Codman

The SYNERGY™ MALIS™ Precision Bipolar Coagulator

100/120/220/240 VAC

(Catalog no. 80-1187)

Service Manual

Johnson & Johnson
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1.0 SCOPE

This manual contains the necessary information to allow a qualified service technician to perform maintenance and repair in the field. If the unit is still under warranty, please refer to Section 2.0.

2.0 WARRANTY

The SYNERGY MALIS Precision Bipolar Coagulator (catalog no. 80-1187) is warranted for one (1) full year from date of purchase. The coagulator is guaranteed to be free from defects in both materials and workmanship. Disassembly, alteration, or repair performed by any person not authorized by Johnson & Johnson Professional, Inc., will result in immediate loss of warranty. A coagulator that is under warranty should be returned to Johnson & Johnson Professional and will be repaired or replaced without charge to the purchaser.THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED. Suitability for use of the device for any surgical procedure shall be determined by the user. Johnson & Johnson Professional shall not be liable for incidental or consequential damages of any kind.

3.0 SERVICE AND REPAIR

For service or repairs to the SYNERGY MALIS generator and footpedal, contact your local Codman sales representative directly or, in the United States, through Codman Customer Service, 1-800-225-0460.

The sales representative coordinates the return to:

Codman Repair Service
c/o Johnson & Johnson Professional, Inc.
4962 Baynton Street
Philadelphia, PA 19144

Include with the unit a repair order number, the serial number of the generator, and a detailed written description of the problem.

4.0 WARNINGS AND CAUTIONS

4.1 WARNINGS

Do not attempt to bypass the grounding prong on the generator by using a three-prong to two-prong adapter. The generator must be properly grounded to ensure operator and patient safety. Grounding reliability can be achieved only when connected to a receptacle marked "Hospital Only" or "Hospital Grade."

Before turning on the generator, verify that the supply voltage selector is set to the appropriate voltage for the electrical outlet. Change the supply voltage selector, if needed.

If you must make a significant change to the supply voltage, such as from 100/120 V to 220/240 V operation, two external fuses must be replaced. This must be done by a qualified person.

Always replace the system's fuse with the appropriate type and value fuse (see Technical Specifications).

Explosion hazard: do not use in the presence of flammable anesthetics.

Do not operate this coagulator near patient devices, such as pacemakers, that are sensitive to radio frequency (RF) interference.

The unit should not be modified in any way by any user. Unauthorized modifications to the unit may cause it to malfunction or fail in use.

Never adjust the power setting while using the coagulation control on the footpedal.

Never immerse the SYNERGY generator in any liquid.

4.2 CAUTIONS

Federal (USA) law restricts this device to sale by or on the order of a physician.

Do not operate the SYNERGY generator at temperatures below 50° F (10° C). Allow the generator to warm up to at least 50° F before attempting to operate it.

Keep the generator away from other electrosurgical devices and their cables. Devices producing excessive RF current radiation may cause this unit to produce output power.

Position the cables to the forceps in such a way that contact with the patient or other leads is avoided.

Always check that the power cord, bipolar cord, and footpedal are functioning properly before using in a surgical procedure. Replace if necessary.

It is recommended that the output power be set as low as possible for the intended purpose.

It is recommended that insulated bipolar forceps be used when higher power settings are employed.

If the tips of the bipolar forceps come in contact with each other, or if the tips become coated with coagulum, no coagulating will take place.

Limit continuous power output to 20 seconds, with a 40-second rest period.

5.0 FUNCTIONAL DESCRIPTION OF CONTROLS AND INDICATORS

5.1 Product Description

The SYNERGY MALIS Precision Bipolar Coagulator (catalog no. 80-1187) includes:

The generator

A Single Footpedal (catalog no. 80-1162) for operating the coagulation function (also available separately).

The following accessories are available separately:

Product Description	Catalog No.
MALIS bipolar insulated forceps	consult your Codman representative
MALIS bipolar non-insulated forceps	consult your Codman representative
bipolar cord	30-1536
disposable bipolar cord	30-1538
MALIS Irrigation Module	80-1164
connecting cable (connects the irrigation module with the SYNERGY generator)	80-1166
CODMAN® floorstand (designed to accommodate the SYNERGY generator and the irrigation module together)	80-1177

In bipolar coagulation, the electrical difference is only in the isolated output and in the lower power requirements.

Isolate the output of the bipolar generator from ground as much as possible, so all current flow takes place between the two tips of the separated forceps. There should be virtually no current flow from either side of the forceps to ground.

The current geometry is dependent upon the tip size and angle at which the tips meet, as well as the medium in which they are immersed. If the forceps blades are virtually parallel, and the forceps are deep in saline, there will be major shunting in the saline. If the forceps are bowed or angled so the tips almost meet while the blades are still well separated, the current flow will be mainly between the tips, with little shunting.

The lowest possible generator output impedance provides the best maintenance of power at the forceps tips with the least decrease in coagulation due to shunting.

5.2 Generator Controls (refer to Figure 1)

A. Power Switch

Turns the power supplied to the generator on and off.

B. Power Setting Control Switch

Increases and decreases the power setting for coagulation.

C. Tone Volume Control

Increases and decreases the volume of the output tone. The tone indicates that coagulation power is being delivered to the bipolar output jacks.

5.3 Footpedal Controls (not shown)

Coagulation power is delivered to the forceps when the footpedal is depressed.

5.4 Indicators (refer to Figure 1)

D. Bipolar Output Light Emitting Diode (LED)

This green LED illuminates whenever coagulation power is delivered to the bipolar output jacks.

E. Bipolar Power Setting Display Window

Displays the power setting for coagulation in Malis units. The following power settings are available.

POWER SETTINGS

MALIS UNITS	WATTS
0	0.0
2	0.045
4	0.18
6	0.5
8	0.72
10	1.1
15	1.6
20	2.9
25	5.1
30	7.2
35	9.2
40	11.5
45	14.0
50	16.8
60	19.2
70	21.8
80	23.8
90	25.2
100	28.9
110	32.0
120	35.3
130	39.6
140	45.1
150	50.0

5.5 Connections (refer to Figures 1 and 2)

F. Bipolar Output Jacks

Coagulation output power is delivered from these jacks. The bipolar cord and disposable bipolar cord plug into these jacks.

G. Footpedal Receptacle

This female receptacle accepts the connector from the single footpedal (catalog no. 80-1162).

H. Power Entry Connector

This receptacle accepts the three-prong power cord plug.

I. Fuse Holder

Two fuse holders are located behind the removable panel above the power entry connector. See Technical Specifications for replacement fuses.

J. Supply Voltage Selector

The selector indicates the supply voltage setting of the generator. The selector must be set to the correct voltage for the electrical outlet being used.

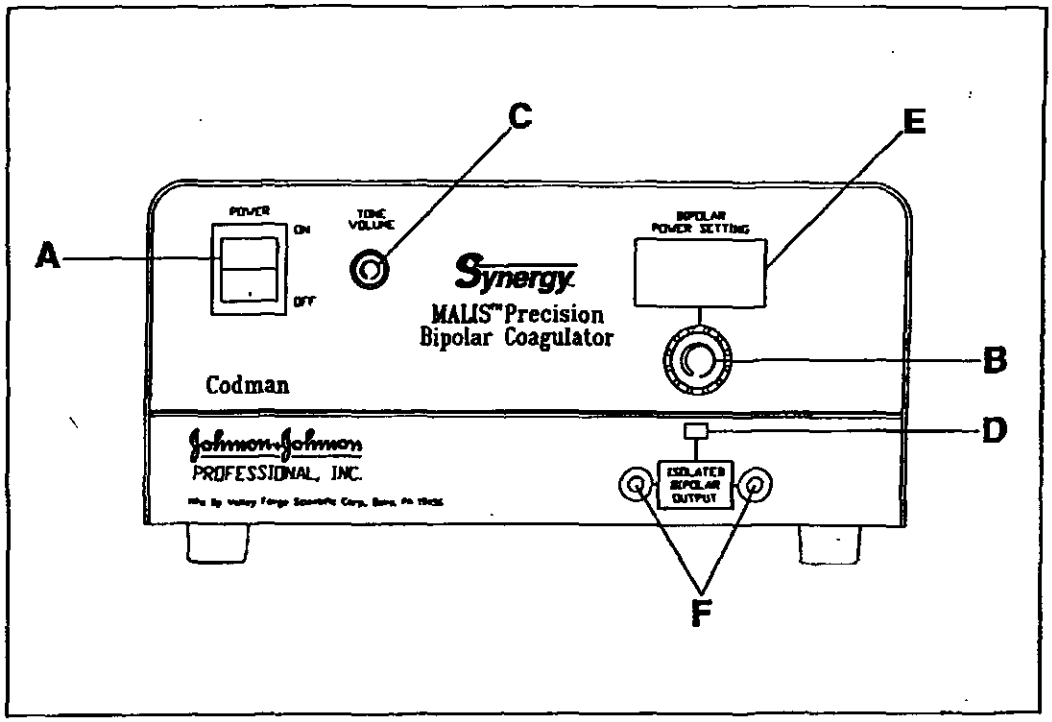


Figure 1. Generator Front Panel

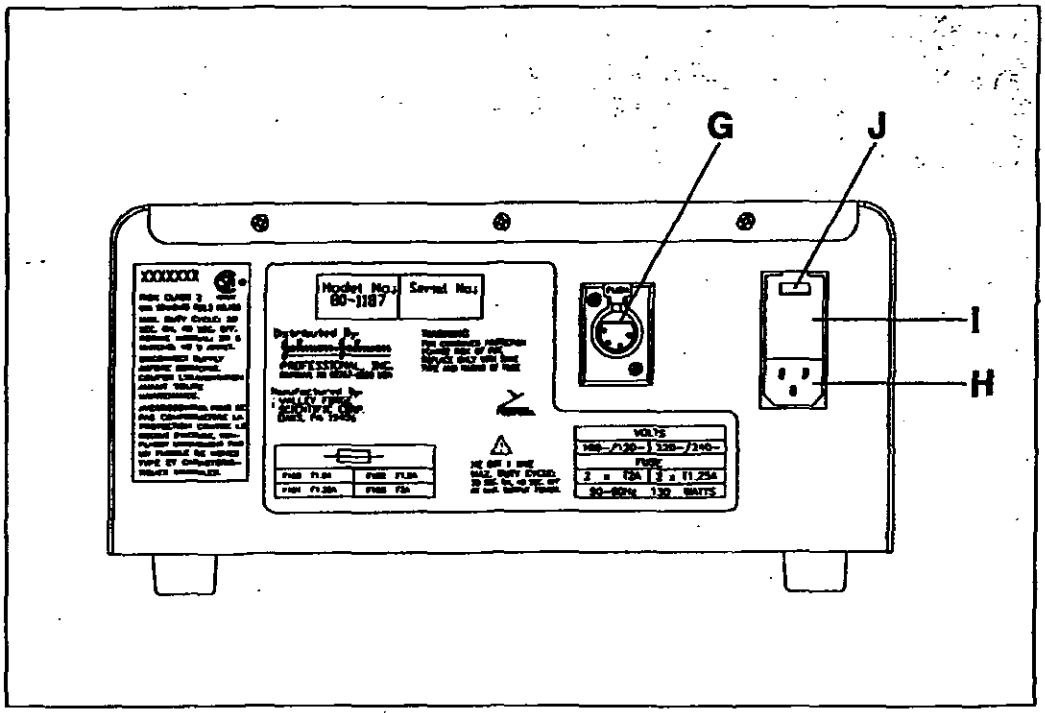


Figure 2. Generator Rear Panel

6.0 SETTING THE SUPPLY VOLTAGE

Verify that the setting shown on the supply voltage selector is appropriate for the electrical outlet. If not, change the setting as outlined below.

To change the supply voltage setting, use a tool, such as a screwdriver and proceed as follows:

Step	Action
1.	Pry down the top edge of the panel.
2.	Gently pull the two fuse holders out and completely remove them.
3.	Pry out the voltage selection drum.
4.	Turn the drum and reinsert it so the appropriate power setting will appear in the window.
5.	Reinsert the fuse holders so the arrows match the arrows on the inside of the panel.
6.	Snap the panel back into position.

WARNING: Always replace the system's fuse with the appropriate type and value fuse (see Technical Specifications).

7.0 TECHNICAL DESCRIPTION

7.1 Printed Circuit Boards (PCBs)

7.1.1 Display Board

The Display Board consists of:
- numeric Light Emitting Diode (LED) displays
- a single LED
- a rotary switch
- an output tone generator, and
- tone volume control.

7.1.2 Main Board

The Main Board consists of:
- a controller section
- a high voltage power supply section
- an RF amplifier section, and
- a low voltage power supply section.

7.1.2.1 Controller Section

The controller section consists of:
- an 8-bit RCA/HARRIS 1805 microprocessor
- clocks
- timers
- clock synchronizer, and
- input/output (I/O) control (N-lines).

7.1.2.2 High Voltage Power Supply Section

The high voltage power supply section consists of a switching high voltage power supply.

7.1.2.3 RF Power Amplifier Section

The RF power amplifier section consists of:
- a push-pull RF amplifier
- coagulation waveform generator
- short circuit detection, and
- RF output filter.

7.1.2.4 Low Voltage Power Supply Section

The low voltage power supply section consists of +5V and +15V regulated supplies, a ground interface, and a footpedal interface.

7.2 Theory of Operation

NOTE: Refer to the Block Diagrams and Schematic Sections for each board.

7.2.1 Display Board

7.2.1.1 Front Panel Numeric LEDs

LED200 through LED202 are driven by U200 through U202, respectively. Data from the 8-bit data bus are latched into U200-U202 from control signals supplied by U203. The latched information is decoded (hexadecimal to 7 segments) and drives the numeric LED displays.

Steering logic, consisting of U203, supplies control signals to U200 through U202. The N1 and N2 signals select the most and least significant bytes of the bipolar power setting display.

The N1 and N2 signals select the proper numeric display. The FTPDON and BLINK signals combine to flash the power setting numeric LED display when RF output power is requested.

7.2.1.2 Front Panel Single LEDs

The OUTLED signal turns on the green bipolar output LED when RF output power is requested. The SCLED signal turns on the reduced power LED when there is a short circuit condition at the output. The reduced power LED is used for test purposes only and is not visible externally.

7.2.1.3 Front Panel Switch

The PWRUP and PWRDN signals are produced by the power setting rotary switch, S200. These signals indicate which direction the switch is being rotated.

7.2.1.4 Tone Output

The potentiometer VR200 adjusts the voltage into the audio amplifier U204. The tone volume control knob from VR200 protrudes through the front panel of the chassis. The audio amplifier outputs the tone to the speaker SP200.

7.2.2 Main Board - Controller Section

7.2.2.1 Microprocessor

The microprocessor has:
- an 8-bit bi-directional data bus (DB(0...7))
- 16-bit memory addressing (64K) and appropriate timing indicators (TPA, TPB, MRD\, MRW\)
- 8-device I/O selection (N-lines)
- 4 external flag-line inputs (EF1 to EF4)
- external interrupt (INT\),
- internal countdown timer, and
- 64-byte random access memory (RAM).

7.2.2.2 I/O Port Select

An N-line decoder, U105, provides one-of-eight operation of I/O devices (N1 to N7).

7.2.2.3 Memory

The memory circuit has fully demultiplexed 16-bit addressing to allow 64K-bytes of data.

Memory consists of:
- one 27128 EPROM (16K-bytes)
- one 2804 (512 x 8) EEPROM, and
- 64-byte RAM in the microprocessor.

Upper 8-bit addressing (of 16 bits) occurs during the Timing Pulse A (TPA) period, and is latched into U110 and U111. U100B provides enabling/disabling signals to all the memory devices to avoid conflicting with one another.

7.2.2.4 Clock Generator

The clock generator includes a stable 8-MHz crystal and two ripple dividers, U101 and U102.

