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SUPERSEDES N/A		PAGE 1 of 115 DO NOT ISSUE REV SHEET	
G4 Service Manual			

ECO #	REVISION	DESCRIPTION
Eng. Draft	1	Version for initial product release.

Prepared by: _____

Date: _____

Approved by: _____

Date: _____

Manufacturing

Approved by: _____

Date: _____

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Quality and Regulatory Affairs

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Management

Cosman G4 Radiofrequency Generator

Service Manual



Cosman G4 Radiofrequency Generator Service Manual (SPI 11291 Rev A)

Title and Publication Number

G4 Service Manual
SPI 11291 Rev. A

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Caution

U.S. Federal law restricts this device to sale by, or on the order of, a physician licensed by the state in which he practices to use, or order the use of, the device.

Limited Warranty

Cosman Medical, Inc. warrants to the original purchaser that the equipment listed in the Operators' Manual shall be free from defects in material and workmanship for a period of 1 year from the date of shipment. Cosman Medical, Inc. obligation under this warranty shall be limited to repair or replacement, at the option of Cosman Medical, Inc. The above warranty is contingent upon normal usage and does not cover products that have been modified without Cosman Medical's approval or which have been subjected to unusual physical or electrical stress.

Electrodes: Since electrodes are more subject to abuse, the warranty differs from the G4 Generator.

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FCC Statement Concerning RFI

The G4 generates and uses radio-frequencies. The equipment may cause interference with other medical equipment in the vicinity. If interference occurs, one or more of the following measures could remedy the problem:

- Move the G4 away from the affected equipment.
- Plug the G4 into a separate outlet so that it is on a different branch circuit.

If necessary, consult the manufacturer of the affected equipment or an experienced technician. In addition, the booklet "How to Identify and Resolve Radio-TV Interference Problems" may be helpful. This booklet is published by the FCC and is available from the U.S. Government Printing Office, Washington, D.C., 20402, Stock No. 004-00-00345-4.

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1. General Information

Safe and effective RF lesioning is dependent not only on equipment design, but also on factors under control of the operator. Do not attempt to operate the G4 prior to completely reading and understanding the instructions for use.

WARNING: Electric Shock Hazard

There are no user serviceable parts inside the G4. To avoid electric shock, return the device to Cosman for servicing.

WARNING: Hazardous Electrical Equipment & Active Implants

This equipment is intended for use by qualified personnel only.

This equipment may damage or interfere with the operation of cardiac pacemakers and other active implants.

Do not use within 15 feet (4 meters) of a cardiac pacemaker unless proper cautions have been taken. Before use of the Generator, contact the pacemaker company to determine whether the pacemaker needs to be converted to fixed rate pacing during the radiofrequency procedure. When the pacemaker is in the sensing mode, it may interpret the RF signal as a heartbeat and may fail to pace the heart.

This equipment has an output which is capable of causing a physiological effect.

WARNING: Risk of Burns and Fire.

Do not use near conductive materials such as metal bed parts or inner spring mattresses.

WARNING: Protective Earth Grounding

Grounding reliability can only be achieved when the equipment is plugged into a receptacle marked "Hospital Grade". Any interruption of the Protective Earth conductor will result in a potential shock hazard which cause injury to patient or operator.

1.1 Device Classification

Classifications as per EN 60601-1, the manufacturer describes the G4 as:

Type of protection against Electric Shock	Class I
Degree of protection against Electric Shock	Type BF Defibrillator Protected
Degree of harmful ingress of water	IPX0 Ordinary
Mode of Operation	Continuous use
Degree of Safety in the Presence of Flammable Anesthetic Mixture with Air, Oxygen, or Nitrous Oxide	Not suitable for use

1.2 Electrical Safety and EMC

The G4 has been tested to and meets the requirements of the following Electrical Safety Standards:

EN 60601-1 Medical Electrical Equipment (1990, A1: 1993, A2: 1995, A13: 1996)
EN 60601-2-2 Particular Requirements for the Safety of High Frequency
Surgical Equipment (2006)

The G4 has been tested to and meets the requirements of the following EMC Standards:

EN 60601-1-2 Collateral Standards: Electromagnetic Compatibility (2001, A1: 2004)

The following standards apply:

CISPR 11/FCC Part 15 Group 1, Class A, ISM
IEC 61000-4-2 (2001), 61000-4-3 (2006), 610004-4 (2004), 61000-4-5 (2005)

1.3 Electrical Safety Information

The G4 is a radiofrequency generator designed to produce local tissue heating at the tip of an electrode by the presence of radio frequency current. Special isolation transformers are imposed between power lines and internal G4 circuitry, resulting in very low leakage current.

WARNING: A needle electrode should not be used as the dispersive electrode, as it is possible to burn the patient at this site due to high current densities. In all applications, care should be taken to maximize the surface area of the dispersive electrode. The dispersive electrode should be reliably attached with its entire area against the patient's body and as close to the operating field as possible.

The risk of igniting flammable gases or other materials is inherent in lesioning and cannot be eliminated by device design. Precautions must be taken to restrict flammable materials and substances from the electrosurgical site. The use of flammable anesthetics and nitrous oxide and oxygen should be avoided, unless these agents are suctioned away. Flammable agents used for cleaning or disinfecting should be allowed to evaporate before the application of RF surgery. There is a risk of flammable solutions pooling under the patient and in body cavities. Any fluid pooled in these areas should be removed before the equipment is used. Avoid use of flammable materials, such as gauze or cotton wool when saturated with oxygen. These materials may be ignited by sparks produced in the normal operation of the G4.

WARNING: Apparent low power output or failure of the equipment to function correctly at normal settings may indicate faulty application of the dispersive electrode or failure of an electrical lead. Do not increase power before checking for obvious defects or misapplication. Effective contact between the patient and the dispersive electrode must be verified whenever the patient is repositioned after the initial application of the dispersive electrode.

WARNING: Electromagnetic interference (EMI) produced by the unit during normal operation may adversely affect the performance of other equipment. The performance of this device may be adversely affected by other high frequency surgical devices in close proximity. If a problem occurs, separate the devices.

WARNING: The use and proper placement of dispersive electrodes is a key element in the safe and effective use of this lesion generator, particularly in the prevention of burns. Read and follow Cosman's dispersive electrode instructions for preparation, placement, surveillance, removal and use of any dispersive electrode. The use of dispersive electrodes that meet or exceed ANSI/AAMI requirements (HF18) is recommended.

WARNING: Use the Cosman's DGP-PM large area dispersive electrode, a large area gel-pad (with a 110 cm² conductive plate area) or an equivalent gel-pad dispersive electrode (with at least 110 cm² conductive plate area) to disperse and return RF current over as large an area as possible, and thus minimize heating effects at that electrode, and to avoid high current densities and resultant burns in adjacent tissue.

NOTICE: The ground pad should be placed in close proximity to the lesion site.

WARNING: Observe the dispersive electrode during lesioning for signs of excessive heating.

WARNING: The long-term risks of creation of RF lesions have not been established.

WARNING: The generator is capable of delivering a significant amount of output. Patient or operator injury can result from improper handling of the active electrode and dispersive electrode, particularly when operating the generator. During energy delivery, the patient should not be allowed to come in contact with metal parts which are earthed or which have an appreciable capacitance to earth. The use of antistatic sheeting is recommended for this purpose. Unshielded leads (active or return) should be positioned so that they cannot come into contact with the patient or other leads connected to the patient and so that they do not run parallel to nearby leads.

WARNING: Electrodes and probes of monitoring, stimulating, and imaging devices can provide paths for high frequency currents even if they are battery powered, insulated, or isolated at 60 Hz. The risk of burns can be reduced. But not eliminated, by placing the electrodes or probes as far away as possible from the lesion site and from the dispersive electrode. Protective impedances incorporated into the monitoring leads may further reduce the risk of these burns and permit continuous monitoring during energy delivery. Needles should not be used as monitoring electrodes during such procedures.

WARNING: Potentially hazardous conditions may exist when accessories of similar connector types are combined. Use only appropriate accessories certified by an accredited test body.

WARNING: Never proceed in a temperature monitored procedure if the generator does not read body temperature before you begin delivering RF energy.

WARNING: Raise the temperature slowly, particularly with large electrodes. Displayed temperature lags behind the actual temperature due to the thermal mass of the electrode.

WARNING: Verify functional safety of the device before each use, using the guidelines detailed in this manual.

WARNING: The output of any electrode may change when patient output is being delivered. Do not move electrode(s) or change electrode connections to the generator when patient output is being delivered to any electrode.

WARNING: To avoid unanticipated stimulation to the patient, do not cycle the generator power or turn the generator power on while the patient is connected to the generator.

NOTICE: Always have spare electrodes and cables on hand in case a problem arises with the first one during a procedure. Reuseable cables and accessories should be periodically tested.

NOTICE: Use of DGP-PM ground pad with a stainless steel RF Cannula may provide a galvanic potential (the “battery effect”) resulting in a single stimulation pulse at the time the TC Electrode is placed into an RF Cannula. This should be anticipated, and does not present any risk or danger to the patient.

NOTICE: Always record the wattage readings that correspond to a given temperature for a given technique. This gives extra guidance and helps Cosman Medical diagnose problems.

WARNING: Proper electrode placement should be verified using anatomical landmarks, sensory and motor stimulation techniques, fluoroscopic guidance, Impedance reading, and good clinical judgment before RF lesion making procedures are initiated.

1.4 Key to Device Markings

Mains Power



Mains Power On Switch



Main Power Off Switch

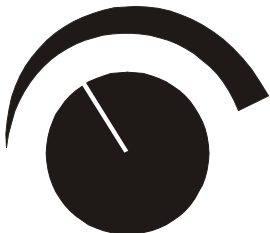
Output Control



Front-panel Start Button (Turn on electrode output)



Front-panel Stop Button (Turn off electrode output)



Output Control Knob

Output Connections



Reference Ground Pad Connection and all RF Electrode Output Connections isolated at low and high leakage currents



Reference Ground Pad Connection (on front panel)



RF Electrode Output Connection 1 (on front panel)

- 2** RF Electrode Output Connection 2 (on front panel)
- 3** RF Electrode Output Connection 3 (on front panel)
- 4** RF Electrode Output Connection 4 (on front panel)

Other Connections



Footswitch Remote Control Connection



Equipotential Jack Terminal



USB Connection (Printer or Memory Stick)

Readings and Indicators



Output On Indicator Light

°C

Temperature (Degrees Celsius)

Ω

Impedance (Ohms)

V

Voltage (Volts)

mA

Current (Milliamps)

W

Power (Watts)

ms

Pulse Duration/Width (milliseconds)

Hz

Pulse Rate/Frequency (Hertz = 1/Seconds)

min

Time (Minutes:Seconds)

Certifications



Unit is compliant with the European Council Directive 93/42/EEC , Medical Device Directive



Unit is approved by CSA to the US standard

Warnings



Warning: Consult Operator's Manual.



Warning: Dangerous Voltage. No user-serviceable parts inside.



Fuse Warning: Replace as marked. Fire Hazard.



Explosion risk if used with flammable anesthetics.

Unit Identification



Reorder Number / Catalog Number



Lot number



Serial Number



Date of Manufacture

Other



Type BF protection against electric shock. Floating or isolated applied part/defibrillator protected.



Alternating current (AC)



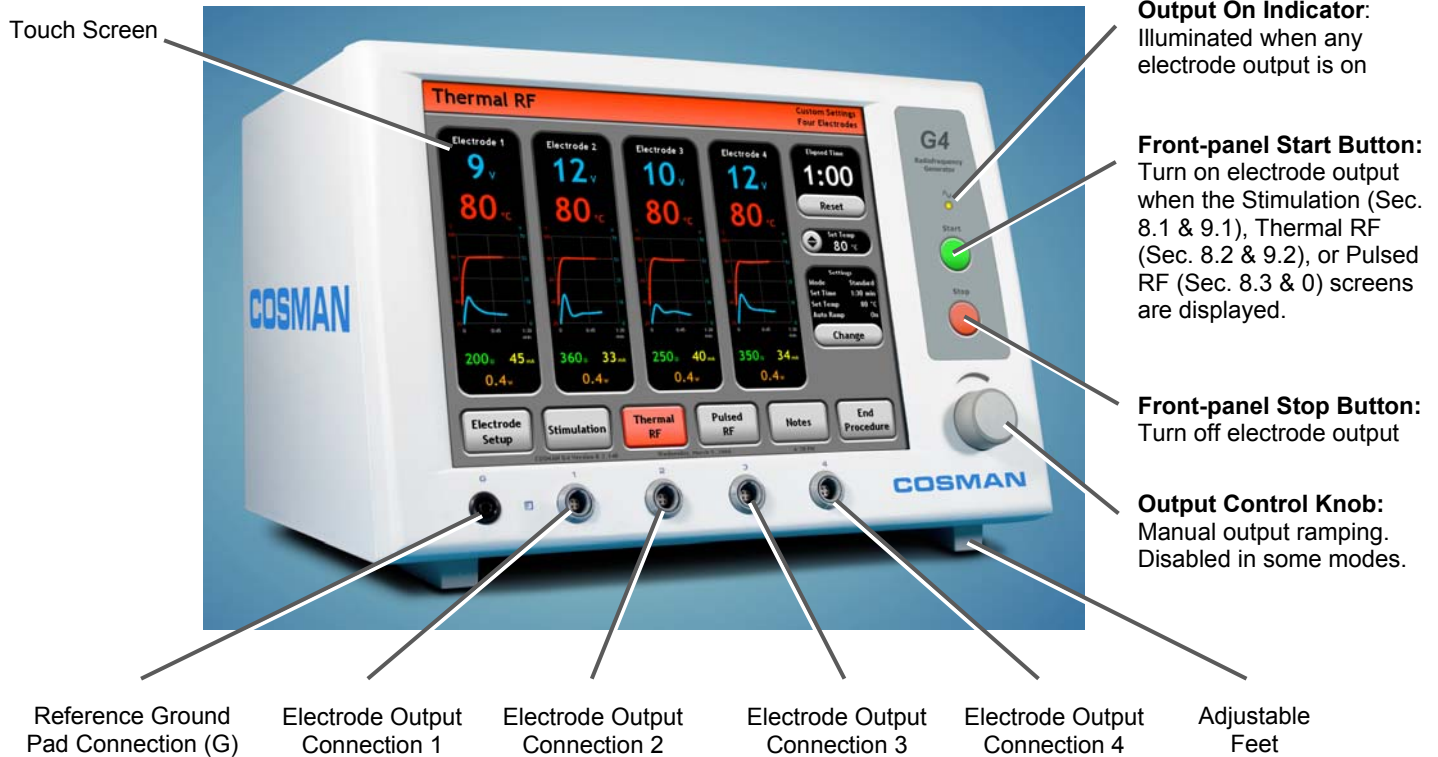
Screen Shot: Save image of screen to Procedure Record

IPX0

Protection against ingress of water: Ordinary

2. Chassis Layout

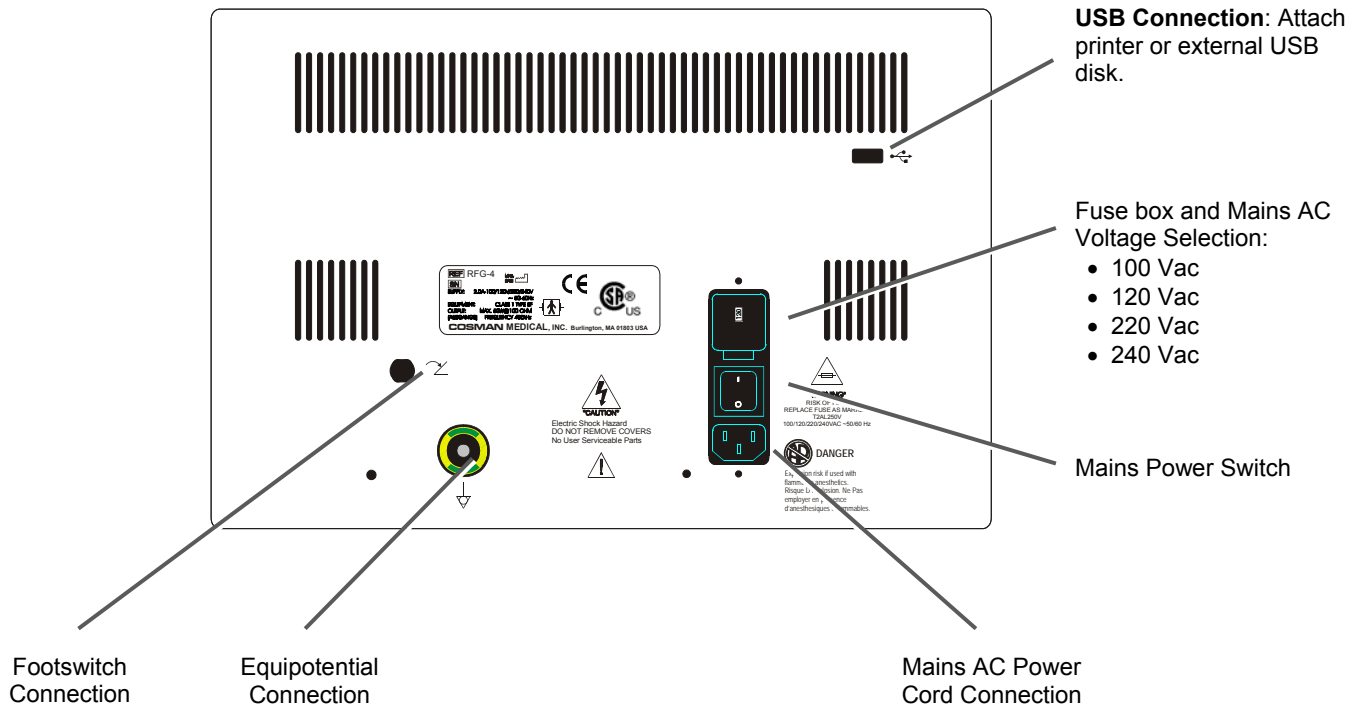
2.1 Front Panel Layout



Notes:

- Electrode connections are made by attaching a CB112-TC cable to an “Electrode Output Connection” jack (gray) shown above.
- Patient “Reference” connection is made by attaching a CB103-B black cable or the DGP-PM Ground Pad to the “Reference Ground Pad Connection” jack (black) shown above.

2.2 Back Panel Layout



Notes:

- **Footswitch Connection:** If the optional Footswitch is connected it will function as the Start button when pressed and the Stop button when released in Stimulation, Thermal RF, and Pulsed RF modes. All other functions of the unit remain the same.
- **Equipotential Connection:** This connection may be used to tie the chassis ground of different pieces of equipment together.

WARNING: When connecting any non-medical peripheral equipment to this device, it must be ensured that the equipment combination meets the requirements of IEC 60601-1-1.

3. Getting Started

3.1 Description

The G4 is a lesion generator capable of supplying up to 50 watts of radiofrequency power while continuously monitoring both the tissue impedance and the temperature at the tip of the one, two, three, or four electrodes. All of these functions are described in more detail in subsequent chapters.

3.2 Indications for Use

The Cosman G4 Radiofrequency Generator is indicated for use in procedures to create radiofrequency lesions for the treatment of pain, or for lesioning nerve tissue for functional neurosurgical procedures. The Cosman G4 Radiofrequency Generator is used with separately approved Cosman Radiofrequency Probes.

3.3 Unpacking the G4 System

G4 Box Contains:

G4	RF Lesion Generator
C119	Power Cord, Domestic (120 V) or
C118	Power Cord, International (220 V)
CB112-TC	Connecting Cable for Electrodes
RFG-TP	Test Plug
Operator's Manual	

NOTICE: Place the Operator's Manual in a safe place for later reference.

NOTICE: Save packaging materials for use in the event that the Generator is shipped back to Cosman Medical, Inc.

4. Turning on the G4 & Main Menu

1. After unpacking the G4 from the shipping box, plug the power cord into the rear of the unit.

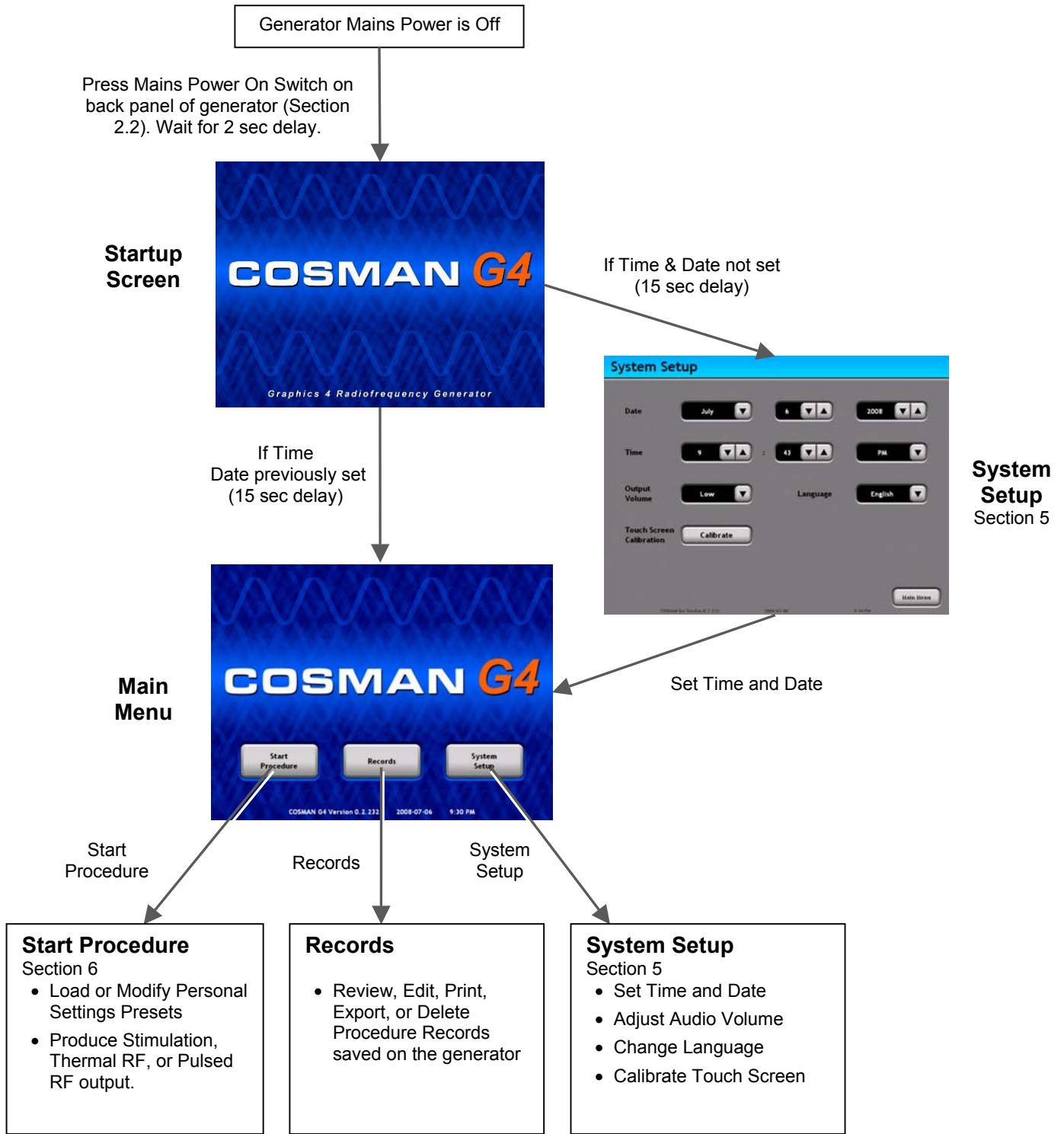
CAUTION: Make sure that the wall outlet voltage matches the voltage displayed on the Voltage Selector located on the rear of unit (100, 120, 220, or 240). If not, open the Fuse drawer, remove the Voltage Selector and rotate it to the proper voltage setting.

2. Plug the power cord into the proper AC receptacle. Rotate the G4's adjustable feet (Section 2.1) downward change the viewing angle of the front panel.

CAUTION: Disconnect all electrodes, ground pad, and associated cables from the G4 before turning the mains power on or off.

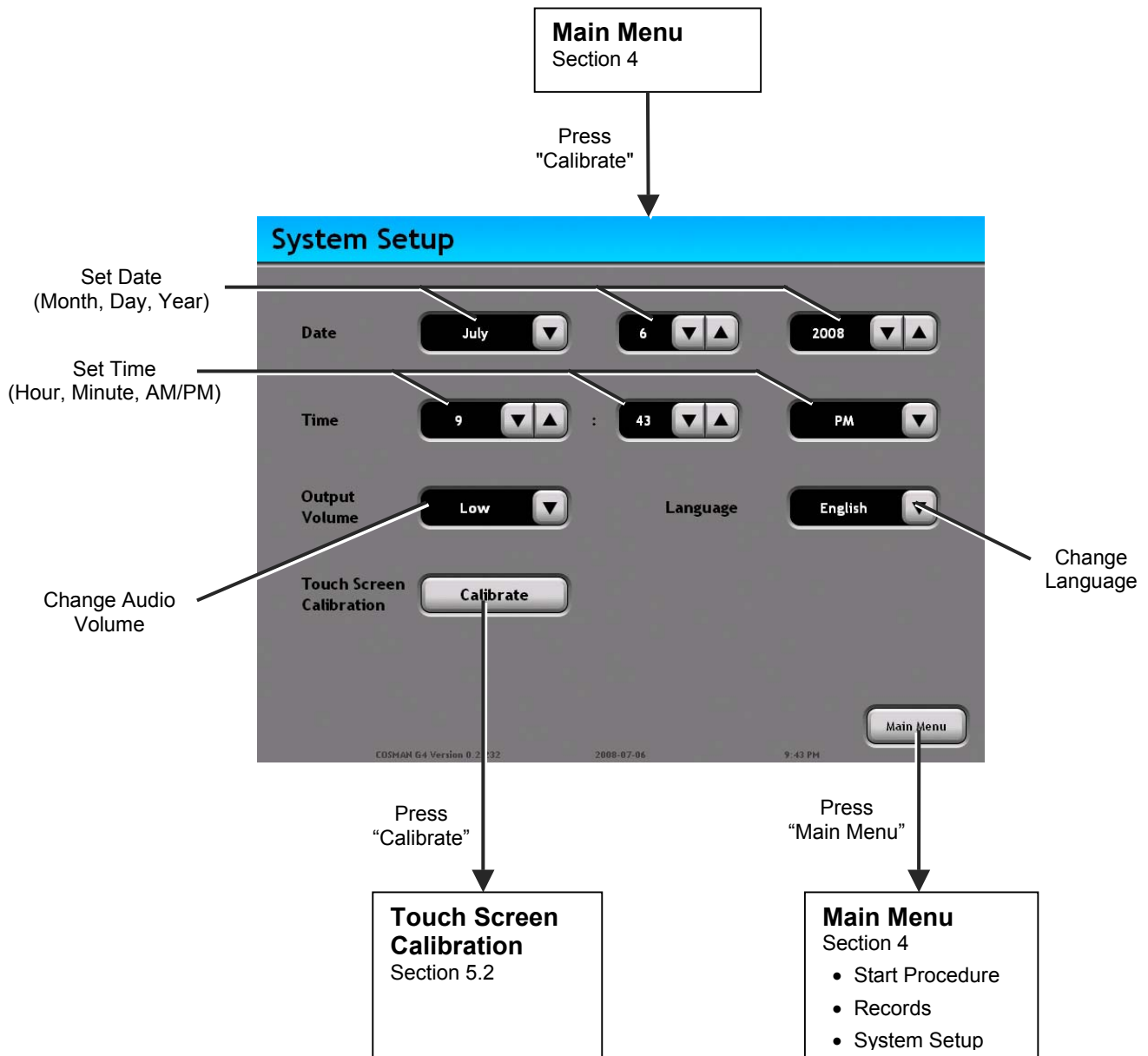
3. Press the Main Power On Switch on the back panel of the generator (Section 2.2). The startup screen appears in approximately 2 seconds, and it is displayed for approximately 15 seconds.

4. If the Time and Date is set, the Main Menu screen is displayed. If the Time and Date is not set, the System Setup screen is displayed and the Time and Date must be set (Section 5.1).



5. System Setup

5.1 Date, Time, Language, and Audio Volume



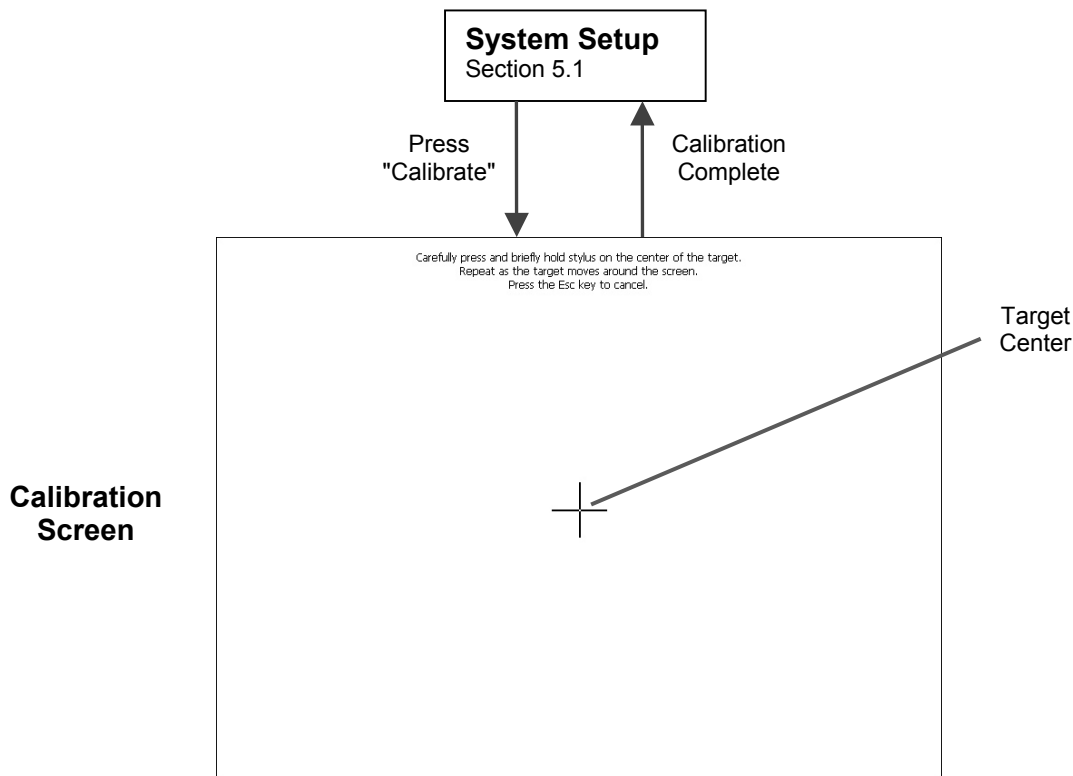
5.2 Touch Screen Calibration

1. Carefully press and briefly hold the center of each cross-shaped target. Lift your finger or stylus from the screen and repeat when the target moves. Lift your finger from the screen when the target disappears.
2. When the cross symbol disappears, press anywhere on the screen to return to the System Setup screen (Section 5.1).
3. Before enabling any generator output, verify the calibration by pressing on-screen buttons that appear in a variety of locations across the screen. For instance, press each button or drop-down menu, except the "Calibrate" button, on the System Setup and Main Menu screens. For each tested button, confirm that a button press is recognized if and only if the screen is pressed within the visible border of that button. If this test fails for any tested button, repeat the touch screen calibration.

WARNING: Poor calibration of the touch screen may cause user input to be recognized incorrectly.

NOTICE: Light use of a blunt, plastic stylus (such as that from a touch-screen PDA) to precisely target the cross symbols may improve touch screen calibration. Damage to the touch screen could occur if too much pressure is applied or if a sharp object is used to touch the screen.

NOTICE: Ignore the text "Press the Esc key to cancel". Touch screen calibration cannot be canceled.

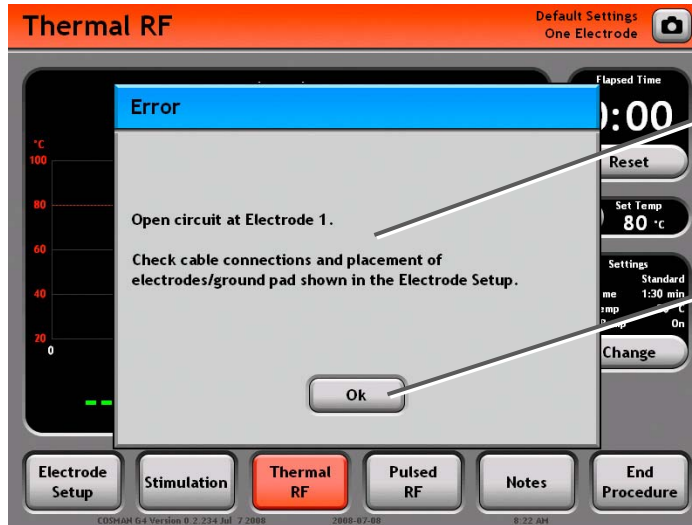


5.3 Testing the G4 Unit

The ability of the generator to produce RF output and to measure Temperature and Impedance can be tested by attaching one or more Test Plugs (RFG-TP) to active electrode jacks and performing a procedure. When a Test Plug is attached to an active electrode jack and the output is off, check that the displayed Impedance is approximately 100 Ω and the displayed Temperature is approximately room Temperature.

5.4 Error and Warning Dialogs

The generator will alert the user with a dialog box when error conditions occur or for other notification purposes. Display of an error dialog box is accompanied by an audible error tone, and the user is prompted



Error or Warning Message: Describes an error condition that has occurred, or describes the function of the available Dialog Box Buttons.

Dialog Box Button: The action of these buttons should always be considered in the context of the Error or Warning Message. For example:

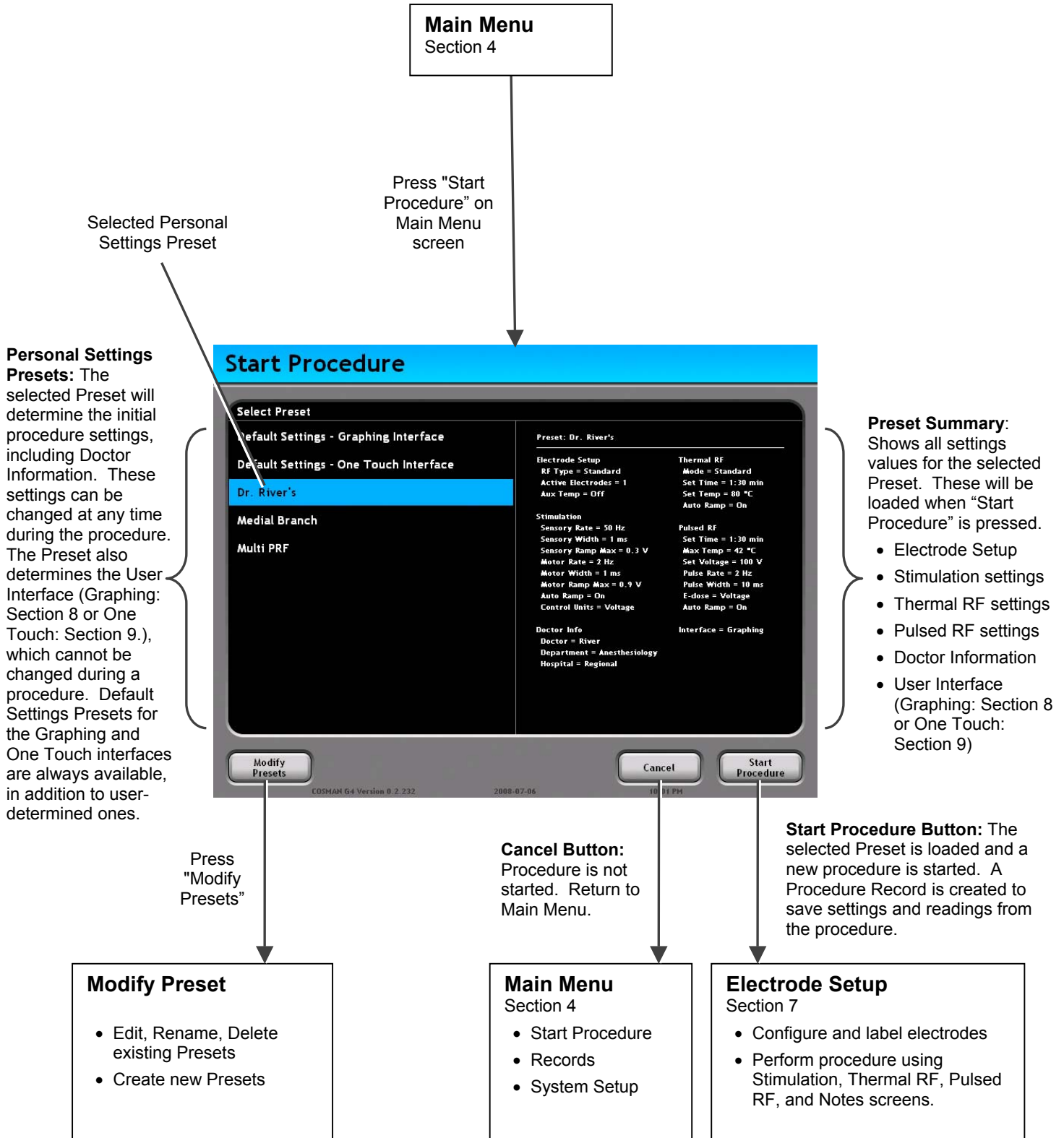
- **Ok:** Perform the described action, or acknowledge the error/warning message.
- **Cancel:** Do not perform the listed action.

to acknowledge the error condition by pressing a button in the error dialog box. An example of a dialog box is shown below.

Common error conditions include the following. See the Troubleshooting guide (Section 11) for more information.

- Open Circuit: Impedance from Electrode to Reference > 3000 Ω
- Short Circuit: Impedance from Electrode to Reference < 30 Ω
- No Temperature: No temperature reading from an Electrode
- Low Temperature: Electrode Temp < 10 °C
- High Temperature: Electrode Temp > 100 °C
- Over Temperature: Electrode Temp > TRF Set Temp or PRF Max Temp
- Disconnect Electrode: Electrodes attached to generator do not match current Electrode Setup settings (Section 7.1).
- High Current/Power: Current or Power output exceeds limits.

6. Start Procedure Screen



7. Electrode Setup Screen

Start Procedure
 Section 6

Disconnect electrodes and probe from any output connector shown on the screen marked with a red "X".

