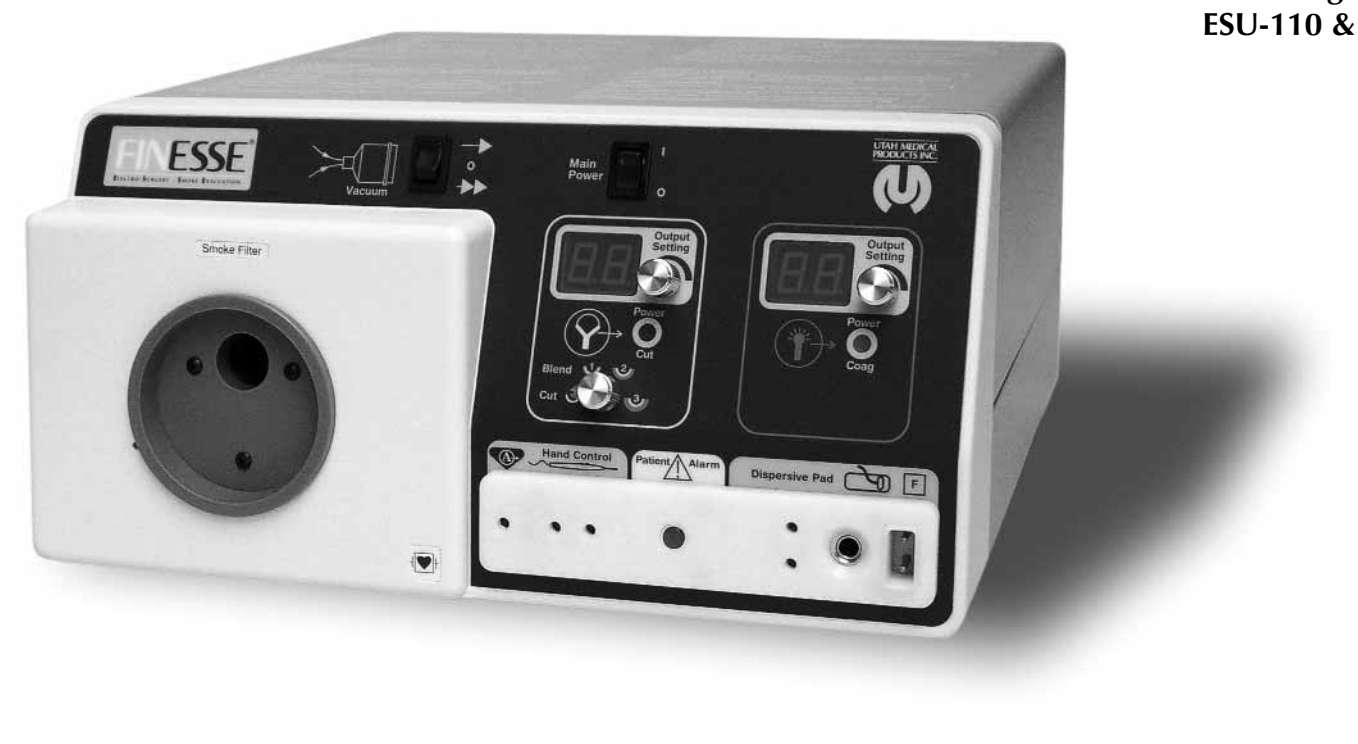
FINESSE®

Electrosurgical Generator and Smoke Evacuation System Service Manual

Catalog Numbers
ESU-110 & ESU-220



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The Finesse® Electrosurgical Generator and Smoke Evacuation System is patented under U.S. patent number 5,160,334.

The information contained in this manual was correct at press time. However, unscheduled changes may have taken place that may render portions of this manual inaccurate. Please contact Utah Medical Products, Inc. for updated information if errors or changes in the contents of this manual are suspected.

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INSTALLATION

Initial Setup

Unpack the Finesse® unit from its packing material. Retain the packing material and box for future use.

Inspect the unit for any visible damage or missing accessories. If damage is found, contact your Utah Medical Products' representative for replacement parts.

The unit should be placed on a flat, level surface at working height within six feet of the operating area.

Connect the footswitch (if used).

Plug the Finesse® unit into an appropriately rated wall outlet.

Functional Checkout

1. Install handswitch pencil into the three-point connector on front panel. If a non-switching "footswitch" pencil is used, install this pencil into the port marked with the "active port" icon on the front panel.

2. Toggle the main power switch to the "on" position. Three things should happen:

   - the green lamp in the power switch should light,
   - the red alarm lamp on the front panel should light, and
   - an interrupted alarm tone should sound.

3. If the three indicators listed in step 2 above do not occur, check to verify that:

   - the power cord is securely plugged in on both ends,
   - the three fuses on the rear panel of the unit are installed,
   - these fuses are not blown, and the room outlet is active.

4. Connect a dispersive pad with a single contact surface to the dispersive pad receptacle on the front panel. The red alarm lamp should go out and beeping should cease.

5. Briefly operate the cut control on the handswitch. The yellow "cut" lamp should light, a tone should be emitted from the internal speaker, and the vacuum pump should come on and stay on approximately five seconds after the cut control button is released. If none of this occurs try another handswitch. If the vacuum motor does not come on, check the position of the vacuum control switch and the 3-amp fuse on the back panel.

6. Repeat step 5 above with the coag switch rather than the cut switch. All operation should be the same except that the blue "coag" lamp illuminates rather than the yellow "cut" lamp.

7. Repeat steps 5 and 6 above using the cut and coag pedals of the foot switch. All indications should be the same as they were using the hand switch.

If any of the above items do not check good, please contact Utah Medical Products Customer Service for assistance.

Maintenance

Daily Maintenance

At the end of any day that the Finesse® unit is used, the primary filter, catalog number ESU-501, should be changed. Using a gloved hand, remove the filter from the front panel by gently pulling and twisting the filter housing. Discard the filter pack with other medical disposables.

Cleaning

The Finesse® system exterior may be wiped clean with alcohol or household spray cleaner applied to a cloth. Do not use acetone. Do not apply cleaning agent directly to the unit.

The loop and ball electrodes, pens, dispersive pads, and speculum

tubing/ reducer are supplied as single patient use items. Cleaning and/or resterilization of these items should not be attempted.

Annual Maintenance

The primary internal filter, catalog number ESU-700, should be changed on an annual basis.

To change the internal filter:

Remove the three button head screws running along the top edge of the rear panel of the Finesse® unit, using a 5/64" hex key. Gently pull the top cover up and away from the front housing.

Release the front filter adapter from the front housing by removing the three externally visible button head screws with a 5/64" hex key. Gently pull the adapter away from the front panel. With a gloved hand, remove the used primary internal filter by pulling it away from the vacuum motor inlet. Note the original positioning of the filter. Dispose of the used filter as you would dispose other medical disposables.

Insert the new filter onto the vacuum motor inlet in the same orientation as the previous filter. Replace the front filter adapter onto the front housing, taking care to verify that the primary internal filter inlet seats properly into the front filter adapter. Secure the front filter adapter to the front panel by replacing the three button head screws.

Replace the top cover onto the chassis by inserting the lip on the front of the cover into its locator slot in the front housing and then drop the rear of the top cover into place. Align the three screw holes and replace the three button head screws.

For the care and performance of your Finesse® electrosurgical unit, the Emergency Care Research Institute (ECRI) recommends the establishment of a program for inspection and preventive maintenance. ECRI Procedure/Checklist 411 recommends that minor inspections should be performed every six months and major inspections should be done on an annual basis.

Information on the ECRI Procedure/Checklist can be obtained by calling ECRI at (610) 825-6000 or visiting www.ecri.org.

Device Description

The Finesse® unit consists of two major modules, the electrosurgical generator and the smoke evacuation system. A single power switch controls both modules; the smoke evacuation system is automatically switched on and off relative to footswitch or handswitch activation of the electrosurgical generator.

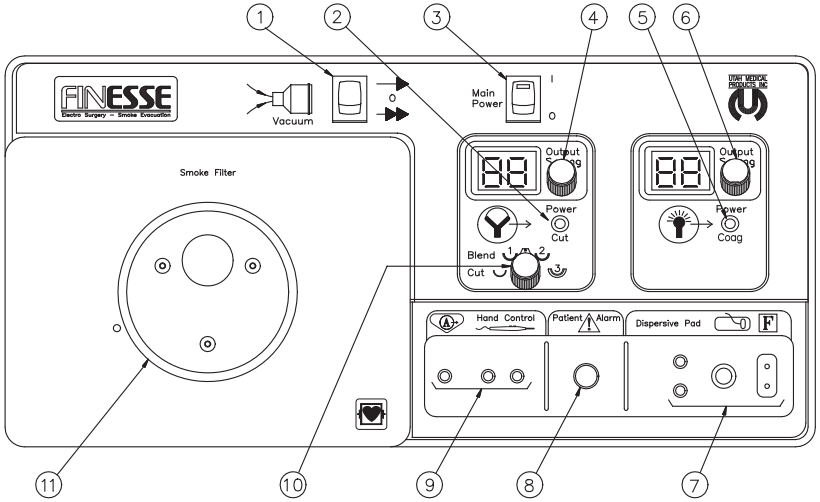


Figure 1. Finesse® front panel connectors and indicators

Front Panel Indicators and Connectors

Connectors and indicators on the Finesse® front panel are shown in *Figure 1* and subsequently described.

1. **Vacuum Level Switch.** This three-position rocker switch controls the smoke evacuation system flow rate.

The upper, or "normal" position runs the vacuum motor at a level that is sufficient to draw the smoke plume away from the surgical site during the LETZ® procedure.

The lower or "high" position of the switch runs the vacuum motor at a higher speed, creating a flow rate approximately 40% greater than the normal setting with the same tubing configuration. This setting should be used whenever the distal smoke removal tube has a very small diameter, or in any other circumstance where the smoke is not being completely removed.

The smoke evacuation system motor can be disabled by setting this switch to the center "off" position (designated by "0").

The vacuum system does not have an activation switch of its own. It is turned on automatically by internal circuitry whenever the cut/blend or coag modes are activated, and shuts off after a delay of five seconds from the time the electrosurgical generator output is deactivated. In addition to its convenience, this intermittent operation is beneficial to the life of the filters and to the vacuum motor itself.

2. **Cut/Blend Indicator Lamp.** This yellow lamp is illuminated whenever cutting or blend voltages are applied to the active lead. Illumination of this lamp is accompanied by an audio tone having a pitch lower than the tone heard during a fault in the dispersive electrode monitoring circuit or during operation in the coag mode.