Ripple dividing provides continual, phase coherent division from 4 MHz to 0.25 Hz in divide-by-two steps. Approximately ten taps are used by devices on the main board.

7.2.2.5 Watchdog Timer

The watchdog timer, U106, provides a reset pulse to the microprocessor when one of the following occurs:

power up, or

no signal to U106, pin 6, watchdog input (WDI) within 1 to 2.5 seconds, continually.

This guards against unit malfunctioning due to microprocessor hang-ups and temporary low supply voltage conditions.

7.2.2.6 Clock Synchronizer

The microprocessor internal clock divider is synchronized with the external clock generator. A flip-flop, U108A, whose output changes only with a rising clock edge on the clock input, is supplied with a 500-kHz clock. The 500-kHz clock is the equivalent of the internal clock frequency of the microprocessor. When the watchdog timer signals a "clear" to both the synchro circuit (U108A) and the microprocessor, the rising edges of both the 4-MHz and 500-kHz clocks are aligned and the microprocessor starts running synchronously with the master clock generator.

7.2.2.7 Select Out

Data to be output from the 8-bit data bus are latched into U120 when the N5, MRD, and TPB signals are synchronous.

7.2.2.8 Select In

Data to be input to the 8-bit data bus are transmitted through U114 and U115 when the N5 and MWR signals are synchronous.

7.2.2.9 Tone Generator

The tone generator consists of U100D, which NANDs 244 Hz with FTPDON to output TONEOUT, which is sent to the display board. Whenever there is no footpedal activity, TONEOUT goes high and the tone is squelched.

7.2.2.10 Display Board Connector

This connector allows power and control signals to be sent back and forth from the main board to the display board.

7.2.2.11 Digital-to-Analog Converter (DAC)

The DAC takes information from the 8-bit data bus and converts it to analog voltage information used by the high voltage power supply. Eight bits of hexadecimal data correspond to 256 units of decimal data, as are applied to the DAC. HEX data are loaded into the DAC when the N4 and MRD\ signals are synchronous. The value of the 4.75 VDC reference output from the DAC will be {N/256} * {4.75 VDC}, with N = hexadecimal value input to DAC.

7.2.2.12 Randomizer Control

While psuedo-randomization data (necessary for coagulation) are primarily maintained by a data table in the EPROM and controlled by the microprocessor, U126 assists the microprocessor by providing delays not otherwise obtainable by the microprocessor itself. When N7 is asserted, data from the 8-bit data bus are loaded into an 8-bit binary down-counter, U126. U126 is clocked down at 1 MHz. Therefore, each data byte latched into the counter inputs represents a delay in one-microsecond increments (µs) (e.g.: hex 10 = 10 µs, hex 3B = 59 µs). The delay is used to control the start of the coagulation waveform bursts. When U126 is finished down-counting a given data byte, it signals the microprocessor via the EF1 flag line input.

7.2.2.13 Coagulation Waveform Generator

The coagulation waveform generator consists of two 8-bit shift registers, U124 and U125, wired together to form a 16-bit word. After receiving a start pulse to the Shift/Load input (pin 15) from the randomizer control, U124 and U125 output pulses from pin 13 at a 0.5 µs rate (due to a 2-MHz signal to the clock input). The logic level of the output pulses is determined by the fixed inputs (A through H) of U124 and U125. The final digital waveform is used by the RF power amplifier to form a damped coagulation waveshape. Timing is as follows:

a. 2.0 µs low
b. 0.5 µs high
c. 1.5 µs low
d. 1.0 µs high
e. 1.0 µs low
f. 1.5 µs high
g. 0.5 µs low

7.2.2.14 8-MHz Shifter

The coagulation waveform requires that the base frequency of 1 MHz be shifted approximately ± 4%. The base waveform is synthesized with a phase-locked-loop (PLL), U123, whose voltage controlled oscillator (VCO) output is approximately 8 MHz. The 8 MHz from the VCO is divided down by U127 and fed back to one reference input of the PLL. The second reference input is connected to a 62.5-kHz reference clock. The U127 divider has been designed to divide at a ratio that provides a near 62.5-kHz output. When the U127 divider ratio is changed and shifted by a 488-Hz clock, the output of the PLL VCO, U123, is 8 MHz, ± 4%, at a change rate of 488 Hz. Further division of the shifted 8-MHz waveform is handled by the 1-MHz split-phase dead zone generator.

7.2.2.15 1-MHz Split-Phase Dead Zone Generator

The RF power amplifier field-effect transistors (FETs) require a 1-MHz signal. However, due to the turn off delay propagation nature of FETs, a somewhat shorter duty cycle (37% on, 63% off) is required to prevent both halves of the bridge from turning on at the same time and reducing efficiency. Eight MHz from the 8-MHz shifter circuit is sequentially divided by two through U108B, U128A, and U128B to 1 MHz. The outputs of U108B and U128A are ANDed together through U103D and delayed through U107D and U107E. They are combined (ORed) with the 1 MHz and 1 MHz\ outputs of U128B through U121A and U121C to form two 37% duty cycle waveforms, Q1MHz and Q\1MHz. The Q1MHz and Q\1MHz rising edges are shifted 180° from each other for proper RF bridge amplifier operation.

7.2.3 Main Board - High Voltage Power Supply Section

The full wave bridge diode, DB100, converts the 160 VAC from T400 (P105) to DC voltage. RT100 provides inrush current limiting. R119 provides a shorter discharge time for C144 when K100 is de-energized. High voltage DC monitoring is provided by opto-isolator U134.

U142 is the pulse width modulation (PWM) controller. When FTPON goes high, it turns on U142, which sends voltage pulses to U119. U119 is a low and high side driver which turns Q101 and Q102 on and off in order to switch the unregulated DC voltage to L104. The unregulated voltage is chopped by Q101 and filtered by L104 and C140 to generate the REGHV signal.

U135A and U135B are used to implement the DAC reference control. The error amplifier inside U142 is set to keep its two inputs at 5.1 V. One input is tied to 5.1 V reference while the other is connected to the output sense divider resistors, R123 and R124, and the output of U135A. As DACOUT is increased, the U135 amplifiers add less voltage to the divider resistors. But U142 wants to see a constant voltage, so it changes the duty cycle to increase REGHV. This results in an output voltage proportional to DACOUT.

Overcurrent protection is incorporated by sensing the main power current via T101 and R137. DC pulse current through Q101 is isolated and monitored through current transformer T101. If peak current is too high, the PWM controller, U142, shuts down for a fixed period of time, thereby lowering REGHV.

U136A provides overvoltage protection by comparing the regulated DC voltage, REGHV, with a voltage reference. If the REGHV voltage is close to the voltage reference, OVMONI goes low and signals the microprocessor to shut down. Two conditions that could cause this to happen are Q101 shorting out and U142 malfunctioning.

7.2.4 Main Board - RF Amplifier Section

7.2.4.1 Coagulation Waveform Generation

DC voltage to power the RF push-pull amplifier is controlled by the coagulation waveform signal driving Q108. When coagulating, the coagulation waveform signal (see description in Main Board - Controller Section) modulates the voltage supplied by the high voltage power supply. The modulated DC voltage is filtered by L100 and C162 into a decaying DC voltage waveform, thus forming the damped sinusoidal signal through the RF push-pull amplifier. Cut-off of DC voltage is provided by U140 and the PWRDIS signal under conditions of short circuit at the forceps.

7.2.4.2 Push-Pull Amplifier

U141, U144, Q106, and Q107 make up the RF push-pull amplifier. The two transistors, Q106 and Q107, are driven 180° out of phase at 1 MHz so that each is active for half the cycle and cut off during the other half of the cycle. The drive signals are Q1MHz and Q\1MHz (see Section 7.2.2.15).

7.2.4.3 RF Output

The RF output transformer, T100, provides an isolated output to the forceps. Coagulation noise filtering is provided by a low pass filter consisting of L101, L102, L103, C168, and C169. The coagulation noise filter also provides proper matching between RF output transformer T100, the forceps cord, and biological loading at the forceps. A capacitive DC block, C171, is inserted between the RF output transformer and the catheter electrodes to limit DC circulatory current that occurs during coagulation to prevent muscle tissue reaction.

7.2.4.4 Short Circuit Detection and Control

Current through the forceps is sensed by R156. The sense current, in the form of a small voltage, is rectified, filtered, and detected by opto-isolator U109 when the threshold is exceeded. The output of U109 causes the one-shot timer in U131B to operate at 100 millisecond (ms) intervals as long as excessive short circuit current is present. The output of U131B forms the signal PWRDIS. During the 100-ms period, voltage to the RF push-pull amplifier is cut off. At the end of the 100-ms period, RF power is restored to test again for a short circuit condition. This cycle continues until the short circuit is removed. An LED marked "short circuit" is used during testing to confirm operation. The purpose of short circuit detection is to prevent excessively high RF currents from destroying the RF power amplifier and forceps.

7.2.5 Main Board - Low Voltage Power Supply Section

7.2.5.1 Low Voltage Supply

The low voltage power supply supplies +5 VDC (regulated) and +15 VDC (regulated).

7.2.5.2 Earth to Signal Ground Interface

The DC grounding system consists of C151, C153, and R142 between earth and signal ground.

7.2.5.3 Footpedal Interface

The FTSWPW signal is sent back to the controller section of the Main Board to enable output power.

7.3 Master List of Board Signals

BLINK	1-Hz signal; 75% on (low), 25% off (high)
COAGWVFM	Digital signal to RF amplifier representing the coagulation waveform
DACREF	4.75 VDC reference voltage from digital to analog converter (DAC)
DACOUT	0 to 5 VDC signal from the DAC to high voltage power supply
DB[0..7]	Bi-directional 8-Bit Data Bus
DP	High-going signal that turns on a decimal point in display when calibrating unit
EF1	High-going signal from randomizer to external flag 1 input on microprocessor
FTEST	Low-going signal that enables factory burn-in
FTPDON	High-going signal from I/O indicating depression of the footpedal
FTSWPW	Low-going signal to I/O indicating the depression of footpedal
HVRLY	Low-going signal from I/O indicating selection of high voltage mains relay, located in the power supply section of Main Board
ISENS	Current sense that shuts down power supply during overcurrent conditions
MA[0..7]	8-Bit Memory access bus
ME\	Low-going signal to microprocessor indicating selection of internal 64-byte RAM
MRD	High-going signal from microprocessor indicating a memory read function
MWR	High-going signal from microprocessor indicating a memory write function
NOHV	Low-going signal to I/O indicating unregulated high voltage DC is present in the high voltage power supply
N1-N2	Output select for displays on the display board
N4	Output select of DAC
N5	I/O select signal
N7	Output select of randomizer controller
OUTLED	Low-going signal indicating output power that activates the bipolar output LED

OVMON	Low-going signal from high voltage power supply indicating regulated DC voltage is too high
PWRDIS	High-going signal from output of short circuit detectors to disable RF output
PWRDN	Control signal to I/O indicating rotation of the power setting switch
PWRUP	Control signal to I/O indicating rotation of the power setting switch
Q1MHz	Digital 1-MHz signal with a 37% "on" (low) duty cycle
Q1MHz	Same as Q1MHz, but 180° out of phase
REGHV	2 to 160 VDC signal from high voltage power supply to RF amplifier
RLYDLY	High-going signal, after delay, to control high voltage relay
SCLED	High-going signal indicating a short circuit condition that activates the reduced power LED
SCRES1A	Short circuit current through R158 to input of short circuit detector
SCRES1B	Short circuit current through R156 to input of short circuit detector
SCTEST	High-going signal used to test the reduced power LED during start-up
TONEOUT	Low-going 244-Hz signal indicating depression of footpedal
TPA	High-going signal from microprocessor indicating selection of high order memory address bytes
TPB	High-going signal from microprocessor indicating selection of low order memory address bytes

7.4 Test Points

Nine test points are available to facilitate troubleshooting. All test points are easily accessed on the Main Board at P101 (Figure 3). Activate test functions by grounding the appropriate pin (momentarily or constantly, refer to each section for details). Note that some test points provide dual function capability.

7.4.1 Pin #1 Display Test/Calibrate Enable2

Momentarily grounding this pin provides a complete sequential test of all LEDs and numeric LEDs. Calibrate Enable2, along with pin #3, enables the power calibration mode (refer to 7.4.3).

7.4.2 Pin #2 Sound Test

Momentarily grounding this pin provides a test of the output tone buzzer.

7.4.3 Pin #3 Calibrate Enable1

Grounding this pin, along with pin #1, enables the calibration function by displaying a three-digit number in the bipolar power setting display window when the footpedal is depressed. Refer to Section 7.6, Calibration, for details.

7.4.4 Pin #4 Factory Profile/Test

This test point should only be grounded when there is a problem with the EEPROM. This can occur during first time power-up with a blank EEPROM, or when the EEPROM malfunctions. When momentarily grounded, the unit will reprogram the EEPROM. The bipolar power setting display

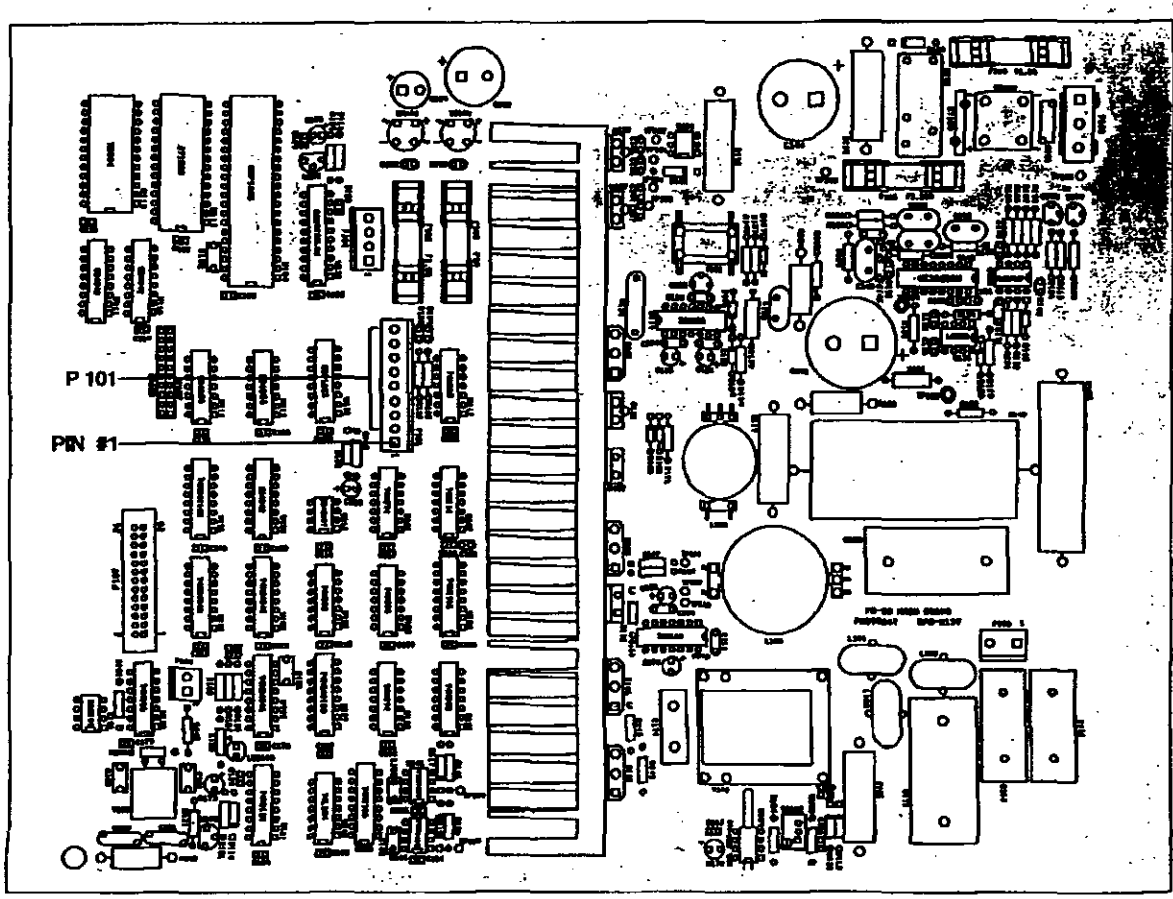


Figure 3. Main Board Test Points

window will display data being transferred. When finished, the generator will reinitialize (assuming no EEPROM problems). With an error condition, the generator will flash "01" in the bipolar power setting display window.

