

The MALIS™ Bipolar Electrosurgical System CMC®-III

Service Manual

Johnson & Johnson
PROFESSIONAL, INC.

RAYNHAM, MA 02767-0350 USA

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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 MALIS Bipolar Electrosurgical System CMC-III (catalog no. 80-1170) is warranted for one full year from date of purchase, except the Remote Control Set which is warranted for six months. The MALIS CMC-III is warranted to be free from defects in both materials and workmanship. This warranty shall not apply where service is required due to (i) Buyer's failure to operate or maintain the Equipment according to the Instruction Manual, (ii) Buyer's use of unauthorized parts or consumables, (iii) accident, abuse, misuse, modification or misapplication, or (iv)

improper service. THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Suitability for use of the device for any surgical procedure shall be determined by the user. Codman shall not be liable for incidental or consequential damages of any kind.

3.0 SERVICE AND REPAIR

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

The sales representative coordinates the return to:

Codman Repair Service
c/o Johnson & Johnson Professional, Inc.
4969 Wakefield Street
Philadelphia, PA 19144

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

The MALIS CMC-III Remote Control is not repairable. Replacements are available from:

Johnson & Johnson Professional, Inc.
325 Paramount Drive
Raynham, MA 02767-0350

4.0 WARNINGS AND CAUTIONS

4.1 WARNINGS

Do not attempt to bypass the grounding prong on the generator by using a 3-prong to 2-prong adaptor. 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". Always replace the system's fuse with the appropriate type and value fuse (see Technical Specifications).

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.

4.2 CAUTIONS

Continuous power output, by either footpedal or remote control, must be limited to 20 seconds, with a 40-second rest period.

Close proximity of this unit and its cables with some Electrosurgical Units producing EXCESSIVE RF CURRENT RADIATION may cause this unit to produce voice annunciation and possibly output power.

We recommend the user insure MAXIMUM PHYSICAL SEPARATION of this unit from any other electrosurgical device and its cables.

5.0 FUNCTIONAL DESCRIPTION OF CONTROLS AND INDICATORS

5.1 PRODUCT DESCRIPTION

The MALIS Bipolar Electrosurgical System CMC-III (catalog no. 80-1170) includes:

1. The Generator;
2. A wireless Remote Control for changing power settings as well as operating the cutting and coagulation functions;
3. An Adapter Cable to allow the use of a MALIS Irrigator and/or a MALIS Bipedal Electric Footswitch with the CMC-III.

The generator is compatible with both a pneumatic footswitch (catalog no. 80-1173) and an electric footswitch (catalog no. 80-1149) both available separately. The generator is equipped with a voice synthesizer that provides an audible indication of changes to the power settings. At the surgeon's option, it also announces the operating mode and power setting each time cutting or coagulation is performed. With the exception of the generator, all the above system components may also be ordered separately.

MALIS Bipolar Cutting Forceps and standard insulated and noninsulated forceps are available separately, as are reusable and disposable bipolar cords. The System may be used with the MALIS Irrigation Module (catalog no. 80-1164). The CODMAN® Floorstand for MALIS CMC-II/III is designed to accommodate the CMC-III Generator and the Irrigator together.

In bipolar coagulation, the electrical difference is only in the isolated output and in the lower power requirements. The output of the bipolar generator should be isolated 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 will now be dependent upon the tip size and the 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.

The MALIS Bipolar Electrosurgical System CMC-III provides the higher energy output needed for rapid cutting of all tissues, including dense fibrous layers, shifting the low impedance of the micro cutting automatically to match the power requirements of the high power cut settings.

5.2 GENERATOR CONTROLS (Figures 1 and 2)

A. Power Switch

Controls the power supplied to the coagulator.

B. Cutting Power Control Switch

Used to increase or decrease the power settings for cutting. (Cutting power control buttons are also located on the remote control set.)

C. Coagulation Power Control Switch

Increases and decreases the power settings for coagulation. (Coagulation power control buttons are also found on the remote control set.)

D. Tone Volume Control

Used to control the volume of the tones which indicate cutting or coagulation power is being delivered to forceps. You can change the tone volume at any time during the operation of the CMC-III, except while cutting or coagulating. While you are using these controls, the tone volume settings appear in the Microcut Power Display Window (Item V in Figure 5). Afterwards, the display window again shows the actual microcut power setting.

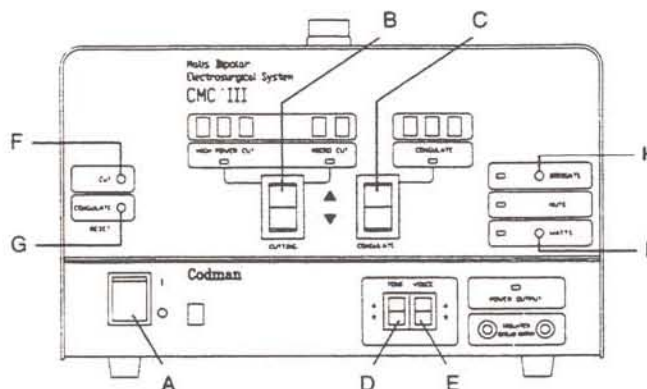


Figure 1. Front Panel Controls (Items A through I)

E. Voice Volume Control

Used to increase or decrease the volume of the voice synthesizer which announces the operating mode being employed and changes in the power settings. You can increase or decrease the voice volume at any time while using the CMC-III, except during cutting or coagulating. While you are using these controls, the voice volume settings appear in the Microcut Power Display Window (Item V in Figure 5). Afterwards, the display window again shows the actual microcut power setting.

F. Cutting Reset Button

By pushing this button, you can immediately reset the cutting power to 35 Malis Units (or 9 watts).

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G. Coagulation Reset Button

You can quickly reset the coagulation power to 35 Malis Units (or 9 watts) by pushing this button.

H. Irrigation Mode Button

When the MALIS Irrigator is properly set up and connected to the CMC-III, push this button to disable and enable irrigation. An additional irrigator button is located on the remote control set. The Irrigation Mode Indicator (Figure 5, Item AA) located on the generator will illuminate when the irrigator is enabled, regardless of which of the two switches is used.

I. Watts Display Button

Press this button to display the power settings in watts. The Watts Display Indicator (Figure 5, Item CC) illuminates whenever power settings show in watts.

J. Voice Mute Button

Used to prevent the voice synthesizer from announcing the operating mode being employed and the power settings each time cutting or coagulating is performed. When the voice is muted, the Mute Indicator, Item BB in Figure 5, illuminates.

K. LED Test Button

When you press this button, all numeric LEDs should illuminate as a self-diagnostic test. Any numeric LED that does not illuminate, signals a problem requiring attention.

L. Supply Voltage Selector

Use this control to set the generator to the same voltage as the power receptacle you are using.

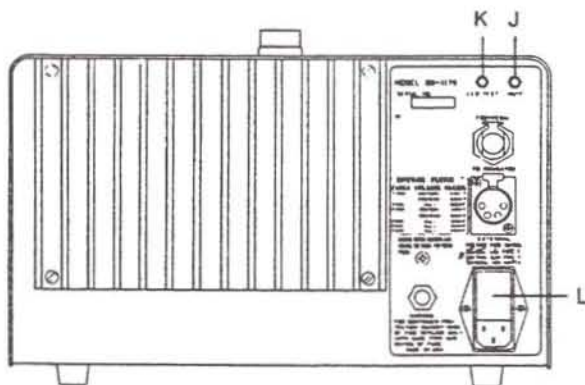


Figure 2. Back Panel Controls (Items J through L)

5.3 REMOTE CONTROL SET CONTROLS (Figure 3)

M. Cutting Output Button

When you press this button, cutting power is delivered to the forceps. (The Cut pedal on the footpedal, Item R in Figure 4, also controls this function.)