Current Personal Settings Preset

Current Electrode Setup

Settings Buttons: Buttons highlighted in green determine the Electrode Setup that applies to the Stimulation, Thermal RF, and Pulsed RF screen. These settings are described in Section 7.1.

Settings Graphic: Shows the current Electrode Setup settings. Attach electrodes, and ground pad to the Electrode output connections on the front panel (Section 2.1) as shown on the screen.

Labels: Lists the current electrode labels.

Mode Bar: Access other procedure screens:

- Electrode Setup (Section 7)
- Stimulation (Sec. 8.1 & 9.1)
- Thermal RF (Sec. 8.2 & 9.2)
- Pulsed RF (Sec. 8.3 & 0)
- Notes
- End Procedure

Edit Button: Launches a keyboard to edit labels for the active electrode

Clear All Button: Erases all electrode labels

Label Text: A labels can be assigned to each electrode, or bipolar electrode pair.

Electrode Labels Keyboard screen

Press "Ok": Accept entered text

Press "Cancel": Discard entered text

7.1 Electrode Setup Settings

The Electrode Setup settings determine which electrode output connections (Section 2.1) are to be delivered Stimulation, Thermal RF, and/or Pulsed RF output.

- **RF Type:** This setting determines the polarity of active electrode output connections.
 - **Standard:** (a.k.a. "Monopolar") A Reference Ground Pad must be used for return Currents from active electrodes flow into Reference Ground Pad Connection (G).
 - **Bipolar:** Return Currents flow from active electrode output connections into other active electrode output connections. Connections 2 and 3 are at reference potential in this configuration. Voltage, Current, and Impedance readings are displayed for "Bipolar Pairs" of electrodes, i.e. "Electrode 1+2" and "Electrode 3+4", of which one is at reference potential and the other is at potential indicated by the displayed Voltage reading.
- **Active Electrodes:** The number of electrode output connections to which active electrodes should be attached.
- **Labels:** Text may be assigned to each electrode if RF Type = Standard, and to each bipolar electrode pair if RF Type = Bipolar. Labels are displayed on the Stimulation, Thermal RF, and Pulsed RF screens, and are logged to the Summary Record.

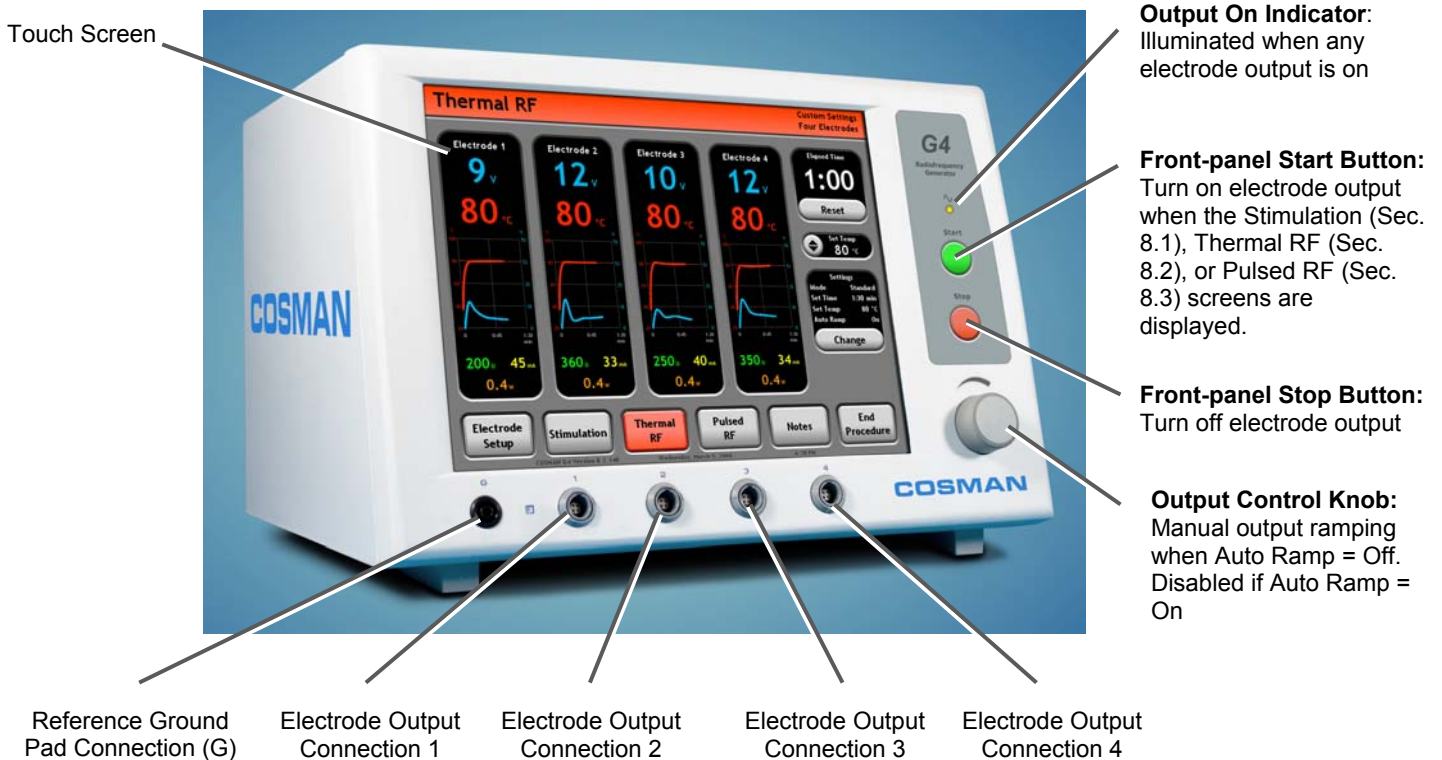
The current Electrode Setup settings are indicated using the following labeling in the upper-right corner of the Stimulation, Thermal RF, Pulsed RF, and Notes screens, as well as in the Summary Record.

RF Type	Active Electrodes	Electrode Setup Indicator
Standard	1	One Electrode
Standard	2	Two Electrodes
Standard	3	Three Electrodes
Standard	4	Four Electrodes
Bipolar	2	Two Electrodes: One Bipolar Pair
Bipolar	4	Four Electrodes: Two Bipolar Pairs

8. Graphing Interface

The Graphing interface is one of two user interfaces available for operation of the generator in Stimulation, Thermal RF, and Pulsed RF modes. The other is One Touch interface (Section 9). Choice of user interface is primarily a matter of user preference, since almost all generator functions (including full automatic ramp and temperature control) are available in both interfaces. The Graphing interface has the following distinguishing characteristics.

- **Graphing:** In Stimulation mode, the output level is plotted as a bar graph (see Section 8.1). In Thermal and Pulsed RF modes, Voltage and Temperature are plotted a function of time when RF output is enabled (see Sections 8.2 and 8.3).
- **Stimulation Level Annotation:** The user can manually mark Stimulation levels (see "Mark Level" button in Section 8.1) for review in the Procedure Record.
- **RF Timer Reset:** The Thermal and Pulsed RF timer can be manually reset when output is on (see Timer, Sections 8.2 & 8.3).
- **Manual Thermal RF Temperature Increment:** The target Temperature (see "Set Temp Panel", Section 8.2) for Thermal RF mode can be increased manually in 5°C steps when electrode output is on.
- **Manual Output Control:** When the "Auto Ramp" setting is Off (see Sections 8.1.2, 8.2.2 & 8.3.2), the Stimulation, Thermal RF, and Pulsed RF output levels can be controlled with the Output Control Knob. Auto Ramp can be disabled in the One Touch interface (Section 9) only if Automatic Temperature Control is disabled (for use with non-temperature-monitoring electrodes).



8.1 Stimulation Screen

Electrode Panel (Black area):
Displays all readings for the indicated electrode output.

Sensory Mode Indicator

Output Off Indicator

Electrode Select Buttons: The selected electrode reads "Selected". Press "Select" to select other electrodes.

Sensory Stimulation Mode Output Off

Output level bars held from previous instances of Stimulation output

Mode Bar: Access other procedure screens

Output Level Reading:
The level of Stimulation output being delivered to the selected electrode in units of Voltage or Current, matching the Stimulation "Control Units" setting.

Press Front-panel Start Button or depress Footswitch:
Stimulation output is delivered only to the selected electrode or bipolar electrode pair.

Press Front-panel Stop Button, release Footswitch, or error occurs:
Electrode output is turned off.

Personal Settings Preset Indicator

Electrode Setup Indicator (Section 7.1)

Screen Shot Button:
Save an image of the screen to the Procedure Record.

Mode: Select Sensory or Motor Stimulation output settings

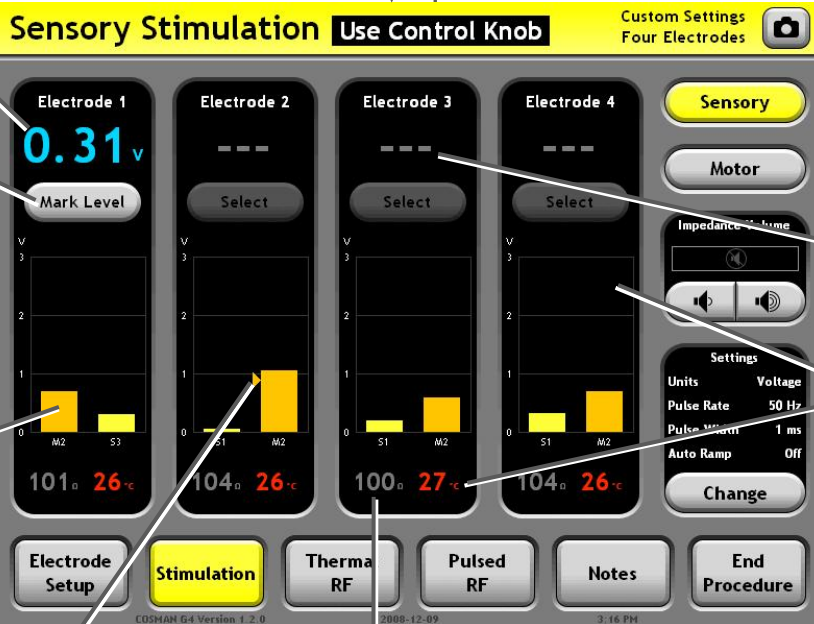
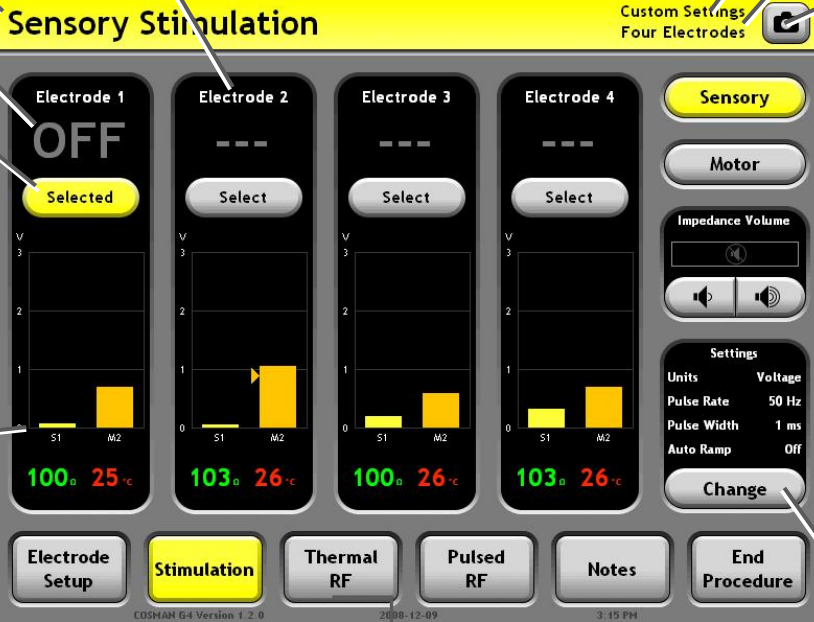
Impedance Tone:
Volume of audio tone with frequency proportional to Impedance reading at selected electrode.

Settings Panel:
Lists the current Stimulation settings.

Press Change Button

Stimulation Settings
Section 8.1.2

- Change settings for Sensory and Motor Stimulation Output



Mark Level Button:
Annotate current output level in Procedure Record

Sensory Stimulation Mode Output On

Output Level Graph:
The height of the rightmost bar in selected electrode's panel shows the level of Stimulation output being delivered to the selected electrode. Bars for past instances of Sensory and Motor Stimulation output are shown on the left for comparison.

Marked Level

Unselected electrodes read "---". Stimulation output is not delivered to unselected electrodes.

Temperature reading:
Reads "-- °C" when Temperature is less than 10°C or absent.

Impedance reading: Held at pre-output on value (gray color) when Stimulation output is on. Reads "-- Ω" when Impedance greater than 3000 Ω (open circuit).

8.1.1 Additional Example Screens

The Graphing Stimulation screen will appear differently depending on the current settings:

- Electrode Setup settings (see Section 7.1)
- Stimulation Mode: Sensory or Motor
- Control Units setting: Voltage- or Current-controlled output (see Section 8.1.2)

Motor Mode Indicator

Motor Stimulation Mode
Four Electrodes

Mode: Select Sensory or Motor Stimulation output

Electrode Panel (Black area):
Displays all readings for the indicated bipolar electrode pair, e.g. "Electrode 1+2".

Output Off Indicator

Sensory Stimulation Mode
One Bipolar Pair

Temperature Readings:
One Temperature reading from each electrode in bipolar pair. For instance, "E1" indicates a reading from Electrode 1.

Bipolar readings:
Voltage/Current and Impedance between the two electrodes in the bipolar pair

Sensory Stimulation Mode
One Electrode & Units= Current

Output Level Reading:
Shown here in units of Current (mA). This is determined by the Control Units = Current.

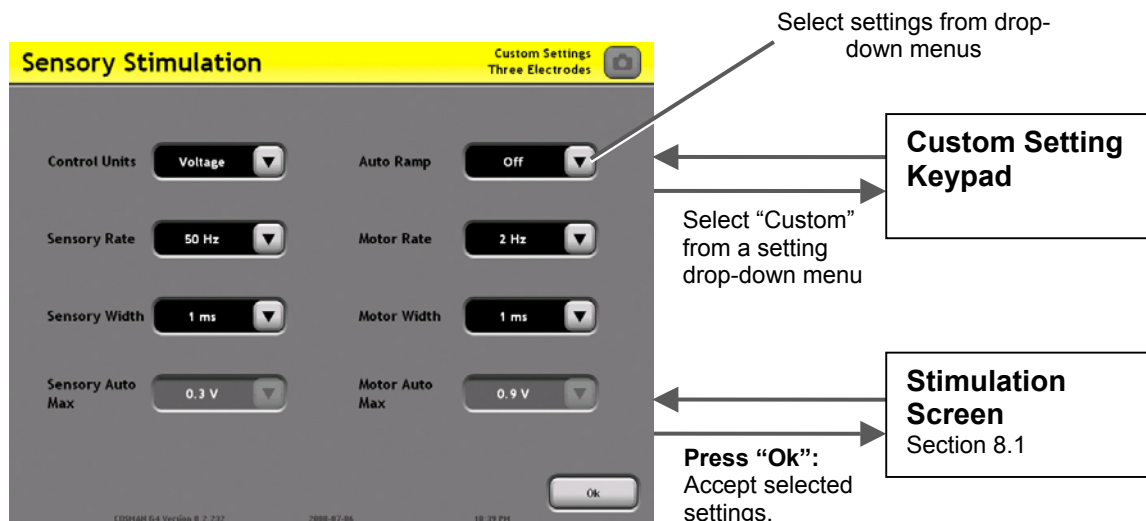
Marked Level

8.1.2 Stimulation Settings

The Electrode Setup settings (Section 7.1) determine the configuration of electrodes when the generator delivers Sensory and Motor Stimulation output. The "Electrode Select Buttons" on the Stimulation screen (see Section 8.1) are used to select one electrode at a time, or one bipolar electrode pair at a time, from those set as "active" on the Electrode Setup screen. Stimulation output is delivered only to the one selected electrode or bipolar electrode pair. The following settings determine the Stimulation output characteristics.

- **Control Units ("Units"):**
 - **Voltage:** Sensory and Motor Stimulation output is Voltage-regulated.
 - **Current:** Sensory and Motor Stimulation output is Current-regulated.
- **Auto Ramp:**
 - **Off:** The Sensory and Motor Stimulation output level is controlled manually by the user with the Output Control Knob (**Graphing Interface Only**).
 - **On:** The Sensory and Motor Stimulation output level increases automatically after the user has turned the output on.
- **Sensory Pulse Rate ("Pulse Rate"):** The rate of Sensory Stimulation output pulses in units of Hertz (Hz), which is equivalent to units of "Pulses Per Second".
- **Sensory Pulse Width ("Pulse Width"):** The width of Sensory Stimulation output pulses in units of milliseconds.
- **Sensory Auto Ramp Max:** The maximum output level if Auto Ramp = On.
- **Motor Pulse Rate ("Pulse Rate"):** The rate of Motor Stimulation output pulses in units of Hertz (Hz), which is equivalent to units of "Pulses Per Second".
- **Motor Pulse Width ("Pulse Width"):** The width of Motor Stimulation output pulses in units of milliseconds.
- **Motor Auto Ramp Max:** The maximum Motor Stimulation output level if Auto Ramp = On.

The Stimulation Settings Screen is shown below.



8.2 Thermal RF Screen

Electrode Panel (Black area):

Displays all readings for the indicated electrode output. When enabled, RF output is delivered to this output.

Personal Settings Preset Indicator

Electrode Setup Indicator (Section 7.1)

Screen Shot Button: Save an image of the screen to the Procedure Record.

Output Off Indicator

Timer: Holds value from last instance of Thermal RF output.

Set Temp Panel: Cycle through Set Temp values when Set Temp is not "Off".

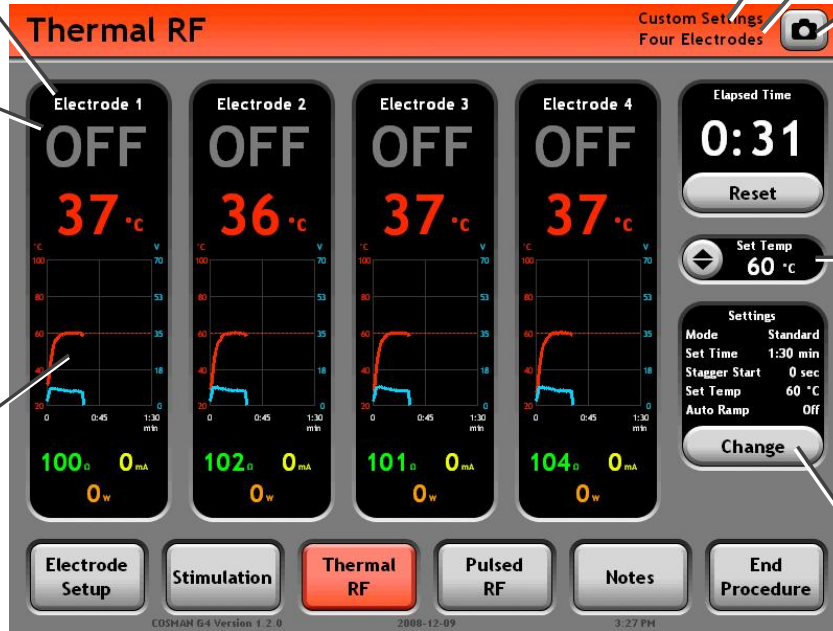
Settings Panel: Lists the current Thermal RF settings.

Press Change Button

Standard Mode Output Off

Temperature & Voltage graphs held from last instance of Thermal RF output

Mode Bar: Access other procedure screens



Press Front-panel Start Button or depress Footswitch: **Thermal RF output is delivered to all active electrodes.**

Press Front-panel Stop Button, release footswitch, timed output completes, or error occurs: **Electrode output is turned off.**

Thermal RF Settings

Section 8.2.2

- Change settings for Thermal RF output

RF Voltage Reading: In units of RMS Volts.

Temperature reading: Reads "-- °C" when Temperature is less than 10°C or absent.

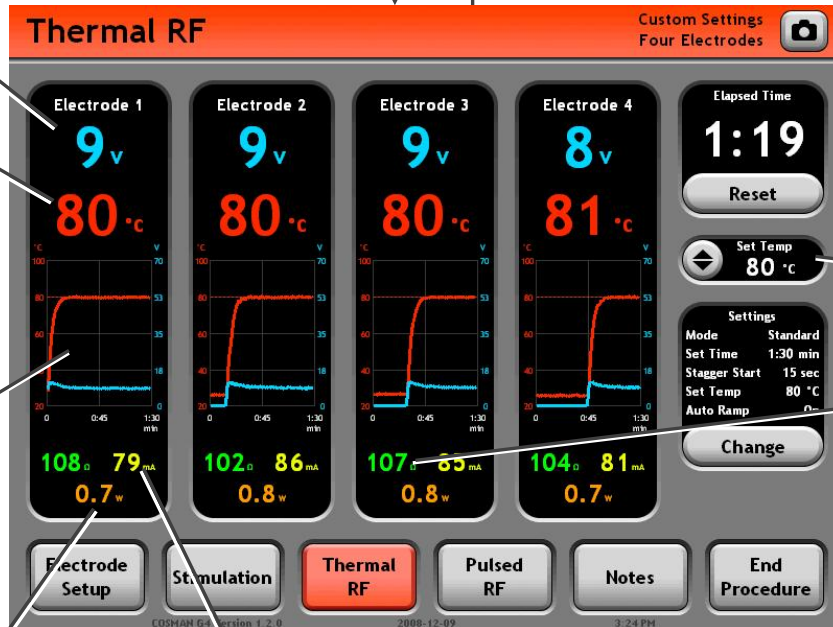
Timer: Counts up to Set Temp in Minutes and Seconds (min:sec) when RF output is on. Reset button sets timer to zero.

Set Temp Panel: Increment Set Temp by 5 °C (up to 90 °C) if Set Temp is not "Off".

Impedance reading: Held at latest value (gray color) when during Stagger Start. Reads "--- Ω" when Impedance greater than 3000 Ω (open circuit).

Standard Mode Output On

Graphs of Temperature & Voltage readings over time



RF Power Reading: In units of RMS Watts.

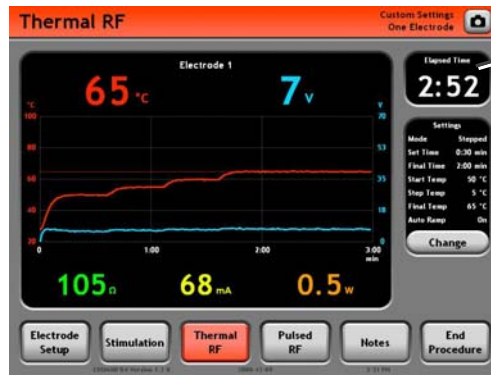
RF Current Reading: In units of RMS Milliamps.

8.2.1 Additional Example Screens

The Graphing Thermal RF screen will appear differently depending on the current settings:

- Electrode Setup settings (see Section 7.1)
- Thermal RF Mode: Standard or Stepped (see Section 8.2.2)

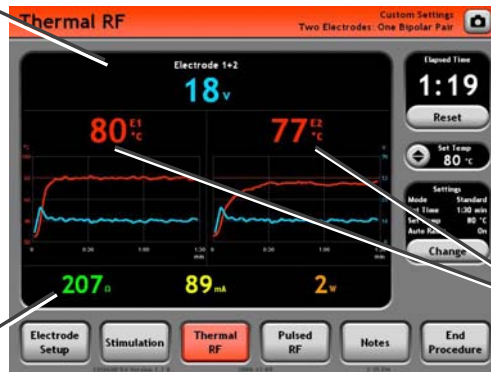
Stepped Mode
One Electrode



Timer: Cannot be reset in Stepped Mode.

Electrode Panel (Black area):
Displays all readings for the indicated bipolar electrode pair, e.g. "Electrode 1+2".

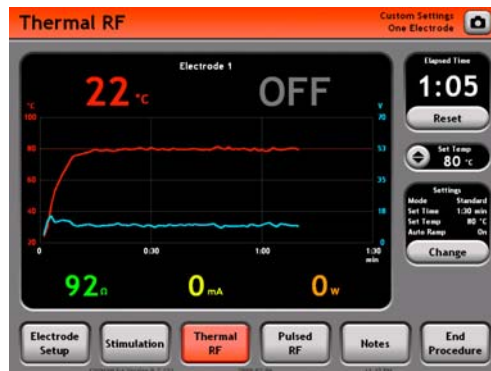
Standard Mode
One Bipolar Pair



Temperature Readings:
One Temperature reading from each electrode in bipolar pair. For instance, "E1" indicates a reading from Electrode 1.

Bipolar readings: Voltage, Current, Power, and Impedance between the two electrodes in the bipolar pair

Standard Mode
One Electrode



8.2.2 Thermal RF Settings

The Electrode Setup settings (Section 7.1) determine the number and configuration of electrodes when the generator delivers Thermal RF output. When Thermal RF output is enabled by the user, it is delivered to all electrodes selected as “active” on the Electrode Setup screen. The following settings determine the Thermal RF output characteristics.

- **Mode:**
 - **Standard:** Time and Temperature control for the Thermal RF output is determined by the Auto Ramp, Set Temp, and Set Time settings.
 - **Stepped:** Time and Temperature control for Thermal RF output is determined by the Start Temp, Step Temp Increment, Final Temp, Step Time, and Final Time settings. RF Voltage is controlled automatically by the generator in order that the Temperatures of active electrodes vary in a stepwise manner.
- **Stagger Start:** When using multiple electrodes, electrodes will turn on sequentially from low to high index, spaced in time by this setting value.
 - **0 seconds:** All electrodes are energized simultaneous when the user enables Thermal RF output using the front-panel Start button.
 - **5-30 seconds:** After the user enables Thermal RF output using the front-panel Start button, each electrode is not energized until Stagger Start seconds after the previous, lower-indexed electrode is energized.

The following settings apply only when Thermal RF Mode = Standard.

- **Auto Ramp** (Graphing Interface Only):
 - **Off:** Thermal RF output Voltage is controlled manually by the user with the Output Control Knob on the front panel of the generator.
 - **On:** Thermal RF output Voltage increases automatically after the user has turned the output on. Applicable only when Automatic Temperature Control is enabled (i.e. Set Temp is not “Off”). The Output Control Knob is inactive.
- **Set Temperature (“Set Temp”):**
 - **Off:** Automatic Temperature Control is disabled. The generator will not control the Temperature at any electrode or check for Temperature-related errors. Auto Ramp is set to Off and the Thermal RF output Voltage must be controlled manually by the user with the Output Control Knob. Use this setting with electrodes that do not monitor temperature, e.g. Cosman CR Electrode.
 - **37-90 °C:** Automatic Temperature Control enabled. Thermal RF output is automatically adjusted to target the Set Temp value for each electrode.
- **Set Time:** This setting determines the total amount of time that Thermal RF output is delivered to each electrode. Once this time interval has elapsed for each electrode, electrode output is disabled automatically.

8.3 Pulsed RF Screen

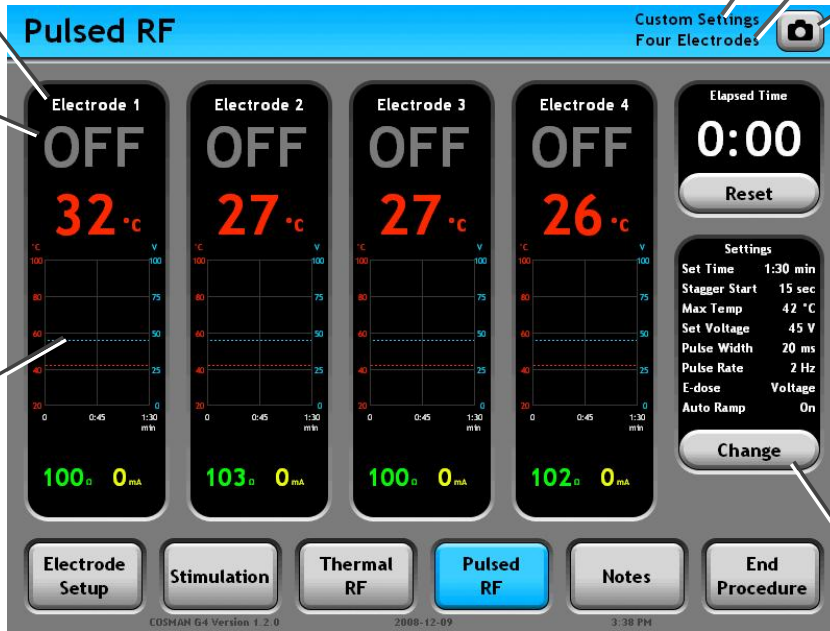
Electrode Panel (Black area):
Displays all readings for the indicated electrode output. When enabled, RF output is delivered to this output.

Output Off Indicator

E-dose = Vary Voltage
Output Off

Temperature & Voltage graphs held from last instance of Thermal RF output (None held here)

Mode Bar: Access other procedure screens



Personal Settings Preset Indicator

Electrode Setup Indicator (Section 7.1)

Screen Shot Button:
Save an image of the screen to the Procedure Record.

Timer: Holds value from last instance of Thermal RF output.

Settings Panel: Lists the current Pulsed RF settings.

Press Change Button

Press Front-panel Start Button or depress Footswitch: **Pulsed RF output is delivered to all active electrodes.**

Press Front-panel Stop Button, release footswitch, timed output completes, or error occurs: **Electrode output is turned off.**

Pulsed RF Settings
Section 8.3.2

- Change settings for Thermal RF output

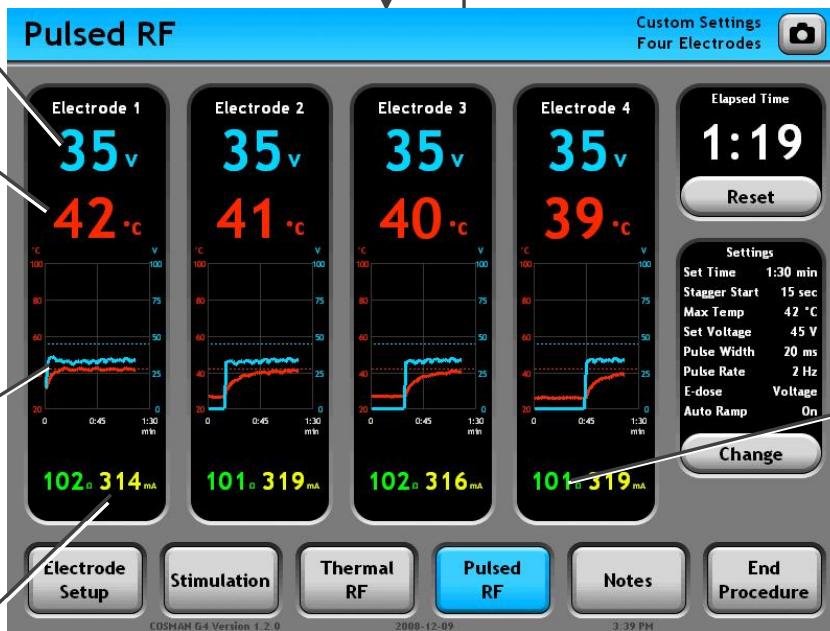
RF Voltage Reading:
In units of Peak Volts.

Temperature reading:
Reads "-- °C" when Temperature is less than 10°C or absent.

E-dose = Vary Voltage
Output On

Graphs of Temperature & Voltage readings over time

RF Current Reading:
In units of Peak Milliamps.



Timer: Counts up t

Set Temp in Minutes and Seconds (min:sec) when RF output is on

Impedance reading:

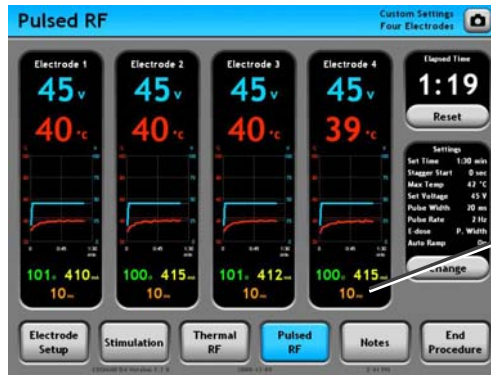
- Held a latest value (gray color) when during Stagger Start.
- Reads "-- Ω" when Impedance greater than 3000 Ω (open circuit).

8.3.1 Additional Example Screens

The Graphing Pulsed RF screen will appear differently depending on the current settings:

- Electrode Setup settings (see Section 7.1)
- E-dose setting: Vary Voltage, Vary Width, or Vary Rate (see Section 8.3.2)

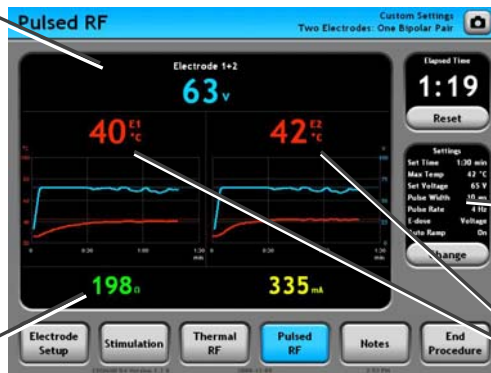
E-dose = Vary Width
Four Electrodes



Pulse Width Reading: Displayed in units of milliseconds only if E-dose = Vary Width. The Pulse Rate is fixed at the value shown in the Settings Panel.

Electrode Panel (Black area): Displays all readings for the indicated bipolar electrode pair, e.g. "Electrode 1+2".

E-dose = Vary Voltage
One Bipolar Pair

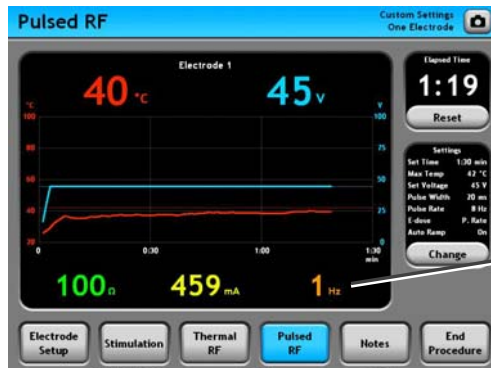


Settings Panel: If E-dose = Vary Width, the Pulse Width and Pulse Rate are fixed at the values shown here.

Bipolar readings: Voltage, Current, and Impedance between the two electrodes in the bipolar pair

Temperature Readings: One Temperature reading from each electrode in bipolar pair. For instance, "E1" indicates a reading from Electrode 1.

E-dose = Vary Rate
One Electrode



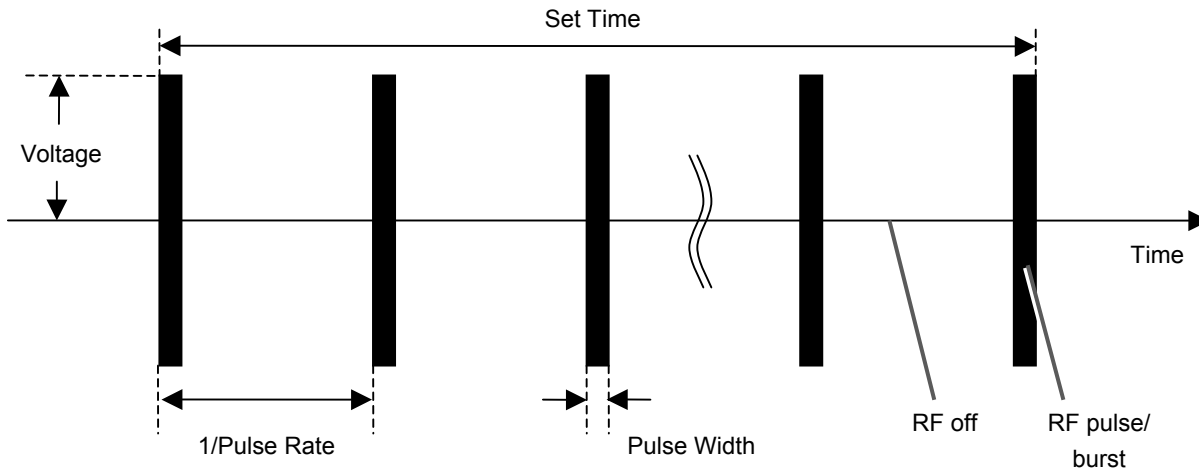
Pulse Rate Reading: Displayed in units of Hertz only if E-dose = Vary Rate. The Pulse Width is fixed at the val

8.3.2 Pulsed RF Settings

The Electrode Setup settings (Section 7.1) determine the number and configuration of electrodes when the generator delivers Pulsed RF output. When Pulsed RF output is enabled by the user, it is delivered to all electrodes selected as “active” on the Electrode Setup screen. The following settings determine the Pulsed RF output characteristics.

- **Stagger Start:** When using multiple electrodes, electrodes will turn on sequentially from low to high index, spaced in time by this setting value.
 - **0 seconds:** All electrodes are energized simultaneous when the user enables Pulsed RF output using the front-panel Start button.
 - **5-30 seconds:** After the user enables Pulsed RF output using the front-panel Start button, each electrode is not energized until Stagger Start seconds after the previous, lower-indexed electrode is energized.
- **Auto Ramp** (Graphing Interface Only):
 - **Off:** Pulsed RF output Voltage is controlled manually by the user with the Output Control Knob on the front panel of the generator.
 - **On:** Pulsed RF output Voltage increases automatically after the user has turned the output on. Applicable only when Automatic Temperature Control is enabled (i.e. Max Temp is not “Off”). The Output Control Knob is inactive.
- **E-Dose:** Applicable if Automatic Temperature Control is enabled (i.e. Max Temp is not “Off”), one of the pulse parameters is automatically reduced to keep all electrode temperatures below the Max Temp setting.
 - **Vary Voltage:** Voltage may be automatically reduced from the Set Voltage setting to keep all electrode temperatures below the Max Temp setting.
 - **Vary Pulse Width (“Vary Width”):** Pulse Width may be automatically reduced from the Pulse Width setting to keep all electrode temperatures below the Max Temp setting. Voltage is reduced when the Pulse Width cannot be reduced below its minimum value.
 - **Vary Pulse Rate (“Vary Rate”):** Pulse Rate may be automatically reduced from the Pulse Rate setting to keep all electrode temperatures below the Max Temp setting. Voltage is reduced if the Pulse Rate cannot be reduced below its minimum value.
- **Max Temperature (“Max Temp”):**
 - **Off:** Automatic Temperature Control is disabled. The generator will not control the Temperature at any electrode. Auto Ramp is set to Off and the Pulsed RF output Voltage must be controlled manually by the user with the Output Control Knob.
 - **37-90 °C:** Automatic Temperature Control enabled. Pulsed RF output is automatically adjusted so that electrode Temperatures do not exceed the Max Temp value.
- **Set Voltage:** The target Voltage amplitude of the Pulsed RF output.
- **Pulse Width:** The duration in milliseconds of each burst of Pulsed RF output.
- **Pulse Rate:** The rate in Hz (equivalent to “Pulses Per Second”) at which bursts of Pulse RF output are delivered.
- **Set Time:** This setting determines the total amount of time that Pulsed RF output is delivered to each electrode. Once this time interval has elapsed for each electrode, electrode output is disabled automatically.