Grounding this pin, along with pin #7, enables the factory burn-in mode. DO NOT ACCESS the factory burn-in mode. This mode is available for factory use only.

7.4.5 Pin #5 DAC Reference

This is a voltmeter test point. The DAC reference voltage should be 4.75 VDC, ± 0.05 volts.

7.4.6 Pin #6 DAC Output

This is a voltmeter test point for the DAC output voltages. When in the calibrate mode, this voltage can be compared against the displayed DAC value shown in the bipolar power setting display window. The DAC output voltage should be [DAC display/255]*[DAC reference voltage].

7.4.7 Pin #7 Factory Test

Grounding this pin, along with pin #4, enables the factory burn-in mode. DO NOT ACCESS the factory burn-in mode. This mode is available for factory use only.

7.4.8 Pin #8 NOHV Bypass

Grounding this pin allows operation of the generator with the high voltage power supply plug P105 unplugged. This test point should be ungrounded for normal operation with plug P105 connected.

7.4.9 Pin #9 Ground

This pin can be used to ground other pins on P101.

7.5 Operational Performance

The coagulator may be tested for operational performance using 50-ohm non-inductive test loads and an RF ammeter or equivalent electrosurgical analyzer. A test set-up is shown in Figure 4; typical values for each power setting are shown in the table below. NOTE: these are typical values; output power may vary depending on the line voltage, test lead lengths, load resistor tolerances, and meter accuracy. The listed values were obtained using 18-inch test leads. When testing the generator, use 18-inch test leads or lead lengths as close to 18 inches as possible.

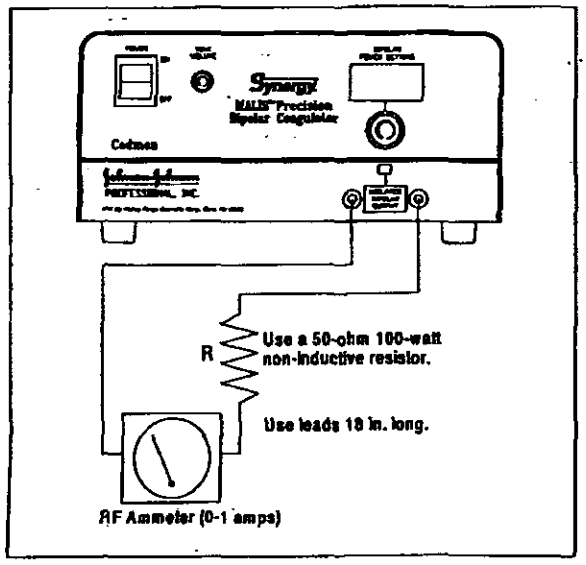


Figure 4. Test Set Up

Typical Output vs Power Setting Coag Output into 50 ohms using 18-in. leads
(For reference only)

Power Setting (Mails Units)	Output Current (RF Amps)	Output Power (RF Watts)
0	0.00	0.0
2	0.03	0.045
4	0.06	0.18
6	0.10	0.5
8	0.12	0.72
10	0.15	1.1
15	0.18	1.6
20	0.24	2.9
25	0.32	5.1
30	0.38	7.2
35	0.43	9.2
40	0.48	11.5
45	0.53	14.0
50	0.58	16.8
60	0.62	19.2
70	0.66	21.8
80	0.69	23.8
90	0.71	25.2
100	0.76	28.9
110	0.80	32.0
120	0.84	35.3
130	0.89	39.6
140	0.95	45.1
150	1.00	50.0

Note: Output current tolerance is ± 10%, except for positions 2 and 4, which is ± 10 mA. Output power tolerance is ± 20%, except for positions 2 and 4, which is +/- 60 mW.

7.6 Calibration

Any one of the coagulator's 23 power output settings may be calibrated individually by changing the target DAC calibration value (as stored in memory) associated with each setting. DAC value adjustments may be performed with the coagulator in the calibration mode.

The calibration mode may be invoked by first grounding pins #1 and #3 of P101 (refer to Section 7.4.3). Pin #3 should be grounded first so that the display test does not run. With these pins grounded, the decimal point will light up in the bipolar power setting display window to indicate calibration mode. When the footpedal is pressed, three numbers will appear in the bipolar power setting display window. This number is the setting's target DAC calibration value. The DAC may be increased or decreased by turning the power setting switch up or down WHILE THE FOOTPEDAL IS DEPRESSED. Turning the power setting switch when the footpedal is NOT depressed will simply change the power setting, not the DAC value. As a safety precaution, DAC settings may be changed by no more than ± 12 steps from the original factory settings.

The output power associated with a setting's new target DAC value may be confirmed by measuring the unit's output current or power, as described in Section 7.5, Operational Performance.

If errors occur during calibration, or if the user wishes to restore the original factory-set DAC targets, momentarily ground pin #4 of P101 (while in the calibrate mode) to reload the standard DAC calibration values.

When calibration is complete, unground pins #1 and #3 to take it out of calibrate mode. The unit will reinitialize to a Malis unit setting of 0 and the decimal point will turn off.

7.7 Technical Specifications

Power Requirements
100 ± 10% VAC with "100" selected on the supply voltage selector
120 ± 10% VAC with "120" selected on the supply voltage selector
220 ± 10% VAC with "220" selected on the supply voltage selector
240 ± 10% VAC with "240" selected on the supply voltage selector
50/60 Hz, 130 Watts

Fuses
External Fuses
For 100 or 120 VAC operation: Two 2.0 Amp Type T (MDL) (250 VAC)
For 220 or 240 VAC operation: Two 1.25 Amp Type T (MDL) (250 VAC)

Internal Fuses
1.5 Amp, 250 VAC SLO-BLO (3AG) (F100)
1.25 Amp, 250 VAC FAST-BLO (AGC-1 1/4) (F101)
1.5 Amp, 250 VAC FAST-BLO (AGC- 1 1/2) (F102)
3.0 Amp, 250 VAC FAST-BLO (AGC-3) (F103)

AC Leakage Current
Less than 10 µA with power ON or OFF, polarity normal or reversed, with ground open or connected.

Output Waveform
Damped aperiodic, centered at 1 MHz.

Output Power Range
0-50 Watts into 50-ohm non-inductive resistor load.

Output Setting Indicators
Visual: three-digit indicator

Power controls
AC: ON/OFF switch
RF Output: panel mounted rotary switch

Panel Connectors
Bipolar: two high voltage jacks

Cooling
Convection; no fan

Weight
11 lb. (5 kg)

Dimensions
5 3/8 H x 10 1/4 W x 14 3/4 D inches
13.7 H x 26 W x 37.5 D centimeters

Minimum Operating Temperature
50° F (10° C)

7.8 Troubleshooting Guide

Symptom	Probable Cause	Corrective Action
Unit does not operate	a. Blown fuse b. Loose wire at power cord plug c. No power at wall outlet	a. Replace fuse b. Check plug for wiring c. Check electrical service
Low power output	a. Low line voltage b. Incorrect test load c. Internal calibration change	a. Adjust input to nominal voltage b. Use 50-ohm non-inductive load c. Return unit for service and recalibration
Erratic power output	a. Loose or dirty connections b. Intermittent break in	a. Gently clean plug surfaces between forceps cord and jacks with abrasive cloth b. Replace forceps cord forceps cord
No power output	Broken wire in forceps cord	Replace forceps cord
Excessive leakage current	Shorted output transformer	Check for shorting to core case. Return unit for service and recalibration.
Excessive power output	Internal calibration change	Return unit for service and recalibration
Power setting display flashes "00"	Blown internal fuse	Replace internal fuse
Power setting display flashes "01"	Operating malfunction — memory error	Return unit for service
Power setting display flashes "02"	Operating malfunction — power supply overvoltage	Return unit for service
Power setting display flashes "03"	Operating malfunction—memory recycle error	Return unit for service

8.0 MAINTENANCE

8.1 Bipolar Forceps

Proper care and maintenance of the bipolar forceps are essential to efficient coagulation. Remove coagulum deposits as often as needed to keep working surfaces clean. This will ensure the flow of current between the forceps tips. If the tips become pitted or misaligned, return the forceps to Johnson & Johnson Professional for repair or replacement.

8.2 Bipolar Cord

Low or erratic performance may be due to poor contact between the bipolar forceps cord plugs and the isolated bipolar output jacks on the generator. Badly oxidized surfaces will impede current flow. Use an abrasive cloth to gently clean and brighten plug surfaces. Inspect the bipolar cord before each use and replace it upon evidence of any deterioration.

NOTE: Do not pull plugs from the jacks by grasping the cord; this could damage the cords and cause intermittent operation. Disconnect the plugs by holding the plug with one hand and the generator with the other.

8.3 Footpedal

Do not store the footpedal with the cord tightly wrapped around it; this may damage the cord. Leave sufficient slack to prevent stress on the cord. Inspect the cord before each use and replace the footpedal upon evidence of any deterioration.

8.4 Power Cord

Never use extension cords, three-prong to two-prong power plug adapters, or extra length power cords with the SYNERGY coagulator. Before each use, visually inspect the power cord and plug for frayed or broken insulation. If necessary, replace the power cord with the same type, length, gauge, and insulation.

9.0 ROUTINE CLEANING

Clean the generator cabinet with a damp cloth or sponge. Use alcohol or mild cleaning solutions to remove stains or adhesives that stick to the cabinet.

DO NOT immerse the generator in any liquid. Subjecting the generator to excessive moisture may damage the electronic components and violate the warranty.

10.0 STERILIZATION

Never sterilize the SYNERGY coagulator or footpedal.

11.0 PARTS LIST

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
BOM#51-1383		SINGLE FOOTSWITCH	
1	250020	FOOTSWITCH - PC/IRRI	1
2	150023	CABLE SHIELDED 2 COND	15
3	170119	CONNECTOR, 4 PIN, NC4MX J14	1
4	180024	TERMINAL RING INSULATED	1
5	180009	TERMINAL CRIMP	2
6	490003	POLY CABLE TIE, BEADED	1
7	650079	8x14x.002 POLY BAG	1
8	000114	SINGLE FTSWITCH, CMC-2-PC/IRR	0
BOM# 51-2063		PWR CORD ASSY	
1	150044	9'10 16/3 SJT BLK HOSP PLUG	1
2	490101	LABEL,SER#/CONT#/DATE CODE	1
3	000315	ASSY, PWR CORD, MOD# 4087,BSCM	0
BOM# 51-2216		DISPLAY BD ASSY	
1	390047	FAB., MAIN BD., CMC-3-PC	0.5
2	070048	CAP, ELEC ALUM,22MF,20%,16V,AL C205	1
3	060026	CAP MONLY CER, .1MF 10% 50V C200,C201,C202	3
4	070049	CAP,ELEC,ALUM,100mF,16V,AL C203	1
5	060070	CAP,POLY FILM,.047mF,20%,100V C204	1
6	100010	LED GREEN RECTANGULAR D200	1
7	100001	LED MV-57124 RED D201	1
8	520014	SPACER, LED, 0.14 FOR FIND #6,7	2
9	130006	LED DISPLAY 7 SEGMENT YELLOW LED200,LED201,LED202	3
10	190017	STRIP SOCKET FOR FIND #9	0.5
11	000369	DISP BD CABLE ASSY., SYNERGY	1
12	020011	RES NETWORK 330 OHMS X 7 RN200,RN201,RN202	3
13	010065	RES CF 680 OHMS 5% 1/4W R200	1
14	010018	RES CF 4.7K OHMS 5% 1/4W R201,R202	2
15	010025	RES CF 47K OHMS 5% 1/4W R203	1
6	010029	RES CF 10 OHMS 5% 1/4W R204	1
17	010069	RES CF 100 OHMS 5% 1/4W R205,R206	2
18	010046	RES CF 330 OHMS 5% 1/4W R207	1
19	360003	SPEAKER, 8 OHM, 0.2W SP200	1
20	250038	SWITCH, ROTARY, ENCODED S200	1
21	120003	INT. CIR. MC14511BCP ONLY U200,U201,U202	3
22	120063	INT. CIR. 74HCOOAP U203	1
23	120034	INT. CIR. LM386N-4 U204	1

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
24	030025	RES VARIABLE 2.5K VR200	1
25	500029	SCREW, MACH, STL 4-40X1/4 FOR FIND #19	4
26	510001	NUT, KEPS, 4-40 THD STL, ZINC FOR FIND #19	4
27	150011	WIRE UL# 1007 HK-UP 22GA BLK FOR FIND #19	0.25
28	150014	WIRE UL# 1007 HK-UP 22GA YEL FOR FIND #19	0.25
29	460099	LABEL, #303-LE10	1
30	460101	LABEL,SER#/CONT#/DATE CODE	1
31	000346	DISPLAY BD ASSY, CMC-3-PC	0
BOM#51-2217 PWR ENTRY CONN ASSY			
1	170143	PWR ENTRY CONNECTOR P400	1
2	150032	WIRE, HOOK-UP,18 AWG,1015,BLUE	0.08
3	180039	TERMINAL CRIMP,S05316SF J402, FOR FIND #2	1
4	150021	WIRE UL# 1015 18GA BLK	0.5
5	150033	WIRE UL# 1015 18GA GRN/YEL	0.25
6	540005	LUG TERMINAL-#6 HOLE,INT TEETH FOR FIND #5	1
7	160003	TUBING, SHRINK, FIT221-3/16	0.25
8	150031	WIRE UL# 1015 18GA BRN	0.08
9	000379	PWR ENTRY CONN ASSY.,	0
BOM# 51-2218 MAIN BD ASSY			
1	390047	FAB., MAIN BD., SYNERGY	0.5
2	060001	CAP NETWORK, 0.01MF CN100	1
3	060015	CAP CER DISC,120PF 5% NPO 100V C101,C100,C126	3
4	060013	CAP CER DISC, 22PF 5% NPO 50V C102	1
5	060026	CAP MONLY CER, .1MF 10% 50V C103-C122,C128,C129, C142,C143,C146,C147, C155,C157,C159,C160, C161,C164,C166,C167, C176-C181,C186,C187,C193	43
6	070027	CAP DIP'D TANT, 22MF 10% 15V C123	1
7	070046	CAP DIP'D TANT, 2.2mF, 10%,16V C124,C135,C158,C170	4
8	060031	CAP MONLY CER, .01MF C125,C127,C131,C132,C139	5
9	070013	CAP DIP'D TANT, 1MF, 20%, 25V C130	1
10	060030	CAP MONLY CER,1.0MF-NO SUBSTI. C133,C134,C137,C154, C158,C163,C165,C191	8
11	060004	CAP CER DISC, .01MF 1KV C136,C151,C153	3
12	060066	CAP POLYESTER, .15MF,10%,400V C138	1
13	060068	CAP POLYPROP, 10MF, 10%, 200V C140	1
14	070045	CAP ELEC ALUM, 100MF 20% 300V C141	1
15	070047	CAP, ELEC, 470mF, 350V C144	1