N. Coagulation Output Button

By pressing this button, you cause coagulation power to be delivered to the forceps. (The Coag pedal on the footpedal, Item S in Figure 4, also controls this function.)

O. Coagulation Power Control Button

Use this button to increase or decrease the power setting for coagulation. (The Coag Power Control Switch on the generator, Item C in Figure 1, controls the same function.)

P. Cutting Power Control Button

Increase or decrease the power setting for cutting by means of this button. (The Cutting Power Control Switch on the generator, Item B in Figure 1, controls the same function.)

Q. Irrigation Mode Button

When the MALIS Irrigator is properly set up and connected to the CMC-III, push this button to disable and enable irrigation. An additional irrigator button is located on the generator. The Irrigation Mode Indicator (Figure 5, Item AA) located on the generator illuminates when the irrigator is enabled, regardless of which of the two switches is used.

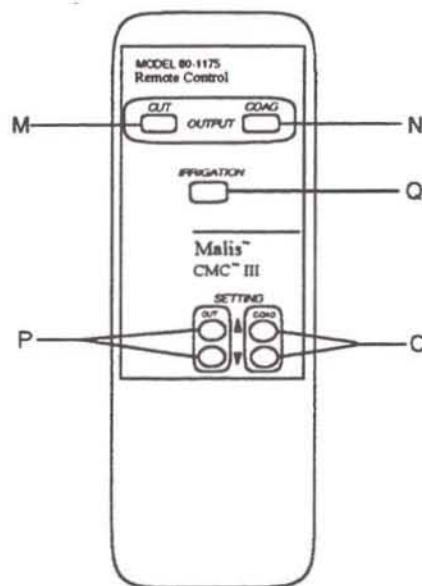


Figure 3. Remote Control (Items M through Q)

5.4 FOOTPEDAL CONTROLS (Figure 4)

R. Cutting Output Pedal

When you depress this pedal, cutting power is delivered to the forceps. (The Cut button on the remote control, Item M as shown in Figure 3, also controls this function.)

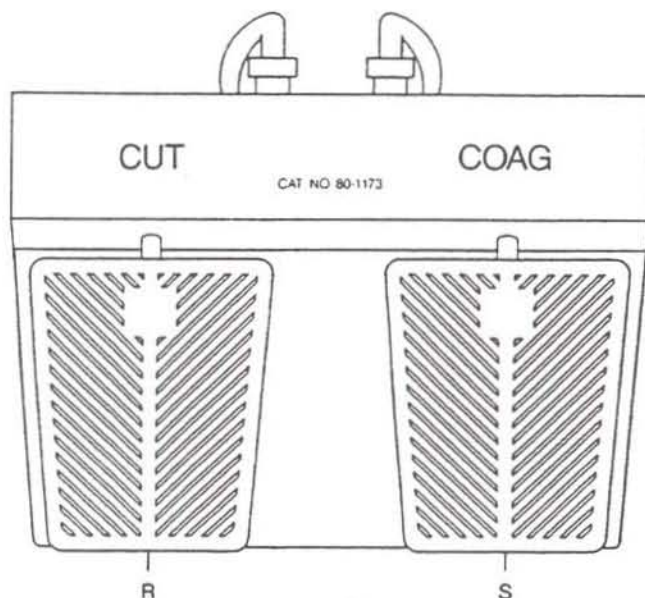


Figure 4. Pneumatic Footpedal Controls (Items R and S)

S. Coagulation Output Pedal

Coagulation power is delivered to the forceps when you depress this pedal. (The Coag button on the remote control, Item N as shown in Figure 3, also controls this function.)

NOTE: Cutting and coagulating power may also be controlled using the MALIS Bipedal Electric Footswitch (catalog no. 80-1149) connected to the CMC-III via the Adapter Cable (catalog no. 80-1179). Refer to the adapter cable instructions for details.

5.5 INDICATORS

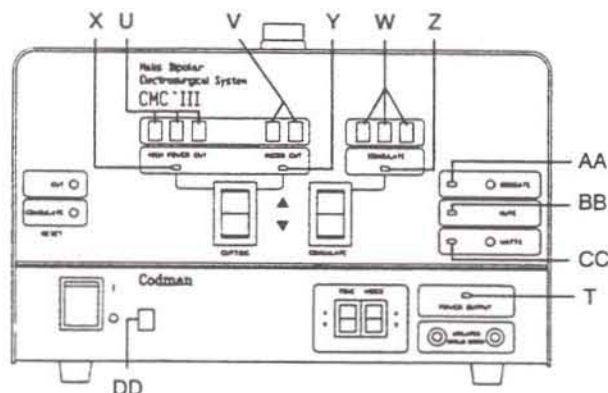


Figure 5. Front Panel Indicators (Items T through DD)

T. Power Output LED

This green LED illuminates whenever power of any kind, for either cutting or coagulation, is delivered to the forceps.

U-W. Power Display Windows

These three sets of windows show the power selections for high power cutting (Item U), microcutting (Item V), and coagulation (Item W). The power selections can be shown in either MALIS Units, or watts; use the Watts Display Button (Item I in Figure 1) to make your choice. When the genera-

tor is initially turned on, the setting "35" will appear in both the microcutting and coagulation windows. The high power cutting window will be blank. The following power settings are available for each operating mode.

POWER SETTINGS

COAGULATE		MICROCUTTING		HIGH POWER CUTTING	
Malis Units	Watts	Malis Units	Watts	Malis Units	Watts
8	0.7	8	0.7	60	20.0
10	1.0	10	1.0	70	40.0
15	1.6	15	1.6	80	60.0
20	3.0	20	3.0	90	80.0
25	5.0	25	5.0	100	100.0
30	7.0	30	7.0	110	120.0
35	9.0	35	9.0	120	140.0
40	11.0	40	11.0	130	160.0
45	14.0	45	14.0	140	180.0
50	17.0	50	17.0	150	200.0
60	19.0				
70	22.0				
80	24.0				
90	25.0				
100	29.0				
110	32.0				
120	35.0				
130	40.0				
140	45.0				
150	50.0				

X. High Power Cutting LED

This yellow LED illuminates whenever cutting power in the high range (60 to 150 MALIS units, or 20 to 200 watts) is delivered to the forceps.

Y. Microcutting Power LED

This yellow LED illuminates when cutting power in the micro range (8 to 50 MALIS Units, or 0.7 to 17 watts) is delivered to the forceps.

Z. Coagulation Power Light

This blue light illuminates whenever coagulation power is delivered to the forceps.

AA. Irrigation Mode LED

Irrigation is enabled when this green light is on and a MALIS Irrigator is properly connected. NOTE: To avoid unintentional irrigation, be sure the power on the Irrigator is switched off whenever the CMC-III generator is switched off.

BB. Mute LED

When you disable the voice synthesizer by using the voice mute button (Item J in Figure 2), this green LED lights up.