Selected parameters of the Pulsed RF waveform are shown schematically in the illustration below.



The Pulsed RF Settings Screen is shown below.

The screenshot shows the 'Pulsed RF' settings screen. The title bar is blue and contains 'Pulsed RF' and 'Custom Settings One Electrode' with a camera icon. The screen has a grey background with various settings:

- E-dose: Vary Voltage (dropdown)
- Auto Ramp: On (dropdown)
- Set Time: 1:30 min (dropdown)
- Maximum Voltage: 45 V (dropdown)
- Max Temp: 42 °C (dropdown)
- Pulse Width: 20 ms (dropdown)
- Stagger Start: 10 sec (dropdown)
- Pulse Rate: 2 Hz (dropdown)

An 'Ok' button is at the bottom center. Annotations include:

- 'Select settings from drop-down menus' pointing to the dropdown arrows.
- 'Select "Custom" from a setting drop-down menu' pointing to the 'Custom Settings One Electrode' header.
- 'Press "Ok": Accept selected settings.' pointing to the 'Ok' button.
- Two boxes on the right: 'Custom Setting Keypad' and 'Pulsed RF Screen Section 8.3', with arrows pointing to the screen area.

At the bottom left, small text reads: 'COSMAN G4 Version 0.2.232 2008-07-06 11:56 PM'.

9. One Touch Interface

The One Touch interface is one of two user interfaces available for operation of the generator in Stimulation, Thermal RF, and Pulsed RF modes. The other is Graphing interface (Section 8). Choice of user interface is primarily a matter of user preference, since almost all generator functions are available in both interfaces. The One Touch interface has the following distinguishing characteristics.

- **On-screen Start/Stop button:** An on-screen Start/Stop toggle button is available to enable and disable electrode output. The mechanical Start and Stop buttons to the right of the Touch Screen are still fully functional, but do not need to be used.
- **Stimulation Incremental Controls:** When the Stimulation “Auto Ramp” setting is Off (see Sections 9.1 & 9.1.2), Stimulation output is incremented and decremented using on-screen buttons, NOT that Output Control Knob.
- **Thermal and Pulsed RF Automatic Control:** Automatic output ramping (“Auto Ramp”) cannot be disabled for Thermal RF and Pulsed RF output unless Automatic Temperature Control is disabled (see Sections 9.2.2 and 9.2.4). Manual output ramping using the Output Control knob can be enabled by setting “Auto Ramp” to Off in the Graphing interface (see Section 8).

Stimulation Increment/Decrement Buttons:
Available on the One Touch Stimulation screen when Stimulation Auto Ramp = Off.

On-screen Start/Stop Button:

- Press “Start” to turn electrode output on.
- Press “Stop” to turn electrode output off.

Output On Indicator:
Illuminated when any electrode output is on

Front-panel Start Button:
Turn on electrode output when the Stimulation (Sec. 9.1), Thermal RF (Sec. 9.2), or Pulsed RF (Sec. 0) screens are displayed.

Front-panel Stop Button:
Turn off electrode output

Output Control Knob:
Manual output ramping in TRF & PRF mode if Set/Max Temp=Off. Disabled at all other times.

Touch Screen



Reference Ground Pad Connection (G)

Electrode Output Connection 1

Electrode Output Connection 2

Electrode Output Connection 3

Electrode Output Connection 4

9.1 Stimulation Screen

Auto Ramp & Units Indicator: Reads “Auto” if Auto Ramp=On, and “Manual” otherwise. Reads “Voltage” or “Current” to match the Control Units setting.

Sensory Mode Indicator

Electrode Panel (Black area): Displays all readings for the indicated, selected electrode or bipolar output.

Output Increment & Decrement Buttons: Increase & decrease the output level when electrode output is on and Auto Ramp=Off. Absent if Auto Ramp = On.

Personal Settings Preset Indicator

Electrode Setup Indicator (Section 7.1)

Screen Shot Button: Save an image of the screen to the Procedure Record.

Start/Stop Button: Press “Start” to turn electrode output on. Press “Stop” to turn electrode output off.

Mode: Select Sensory or Motor Stimulation output settings

Settings Panels: Lists the current Stimulation settings.

Press a Settings Panel button

Stimulation Settings
Section 9.1.2

- Change settings associated with the target Settings Panel

Start/Stop Button: Press “Start” to turn electrode output on. Press “Stop” to turn electrode output off.

Control Units & Auto Ramp Settings

Sensory Pulse Rate Setting

Sensory Pulse Width Setting

Impedance reading: Held at pre-output on value (gray color) when Stimulation output is on. Reads “--- Ω” when Impedance greater than 3000 Ω (open circuit).

Temperature reading: Reads “-- °C” when Temperature is less than 10°C or absent. Only shown for the selected electrode.

Output Off Indicator

Sensory Stimulation Mode Output Off

Impedance Tone: Volume of audio tone with frequency proportional to Impedance reading at selected electrode.

Electrode Select Buttons: The selected electrode or bipolar electrode pair is highlighted.

Output Level Reading: The level of Stimulation output being delivered to the selected electrode in units of Voltage or Current, matching the Stimulation “Control Units” setting.

Sensory Stimulation Mode Output On

Impedance Tone: Muted when electrode output is on.

Mode Bar: Access other procedure screens

Press front-panel or on-screen Start Button or depress Footswitch: **Stimulation output is delivered to the selected electrode or bipolar electrode pair.**

Press front-panel or on-screen Stop Button, release Footswitch, or error occurs: **Electrode output is turned off.**

Sensory Stimulation Custom Settings Three Electrodes

Electrode 1

Manual Voltage 0.1 V 0.01 V

OFF

Impedance 94 Ω Temperature 24 °C

Electrode Select 1 2 3

Electrode Setup Stimulation Thermal RF Pulsed RF Notes End Procedure

COSMAN G4 Version 0.2.232 2008-07-07 12:04 AM

Start

Sensory Motor

Voltage Ramp OFF

Pulse Rate 50 Hz

Pulse Width 1 ms

Stop

Sensory Motor

Voltage Ramp OFF

Pulse Rate 50 Hz

Pulse Width 1 ms

Electrode Setup Stimulation Thermal RF Pulsed RF Notes End Procedure

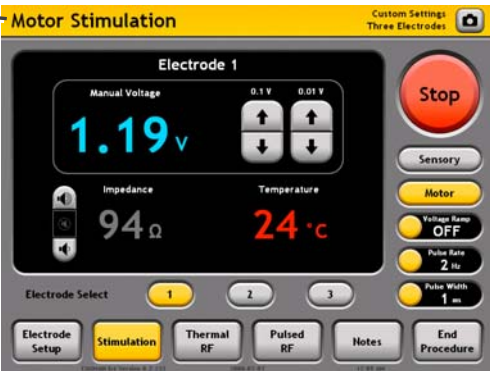
COSMAN G4 Version 0.2.232 2008-07-07 12:04 AM

9.1.1 Additional Example Screens

The One Touch Stimulation screen will appear differently depending on the current settings:

- Electrode Setup settings (see Section 7.1)
- Stimulation Mode: Sensory or Motor
- Auto Ramp Setting: Off/Manual or On/Auto (see Section 9.1.2)
- Control Units setting: Voltage- or Current-controlled output (see Section 9.1.2)

Motor Stimulation Mode
Three Electrodes

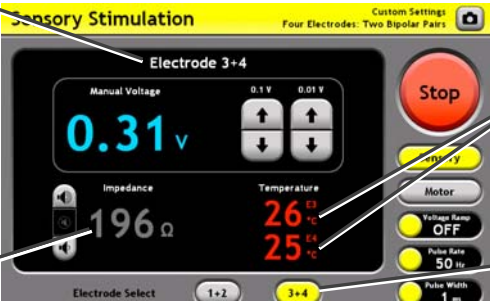


Motor Mode Indicator

Mode: Select Sensory or Motor Stimulation output

Settings Panels: Mode switches between Sensory & Motor settings

Sensory Stimulation Mode
Two Bipolar Pairs

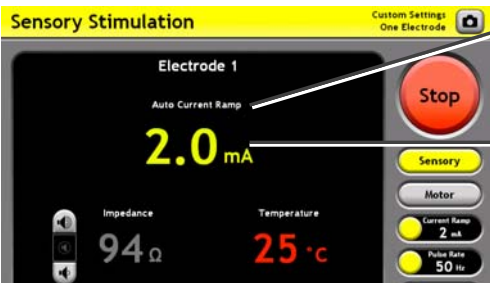


Electrode Panel (Black area): Displays all readings for the indicated bipolar electrode pair, e.g. "Electrode 1+2".

Temperature Readings: One Temperature reading from each electrode in bipolar pair. For instance, "E1" indicates a reading from Electrode 1.

Electrode Select Buttons: Select between bipolar electrode pairs 1+2 or 3+4.

Sensory Stimulation Mode
One Electrode,
Auto Ramp = On &
Units= Current



Bipolar readings: Voltage/Current and Impedance between the two electrodes in the bipolar pair

Auto Ramp & Units Indicator: Reads "Auto" if Auto Ramp=On, and "Manual" otherwise. Reads "Voltage" or "Current" to match the Control Units setting.

Output Level Reading: Shown here in units of Current (mA). This is determined by the Control Units = Current.

Electrode Select Buttons: Absent when Electrode Setup for one electrode or one bipolar pair.

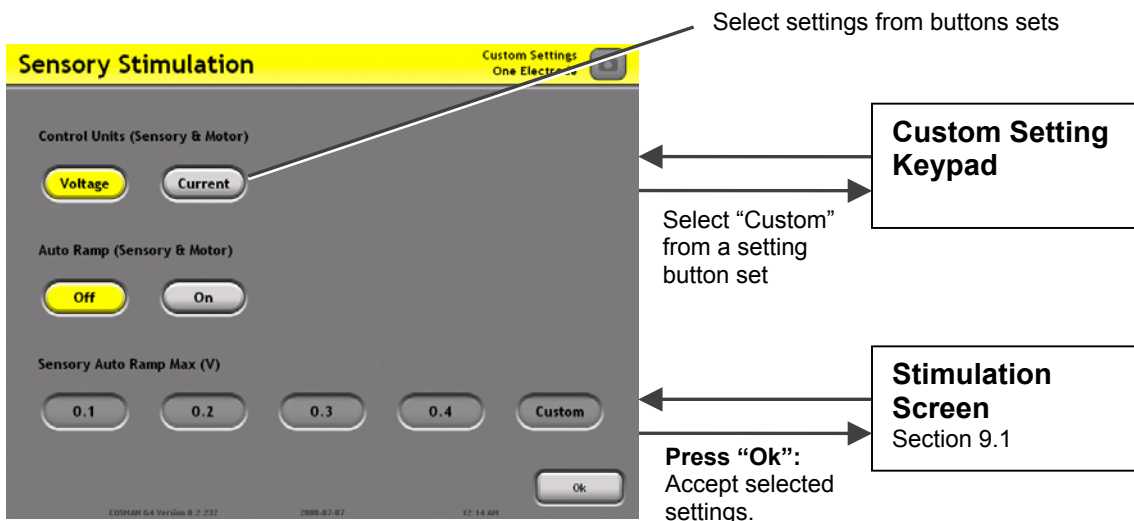
Output Increment & Decrement Buttons: Absent if Auto Ramp = On.

9.1.2 Stimulation Settings

The Electrode Setup settings (Section 7.1) determine the configuration of electrodes when the generator delivers Sensory and Motor Stimulation output. The "Electrode Select Buttons" on the Stimulation screen (see Section 9.1) are used to select one electrode at a time, or one bipolar electrode pair at a time, from those set as "active" on the Electrode Setup screen. Stimulation output is delivered only to the one selected electrode or bipolar electrode pair. The following settings determine the Stimulation output characteristics.

- **Control Units ("Units"):**
 - **Voltage:** Sensory and Motor Stimulation output is Voltage-regulated.
 - **Current:** Sensory and Motor Stimulation output is Current-regulated.
- **Auto Ramp:**
 - **Off:** The Sensory and Motor Stimulation output level is controlled manually by the on-screen Output Increment and Decrement buttons (One Touch interface only).
 - **On:** The Sensory and Motor Stimulation output level increases automatically after the user has turned the output on.
- **Sensory Pulse Rate ("Pulse Rate"):** The rate of Sensory Stimulation output pulses in units of Hertz (Hz), which is equivalent to units of "Pulses Per Second".
- **Sensory Pulse Width ("Pulse Width"):** The width of Sensory Stimulation output pulses in units of milliseconds.
- **Sensory Auto Ramp Max:** The maximum output level if Auto Ramp = On.
- **Motor Pulse Rate ("Pulse Rate"):** The rate of Motor Stimulation output pulses in units of Hertz (Hz), which is equivalent to units of "Pulses Per Second".
- **Motor Pulse Width ("Pulse Width"):** The width of Motor Stimulation output pulses in units of milliseconds.
- **Motor Auto Ramp Max:** The maximum Motor Stimulation output level if Auto Ramp = On.

An example of a Stimulation Change Settings screen is shown below.



9.2 Thermal RF Screen

Electrode Panel (Black area):
Displays all readings for the indicated electrode output. When enabled, RF output is delivered to this output.

Timer: Holds value from last instance of Thermal RF output.

Personal Settings Preset Indicator

Electrode Setup Indicator (Section 7.1)

Screen Shot Button:
Save an image of the screen to the Procedure Record.

Start/Stop Button:
Press "Start" to turn electrode output on. Press "Stop" to turn electrode output off.

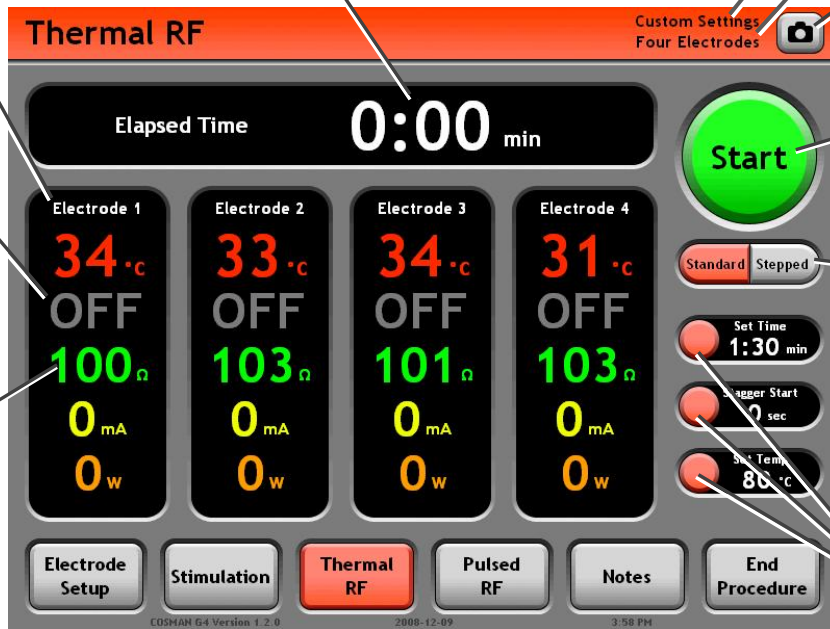
Mode: Select Standard or Stepped control mode

Settings Panels:
Lists the current Thermal RF settings.

Press a Settings Panel button

Thermal RF Settings
Section 9.2.2

- Change settings associated with the target Settings Panel



Standard Mode
Output Off

Impedance Reading

Mode Bar: Access other procedure screens

Timer: Counts up to Set Temp in Minutes and Seconds (min:sec) when RF output is on.

Press front-panel or on-screen Start Button or depress Footswitch: **Thermal RF output is delivered to all active electrodes.**

Press front-panel or on-screen Stop Button, release Footswitch, timed output completes, or error occurs: **Electrode output is turned off.**

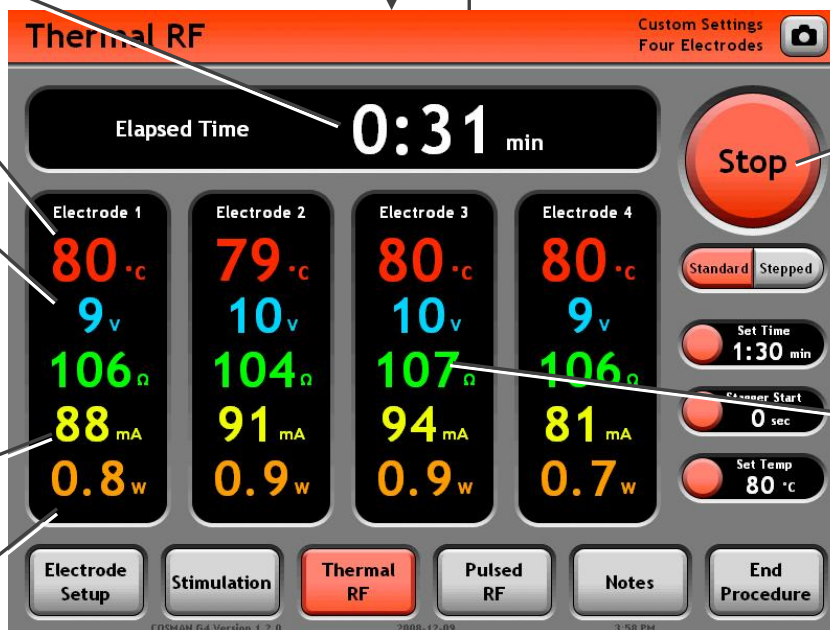
Temperature reading:
Reads "-- °C" when Temperature is less than 10°C or absent.

RF Voltage Reading:
In units of RMS Volts.

Standard Mode
Output On

RF Current Reading:
In units of RMS Milliamps.

RF Power Reading:
In units of RMS Watts.



Start/Stop Button:
Press "Start" to turn electrode output on. Press "Stop" to turn electrode output off.

Impedance reading:

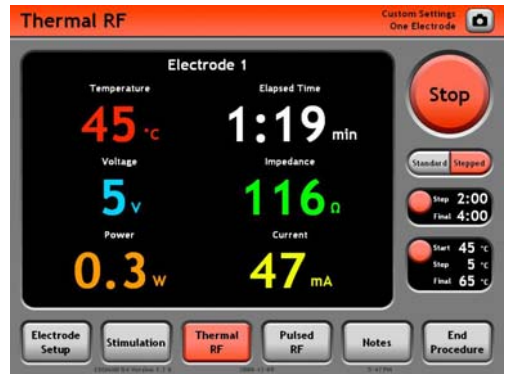
- Held at latest value (gray color) when during Stagger Start.
- Reads "-- Ω" when Impedance greater than 3000 Ω (open circuit).

9.2.1 Additional Example Screens

The One Touch Thermal RF screen will appear differently depending on the current settings:

- Electrode Setup settings (see Section 7.1)
- Thermal RF Mode: Standard or Stepped (see Section 9.2.2)

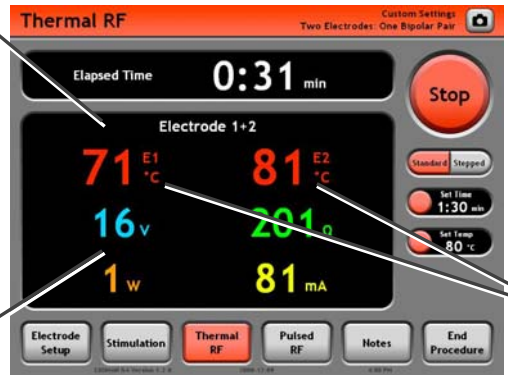
Stepped Mode
Four Electrodes



Settings Panels:
Lists the current Thermal RF settings for Stepped mode.

Electrode Panel (Black area):
Displays all readings for the indicated bipolar electrode pair, e.g. "Electrode 1+2".

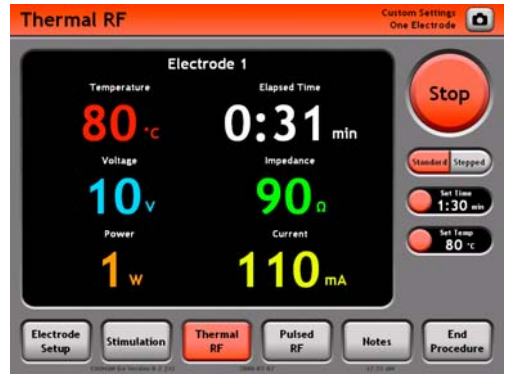
Standard Mode
One Bipolar Pair



Bipolar readings: Voltage, Current, Power, and Impedance between the two electrodes in the bipolar pair

Temperature Readings:
One Temperature reading from each electrode in bipolar pair. For instance, "E1" indicates a reading from Electrode 1.

Standard Mode
One Electrode



9.2.2 Thermal RF Settings

The Electrode Setup settings (Section 7.1) determine the number and configuration of electrodes when the generator delivers Thermal RF output. When Thermal RF output is enabled by the user, it is delivered to all electrodes selected as “active” on the Electrode Setup screen. The following settings determine the Thermal RF output characteristics.

- **Mode:**
 - **Standard:** Time and Temperature control for the Thermal RF output is determined by the Auto Ramp, Set Temp, and Set Time settings.
 - **Stepped:** Time and Temperature control for Thermal RF output is determined by the Start Temp, Step Temp Increment, Final Temp, Step Time, and Final Time settings. RF Voltage is controlled automatically by the generator in order that the Temperatures of active electrodes vary in a stepwise manner.
- **Stagger Start:** When using multiple electrodes, electrodes will turn on sequentially from low to high index, spaced in time by this setting value.
 - **0 seconds:** All electrodes are energized simultaneous when the user enables Thermal RF output using the front-panel Start button.
 - **5-30 seconds:** After the user enables Thermal RF output using the front-panel Start button, each electrode is not energized until Stagger Start seconds after the previous, lower-indexed electrode is energized.

The following settings apply only when Thermal RF Mode = Standard.

- **Auto Ramp:** This setting cannot be set by the user in the One Touch interface. It is implicitly set to On at all times, except when Automatic Temperature Control is disabled (Set Temp = Off), in which case it is set to Off and the Thermal RF output Voltage must be controlled manually by the user with the Output Control Knob.
- **Set Temperature (“Set Temp”):**
 - **Off:** Automatic Temperature Control is disabled. The generator will not control the Temperature at any electrode or check for Temperature-related errors. Auto Ramp is set to Off and the Thermal RF output Voltage must be controlled manually by the user with the Output Control Knob. Use this setting with electrodes that do not monitor temperature, e.g. Cosman CR Electrode.
 - **37-90 °C:** Automatic Temperature Control enabled. Thermal RF output is automatically adjusted to target the Set Temp value for each electrode.
- **Set Time:** This setting determines the total amount of time that Thermal RF output is delivered to each electrode. Once this time interval has elapsed for each electrode, electrode output is disabled automatically.

Pulsed RF Screen

Electrode Panel (Black area):
Displays all readings for the indicated electrode output. When enabled, RF output is delivered to this output.

Timer: Holds value from last instance of Pulsed RF output.

Personal Settings Preset Indicator

Electrode Setup Indicator (Section 7.1)

Screen Shot Button:
Save an image of the screen to the Procedure Record.

Start/Stop Button:
Press "Start" to turn electrode output on. Press "Stop" to turn electrode output off.

Settings Panels:
Lists the current Pulsed RF settings.

Press a Settings Panel button

Pulsed RF Settings
Section 9.2.4

- Change settings associated with the target Settings Panel

Start/Stop Button:
Press "Start" to turn electrode output on. Press "Stop" to turn electrode output off.

Set Voltage & E-dose Settings

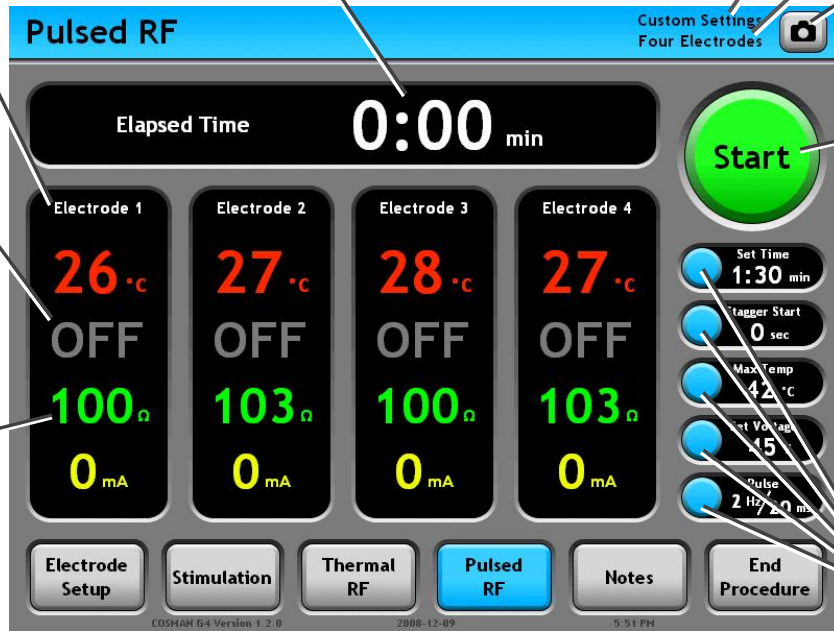
Pulse Rate, Pulse Width & E-dose Settings

Output Off Indicator

E-dose = Vary Voltage
Output Off

Impedance Reading

Mode Bar: Access other procedure screens



Timer: Counts up to Set Temp in Minutes and Seconds (min:sec) when RF output is on.

Press front-panel or on-screen Start Button or depress Footswitch: **Pulsed RF output is delivered to all active electrodes.**

Press front-panel or on-screen Stop Button, release Footswitch, timed output completes, or error occurs: **Electrode output is turned off.**

Temperature reading:
Reads "-- °C" when Temperature is less than 10°C or absent.

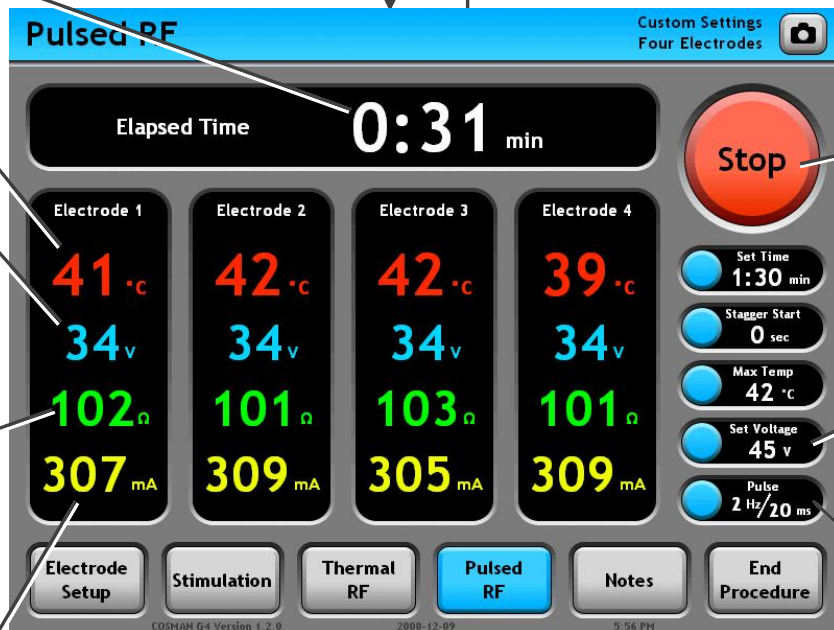
RF Voltage Reading:
In units of Peak Volts.

E-dose = Vary Voltage
Output On

Impedance reading:

- Held a latest value (gray color) when during Stagger Start.
- Reads "--- Ω" when Impedance greater than 3000 Ω (open circuit).

RF Current Reading: In units of Peak Milliamps.

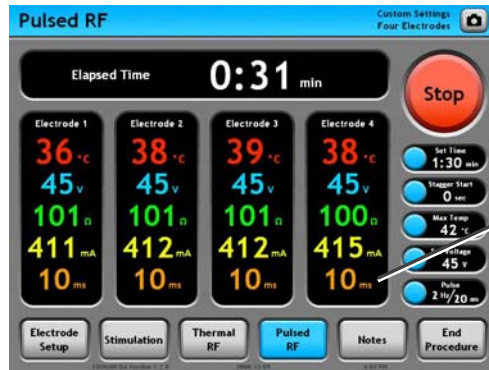


9.2.3 Additional Example Screens

The One Touch Pulsed RF screen will appear differently depending on the current settings:

- Electrode Setup settings (see Section 7.1)
- E-dose setting: Vary Voltage, Vary Width, or Vary Rate (see Section 9.2.4)

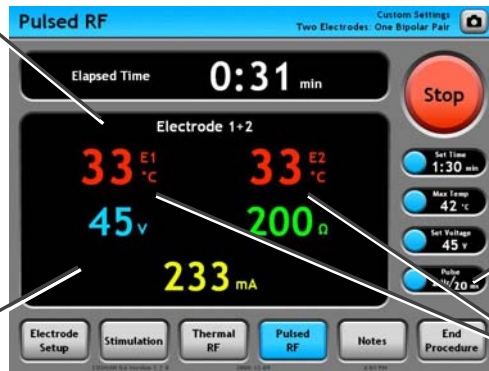
E-dose = Vary Width
Four Electrodes



Pulse Width Reading: Displayed in units of milliseconds only if E-dose = Vary Width. The Pulse Rate is fixed at the value shown in the Settings Panel.

Electrode Panel (Black area): Displays all readings for the indicated bipolar electrode pair, e.g. "Electrode 1+2".

E-dose = Vary Voltage
One Bipolar Pair

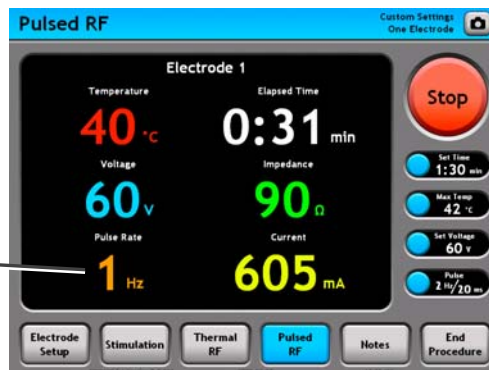


Pulse Panel: If E-dose = Vary Width, the Pulse Width and Pulse Rate are fixed at the values shown here.

Bipolar readings: Voltage, Current, and Impedance between the two electrodes in the bipolar pair

Temperature Readings: One Temperature reading from each electrode in bipolar pair. For instance, "E1" indicates a reading from Electrode 1.

E-dose = Vary Rate
One Electrode



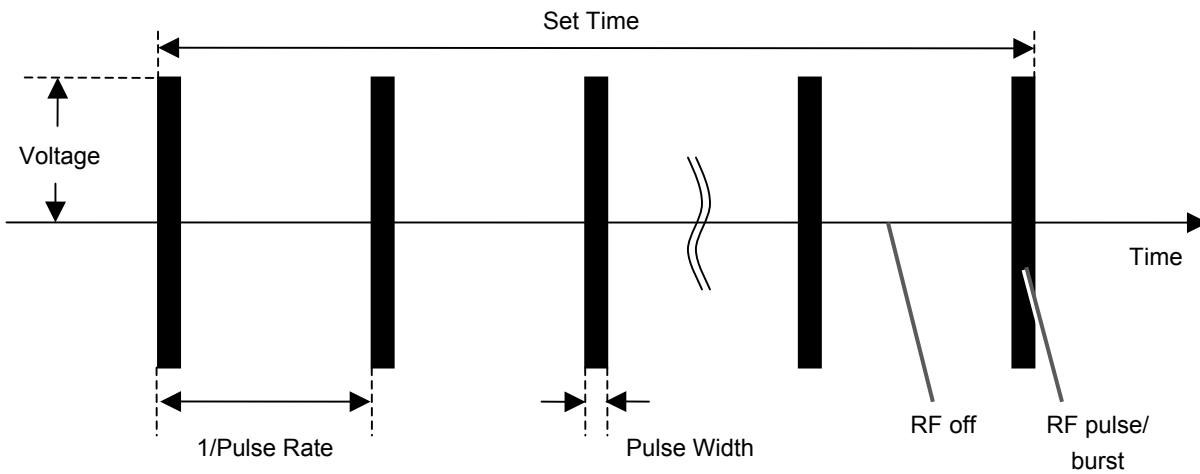
Pulse Rate Reading: Displayed in units of Hertz only if E-dose = Vary Rate. The Pulse Width is fixed at the value shown in the Settings Panel.

9.2.4 Pulsed RF Settings

The Electrode Setup settings (Section 7.1) determine the number and configuration of electrodes when the generator delivers Pulsed RF output. When Pulsed RF output is enabled by the user, it is delivered to all electrodes selected as “active” on the Electrode Setup screen. The following settings determine the Pulsed RF output characteristics.

- **Stagger Start:** When using multiple electrodes, electrodes will turn on sequentially from low to high index, spaced in time by this setting value.
 - **0 seconds:** All electrodes are energized simultaneous when the user enables Pulsed RF output using the front-panel Start button.
 - **5-30 seconds:** After the user enables Pulsed RF output using the front-panel Start button, each electrode is not energized until Stagger Start seconds after the previous, lower-indexed electrode is energized.
- **Auto Ramp:** This setting cannot be set by the user in the One Touch interface. It is implicitly set to On at all times, except when Automatic Temperature Control is disabled (Max Temp = Off), in which case it is set to Off and the Pulsed RF output Voltage must be controlled manually by the user with the Output Control Knob.
- **E-Dose:** Applicable if Automatic Temperature Control is enabled (i.e. Max Temp is not “Off”), one of the pulse parameters is automatically reduced to keep all electrode temperatures below the Max Temp setting.
 - **Vary Voltage:** Voltage may be automatically reduced from the Set Voltage setting to keep all electrode temperatures below the Max Temp setting.
 - **Vary Pulse Width (“Vary Width”):** Pulse Width may be automatically reduced from the Pulse Width setting to keep all electrode temperatures below the Max Temp setting. Voltage is reduced when the Pulse Width cannot be reduced below its minimum value.
 - **Vary Pulse Rate (“Vary Rate”):** Pulse Rate may be automatically reduced from the Pulse Rate setting to keep all electrode temperatures below the Max Temp setting. Voltage is reduced if the Pulse Rate cannot be reduced below its minimum value.
- **Max Temperature (“Max Temp”):**
 - **Off:** Automatic Temperature Control is disabled. The generator will not control the Temperature at any electrode. Auto Ramp is set to Off and the Pulsed RF output Voltage must be controlled manually by the user with the Output Control Knob.
 - **37-90 °C:** Automatic Temperature Control enabled. Pulsed RF output is automatically adjusted so that electrode Temperatures do not exceed the Max Temp value.
- **Set Voltage:** The target Voltage amplitude of the Pulsed RF output.
- **Pulse Width:** The duration in milliseconds of each burst of Pulsed RF output.
- **Pulse Rate:** The rate in Hz (equivalent to “Pulses Per Second”) at which bursts of Pulse RF output are delivered.
- **Set Time:** This setting determines the total amount of time that Pulsed RF output is delivered to each electrode. Once this time interval has elapsed for each electrode, electrode output is disabled automatically.

Selected parameters of the Pulsed RF waveform are shown schematically in the illustration below.



An Example of a Pulsed RF Change Settings screen is shown below.

The screenshot shows the 'Pulsed RF' settings interface. At the top, it says 'Pulsed RF' and 'Custom Settings One Electrode'. Under 'Maximum Voltage (V)', there are buttons for 45, 50, 55, 60 (which is highlighted in blue), and Custom. Below this, a note reads 'E-dose: If necessary, reduce Voltage to maintain Max Temp setting'. There are three buttons: 'Vary Voltage' (highlighted in blue), 'Vary Width', and 'Vary Rate'. At the bottom right is an 'Ok' button. Annotations on the right side explain the 'Custom Setting Keypad' (pointing to the '60' button) and the 'Pulsed RF Screen' (pointing to the 'Ok' button). A note says 'Select "Custom" from a setting button set' with an arrow pointing to the 'Custom' button. Another note says 'Press "Ok": Accept selected settings.' with an arrow pointing to the 'Ok' button.

10. Sterilization, Care, and Service

10.1.1 Sterilization

CAUTION: It is recommended the CB112-TC, the SKG Knob and the RFG-STP Test Pad be sterilized by steam autoclave.

The above parts may be sterilized in a Prevacuum Sterilizer at 132-135 °C (270-275 °F) for at least 4 minutes.

No other parts may be autoclaved.

10.1.2 Care

The G4 may be cleaned by wiping with a soft cloth dampened with a mild detergent. Do not allow liquid to get into the unit.

The cables and accessories may be wiped with mild detergent cleaning solutions, taking care to keep moisture out of the connectors. Store in a clean, dry and non-corrosive atmosphere. The generator is designed to withstand all normally encountered environmental conditions. Do not drop or bang the generator.

10.1.3 Service

WARNING: Electric Shock Hazard

There are no user serviceable parts inside the G4. To avoid electric shock, return the device to Cosman for servicing.

To ensure accuracy of unit output and displays, the unit should be tested yearly.

In case of failure or malfunction of the device, discontinue use and report the failure or malfunction to Cosman Medical. For any electrical malfunction, accident, misuse, alteration, or other damage, return the unit immediately to Cosman Medical with a problem description.

Contact Cosman Medical Customer Service for further assistance if needed.

Fuse Replacement



WARNING: Risk of fire. Fuse must be replaced as marked.

The generator has two fuses, one for line and one for neutral conductors. Replace with T2AL250V ("T" indicates slow blow or time lag fuse.)

