the red wire is seated behind the top screw. Secure using the Phillips torque screwdriver set to 1.0Nm ±10%.
11. Install the power supply into the chassis using the 4 screws removed in step 6.
12. Using the screwdriver, secure the Power Entry with cable wires to the power supply. View looking forward from the back panel, left to right, red, blue, and green.Tighten to 1.0Nm ±10%.
13. Connect the power supply control cable from the main PCBA P31 to the power supply at J3.
14. Connect the power supply cable from the power supply to P30 on the main PCBA.
15. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Volume Control Cable Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the volume control cable from the main PCBA at P28.
4. Using the 12 mm wrench, remove the nut and washer securing the cable to the back panel and remove the cable.
5. Get the replacement volume control cable and disassemble the nut and washer from the cable.
6. Insert the cable into the cutout in the back panel.
7. Making sure that the white wire is facing up, put the washer and nut over the threaded stud and tighten with the wrench.
8. Insert the connector into P28 on the main PCBA.

9. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Footswitch Cable Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the cable at the main PCBA at P34.
4. Using the screwdriver, remove the 4 screws securing the cable to the back panel and remove the cable.
5. Insert the replacement cable into the back panel ensuring that the white dot on the circular connector is facing the power entry with cable.
6. Secure the cable to the rear panel using the Phillips torque screwdriver and the 4 screws tightened to 0.7Nm ±0%.
7. Connect the cable to P34 on the main PCBA.
8. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

PCBA PROG MAIN Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Remove all cable connections to the main PCBA.
4. Remove the 6 screws securing the main PCBA to the chassis.
5. Lift the main PCBA out of the chassis and insert the replacement main PCBA in its place.
6. Replace and tighten the 6 screws.
7. Insert all cable connections to the main PCBA.
8. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Fan with Cable Replacement

1. Remove the assembly back panel.
2. Using the screwdriver, remove the 4 screws securing the fan to the rear panel and lift the fan away from the rear panel.

3. Get the replacement fan and orient it in the same position as the original fan, ensuring that the 2 air flow direction arrows on the side of the fan point down and out and that the cable is oriented to the upper left as viewed from the front panel looking towards the rear panel.
4. Secure the fan to the rear panel using the torque screwdriver and the 4 screws previously removed.
5. Tighten the screws to 1.0Nm ±10%.
6. Reinstall the assembly back panel.

Speaker Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the speaker cable at P27 on the main PCBA.
4. Remove the 4 screws securing the speaker to the chassis. Retain the screws and any other mounting hardware for reinstallation.
5. Lift the speaker away from the chassis.
6. Obtain the replacement speaker and using the 4 screws and any other mounting hardware removed in step 4, install in the same location as the original speaker, ensuring that the speaker wire connections are oriented towards the power supply module.
7. Tighten the screws to 0.3Nm ±10%.
8. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Display Board Cable Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the display board cable from the display board at P1.
4. Remove the display board cable from the main PCBA at P23.
5. Install the replacement display board cable by connecting it in the 2 locations listed in steps 3 and 4 above.
6. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Assembly Back Panel Replacement

1. Turn the system off. Disconnect the power cord from the wall receptacle.
2. Remove the 4 screws that secure the top cover to the chassis. Lift the cover off the chassis. Set the cover and screws aside for reinstallation.
3. Disconnect the following cables from the main PCBA: P21, P28, P27, and P34.
4. Using the screwdriver, remove the power entry with cable wires from TB1 of the power supply module.
5. Remove the 2 screws, lower left and lower right, that secure the back panel to the chassis and remove the assembly from the chassis.
6. Set the replacement back panel assembly in the same location and orientation as the removed panel and secure to the chassis using the 2 screws from step 5. Tighten to 0.7Nm ±10%.
7. Using the screwdriver, secure the power entry with cable wires to TB1 of the power supply. View looking forward from the back panel, left to right, red, blue, and green.Tighten to 1.0Nm ±0%.
8. Connect the cables that were disconnected in step 3.
9. Replace the top cover onto the chassis and secure with the 4 screws removed in step 2.

Chapter 7

Maintenance and Repair

This chapter presents the following information:

- The manufacturer's responsibility
- Routine maintenance
- Returning the system for service
- Service centers

Precaution
Read all warnings, precautions, 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 system only if all of the following conditions have been met:

- Installation and set-up procedures in this manual are followed.
- Assembly, operation, readjustments, modifications, or repairs are carried out by qualified personnel only.
- 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 and Periodic Safety Checks

When should the system be checked or serviced?