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
16	060069	CAP DIP'D MICA, 390PF, 5%,500V C145	1
17	060062	CAP. MONO CER. 3300PF 5% 50V C146	1
18	060063	CAP. MONO CER. 820PF 5% 50V C149	1
19	060064	CAP POLYESTER, .082MF, 5%,100V C150	1
20	060061	CAP. MONO CER. 270PF 5% 200V C152,C189,C192	3
21	060036	CAP POLYPROP FILM .047MF 1.2KV C182,C171	2
22	060071	POLYPROPYLENE FILM 0.0012 MF C168,C169	2
23	070028	CAP DIP'D TANT, 4.7MF 35V RL C172,C173	2
24	060050	DIPPED MICA CAP, 560 PF 2KV C174	1
25	060022	CAP MONLY CER, .01MF C182,C175	2
26	070039	CAP.ALUM.ELEC.,2200MF,16V C184	1
27	070032	CAP ELEC ALUM, 4700MF 35V RL C185	1
28	100036	BRIDGE RECT., 6A, 400V DB100	1
29	100028	BRIDGE RECT.,2A,400V DB101,DB102	2
30	100005	DIODE 1N4148 D100,D102,D107,D108,D111, D113,D114,D115,D116,D117	10
31	100034	DIODE, 1A, 600V D103,D110	2
32	100032	DIODE, 1N5817 D104,D105,D106	3
33	100003	DIODE ZENER 1N52448 14V 5% D120	1
34	570036	FUSE,SLO-BLO,3AG,1.5A,250V F100	1
35	570018	FUSE, NO EQ., 1-1/4A,250V,3AG F101	1
36	570004	FUSE, 1.5A, 250V, FAST-BLO F102	1
37	570023	FUSE, 3AMP 250V FAST-BLO F103	1
38	260001	RELAY K100	1
39	100027	LED RED T-1 3/4 LED100	1
40	310009	PWR IND ASSY, 78uH L100	1
41	310024	TOROID INDCTR ASSY, 13.3uH L101,L103	2
42	310025	TOROID INDCTR ASSY, 27.7uH L102	1
43	310020	INDUCTOR SWTCH ASSY., CMC-3-PC L104	1
44	170118	CONN., HEADER, 9 CIR. P101	1
45	170095	CONN., HEADER, 2 CIR. P102	1
46	170093	CONN., HEADER, 3 CIR. P103	1

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
47	170098	CONN., HEADER, 4 CIR. P104	1
48	170062	CONNECTOR, PLUG, INT'L 3 CIR. P105	1
49	170121	HEADER, IDC26 P107	1
50	110015	TRANSISTOR, VN0300L Q103,Q105	2
51	110004	TRANSISTOR 2N3704, TO-92 PKG Q104,Q109	2
52	020013	RES NETWORK 27K OHMS X 9 RN100	1
53	010086	THERMIS NTC INRUSH CUR LIMITER RT100	1
54	010019	RES CF 10 MEGOHMS 5% 1/4W R100	1
55	010018	RES CF 4.7K OHMS 5% 1/4W R101,R111	2
56	010015	RES CF 27K OHMS 5% 1/4W R102,R112,R130	3
57	010016	RES CF 10K OHMS 5% 1/4W R103,R106,R118,R122,R129, R133,R143,R147,R148,R149	10
58	010029	RES CF 10 OHMS 5% 1/4W R104,R146,R152	3
59	010017	RES CF 2.2K OHMS 5% 1/4W R107	1
60	010062	RES CF 3K OHMS 5% 1/4W R108	1
61	010063	RES MF 49.9 OHMS 1% 1/4W R109	1
62	010064	RES MF 1.02K OHMS 1% 1/4W R110	1
63	010170	RES CF 390 OHMS, 5%, 1/4W R113	1
64	010153	RES. CF, 51 OHM, 1/4W, 5% R114	1
65	010157	RES CF 33 OHMS, 5% 1/4W R115	1
66	010072	RES FP MO 75K OHMS 5% 5W R116	1
67	010158	RES FP MO, 5 OHMS 5% 5W R117	1
68	010171	RES CC 18K, 5%, 5W R119	1
69	010160	RES WIREWOUND 3.3 OHMS, 5%, 1W R120	1
70	010177	RES, CF, 270K OHM, 1/2W, 5% R121	1
71	010165	RES CF, 10.2K OHMS, 1%, 1/4W R123	1
72	010146	RES. MF, 174K OHM 1W 1% R124	1
73	010163	RES CF, 16.9K OHMS, 1%, 1/4W R125	1
74	010162	RES CF, 9.76K OHMS, 1%, 1/4W R126	1
75	010144	RES. MF, 4.99K OHM 1/4W 1% R127,R128,R131	3
76	010161	RES CF, 5.49K OHMS, 1%, 1/4W R132	1
77	010169	RES CF, 470K OHMS, 5%, 1/4W R134	1

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
78	010155	RES CF 1.87K OHMS, 1% 1/4W R135	1
79	010027	RES CF 2.7K OHMS 5% 1/4W R136	1
80	010100	RES CF 5.1 OHMS 5% 1/4W R137	1
81	010156	RES CF 6.19K OHMS, 1% 1/4W R138	1
82	010172	RES CF 560 OHMS, 5% 1/2W R139	1
83	010065	RES CARB FILM 680 OHMS, 5% 1/4 R140	1
84	010103	RES CF 1 MEGOHM, 5%, 1W R142	1
85	010067	RES CF 1.3K OHMS 5% 1/4W R150	1
86	010025	RES CF 47K OHMS 5% 1/4W R162,R151	2
87	010014	RES CF 1K OHMS 5% 1/4W R154	1
88	010130	RES. 10 OHM, 5% 15W R155	1
89	010061	RES FP MO 1.5 OHMS 5% 5W R156	1
90	010020	RES CF 47 OHMS 5% 1/4W R157	1
91	010046	RES CF 330 OHMS 5% 1/4W R158	1
92	170064	TEST POINT TP100-TP104,TP106-TP111,TP113	12
93	300064	RF OUTPUT XFORMER ASSY. T100	1
94	300031	CUR SENSE XFORMER, CMC-III T101	1
95	120063	INT. CIR. 74HC00AP U100,U122	2
96	120064	INT. CIR. 74HC40AP U101,U102	2
97	120065	INT. CIR. 74HC08AP U103,U117	2
98	120058	INT. CIR. CDP1805ACE U104	1
99	120009	INT. CIR. CDP1853CE U105	1
100	120061	INT. CIR. TIMER MAX699CPA U106	1
101	120071	INT. CIR. 74HC14AP U107	1
102	120069	INT. CIR. 74HC74AP U108,U126	2
103	120053	INT. CIR. HCPL2200 U109	1
104	120008	INT. CIR. CD4042BE U110,U111,U120	3
105	120042	INT. CIR. EPROM 27128A 250NS U112	1
106	120045	INT. CIR. EEPROM X2804CP-20 U113	1
107	120066	INT CIR. CD4066BE, HARRIS ONLY U114,U115	2
108	120051	INT. CIR. CD40107BE U116	1
109	120097	INT. CIR. IR2110 U119,U140	2

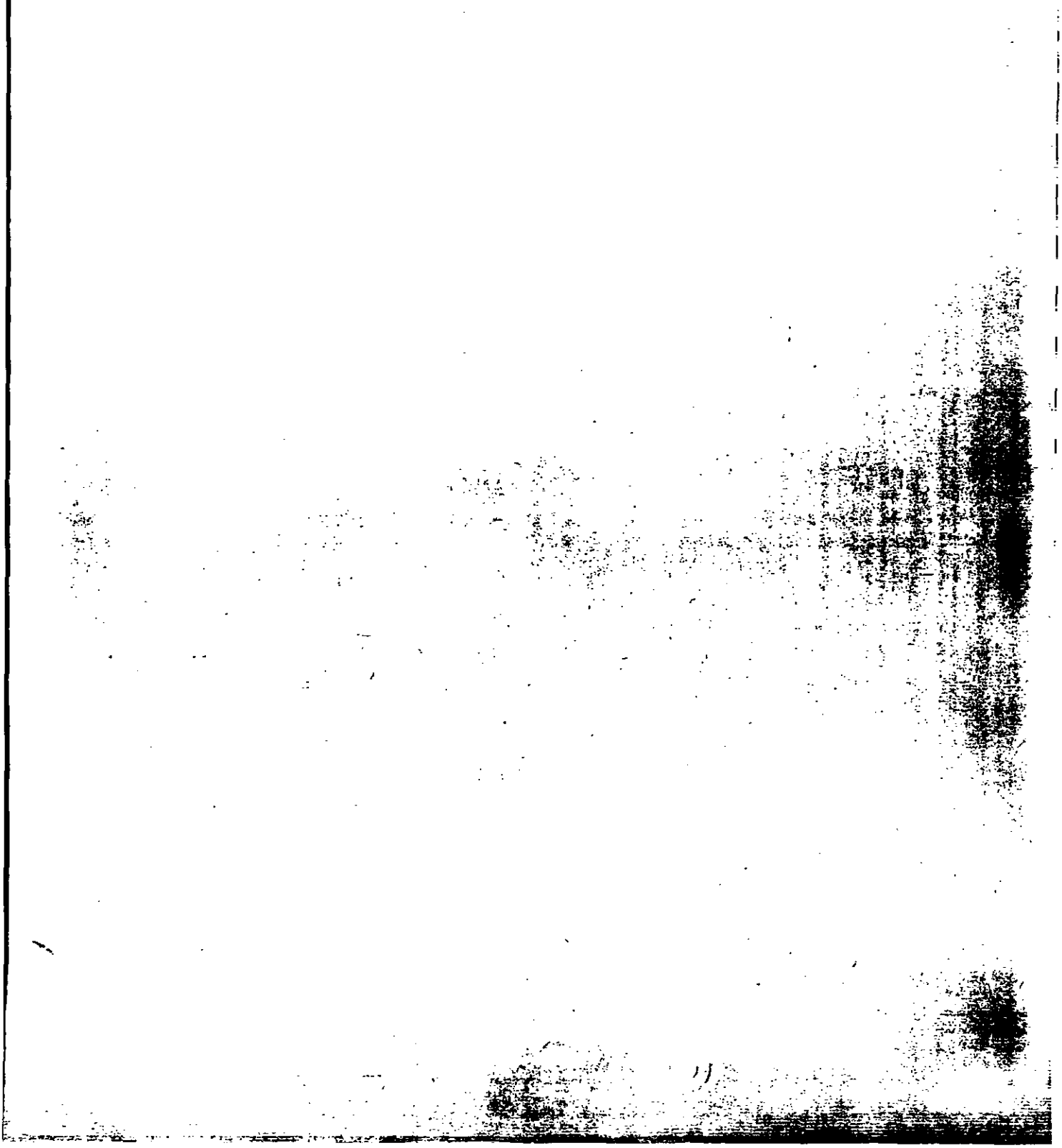
FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
110	120070	INT. CIR. 74HC32AP U121	1
111	120059	INT. CIR. 74HC4046AN U123	1
112	120068	INT. CIR. 74HC166AP U124,U125	2
113	120067	INT. CIR. 74HC40103AP U126,U127	2
114	120062	REGULATOR 5V, LP2950ACZ-5.0 U129	1
115	120020	INT. CIR. DAC0832LCN U130	1
116	120074	INT. CIR. CD74HC123 U131	1
117	120012	INT. CIR. 4N37 U134	1
118	120101	INT CIR., TLC272CP U135	1
119	120093	INT. CIR. LM393N U136	1
120	120072	INT. CIR. TC4429CPA U141,U144	2
121	120100	INT CIR., UC3823AN U142	1
122	120073	INT. CIR. 74LS04 U143	1
123	030018	TRIMPOT 5K OHMS VR102	1
124	350002	CRYSTAL, MICROPROCESSOR 8MHZ Y100	1
125	570006	CLIP, FUSE FOR FIND #34,35,36,37	8
126	180029	TERMINAL MALE FOR FIND #48	3
127	500065	SCREW, MACH, NYLON, 10-32X1 FOR FIND #40	1
128	510003	NUT, KEPS, 10-32 THREADED STL FOR FIND #40	1
129	500068	SCREW, 6-32x3/4, NYLON FOR FIND #43	1
130	510002	NUT, KEPS, 6-32 THD STL, ZINC FOR FIND #43	1
131	000367	HEATSINK ASSY., CMC-3-PC	1
132	500021	SCREW, MACH, SS, 4-40X5/16 FOR FIND #131	3
133	530001	WASHER, SPLIT #4 MED, STL,ZINC FOR FIND #131	3
134	190016	DIP SOCKET,8 PIN,LO-PROFILE	1
135	190009	8 PIN DIP SOCKET	8
136	190010	14 PIN DIP SOCKET	13
137	190011	16 PIN DIP SOCKET	14
138	190004	20 PIN DIP SOCKET	2
139	190002	24 PIN DIP SOCKET	1
140	190005	28 PIN DIP SOCKET	1
141	190003	40 PIN DIP SOCKET	1
142	460005	NYLON CABLE TIE, ULI NT-70E FOR FIND #93	1
143	460099	LABEL, #303-LE10 FOR FIND #1	1
144	460100	LABEL, #4-PW10F FOR FIND #1	1
145	980030	SYNERGY,SOFTWARE, REV.2	1
146	000342	ASSY, MAIN BD, CMC-3-PC	0

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
BOM# 51-2220		HEATSINK ASSY	
1	400085	HEATSINK, BSC/CMCIII-PC	1
		HS1	
2	100035	DIODE, DSEI8-06A, 600V	2
		D112,D127	
3	110010	TRANSISTOR HP FET IRFP450	2
		Q101,Q108	
4	110019	TRANSISTOR, IRF840	1
		Q102	
5	110012	POWER MOSFET, ADVANCED POWER	2
		Q106,Q107	
6	120002	VOLTAGE REGULATOR, LM7815CT	1
		U137	
7	120001	VOLTAGE REG LM7805CT	1
		U138	
8	550008	SIL-PADS 400 SILICONE PAD	4
		FOR FIND #3,5	
9	500004	SCREW, MACH, ST 6-32X1/2, ZINC	4
		FOR FIND #3,5	
10	530012	WASHER, FLAT #6 MED, STL, ZINC	4
		FOR FIND #3,5	
11	530005	WASHER, SPLIT #6 MED, STL,ZINC	4
		FOR FIND #3,5	
12	550010	SIL-PADS 400 SILICONE PADS	5
		FOR FIND #2,4,6,7	
13	500081	SCREW, MACH ST ZC PL 4-40X3/8	5
		FOR FIND #2,4,6,7	
14	550009	WASHER,SHOULDER,NYLON,#4	5
		FOR FIND #2,4,6,7	
15	530001	WASHER, SPLIT #4 MED, STL,ZINC	5
		FOR FIND #2,4,6,7	
16	000367	HEATSINK ASSY., CMC-3-PC	0
BOM# 51-2221		FINAL ASSY	
1	400104	CHASSIS, SYNERGY	1
2	460161	OVERLAY, FRONT PANEL, SYNERGY	1
3	000346	DISPLAY BD ASSY, CMC-3-PC	1
4	520012	WASHER, FLAT, NYLON	1
		FOR FIND #3	
5	510014	NUT, HEX, METRIC(NOBLE SWITCH)	1
		FOR FIND #3	
6	220016	KNOB 13MM	1
7	220017	CAP FOR KNOB	1
		FOR FIND #6	
8	220014	KNOB, 6MM, LT GREY	1
		FOR FIND #3	
9	220015	CAP FOR KNOB, LT GREY	1
		FOR FIND #8	
10	580010	DOW CORN'G COAT'G SILASTIC BLK	0.05
		FOR FIND #3	
11	000373	PWR SWITCH ASSY., CMC-3-PC	1
12	000371	PWR OUTPUT CBL ASSY., CMC-3-PC	1
13	170073	BANANA PLUG, WITH NUT	2
14	530008	WASHER, INTERNAL TEETH, STEEL	2
		FOR FIND #13	
15	160003	TUBING, SHRINK, FIT221-3/16	0.13
		FOR FIND #13	
16	460116	OVERLAY, REAR PANEL, CMC3-PC	1
17	570042	FUSE, 2A, 250V TYPE T	1
		FOR FIND #20	
18	510005	NUT, HEX, 6-32 THREADED BRASS	1
19	000379	PWR ENTRY CONN ASSY.,	1
20	490009	CLAMP,CABLE,NYLON, #CCL250-170	1
21	490014	FLAT CABLE CLAMP	1