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11. Troubleshooting

Problem	Possible Cause
Generator will not turn on by Mains Power switch	<ul style="list-style-type: none"> • Bad AC outlet • Defective power cord • Blown fuses
No response when button is pressed	<ul style="list-style-type: none"> • Button has no function in current operating mode, e.g. Start button only functional on Stimulation, Thermal RF, and Pulsed RF screens • Button stuck in depressed possible (Error message & alarm will sound) • Button is broken
No response when Touch Screen is pressed	<ul style="list-style-type: none"> • Touch Screen is not calibrated (See Section 5 & 5.2) • Region of screen contains a “disabled” (grayed-out) button or no button • Touch screen is broken • System software error
Short Circuit Error	<ul style="list-style-type: none"> • Electrode in contact with reference structure, such as ground pad • Bipolar electrodes in contact with each other
<ul style="list-style-type: none"> • No electrode output • No Impedance Reading (“--- Ω”) • Open Circuit Error 	<ul style="list-style-type: none"> • No ground connection • Problem with electrode • Break on electrode cable
<ul style="list-style-type: none"> • No Temperature Reading (“-- °C”) • No Temperature Error 	<ul style="list-style-type: none"> • Problem with electrode • Break on electrode cable
Voltage or Current does not increase automatically when electrode output is turned on	<ul style="list-style-type: none"> • Auto Ramp setting is “Off” (see Sections 8.1.2, 8.2.2 & 8.3.2 for Graphing interface; 9.1.2, 9.2.2 & 9.2.4 for One Touch interface)
Stimulation, Thermal RF, or Pulsed RF output will not turn on	<ul style="list-style-type: none"> • Output Control Knob not in minimum position • Open or Short Circuit Impedance reading • No Temperature on electrode or • Temperature below 10 °C • Temperature above 100 °C, Set Temp, or Max Temp setting. • Electrodes attached to generator do not match Electrode Setup
Stimulation, Thermal RF, or Pulsed RF	<ul style="list-style-type: none"> • Open or Short Circuit Impedance reading

Problem	Possible Cause
output shuts down prematurely	<ul style="list-style-type: none">• Temperature above 100 °C.• Break in electrode or electrode cables. May be intermittent problem.• Set Time setting too low• Maximum RF Current or Power limit exceeded• Electrodes attached to generator do not match Electrode Setup
Temperature does not reach Set Temp or Max Temp setting	<ul style="list-style-type: none">• Required total RF Current or Power limit exceeds allowed limit• Total Impedance too low• Too many electrodes energized simultaneously• Set Temp or Max Temp too high• Temperature can only be controlled on one electrode in a Bipolar Pair• Ground pad used when RF Type=Bipolar

12. Specifications

ELECTRICAL SUPPLY

<i>Voltage Specifications:</i>	<u>Volts (mains switch unit)</u>	<u>Volts input range</u>
	100Vac	90-110
	120Vac	105-125
	220Vac	200-240
	240Vac	220-260
	Maximum input voltage:	260Vac
	Maximum voltage on any input connector:	260Vac
	Maximum input power:	480VA
	Supply current:	2.0 Amp ~ alternating current sinusoidal wave
	Fusing:	2.0 Amp (T) time-lag
	Frequency:	50/60 Hz

ENVIRONMENT OPERATING RANGE

Temperature:	15 – 40 °C
Humidity:	15 – 80% non-condensing relative humidity
Atmospheric Pressure:	500 – 1060 hPa

TRANSPORT AND STORAGE ENVIRONMENT

Temperature:	0 – 50 °C
Humidity:	15 – 80% non-condensing relative humidity
Atmospheric Pressure:	500 – 1060 hPa

IMPEDANCE MONITOR

Range:	0 – 3000 ohms digital
Resolution:	1 ohm between 0 – 999, 100 ohms between 1000 – 3000
Accuracy:	± 20 ohms between 30 and 100 ohms ± 20% between 51 and 3000 ohms

STIMULATOR OUTPUT

Rate:	2, 5, 50, 75, 100, 150, 180, 200Hz
Duration:	0.1, 0.5, 1, 2, 3 milliseconds
Voltage Stimulation Mode:	0 – 3 volts
Constant Current Stim. Mode:	0 –10 mA

THERMAL & PULSED RF OUTPUT

Timing:	Selectable:	0:30 – 30:00 minutes
	Resolution:	1 second
	Accuracy:	± 1%
Watts:	0 to 50 watts RMS (into 100Ω load)	
	Resolution:	1 watt (in Thermal RF output only)
	Accuracy:	± 20% of full scale (in Thermal RF output only)
	Frequency:	480 kHz

THERMAL & PULSED RF OUTPUT (continued)

Volts: 0 to 70 volts RMS into 100Ω load during Thermal RF output.
0 to 100 volts peak into 100Ω during Pulsed RF output.
Resolution: 1 volt RMS during Thermal RF output
1 volt peak during Pulsed RF output
Accuracy: ± 10% of full scale

Current: 0 to 700 mA RMS
Resolution: 1 mA RMS during Thermal RF output
1 mA peak during Pulsed RF output
Accuracy: ± 10% of full scale

PULSED RF SETTINGS:

Repetition Rate: 1, 2, 3, 4, 5, 6, 7, 8 PPS (Hz)
Burst Duration: 0.5, 1, 5, 10, 20, 30 ms

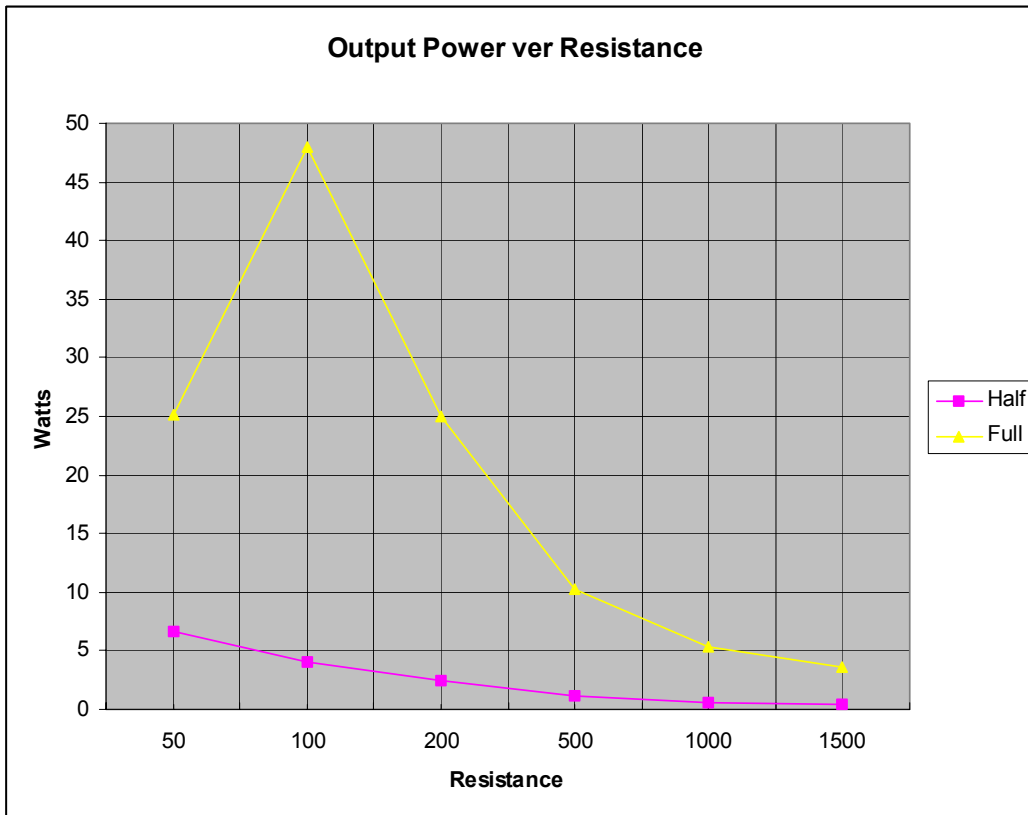
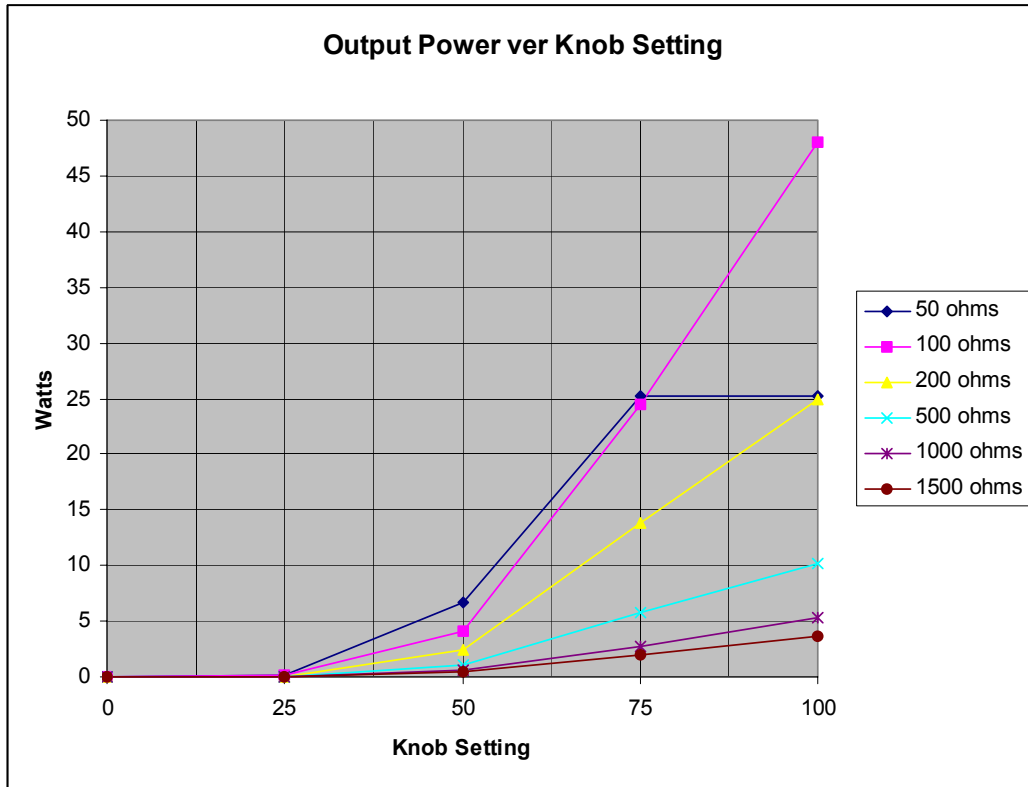
TEMPERATURE MONITOR

Range: 0 – 110°C
Resolution: 1 °C
Accuracy: ± 3 °C between 40 and 90 °C
± 4 °C between 10 and 40 °C, and between 90 and 110 °C

GENERAL

Size: W 14.25" (36.2 cm), H 9.5" (24.1 cm), D 12.15" (30.9 cm)
Weight: 22 lbs (10 kg)

13. Output Power Curves



14. Accessories

Cosman Medical Part No.	Description
CB112-TC	Connecting Cable for TC Electrodes
C119	Power Cord (120 Volts)
C118	Power Cord (foreign style, 230 Volts)
FUSE-2A	2.0 Amp Fuse (2)
RFG-TP	Output Test Plug
RFG-STP	Sterilizable Electrode Test Pad
FS-1	Footswitch
SKG	Sterilizable Knob (Gold)
CB103B	Reference Cable, 3m, w/Alligator Clip
CB103R	Active cable, 8ft., Red, w/Alligator Clip, for non-TC electrodes
DGP-PM	Electrosurgical Grounding Pad (disposable)

15. Test Equipment

- AC Power source
- AC/DC voltmeter
- 2 Channel Oscilloscope
- 40/90 Temp Baths
- Omega Temp meter and Probe
- 4ea Test Plugs
- Universal safety tester (leakage current tester)
- Resistance Substituter (as needed)
- Power cord
- Test leads, Patient Lead
- Test Mono-polar Electrode
- Footswitch
- Fully populated USB Card PC board
- Scope Probes
- Ground Bond Tester
- Kelvin test cables
- Hipot tester
- 110v-220v adapter plug
- Ground Bond tester
- 4ea 100 Ω , 500 Ω , and 1K Ω high power non-inductive resistors
- CB112 Cable
- CB103R Cable
- Test Reference Adaptor Cable

Note: If any of the tests fail, use the schematics and part specs to determine the faulty component or assembly fill out a Reject tag (SPI#10015-3) attach to the component or assembly under test (PCB, Transformer, unit assembly, etc) and place in the MRB Area for disposition. On the original Data Sheet explain the nature of the failure. Obtain a new blank data sheet and restart the testing. The new data sheet must be attached to the original.

16. System Testing

16.1 Application Program check

Turn the power on and watch the screen for errors that would indicate one or more of the files was not loaded correctly.

The screen will change to the Main Menu screen.

The Application rev will be displayed on the bottom of the screen.

Record this value for reference purposes on the data sheet

If any errors appear the unit must be returned to Cosman Medical for evaluation and repair.

16.2 Low voltage Oscillator resonance check

Attach a 25 Ω (4x100 Ω) load between the connectors using test cables.

Using an oscilloscope measure the signal across the output and reference jacks.

With the 25 Ω load the signal should be larger than .5v peak to peak.

Open circuit the signal should be smaller than 2.5v peak to peak.

With a single 100 Ω load the signal should be smaller than 2v peak to peak.

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.3 Touch Screen Display test

A couple of seconds after the unit is turned on the LCD screen will display a Start-Up image.

The first time the system is started or any time the date has not been set (removing the battery) the system should automatically go to the System Settings display.

Record Pass Fail on the traveler for initial display

If the system date has already been set then you must select the System settings button on the LCD screen

The display should change to the system settings menu

Using a stylus (pointer) set the screen calibration (be sure to select as close to the center of the cross-hair as possible)

Set the time date and day using the up down on screen buttons

Adjust the Output Volume setting by selecting each of the available settings.

Adjust P5 on the Backplane PC board (11070) so that the speaker is not over driven when the Output volume is set to high and is just audible when set to Low.

Set the default settings to: Output Volume Low, Language English and then the Main menu.

The screen will change to the Main Menu screen.

Record Pass Fail on the traveler for touch screen display test

Turn the power off

Connect a Resistance Substituter set for 100 Ω across the patient outputs (E1)

Connect the oscilloscope across the 100 Ω load

Verify that the output is a clean undistorted 480kHz sign wave

Record Pass Fail on the traveler for RF Output Waveform

16.4 Temperature Display calibration check

Plug a room temperature test plug into each output jack (four total)

Verify that they all read the same room temperature within $\pm 2^\circ$

Remove the test plugs and plug a CB112-TC cable and CSK-TC electrode into output jack 1

Place the tip of the electrode into the 40° water bath with the Omega temp meter

Verify that both read within $\pm 3^\circ\text{C}$ of each other

Place the tip of the electrode into the 90° water bath with the Omega temp meter

Verify that both read within $\pm 3^\circ\text{C}$ of each other

Repeat for electrode output jacks 2 through 4

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.5 High volts measurement calibration

Select Electrode Setup, 1 Active Electrodes, then Thermal RF, Auto Ramp off

Attach the 100 Ω load to the E1 patient output and Reference

Attach an Oscilloscope across the 100 Ω load.

Make sure the Output control knob is fully CCW to minimum

Press the Start button and increase the output until the scope reads approximately 50v RMS. The LCD display should display 50v

Check the LCD displayed values relative to the RMS values measured by the scope at minimum, 10, 30, 50 and Max.

All value must be within 10%.

Press the off button

Record Pass Fail on the data sheet for RF volts calibration.

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.6 Peak voltage display calibration

Select Pulsed RF, Change (settings), Auto Ramp Off, then OK

Attach the 100 Ω load to the E1 patient output and Reference

Attach an Oscilloscope across the 100 Ω load.

Make sure the Output control knob is fully CCW to minimum

Press the Start button and increase the output until the LCD display reads approximately 45v peak.

Verify that the Peak value measured by the scope is between 44-45v peak.

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.7 Off zero lockout test

Attach the 100 Ω high power resistor to the outputs
Press the Thermal RF button, set Auto Ramp Off, then OK
Turn the Output Control knob up off minimum approximately 1/8 of a turn.
Press the ON button and verify the output will not turn on
Record Pass/Fail on the Test Traveler

If not the unit must be returned to Cosman Medical for evaluation and repair.

16.8 Display checks

Set number of active electrodes to four (4), Thermal RF, Change stagger start to 20 sec, set timer to 30 sec
Attach the 100 Ω high power resistor to each of the outputs
Attach an oscilloscope across the load
Press the ON button and increase the output until the oscilloscope reads 10v RMS (14.1v peak)
Move the scope to each output after it is enabled
Verify that the generator RF Volts display reads 9.0-11.0v
Verify that the RF watts display is between .9 and 1.1w
Restart the output and increase the output until the RF volts display is 20v
Verify that the RMS current display is between 180 and 220mA for each active electrode
Change the stagger start to 30 sec and restart the output
Increase the output until the scope reads 50v RMS
Verify that the RMS current display is between 450 and 550mA for each output when it activates
Verify that the RF watts display is between 22.5 and 27.5 for each output when it activates
Record Pass/Fail on the Test Traveler for RF Current, and Watts display

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.9 Lesion timer test

Press the Time button to set to 30 seconds
Set the Output Control knob to minimum
Press the ON button and increase the output to mid setting
Verify that when the timer get to 30 seconds the output goes from on to off
Record Pass/Fail on the Test Traveler

If not the unit must be returned to Cosman Medical for evaluation and repair.

16.10 Automatic temperature control

Attach a test plug to each of the generator outputs (version without TVS)
Set the number of active electrodes to four (4)
Set the Temperature control to 60, Auto Ramp ON
Rotate the Control knob to minimum
Press the ON button
Verify that the output will ramp up to approximately 8v and then automatically reduce in order to hold the temperature at the Set Temp value
Set the Temperature control to 90

Press the ON button the output should increase to about 10-14v then automatically reduce in order to hold the temperature at the Set Temp value
Press the Pulsed RF button and verify the Set Temp is set for 42
Set the Duration for 30mS
Set the Rate for 8
Set the Auto Ramp to Off
Rotate the Control knob to minimum
Press the ON button and increase the output gradually to about 15-20v
Verify that the output will ramp up to the control knob setting and then automatically reduce in order to hold the Temperature of all the test plugs to less than 42° and the hottest test plug to within 1° of the Set Max Temp Limit
Record Pass/Fail on the Test Traveler

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.11 Temperature Variation with cables

Set the stagger start to 30 sec, timer to 30 sec, set temp to off
Attach a CB112-TC cable, CSK-TC10 electrode, and a high power 100 Ω the output and reference jacks of each electrode output (E1-E4).
Verify the temperature does not vary by more than five degrees when the RF output is increased from minimum to maximum
Record Pass/Fail on the Test Traveler

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.12 Impedance Variation with cables

Verify the impedance display remains around 100 when the RF output is increased from minimum to maximum
Record Pass/Fail on the Test Traveler

If not the unit must be returned to Cosman Medical for evaluation and repair.

16.13 Impedance range tests

Remove the cables from E2-E4 outputs
Set the number of active electrodes to one (1), Thermal RF mode, Auto Ramp off.
Fill in the table of impedance measurements at Minimum, Mid and at Maximum output

If the values differ substantially from those listed on the data sheet the unit must be returned to Cosman Medical for evaluation and repair.

16.14 No Temp lock-out test

Remove the cables from the outputs
Set the number of active electrodes to one (1), Thermal RF mode, Set Temp off
Replace the CB112-TC cable and TC electrode on E1 with a CB103-R cable (No temperature measurement)
Verify that the temperature display shows “- -” indicating no temperature is measured
Rotate the Output Control knob to minimum
Press the ON button
Verify that the display prompts the user to acknowledge that set temp is off before the output will turn on
Press the OK button and verify that the output turns on at minimum level and the output control knob can adjust the output level

Record Pass/Fail on the Test Traveler

If not the unit must be returned to Cosman Medical for evaluation and repair.

16.15 Audio calibration adjustment

Select Stim mode

Set the on screen audio volume control to maximum

Set the load to 1K Ω

Verify that the on screen volume control increases the volume with each press of the increase button, and decreases with each press of the decrease button to the off position.

Verify that the audio frequency varies with the load resistance.

Record Pass/Fail on the Test Traveler

If not the unit must be returned to Cosman Medical for evaluation and repair.

16.16 Stimulator tests

Attach the 330 Ω load (500 Ω in parallel with 1k Ω) to the generator outputs for E1

Attach an oscilloscope across the load

Press the Stim button

Rotate the Output Control knob to minimum

Press the ON button

Increase the output until the display reads 3.00 (max)

Note: There will be a 1v peak RF sign wave riding on the square wave signal, in order to get the measurement, adjust the scope to normal trigger on the waveform in peak detection mode, and then change to average mode. This will help remove the RF and allow a more accurate reading.

Verify that the oscilloscope displays a biphasic square wave with peak amplitude of 2.9 to 3.0v

Replace the 330 Ω with a 250 Ω (2x500 Ω in parallel)

Verify that the output is greater than or equal to 2.7v

Replace the 250 Ω with a 1k Ω

Verify that the output is less than or equal to 3.3v

Record Pass/Fail on the Test Traveler

Record the final value measured by the Oscilloscope across the 330 Ω on the Test Traveler

Change the stimulator output units setting to Current

Replace the 1k Ω with the 500 Ω

Rotate the output control knob to minimum

Press the ON button

Increase the output to until the display reads approximately 9.98mA

Verify that the oscilloscope displays a biphasic square wave with peak amplitude of 4.5 to 5.5v

Replace the 500 Ω with the 1k Ω and verify that the output is greater than or equal to 9v

Record the final value measured by the Oscilloscope across the 500 on the Test Traveler

Measure each of the available Stimulation Rates (PPS) and Durations (mS) and record on the Test Traveler

With the output knob up off minimum press the On Button, then turn the output up to maximum

Verify that there are no stim pulses present on the oscilloscope

Attach the 500 Ω load to each of the other generator outputs in turn.

Verify that each output produces the correct stimulation frequency and duration only when selected.

If the values differ substantially from those listed above the unit must be returned to Cosman Medical for evaluation and repair.

16.17 Maximum RF output test

Attach a 100 Ω load to the generator outputs for E1 using a CB112-TC cable and a TC Electrode

Attach an oscilloscope across the load

Press the Thermal RF button
Rotate the Output Control knob to minimum
Press the ON button
Record the minimum peak RF voltage displayed on the oscilloscope on the Test Traveler
Increase the output to maximum
Record the maximum peak RF output voltage displayed on the oscilloscope on the Test Traveler
Remove the scope probe

17. Electrical Safety Tests

17.1 HIPOT Testing

Connect a HIPOT to the generator's AC mains input using the power cord supplied with the unit.
Connect the ground sense lead of the HIPOT to the equipotential connector (or jack) on the back panel of the generator.
Set the HIPOT to 1800 volts for one (1) second (approximately #34 on the HIPOT setting knob, and Test Mode B).
Turn HIPOT on.

Warning! Stand clear of the unit under test! Some parts may become live.

Warning! Keep your left hand in left pants pocket during HIPOT testing!

Turn the generator's power switch to the ON (or I) position for this test.

Press the START button on the HIPOT. The output will ramp up from zero (0) to its maximum level and turn off when testing is completed. A failure is indicated by an alarm sounding on the HIPOT.

Turn HIPOT off.

Attach the HIPOT to the patient output connections using the test cable, set the HIPOT for 500 volts (approximately #20 on HIPOT setting knob, and turn HIPOT on. *This is only a test for shorted transient voltage protectors between the patient outputs and the chassis. The true qualifying test would be 3000v with the protection devices removed.*

Again, Press the START button to initiate the One (1) second test. The output will ramp up from zero (0) to its maximum level and turn off when the testing is completed.

Turn off HIPOT tester, and disconnect from the generator.

Record Pass/Fail of HIPOT Testing on the Test Traveler

If any of the testing above fails the unit must be returned to Cosman Medical for evaluation and repair.

17.2 Leakage Testing

Plug the Safety Analyzer into an AC power source

Set the AC power source to 132V (for 120V units) or 242V (for 220V units)

This is line voltage plus 10%

Attach the Generator's power cable to the Test Receptacle of the Safety Analyzer.

Turn Safety Analyzer on. Check that the Generator power switch is still on.

Set Mode switch to measure EARTH leakage current.

Then switch the TEST RECEPTACLE switches to all possible states. The AC leakage current must be less than 100 microamps.

Record the highest leakage current value on the Leakage Current (Mains) entry on the Test Traveler.

Connect the Output Test Cable from Generator's Active and Reference jacks (the Black alligator lead) to any of the Safety Analyzer's patient lead jacks (or ECG LEADS jacks).

Set MODE switch to LEAD TO GND setting.

Then switch the TEST RECEPTACLE switches to all possible states. The leakage current must be less than 15 microamps (30 microamps for 220v units).

Note: the standards allow up to 100 microamps, but anything more than shown above is an indication of a potential problem with the unit.

Record the highest leakage current value on the Leakage Current (Patient) entry on the Test Traveler.

Turn off the Safety Analyzer.

Unplug the generator from the Safety Analyzer.

If any of the testing above fails the unit must be returned to Cosman Medical for evaluation and repair.

17.3 Ground Bond Test

Turn on the Ground bond tester and set the output to 25A and 5 seconds duration

Set the upper trigger level to 200mOhms

Attach one lead of the tester to the shell of the footswitch connector on the back panel

Attach the other lead of the tester to the third (ground) prong of the power cord

Press the start button on the Ground bond tester

Record Pass/Fail on the Test Traveler

Move the lead from the shell of the footswitch to the equipotential connector and repeat the test

If the testing above fails the unit must be returned to Cosman Medical for evaluation and repair.

18. Final check out

Attach the generators power cable to a 120v (or 220v if configured for 220v) power source

Attach a footswitch to the connector on the back panel

Turn the generator on and connect a Test Plug to the E1 output connector.

Set the unit for single output Thermal RF mode, default settings.

Verify that pressing the foot switch enables the generator output and releasing it turns the output off

Record Pass/Fail on the Test Traveler

Perform a visual inspection of the generator looking for scratches, dents, and any other defects

Record Pass/Fail on the Test Traveler

The Power Cable used in testing is considered a component of the Generator, and is kept with the Generator until it later is packed with the Generator in the shipping carton.

Sign and date the Test Record form (as Tested by) and the assembly traveler line for Generator Test Procedure.

The Test Record is now ready for review.

If the generator needs to be reconfigured to 220v or 240V after all of the testing has been completed:

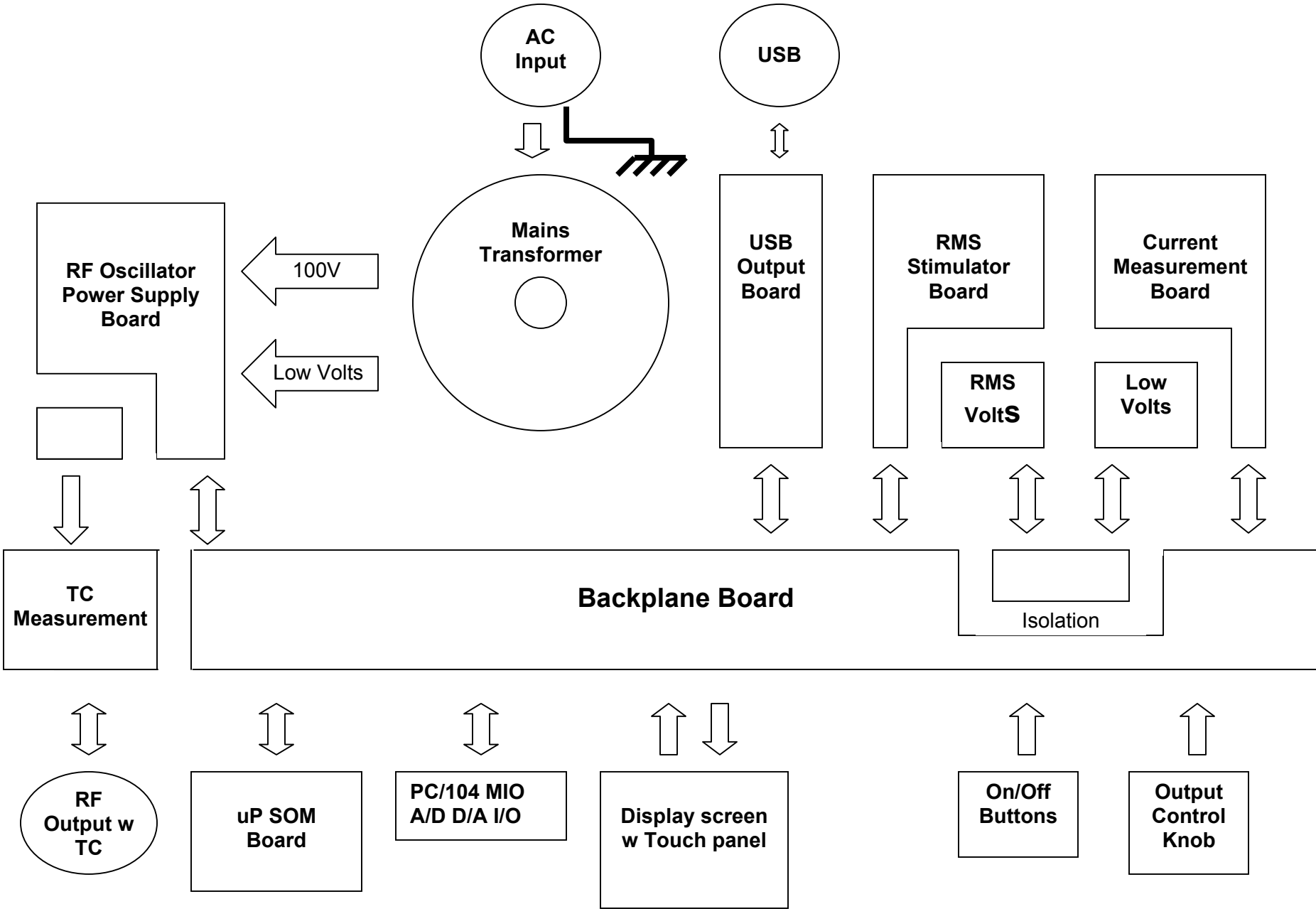
Set the voltage selector to the appropriate value, by removing the fuse drawer and rotating the voltage selector.

Set the AC Power source to match the voltage setting and repeat the Electrical Safety Tests step and this step.

Record the results under the 220v section of the test data record.

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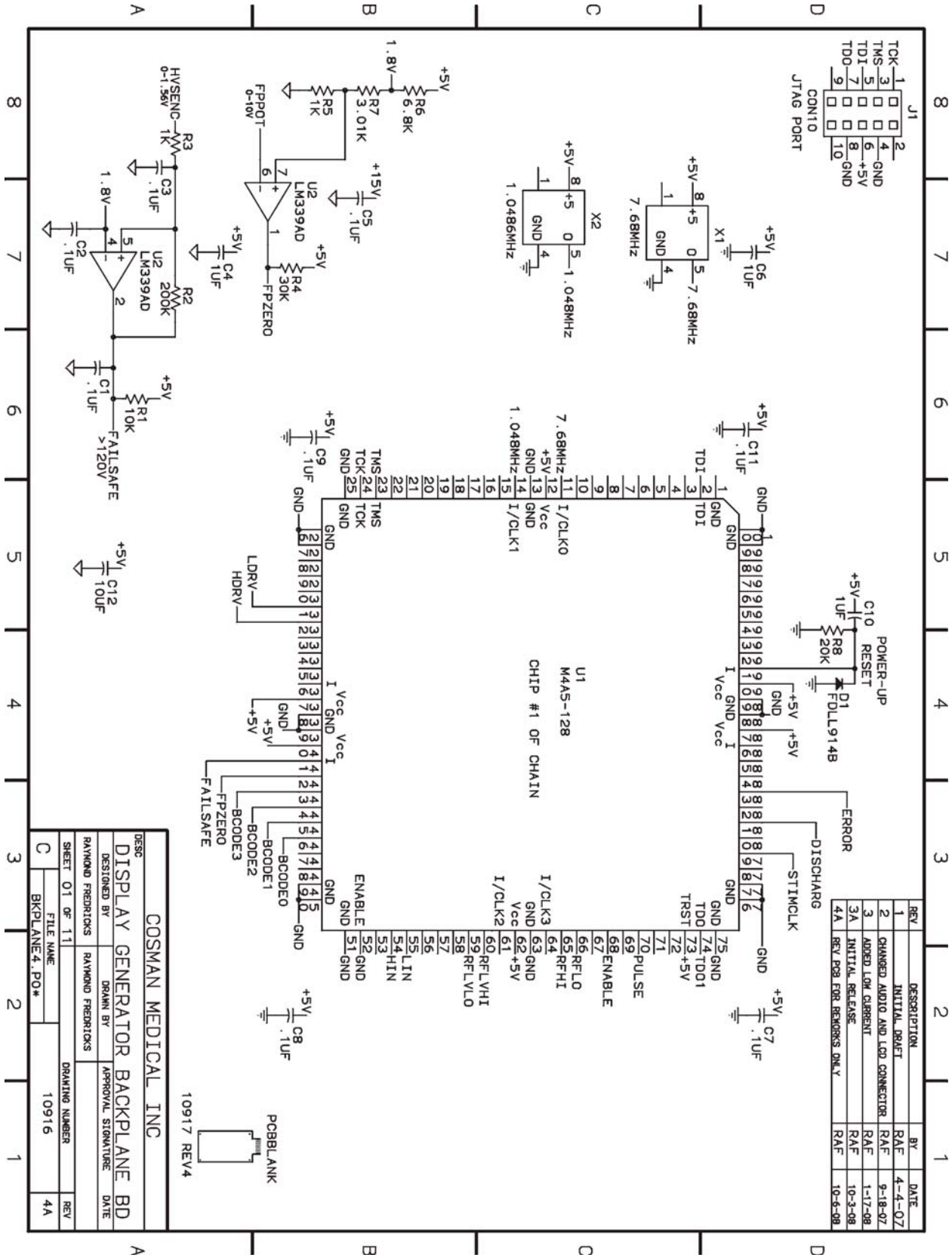
19. System Diagram

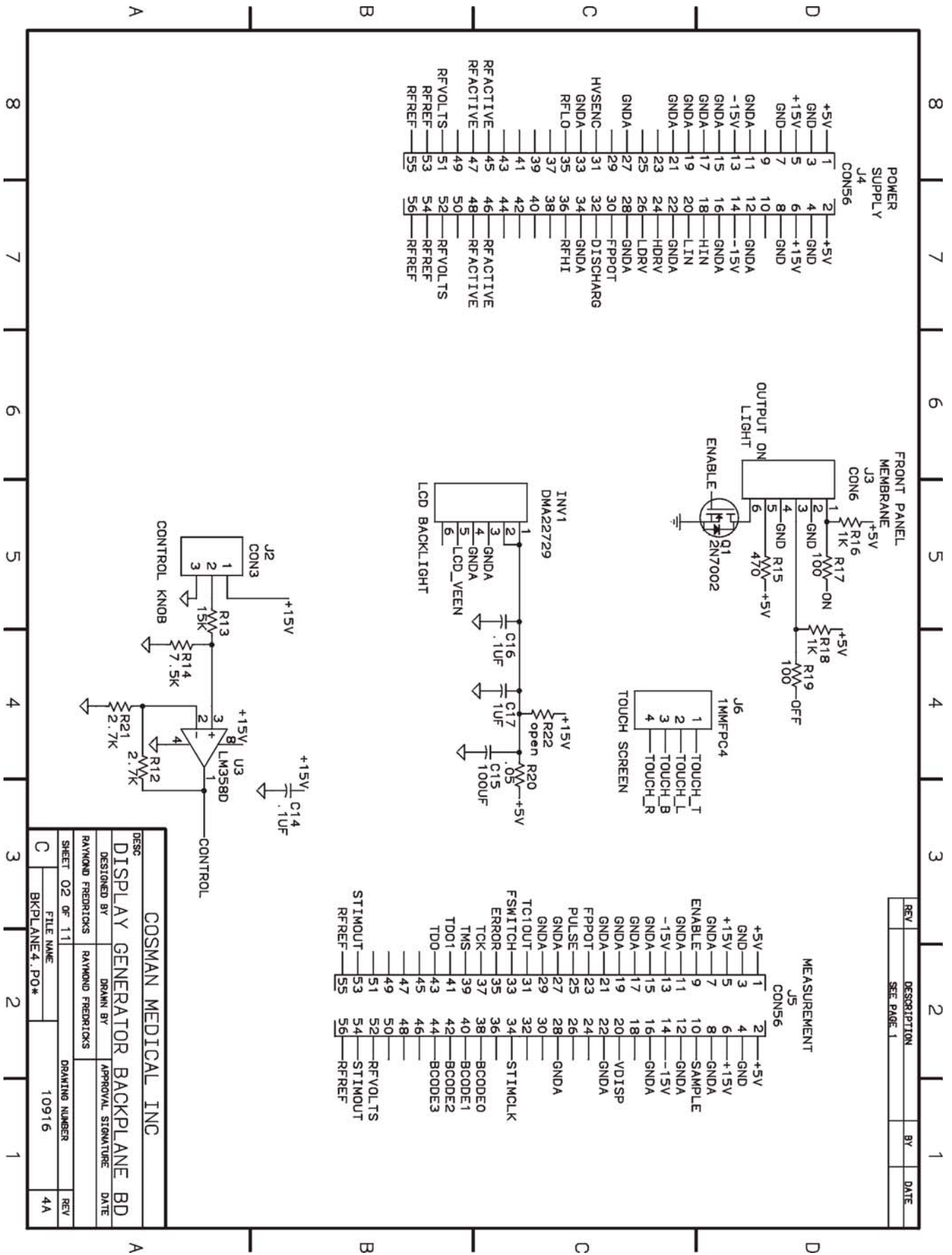


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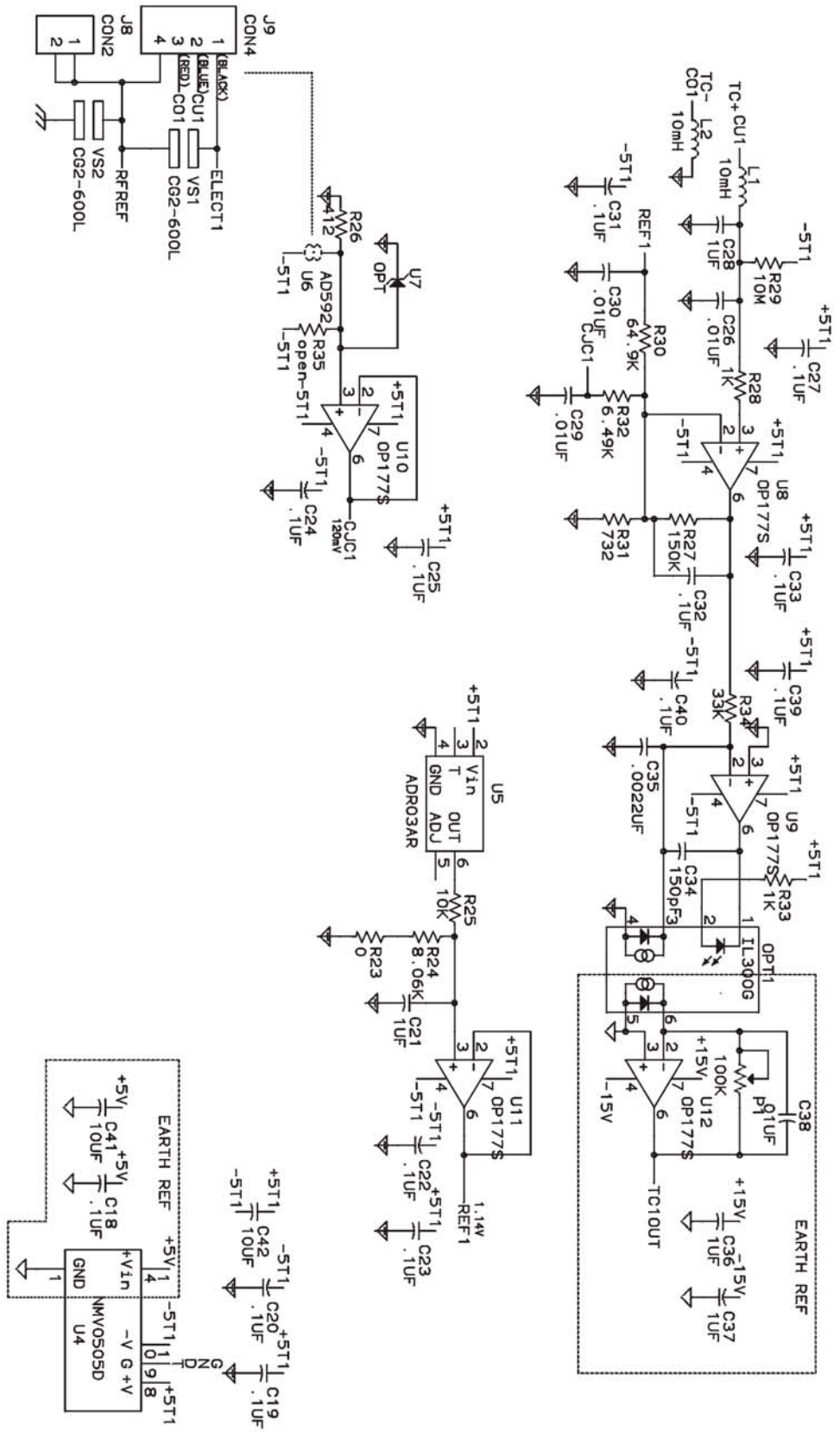
20. Schematic Drawings