3. **Main Power (on/off) switch.** This switch must be turned on to enable all functions of the instrument. A green light internal to the switch illuminates when the unit is powered on.

4. **Cut/Blend Output Control Knob and Indicator.** This knob is used to specify the output level desired for the intended cut. The adjacent digital readout indicates the output setting.

Due to line voltage and thermal variations, it is normal for the number displayed on the digital indicator to vary by one or two digits while the control knob is stationary. While this variation truly reflects the relative output setting, it is of no clinical significance and will not affect cutting quality.

The cut mode display can be continuously adjusted between "05" and "99". In general, higher output levels are required for thicker or wider loop electrodes or for deeper submersion of

the cutting electrodes in the tissue. These principles are discussed in the "Principles of Electrosurgery" section of the *Finesse® Operator's Manual*.

As mentioned in the safety warnings of the operator's manual, this knob should not be turned up to correct an apparent power output deficiency without first verifying that all connections are in good order and the patient dispersive electrode is still properly applied.

5. **Coag Indicator Lamp.** This blue lamp is illuminated whenever coag voltage is applied to the active lead. Illumination of this lamp is accompanied by an audio tone having a pitch lower than the tone heard during a fault in the dispersive electrode monitoring circuit but has a pitch higher than the tone heard during operation in the cut mode.

6. **Coag Output Control Knob and Indicator.** This knob is used to specify the output level desired for the intended coag operation. The adjacent digital readout indicates the output setting.

   Due to line voltage and thermal variations, it is normal for the number displayed on the digital indicator to vary by one or two digits while the control knob is stationary. While this variation truly reflects the relative output setting, it is of no clinical significance and will not affect coagulation quality.

   The coag mode display can be continuously adjusted between "05" and "75". Smaller or finer electrodes require a lower setting and larger electrodes will require a higher setting. Lower settings on this knob may be used for desiccation coagulation.

   The principles of coagulation by desiccation and fulguration are explored in the "Principles of Electrosurgery" section of the *Finesse® Operator's Manual*.

7. **Patient Dispersive Electrode Receptacles.** Three sets of dispersive pad receptacles are provided to accommodate the dispersive pad cable configurations that are commonly available.

   The left-most socket pair is provided to take two redundant leads out to a dispersive electrode. If either of these leads has broken continuity, or if either lead is omitted, the red patient alarm warning lamp in the center of the terminal block illuminates and current from the generator is automatically shut off.

   The center dispersive pad connector is a phone plug that accommodates the phone plugs provided with many of the available pads. Redundant leads are used, and the continuity sensing circuit warns of a compromised dispersive electrode connection.

   The right-most rectangular socket is compatible with most of the remainder of the available pads. Like the other two receptacles, it accommodates dual-conductor cables.

8. **Patient Alarm Indicator Lamp.** This red lamp is illuminated whenever the generator is disabled due to one of the following conditions:

   1) Incomplete redundant dispersive electrode connections (accompanied by intermittent high-pitched alarm tone);
   2) Simultaneous activation of both cut and coag modes ("cross-key") (accompanied by continuous high-pitched alarm tone); or
   3) Activation of the output safety circuit (accompanied by a continuous high pitched audio tone).

   The output safety circuit continuously monitors the output of the generator and will disable the system when an unexpected discrepancy between the displayed output setting and the output power is detected. The main power switch must be toggled off to clear this condition.

9. **Monopolar Handswitch Receptacle.** This connector consists of three banana sockets which accommodate most of the reusable and disposable hand-switching electrosurgical pens that are available.

   The left-most of the three sockets, marked with the "active port" icon, accommodates a non-switching pen for monopolar

cutting loops, balls, and other surgical tools. When these pens are used, the electrosurgical current must be activated by a footswitch connected to the footswitch connector on the rear panel of the unit.

10. Mode Select Switch. This switch allows the selection of the appropriate mix of cut and coagulation activity for the performed procedure.

In the cut mode, a continuous sinusoid voltage is applied to the surgical tool in use. If the loop wire diameter is small enough, it will cut through tissue very cleanly with very little surface heating that would stop bleeding.

In the blend modes, the same loop electrode will cut cleanly through the tissue while the surface of the cut is heated to accomplish a degree of coagulation. "Blend 1" produces slight coagulation, whereas "Blend 2" and "Blend 3" produce successively higher degrees of coagulation.

In switching between these modes the total output delivered to the surgical tool is maintained at a constant setting as set by the output control knob above the switch. Further information useful in selecting blend modes is given in the “Principles of Electrosurgery” section of the *Finesse® Operator's Manual* and the “Technical Data” section of this manual.

11. Smoke Filter Connection. This connection, the large circular structure on the face of the front panel, accepts the external disposable filter pack which provides first- and second-stage particulate removal and odor adsorption.

Rear Panel Controls and Connectors

Controls and connectors on the Finesse® rear panel are shown in *Figure 2* and are described below.

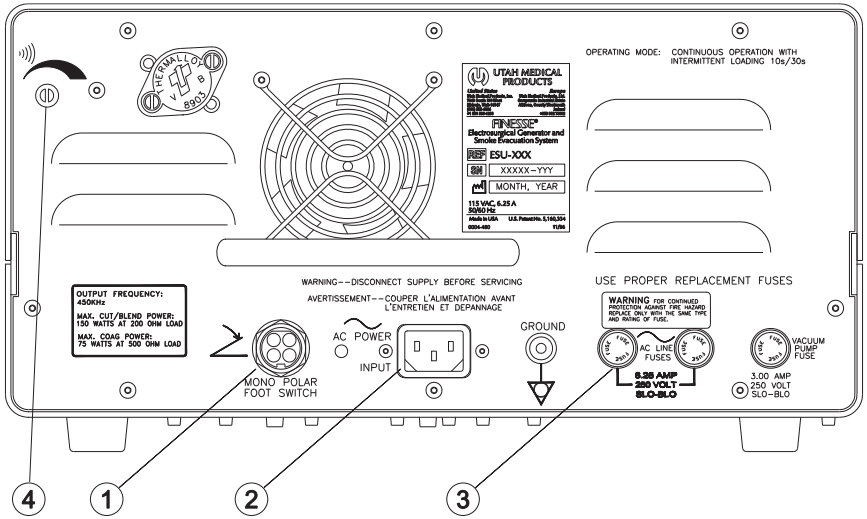


Figure 2. Finesse® rear panel connectors

1. **Footswitch Connector.** This connector accommodates two-pedal footswitches designed to separately control cut and coag modes.

2. **AC Power Cord Connector.** This connector is a three-contact connector for use with high quality three wire power cords.

3. **Fuse Sockets.** These three sockets house the fuses that provide overcurrent protection for the Finesse® unit. They are labeled with the appropriate fuse specifications for these circuits. Use only the correct fuses as specified by these labels.

4. **Audible Tone Volume Control.** This control adjusts the volume of the cut and coag mode activation tones. Due to international regulatory requirements, alarm tones are not affected by this control, and are not adjustable.

SPECIFICATIONS

General Specifications

Dimensions:	14.0" (35.6 cm) W x 14.2" (36.1 cm) D x 7.1" (18.0 cm) H
Weight:	22 lbs. (10.0 kg)
IEC Classification:	Class I, Type CF
EU Directive:	Compliant with 93/42/EEC (Medical Device Directive) *(ESU-220 only)*
Mode of Operation:	Continuous operation with intermittent loading (10s/30s)

Supply Voltage & Current Specifications

The Finesse® unit can be obtained in either a 115 VAC (catalog no. ESU-110) or 230 VAC (catalog no. ESU-220) configuration.

Supply Voltages (voltages are AC rms)

Nominal Voltage:	115 volts	230 volts
Regulated Range:	100-130 volts	200-260 volts
Operating Range:	90-140 volts	180-280 volts
Frequency:	45-65 Hz	45-65 Hz

Output Power vs. Supply Voltage

Within the Regulated Range listed above, the output power into a 500Ω load remains within ±15% of the power delivered at the center of this range in cut and blend modes and ±30% in coagulation mode.

Maximum Supply Current and Power (total)

	115 V model	230 V model
Idle State:	0.5 A, 60 W	0.3 A, 70 W
Cut Mode:	6 A, 690 W	4.5 A, 1035 W
Coag Mode:	6 A, 690 W	4.5 A, 1035 W

Overcurrent Protection

The Finesse® 115 V model is protected by a 6.25 amp slo-blo fuse in each lead to the primary winding of the main power transformer.

The Finesse® 230 V model is protected by a 4 amp slo-blo fuse in each lead to the primary winding of the main power transformer.

Output Characteristics

Output Frequencies

The frequency of the interrupted waveforms is 450 kHz ± 50 kHz. Interrupted patterns for blend and coagulation modes repeat at 28 kHz ± 3 kHz.

Output Values at Maximum Settings

Mode	Setting[a]	Duty Cycle[b]	Max Voltage[d]
Cut	99	100%	1000
Blend 1	99	62.5%	1925
Blend 2	99	50%	2050
Blend 3	99	37.5%	2200
Coag	75	[c]	3500

a Output Setting specified is power in watts, plus or minus 15%, delivered into a 500Ω patient load.

b Duty Cycle is ratio of burst duration to burst-plus-rest duration.

c Coag pulse consists of two high voltage cycles followed by lower amplitude ringout for about 10 µsec, repeated at 28 kHz.

d Maximum voltage is peak-to-peak, open circuit. Lower values are permitted.

Floating Patient Leads

The dispersive and active leads are RF isolated as defined by ANSI/AAMI standard HF-18/1993.

Output Power vs. Load

Output display is calibrated to be relative power in watts at a load of 500Ω.

The negative-feedback output stage limits the output voltage under high resistance loads. The same feedback circuit attempts to maintain the output voltage under low resistance loads so that the cutting characteristics are quite uniform throughout the entire cut. See *Figure 3* and *Figure 4* for output power vs. load data for cut, blend and coag modes. Cut mode maximum output power is 150 watts at 200Ω patient load.

Output Power vs. Displayed Setting

The output of the Finesse® unit increases linearly with adjustment of the front panel output settings. *Figure 5* and *Figure 6* show the typical output power of each of the five modes over the full control range. Both curves shown indicate output at 500Ω load resistance.

Output Safety Circuit Specifications

The Finesse® system is equipped with a safety circuit that monitors the output signal levels and disables all unit functions when the output exceeds the expected "nominal" output. The alarm system can only be reset by turning off the main power switch.

The output safety alarm system will activate if the output voltage exceeds 180 volts rms or exceeds the nominal output voltage by 50%, whichever is greater.