CC. Watts Display Indicator

If you choose watts to be displayed in the power indicator windows (Items U, V, and W, Figure 5) by pressing the watts display button (Item I, Figure 1), this green LED illuminates.

DD. Infrared Signal Receiver Window

This window receives signals from the remote control set. Do not obscure the window during use.

Tone Indicators (not shown)

The CMC-III generator produces a tone whenever power is delivered to the forceps. Two different tones are employed to differentiate between coagulation and cutting. A low frequency major chord indicates coagulation.

A higher frequency minor chord indicates cutting. You can control the volume of the tone indicator with the tone volume control (Item D in Figure 10).

Voice Indicator (not shown)

The voice indicator enables you to check or adjust the power setting and mode of operation without removing your eyes from the surgical site. As you change the power setting, the voice indicator announces each new setting. When you use the Cut switch (on either the remote control set or the footpedal) the voice announces either "Microcut" or "Cutting". It also announces the power setting before the generator delivers either cutting or coagulating power to the forceps. You can use the voice volume control (Item E in Figure 1) to change the volume of the voice.

In addition, the voice indicator functions as part of the self-diagnostic feature for the five conditions shown below.

"Internal Fuse"	Indicates an internal fuse must be replaced
"Memory Error"	Operating malfunction
"Error"	Indicates the two front panel power setting controls were pressed simultaneously
"Footpedal Error"	Indicates that both footpedals were pressed simultaneously
"Internal Power Error"	Operating malfunction

Refer to the Section 6.8, Troubleshooting Guide, for further information.

5.6 CONNECTIONS (Figures 6 and 7)

EE. Isolated Bipolar Output Jacks

These jacks accept the banana-type plugs of either the reusable or disposable bipolar cords.

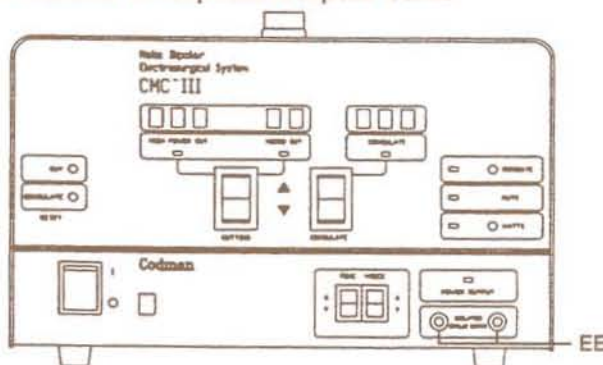


Figure 6. Front Panel Connections (Item EE)

FF. Pneumatic Footpedal Receptacle

Accepts the connector of the pneumatic footpedal.

GG. Irrigator Receptacle

You may plug the CMC-III Adapter Cable (catalog no. 80-1179) into the generator here to use the MALIS Irrigation Module (catalog no. 80-1164) and/or the MALIS Bipedal Electric Footswitch (catalog no. 80-1149) along with the CMC-III. Refer to the set up instructions in the manual supplied with the adapter cable for more information.

NOTE: To avoid unintentional irrigation, be sure the power on the Irrigation Module is switched to the OFF position whenever the power switch on the CMC-III generator is in the OFF position.

HH. Power Receptacle

This receptacle accepts the three-prong power cord plug and also contains the supply voltage selector and external fuses. (See Technical Specifications.)

II. Equipotential Connector

Use this terminal to connect a potential equalization conductor to a busbar in rooms where potential equalization is required.

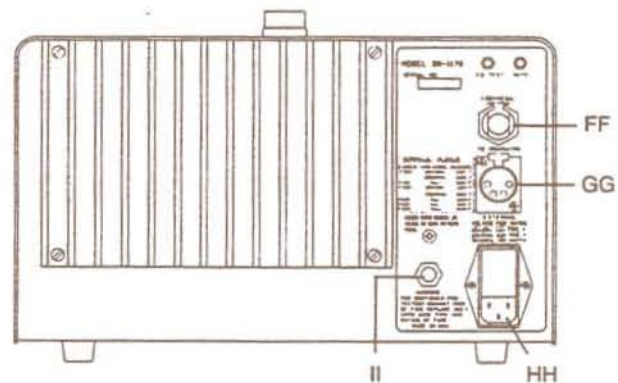


Figure 7. Back Panel Connections (Items FF through II)

6.0 TECHNICAL DESCRIPTION

6.1 PRINTED CIRCUIT BOARDS (PCBs)

6.1.1 Mother Board

The Mother Board consists of low voltage power supplies, an infrared remote control receiver, open circuit detector, pneumatic footswitches, tone, and voice volume control switches, RF output DC blocking capacitors, and all cardedge connectors necessary for joining the printed circuit boards.

6.1.2 Display Board

The Display Board consists of numeric Light Emitting Diode (LED) displays, single LEDs, pushbutton, and rocker-type switches.

6.1.3 Controller Board

The Controller Board houses an 8-bit RCA/HARRIS 1805 microprocessor (μ P). Also included are clocks, watchdog timer, clock synchronizer, and input/output (I/O) control (N-lines).

6.1.4 Sound Board

The Sound Board consists of a Digitalker™, EPROM, digital tone generators, steering logic, audio filters, amplifiers, and two electronic volume controls for voice and tones.

6.1.5 High Voltage Power Supply Board

The High Voltage Power Supply Board is an off-line switching-type power supply utilizing the flyback principle of voltage transfer and isolation from power line (mains) sources.

6.1.6 RF Power Amplifier Board

The RF Amplifier Board consists of a bridge-type RF amplifier, coagulation waveform generator, RF output steering, short circuit detection, and isolated bias supplies.

6.2 THEORY OF OPERATION

NOTE: Refer to each board's block diagram and schematic, Sections 8.0 and 9.0, respectively.

6.2.1 Mother Board

6.2.1.1 Low Voltage Power Supplies

Four low voltages are supplied on the mother board:

- (a) +5 VDC @ 2 Amps (regulated);
- (b) +15 VDC @ 1 Amp (regulated);
- (c) +18 VDC @ 1 Amp (unregulated); and,
- (d) -18 VDC @ 0.1 Amp (unregulated).

6.2.1.2 Infrared Remote Control Receiver

The Infrared Remote Control Receiver monitors activity from the infrared remote control handheld transmitter, and sends the serial data to the μ P for processing.

6.2.1.3 Pneumatic Footswitches

Air pressure from the cut and coag footpedals pressurize their respective air switches. Signals are sent to the μ P for processing.

6.2.1.4 Tone and Voice Volume Control Switches

The Tone and Voice Volume Control Switches are located on the front of the Mother Board, protruding through the front panel of the CMC-III. Signals from these switches are sent to the μ P for processing.

6.2.1.5 DC Blocking Capacitors

A capacitive DC block is inserted between the output of the RF Amplifier and the forceps to limit DC circulatory current that occurs during cutting or coagulating to prevent muscle tissue reaction.

6.2.1.6 Open Circuit Detector

The Open Circuit Detector circuitry is located primarily on the Mother Board, with interfacing elements on the RF Power Amplifier Board.

The open circuit detector helps prevent excessively high cutting voltage during periods of open forceps tips from breaking down components in the RF path. It also eliminates the occurrence of RF interference. This circuit is active only during the high power cut mode.