20.1 Backplane Board Assembly





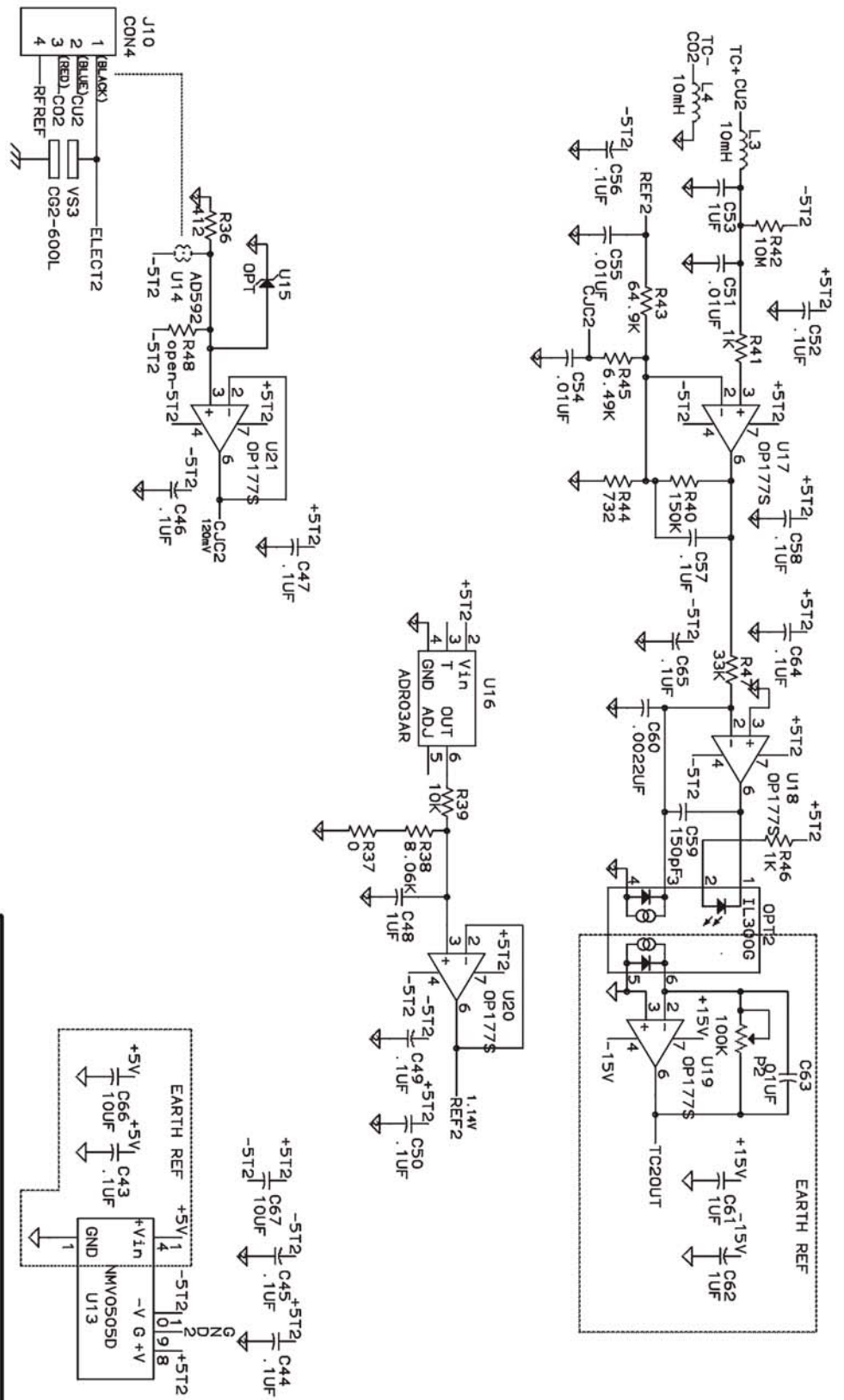
ISOLATED TEMPERATURE



COSMAN MEDICAL INC	
DESC	DISPLAY GENERATOR BACKPLANE BD
DESIGNED BY	RAYMOND FREDERICKS
DRAWN BY	RAYMOND FREDERICKS
APPROVAL SIGNATURE	DATE
SHEET 03 OF 11	DRAWING NUMBER 10916
FILE NAME	BKPLANE4.P0*
REV	4A

8 7 6 5 4 3 2 1

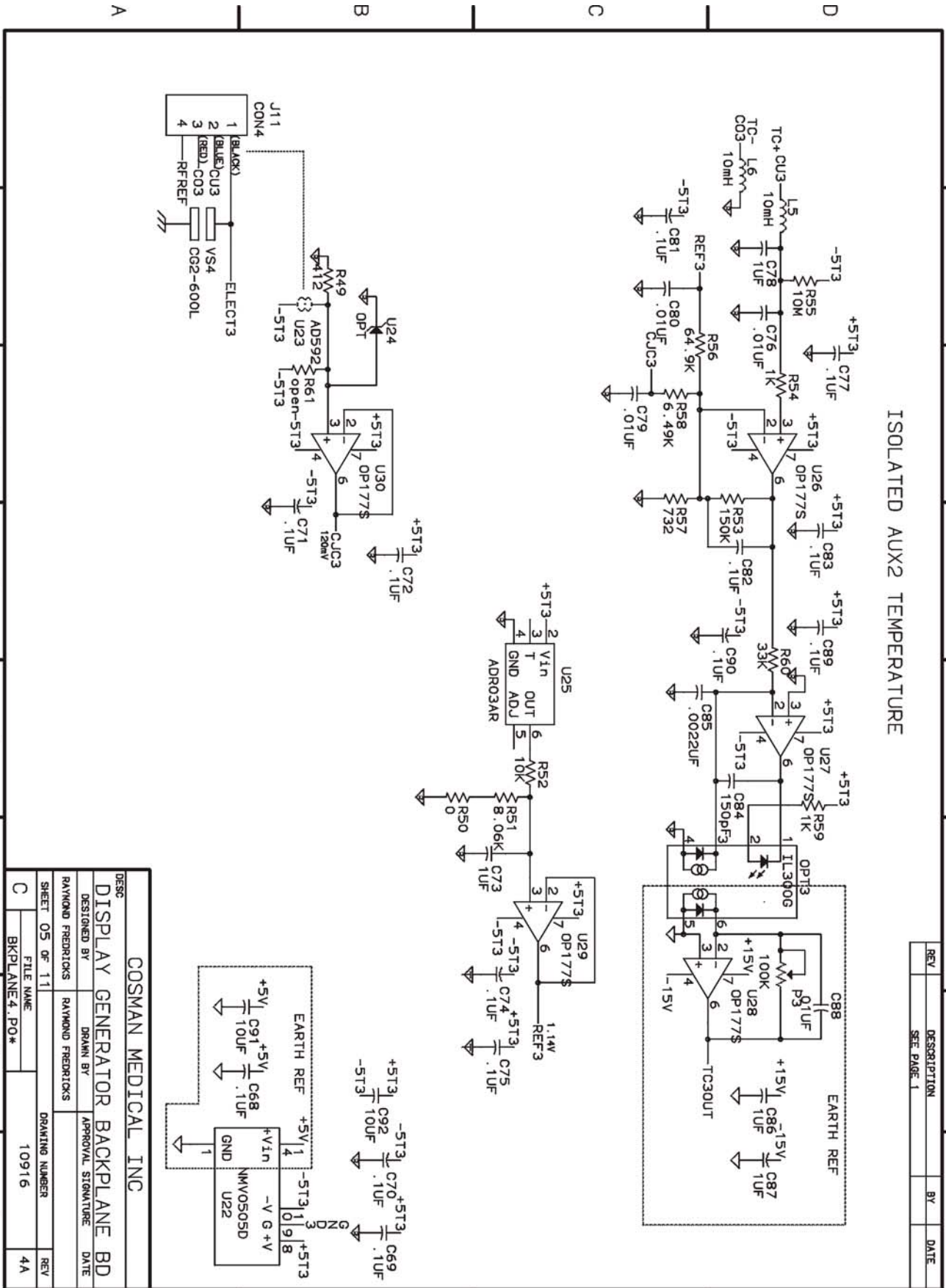
ISOLATED AUX1 TEMPERATURE



REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

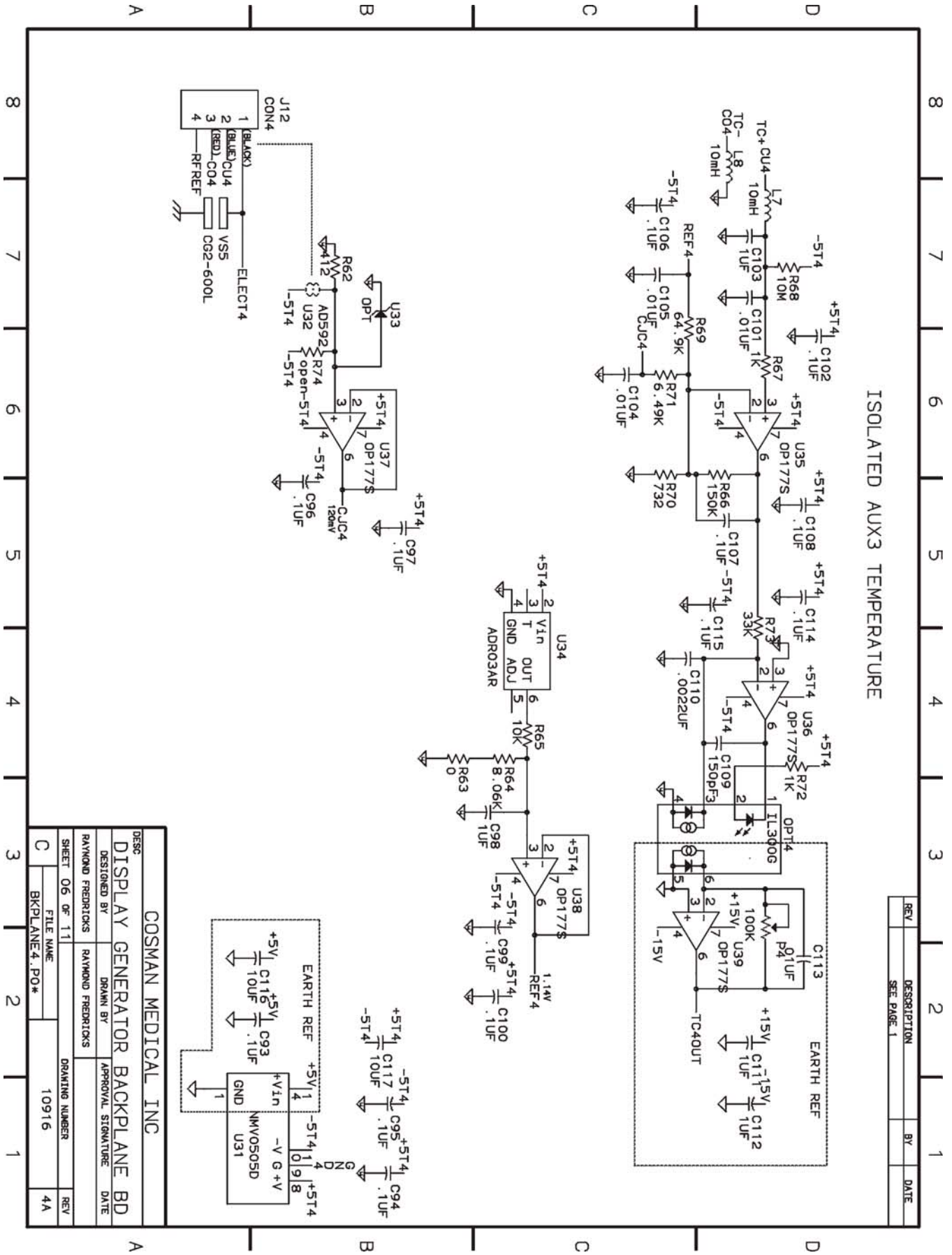
COSMAN MEDICAL INC	
DESC: DISPLAY GENERATOR BACKPLANE BD	
DESIGNED BY: RAYMOND FREDRICKS	DRAWN BY: RAYMOND FREDRICKS
APPROVAL SIGNATURE: _____ DATE: _____	
SHEET 04 OF 11	DRAWING NUMBER: 10916
FILE NAME: BKPLANE4.P0*	REV: 4A

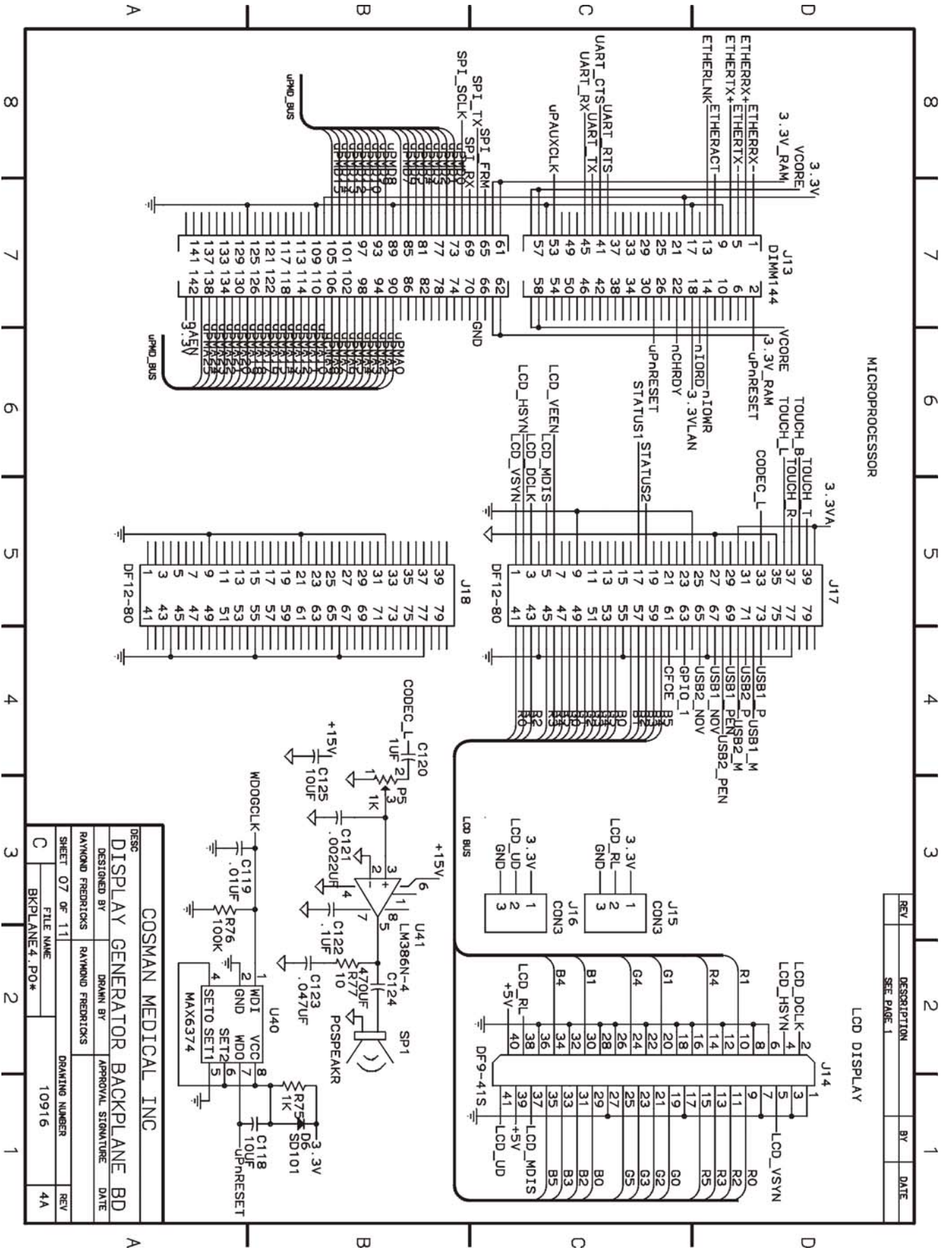
ISOLATED AUX2 TEMPERATURE



REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

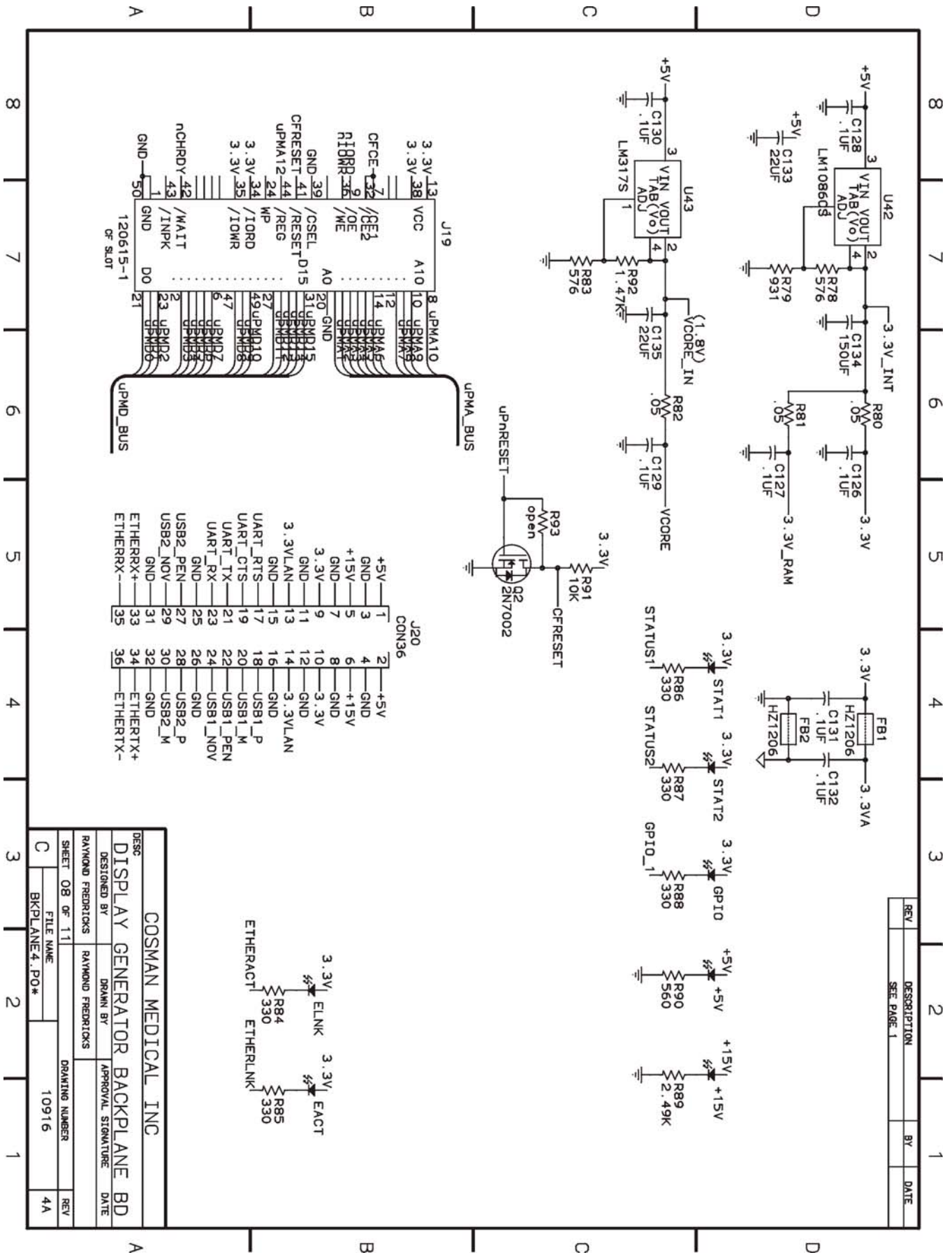
COSMAN MEDICAL INC	
DESC: DISPLAY GENERATOR BACKPLANE BD	
DESIGNED BY: RAYMOND FREDERICKS	DRAWN BY: APPROVAL SIGNATURE: DATE:
RAYMOND FREDERICKS	
SHEET 05 OF 11	
FILE NAME: BKPLANE4.P0*	DRAWING NUMBER: 10916
C	REV: 4A





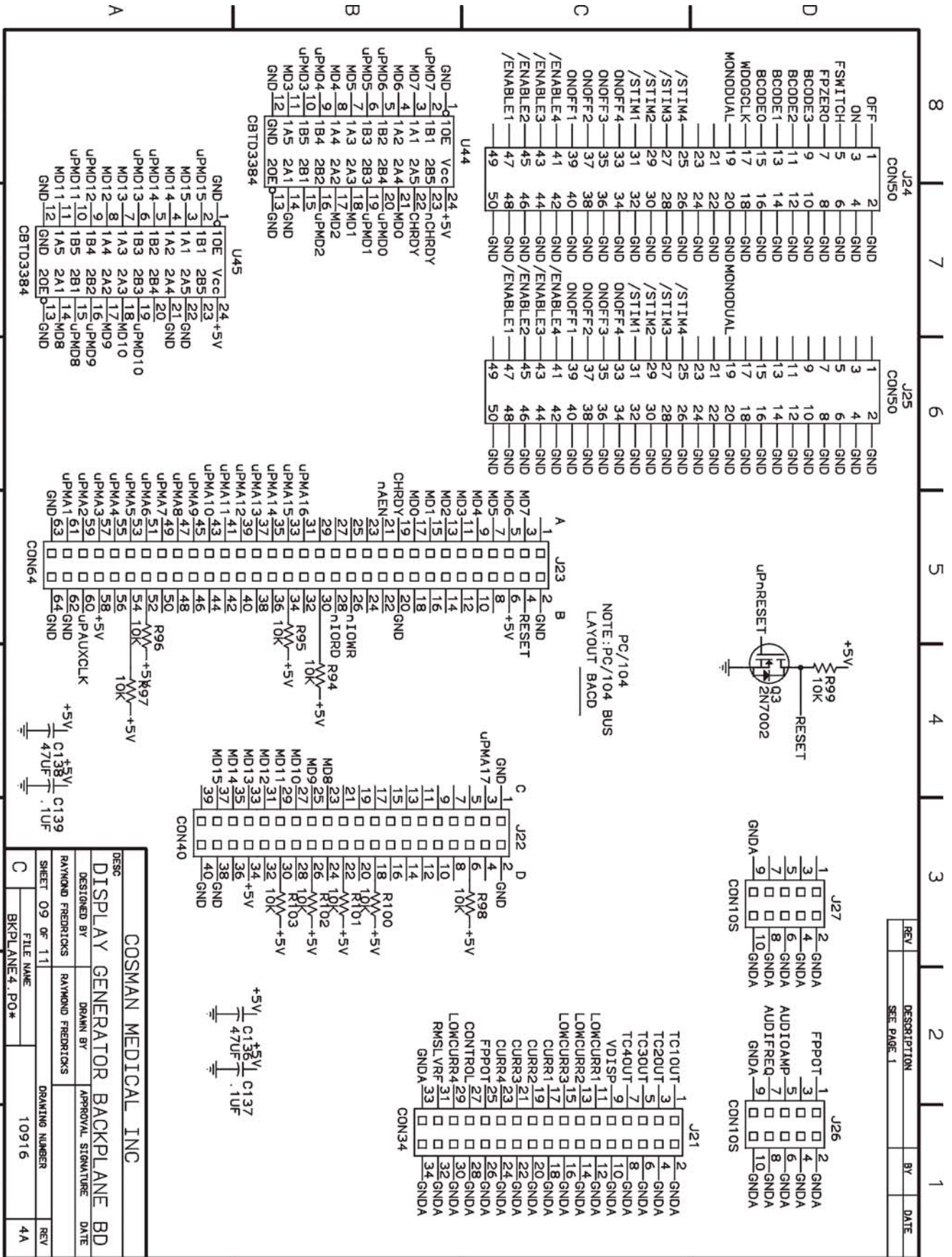
REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

COSMAN MEDICAL INC	
DESC	DISPLAY GENERATOR BACKPLANE BD
DESIGNED BY	RAYMOND FREDERICKS
DRAWN BY	RAYMOND FREDERICKS
APPROVAL SIGNATURE	DATE
SHEET 07 OF 11	DRAWING NUMBER
FILE NAME	10916
BKPLANE4.P0*	REV
	4A



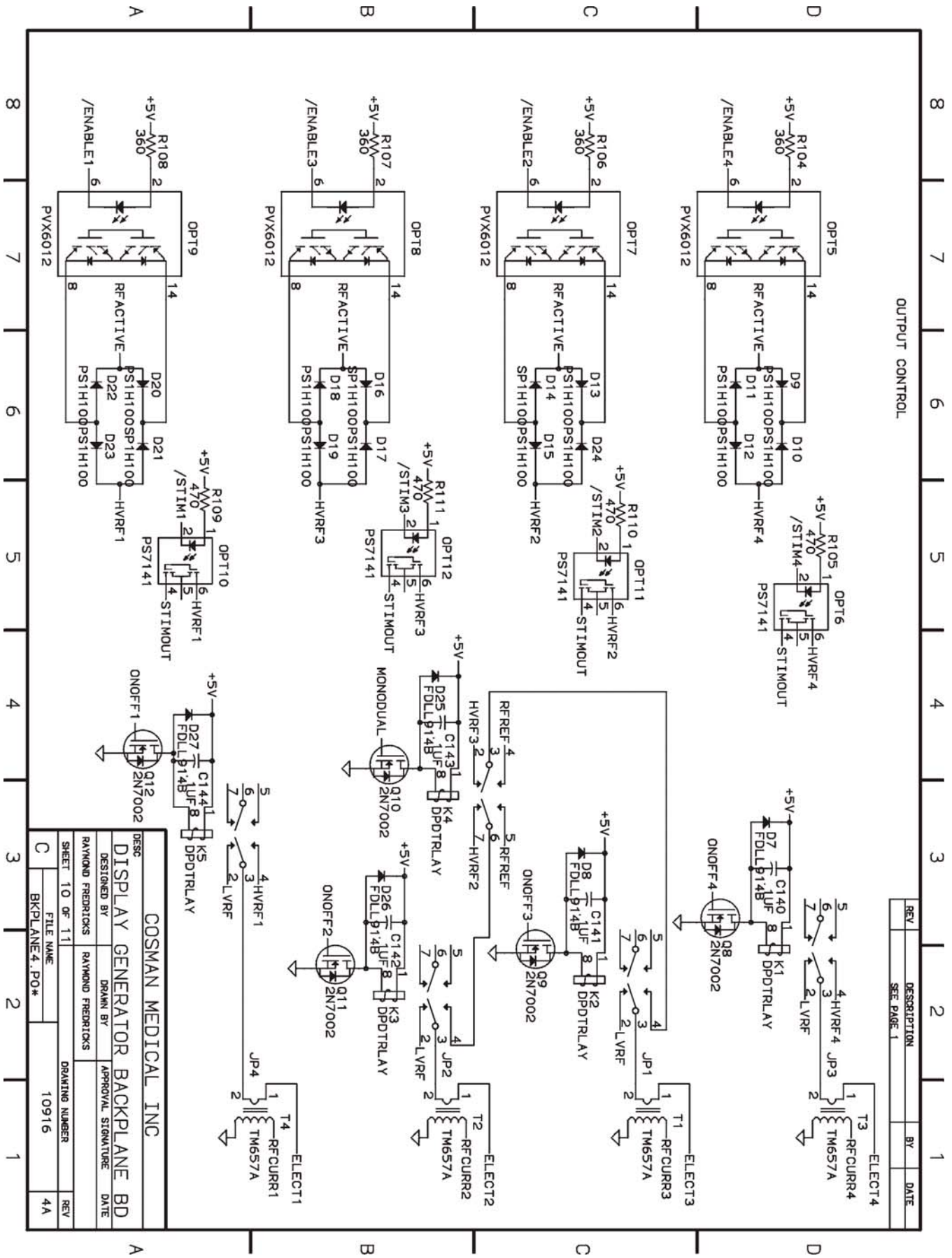
REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

COSMAN MEDICAL INC			
DESC: DISPLAY GENERATOR BACKPLANE BD			
DESIGNED BY	DRAWN BY	APPROVAL SIGNATURE	DATE
RAYMOND FREDRICKS	RAYMOND FREDRICKS		
SHEET 08 OF 11		DRAWING NUMBER	
FILE NAME: BKPLANE4.P0*		10916	
C		REV	4A



REV	DESCRIPTION	BY	DATE
SEE PAGE 1			

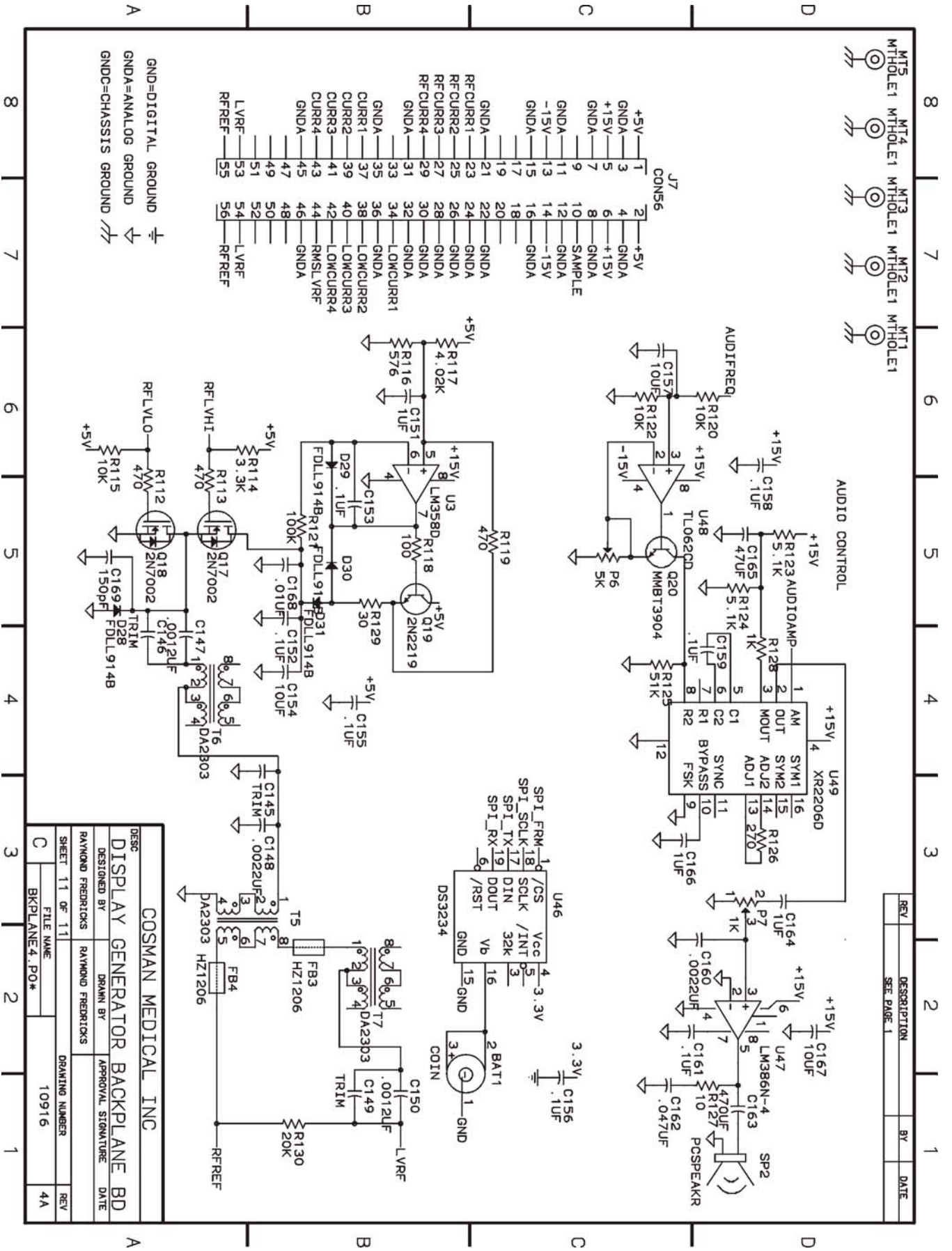
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DESIGNED BY		DRAWN BY	
RAYMOND FREDERICKS		RAYMOND FREDERICKS	
SHEET 09 OF 11		APPROVAL SIGNATURE	
FILE NAME		DATE	
BKPLANE4.P0*		DRAWING NUMBER	
10916		REV	
		4A	



OUTPUT CONTROL

REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

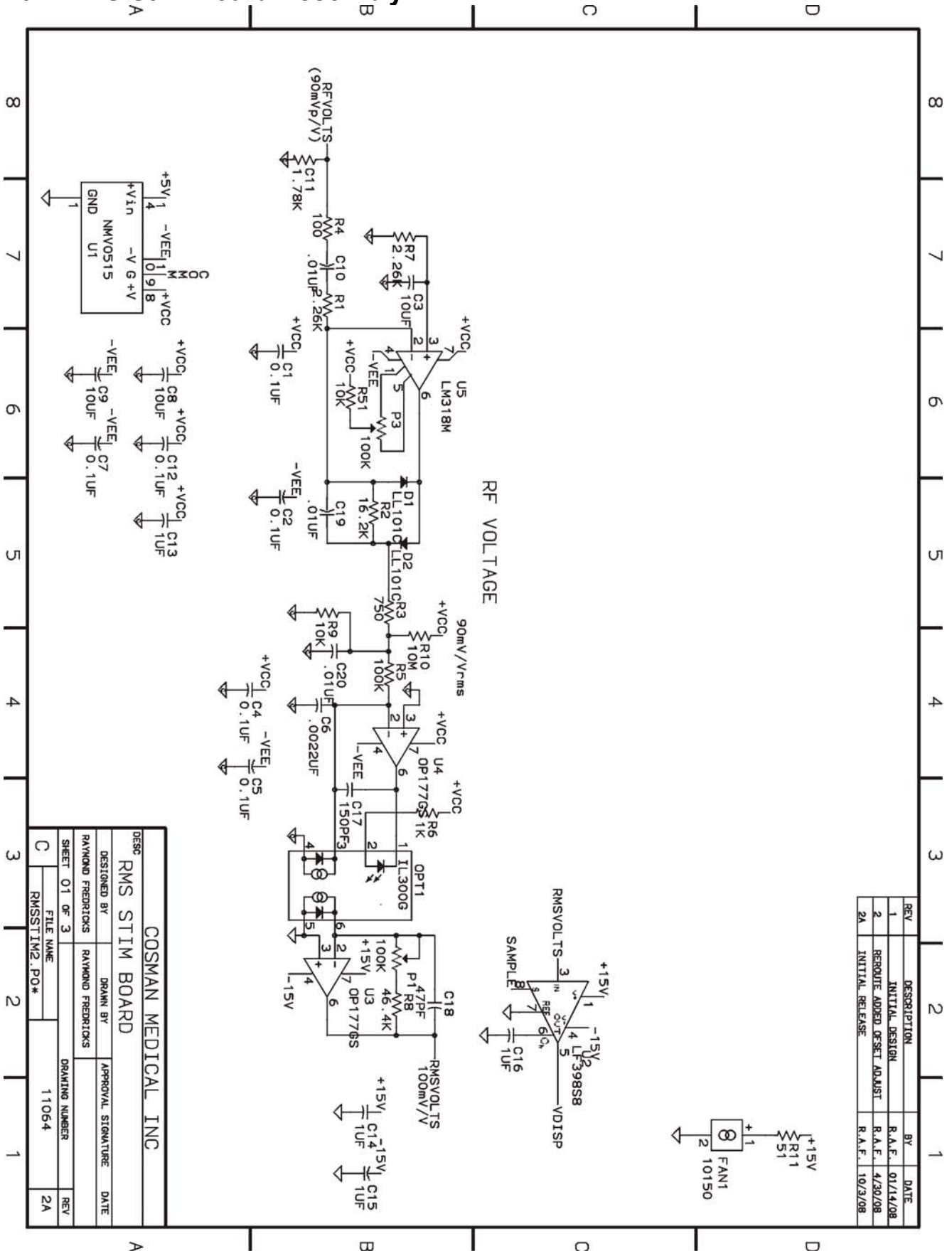
COSMAN MEDICAL INC	
DESC: DISPLAY GENERATOR BACKPLANE BD	
DESIGNED BY: RAYMOND FREDRICKS	DRAWN BY: APPROVAL SIGNATURE
DATE: _____	
SHEET 10 OF 11	
FILE NAME: BKPLANE4.P0*	DRAWING NUMBER: 10916
REV: 4A	