Audible Tone/Alarm System

Volume:	65 dBA min @ 1m (3.3 ft)	
Frequency:	Cut	0.8 kHz nominal
	Coag	1.5 kHz nominal
	Alarm	3.0 kHz nominal

Smoke Evacuator System

Supply Voltages (all voltages are AC rms)

Nominal Voltage:	115 volts	230 volts
Operating Range:	90-140 volts	180-280 volts
Frequency:	45-65 Hz	45-65 Hz

Maximum Supply Current and Power

At the Nominal Voltage, the maximum supply current is 2 amps. Maximum supply power for the ESU-110 is 230 watts and for the ESU-220 is 460 watts.

Overcurrent Protection

The smoke evacuation motor is protected by a 3 amp fuse in the hot lead.

Air Flow vs. Supply Voltage

At a supply voltage within the Regulated Range, the air flow through a new disposable filter coupled to a 15 cm long 7 mm ID tube is not less than 100 liters per minute (3.5 cubic feet per minute) at the "high" setting and not less than 70 liters per minute (2.5 cfm) at the "normal" setting.

Smoke Evacuation Duration

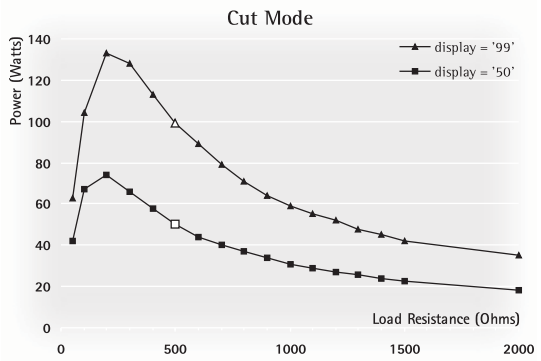
The smoke evacuation system will begin running immediately on activation of the electrosurgery module and remain running five seconds after the output power is deactivated.

Disposable Filter Cartridge

The Finesse® Filter Pack, catalog number ESU-501, consists of a pleated HEPA paper filter followed by a compartment containing activated charcoal.

Filter Life

The Finesse® Filter Pack, to ensure total elimination of odors between procedures, should be replaced on a daily basis. However, the three-stage filtration system has been tested to effectively remove odors and particles for up to 15 electrosurgical procedures. Over a period of time the external disposable filter pack can be a source of odor and possible viral contamination. Therefore, it is recommended that the external filter pack be changed every day or after 15 procedures if more than 15 procedures are performed in a single day.



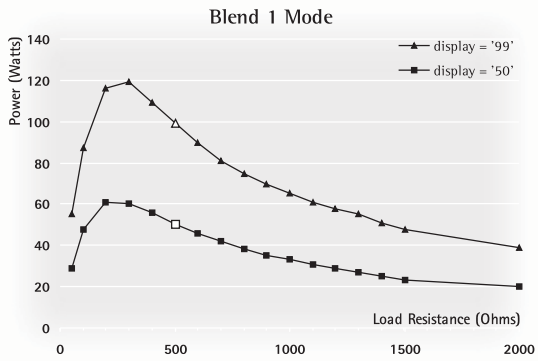
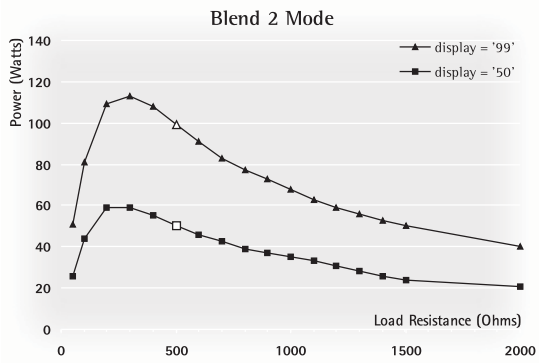
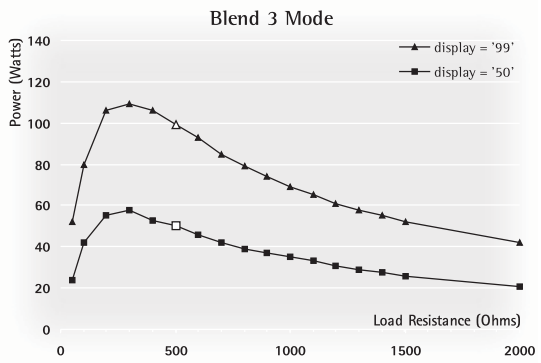


Figure 3. Typical output power vs. load resistance for cut and blend modes





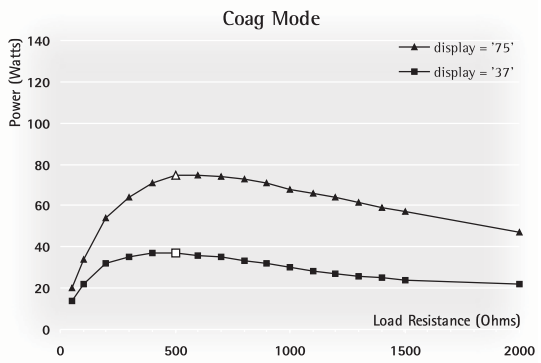


Figure 4. Typical output power vs. load resistance for coag mode

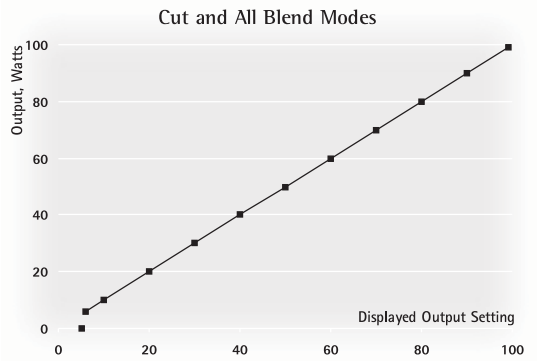


Figure 5. Typical output power vs. output setting for cut and blend modes

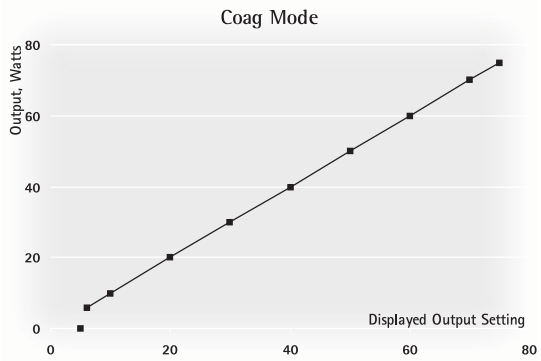


Figure 6. Typical output power vs. output setting for coag mode

Third-Stage Internal Filter

The Finesse® Internal Filter, catalog number ESU-700, is a pleated ULPA filter element.

Filter Life

Annual replacement is recommended.

Combined Filter System

Particle Removal Efficiency

In laboratory tests, spherical particles with a mean diameter of 0.1 microns were removed with a minimum efficiency of 99.999%.

Circuit Descriptions

Note: Schematics for the Finesse® generator will be made available on request to qualified technical personnel.

Power Supply

The power supply for all electronic functions is derived from the input line supply through a multi-winding transformer mounted on the floor of the unit. Circuits are conventional, non-switching supplies using bridge rectifiers, electrolytic filter capacitors, and series regulators. Except for the line connections, transformer, and fuses, all DC power supply components are mounted on the power supply board (see functional diagram on page 28 and assembly diagram on page 24).

The 200 volt supply furnishes power to the preamplifier and final output stages. This supply is not actively regulated; however the volt-amp capacity of the transformer itself is sufficient to maintain sufficient voltage under load to provide the set cutting or coag output, and the preamplifier and output stages are feedback regulated at the RF level so that the variation in cutting output over a large change in supply line voltage is small.

The 30 volt regulated DC supply begins with a 28 volt rms secondary winding on the main power transformer winding. A bridge rectifier with a capacitor input filter converts this to approximately 40 volts DC for use by both the 30 volt and 15 volt regulators. The 30 volt regulator is a three terminal linear regulator.

The 15 volt regulated DC supply for powering the CMOS logic chips also uses the 40 volt bridge with a three terminal linear regulator. A resistor between the regulator and the 40 volt unregulated supply protects it from excessive current in the event of a shorted component.

The five volt regulated supply furnishes power to the LED display devices on the display board. A 5 volt regulator chip is fed from a separate winding on the main power transformer.

Output Level Control and Display

The cut/blend and coag modes of operation are separately controlled with parallel circuitry. However, only the operation of the cut/blend control circuit will be described.

The desired output for cutting is set by turning the cut/blend output control knob on the front panel until the digital output indicator displays the correct value. Voltage from the front panel potentiometer is routed to the A-D input on the digital display board. R3 in this path is provided to set the display to read "99" at the fully clockwise setting of the front panel knob.

The A-D converter converts the adjusted voltage at this point to a digital value which can be manipulated by the main display processor. A linearization curve is programmed in the processor for each of the cut and three blend modes so that the proper output control level is presented digitally to the D-A converter at any setting from the front panel.

The D-A converter translates the output of the processor to an analog voltage which, after some additional scaling, will act as drive to the power generation circuits. Two potentiometers on the logic board allow for offset and gain adjustment of this voltage. A summing amplifier at the output of the D-A converter provides a means for amplifying, attenuating, or offsetting the control voltage and, also, provides a mixing point for subtraction of the voltage signal fed back from the generator output.

The adjusted output voltage, mixed with the feedback signal, is routed to individual variable-gain buffer amplifiers that are provided for setting the drive levels of each mode in final calibration. The outputs of these power level control amplifiers are connected to a bank of transistor switches which act to select the proper voltage for each selected mode of operation and present it to the DC-AC converter. These transistor switches are logically controlled by signals from the mode switch on the front panel and by the cut/blend and coag activation signals from the power board.

The DC-AC converter is a FET chopper whose drain voltage is the conditioned output control DC voltage and whose gate is driven

from the high frequency waveform generator. This converter is transformer coupled to the base of the output preamplifier which, in turn, drives the final output stage.

Waveform Generation

Each of the cut, blend, and coag modes are distinguished from each other by the voltage waveforms delivered to the output terminals. All of these waveforms are originally derived from a 450 kHz square wave oscillator on the logic board. In the pure cut mode, the unmodified 450 kHz square wave is applied to the gate of the chopper FET in the DC-AC converter. In the blend modes and in the coag mode, the continuous square wave is interrupted for various durations. Blend 1 removes 6 cycles of every 16 for a duty cycle of 62.5 percent. Blend 2 removes 8 cycles of 16 for a duty cycle of 50 percent. Blend 3 removes 10 of 16 for a duty cycle of 37.5 percent, and the coag mode removes 15 of 16 for a duty cycle of 6.25 percent.