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
22	000370	PWR XFORMER ASSY., CMC-3-PC	1
23	510003	NUT, KEPS, 10-32 THREADED STL	4
		FOR FIND #25	
24	430001	RUBBER FOOT MOUNTING	4
25	500006	SCREW, MACH, STL, 8-32X1/2	4
		FOR FIND #27	
26	000372	FTPDL JACK ASSY., CMC-3-PC	1
27	500001	SCREW, MACH, STL, ZC, 4-40X1/4	2
		FOR FIND #29	
28	000342	ASSY, MAIN BD, CMC-3-PC	1
29	500020	SCREW, MACH SS 4-40X1/4	13
		FOR FIND #31,3	
30	530008	WASHER, INT. TEE. #4 MED ST ZC	13
		FOR FIND #31,3	
31	000374	COVER ASSY., CMC-3-PC	1
32	500064	SCREW, STEEL, ZINC PL,6-32X3/8	9
		FOR FIND # 22,34	
33	530013	LOCK WASHER, #6 INTERNAL TEETH	8
		FOR FIND #34	
34	210051	BUTTON BUMPER	4
35	460001	NYLON CABLE TIE, UL#NT-70	7
36	460022	SERIAL NUMBER OVERLAY	1
37	460077	TAB PROTECT LABEL, TRANSPARENT	1
38	460100	LABEL, #4-PW10F	1
39	990021	ROUTING CARD, 4 X 6, FANFOLD	1
40	460099	LABEL, #303-LE10	1
		FOR FIND #42	
41	000461	WHITE MAINS WIRE ASSY.	1
42	000462	BROWN MAINS WIRE ASSY.	1
43	000463	BLUE MAINS WIRE ASSY.	1
44	180013	TERMINAL CRIMP	1
45	000375	FINAL ASSY., CMC-3-PC	0
BOM# 51-2222	DISPLAY BD CABLE ASSY		
1	150053	RIBBON CBL, 26 COND., .050 SPC	1
2	170122	SOCKET CONN., 26 CIR.	1
3	170123	HEADER IDC 26	1
		P200	
4	000369	DISP BD CABLE ASSY., CMC-3-PC	0
BOM# 51-2223	PWR SWITCH ASSY		
1	250039	POWER SWITCH BSC	1
2	150021	WIRE UL# 1015 18GA BLK	2
3	180008	TERMINAL CRIMP	1
		J401	
4	000373	PWR SWITCH ASSY., CMC-3-PC	0
BOM# 51-2224	PWR OUTPUT CABLE ASSY		
1	170007	3 CIR CONN RECEPT	1
		J103	
2	180007	TERMINAL CRIMP	2
		FOR FIND #1	
3	150017	WIRE UL# 1015 18GA RED	1.33
4	000371	PWR OUTPUT CBL ASSY., CMC-3-PC	0
BOM# 51-2225	FOOTPEDAL JACK ASSY		
1	170146	4 CIR CONN RECEPT, NC4FP-1	1
		J407	
2	060026	CAP MONLY CER, .1MF 10% 50V	1
		C400	
3	150012	WIRE UL# 1007 HK-UP 22GA GRN	0.5
4	150013	WIRE UL# 1007 22GA BLU	0.5
5	170008	2 CIR CONN RECEPT	1
6	180002	TERMINAL CRIMP	2

FIND #	PART NO.	ITEM DESCRIPTION	QTY/BILL
7	180005	TUBING, SHRINK, FIT221-1/8	0.17
8	480001	NYLON CABLE TIE, UL#NT-70	1
9	150033	WIRE UL #1015 18GA GRN/YEL	0.25
10	540005	LUG TERMINAL # 6 HOLE INT. TEETH	1
11	180003	TUBING, SHRINK FIT 221-3/16	0.10
12	000372	FTPDL JACK ASSY., CMC-3-PC	0
BOM# 51-2226	PWR XFORMER ASSY		
1	170104	CONNNECTOR, RECP INT'L 3 CIR J105	1
2	180026	TERMINAL CRIMP FEMALE FOR FIND #1	2
3	170105	CONNNECTOR, RECP 4 CIR, MOLEX J104	1
4	180007	TERMINAL CRIMP FOR FIND #3	4
5	300060	PWR TRANSFORMER, BSC 96 T400	1
6	180039	TERMINAL CRIMP, S05316SF J403,J404 FOR FIND #5	4
7	480001	NYLON CABLE TIE, UL#NT-70	2
8	000370	PWR XFORMER ASSY., CMC-3-PC	0
BOM# 51-2227	COVER ASSY		
1	400063	COVER, CMC-3-PC	1
2	420003	GREY HANDLE W/HARDWARE - MOD.	1
3	510003	NUT, KEPS, 10-32 THREADED STL	2
4	460069	OVERLAY, COVER, CMC-3-PC	1
5	580006	DOW CORNING COATING #3140 RTV	0.05
6	000374	COVER ASSY., CMC-3-PC	0
BOM# 51-2230	PACKING ASSY		
1	000375	FINAL ASSY., CMC-3-PC	1
2	000114	SINGLE FTSWITCH, CMC-2-PC/IRR	1
3	650069	POLYBAG - 16 X 24 X .002	1
4	650102	INNER CARTON, CMC-3-PC	1
5	650103	MASTER CARTON, CMC-3-PC	0.25
6	650009	STAPLE - FOR MASTER CARTON	2
7	600003	WHITE NON-ASPH REINF TAPE 3	2
8	650104	END CAPS, CMC-3-PC	1
9	460015	FRAGILE LABEL	4
10	460122	LABEL, PKG CHECKOFF, CMC-3-PC	1
11	600004	BROWN NON-ASPH REINF TAPE 3	4
12	650010	POLYBAG 10X8X22,.002 GUSSETED	1
13	480003	POLY CABLE TIE, BEADED	2
14	000315	ASSY, PWR CORD, MOD# 4087,BSCM	1
15	650093	POLYBAG, 8x14x.002 BSC FOR FIND #14	1
16	000378	PACKING ASSY., CMC-3-PC	0
BOM # 51-2462	BROWN MAINS WIRE ASSY.		
1	150031	WIRE UL # 1015 18GA BRN	2
2	180006	TERMINAL CRIMP	1
3	180039	TERMINAL CRIMP, S05316SF	1
4	000462	BROWN MAINS WIRE ASSY.	0
BOM # 51-2463	WHITE MAINS WIRE ASSY.		
1	150042	WIRE UL # 1015 18GA WHT	2
2	180006	TERMINAL CRIMP	1
3	180039	TERMINAL CRIMP, S05316SF	1
4	000461	WHITE MAINS WIRE ASSY.	0
BOM # 51-2464	BLUE MAINS WIRE ASSY.		
1	150032	WIRE UL # 1015 18GA BLU	2
2	180006	TERMINAL CRIMP	1
3	180039	TERMINAL CRIMP, S05316SF	1
4	000463	BLUE MAINS WIRE ASSY.	0

12.0 BLOCK DIAGRAMS



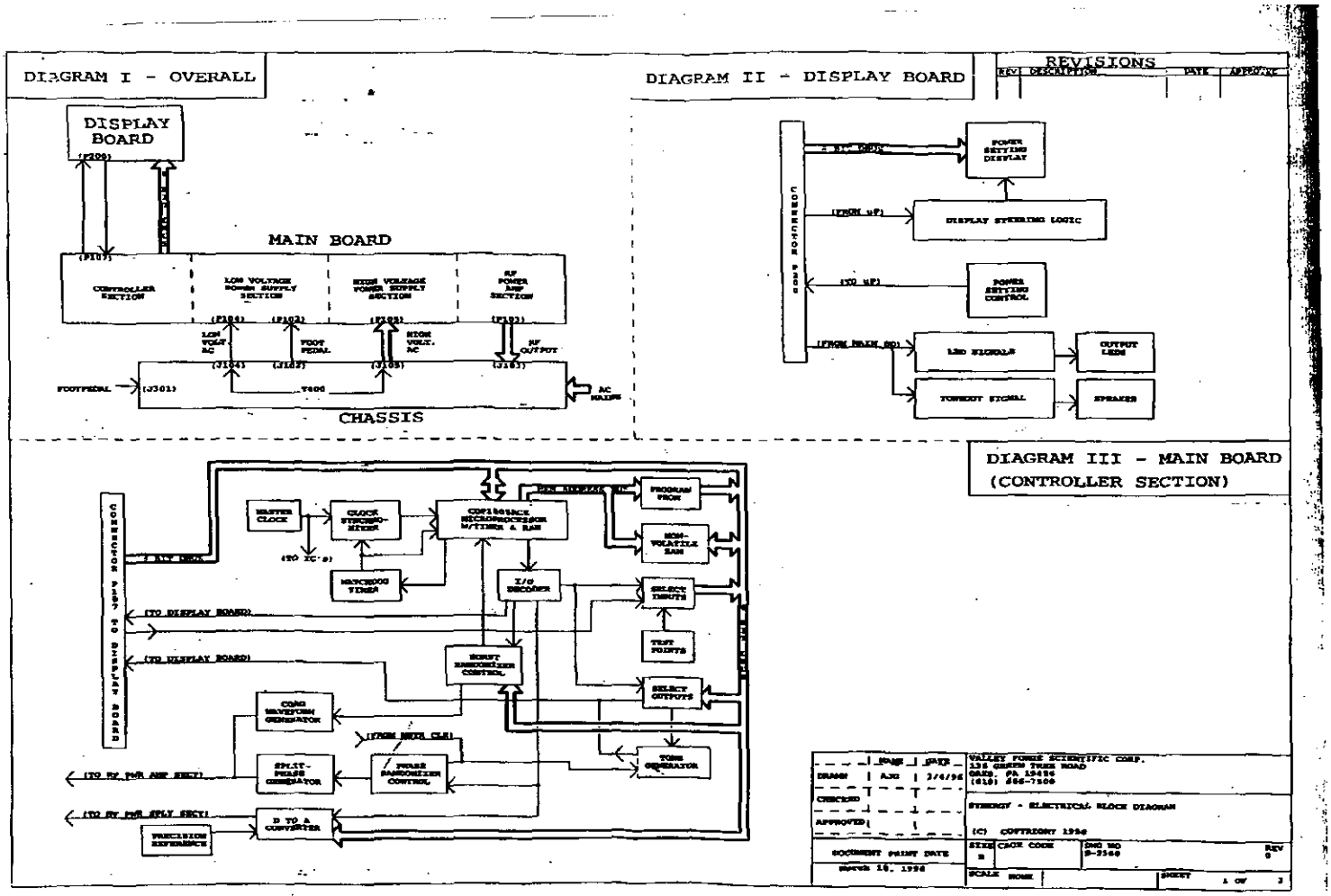


DIAGRAM I - OVERALL
DISPLAY BOARD
MAIN BOARD
CHASSIS
DIAGRAM II - DISPLAY BOARD
REVISIONS
DIAGRAM III - MAIN BOARD
(CONTROLLER SECTION)

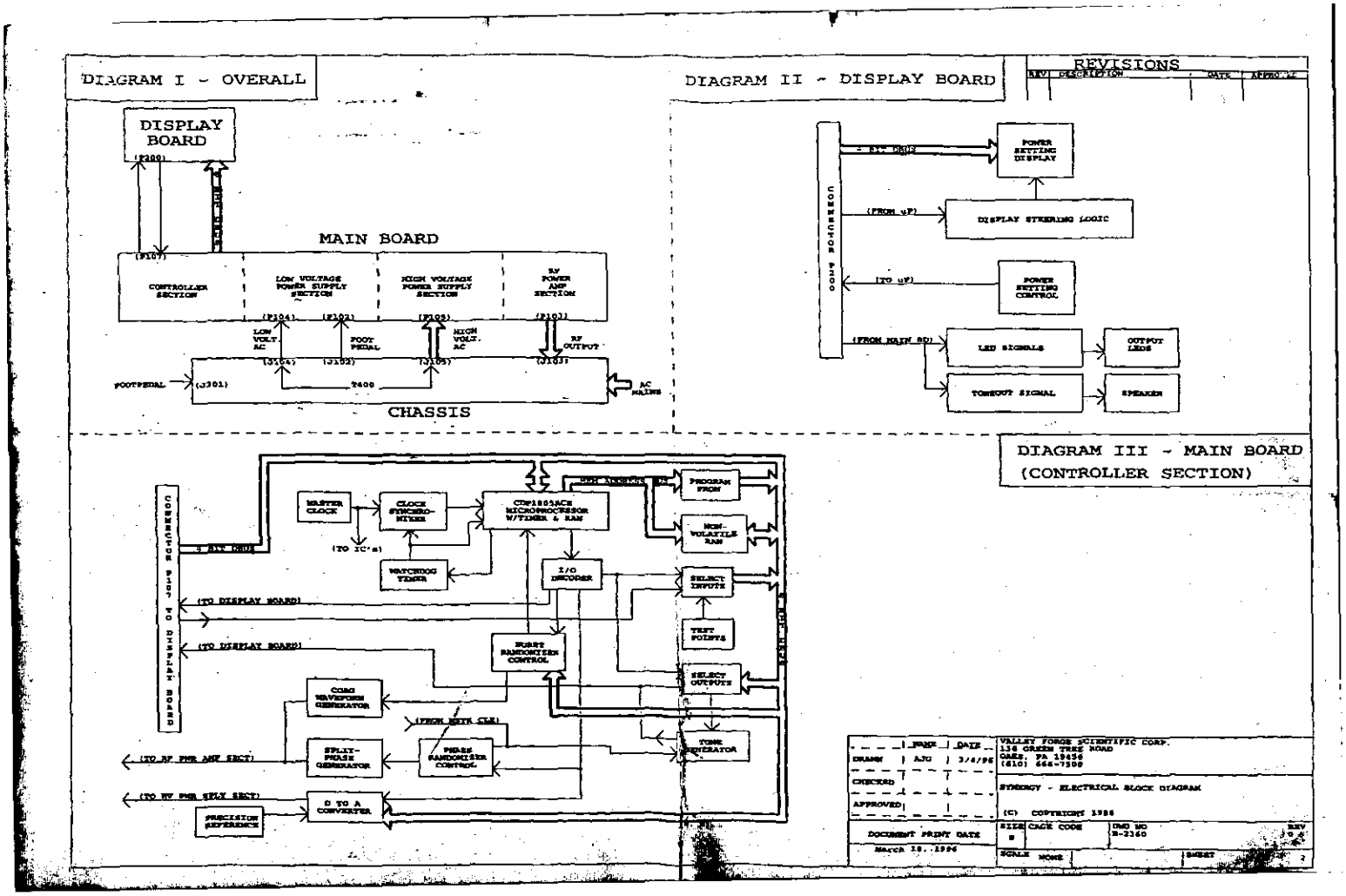


DIAGRAM I - OVERALL
DISPLAY BOARD
MAIN BOARD
CONTROLLER SECTION
LOW VOLTAGE POWER SUPPLY SECTION
HIGH VOLTAGE POWER SUPPLY SECTION
RF POWER AMP SECTION
CHASSIS
FOOTPEDAL
AC MAINS
DIAGRAM II - DISPLAY BOARD
POWER SETTING DISPLAY
DISPLAY STEERING LOGIC
POWER SETTING CONTROL
LED SIGNALS
OUTPUT LEDS
TONEOUT SIGNAL
SPEAKER
DIAGRAM III - MAIN BOARD (CONTROLLER SECTION)
MASTER CLOCK
CLOCK SYNCHRONIZER
CDP1805ACE MICROPROCESSOR W/TIMER & RAM
PROGRAM PROM
NON-VOLATILE RAM
WATCHDOG TIMER
I/O DECODER
SELECT INPUTS
TEST POINTS
BURST RANDOMIZER CONTROL
SELECT OUTPUTS
CORG WAVEFORM GENERATOR
SPLIT-PHASE GENERATOR
PHASE RANDOMIZER CONTROL
TONE GENERATOR
D TO A CONVERTER
PRECISION REFERENCE
REVISIONS
VALLEY FORGE SCIENTIFIC CORP.
SYNERGY - ELECTRICAL BLOCK DIAGRAM
(C) COPYRIGHT 1996
DOCUMENT PRINT DATE
March 18, 1996