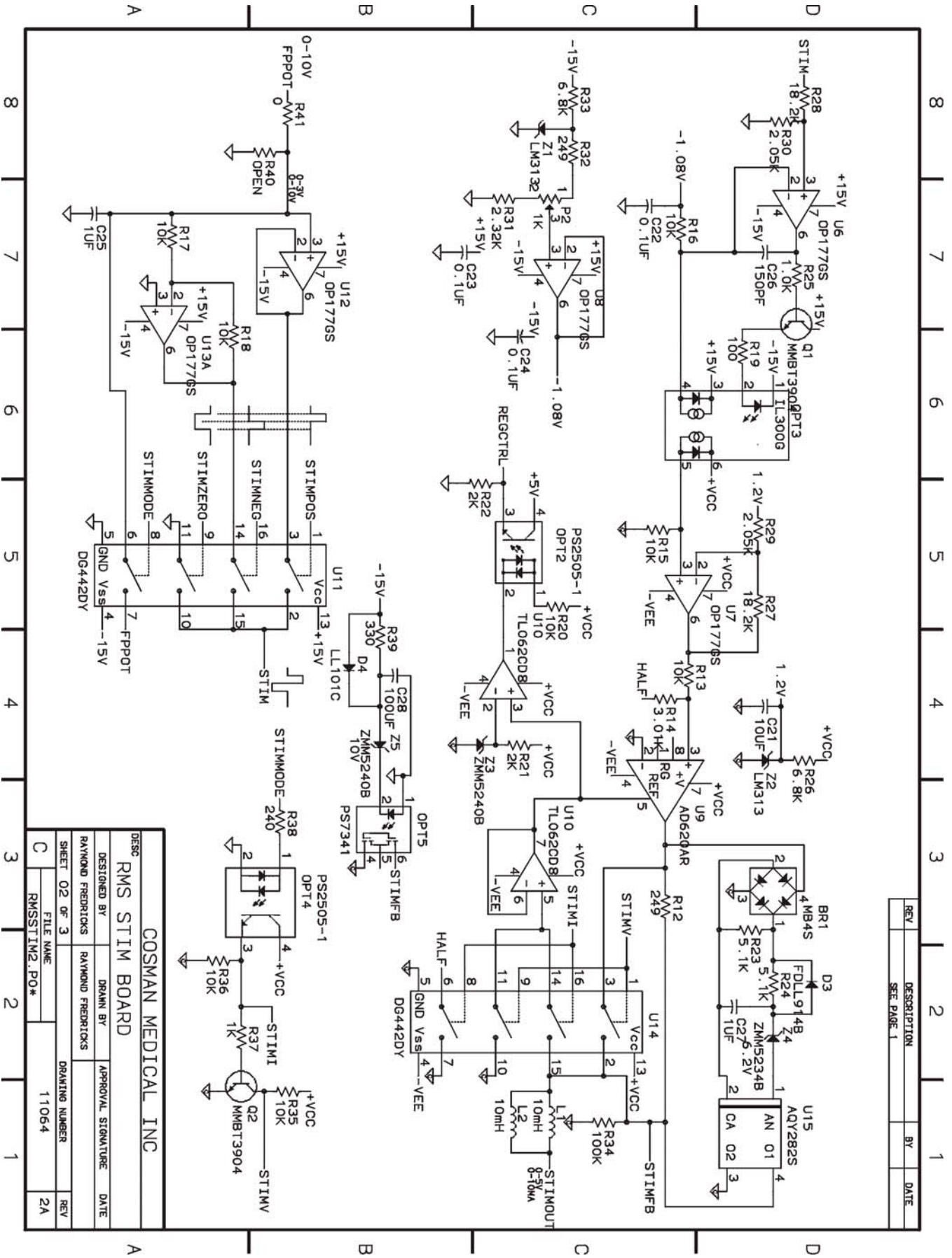


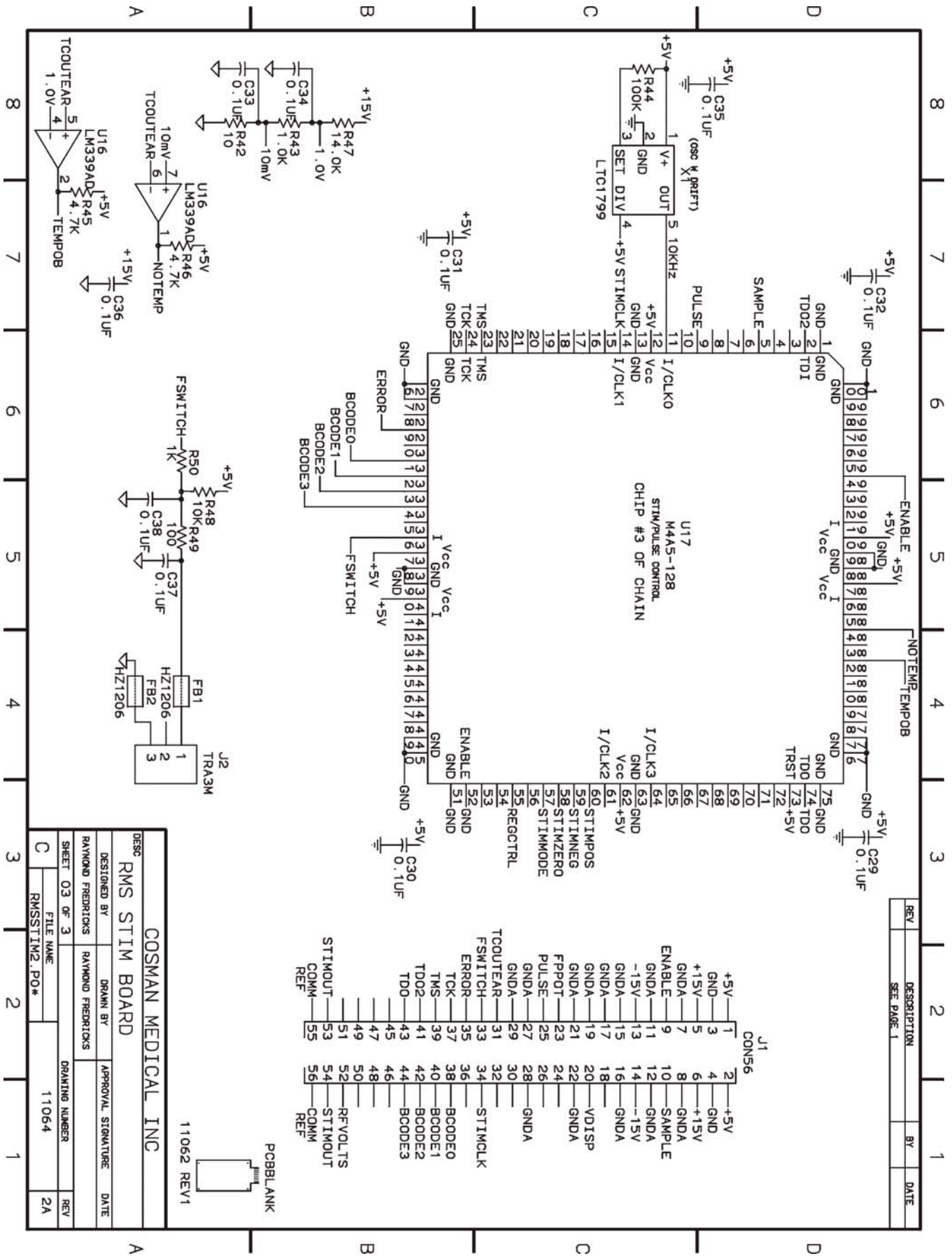
REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

DESC		COSMAN MEDICAL INC	
DISPLAY GENERATOR BACKPLANE BD		DESIGNED BY	
RAYMOND FREDERICKS		DRAWN BY	
RAYMOND FREDERICKS		APPROVAL SIGNATURE	
SHEET 11 OF 11		DATE	
FILE NAME		DRAWING NUMBER	
BKPLANE4.P0*		10916	
REV	4A		

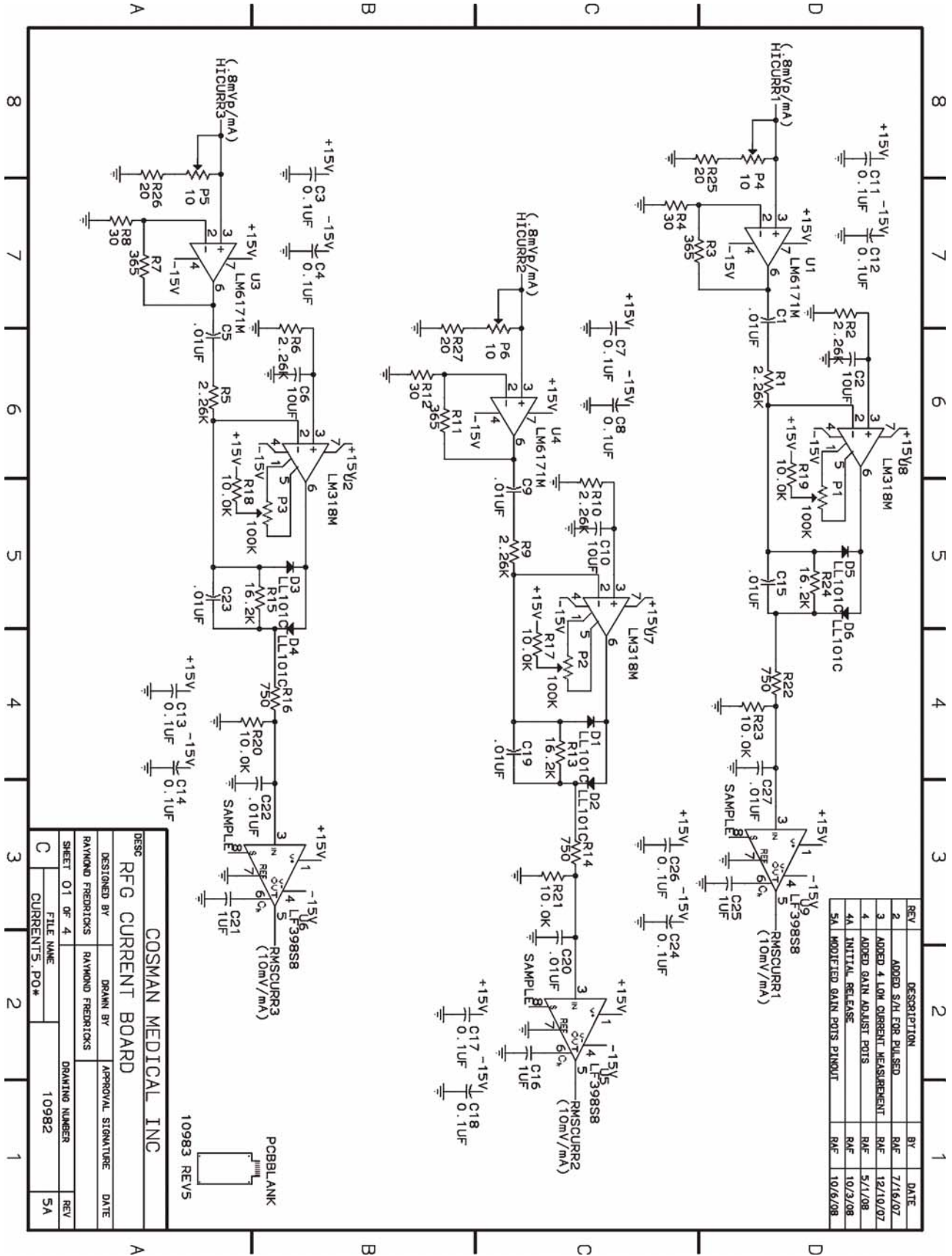
20.2 RMS Stim Board Assembly

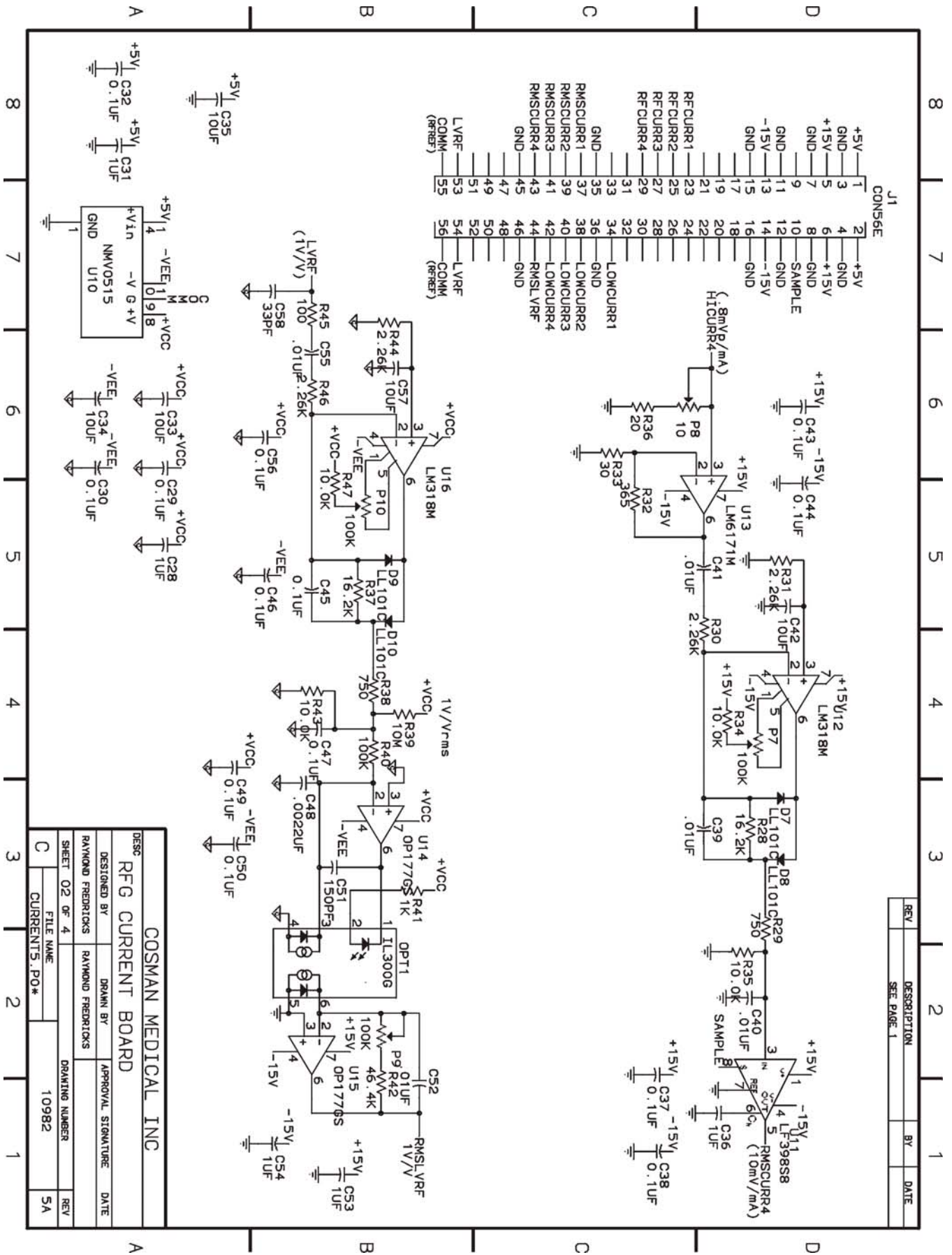


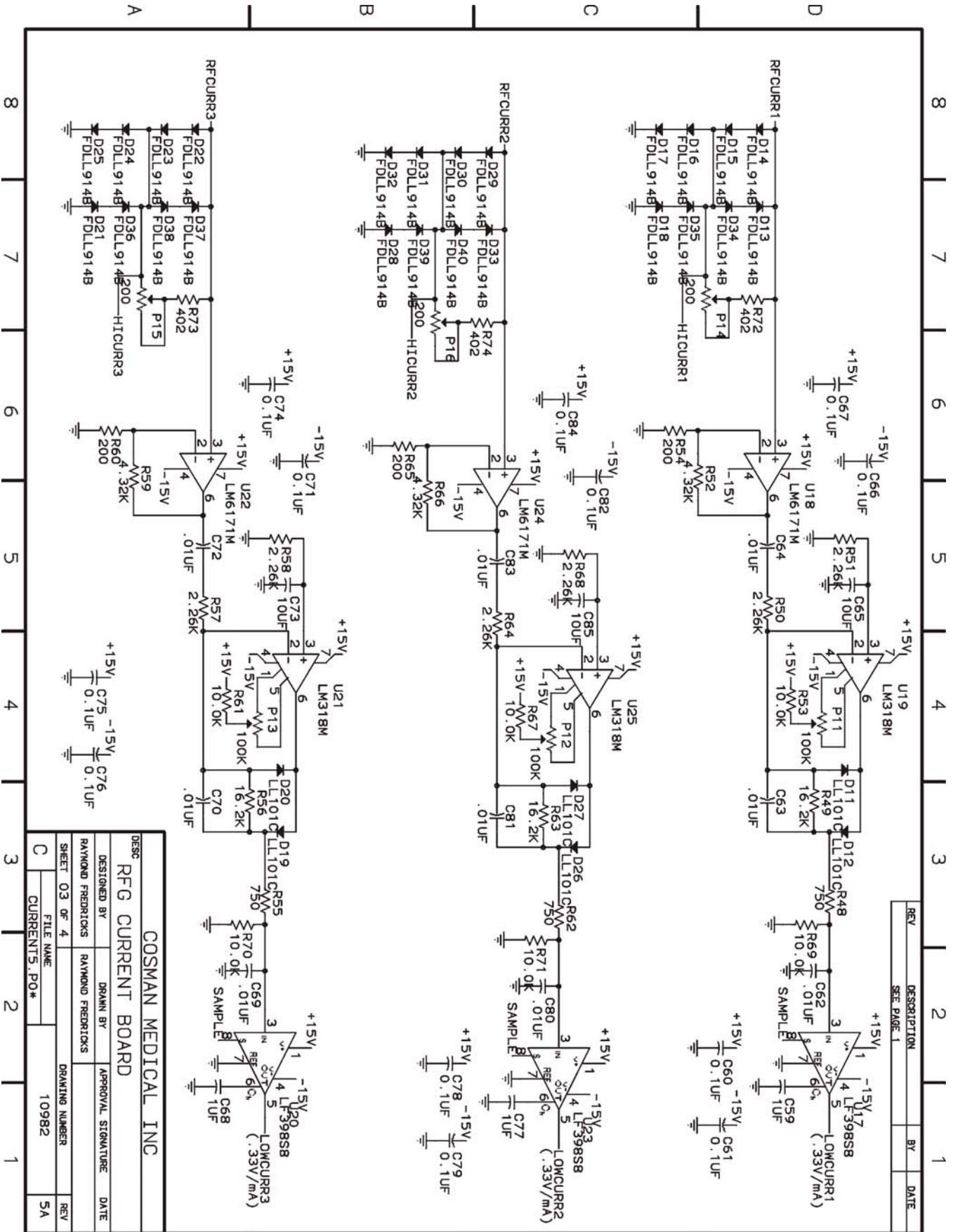




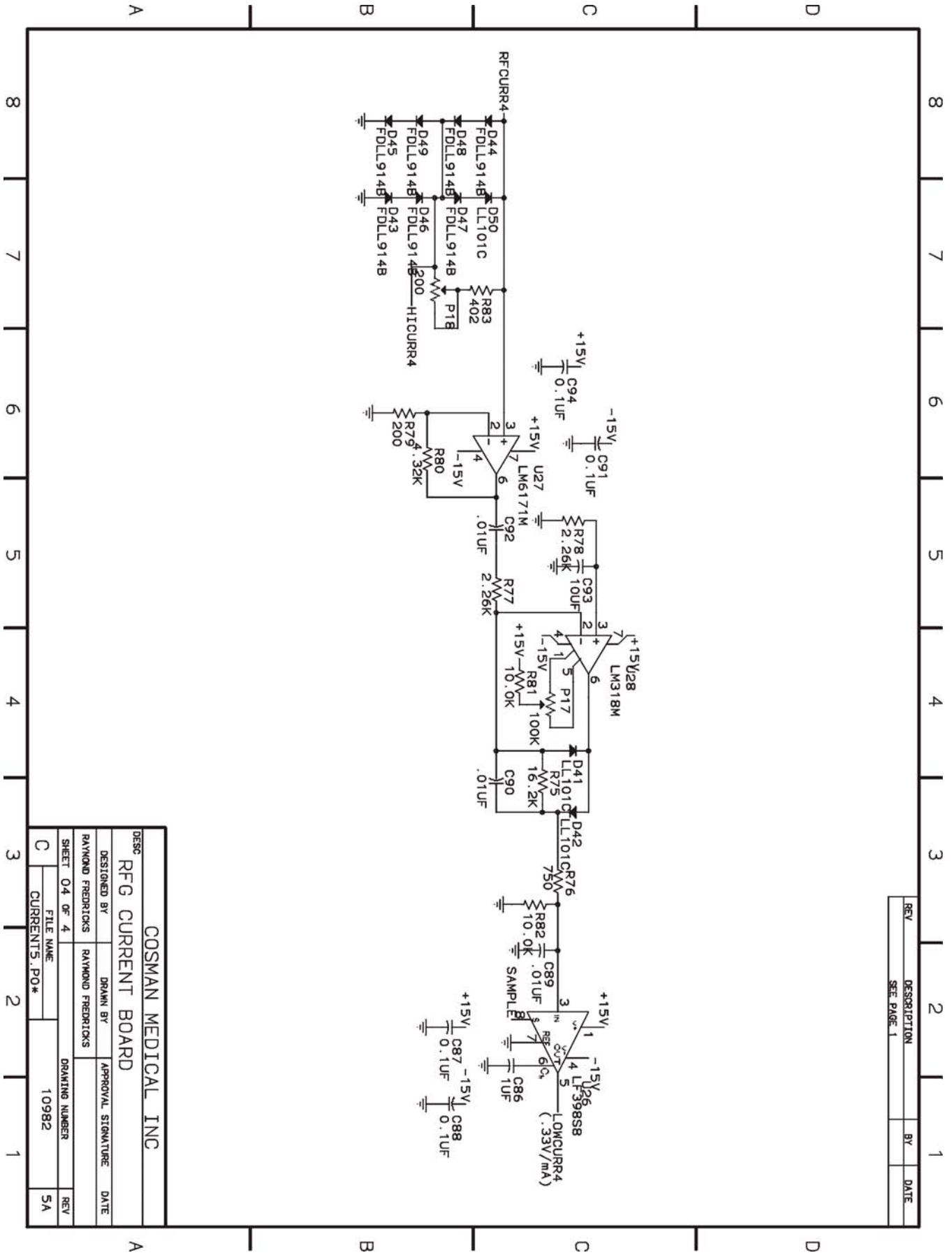
20.3 Current Board Assembly







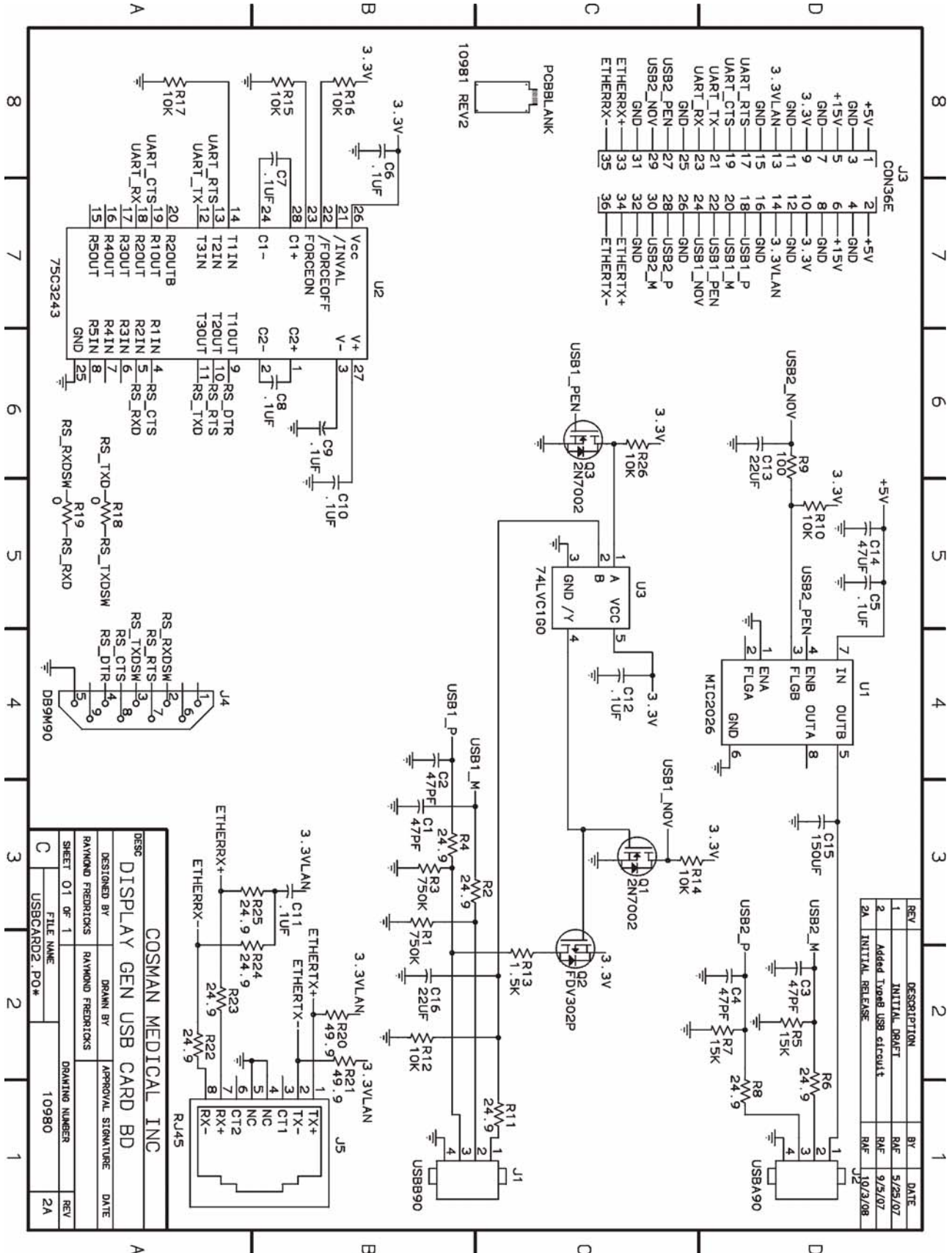
DESC		COSMAN MEDICAL INC	
RFG CURRENT BOARD			
DESIGNED BY	RAYMOND FREDRICKS	DRAWN BY	RAYMOND FREDRICKS
APPROVAL SIGNATURE		DATE	
SHEET 03 OF 4		DRAWING NUMBER	
FILE NAME		10982	
CURRENTS.PO*		REV	
		5A	



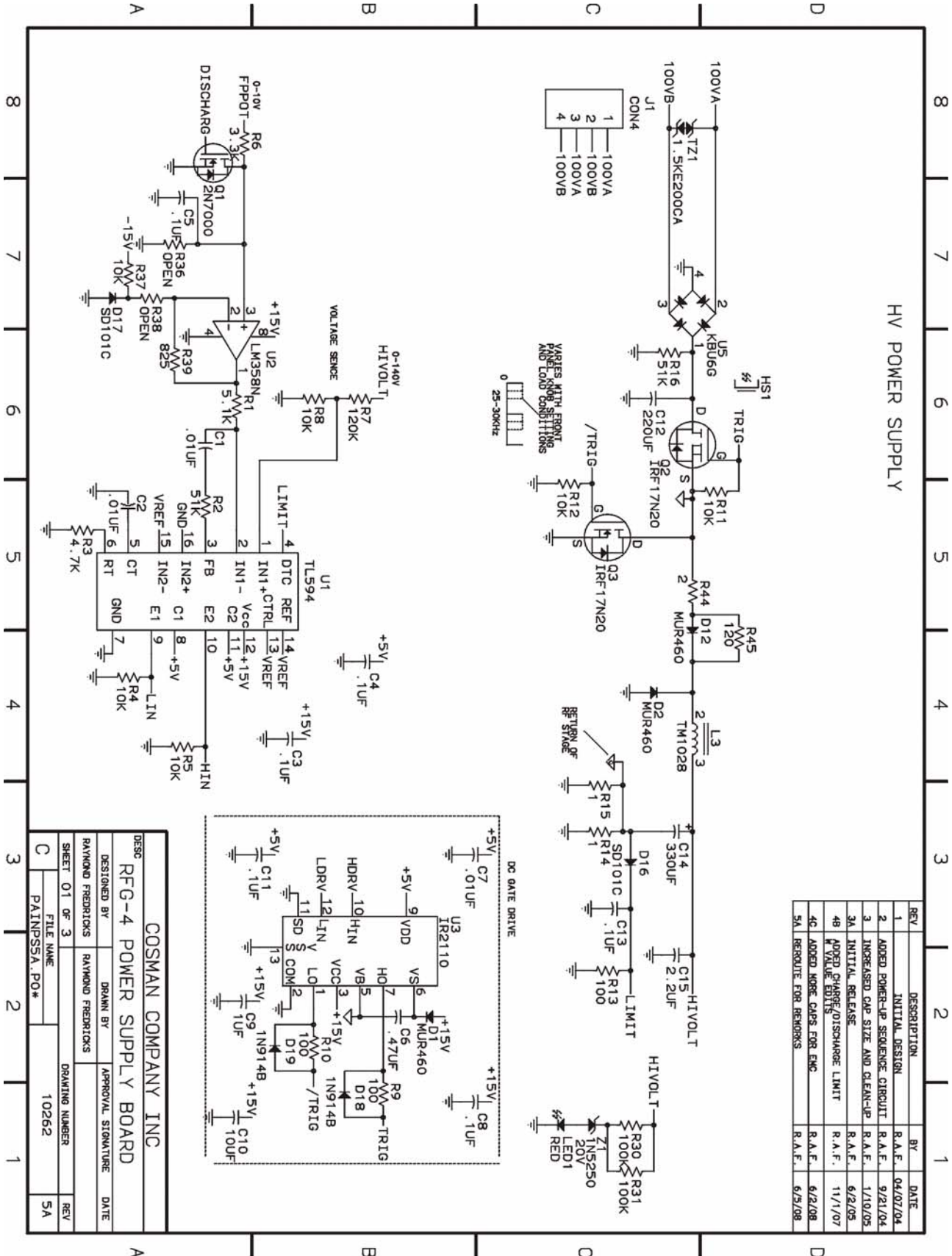
REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

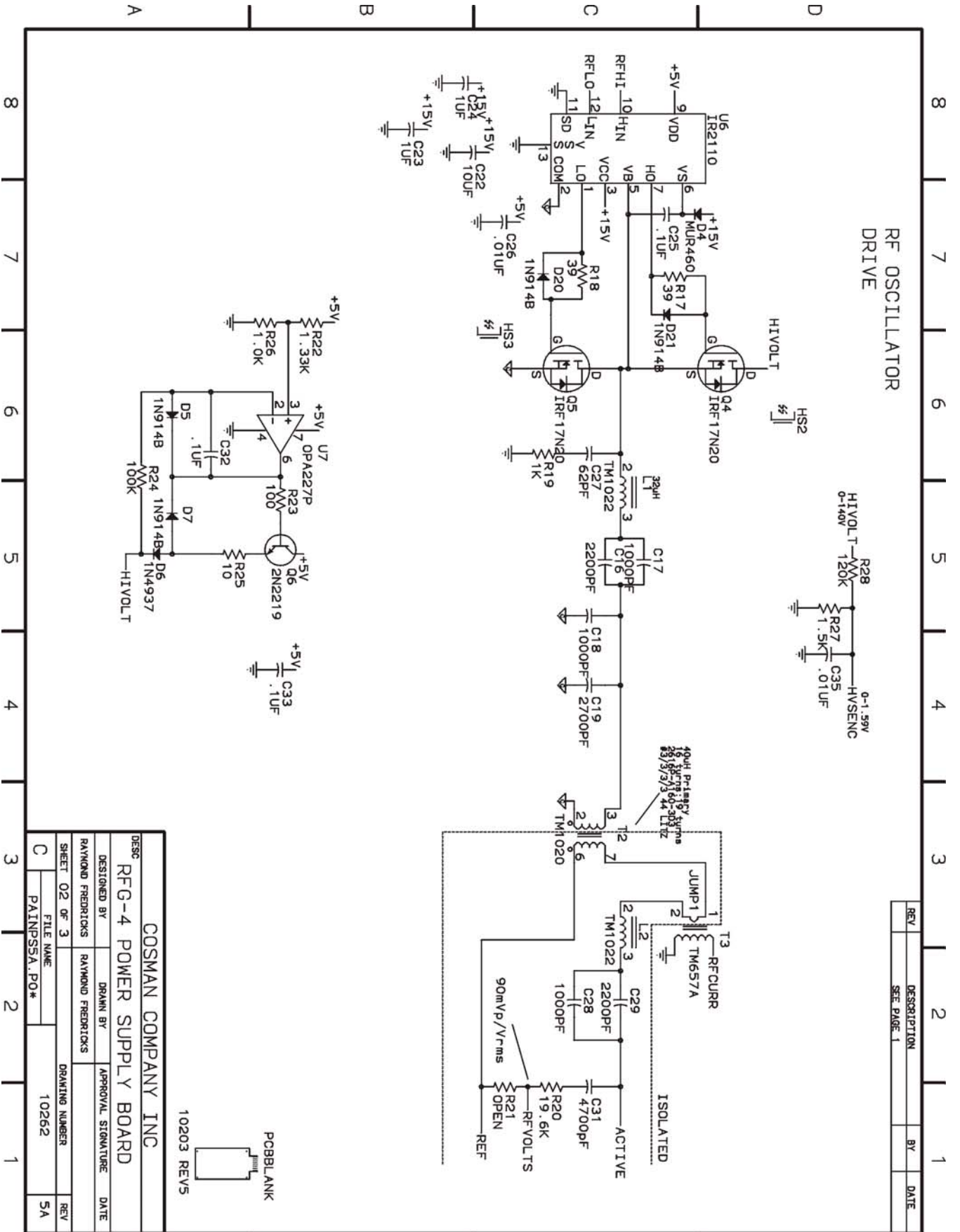
COSMAN MEDICAL INC			
DESC	RFG CURRENT BOARD		
DESIGNED BY	RAYMOND FREDRICKS	DRAWN BY	RAYMOND FREDRICKS
APPROVAL SIGNATURE		DATE	
SHEET 04 OF 4	FILE NAME	DRAWING NUMBER	REV
C	CURRENTS.P0*	10982	SA

20.4 USB Card Board Assembly



20.5 Power Supply Board Assembly

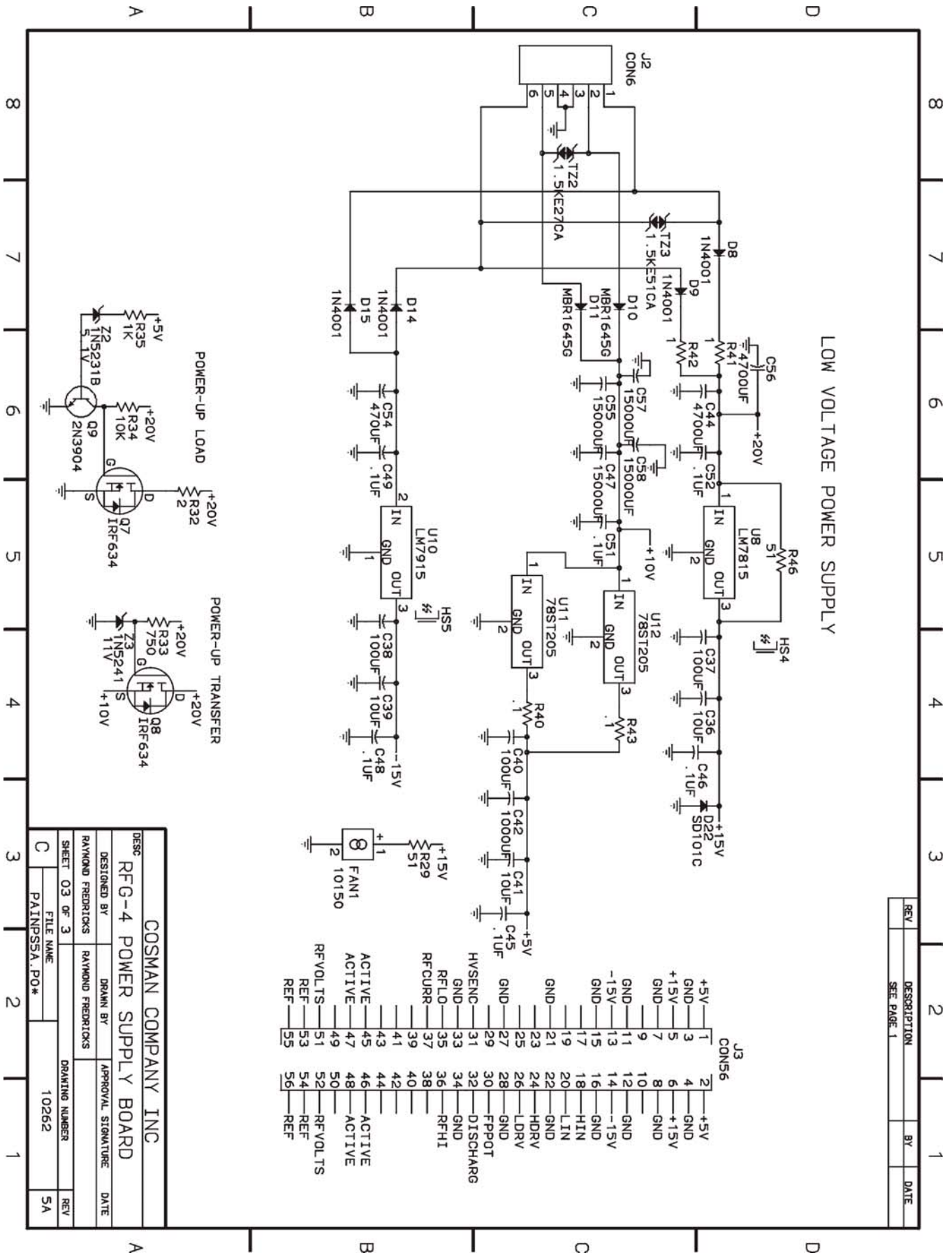




REV	DESCRIPTION	BY	DATE
1	SEE PAGE 1		

DESC		COSMAN COMPANY INC	
DESIGNED BY		RAYMOND FREDERICKS	
DRAWN BY		RAYMOND FREDERICKS	
APPROVAL SIGNATURE		DATE	
RAYMOND FREDERICKS			
SHEET 02 OF 3		DRAWING NUMBER	
FILE NAME		10262	
PAINPSSA.PO*		REV	
		5A	