Cycle removal for these functions is accomplished using a ripple counter, an array of gates, and a D-type flip flop. The 450 kHz oscillator is disabled unless either the cut/blend switching circuit or the coag switching circuit is active.

RF Power Amplification

After the variable-amplitude, output-control voltage is converted to AC by the DC-AC converter, the resultant RF signal is transformer coupled to the input of the preamplifier and amplified in two stages to the level necessary for performing electrosurgery. The preamplifier consists of a bipolar power transistor with collector-to-base local feedback and a transformer coupled to the final output stage. With the exception of the power transistor itself, which is mounted on the back panel heat sink, all components of the preamplifier are mounted on the RF power board.

The final output stage uses four parallel power transistors mounted on a fan-cooled internal heat sink. Other components of this circuit, which consist of biasing resistors, output transformer, and output coupling capacitors are mounted on the RF power board.

The RF output is coupled to the active and dispersive output terminals through an output transformer with series capacitors in both leads. This results in an output which is RF isolated from ground and which is incapable of conducting low frequency currents which may cause serious neuromuscular stimulation in the patient.

Feedback Circuit

Feedback control of the output is provided to 1) limit the maximum open circuit output voltage, 2) regulate the output to optimum levels under various cutting conditions, and 3) diminish the sensitivity of the cutting output to line voltage variations. The output voltage is detected by a high frequency bridge rectifier connected across the secondary of the output transformer. This rectifier produces a DC output which is proportional to the peak RF voltage across the output terminals. This proportional voltage is applied to the LED input of a opto-isolator device, and the emitter voltage from the isolator is fed back to the cut/blend gain and offset control amplifier on the digital display board.

With this circuit in place, an increase in the output, caused by a decrease in load current or any other cause, will be detected and subtracted from the output control signal, which will, in turn, result in less drive to the preamplifier and, therefore, less change in the output. Conversely, any attempted decrease in the output voltage will be suppressed by the opposite action.

The degree of feedback control is adjustable using R333 on the power board. This resistor is adjusted as part of the factory calibration procedure. It is interactive with the power gain adjustments. Changing it without corresponding adjustment of the gain will result in miscalibration of the generator.

Function Switching Circuits

The commonly available hand switches for electrosurgery have three wire connections to the generator with two single pole switches for cut/blend and coag. The active lead to the electrosurgical implement is the common wire for both switching functions. To maintain RF isolation of the generator output, it is necessary that the hand

switching circuit be electrically isolated from ground. To achieve this result, optical isolators are driven by op amp comparators between the hand switch wires and the generator logic elements. Between periods of surgical activity the comparator outputs are low and the optical isolators stay in the "off" condition. When one of the two handswitches is activated, the corresponding comparator toggles high and the optical isolator switches "on". When current flows through either of these optical isolators, the various gates that activate the 450 kHz oscillator, select the appropriate output control voltage, produce the correct cut/blend or coag waveforms, and activate the vacuum motor, are enabled.

The footswitch operates an isolated circuit that is identical to the handswitching circuit.

Downstream of the first level cut/blend and coag gates, another pair of gates are used which are disabled in case of cross key activation. This blocks output from the generator when both cut/blend and coag switches are simultaneously activated and generates a high pitch tone on the speaker.

Besides their functional purposes, the signals generated by the switching logic circuits also trigger the visual and audible indications of their operation. The logic board contains a group of switching transistors that control the indicator lamps, amber for cut/blend, and blue for coag. They also select the appropriate tone outputs from a frequency divider driven by an audio frequency oscillator which, together, constitute the audio frequency generator block. These tone signals are routed to a FET which drives a speaker mounted on the front panel. The lowest pitch tone denotes cut or blend. The next higher pitch tone denotes coag, and the highest tones are reserved for cross key, patient alarm, and output alarm functions.

Vacuum Motor Control Circuit

The vacuum motor circuit is activated by either the cut/blend or coag switches. A voltage representing either cut/blend or coag operation is applied to the trigger input of a timer chip connected in a monostable mode. The output of the timer turns on a solid-state relay which controls the current to the vacuum motor. At an adjustable interval after cessation of output activation, the timer output goes low and the vacuum motor is shut off. The nominal delay for turn-off is five seconds which is adjusted by R102 on the logic board.

Patient Alarm Circuit

The patient alarm circuit monitors the continuity between the two parallel leads that are used to connect the dispersive pads to the generator. If either lead breaks or is otherwise compromised such that the impedance between the two leads becomes greater than about 300 ohms, the generator shuts down and both visual and audible alarms are produced.

Detection of the patient safety alarm condition is accomplished by a transistor with a transformer in its collector circuit whose secondary is connected between the two dispersive pad leads. The base of the transistor is driven with a square wave at approximately 44 kHz. When the dispersive leads are intact, the secondary of the transformer in the collector circuit is shorted. If this circuit opens or develops a high impedance, an AC potential is produced on the secondary. This is rectified and applied to an optical isolator which, when turned on, activates a number of gates that shut down the RF waveform generator, turn on the red alarm indicator lamp on the front panel, and generate a high-pitch interrupted beep signal in the audio frequency generator.

Output Alarm Circuit

An output alarm circuit is included to prevent excessive output power in the event of a generator malfunction. This circuit is a direct copy of the controlled output feedback circuit described previously. The circuit monitors the generator output and sends a signal directly to the microprocessor, where it is compared to pre-programmed values in a table. Should the output exceed conditions that are considered normal with respect to the output setting, the microprocessor will disable all unit functions and enable the audio alarm circuit. The Finesse® system must be shut off to clear this problem.

Overheat Protection Sensor

The Finesse is equipped with a temperature sensor that interrupts one leg of the AC line in the event of a rear panel overheat. The sensor opens at a nominal temperature of 160°F and is not adjustable. The sensor is mounted on the rear panel near the output transistors.

In the event of an overheat condition, all functions will cease and the green lamp inside the main power switch will turn off. The unit will automatically reset after about 30 to 45 seconds.

Under normal clinical conditions, the unit should perform without any activation of the thermal shutdown sensor. However, during calibration and testing of the unit, the technician should allow for occasional cooling down of the rear panel to avoid the shutdown.

TEST AND CALIBRATION PROCEDURE

Complete Calibration Procedure

This procedure is intended as a protocol for functional testing and calibration of the Finesse® electrosurgical generator and smoke evacuation system. It should be conducted in whole or in part whenever malfunction or miscalibration is suspected. If the problems encountered are correctable by the adjustments contained in this procedure, the adjustments should be made and the generator should be considered suitable for clinical use. If the problems cannot be thus corrected, more thorough testing or parts replacement may be necessary. In such a case the user technician should note the step or steps in this procedure that cannot be accomplished as described, note the measurements actually obtained where applicable, and contact Customer Service at Utah Medical Products for further assistance or to make arrangements for factory repair.

CAUTION: *The procedures described herein require understanding and skill in electronics technology. They should be performed only by qualified electronic or biomedical technicians who understand the terminology and recognize the various components of radio frequency power circuits. Attempts to carry out these procedures by unqualified personnel may result in human injury or equipment damage.*

EQUIPMENT NEEDED:

- Allen wrench set
- Oscilloscope with two high voltage probes and ***line isolation transformer***
- Digital multimeter
- Electrosurgical analyzer, such as Fluke/DNI 454A
- Safety analyzer, such as Bio-Tek model 170
- AC Hi-Pot Tester
- Handswitch and cable
- Footswitch and cable
- Jumpered dispersive cable with rectangular plug
- 900Ω jumper

1.0 VISUAL AND MECHANICAL INSPECTION

1.1 Remove the top shell of the Finesse® and inspect the interior. Verify that all connectors are fully seated, that the vacuum motor is properly secured to its shock mounts, and that all boards and components attached to the chassis are solidly mounted.

1.2 Verify that the internal smoke filter is properly aligned with the pump intake with no discontinuity or visible leaks in the vacuum connections.

1.3 Correct all observed mechanical problems by reseating connectors and/or tightening mounting screws as needed.

2.0 INITIAL UNIT SETUP PROCEDURES

CAUTION: *The input power connections have an AC voltage of 120 volts or 240 volts, and the collectors of the power transistors, as well as several points on the circuit boards, have DC voltages in excess of 200 volts. During application of output power, the voltage between the active and dispersive terminals or circuit components connected to these terminals may be as high as 2000 volts peak-to-peak at high frequencies. To prevent shocks or burns, avoid touching any bare metallic objects, wires, or connections.*

CAUTION: *Use of an oscilloscope on the Finesse® generator requires that the oscilloscope be fully isolated from the main power line by a transformer. Failure to properly isolate the oscilloscope could result in extensive damage to the Finesse® generator and/or oscilloscope.*

NOTE: *Reference to board level components will be as follows:*

1 - 99	*display board*
101 - 199	*logic board*
201 - 299	*power supply board*
301 - 399	*RF power board*

2.1 Connect unit to AC power With the main power switch off, verify that the neon lamp is not lit. Then, switch the unit on and verify that the lamp lights.

2.2 Verify that the unit is now making a high pitched beep with a 1 second repetition rate and the red alarm lamp is lit.

2.3 Plug the dispersive pad connector dummy or a dispersive pad into the dispersive pad connector and verify that the alarm condition is canceled.

2.4 Connect black lead of multimeter to TP103. ***This will serve as the ground reference for all measurements.***

2.5 Plug the power cord into the receptacle. Also plug in the footswitch, the handswitch pen and the dispersive pad plug.

2.6 Switch the unit on. Verify that the green light in the switch is on and that the displays light. No other indicator lights should be on and the unit should not beep.

2.7 Verify regulated 5 volts on pin 1 of J203 measures 4.5 to 5.5 volts.

2.8 Verify regulated 15 volts on pin 2 of J203 measures 13.5 to 15.5 volts.

2.9 Verify regulated 30 volts on pin 4 of J203 measures 28.5 to 31.5 volts.

2.10 Verify unregulated 200 volts on pin 12 of J203 measures 170 to 205 volts.

3.0 INITIAL SETUP OF CONTROL CIRCUITS

NOTE: *ADJUSTMENTS MADE IN THIS SECTION SHOULD NOT BE NECESSARY FOR PREVIOUSLY CALIBRATED SYSTEMS. IF ADJUSTMENTS IN THIS SECTION ARE MADE, THE FINESSE SYSTEM CALIBRATION PROCEDURE SHOULD BE FOLLOWED IN ITS ENTIRETY. IF ONLY POWER OUTPUT RECALIBRATION IS DESIRED, PROCEED TO STEP 6.6.*

3.1 Adjust the vacuum motor delay by pressing the cut switch momentarily. The vacuum motor will start and should stay on for five (5) seconds. Adjust R102 until a five second delay is achieved.