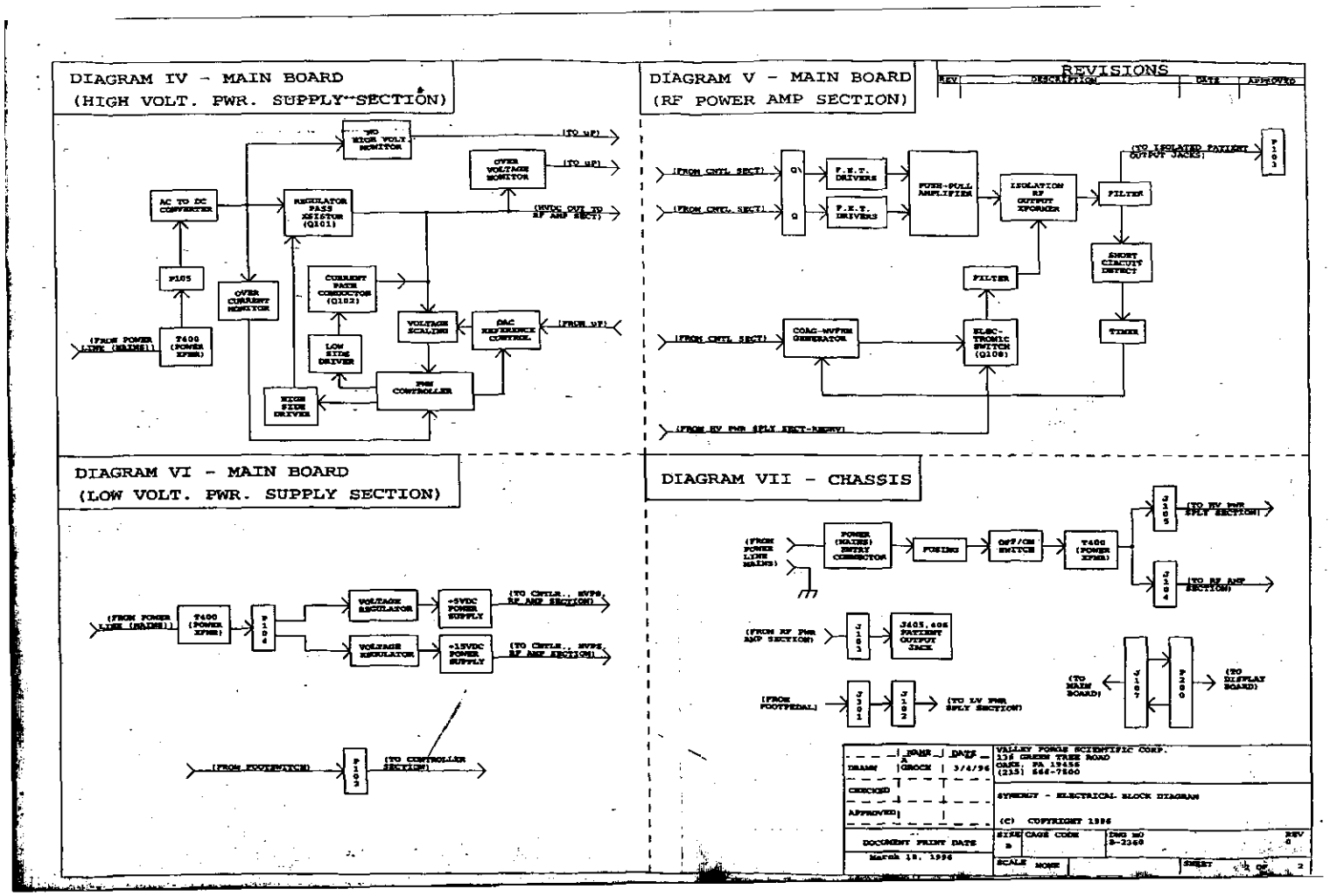


DIAGRAM IV - MAIN BOARD
(HIGH VOLT. PWR. SUPPLY SECTION)
DIAGRAM V - MAIN BOARD
(RF POWER AMP SECTION)
REVISIONS
DIAGRAM VI - MAIN BOARD
(LOW VOLT. PWR. SUPPLY SECTION)
DIAGRAM VII - CHASSIS
AC TO DC CONVERTER
REGULATOR PASS XSISTOR (Q101)
OVER CURRENT MONITOR
OVER VOLTAGE MONITOR
CURRENT PACK CONNECTOR (Q102)
LOW SIDE DRIVER
HIGH SIDE DRIVER
VOLTAGE SCALING
DAC REFERENCE CONTROL
PWM CONTROLLER
F.E.T. DRIVERS
PUSH-PULL AMPLIFIERS
ISOLATION RF OUTPUT XFORMER
FILTER
SHORT CIRCUIT DETECT