Operation is as follows:

A small (<3 V P-P) audio signal of approximately 20 Khz is generated by U602 in the form of a sine wave, buffered by Q600 and capacitor coupled to transformer T502 and C529. This is the 20KHZOUT signal. The primary of T502 and capacitor C529 form a parallel resonant circuit. Signal 20KHZIN is a path to a filter, buffer U603B, detector, and threshold comparator U603A. Providing there is essentially an open across the secondary winding of T502 (forceps open), the parallel resonant circuit acts to impede the flow of the 20 Khz sine wave from 20KHZOUT to 20 KHZIN. During this period of open forceps, U603A toggles on and asserts the PWRDIS signal to U503 on the RF Amplifier Board, thereby shutting off RF power. If the forceps should see resistance under 5000 ohms, the secondary winding of T502 acts to reflect this impedance back to the primary winding of T502 and lower the Q of the parallel resonant circuit, thereby allowing the 20 Khz sine wave to pass from 20 KHZOUT to 20 KHZIN. This signal level is detected by D600 and D601, causing comparator U603A to change state and allow the RF amplifier to operate.

Time delay is built into the detector circuit to allow continuous application of RF power during short periods of open circuit. After approximately 0.5 seconds of open circuit at the forceps, RF power is extinguished.

L504 and C530, on the RF Amplifier Board, is a series resonant circuit that acts to prevent the 1 Mhz RF power waveform from saturating T502 and interfering with the low level detection circuitry.

6.2.2 Display Board

6.2.2.1 Front Panel Numeric LEDs

LED101 through LED108 are driven by U101 through U108, respectively. Data from the 8-Bit Data Bus (DB{0..7}) are latched into U101-U108 from control signals supplied by U109, U110, and U111. The latched information is decoded (hexadecimal to 7 segments) and drives the numeric LED displays.

Steering logic, consisting of U109 through U111, supply control signals to U101 through U108. The N1 signal selects the most significant byte of the Cut and Coag displays, the decimal points used on the Microcut and Coag displays, as well as the two least significant bytes on the Cut, Microcut, and Coag displays.

The N1, N2, HPCUT, LPCUT, and COAG signals combine, respectively, to select the proper numeric LED display. The HPCUT, LPCUT, COAG, BLINK, and FTPDON signals combine to flash the selected numeric LED display when RF power output is requested.

6.2.2.2 Front Panel Single LEDs

The HPCUT, LPCUT, COAG, and FTPDON, signals are combined, selectively, to turn on the HPCUT, LPCUT, or COAG mode display LED/lamp. The FTPDON signal turns on the Generator LED when RF output power is requested. The MUTELED signal turns on the Mute LED when voice muting is requested. The IRGLED signal turns on the Irrigate LED when irrigation is requested. The WATTSLED signal turns on the Watts LED when the watts display mode is requested.

6.2.2.3 Front Panel Switches

The UP/DN signal is produced by the RF power control rocker switches, S101 and S102. The CUTSTRB signal is produced by the Cut RF power control switch, S101. The COAGSTRB signal is produced by the Coag RF power control switch, S102. The IRIGSW signal is produced by the Irrigator control switch, S103. The WATTSW signal is produced by the Watts switch, S104. The CUTRST signal is produced by the Cut Reset switch, S105. The COAGRST signal is produced by the Coag Reset switch, S106.

6.2.2.4 On-Card Signals

LPDP High going signal indicating selection of the microcut decimal point
CGDP High going signal indicating selection of the coag decimal point

6.2.3 Controller Board

6.2.3.1 Microprocessor

The microprocessor has an 8-bit bidirectional 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). An N-line decoder, U205, provides one-of-eight operation of I/O devices (N1 to N7).

6.2.3.2 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 2805 EEPROM (0.5k-bytes) and a 64-byte RAM in the μ P. Upper 8-bit addressing (of 16 bits) occurs during the Timing Pulse A (TPA) period, and is latched into U207 and U208. U201D and U233C provide enabling/disabling signals to all the memory devices to avoid conflicting with one another.

6.2.3.3 Clock Generator

The clock generator includes a stable 8 Mhz crystal and two ripple dividers, U202 and U203. Ripple dividing provides continual, phase coherent division from 4 Mhz to .25Hz in divide-by-two steps. Approximately eight taps are used by devices on the controller board.

6.2.3.4 Watchdog Timer

The watchdog timer, U206, provides a reset pulse to the μ P when one of the following occurs:

- (a) power up; or,
- (b) no signal to U206, pin 6, watchdog input (WDI) within 1 to 2.5 seconds, continually.

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

6.2.3.5 Clock Synchronizer

The μ P internal clock divider is synchronized with the external clock generator. A flip-flop, U231B, 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 μ P. When the watchdog timer signals a "clear" to both the synchro circuit (U231B) and the μ P, the rising edges of both the 4 Mhz and 500 KHz clocks are aligned and the μ P starts running synchronously with the master clock generator.

6.2.3.6 Select Out

Data to be output from the 8-bit data bus are latched into U212, U213, U214, and U215 when the N5, N6, MRD, and TPB signals are synchronous.

6.2.3.7 Select In

Data to be input to the 8-bit data bus are transmitted through U216, U217, U218, U219, U237, and U238 when the N3, N5, N6, and MWR signals are synchronous.

6.2.3.8 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 corresponds to 256 units of decimal data, as is 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 $\{N/256\} * \{4.75 \text{ VDC}\}$, with N=hexadecimal value input to DAC.

6.2.3.9 Randomizer Control

While pseudorandomization data (necessary for coagulation) is primarily maintained by a data table in the EPROM and controlled by the μP , U225 assists the μP by providing delays not otherwise obtainable by the μP itself. When N7 is asserted, data from the 8-bit data bus are loaded into an 8-bit binary down-counter, U225. U225 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 U225 is finished down-counting a given data byte, it signals the μP via the EF1 flag line input.

6.2.3.10 Coagulation Waveform Control

The coag waveform generator consists of two 8-bit shift registers, U226 and U227, wired together to form a 16-bit word. After receiving a start pulse to the Shift/Load input (pin 15) from the randomizer control, U226 and U227 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 U226 and U227. 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; | (e) 1.0 μs low; |
| (b) 0.5 μs high; | (f) 1.0 μs high; |
| (c) 1.5 μs low; | (g) 0.5 μs low. |
| (d) 1.0 μs high; | |

U226 and U227 are locked out during the cutting mode since they are not required.

6.2.3.11 8 Mhz Shifter

The coagulation waveform requires that the base frequency of 1 Mhz be shifted approximately $\pm 4\%$. The base waveform is synthesized with a phase-locked-loop (PLL), U228, whose voltage controlled oscillator (VCO) output is approximately 8 Mhz. The 8 Mhz from the VCO is divided down by U229 and fed back to one reference input of the PLL. The second reference input is connected to a 62.5 KHz reference clock. The U229 divider has been designed to divide at a ratio that provides a near 62.5 KHz output.

When the U229 divider ratio is changed and shifted by a 488 Hz clock, the output of the PLL VCO, U228, is 8 Mhz, $\pm 4\%$ 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. The 8 Mhz shifter circuit is locked to one frequency near 8 Mhz during the cutting mode.