3.2 Turn the cut mode output setting adjustment knob fully clockwise. Adjust R3 to make the cut display read '98'. Then adjust R3 so that the cut display jumps to '99', then add ¼ turn in the same direction.

3.3 Turn cut mode output setting knob fully counter clockwise. Verify that the display reads '05'.

3.4 Turn the coag mode output setting adjustment knob fully clockwise. Adjust R2 to make the coag display read '74'. Then adjust R2 so that the cut display jumps to '75', then add ¼ turn in the same direction.

3.5 Turn coag mode output setting knob fully counter clockwise. Verify that the display reads '05'.

3.6 Set cut mode output setting to '99' and coag mode output setting to '75'.

3.7 Measure TP105 and adjust R164 to read zero (0) volts.

3.8 Measuring cathode of D102, adjust R163 to read 12 volts DC.

3.9 Verify voltage on D102 varies as you adjust the cut mode output setting knob.

3.10 Set cut mode output setting to '99'. Measuring the voltage at TP104, follow steps 3.11 - 3.14.

3.11 Set mode to "CUT". Adjust R142 to 12 VDC.

3.12 Set mode to "BLEND 1". Adjust R144 to 10 VDC.

3.13 Set mode to "BLEND 2". Adjust R146 to 10 VDC.

3.14 Set mode to "BLEND 3". Adjust R148 to 10 VDC.

3.15 Measure voltage at D107. Voltage should be zero (0). Press cut switch and verify that the voltage jumps to approximately 9

volts DC.

3.16 Measuring voltage on the cathode of D109, adjust R169 to 12 volts DC.

3.17 Verify voltage on D109 varies as you adjust coag output setting knob.

3.18 Set coag mode output setting to '75'. Measure the voltage on TP102. Adjust R150 to 13 VDC.

3.19 Measure voltage at D107. Voltage should be zero (0). Press coag switch and verify that the voltage jumps to approximately 12 volts DC.

3.20 Set R333 and (if present) R362 fully clockwise, then set R351 and (if present) R363 fully counter-clockwise.

4.0 TEST OF SWITCHING CIRCUITS

4.1 Set cut and coag output setting knobs to '05'.

4.2 Remove the dispersive pad plug. The Finesse® should begin to alarm at a 1 second interval with a high pitched beep. Also verify that red alarm light comes on.

4.3 Verify that the phone jack and the banana plugs silence the alarm and the red light turns off.

4.4 Reinsert dispersive pad plug.

4.5 Press the yellow 'cut' button on the handswitch pen. This should: 1) cause the yellow cut indicator to light, 2) generate a high pitch tone, and 3) start the vacuum motor.

4.6 Press the left (cut) footswitch pedal. The three items mentioned in 4.4 should again occur.

4.7 Press the blue 'coag' button on the handswitch pen. This should: 1) cause the blue coag indicator to light, 2) generate a higher pitch tone, and 3) start the vacuum motor.

4.8 Press the right (coag) footswitch pedal. The three items mentioned in 4.6 should again occur.

4.9 Pressing both buttons of the handswitch pen or both pedals of the footswitch should: 1) cause the red alarm indicator to light, 2) generate an even higher pitch tone, and 3) cause the vacuum motor to briefly start and deactivate.

5.0 WAVEFORM TESTS AND FREQUENCY ADJUSTMENT

5.1 Set oscilloscope to sensitivity of 5 volts per division and sweep rate of 1 microsecond per division. Connect scope reference to TP303. Make measurements from either side of R304.

5.2 Set mode to "CUT". Adjust R107 until fundamental frequency is 450 kHz (Period is 2.22 microseconds.).

5.3 Adjust oscilloscope to 10 or 20 microseconds per division.

5.4 Press the cut switch and observe that the cut waveform is a clean and continuous sinusoid.

5.5 Switch unit to "BLEND 1" mode and observe interrupted sinusoid waveform with 10 cycles 'on' and 6 cycles 'off'.

5.6 Switch unit to "BLEND 2" mode and observe interrupted sinusoid waveform with 8 cycles 'on' and 8 cycles 'off'.

5.7 Switch unit to "BLEND 3" mode and observe interrupted sinusoid waveform with 6 cycles 'on' and 10 cycles 'off'.

5.8 Press COAG button and observe interrupted waveform with 1 cycle 'on' and 15 cycles 'off'.

6.0 POWER OUTPUT CALIBRATION

CAUTION: The screws of the transistors on the heat sink assembly and the preamplifier transistor on the rear panel have 200 Volts DC on them.

6.1 Attach the active and dispersive leads to the electrosurgical analyzer. Set the patient load to 500 ohms.

6.2 Set output mode to "CUT" and output setting to '99'. Verify voltage on TP104 is 12.0 VDC and adjust R142 if necessary.

6.3 If R362 is present, activate the system in “CUT” mode and

adjust R362 until output power is 60 watts. For models without R362, skip to the next step.

6.4 Activate “CUT” mode and adjust R333 until measured output is 99 watts.

6.5 Adjust “CUT” output setting to ‘30’ and activate “CUT” switch. Adjust R333 to 30 watts, if necessary.

6.6 Set “CUT” output setting to ‘99’ and activate “CUT” switch. Adjust R142 to 99 watts output. Repeat steps 6.5 and 6.6 until no adjustment is necessary.

6.7 Disconnect active electrode from the electrosurgical analyzer, activate the “CUT” switch and observe waveform. The waveform should be clean and have sharper and higher peaks on the positive side compared to the negative side.

6.8 Reset cut mode display to '99' and coag mode display to '75'.

6.9 Reconnect the active and dispersive pad leads to the electrosurgical analyzer.

6.10 Switch unit to "BLEND 1" mode. Activate cut switch and adjust R144 to get 99 watts output.

6.11 Switch unit to "BLEND 2" mode. Activate cut switch and adjust R146 to get 99 watts output.

6.12 Switch unit to "BLEND 3" mode. Activate cut switch and adjust R148 to get 99 watts output.

6.13 Set "COAG" power to 75 watts. Activate coag switch and adjust R150 to get 75 watts output.

7.0 SAFETY SHUTDOWN CIRCUIT CALIBRATION

7.1 Set output mode to "CUT". Remove the dispersive pad connection to the electrosurgical analyzer. If R363 is present on board, activate cut mode and adjust R363 until voltage at TP2 is 2.5 volts.

7.2 Activate “CUT” mode and adjust R351 until voltage at TP2 is 3.0 volts.

7.3 Turn unit off and short pin 1 to pin 16 (these are the only two pins on the top side of the chip) of opto-isolator U301 to disable the feedback opto-isolator.

7.4 Turn unit back on. Press cut switch and verify that the unit makes a constant high pitched tone.

7.5 Turn the unit off and remove the short from U301.

7.6 Turn unit on. Verify that the unit does not alarm when coag is activated into an open circuit.

8.0 Calibration Verification

NOTE: Do not exceed 10 seconds of output power activation in any given 30 second period when verifying output calibration.

8.1 Set unit output mode to "CUT". With the cut mode output settings shown in the checksheet, measure the output power and verify that these fall within ±15% or ±5 watts of the displayed setting, whichever error is greater.

8.2 Repeat section 8.1 for "BLEND 1" mode.

8.3 Repeat section 8.1 for "BLEND 2" mode.

8.4 Repeat section 8.1 for "BLEND 3" mode.

8.5 Repeat section 8.1 for "COAG" mode.

9.0 Open Circuit Safety Circuit Trip Test

9.1 Disconnect the active and dispersive leads from the electrosurgical analyzer.

9.2 Activate the cut mode switch for five seconds with the cut mode output settings at '30' and '99' with the unit set in "CUT" mode. Verify that the alarm circuit does not activate.

9.3 Repeat section 9.2 for "BLEND 1" mode.

9.4 Repeat section 9.2 for "BLEND 2" mode.

9.5 Repeat section 9.2 for "BLEND 3" mode.

9.6 Repeat section 9.2 for "BLEND 3" mode, using '30' and '75'.

10.0 ELECTRICAL SAFETY TESTS

RF LEAKAGE TEST

10.1 Set patient load on the electrosurgical analyzer to 200 ohms. Remove the dispersive lead from the dispersive input and replace with a lead from chassis ground of generator.

10.2 Set cut display to '99' and coag display to '75'.

10.3 Set mode to "CUT" and activate cut switch. Power output should be less than 4 watts.

10.4 Set mode to "BLEND 1" and activate cut switch. Power output should be less than 4 watts.

10.5 Set mode to "BLEND 2" and activate cut switch. Power output should be less than 4 watts.

10.6 Set mode to "BLEND 3" and activate cut switch. Power output should be less than 4 watts.

10.7 Activate coag switch. Power output should be less than 4 watts.

10.8 Remove ground lead from analyzer.

CABLE FAULT SHUTDOWN

10.9 Reconnect active and dispersive leads to their corresponding inputs on the analyzer.

10.10 Activate cut switch and remove dispersive pad plug from its receptacle. Verify that the ESU indicates a lead fault and that output drops to zero.

10.11 Replace dispersive pad plug and repeat for coag.

CROSS-KEY SHUTDOWN

10.12 Activate the cut and the coag buttons simultaneously. Verify that there is no output power, a constant high pitch tone is generated, and the red alarm lamp lights.

900 OHM ALARM TEST

10.13 Remove dispersive pad plug. Note that the ESU will indicate a cable fault alarm. Plug the test connector jumpered with a 900 ohm resistor into the dispersive pad receptacle. The alarm should continue to sound.

HIGH POTENTIAL TEST

10.14 Disconnect the active and dispersive leads from the electrosurgical analyzer and remove the power cord from the rear of the unit.

10.15 Set test voltage to 1200 VAC. Connect ground lead of tester to chassis ground of unit and touch high voltage probe to each of the two supply line prongs of the power cord receptacle for 1 second. Verify that there is no arcing occurring in the unit.

11.0 HAZARD CURRENT TEST

11.1 Set the safety analyzer to measure chassis leakage, and set the lead selector of the analyzer to the "SINGLE LEAD" position.

11.2 Plug the power cord from the Finesse® unit into the test receptacle on the safety analyzer.

11.3 Set Ground to "NORMAL" and Polarity to "NORMAL". Turn the safety analyzer and the ESU on. Record hazard current measurement.