Covidien recommends that at least once a year, qualified service personnel inspect the system and conduct periodic safety checks (see page 3-4). This inspection should include adjusting the system to factory specifications.

When should the power cord be checked or replaced?

Check the power cord before each use of the system or at the intervals recommended by your institution. Check the power cord for exposed wires, cracks, frayed edges, or a damaged connector. Replace damaged cords.

When should the fuses be replaced?

An internal component malfunction can damage the fuses. The system fuses may need to be replaced if the system fails the self-test or if the system stops functioning, even though it is receiving power from a wall outlet. Refer to *Fuse 250 VAC 8A RoHS Replacement* on page 6-6 for instructions.

Cleaning

Warning

Electric Shock Hazard Always turn off and unplug the system before cleaning.

Notice

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

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

Product Service

Covidien recommends that all Valleylab generators be returned to the manufacturer for all service requirements. If any service is required without returning the system to the manufacturer, Covidien recommends that only qualified personnel service the generators.

Covidien defines qualified personnel as a person with electrosurgical equipment repair experience, such as biomedical personnel, and/or individuals who have taken official Covidien training courses.

Returning the System for Service

Before returning the system, call a Covidien sales representative for assistance. If instructed to send the system to Covidien, do the following:

1. Obtain a return authorization number.

   Call the Covidien Technical Service (see page 7-4) to obtain a Return Authorization Number. Have the following information ready before the call:

   – Hospital/clinic name/customer number
   – 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 system.
   See the *Cleaning* on page 7-3.

3. Ship the system.
   a. Attach a tag to the system that includes the return authorization number and the information (hospital, phone number, etc.) listed in step 1.
   b. Be sure the system is completely dry before packing it for shipment. Package it in its original shipping container, if available.
   c. Ship the system, prepaid, to the Covidien Service Center.

Adjustment to Factory Specification (Calibration)

Covidien recommends that only qualified personnel calibrate the system. The system incorporates automatic calibration where possible to reduce the required equipment and manual steps.

Software Updates

Software updates are available directly from Covidien by using the Valleylab Exchange Remote Software System application. Go to www.covidien.com/valleylabexchange to download and install the latest version of the Valleylab Exchange application. For additional information, the *Valleylab Exchange Remote Software System User's Guide* is available on the Valleylab Exchange website.

Covidien Technical Service

For service, contact Covidien Technical Service or your Covidien 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: 1-303-476-7996
- Email: valleylab.technicalservice@covidien.com
- Internet: http://surgical.covidien.com/service-centers

Chapter 8

Service Parts

Replacement parts for the Valleylab LS10 Generator are listed in this chapter. All components must be replaced with parts of identical construction and value acquired from Covidien Customer Service Centers. Covidien does not recommend nor supply components for field replacement of surface-mount components. Only PCBA level changes should occur in the field.

Ordering Replacement Parts

Parts may be ordered from the Covidien Customer Service for your location.

When ordering replacement parts, include this information:

- Model number (located on the rear panel of the system)
- Serial number (located on the rear panel of the system)
- Part description (PCBA PROG MAIN, fan with cable)
- System configuration (dock generator to Valleylab Exchange Remote Software System)

  Use the system menus to identify the system configuration. See *Instrument Information* on page 3-19.

  – Software Build Part Number
  – Main PCBA HW Revision
  – Main PCBA HW Part Number
  – Main PCBA HW Serial Number
  – VIBE HW Part Number
  – VIBE HW Revision
  – VIBE HW Serial Number

If the information cannot be obtained, contact Covidien Technical Service (see page 7-4).

Replacement Components

Refer to Chapter 6, *Replacement Procedures* for step-by-step instructions for the removal of the referenced components.

Precaution

Take proper ESD precautions when handling and replacing components. Irreversible damage may occur due to static transfer if the component is handled improperly.

The following printed circuit board assemblies (PCBA) can be replaced:

- PCBA Display
- PCBA PROG MAIN

The following system components can be replaced:

- Front Panel Assembly
- Assy RFID/Barcode VIBE
- Power Supply
- Assy Receptacle LigaSure
- Speaker Assy

- Fan with Cable
- Power Entry with Cable
- Assy Back Panel

Replacing Cable Assemblies

The complete wiring schematic is at the beginning of Chapter 4, *Principles of Operation*. Refer to the schematic for location of the cable assemblies.

1 Display Board Cable
2 Assy Cable Power Supply to Main PCBA
3 Control Cable Main BD to PS
4 Volume Control Cable
5 Footswitch Cable

Rx ONLY

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