6.2.3.12 1 Mhz Split-Phase Dead Zone Generator

The RF Power Amplifier bridge 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 U230A, U230B, and U231A to 1 Mhz. The outputs of U230A and U230B are ANDed together through U233D and delayed through U234A and U234B. They are combined (ORed) with the 1 Mhz and 1Mhz\ outputs of U231A through U232A and U232C 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.

6.2.3.13 On-Card Signals

EF1	Low going signal from the randomizer controller, U225, to external flag 1 input on μP
EF2	Low going signal from A to D converter to external flag 2 input on μP
ME\	Low going signal to μP indicating selection of internal 64 byte RAM
N4	I/O select of DAC or ADC
N5	I/O select
N6	I/O select
N7	Output select of randomizer controller
RLYDLY	High going signal, after delay, to control high voltage relay
TPA	High going signal from μP indicating selection of high order memory address bytes
TPB	High going signal from μP indicating selection of low order memory address bytes

6.2.4 Sound Board

6.2.4.1 Digitalker

The Digitalker, U301, is started by a write pulse to U301, pin 4, from N3 and simultaneous data from the 8-bit data bus. Information written to the Digitalker determines which word is to be selected from the word list. The word list is stored in the EPROM, U203. Digital voice audio from U301, pin 39, is buffered and filtered by U303.

6.2.4.2 Tone Generator

Tone generators consist of U305, U306, and U307. One tone, 390 Hz, is shared by both cut and coag modes. U305D determines which of the two other tone oscillators are used. The tones are squelched whenever there is no footpedal activity or the Digitalker is accessed.

6.2.4.3 Volume Control

U309 and U310 are electronic volume control devices. The TONEVOL and TALKVOL signals determine selection of either U309 (tone) or U310 (voice). The VOLUPDN signal determines the direction of volume: either up or down. The N3\ signal strobes U309 and U310 for volume control function. The outputs of U309 and U310 are fed to U304 for final amplification to the speaker.

The DLY signal provides a small time delay upon power-up to quiet down the Digitalker and tone generators. U301, pin 6, generates an interrupt to external flag line 3, EF3, of the μ P when the Digitalker is active.

6.2.5 High Voltage Power Supply Board

6.2.5.1 General

Relay K401 breaks both the AC and off-line DC voltages simultaneously for safety. A line voltage auto-switch mechanism is employed to select proper connection to either 100/120 or 220/240 VAC. Relay K400 has a 120 VAC coil connected across the primary of low voltage transformer, T701, so that when T701 is operated at 220/240 VAC, no AC voltage is presented to K400; and the diode bridge, DB400, operates as a full wave bridge rectifier. When T701 is operated at 100/120 VAC, K400 energizes and forces the diode bridge, DB400, and capacitors C401 and C402 to operate as a voltage doubler system. Relay K400 initially defaults to the 220/240 mode for safety. RT400 and RT401 provide inrush current limiting. R400 and R401 provide voltage balancing due to unequal leakage currents in C401 and C402. R402 provides a shorter discharge time for C401 and C402 when K401 is de-energized. Unloaded off-line voltage is approximately 330 VDC. High DC voltage monitoring is provided by opto-isolator U400. Two separate DC grounding systems are maintained: isolated for off-line; and earth, for post-off-line and chassis.

Unregulated high DC voltage is transferred from the off-line side (isolated) to the post-off-line side (earth ground referenced) via FET Q400 and flyback transformer T400. Q400 is controlled by pulse width modulation (PWM) controller, U403, and pulses T400 by PWM at 125 KHz. During Q400's off time, flyback energy is transferred from T400's primary to T400's isolated secondary winding. R404, R405, C403, and C404 comprise two snubber circuits to prevent destructive voltages from destroying Q400. Flyback energy is rectified by D402 and filtered by C405. Regulated DC voltage is now available to the RF Power Amplifier. R449 and C440 provide snubber protection for D402.

Input to the PWM controller, U403, is derived from several sources, and combined before being input to U403, pin 9. The purpose of U403 is to maintain voltage regulation from several volts to as much as 225 VDC.

DAC voltage (from the controller board) is first buffered by U404B, and then is applied to two locations: U404A and U401B.

6.2.5.2 Voltage Sensing

U401B compares DAC voltage and scaled down high DC voltage from C405. The resultant output signal from U401B, VCNTL, is applied to the data input on flip-flop U405A. VCNTL is combined with SYNC from the PWM controller, U403. The output of flip-flop U405A is then applied to U403, pin 9, the shutdown input. Scaled down high DC voltage that exceeds the DAC reference voltage causes shutdown of the PWM controller, U403. Synchronizing (SYNC) is used to preclude sporadic duty cycle pulses from occurring and causing premature shutdown of U403.

6.2.5.3 Current Sensing

DC pulse current through Q400 and T400 is isolated and monitored through current transformer, T401, and then applied to U401A. If peak current exceeds the reference set by the DAC voltage, the PWM controller, U403, is shutdown. Comparator U401A's trip point is modified by U404A. At DAC reference voltages up to 3 VDC, U404A acts linearly; above 3 VDC, U404A clamps. The purpose of this circuit is to prevent excessive high DC voltage overshoot during periods of light or no load while output DC voltages are less than 125 VDC. With DAC voltages above 3 VDC (greater than 125 VDC at the output), the overshoot problem is minimal.

Additional over-current protection is provided by U409. When current exceeds 10 amps at the output of the high voltage power supply, the PWM controller, U403, shuts down and a signal, SCMONI, is transmitted to the μ P for error control handling (error code 02). The purpose of this additional circuit is to prevent destruction of the power supply and RF Amplifier.

6.2.5.4 Isolated FET (Q400) Drive

The PWM controller's clock provides an isolated bias voltage for FET driver, U402. Clock signal, SYNC, drives U406, Q404, and T403. T403 provides isolation between off-line and post-off-line sides. The "A" drive signal from the output of U403 drives Q401, T402, U402, and FET Q400. T402 also provides isolation.

6.2.5.5 Normal Operation (Flyback Mode)

The flyback transformer, T400, operates in the discontinuous mode for light loads. That is, T400's primary current starts at zero, and secondary current drops to zero during each cycle. The flyback transformer operates in the continuous mode for heavier or transient load conditions. The continuous mode of operation is characterized by nonzero primary current at the start of each cycle, where the primary current immediately steps up, then ramps linearly (i.e., ramp on pedestal waveform).

6.2.5.6 On-Card Signals

ACIN_	120/240 VAC input to diode bridge
DACOUT	Buffered DAC output voltage
PWM	Pulse width modulated signal from PWM controller to power FET
SYNC	Buffered clock signal from PWM controller, U403
VCNTL	Signal from output of voltage sense comparator
+15V/ISO	Isolated 15 volt bias supply for power FET driver

6.2.6 RF Power Amplifier Board

6.2.6.1 RF Bridge Amplifier

The RF Bridge Amplifier is of the "H" bridge design. Each vertical half-leg of the "H" is an FET suitably driven at 1 Mhz. The drive signals are Q1Mhz and Q\1Mhz. (See description under Controller Board). Each alternate half-leg (i.e., top left/bottom right; bottom left/top right) is driven in phase. Voltage is supplied from the coag waveform generator to the top half-legs of the bridge amp (top left; top right), marked BRIDGE. The load, T501, is placed as the horizontal bridge across the middle of the two vertical elements.