11.4 Set Polarity to "REVERSE". Record measurement.

11.5 Set Ground to "OPEN". Record measurement.

11.6 Set Polarity to "NORMAL". Record measurement.

11.7 If any measurement exceeds 100µA, analysis and repair of the problem should be done.

Preventive Maintenance Checklist

Scope

This checklist is intended to provide documentation of preventive maintenance for Utah Medical Products, Inc. Finesse Electrosurgical Generator and Smoke Evacuation Systems, model numbers ESU-110 and ESU-220. It is intended for use by technical personnel who have experience with electrosurgical generator operation and maintenance, and who possess the test equipment and tools necessary to obtain the requested data. This document may not reference all tests necessary to demonstrate compliance to all regulations. Technical personnel should consult local regulations and industry recommendations in order to develop their own protocol for inspection and preventive maintenance of the Finesse system.

Required Equipment and Tools

- Electrosurgical analyzer and leads (Fluke/DNI 454A, Fluke QA-ES, BC Int'l 2050, 2300, 2400, or equivalent)
- Electrical safety analyzer (Biotek 170 or equivalent)
- Oscilloscope, isolated from power mains
- High potential tester
- Two-button electrosurgical switchpen
- Digital multimeter
- ESU-700 Finesse Internal Smoke Evacuation Filter (includes 5/64" hex key)

External Mechanical Inspection

☐ Pass ☐ Corrected Verify front panel controls, switches, lights, and dispersive pad receptacles are not damaged.

☐ Pass ☐ Corrected Verify switchpen receptacles firmly hold switchpen.

☐ Pass ☐ Corrected Verify power cord and rear panel receptacle are not damaged.

☐ Pass ☐ Corrected Verify footswitch cord (if present) and rear panel receptacle are not damaged.

Internal Inspection and Service

☐ Pass ☐ Corrected Replace internal smoke evacuation filter.

☐ Pass ☐ Corrected Verify all connectors are fully seated in their sockets.

Performance Inspection

Verify the following power supply voltages (tolerances in parentheses)

☐ Pass ☐ Corrected J203 pin 1 _____VDC (4.5-5.5)

☐ Pass ☐ Corrected J203 pin 2 _____VDC (13.5-15.5)

☐ Pass ☐ Corrected J203 pin 4 _____VDC (28.5-31.5)

☐ Pass ☐ Corrected J203 pin 12 _____VDC (170-205)

☐ Pass ☐ Corrected Green LED in main power switch lights

Verify power displays can be adjusted through the full output range

☐ Pass ☐ Corrected Cut: 05-99

☐ Pass ☐ Corrected Coag: 05-75

Press cut button on switchpen (repeat with cut pedal on footswitch, if available), and verify:

☐ Pass ☐ Corrected Yellow cut activity indicator lights

☐ Pass ☐ Corrected Cut mode tone is audible

☐ Pass ☐ Corrected Smoke evacuation motor activates, and remains running 5 seconds after deactivation

Press coag button on switchpen (repeat with coag pedal on footswitch, if available), and verify:

☐ Pass ☐ Corrected Blue coag activity indicator lights

☐ Pass ☐ Corrected Coag mode tone is audible

☐ Pass ☐ Corrected Smoke evacuation motor activates, and remains running 5 seconds after deactivation

☐ Pass ☐ Corrected Verify smoke evacuation flow rate switch changes motor speed.

☐ Pass ☐ Corrected Verify heat sink module fan is operating.

☐ Pass ☐ Corrected Check RF Power Board fuses F302-F309. If any are open, replace the fuse and corresponding output transistor

Waveform Verification

Set and verify the following output waveforms with an isolated oscilloscope, into open circuit conditions

☐ Pass	☐ Corrected	Frequency _____kHz	(400-500)
☐ Pass	☐ Corrected	"CUT"	continuous 450 kHz sinusoid
☐ Pass	☐ Corrected	"BLEND 1"	10 cycles on 6 cycles off
☐ Pass	☐ Corrected	"BLEND 2"	8 cycles on 8 cycles off
☐ Pass	☐ Corrected	"BLEND 3"	6 cycles on 10 cycles off
☐ Pass	☐ Corrected	"COAG"	1 cycle on and 15 cycles off

Output Calibration

Check system output power at the following displayed settings. All measurements should be made through a 500Ω load. Tolerances are listed in parentheses, and trimpot for adjustment in square brackets. Do not activate system for more than 5 seconds for each reading, and allow at least 15 seconds between readings.

☐ Pass	☐ Corrected	Cut	[R142]		
		30: _____	60: _____	90: _____	
		(25-35W)	(51-69W)	(77-103W)	
☐ Pass	☐ Corrected	Blend 1	[R144]		
		30: _____	60: _____	90: _____	
		(25-35W)	(51-69W)	(77-103W)	
☐ Pass	☐ Corrected	Blend 2	[R146]		
		30: _____	60: _____	90: _____	
		(25-35W)	(51-69W)	(77-103W)	
☐ Pass	☐ Corrected	Blend 3	[R148]		
		30: _____	60: _____	90: _____	
		(25-35W)	(51-69W)	(77-103W)	
☐ Pass	☐ Corrected	Coag	[R150]		
		30: _____	60: _____	75: _____	
		(25-35W)	(51-69W)	(64-86W)	

RF Leakage Currents

Set cut display to "99" and coag display to "75". Disconnect dispersive lead from analyzer and connect the Finesse system chassis ground (equipotential connector on rear panel) to the dispersive input on the analyzer. Check RF output through 200Ω load:

☐ Pass	☐ Corrected	Cut	_____ (<4W)
☐ Pass	☐ Corrected	Blend 1	_____ (<4W)
☐ Pass	☐ Corrected	Blend 2	_____ (<4W)
☐ Pass	☐ Corrected	Blend 3	_____ (<4W)
☐ Pass	☐ Corrected	Coag	_____ (<4W)

Chassis Leakage Currents

Using an electrical safety analyzer, measure the following conditions. Acceptable conditions are listed in parentheses:

Ground lead intact

☐ Pass	☐ Corrected	Normal Polarity	_____ (<100µA)
☐ Pass	☐ Corrected	Reverse Polarity	_____ (<100µA)

Ground lead open

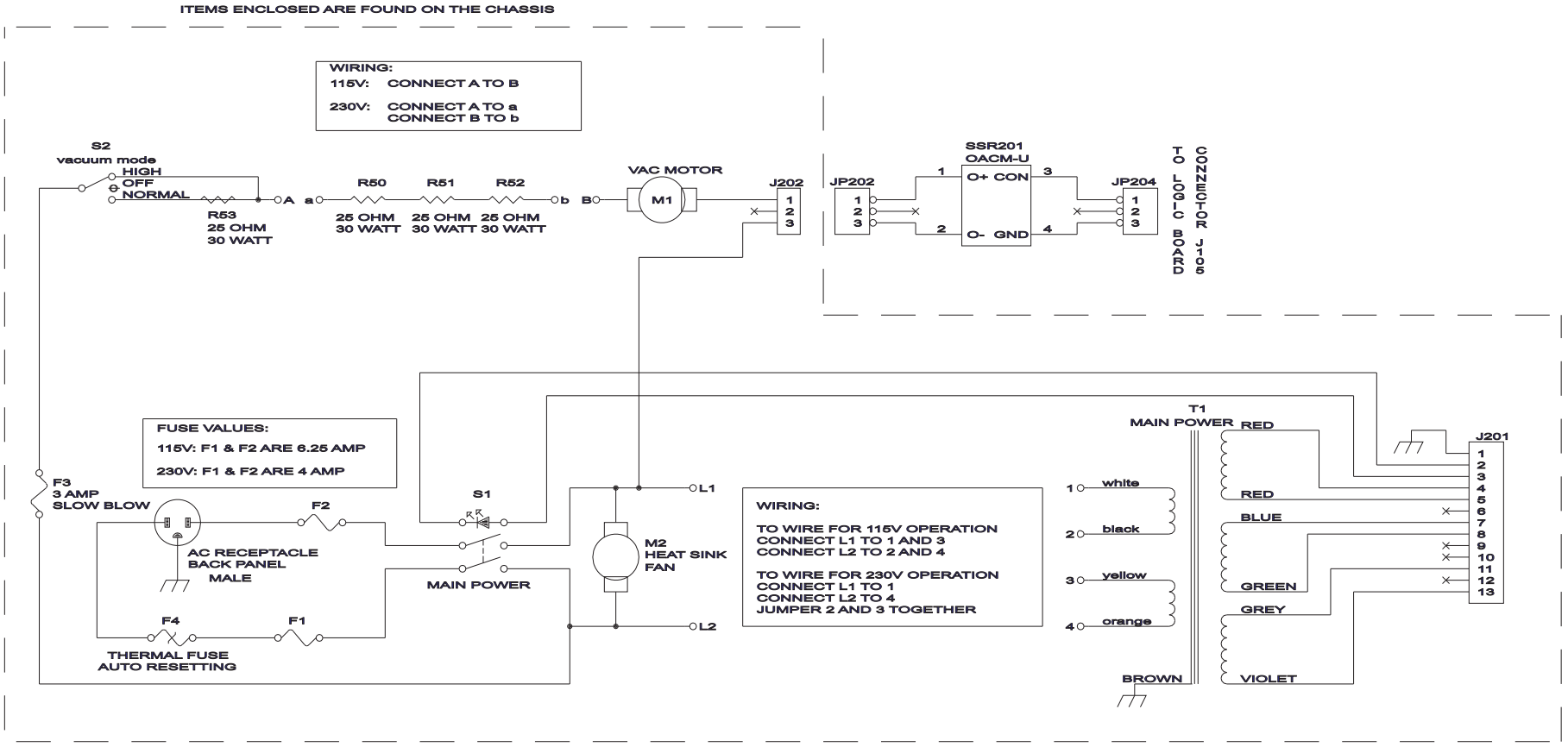
☐ Pass	☐ Corrected	Normal Polarity	_____ (<100µA)
☐ Pass	☐ Corrected	Reverse Polarity	_____ (<100µA)