PCBBLANK
10203 REVS

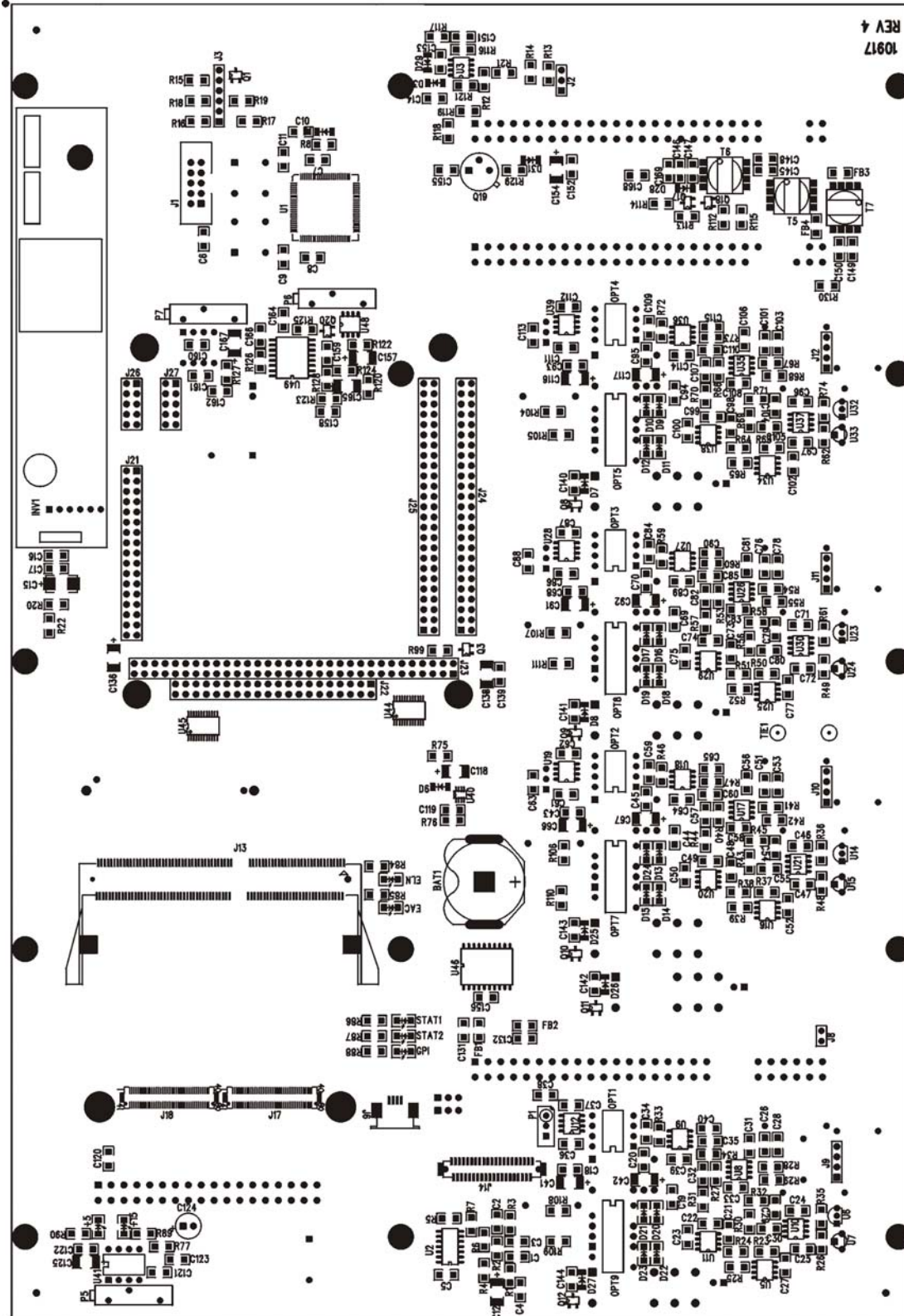


COSMAN COMPANY INC	
RFG-4 POWER SUPPLY BOARD	
DESIGNED BY	DRAWN BY
RAYMOND FREDRICKS	RAYMOND FREDRICKS
APPROVAL SIGNATURE	DATE
SHEET 03 OF 3	
FILE NAME	DRAWING NUMBER
PAINPSSA.P0*	10262
REV	SA

21. PC Board Assemblies

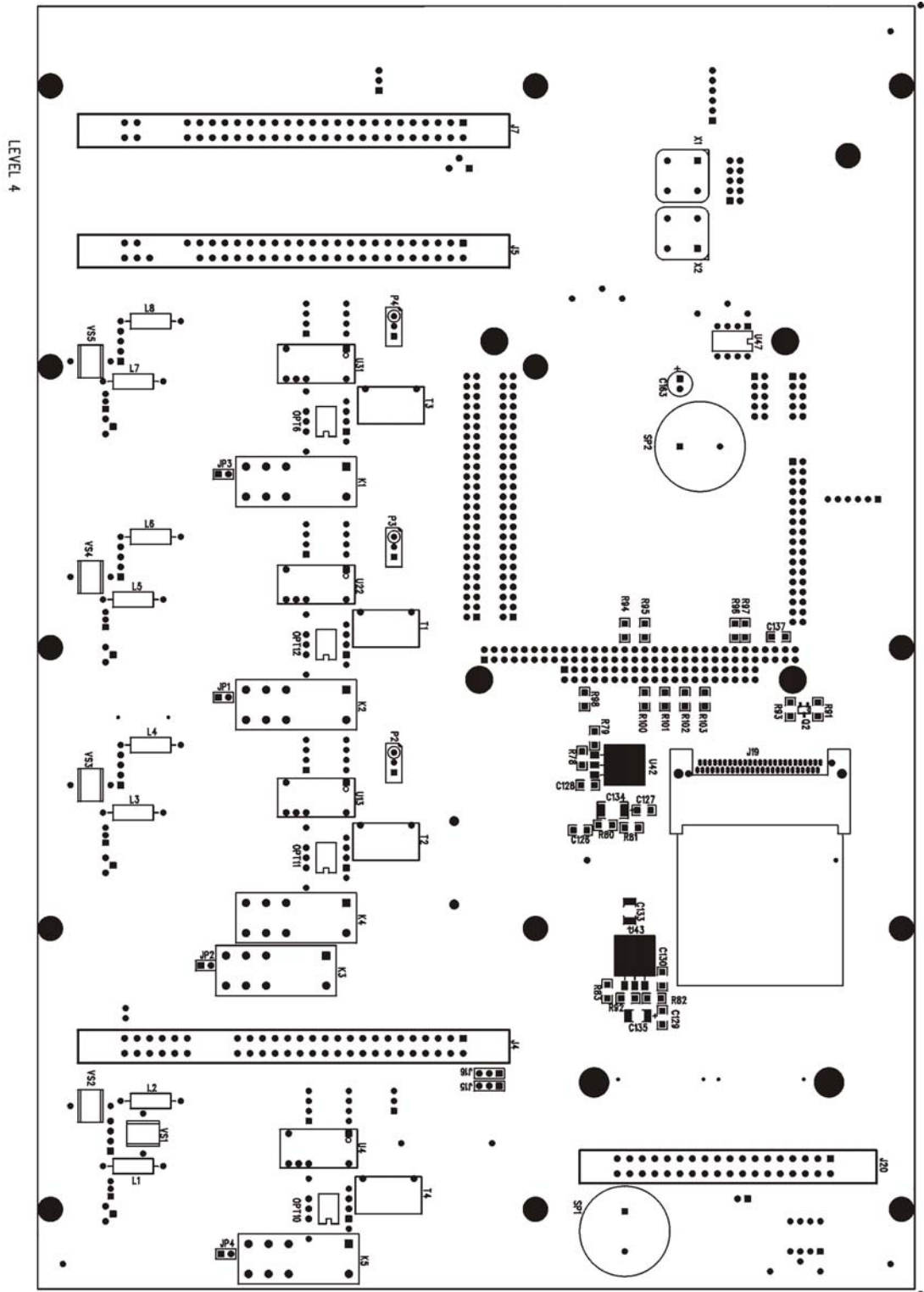
21.1 Backplane Board Assembly

21.1.1 Topside part placement



COSMAN MEDICAL	
RFG BACKPLANE	ASSEMBLY TOP
DESIGNED BY	ROUTED BY
R.A.FREDRICKS	R.A.FREDRICKS
SHEET 1 OF 13	DATE 08-08-08
A	FILE NAME
	BPPLANE4JOB
	DRAWING NUMBER
	10917
	REV
	4

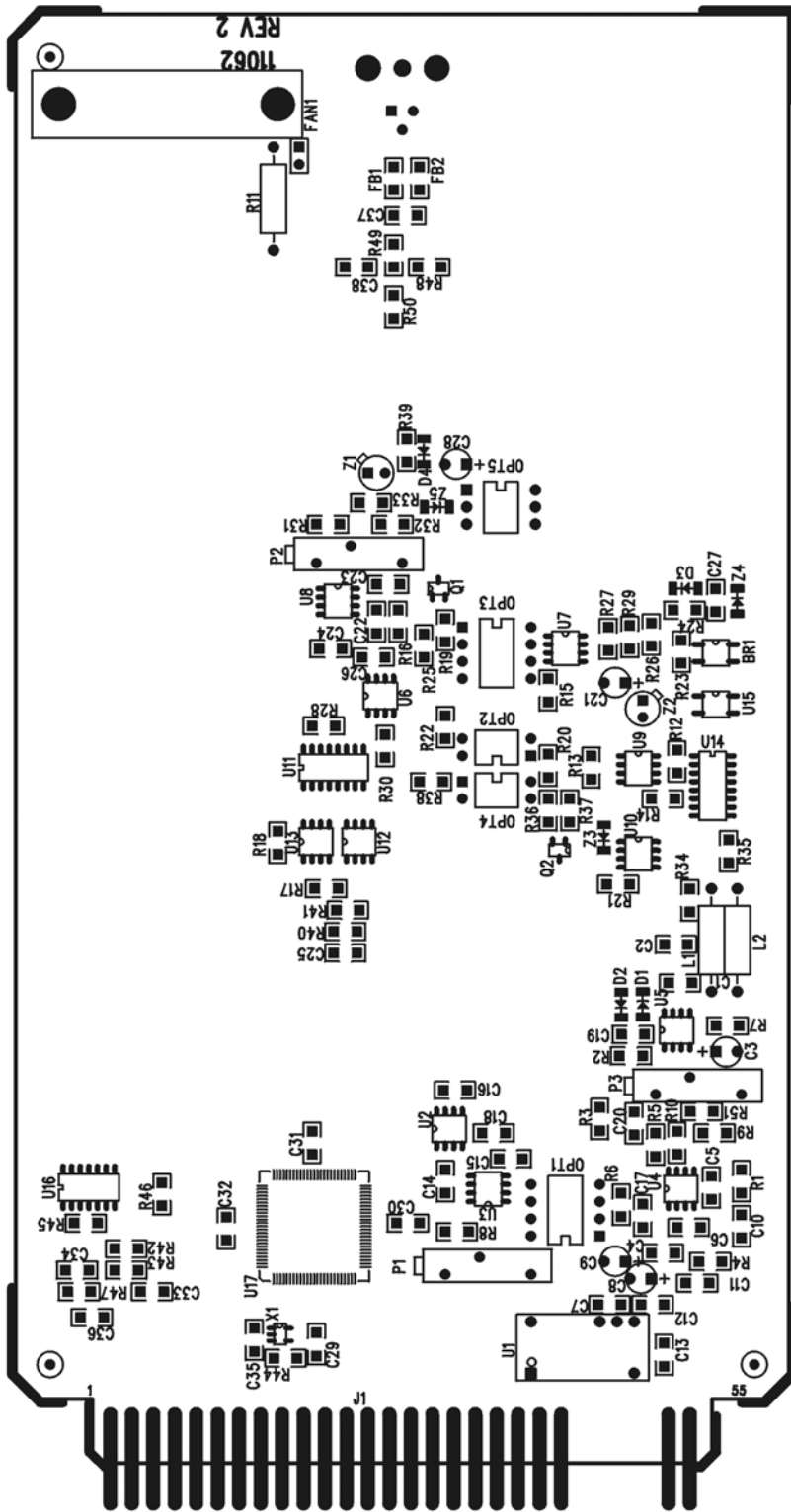
21.1.2 Bottomside part placement



COSMAN MEDICAL	
RFSG BACKPLANE	ASSY BOTTOM
DESIGNED BY: R.A.FREDRICKS	APPROVAL SIGNATURE: DATE
ROUTED BY: R.A.FREDRICKS	APPROVAL SIGNATURE: DATE
SHEET # OF 13: 08-08-01	DRAWING NUMBER: RCY
FILE NAME: 10917	REV: A
BRNLINEJOB	

21.2 RMS Stim Board Assembly

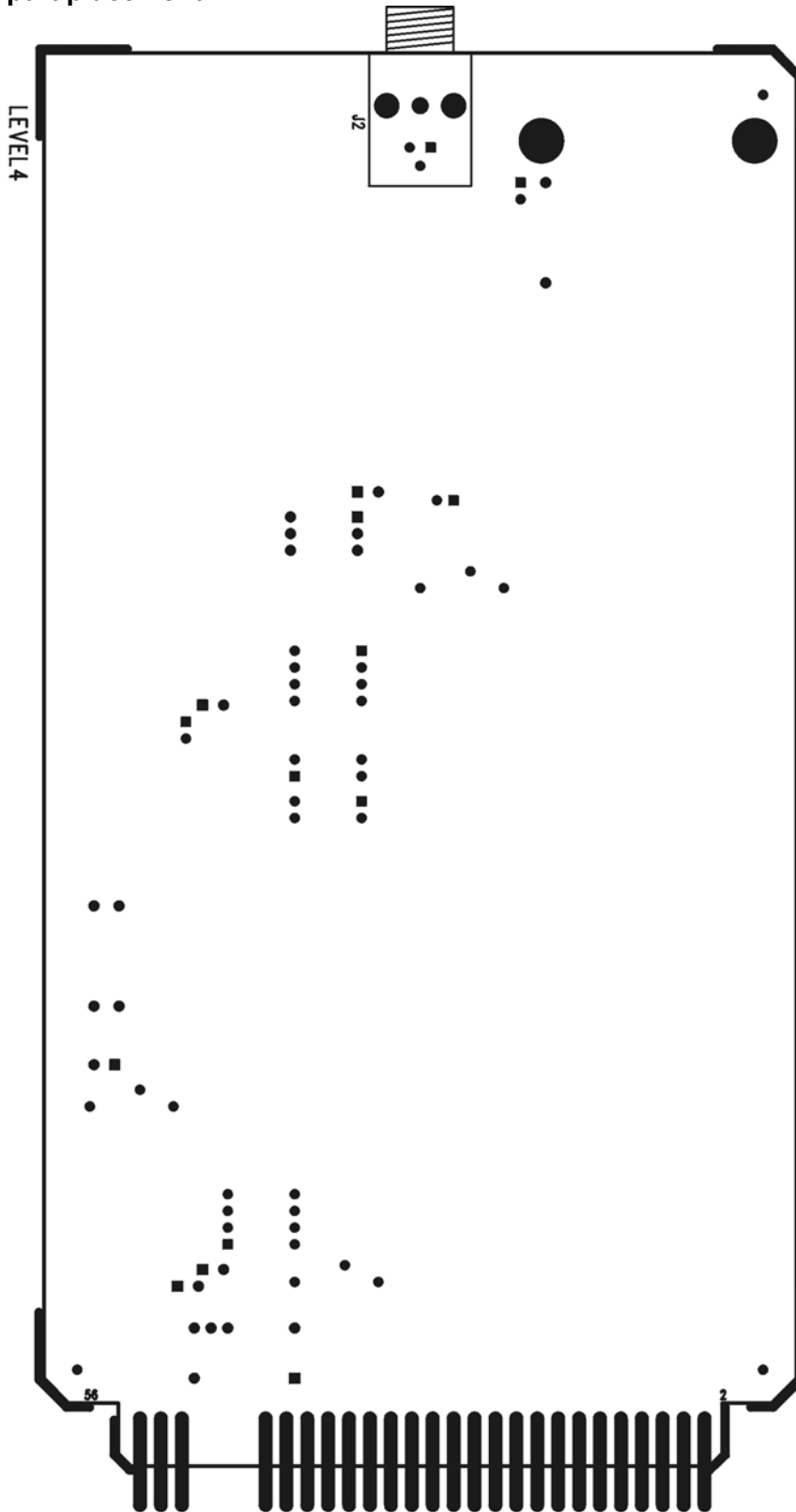
21.2.1 Topside part placement



LEVEL 1

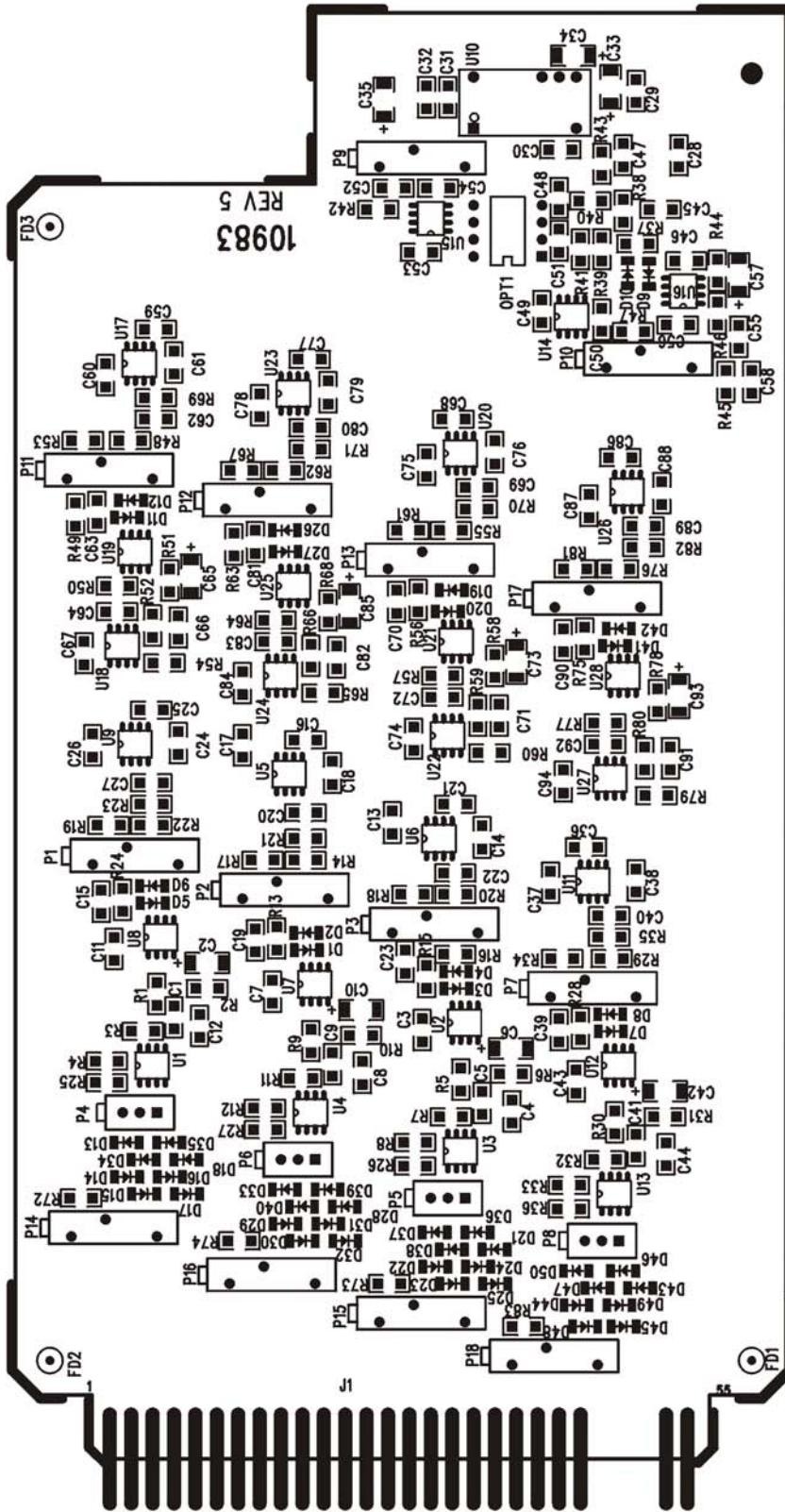
COSMAN MEDICAL			
DESC	RMS STIM BOARD	ASSEMBLY DWG TOP	
DESIGNED BY	R.A.FREDRICKS	ROUTED BY	APPROVAL SIGNATURE
SHEET 1 OF 12	DATE 4/30/08	DRAWING NUMBER	11062
A	FILE NAME	RMSSTM2.10D	REV

21.2.2 Bottomside part placement



COSMAN MEDICAL	
DESC	RMS STIM BOARD
DESIGNED BY	R.A.FREDRICKS
ROUTED BY	R.A.FREDRICKS
DATE	4/30/08
SHEET 11 OF 12	11062
FILE NAME	RMSSTM2.job
REV	2

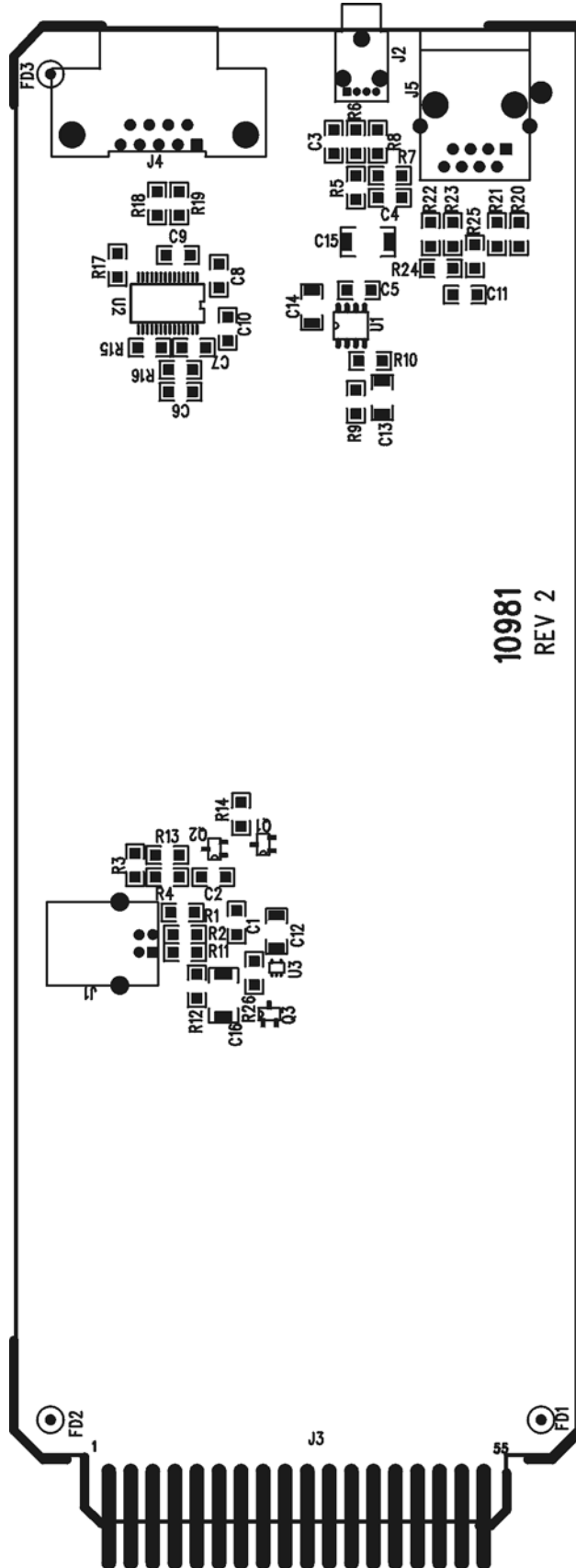
21.3 Current Board Assembly



COSMAN MEDICAL			
DESIGNED BY	ROUTED BY	APPROVAL SIGNATURE	DATE
R.A.FREDRICKS	R.A.FREDRICKS		
SHEET 1 OF 10		DATE: 08/06/08	DRAWING NUMBER: 10983
FILE NAME: A CURRENT5.iob			REV: 5

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21.4 USB Card Board Assembly



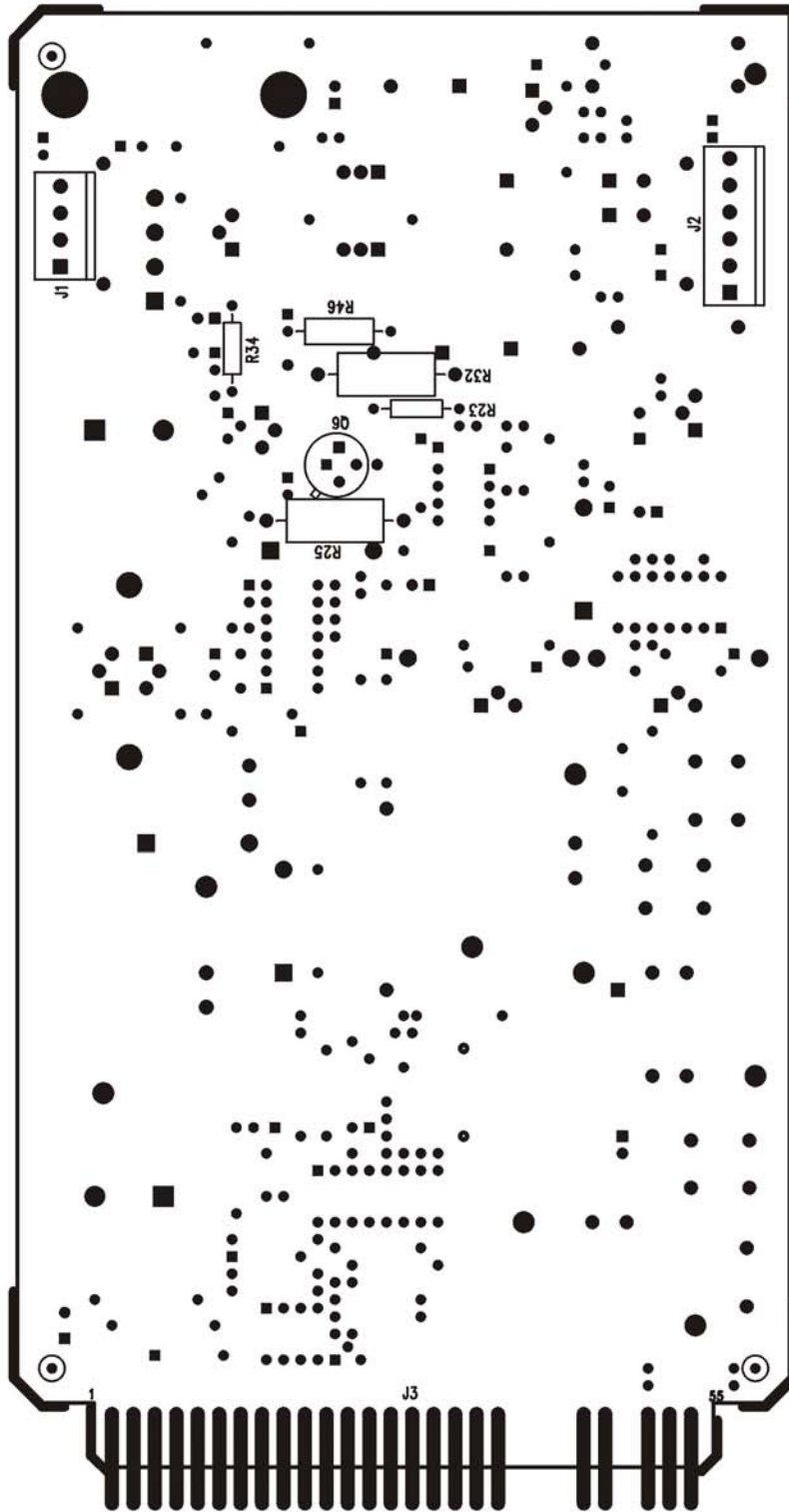
10981
REV 2

COSMAN MEDICAL			
DESC	RFG USB CARD	ASSEMBLY DWG TOP	
DESIGNED BY	Routed by	Approval	Signature
R.A.FREDRICKS	R.A.FREDRICKS		
SHEET 1 OF 10	DATE 10/10/07	DRAWING NUMBER	
A	FILE NAME	10981	2
	USBCARD2.iob		REV

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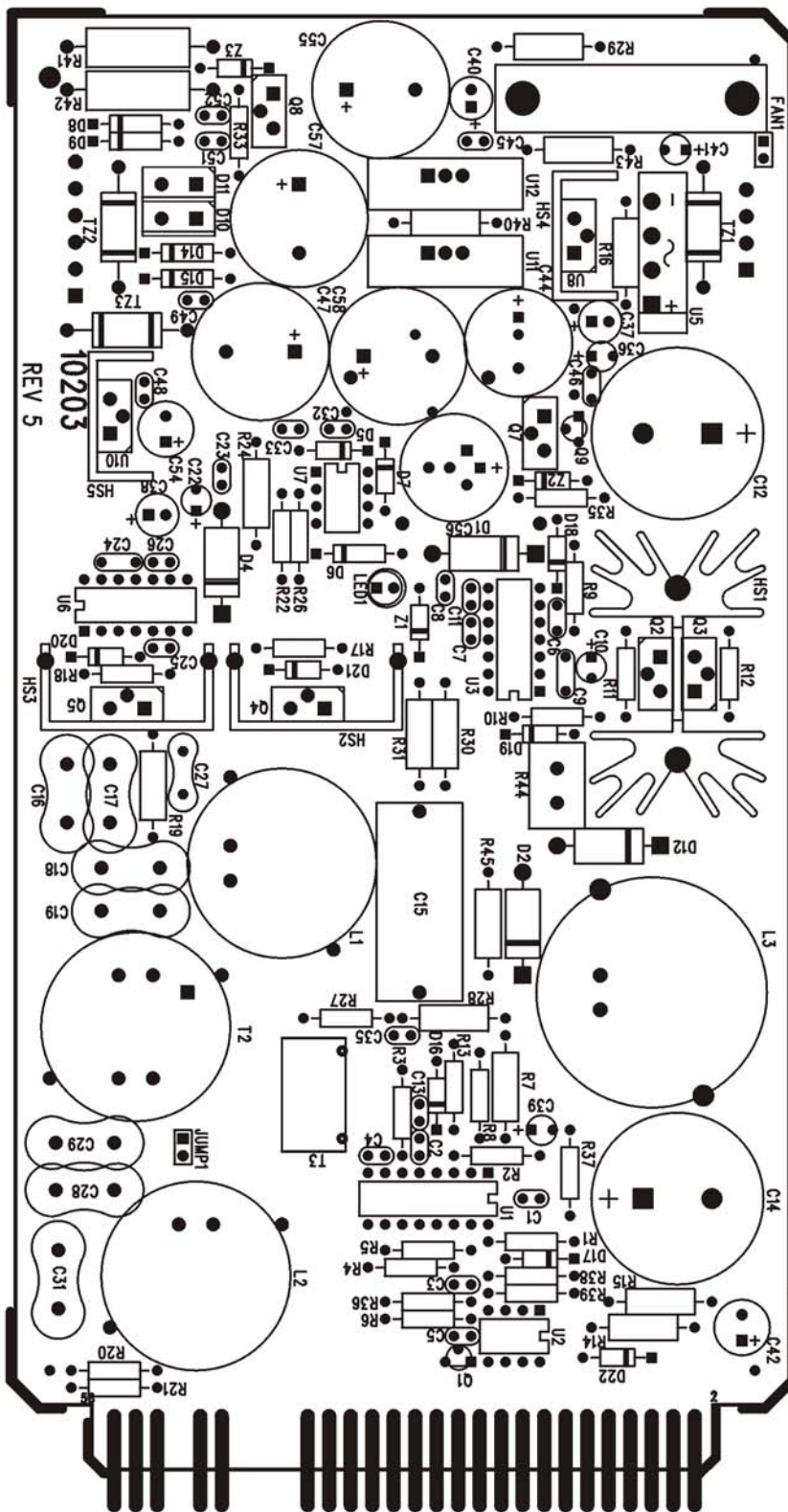
21.5 Power Supply Board Assembly

21.5.1 Topside part placement



COSMAN MEDICAL			
DESC	GRAPHICS GEN POWER ASSEMBLY DWG TOP		
DESIGNED BY	ROUTED BY	APPROVAL SIGNATURE	DATE
R.A.FREDRICKS	R.A.FREDRICKS		
SHEET 1 OF 1	DATE	DRAWING NUMBER	
	8/8/08	10203	5
A	FILE NAME		REV
	PAINPS5.JOB		

21.5.2 Bottomside part placement



COSMAN MEDICAL	
DESC	GRAPHICS GEN POWER ASSEMBLY BOTTON
DESIGNED BY	ROUTED BY
APPROVAL SIGNATURE	DATE
R.A.FREDRICKS	R.A.FREDRICKS
8/8/08	
SHEET 10 OF 10	DRAWING NUMBER
10203	5
FILE NAME	REV
PAINPSS.JOB	

22. Part lists

22.1 Backplane Board Assembly

QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	10917 REV4	BLANK PC BOARD	PCB1
4	CAB-WP-24GR	PVC INSULTAED WIRE #24, 6" Long (Pass through current trans then twisted)	JP1,JP2,JP3, JP4
1	CAB-COAX-22AWG	22AWG shielded cable Belden 8451 8 ¼" long	SHIELD
2	CAE-16V-470UF	,ELECTRO CAP,470UF,16V,,Radial	C124,C163
2	CAM-50V-.0015UFS	,MONO CAP,.0015UF(1500pF),50V,,,1206	C147,C150
7	CAM-50V-.0022UFS	,MONO CAP,.0022UF(2200pF),50V,,,1206	C35,C60,C85 C110,C121,C148 C160
17	CAM-50V-.01UFS	,MONO CAP,.01UF,50V,,,1206	C26,C29,C30, C38,C51,C54, C55,C63,C76, C79,C80,C88 C101,C104,C105 C113,C119,C168
2	CAM-50V-.047UFS	,MONO CAP,.047UF,50V,,,1206	C123,C162
84	CAM-50V-.1UFS	,MONO CAP,.1UF,50V,,,1206	C1,C2,C3,C5,C7 C8,C9,C11,C14 C16,C18,C19, C20,C22,C23, C24,C25,C27, C31,C32,C33, C39,C40,C43, C44,C45,C46, C47,C49,C50, C52,C56,C57, C58,C64,C65, C68,C69,C70, C71,C72,C74, C75,C77,C81, C82,C83,C89, C90,C93,C94, C95,C96,C97, C99,C100,C102 C106,C107,C108 C114,C115,C122 C126,C127,C128 C129,C130,C131 C132,C137,C139 C140,C141,C142 C143,C144,C152 C153,C155,C156 C158,C159,C161

Cosman G4 Radiofrequency Generator Service Manual (SPI 11291 Rev A)

QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
4	CAM-50V-150pFS	, MONO CAP, 150pF, 50V, , , 1206	C34, C59, C84 C109, C169
24	CAM-50V-1UFS	, MONO CAP, 1UF, 50V, , , 1206	C4, C6, C10, C17 C21, C28, C36, C37, C48, C53, C61, C62, C73, C78, C86, C87, C98, C103, C111 C112, C120, C151 C164, C166
3	CAM-50V-TRIMS	(NOT INSTALLED)	C145, C146, C149
1	CAT-10V-150UFS	, TANTALUM CAP, 150UF, 10V, , , 7.3x4.3mm	C134
3	CAT-10V-47UFS	, TANTALUM CAP, 47UF, 10V, , , 6x3.2mm	C136, C138, C165
1	CAT-16V-100UFS	, TANTALUM CAP, 100UF, 16V, , , 7.3x4.3mm	C15
2	CAT-16V-22UFS	, TANTALUM CAP, 22UF, 16V, , , 6x3.2mm	C133, C135
14	CAT-25V-10UFS	, TANTALUM CAP, 10UF, 25V, , , 6x3.2mm	C12, C41, C42, C66, C67, C91, C92, C116, C117 C118, C125, C154 C157, C167
8	CHK-AL-10mH	9250-106, INDUCTOR, 10mH, 24mA, 10%	L1, L2, L3, L4, L5 L6, L7, L8
4	CHK-AL-HZ1206	HZ1206E601R-10, FARRITE BEAD, SMD, , 1206	FB1, FB2, FB3, FB4
1	CON-CO-0008	22-03-2041, CONNECTOR HEADER, 4PIN, , .100"	J9
1	CON-CO-0034	PPPC172LFBN, CONN SOCKET, 34PIN, DUAL ROW, .100	J21
1	CON-CO-0060	PPPC252LFBN, CONN SOCKET, 50PIN, DUAL ROW, .100	J24
1	CON-CO-OPT	(NOT INSTALLED)	J25
1	CON-CO-0090	PBC20DAAN, CONN HEADER, 40PIN, DUAL ROW, .100"	J22
1	CON-CO-0104	22-03-2021, CONNECTOR HEADER, 2PIN, , .100"	J8
6	CON-CO-0105	22-03-2031, CONNECTOR HEADER, 3 PIN, , .100"	J2, J10, J11, J12 J15, J16
2	CON-CO-0106	22-03-2061, MOLEX HEADER, 6PIN, .100"	J3, INV1
1	CON-CO-144	AMP 390112-1, 144 PIN SOM CARD CONNECTOR	J13
1	CON-CO-1MMFPC4	84953-4, FPC RIBBON CONNECTOR, 4PIN, , 1mm	J6
1	CON-CO-2012	PTC05DAAN, CONN HEADER, 10PIN, DUAL ROW, .100"	J1