6.2.6.2 Coag Waveform Generator

DC voltage to power the RF Bridge Amplifier is controlled by the coag waveform signal driving Q501. When in the cut mode, Q501 is fully saturated and allows pass-through of the voltage from the High Voltage Power Supply. During the coag mode, the coag waveform signal (see description in Controller Board) modulates the voltage supplied by the High Voltage Power Supply. The modulated DC voltage is filtered by L501, L502, L503, C508, and C509 into a decaying DC voltage waveform, thus forming the damped sinusoidal signal through the RF bridge amplifier. Cut-off of DC voltage to the RF bridge amplifier is provided by U503 and the PWRDIS signal under conditions of short and open circuit at the forceps.

6.2.6.3 RF Output Steering

The RF output transformer, T501, is prevented from saturating by a DC blocking capacitor, C528, in series with the primary winding. T501's secondary comprises two separate windings; one low impedance and one high impedance. Coag and low power cut modes are very low impedance (<20 ohms); high power cut is somewhat higher (<300 ohms). Switching secondary windings is controlled by relays K501, K502, and the CUTRLY signal. When required, the high power cut secondary winding is added in series with the coag/low power cut winding to achieve the desired higher impedance.

The high power cut winding added in series with the coag/low power cut winding, instead of a tap-type connection, limits the amount of high voltage energy generated in the high power cut winding when the coagulation mode is used. This excessive noise energy can create interference problems both inside and outside the metal case of the CMC-III. Further coag noise filtering is provided by a low pass filter consisting of L505, L506, L507, C531, and C532. The coag noise filter also provides proper matching between RF output transformer T501, the forceps cord, and biological loading at the forceps. Transformer T502 and L504, C529 and C530 are part of the Open Circuit Detector, and is explained in the Mother Board description.

6.2.6.4 Short Circuit Detection

Two short circuit detection circuits are used; one each for coag/low power cut and high power cut.

Current through the forceps is sensed by R525 for coag/low power cut, or R524 for high power cut. The sense current, in the form of a small voltage, is rectified, filtered, and detected by opto-isolators U513 or U515 when the threshold is exceeded. The outputs of U513 or U515 cause the one-shot timers in U514 to operate at 100 millisecond (ms) intervals as long as excessive short circuit current is present. The outputs of U514 are ORed together to form the signal PWRDIS. During the 100 ms period, voltage to the RF bridge amplifier is cut off. At the end of the 100 ms period, RF power is restored to test again for a shorted condition. This cycle continues until the short circuit is removed. The PWRDIS signal is also shared by the Open Circuit Detector. 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.

6.2.6.5 Isolated Bias Supplies

Isolated Bias Supplies of 7.5 VDC are required for the upper halves of the RF bridge amplifier and the coag waveform generator. These stages "float" with respect to earth ground when operating, and must have the Isolated Bias Supplies.

6.2.6.6 On-Card Signals

BRIDGE	Modulated DC voltage (during coag) from coag waveform generator filter to RF bridge amplifier
ISO+7V(n)	Isolated 7.5 VDC bias power supplies to RF bridge amplifier and coag waveform generator
ISOGND(n)	Isolated grounds of bias power supplies to RF bridge amplifier and coag waveform generator
PWRDIS	Signal from output of short circuit detectors to disable RF output

SCRES1	Short circuit current through R525 to input of coag/low power cut short circuit detector	IRRIG	Low going signal from I/O indicating selection of external irrigator
SCRES2	Short circuit current through R525 to input of coag/low power cut short circuit detector	LPCUT	High going signal from I/O indicating selection of low power cut mode
SCRES3	Short circuit current through R524 to input of high power cut short circuit detector	LT	Low going signal to Display board indicating selection of LED test mode
SCRES4	Short circuit current through R524 to input of high power cut short circuit detector	MRD	High going signal from μ P indicating a memory read function
		MUTELED	High going signal from I/O indicating selection of mute LED
		MUTESW	Low going signal to I/O indicating depression of the mute switch

6.3 MASTER LIST OF CARD CONNECTOR SIGNALS

A/DIN	0 to 5 VDC signal to the analog to digital converter (ADC)	MWR	High going signal from μ P indicating a memory write function
BLINK	1 Hz signal; 75% on, 25% off	NOHV	Low going signal to I/O indicating unregulated high voltage DC is present on the High Voltage Power Supply (HVPS) board
COAG	High going signal from I/O indicating selection of coag mode	N1-N2	Output select for displays on display board
COAGFTSW	Low going signal to I/O indicating depression of coag footswitch	N3	Output select for Digitalker and volume controls; input select for I/O
COAGRST	Low going signal to I/O indicating depression of the coag reset switch	OCMONI	Low going signal to I/O indicating an open forceps condition
COAGSTRB	Low going signal to I/O indicating selection of coag power switch	PWMON	Low going signal to HVPS indicating selection of pulse width modulator (PWM) IC to start output voltage supply to RFAMP
COAGWVFM	Digital signal to RF Power Amplifier (RFAMP) representing the coagulation waveform	PWRDIS	Additional low going signal from output of open circuit detector to RF AMP to disable RF output
CUTFTSW	Low going signal to I/O indicating depression of cut footswitch	Q1MHZ	Digital 1 Mhz signal with a 37% "on" duty cycle
CUTRST	Low going signal to I/O indicating depression of the cut reset switch	Q\1MHZ	Same as Q1MHZ, but 180° out of phase
CUTRLY	Low going signal from I/O indicating selection of high power cut winding of T501 via cut control relays	RFPWR1	RF output power to patient output jacks
CUTSTRB	Low going signal to I/O indicating selection of cut power switch	RFPWR2	RF output power to patient output jacks
DAC	0 to 5 VDC signal from the digital to analog converter (DAC) to the HVPS	SCMONI	Low going signal to I/O indicating an overcurrent condition on the HVPS
DB[0..7]	Bidirectional 8-Bit Data Bus	TALKVOL	Low going signal to volume controls on Sound board indicating selection of voice volume control
EF3	Low going signal from Digitalker to external flag 3 input on μ P	TONEDN	Low going signal to I/O indicating depression of the Tone Volume Down switch
FTPDON	High going signal from I/O indicating depression of any footpedal	TONEUP	Low going signal to I/O indicating depression of the Tone Volume Up switch
HPCUT	High going signal from I/O indicating selection of high power cut mode	TONEVOL	Low going signal to volume controls on Sound board indicating selection of tone volume control
HVRLY	Low going signal from I/O indicating selection of high voltage mains relay, located on the HVPS board	UP/DN	Signal to I/O indicating selection of cut or coag power control; high for up and low for down
IRIGLED	High going signal from I/O indicating selection of irrigate LED		
IRIGSW	Low going signal to I/O indicating depression of the irrigation switch		
IRRECV	Digital signal from infrared receiver to μ P		

VOICEDN	Low going signal to I/O indicating depression of the Voice Volume Down switch
VOICEUP	Low going signal to I/O indicating depression of the Voice Volume Up switch
VOLUPDN	Digital signal to volume controls on Sound board representing volume direction
WATTSLED	High going signal from I/O indicating selection of watts LED
WATTSW	Low going signal to I/O indicating depression of the Watts switch
20KHZIN	20 KHz (approximate) sine wave from output of open circuit detector filter
20KHZOUT	20 KHz (approximate) sine wave to input of open circuit detector filter
+200V	0 to 225 VDC @ 2 Amps from HVPS to RF AMP

6.4 TEST POINTS

Eleven test points are available to facilitate trouble shooting. All test pins are easily accessed at the top of the controller board on P203 (Figure 8). Activate test functions by grounding (momentarily or constantly, refer to each section for details) the appropriate pin. Note that some test points provide dual function capability.