Alarm Checks

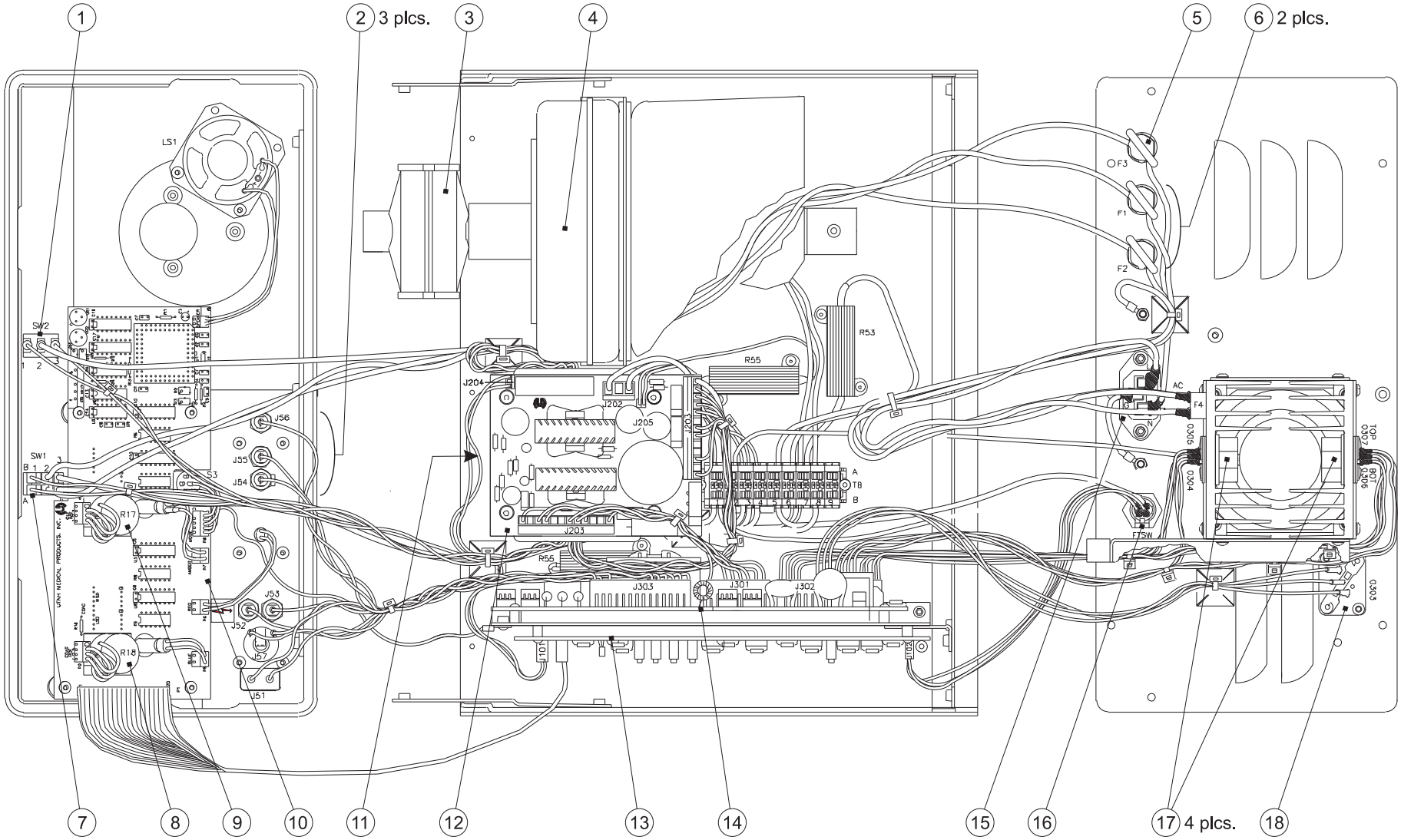
☐ Pass	☐ Corrected	Pressing both cut and coag switchpen buttons simultaneously produces alarm and disables output
☐ Pass	☐ Corrected	Pressing both cut and coag foot pedals (if used) simultaneously produces alarm and disables output
☐ Pass	☐ Corrected	A 900 ohm resistor placed between dispersive pad receptacle pins does not correct patient alarm condition
☐ Pass	☐ Corrected	With jumper in place between U301 pins 1 and 16, activation of any output mode results in a continuous alarm
☐ Pass	☐ Corrected	Activation of coag mode into open circuit conditions does not produce output error alarm
☐ Pass	☐ Corrected	Each mains lead connection, tested individually, withstands 1200 VAC relative to chassis
☐ Pass	☐ Corrected	Adjust volume control so that cut and coag audible tones can be clearly heard over the smoke evacuation motor set at the 'high' flow rate position.

List of Drawings

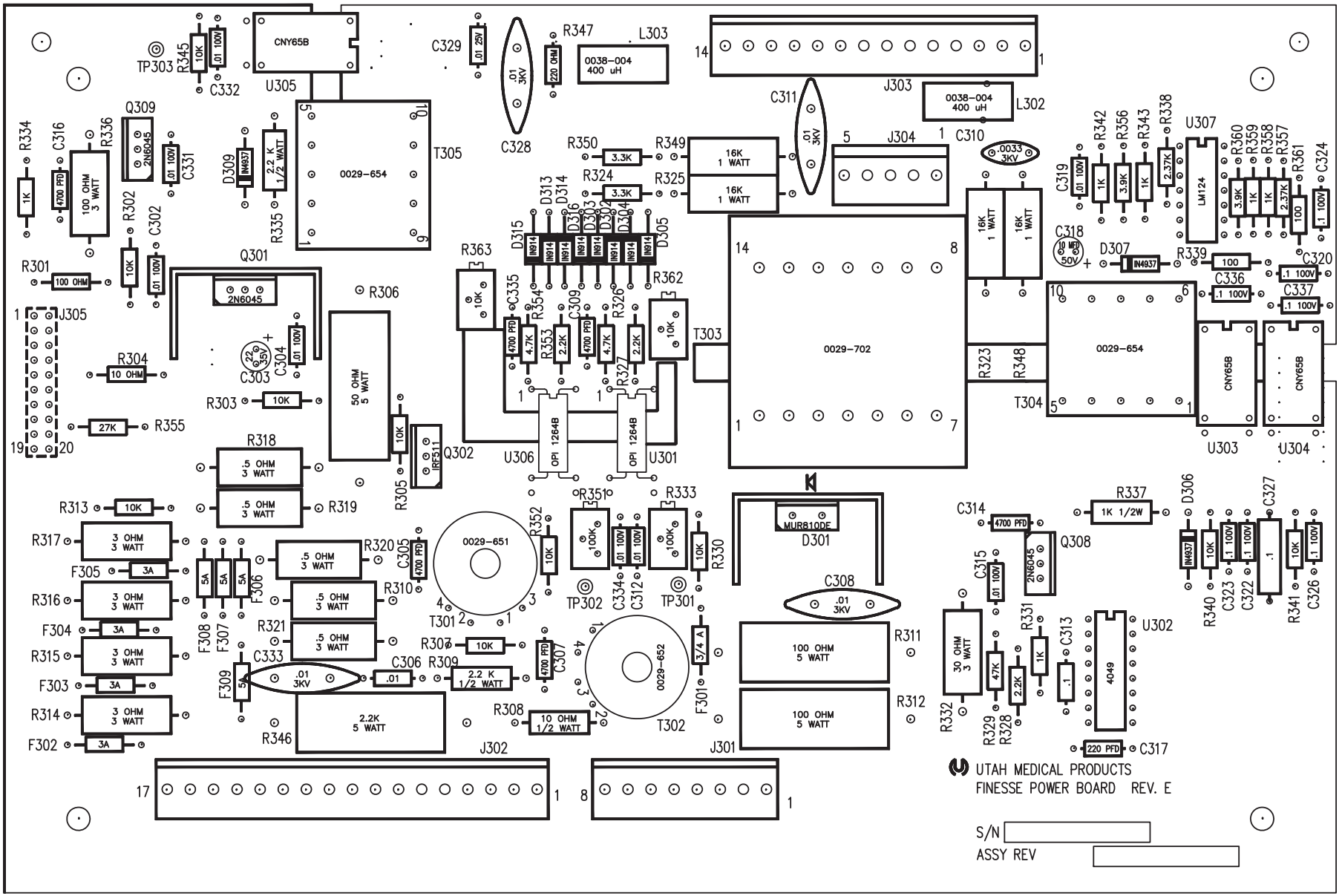
Mains Power Wiring Diagram



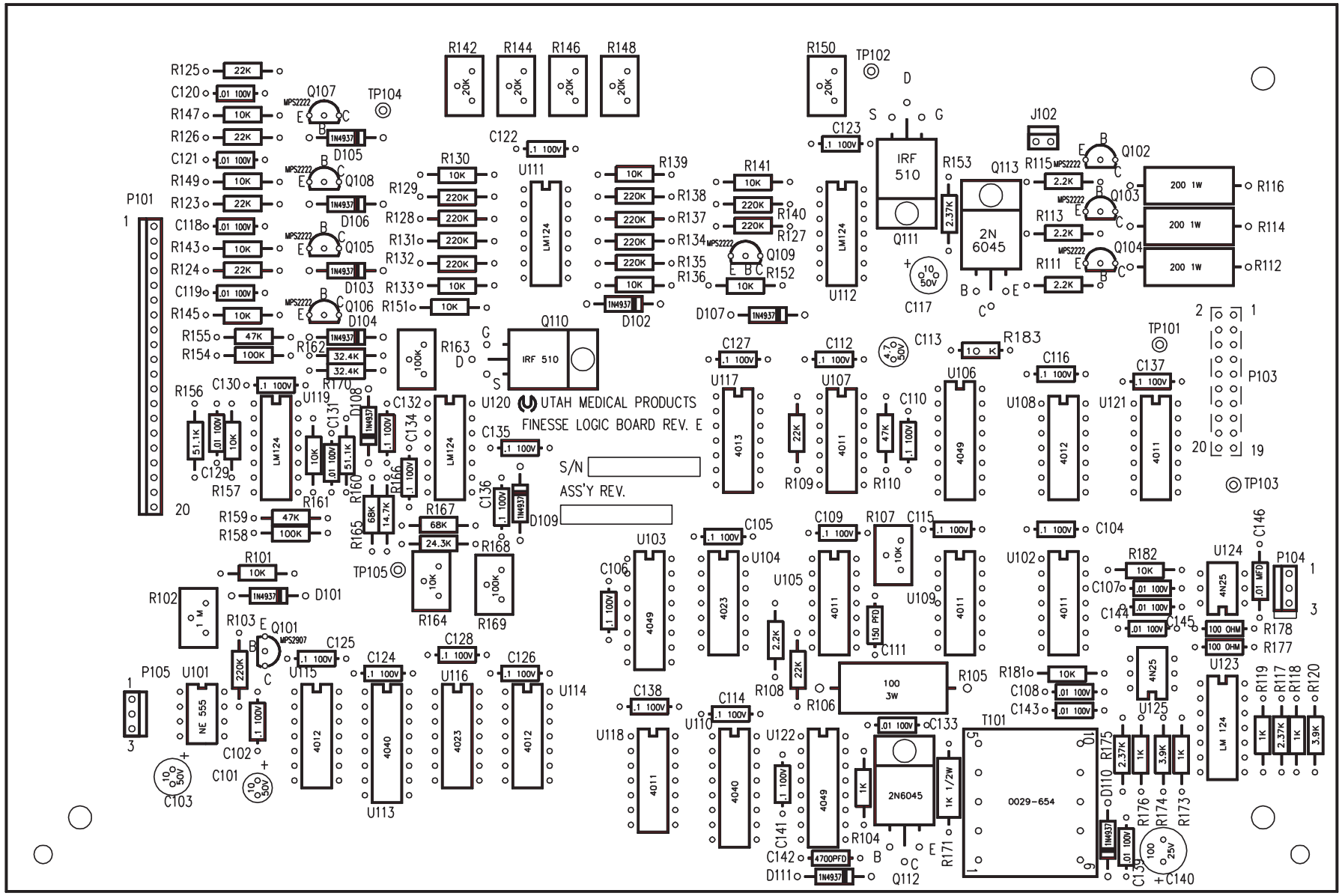
Assembly Diagram, Finesse® Internal View