TIMER
COAG-WAVEFM GENERATOR
ELEC-TRONIC SWITCH (Q108)
POWER (MAINS) ENTRY CONNECTOR
FUSING
OFF/ON SWITCH
VOLTAGE REGULATOR
+5VDC POWER SUPPLY
+15VDC POWER SUPPLY
VALLEY FORGE SCIENTIFIC CORP.
SYNERGY - ELECTRICAL BLOCK DIAGRAM
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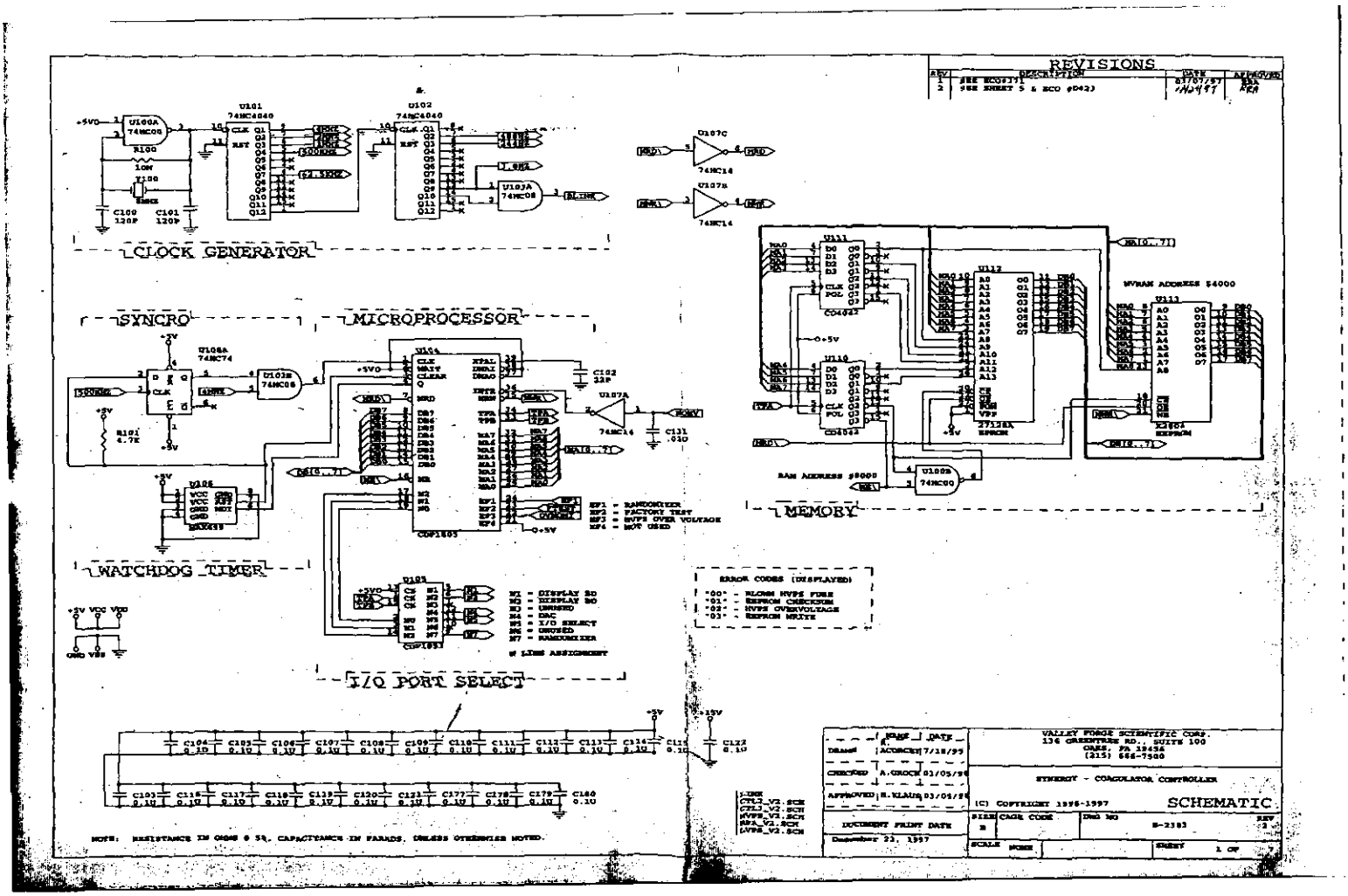
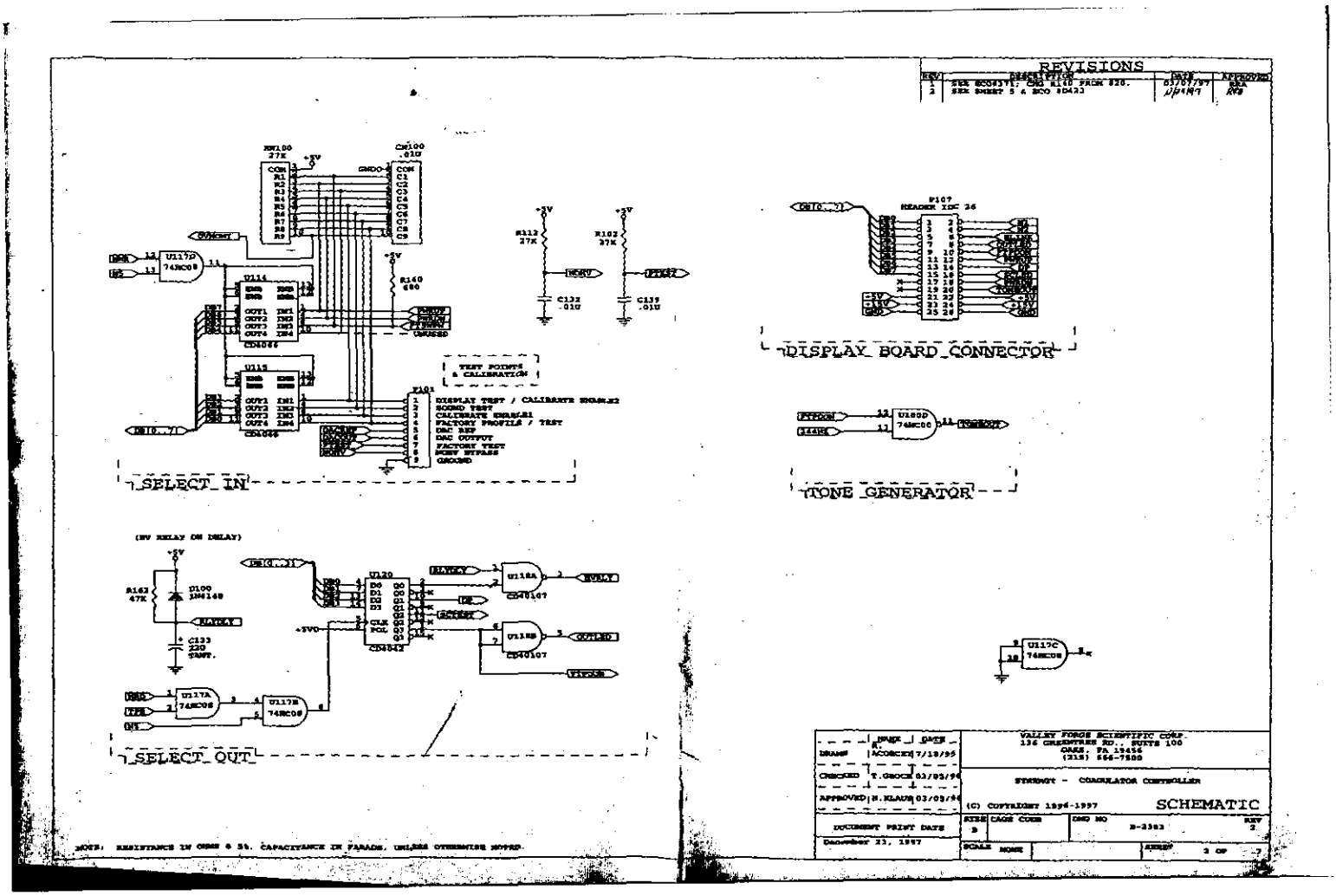
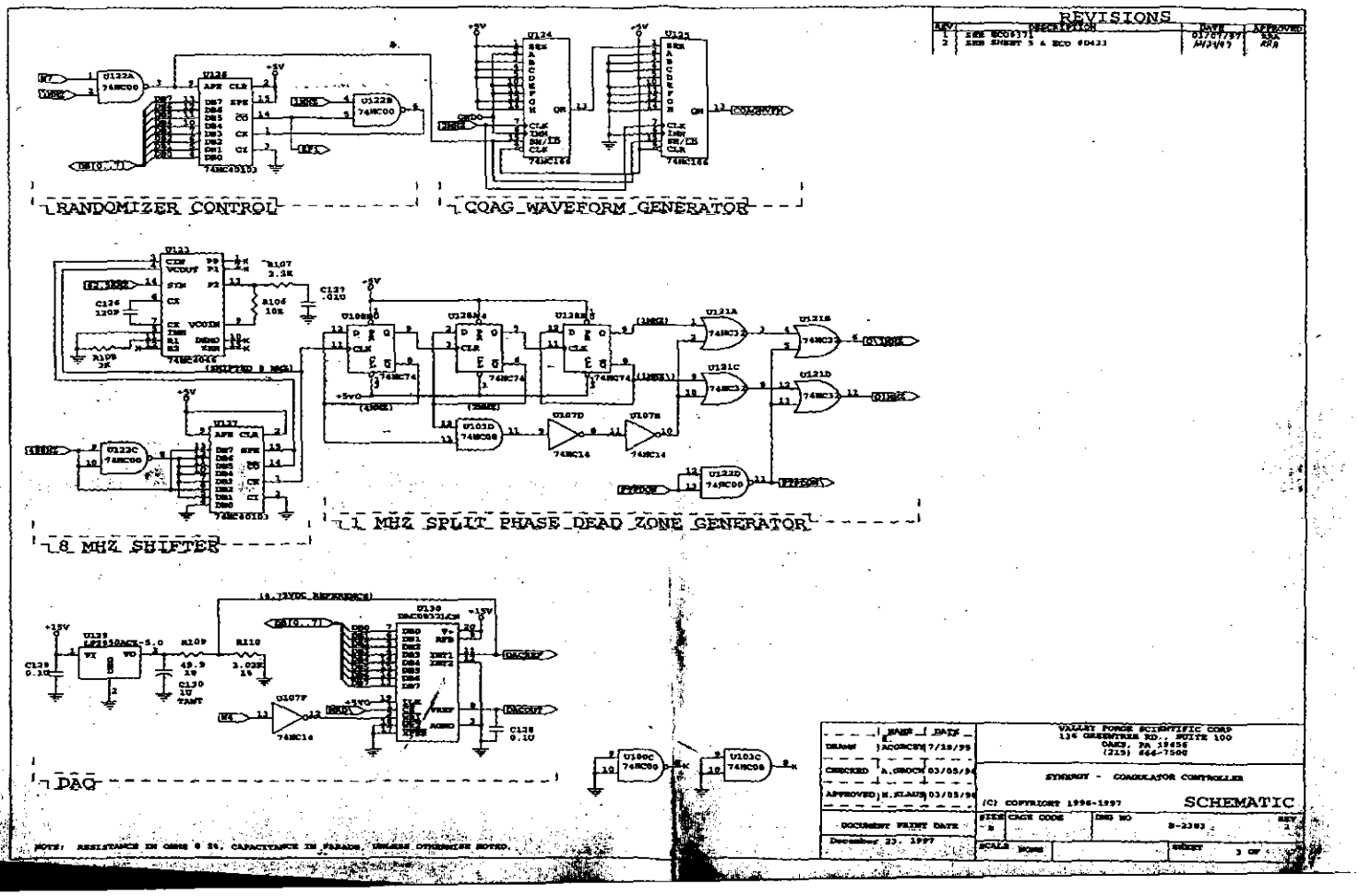
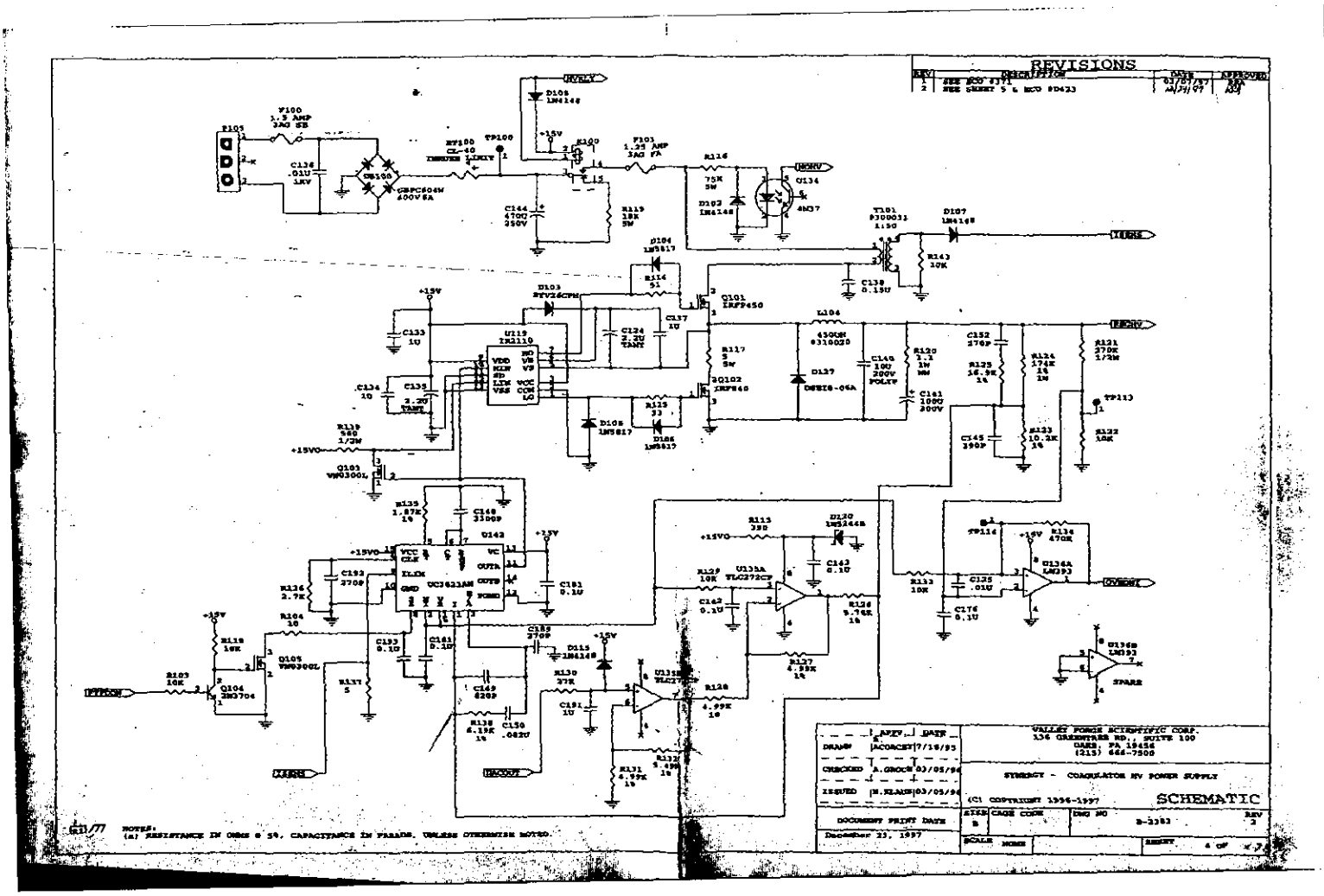
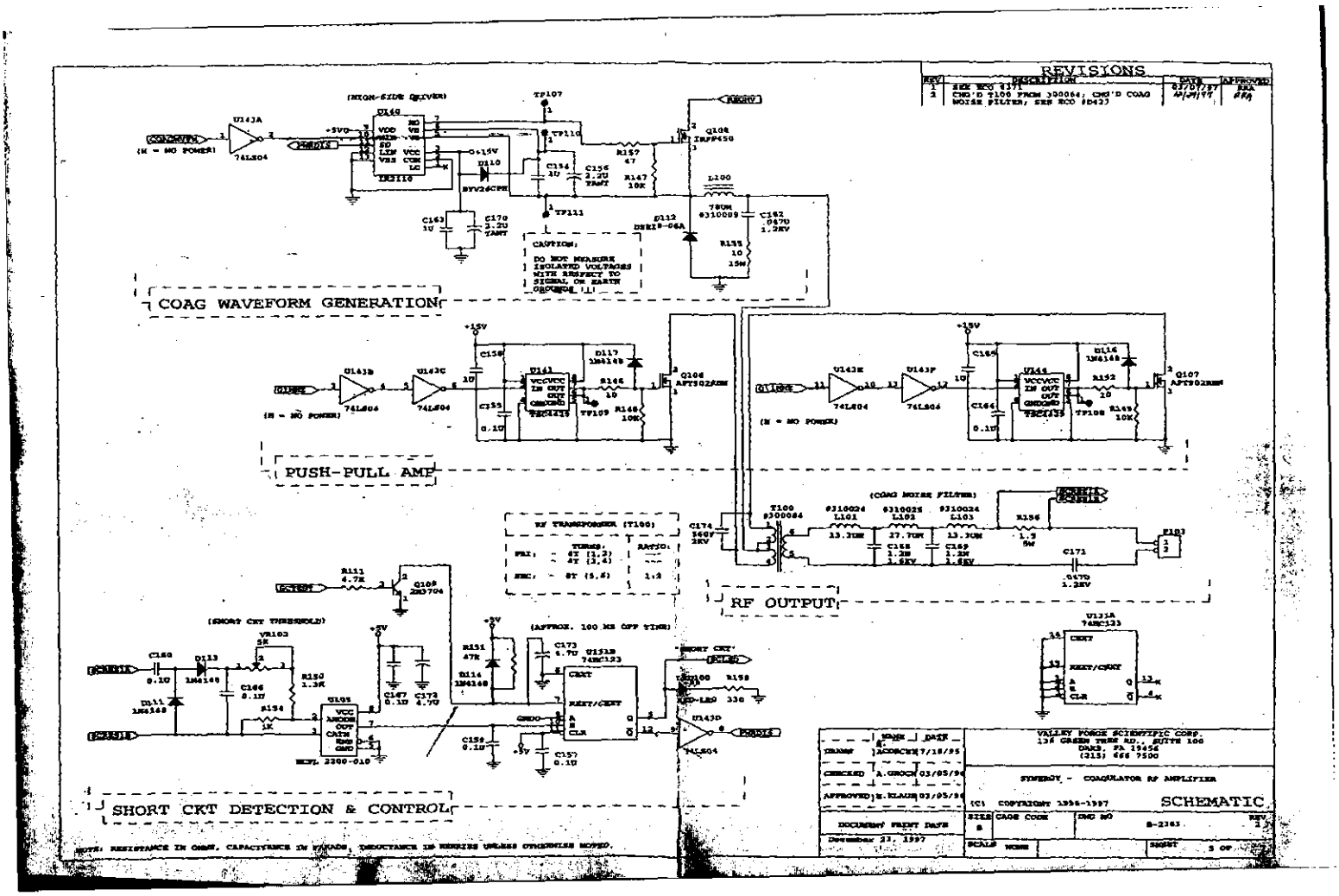
DOCUMENT PRINT DATE
March 18, 1996