6.4.1 Pin #1 Display Test/Power Up

Momentarily grounding this pin provides a complete, sequential test of all LEDs, lamps, and numeric LEDs. For Power Up, see 6.4.4, Calibrate On/Off.

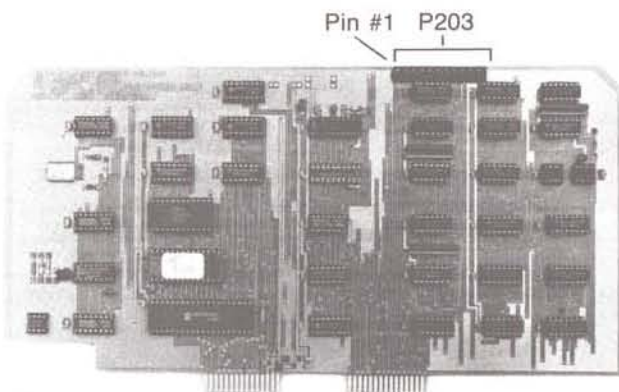


Figure 8. Controller Board Layout

6.4.2 Pin #2 Sound Test/Power Down

Momentarily grounding this point provides a complete, sequential test of all Digitalker words, tones, and voice/tone volume control functions. For Power Down, see Calibrate On/Off.

6.4.3 Pin #3 Deactivate PWM

Grounding this point turns off the PWM controller IC on the High Voltage Power Supply. The message "output power is off" announces and LED 201 turns on. This test mode allows full functioning of the CMC-III except for output power.

Its purpose is to zero out the high voltage available to the RF Power Amplifier. Unregulated high voltage DC, however, remains on the High Voltage Power Supply board and must be approached with caution. Removing the ground turns off LED 201 and the unit announces "output power is on".

6.4.4 Pin #4 Calibrate ON/OFF

Grounding this pin enables the calibration function by announcing "calibrate output power". Refer to Section 6.6, Calibration, for details.

6.4.5 Pin #5 Factory Profile

This test point can be activated only 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 announces "recycle memory" and reprograms the EEPROM. Transferring data is seen in the coag display. When finished, the unit announces "memory is correct" (assuming no EEPROM problems) and then reinitializes the CMC-III. With an error condition, the unit announces "internal memory error" and flashes "01" in the microcut display.

6.4.6 Pin #6 RAM Read

Grounding this test point causes an instantly calculated checksum of the EEPROM to be compared with the checksum stored within the EEPROM. The compared values show on the high power cut and coag displays. If the compared sums are equal, the unit announces "internal memory is correct." When this test point is ungrounded, the unit reinitializes.

6.4.7 Pin #7 Factory Test

Grounding this test point causes the unit to announce "internal power recycle on." This mode is available for factory use only. It is recommended that this test point NOT BE ACCESSED.

6.4.8 Pin #8 DAC Reference

Voltmeter test point. DAC reference input voltage should be 4.75 VDC, $\pm .05$ volts.

6.4.9 Pin #9 DAC Output

Voltmeter test point. DAC output voltage. When in calibrate mode, this voltage can be compared against the displayed DAC value shown on the numeric LED display. The DAC output voltage should be $[\text{DAC display}/255] * [\text{DAC reference voltage}]$.

6.4.10 Pin #10 ADC Input

Not used.

6.4.11 Pin #11 NOHV Bypass

Grounding this test point allows operation of the CMC-III with the High Voltage Power Supply board removed. It requires that the two High Voltage Power Supply board connectors, J403 and P404, be connected together to provide AC power to the low voltage power supply transformer, T701. This test point must be ungrounded for normal operation with the High Voltage Power Supply connected.

6.5 OPERATIONAL PERFORMANCE

The MALIS Bipolar Electrosurgical System CMC-III may be tested for operational performance using 50 ohm and 400 ohm noninductive test loads and RF ammeter or equivalent electrosurgical analyzer. A test set up in the accompanying figure shows typical values for each power setting. It should be noted that these are typical values and that output power may vary depending on line voltage, load resistor tolerances, and meter accuracy.

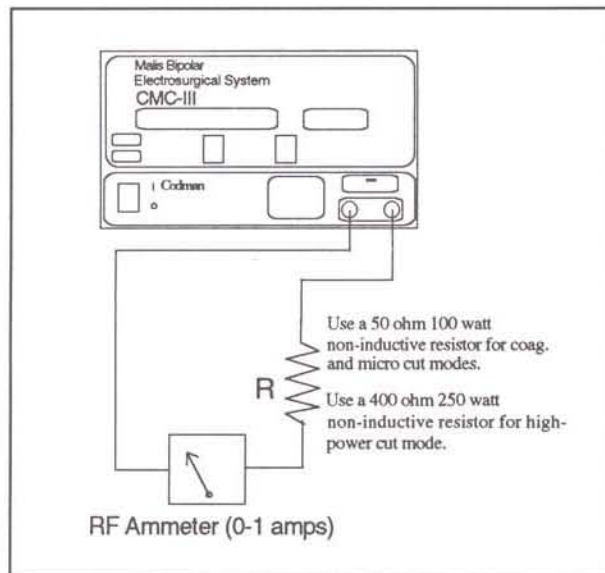


Figure 9. Test Set Up

Typical Output vs. Power Setting

(For reference only)				Coag. Output into 50 ohms	
Power Setting Mode		Output Current (RF amp)	Output Power (Watts)	Output Current (RF amp)	Output Power (Watts)
(Malis Units)	(Watts)				
8	- 0.7	0.12	0.72		
10	- 1.0	.15	1.1		
15	- 1.6	.18	1.6		
20	- 3.	.24	2.9		
25	- 5.	.32	5.1		
30	- 7.	.38	7.2		
35	- 9.	.43	9.3		
40	- 11.	.48	11.5		
45	- 14.	.53	14.1		
50	- 17.	.58	16.8		
60	- 19.	.62	19.2		
70	- 22.	.66	21.3		
80	- 24.	.69	23.3		
90	- 25.	0.71	25.2		
100	- 29.	0.76	28.9		
110	- 32.	0.80	32.0		
120	- 35.	0.84	35.3		
130	- 40.	0.89	39.6		
140	- 45.	0.95	45.1		
150	- 50.	1.00	50.0		

Cut Output

Power Setting Mode		Output Current (RF Amp)	Output Power (Watts)	
(Malis Units)	(Watts)			
Micro-Cut	8 - 0.7	.12	0.72	Into 50 Ohms
	10 - 1.0	.15	1.1	
	15 - 1.6	.18	1.6	
	20 - 3	.24	2.9	
	25 - 5	.32	5.1	
	30 - 7	.38	7.2	
	35 - 9	.43	9.3	
	40 - 11	.48	11.5	
Cut	45 - 14	.53	14.1	Into 400 Ohms
	50 - 17	.58	16.8	
	60 - 20	.62	20.0	
	70 - 40	.66	40.0	
	80 - 60	.69	60.0	
	90 - 80	.71	80.0	
	100 - 100	.76	100.00	
	110 - 120	.80	120.00	
Cut	120 - 140	.84	140.00	Into 400 Ohms
	130 - 160	.89	160.00	
	140 - 180	.95	180.00	
	150 - 200	1.00	200.00	

6.6 CALIBRATION

Any one, or all, of the CMC-III's 40 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 CMC-III in the calibration mode.