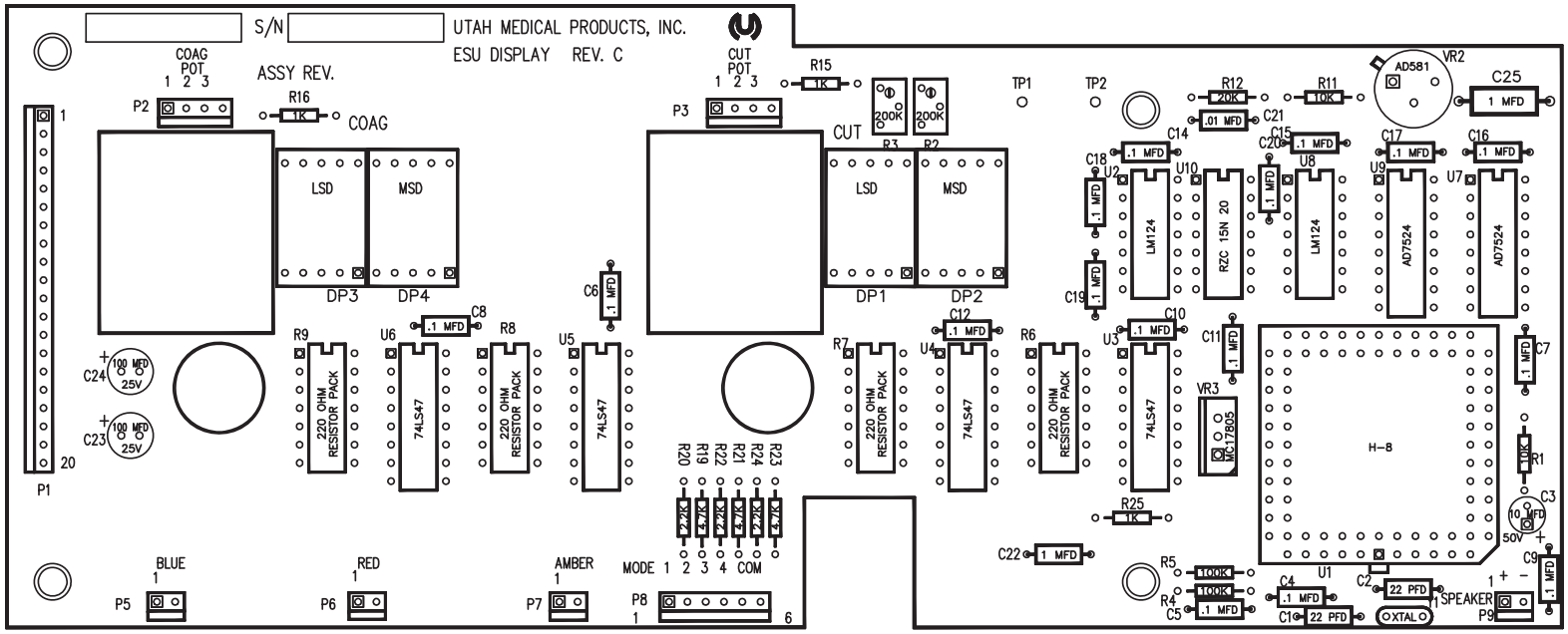
RF Power Board Assembly Drawing



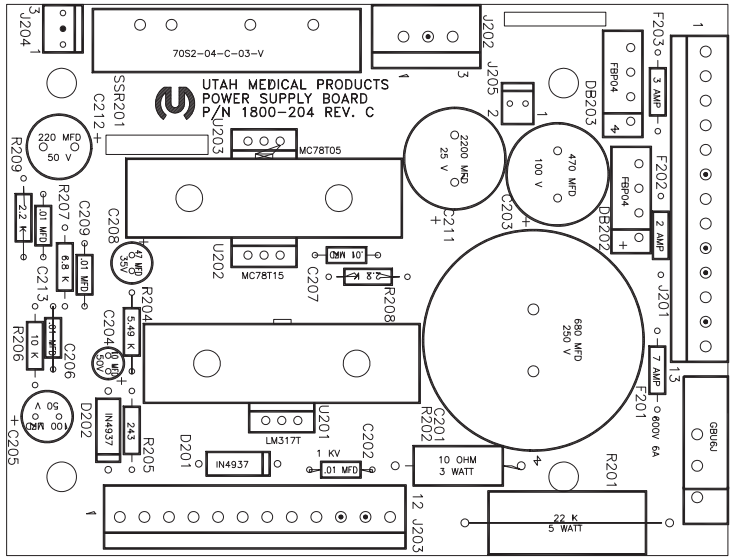
Logic Board Assembly Drawing



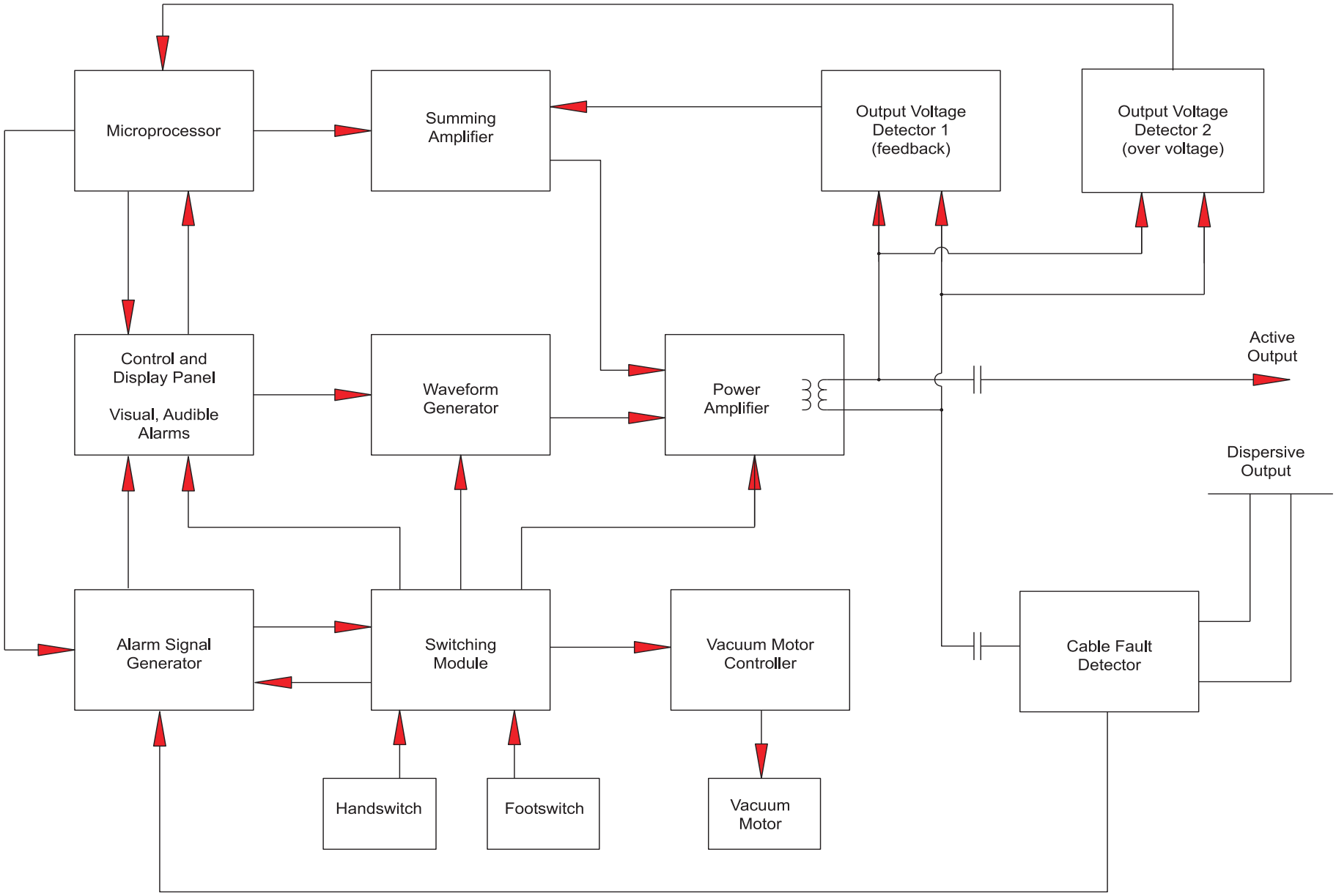
Display Board Assembly Drawing



Power Supply Board Assembly Drawing



System Functional Diagram



Parts List

NOTE: "Item" refers to the assembly drawing on page 24.

Item	Part No.	Description
1	0012-351	Vacuum Motor Control Switch
2	0007-300	Handswitch Receptacles
3	ESU-700	Finesse® Internal Filter
4	0064-900	Vacuum Motor (also requires boot part number 1850-007)
5	ESU-750	Fuse, 3A slo-blo for vacuum motor
6	ESU-760 ESU-761	Fuse, 6.25A slo-blo (ESU-110) ***OR*** Fuse, 4A slo-blo (ESU-220)
7	0010-115	Main Power Switch
8	0013-205	Power Adjustment Pot, Coag Mode
9	0013-205	Power Adjustment Pot, Cut Mode
10	90014	Display Board Assembly
11	0029-550	Main Transformer
12	90017	Power Supply Board Assembly
13	90015	Logic Board Assembly
14	90016	RF Power Board Assembly
15	0006-300	Main Power Cord Receptacle
16	0049-400	Footswitch Receptacle
17	0050-012	Output Transistors
18	0050-145	Preamplifier Transistor

Utah Medical Products will make available to qualified service personnel the necessary replacement parts for the Finesse unit for a period of five years from the date of shipment of the unit.

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