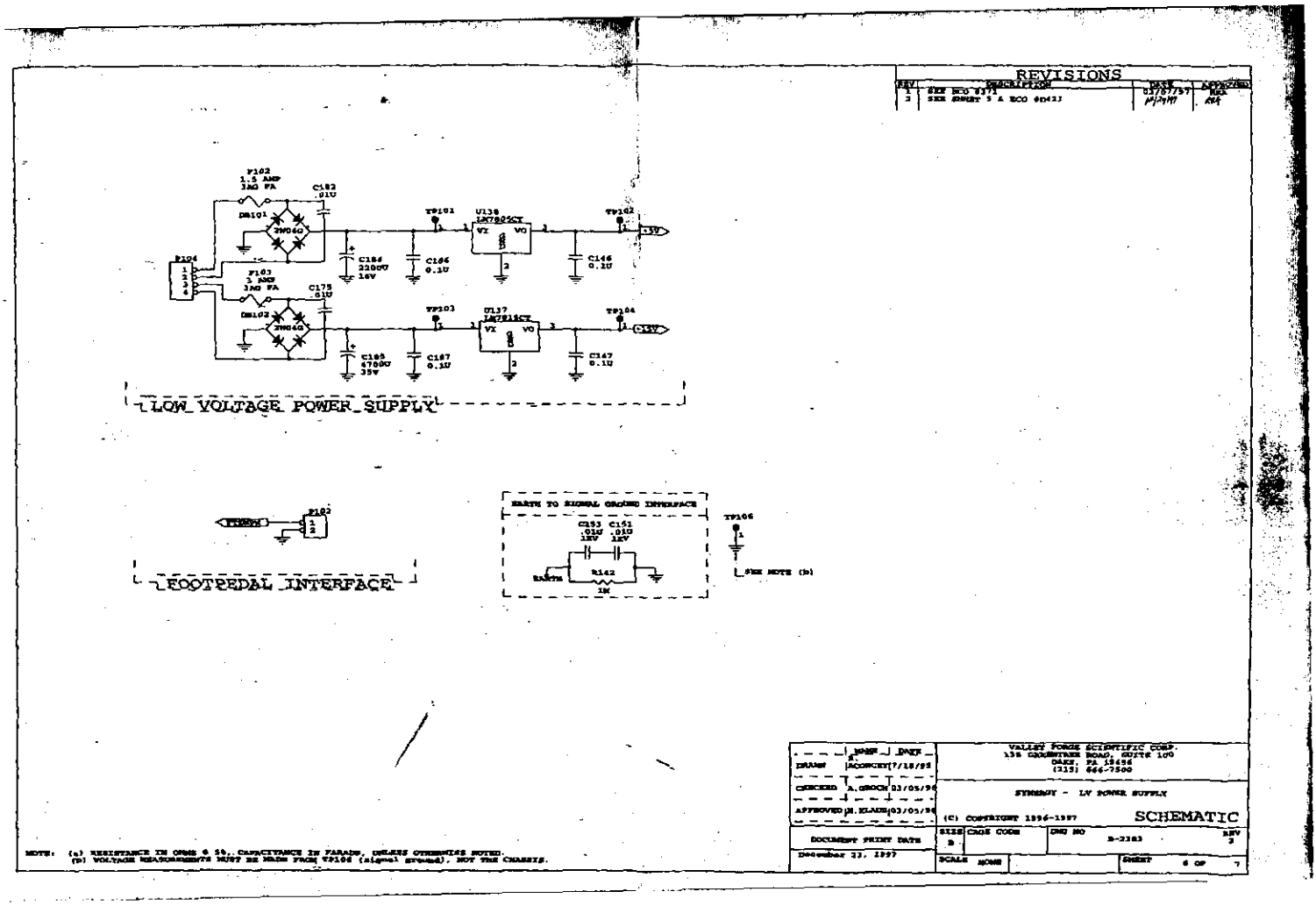

REVISIONS
CLOCK GENERATOR
SYNCRO
MICROPROCESSOR
MEMORY
WATCHDOG TIMER
I/O PORT SELECT
ERROR CODES (DISPLAYED)
SCHEMATIC

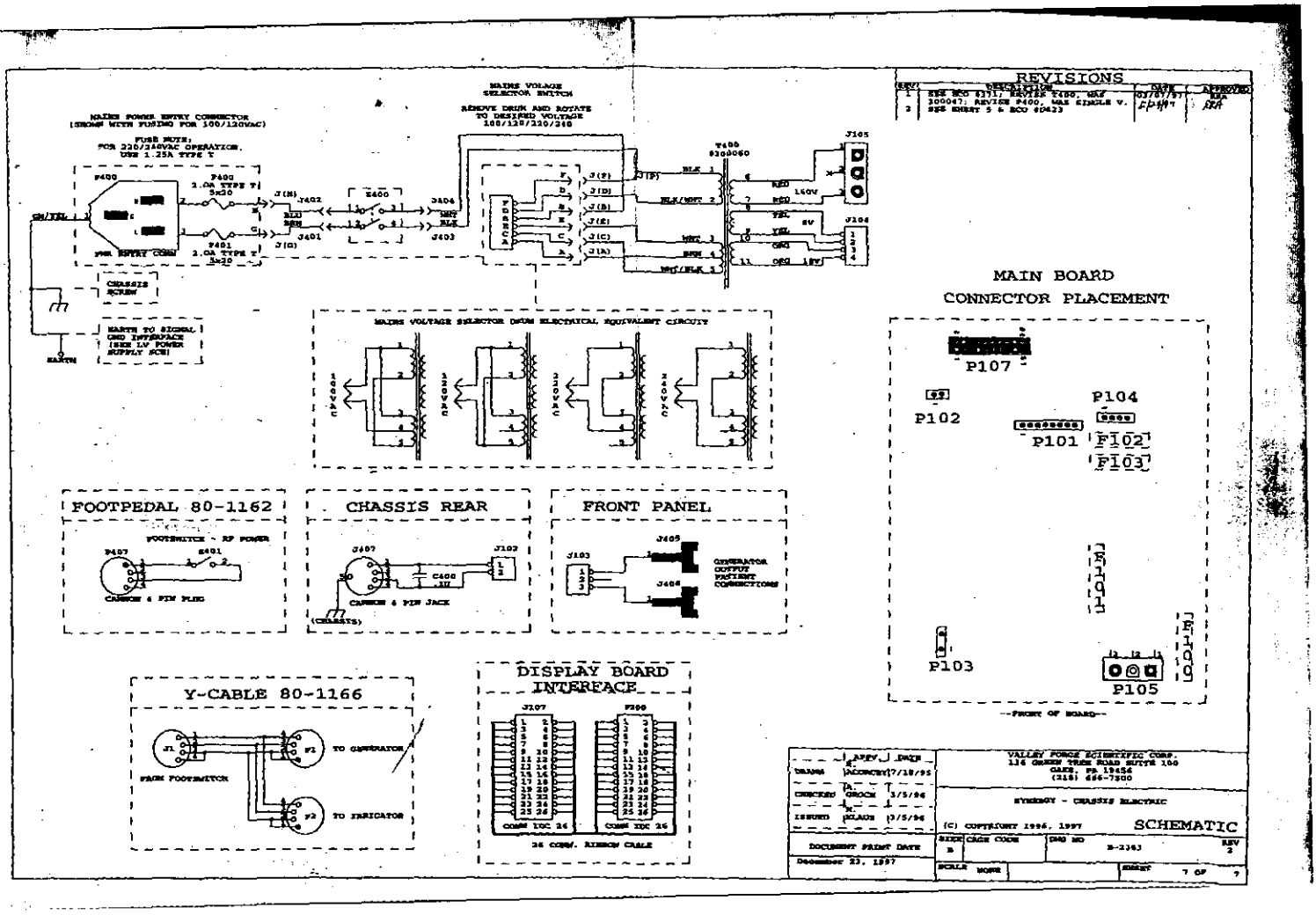

REVISIONS
SELECT_IN
SELECT_OUT
DISPLAY_BOARD_CONNECTOR
TONE_GENERATOR
SCHEMATIC

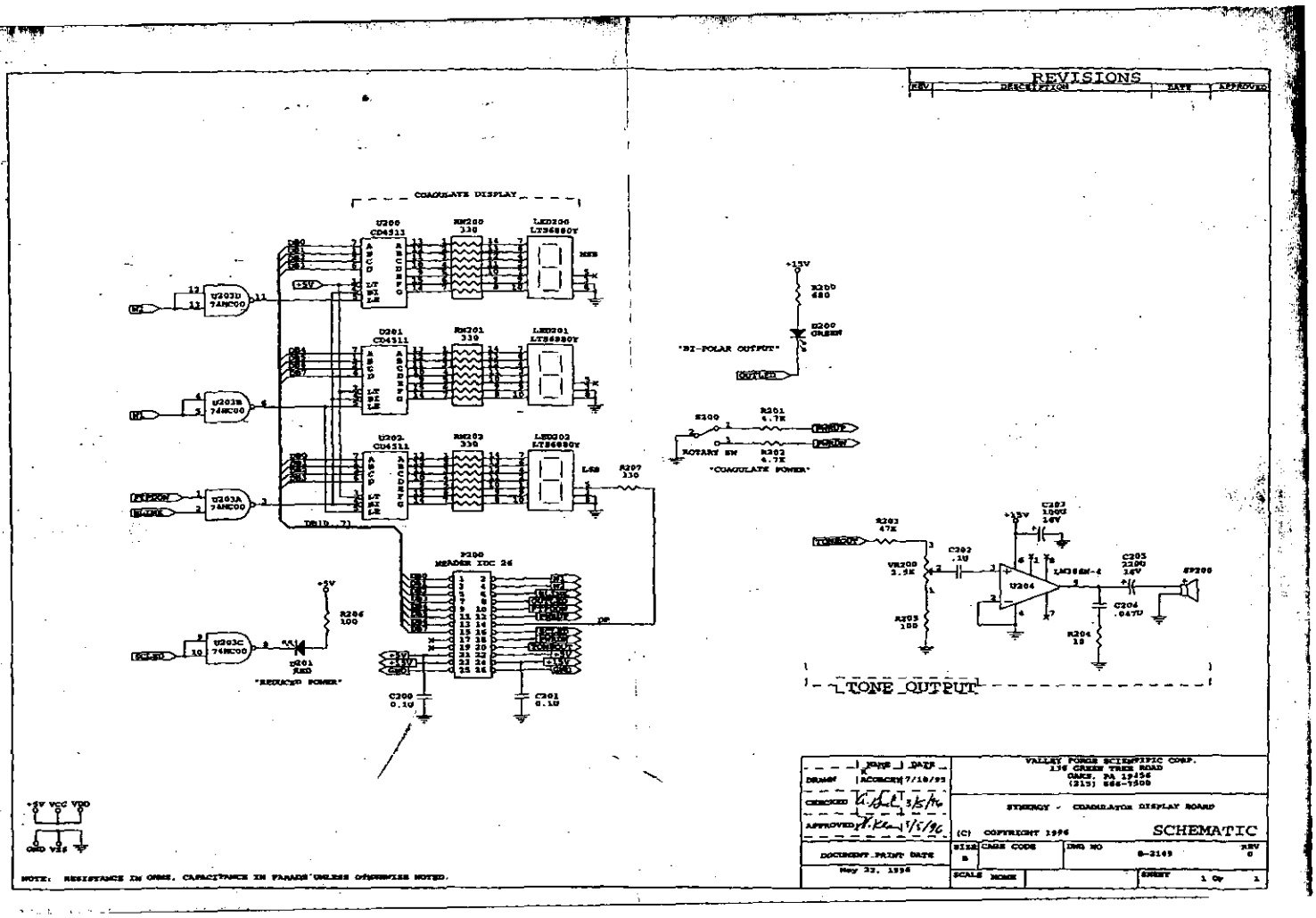

REVISIONS
RANDOMIZER CONTROL
COAG WAVEFORM GENERATOR
8 MHZ SHIFTER
1 MHZ SPLIT PHASE DEAD ZONE GENERATOR
DAC
SCHEMATIC

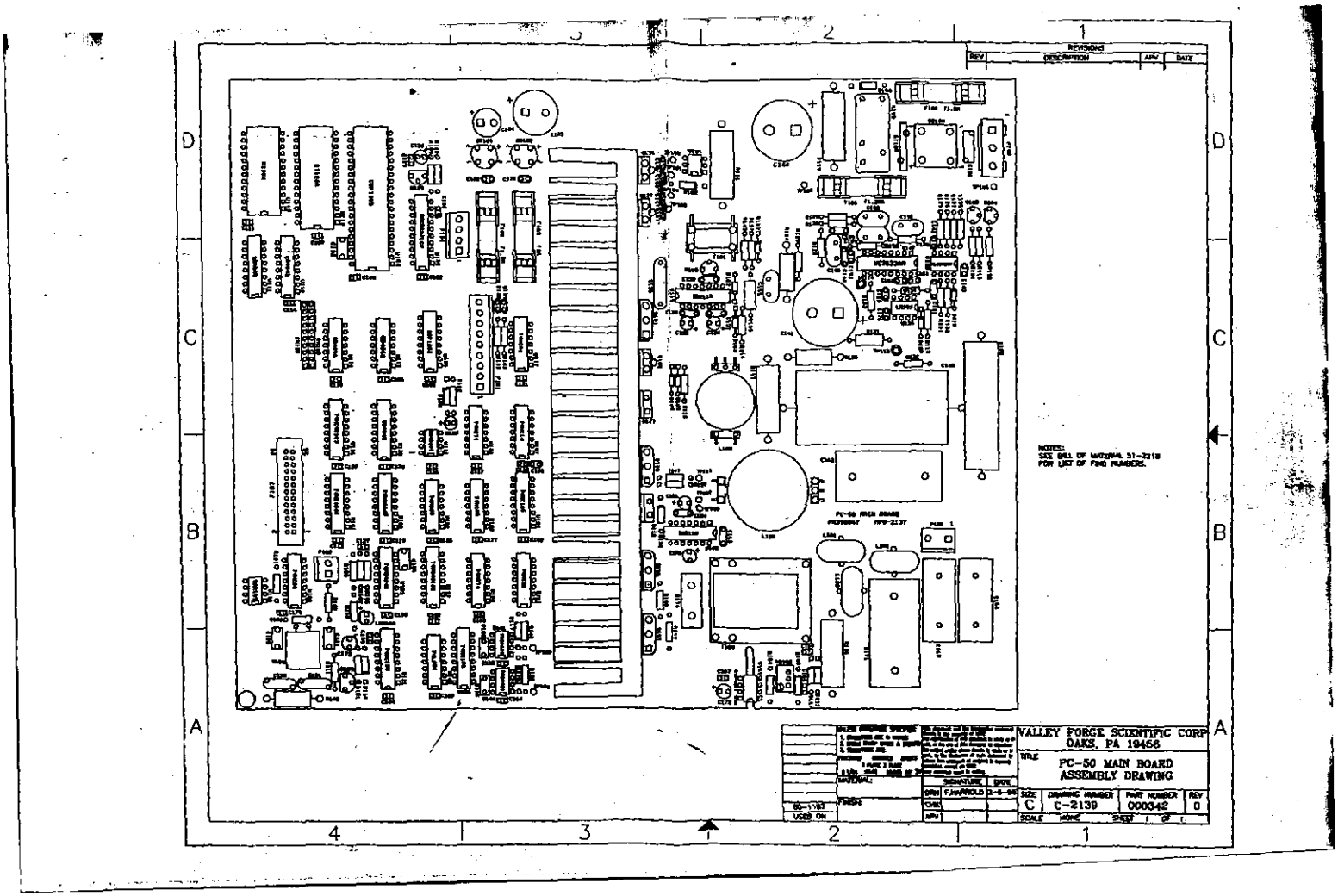

REVISIONS
SCHEMATIC
VALLEY FORGE SCIENTIFIC CORP.
STRIDENT - COAGULATOR RV POWER SUPPLY
DOCUMENT PRINT DATE
December 23, 1997

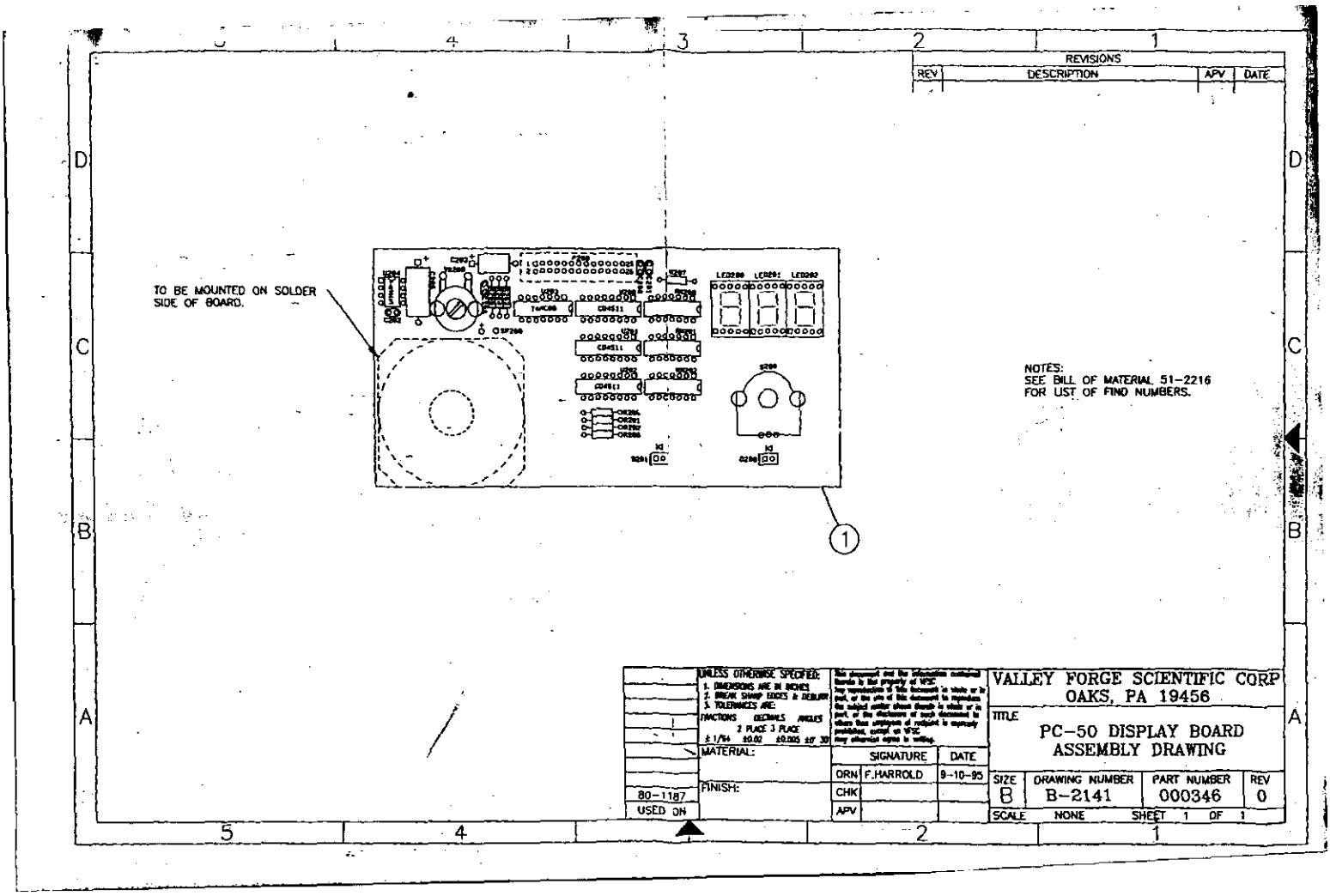

REVISIONS
COAG WAVEFORM GENERATION
PUSH-PULL AMP
RF OUTPUT
SHORT CKT DETECTION & CONTROL
SCHEMATIC


REVISIONS
LOW VOLTAGE POWER SUPPLY
FOOTPEDAL INTERFACE
EARTH TO SIGNAL GROUND INTERFACE
SCHEMATIC


REVISIONS
MAIN BOARD
CONNECTOR PLACEMENT
P107
P102
P104
P101
P103
P105
FOOTPEDAL 80-1162
CHASSIS REAR
FRONT PANEL
Y-CABLE 80-1166
DISPLAY BOARD
INTERFACE
SCHEMATIC


REVISIONS
COAGULATE DISPLAY
"BI-POLAR OUTPUT"
"COAGULATE POWER"
"REDUCED POWER"
TONE OUTPUT
VALLEY FORGE SCIENTIFIC CORP.
136 CREEK TREE ROAD
OAKS, PA 19456
(215) 666-1500
SYNERGY - COAGULATOR DISPLAY BOARD
(C) COPYRIGHT 1996
SCHEMATIC
DOCUMENT PRINT DATE
May 22, 1996
SCALE NONE
NOTE: RESISTANCE IN OHMS, CAPACITANCE IN FARADS UNLESS OTHERWISE NOTED.


REVISIONS
REV
DESCRIPTION
APV
DATE
NOTES:
SEE BILL OF MATERIAL 31-2218
FOR LIST OF PART NUMBERS.
VALLEY FORGE SCIENTIFIC CORP
OAKS, PA 19456
TITLE
PC-50 MAIN BOARD
ASSEMBLY DRAWING
SIZE
C
DRAWING NUMBER
C-2139
PART NUMBER
000342
REV
D
SCALE
NONE
SHEET 1 OF 1



REVISIONS			
REV	DESCRIPTION	APV	DATE

NOTES:
SEE BILL OF MATERIAL 51-2216
FOR LIST OF FIND NUMBERS.

UNLESS OTHERWISE SPECIFIED:
1. DIMENSIONS ARE IN INCHES
2. BREAK SHARP EDGES & DEBURR
3. TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
2 PLACE 3 PLACE
± 1/64 ±0.02 ±0.005 ±0° 30'

MATERIAL:

FINISH:

80-1187
USED ON

	SIGNATURE	DATE
DRN	F.HARROLD	9-10-95
CHK		
APV		

VALLEY FORGE SCIENTIFIC CORP
OAKS, PA 19456

TITLE
PC-50 DISPLAY BOARD
ASSEMBLY DRAWING

SIZE	DRAWING NUMBER	PART NUMBER	REV
B	B-2141	000346	0

SCALE NONE SHEET 1 OF 1