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	CON-CO-3VT18	3VT18/1CDD5,CARD EDGE CONN,36PIN,.125x.145"	J20
3	CON-CO-3VT28	3VT28/1CDD5,CARD EDGE CONN,56PIN,.125x.145"	J4,J5,J7
1	CON-CO-C052	PPPC052LFBN,CONN SOCKET,10PIN,DUAL ROW,.100	J26
1	CON-CO-OPT	(NOT INSTALLED)	J27
2	CON-CO-DF12-80S	DF12(3.0)-80DS,HIROSE CONNECTOR,80PIN,.5mm	J17,J18
1	CON-CO-DF9-41S	DF9-41S,HIROSE CONNECTOR,41PIN,,1mm	J14
1	CON-CO-PBC32	PBC32DAAN,CON HEADER,64PIN,DUAL ROW,.100"	J23
1	CON-SO-120615	120615-1,COMPACT FLASH SOCKET,50PIN	J19
10	DIO-FDLL914B	FDLL914B,DIODE,,100mA,75V,SOD-80	D1,D7,D8,D25 D26,D27,D28, D29,D30,D31
1	DIO-LLSD101C	LLSD101C,DIODE,,15mA,40V,SOD-80	D6
4	DIO-OPT	(NOT INSTALLED)	U7,U15,U24,U33
8	DIO-PS1H100	(NOT INSTALLED)	D10,D11,D14 D17,D18,D21 D22,D24
1	ICS-AN-1.0486MHz	,CRYSTAL CLOCK OSC,1.0486MHz,,4PIN DIP8	X2
1	ICS-AN-2206D	XR2206D,FUNCTION GEN,,,,SOIC-16 .300	U49
4	ICS-AN-300G	IL300G,LINEAR OPTOCOUPLER,,,,DIP8	OPT1,OPT2,OPT3 OPT4
4	ICS-AN-6012	PVX6012,IGBT PHOTOVOLT RELAY,280V,1A,DIP14	OPT5,OPT7,OPT8 OPT9
1	ICS-AN-7.68MHz	,CRYSTAL CLOCK OSC,7.68MHz,,4PIN DIP8	X1
8	ICS-AN-7141	PS7141-1A,OPTO ISOLATOR,400V,200mA,DIP6 (*PIGGY BACKED EACH PART)	OPT6*,OPT10* OPT11*,OPT12*
4	ICS-CO-0505	NMV0505D,DUAL DC-DC,5V/5V,3000V,,DIP16	U4,U13,U22,U31
1	ICS-DI-3234	DS3234,RTC W CLK,SOIC-20	U46
2	ICS-DI-3384	74CBTD3384PW,10-BIT LEVEL SHIFT,,24 TSSOP	U44,U45
1	ICS-MI-12864	M4A5-128/64,ISP PLD,,,,100PIN TQFP	U1
1	ICS-MI-6374KA	MAX6374KA,PROG WDOG,,SOT23-8	U40

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
20	ICS-OP-177S	OPA177S,ULTRA LOW OFFSET OP AMP,,,,SO-08	U8,U9,U10,U11 U12,U17,U18, U19,U20,U21, U26,U27,U28, U29,U30,U35, U36,U37,U38, U39
1	ICS-OP-339AD	LM339AD,LOW POWER QUAD COMP,,,,SOIC-14	U2
1	ICS-OP-358D	LM358D,DUAL OP-AMP,,,,SOIC-8	U3
2	ICS-OP-386N	LM386N-4,AUDIO AMPL,15V,,,DIP8	U41,U47
4	ICS-OP-592	AD592,TEMPERATURE TRANSDUCER,,,,TO-92	U6,U14,U23,U32
1	ICS-OP-L062CD	TL062CD,DUAL JFET OP AMP,,,,SO-8	U48
1	ICS-VO-1086CS	LM1086CS,LDO VOLTAGE REGULATOR,ADJ,,,TO-263	U42
1	ICS-VO-LM317S	LM317S,VOLTAGE REGULATOR,ADJ,,,TO-263	U43
4	ICS-VO-R03AR	ADR03AR,REFERENCE,2.5V,,,SO-08	U5,U16,U25,U34
7	LIG-DI-CMD15G	CMD15-21VGC,LED,GREEN,20mA,2V,10mCd,1206	+5V,+15V,EACT ELNK,GPIO, STAT1,STAT2
1	MSC-CON-COINBAT	3003,COIN BATTERY HOLDER,20MM	BAT1
5	MSC-MI-600L	CG2-600L,600V SPARK GAP,RADIAL LEAD	VS1,VS2,VS3, VS4,VS5
5	MSC-REL-G2RL24	G2RL-24-DC5,RELAY,115V,8A,5V COIL,DIP24	K1,K2,K3,K4,K5
2	MSC-SP-2308	AT-2308,MINI PCB MNT SPEAKER	SP1,SP2
4	POT-TR-100KU	,TRIM POT,100K,25TURN,1/2W,3296W	P1,P2,P3,P4
2	POT-TR-1KS	,TRIM POT,1K,15 TURN,1/2W,3006P	P5,P7
1	POT-TR-5KS	,TRIM POT,5K,15 TURN,1/2W,3006P	P6
5	R0-X4-open	(NOT INSTALLED)	R22,R35,R48, R61,R74,R93
4	R01%-X4-.05	,RESISTOR,.05,1/4W,1%,,1206	R20,R80,R81, R82
12	R01%-X4-0	,RESISTOR,0,1/4W,1%,,1206	R23,R37,R50, R63,D9,D12,D13 D15,D16,D19,D20 D23
1	R01%-X4-1.47K	,RESISTOR,1.47K,1/4W,1%,,1206	R92

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
4	R01%-X4-10K	,RESISTOR,10K,1/4W,1%,,1206	R25,R39,R52, R65
4	R01%-X4-150K	,RESISTOR,150K,1/4W,1%,,1206	R27,R40,R53, R66
1	R01%-X4-2.49K	,RESISTOR,2.49K,1/4W,1%,,1206	R89
1	R01%-X4-3.01K	,RESISTOR,3.01K,1/4W,1%,,1206	R7
4	R01%-X4-33K	,RESISTOR,33K,1/4W,1%,,1206	R34,R47,R60, R73
1	R01%-X4-4.02K	,RESISTOR,4.02K,1/4W,1%,,1206	R117
4	R01%-X4-412	,RESISTOR,412,1/4W,1%,,1206	R26,R36,R49, R62
3	R01%-X4-576	,RESISTOR,576,1/4W,1%,,1206	R78,R83,R116
4	R01%-X4-6.49K	,RESISTOR,6.49K,1/4W,1%,,1206	R32,R45,R58, R71
4	R01%-X4-64.9K	,RESISTOR,64.9K,1/4W,1%,,1206	R30,R43,R56, R69
4	R01%-X4-732	,RESISTOR,732,1/4W,1%,,1206	R31,R44,R57, R70
4	R01%-X4-8.06K	,RESISTOR,8.06K,1/4W,1%,,1206	R24,R38,R51, R64
1	R01%-X4-931	,RESISTOR,931,1/4W,1%,,1206	R79
2	R05%-X4-10	,RESISTOR,10,1/4W,5%,,1206	R77,R127
5	R05%-X4-100	,RESISTOR,100,1/4W,5%,,1206	R17,R19,R112 R113,R118
2	R05%-X4-100K	,RESISTOR,100K,1/4W,5%,,1206	R76,R121
15	R05%-X4-10K	,RESISTOR,10K,1/4W,5%,,1206	R1,R91,R94,R95 R96,R97,R98, R99,R100,R101 R102,R103,R115 R120,R122
4	R05%-X4-10M	,RESISTOR,10M,1/4W,5%,,1206	R29,R42,R55, R68
1	R05%-X4-15K	,RESISTOR,15K,1/4W,5%,,1206	R13
14	R05%-X4-1K	,RESISTOR,1K,1/4W,5%,,1206	R3,R5,R16,R18 R28,R33,R41, R46,R54,R59, R67,R72,R75 R128

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
2	R05%-X4-2.7K	,RESISTOR,2.7K,1/4W,5%,,1206	R12,R21
1	R05%-X4-200K	,RESISTOR,200K,1/4W,5%,,1206	R2
1	R05%-X4-20K	,RESISTOR,20K,1/4W,5%,,1206	R8,R130
1	R05%-X4-270	,RESISTOR,270,1/4W,5%,,1206	R126
1	R05%-X4-3.3K	,RESISTOR,3.3K,1/4W,5%,,1206	R114
1	R05%-X4-30	,RESISTOR,30,1/4W,5%,,1206	R129
1	R05%-X4-30K	,RESISTOR,30K,1/4W,5%,,1206	R4
5	R05%-X4-330	,RESISTOR,330,1/4W,5%,,1206	R84,R85,R86, R87,R88
10	R05%-X4-470	,RESISTOR,470,1/4W,5%,,1206	R15,R104,R105 R106,R107,R108 R109,R110,R111 R119
2	R05%-X4-5.1K	,RESISTOR,5.1K,1/4W,5%,,1206	R123,R124
1	R05%-X4-51K	,RESISTOR,51K,1/4W,5%,,1206	R125
1	R05%-X4-560	,RESISTOR,560,1/4W,5%,,1206	R90
1	R05%-X4-6.8K	,RESISTOR,6.8K,1/4W,5%,,1206	R6
1	R05%-X4-7.5K	,RESISTOR,7.5K,1/4W,5%,,1206	R14
1	TRN-2N2219	2N2219,NPN TRANSISTOR,800ma,40v,TO-39	Q19
10	TRN-2N7002	2N7002,MOSFET,,60V,300mA,TO-236AA	Q1,Q2,Q3,Q8, Q9,Q10,Q11, Q12,Q17,Q18
1	TRN-MMBT3904	MMBT3904 NPN GEN PURPOSE TRANSISTER,TO-236A	Q20
4	XFMR-XF-0037	TM657,CURRENT XFMR,	T1,T2,T3,T4
3	XFR-XF-2303	DA2303-AL,ISOLATED RS-485 TRANSFORMER,SMT	T5,T6,T7

22.2 RMS Stim Board Assembly

QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	11062 REV2	BLANK PC BOARD	PCB1
1	CAM-50V-.0022UFS	, MONO CAP, .0022UF, 50V, , , 1206	C6
3	CAM-50V-.01UFS	, MONO CAP, .01UF, 50V, , , 1206	C10, C19, C20
19	CAM-50V-0.1UFS	, MONO CAP, 0.1UF, 50V, , , 1206	C1, C2, C4, C5, C7 C12, C22, C23, C24, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38
2	CAM-50V-150PFS	, MONO CAP, 150PF, 50V, , , 1206	C17, C26
6	CAM-50V-1UFS	, MONO CAP, 1UF, 50V, , , 1206	C13, C14, C15, C16, C25, C27
1	CAM-50V-47PFS	, MONO CAP, 47PF, 50V, , , 1206	C18
4	CAT-25V-10UF	, TANTALUM CAP, 10UF, 25V, , , 2.54mm	C3, C8, C9, C21
1	CAT-10V-100UF	, TANTALUM CAP, 100UF, 10V, , , 2.54mm	C28
4	CHK-AL-10mH	9250-106, INDUCTOR, 10mH, , AXIAL	L1, L2, L3*, L4* (tack on)
2	CHK-AL-HZ1206	HZ1206E601R-10, FARRITE BEAD, SMD, , 1206	FB1, FB2
1	CON-CO-3VT28	(Part of PC Board)	J1
1	CON-CO-TRA3M	TRA3M, PCB MOUNT 90 CON, 3 PIN	J2
1	DIO-FDLL914B	FDLL914B, DIODE, , 100mA, 75V, MMELF	D3
3	DIO-LL101C	LL101C, DIODE, , 10mA, 40V, MMELF	D1, D2, D4
1	DIO-MB4S	MB4S, BRIDGE RECTIFIER, , .5A, 400V, TO-269AA	BR1
1	DIO-ZMM5234B	ZMM5234B, ZENER DIODE, , 6.2V, MMELF	Z4
2	DIO-ZMM5240B	ZMM5240B, ZENER DIODE, 10V, , , MMELF	Z3, Z5
1	ICS-AN-1799	LTC1799, ADJ OSCILLATOR, , , , SOT-23	X1
2	ICS-AN-300G	IL300G, LINEAR OPTOCOUPLER, , , , DIP8	OPT1, OPT3
1	ICS-AN-398S8	LF398S8, SAMPLE AND HOLD, , , , SO-8	U2
3	ICS-AN-442DY	DG442DY, QUAD ANALOG SWITCH NO, , , , SO-16	U11, U14 U18* (tack on)

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	ICS-CO-0515	NMV0515DC, ISOLATED DC-DC,	U1
1	ICS-MI-12864	M4A5-128/64, ISP PLD, , , , 100PIN TQFP	U17
2	ICS-MI-2505	PS2505-1, NEC OPTO ISOLATOR, , , , DIP4	OPT2, OPT4
1	ICS-MI-7341	PS7341-1B, DUAL OPTO ISOLATOR, , , , DIP8	OPT5
1	ICS-MI-Y282S	AQY282S, PHOTOMOS RELAY, , , , TO-269AA	U15
7	ICS-OP-177GS	OP177GS, ULTRA LOW OFFSET OP AMP, , , , SO-8	U3, U4, U6, U7, U8 U12, U13
1	ICS-OP-318M	LM318M, HIGH SPEED OP-AMP, , , , SO-8	U5
1	ICS-OP-339AD	LM339AD, LOW POWER QUAD COMP, , , , SOIC-14	U16
1	ICS-OP-D620AR	AD620AR, INSTRUMENTATION AMP, , , , SO-8	U9
1	ICS-OP-L062CD	TL062CD, DUAL JFET OP AMP, , , , SO-8	U10
2	ICS-VO-M113	LM113, REFERENCE DIODE, , 1.2V, H02A	Z1, Z2
2	POT-TR-100KS	, TRIM POT, 100K, 15 TURN, 1/2W, 3006P	P1, P3
1	POT-TR-1KS	, TRIM POT, 1K, 15 TURN, 1/2W, 3006P	P2
1	R01%-X4-0	, RESISTOR, 0, 1/4W, 1%, , 1206	R41
2	R01%-X4-1.0K	, RESISTOR, 1.0K, 1/4W, 1%, , 1206	R25, R43
1	R01%-X4-10	, RESISTOR, 10, 1/4W, 1%, , 1206	R42
1	R01%-X4-100K	, RESISTOR, 100K, 1/4W, 1%, , 1206	R5
7	R01%-X4-10K	, RESISTOR, 10K, 1/4W, 1%, , 1206	R9, R13, R15, R16, R17, R18, R51
1	R01%-X4-10M	, RESISTOR, 10M, 1/4W, 1%, , 1206	R10
1	R01%-X4-14.0K	, RESISTOR, 14.0K, 1/4W, 1%, , 1206	R47
1	R01%-X4-16.2K	, RESISTOR, 16.2K, 1/4W, 1%, , 1206	R2
1	R01%-X4-1.78K	, RESISTOR, 1.78K, 1/4W, 1%, , 1206	C11
2	R01%-X4-18.2K	, RESISTOR, 18.2K, 1/4W, 1%, , 1206	R27, R28
2	R01%-X4-2.05K	, RESISTOR, 2.05K, 1/4W, 1%, , 1206	R29, R30
2	R01%-X4-2.26K	, RESISTOR, 2.26K, 1/4W, 1%, , 1206	R1, R7
1	R01%-X4-2.32K	, RESISTOR, 2.32K, 1/4W, 1%, , 1206	R31
2	R01%-X4-249	, RESISTOR, 249, 1/4W, 1%, , 1206	R12, R32
1	R01%-X4-3.01K	, RESISTOR, 3.01K, 1/4W, 1%, , 1206	R14

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	R01%-X4-330	,RESISTOR,330,1/4W,1%,,1206	R39
1	R01%-X4-46.4K	,RESISTOR,46.4K,1/4W,1%,,1206	R8
1	R01%-X4-750	,RESISTOR,750,1/4W,1%,,1206	R3
1	R01%-X4-OPEN	,RESISTOR,OPEN,1/4W,1%,,1206	R40
1	R05%-X2-51	,RESISTOR,51,1/2W,5%,	R11
3	R05%-X4-100	,RESISTOR,100,1/4W,5%,,1206	R4,R19,R49
2	R05%-X4-100K	,RESISTOR,100K,1/4W,5%,,1206	R34,R44
4	R05%-X4-10K	,RESISTOR,10K,1/4W,5%,,1206	R20,R35,R36, R48
3	R05%-X4-1K	,RESISTOR,1K,1/4W,5%,,1206	R6,R37,R50
1	R05%-X4-240	,RESISTOR,240,1/4W,5%,,1206	R38
2	R05%-X4-2K	,RESISTOR,2K,1/4W,5%,,1206	R21,R22
2	R05%-X4-4.7K	,RESISTOR,4.7K,1/4W,5%,,1206	R45,R46
2	R05%-X4-5.1K	,RESISTOR,5.1K,1/4W,5%,,1206	R23,R24
2	R05%-X4-6.8K	,RESISTOR,6.8K,1/4W,5%,,1206	R26,R33
2	TRN-MMBT3904	MMBT3904 NPN GEN PURPOSE TRANSISTER,TO-236A	Q1,Q2
1	10150	MODIFIED,FAN,12V,.06A,3CFM,40x40x10mm	FAN1
2 (SEE INSTRUCTIONS)	HRD-FAN-001	4-40 X ¼" PHILIPS SCREW	FAN1
2	HRD-FAN-002	#4 INTERNAL TOOTH LOCK WASHER	FAN1

22.3 Current Board Assembly

QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	10983 REV5	BLANK PC BOARD	PCB1
1	CAM-1KV-33PFS	, MONO CAP, 33PF, 1KV, , , 1206	C58
1	CAM-50V-.0022UFS	, MONO CAP, .0022UF, 50V, , , 1206	C48
26	CAM-50V-.01UFS	, MONO CAP, .01UF, 50V, , , 1206	C1, C5, C9, C15 C19, C20, C22, C23, C27, C39, C40, C41, C52, C55, C62, C63, C64, C69, C70, C72, C80, C81, C83, C89, C90, C92
41	CAM-50V-0.1UFS	, MONO CAP, 0.1UF, 50V, , , 1206	C3, C4, C7, C8, C11, C12, C13, C14, C17, C18, C24, C26, C29, C30, C32, C37, C38, C43, C44, C45, C46, C47, C49, C50, C56, C60, C61, C66, C67, C71, C74, C75, C76, C78, C79, C82, C84, C87, C88, C91, C94
1	CAM-50V-150PFS	, MONO CAP, 150PF, 50V, , , 1206	C51
12	CAM-50V-1UFS	, MONO CAP, 1UF, 50V, , , 1206	C16, C21, C25, C28, C31, C36, C53, C54, C59, C68, C77, C86
12	CAT-25V-10UFS	, TANTALUM CAP, 10UF, 25V, , , 6x3.2mm	C2, C6, C10, C33 C34, C35, C42, C57, C65, C73, C85, C93
31	DIO-FDLL914B	FDLL914B, DIODE, , 100mA, 75V, MMELF	D13, D14, D15, D16, D17, D18, D21, D22, D23, D24, D25, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D43, D44, D45, D46, D47, D48, D49

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
19	DIO-LL101C	LL101C, DIODE, , 10mA, 40V, MMELEF	D1, D2, D3, D4, D5 D6, D7, D8, D9, D10, D11, D12, D19, D20, D26, D27, D41, D42, D50
1	ICS-AN-300G	IL300G, LINEAR OPTOCOUPLER, , , , DIP8	OPT1
8	ICS-AN-398S8	LF398S8, SAMPLE AND HOLD, , , , SO-8	U5, U6, U9, U11 U17, U20, U23, U26
1	ICS-CO-0515	NMV0515DC, ISOLATED DC-DC,	U10
2	ICS-OP-177GS	OP177GS, ULTRA LOW OFFSET OP AMP, , , , SO-8	U14, U15
9	ICS-OP-318M	LM318M, HIGH SPEED OP-AMP, , , , SO-8	U2, U7, U8, U12 U16, U19, U21, U25, U28
8	ICS-OP-6171M	LM6171BIM, LOW OFFSET OP AMP, , , , SO-8	U1, U3, U4, U13 U18, U22, U24, U27
10	POT-TR-100KS	, TRIM POT, 100K, 15 TURN, 1/2W, 3006P	P1, P2, P3, P7, P9 P10, P11, P12, P13, P17
4	POT-TR-10S	, TRIM POT, 10, 25 TURN, 1/2W, 2396X	P4, P5, P6, P8
4	POT-TR-200S	, TRIM POT, 200, 15 TURN, 1/2W, 3006P	P14, P15, P16, P18
18	R01%-X4-10.0K	, RESISTOR, 10.0K, 1/4W, 1%, , 1206	R17, R18, R19, R20, R21, R23, R34, R35, R43, R47, R53, R61, R67, R69, R70, R71, R81, R82
1	R01%-X4-100K	, RESISTOR, 100K, 1/4W, 1%, , 1206	R40
1	R01%-X4-10M	, RESISTOR, 10M, 1/4W, 1%, , 1206	R39
9	R01%-X4-16.2K	, RESISTOR, 16.2K, 1/4W, 1%, , 1206	R13, R15, R24, R28, R37, R49, R56, R63, R75
18	R01%-X4-2.26K	, RESISTOR, 2.26K, 1/4W, 1%, , 1206	R1, R2, R5, R6, R9 R10, R30, R31, R44, R46, R50, R51, R57, R58, R64, R68, R77, R78

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QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
4	R01%-X4-20	,RESISTOR,20,1/4W,1%,,1206	R25,R26,R27, R36
4	R01%-X4-200	,RESISTOR,200,1/4W,1%,,1206	R54,R60,R65, R79
4	R01%-X4-30	,RESISTOR,30,1/4W,1%,,1206	R4,R8,R12,R33
4	R01%-X4-365	,RESISTOR,365,1/4W,1%,,1206	R3,R7,R11,R32
4	R01%-X4-4.32K	,RESISTOR,4.32K,1/4W,1%,,1206	R52,R59,R66, R80
4	R01%-X4-402	,RESISTOR,402,1/4W,1%,,1206	R72,R73,R74, R83
1	R01%-X4-46.4K	,RESISTOR,46.4K,1/4W,1%,,1206	R42
9	R01%-X4-750	,RESISTOR,750,1/4W,1%,,1206	R14,R16,R22, R29,R38,R48, R55,R62,R76
1	R05%-X4-100	,RESISTOR,100,1/4W,5%,,1206	R45
1	R05%-X4-1K	,RESISTOR,1K,1/4W,5%,,1206	R41

22.4 USB Card Board Assembly

QUAN.	PART NUMBER	DESCRIPTION	REF. DES.
1	10981 REV2	BLANK PC BOARD	PCB1
4	CAM-25V-47PFS	, MONO CAP, 47PF, 25V, , , 1206	C1, C2, C3, C4
7	CAM-50V-.1UFS	, MONO CAP, .1UF, 50V, , , 1206	C5, C6, C7, C8, C9 C10, C11
1	CAT-10V-150UFS	, TANTALUM CAP, 150UF, 10V, , , 7.3x4.3mm	C15
1	CAT-10V-47UFS	, TANTALUM CAP, 47UF, 10V, , , 6x3.2mm	C14
2	CAT-16V-22UFS	, TANTALUM CAP, 22UF, 16V, , , 6x3.2mm	C13, C16
1	CON-CO-USBA90	89485-8000, USB A, VERT90, 4PIN, DIP	J2
1	ICS-DI-2026	MIC2026-1YM, DUAL-CHANNEL SWITCH, SO-8	U1
1	PCB-FINGERS	36PIN CARD EDGE FINGERS (PART OF PCB)	J3
9	R01%-X4-24.9	, RESISTOR, 24.9, 1/4W, 1%, , 1206	R2, R4, R6, R8, R11, R22, R23, R24, R25
1	R05%-X4-100	, RESISTOR, 100, 1/4W, 5%, , 1206	R9
7	R05%-X4-10K	, RESISTOR, 10K, 1/4W, 5%, , 1206	R10, R12, R14, R15, R16, R17, R26
2	R05%-X4-15K	, RESISTOR, 15K, 1/4W, 5%, , 1206	R5, R7

The following parts are not installed on production units

1	CON-CO-USBB90	33UBBR-04SW11, USB B, VERT90, 4PIN, DIP	J1
1	ICS-DI-1G00D	SN74LVC1G00DCKR, SWITCH, SC-70	U3
1	TRN-FDV302P	FDV302P, P CH MOSFET, , -25V, -120mA, TO-236AA	Q2
2	TRN-2N7002	2N7002, MOSFET, , 60V, 300mA, TO-236AA	Q1, Q3
1	ICS-DI-3243	75C3243DB, RS-232 DRIVER, SSOP-28	U2
1	CON-CO-RJ45	A00-108-662-450, RJ45 90 JACK	J5
1	CON-CO-DB9M90	747250-4, MALE DB9 90, DIP	J4
2	R05%-X4-750K	, RESISTOR, 750K, 1/4W, 5%, , 1206	R1, R3
1	R05%-X4-1.5K	, RESISTOR, 1.5K, 1/4W, 5%, , 1206	R13
2	R05%-X4-0	, RESISTOR, 0, 1/4W, 5%, , 1206	R18, R19
2	R01%-X4-49.9	, RESISTOR, 49.9, 1/4W, 1%, , 1206	R20, R21
1	CAM-50V-.1UFS	, MONO CAP, .1UF, 50V, , , 1206	C12

22.5 Power Supply Board Assembly

QNT.	PART No.	DESCRIPTION	REF. DES.
1	10203 REV 5	RFG-4 POWER SUPPLY BLANK PC BOARD	PCB1
1	PCB-BD	56 PIN CARD FINGERS (PART OF PCB)	J3
1	R01%-X4-750	,RESISTOR,750,1/4W,1%	R33
1	R01%-X4-1.50K	,RESISTOR,1.50K,1/4W,1%,	R27
1	R01%-X4-11K	,RESISTOR,11K,1/4W,1%,	R8
1	R01%-X4-19.6K	,RESISTOR,19.6K,1/4W,1%,	R20
1	R01%-X4-1.0K	,RESISTOR,1.0K,1/4W,1%,	R26
1	R01%-X4-1.33k	,RESISTOR,1.33K,1/4W,1%	R22
1	R05%-X4-1K	,RESISTOR,1K,1/4W,5%	R35
1	R05%-X4-3.3K	,RESISTOR,3.3K,1/4W,5%	R6
2	R05%-X4-39	,RESISTOR,39,1/4W,5%,	R17,R18
4	R05%-X4-100	,RESISTOR,100,1/4W,5%, *(See instructions)	R9,R10,R13,R23*
6	R05%-X4-10K	,RESISTOR,10K,1/4W,5%,	R4,R5,R11,R12,R34,R37
1	R05%-X4-4.7K	,RESISTOR,4.7K,1/4W,5%,	R3
1	R05%-X4-5.1K	,RESISTOR,5.1K,1/4W,5%,	R1
1	R05%-X4-51K	,RESISTOR,51K,1/4W,5%,	R2
1	R05%-X4-825	,RESISTOR,825,1/4W,5%	R39
2	R05%-X2-1	,RESISTOR,1,1/2W,5%,	R14,R15
3	R05%-X2-100K	,RESISTOR,100K,1/2W,5%,	R24,R30,R31
2	R05%-X2-120K	,RESISTOR,120K,1/2W,5%,	R7,R28
1	R05%-X2-1K	,RESISTOR,1K,1/2W,5%,	R19
2	R05%-X2-51	,RESISTOR,51,1/2W,5%, *(See instructions)	R29,R46*
1	R05%-X2-51K	,RESISTOR,51K,1/2W,5%,	R16
1	R05%-X2-120	,RESISTOR,120,1/2W,5%,	R45
1	R05%-03-10	,RESISTOR,10,3W,5%,	R25
2	R05%-03-1	,RESISTOR,1,3W,5%	R41,R42
1	R05%-03-2	,RESISTOR,2,3W,5%	R32*

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QNT.	PART No.	DESCRIPTION	REF. DES.
		*(See instructions)	
1	R05%-03-2	TWW3J2R0E,RESISTOR,2,3W,5%,CER .20" RADIAL	R44
1	R05%-02-0.1	,RESISTOR,0.1,2W,5%	R40,R43
3	R05%-X4-OPEN	(Not installed for RFG-4)	R21,R36,R38
1	DIO-1.5KE27CA	1.5KE27CA,TRANSIENT VOLTAGE SUP,27V	TZ2
1	DIO-1.5KE200CA	1.5KE200CA,TRANSIENT VOLTAGE SUP,200V	TZ1
1	DIO-1.5KE51CA	1.5KE51CA,TRANSIENT VOLTAGE SUP,51V	TZ3
4	DIO-1N4001	1N4001,DIODE,,1A,50V,DO-41	D8,D9,D14,D15
1	DIO-1N4937	1N4937,DIODE,,1A,600V,DO-41	D6
1	DIO-1N5231B	1N5231B,ZENER DIODE,,5.1V,,DO-41	Z2
1	DIO-1N5250	1N5250,ZENER DIODE,,20V,,DO-41	Z1
1	DIO-1N5241	1N5241,ZENER DIODE,,11V,,DO-41	Z3
6	DIO-1N914B	1N914B,DIODE,,100mA,75V,DO-35	D5,D7,D18,D19,D20,D21
1	DIO-KBU6G	KBU6G,RECTIFIER BRIDGE,6A,400V,,SIP	U5
2	DIO-MBR1645G	MBR1645G,DIODE,,16A,45V,TO-220AC	D10,D11
4	DIO-MUR460	MUR460,DIODE,,4AMP,600V,267-03	D1,D2,D4,D12
3	DIO-SD101C	SD101C,DIODE,,10mA,40V,DO-35	D16,D17,D22
2	ICS-AN-0012	IR2110,DUAL GATE DRIVER,,500V,,DIP14	U3,U6
1	ICS-DI-594	TL594,PWM CONTROL,,,,DIP16	U1
1	ICS-OP-0009	LM358N,DUAL OP-AMP,,,,DIP8	U2
1	ICS-OP-227	OPA227P,OP AMP,,,,DIP8	U7
5	CAM-50V-.01UF	,MONO CAP,.01UF,50V,,	C1,C2,C7,C26,C35
15	CAM-50V-.1UF	,MONO CAP,.1UF,50V,,	C3,C4,C5,C8,C11,C13,C25, C32,C33,C45,C46, C48,C49,C51,C52
1	CAM-50V-.47UF	,MONO CAP,.47UF,50V,,	C6
3	CAM-50V-1UF	,MONO CAP,1UF,50V,,	C9,C23,C24
5	CAT-25V-10UF	,TANTALUM CAP,10UF,25V,,	C10,C22,C36,C39,C41
2	CAD-500V-2200PF	,DIP MICA CAP,2200PF,500V,,	C16,C29
3	CAD-500V-1000PF	,DIP MICA CAP,1000PF,500V,,	C17,C18,C28

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QNT.	PART No.	DESCRIPTION	REF. DES.
1	CAD-500V-2700PF	,DIP MICA CAP,2700PF,500V,,	C19
1	CAD-500V-4700PF	,DIP MICA CAP,4700pF,500V,,	C31
1	CAD-500V-62PF	,DIP MICA CAP,62PF,500V,,	C27
1	CAE-16V-100UF	,ELECTRO CAP,100UF,16V,,	C40
1	CAE-16V-1000UF	,ELECTRO CAP,1000UF,16V,,	C42
4	CAE-16V-15000UF	,ELECTRO CAP,15000UF,16V,,	C47,C55,C57,C58
1	CAE-250V-220UF	,ELECTRO CAP,220UF,250V,,	C12
1	CAE-250V-330UF	,ELECTRO CAP,330UF,250V,,	C14
2	CAE-25V-100UF	,ELECTRO CAP,100UF,25V,,	C37,C38
2	CAE-25V-4700UF	,ELECTRO CAP,4700UF,25V,,	C44,C56
1	CAE-25V-470UF	,ELECTRO CAP,470UF,25V,,	C54
1	CAF-250V-2.2UF	,POLY FILM CAP,2.2UF,250V,,	C15
2	ICS-VO-0021	78ST205VC,SWITCHING VOLTAGE REG,+5V,2Amp,,T	U11,U12
1	ICS-VO-7915	LM7915C,VOLTAGE REGULATOR,-15VDC,,,TO-220 *(See instructions)	U10*
1	LIG-DI-4700	,LED,RED,2mA,,,T-1 3/4	LED1
1	TRN-2N2219	2N2219,NPN TRANSISTOR,800ma,40v,TO-39 *(See instructions)	Q6*
1	MSC-MP-7717	NYLON MOUNTING PAD, 7717	Q6
1	TRN-2N7000	2N7000,MOSFET,,,,TO-92	Q1
4	TRN-IRFB17N20D	IRFB17N20D,N-CHANNEL HEXFET,200V,,,TO-220 *(See instructions)	Q2*,Q3*,Q4*,Q5*
2	TRN-IRF634	IRF634, N-CHANNEL HEXFET,,,,TO-220	Q7,Q8
1	TRN-2N3904	2N3904, NPN TRANSISTOR,,TO-92	Q9
2	MSC-HE-0001	593002b03400,HEAT SINK FOR TO-220,	HS2,HS3
1	MSC-HE-0010	529802b02500,HEAT SINK FOR TO-220,	HS1
5	MSC-HE-4880MG	,TO-220 MOUNTING KIT FOR HEAT SINK, Mica	Q2,Q4,Q5,U8,U10
2	MSC-HE-SW	5607-212 HEAT SINK SHOULDER WASHER	Q2,Q3
2	MSC-HE-0009	273,HEAT SINK FOR TO-220, * (See instructions)	HS4*,HS5*
1	ICS-VO-7815	LM7815C,VOLTAGE REGULATOR,+15VDC,,,TO-220	U8*

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QNT.	PART No.	DESCRIPTION	REF. DES.
		*(See instructions)	
1	XFMR-XF-0037	(Not installed for RFG-4)	T3
A/R	CAB-WP-24	#24 AWG BUSS WIRE *(See instructions)	JUMP1*
2	XFR-IN-1022	TM1022, INDUCTOR ASSEMBLY, 32uH, 2AMP, , 2616	L1, L2
1	XFR-IN-1028	TM1028, INDUCTOR, 2mH, 2AMP, , 3019	L3
1	XFR-XF-1020	TM1020, TRANSFORMER, , , , 2616	T2
1	CON-CO-0073	26-48-1065 CONNECTOR HEADER, MOLEX, 6 PIN *(See instructions)	J2*
1	CON-CO-0108	26-48-1045 CONNECTOR HEADER, MOLEX, 4 PIN *(See instructions)	J1*
1	10150	MODIFIED, FAN, 12V, .06A, 3CFM, 40x40x10mm *(See instructions)	FAN1*
2	HRD-FAN-001	4-40 X ¼" PHILIPS SCREW *(See instructions)	FAN1*
2	HRD-FAN-002	#4 INTERNAL TOOTH LOCK WASHER *(See instructions)	FAN1*
A/R	MSC-HSG-1977	Thermal Grease	Q2-Q5

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23. Data sheet

Certificate of Conformance

Unit Serial number _____ As Tested Voltage _____V Date ___/___/___

Application ver _____

Initial Display Pass Fail

Touch screen Display test Pass Fail

RF Output Waveform Pass Fail

E1 output		E2 output		E3 output		E4 output	
Temp Cal		Temp Cal		Temp Cal		Temp Cal	
40 _____ (38-42)	90 _____ (88-92)	40 _____ (38-42)	90 _____ (88-92)	40 _____ (38-42)	90 _____ (88-92)	40 _____ (38-42)	90 _____ (88-92)
No Temp – display	Pass Fail	No Temp – display	Pass Fail	No Temp – display	Pass Fail	No Temp – display	Pass Fail

RF Volts display Pass Fail

Knob zero lock-out Pass Fail

RF Current display Pass Fail

RF Current display Pass Fail

RF Current display Pass Fail

RF Current display Pass Fail

RF Watts display Pass Fail

RF Watts display Pass Fail

RF Watts display Pass Fail

RF Watts display Pass Fail

Lesion Timer Pass Fail

ATC control Pass Fail

ATC control Pass Fail

ATC control Pass Fail

ATC control Pass Fail

Temp variation Pass Fail

Temp variation Pass Fail

Temp variation Pass Fail

Temp variation Pass Fail

Imped variation Pass Fail

Imped variation Pass Fail

Imped variation Pass Fail

Imped variation Pass Fail

Impedance Cal at various output levels

100Ω	Min _____	Mid _____	Max _____ (90-110)
500Ω	Min _____	Mid _____	Max _____ (450-550)
1000Ω	Min _____	Mid _____	Max _____ (900-1100)

No Temp Lockout Pass Fail

Audio Calibration Pass Fail

Stim Output Waveform Pass Fail

Volts output Max _____(2.9-3.0Vp) mA output Max _____(4.5-5.5Vp @500Ω)

Rate (Hz)		Duration (mS)	
50 _____ (49-51)	100 _____ (99-101)	1.0 _____ (.9-1.1)	0.5 _____ (.48-.52)
2 _____ (1.9-2.1)	150 _____ (148-152)	2.0 _____ (1.9-2.1)	
5 _____ (4.9-5.1)	180 _____ (177-183)	3.0 _____ (2.8-3.2)	
75 _____ (74-76)	200 _____ (195-205)	0.1 _____ (.09-.11)	

RF Output Min _____ (≤4.0Vp) Max _____ (90-100Vp)

----- Safety testing -----

(100/120v configuration)

Hipot test Pass Fail
 AC mains Leakage _____ (<100uA)
 Patient Leakage _____ (<15uA)
 Ground Bond Test Pass Fail

(220/240v configuration)

Hipot test Pass Fail
 AC mains Leakage _____ (<200uA)
 Patient Leakage _____ (<30uA)
 Ground Bond Test Pass Fail

Testers Signature _____ Date _____

Reviewed by _____ Date _____