The calibration mode may be invoked by grounding pin 4 of P203 (refer to Section 6.4.4). With this pin grounded, the message "calibrate output power" announces, and two numbers appear on the front panel numeric LED windows. One of the numbers is the Malis Unit setting of the previously selected mode; the other corresponds to the setting's target DAC calibration value. The DAC value may be increased by momentarily grounding pin 1 of P203, or decreased by momentarily grounding pin 2 of P203 (as a safety precaution, DAC settings may be changed by no more than ± 15 steps from the original factory supplied settings).

The output power associated with a setting's new target DAC value may be confirmed by measuring the unit's output current as described in Section 6.5, Operational Performance. Note that the remote control is not functional during the calibration mode. Therefore, use the front panel rocker switches to change from one power output setting to the next, use the footpedal to activate the output.

If errors occur during calibration, or if the user wishes to restore the original factory set DAC targets, momentarily ground pin 5 of P203 to reload the standard DAC calibration values.

When calibration is complete, remove the ground from pin 4. The unit announces "calibration off" and then reinitializes at Malis Unit settings of 35 in both microcut and coagulate modes.

6.7 TECHNICAL SPECIFICATIONS

Power Requirements

100 \pm 10% VAC with 100 selected on the supply voltage selector
 120 \pm 10% VAC with 120 selected on the supply voltage selector
 220 \pm 10% VAC with 220 selected on the supply voltage selector
 240 \pm 10% VAC with 240 selected on the supply voltage selector
 50/60Hz 400 Watts

Fuses

External For 100 or 120 VAC operation:
 Two 4.0 Amp Type T (MDL) (125 VAC)
 For 220 or 240 VAC operation:
 Two 2.5 Amp Type T (MDL) (250 VAC)

Internal

Mother Board: Two (F600, F601) 3.0 Amp Type F (AGC) 250 VAC
 One (F602) 0.5 Amp Type F (AGC) 250 VAC

High Voltage Power

Supply Board: F400: 4.0 Amp Type T (MDL)
 250 VAC for 100/120V operation
 2.5 Amp Type T (MDL)
 250 VAC for 220/240V operation
 F401: 2.0 Amp Type F (AGC)
 250 VAC

F402: 1.0 Amp Type T (MDL)
 250 VAC for 220/240V operation
 0.6 Amp Type T (MDL)
 250 VAC for 220/240V operation

AC Leakage Current

Less than 10 μ A with power ON or OFF, polarity normal or reversed, with ground open or connected.

Output Waveforms

Coagulate: Damped Aperiodic, centered at 1 MHz
 Cut: Sinusoidal, 1 MHz

Output Power Range

Coagulate (20 settings) .72-50 watts into 50 ohm noninductive resistor load
 Micro Cut (10 settings) .72-16.8 watts into 50 ohm noninductive resistor load
 Cutting (10 settings) 20-200 watts into 400 ohm non-inductive resistor load

Output Setting Indications

Visual: Three-digit indicators, except micro cut, which is two-digit
 Aural: Voice annunciator (synthesizer)

Power Controls

AC: ON/OFF Switch
 RF Output: Panel mounted three-position rocker types

Panel Connectors

Bipolar: Two high voltage jacks

Cooling

Convection; no fan

Weight

21 lb. (10.4kg)

Dimensions

8 $\frac{1}{2}$ "H x 12 $\frac{3}{4}$ "W x 17"D inches
 21.6H x 32.4W x 43.2D centimeters

Minimum Operating Temperature

50°F (10°C)

Remote Control Power Source

Two 1.5v AAA alkaline batteries

6.8 TROUBLE SHOOTING GUIDE

Symptoms	Probable Cause	Correction
1. Unit does not operate (Power-on indicator light)	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
2. Low power output	a. Low line voltage b. Incorrect test load c. Internal calibration change	a. Adjust to 120, 220, or 240 volts nominal, as appropriate b. Use 50 ohm noninductive load for coag and microcut; 400 ohm for regular cut c. Return for service and recalibration
3. Erratic power output	a. Loose or dirty connections between forceps cord and jacks b. Intermittent break in forceps cord	a. Gently clean plug surfaces with abrasive cloth b. Replace forceps cord
4. No power output	a. Broken wire in forceps cord	a. Replace forceps cord
5. Excessive leakage current	a. Shorted output transformer	a. Check for shorting to core case. Return for service and recalibration
6. Excessive power output	a. Internal calibration change	a. Return for service and recalibration
7. Voice indicator announces "Internal fuse". Power Setting Display flashes "00"	a. Blown internal fuse	a. Replace internal fuse
8. Voice indicator announces "Memory error"	a. Operating malfunction	a. Return for service
9. Voice indicator announces "Error"	a. Two front panel setting controls pressed simultaneously	a. Use care when pressing controls
10. Voice indicator announces "Footpedal error"	a. Two footpedals pressed simultaneously	a. Use care when depressing footpedal
11. Voice indicator announces "Internal power error"	a. Operating malfunction	a. Return for service

7.0 REPLACING INTERNAL FUSES

Significant changes in the supply voltage setting, such as from 110/120V to 220/240V, require a change in two internal fuses. Fuses F400 and F402 are located on the power supply board. Figure 10 shows the location of the power supply board in the CMC-III chassis.

1. Disconnect the generator from the power supply.
2. Remove the six Phillips head screws and washers holding the cover in place. Remove the cover.
3. Remove the Phillips head screw (Item A in Figure 10) that holds the power supply board to the metal bracket.

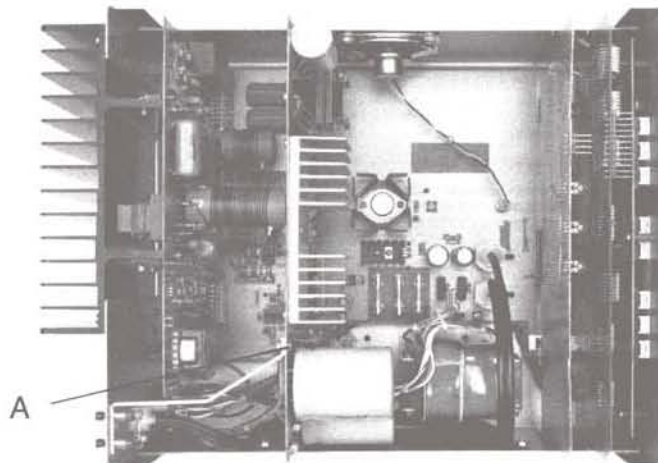


Figure 10. Power Supply Board

4. Firmly pull the power supply board upward until it can be disengaged from the card holders on either side. Do not attempt to pull the board completely out of the chassis; it is still connected via the supply voltage wiring.

5. Remove fuses F400 and F402 (see Figure 11); replace with appropriate type and value fuses (see Section 6.7, Technical Specifications).

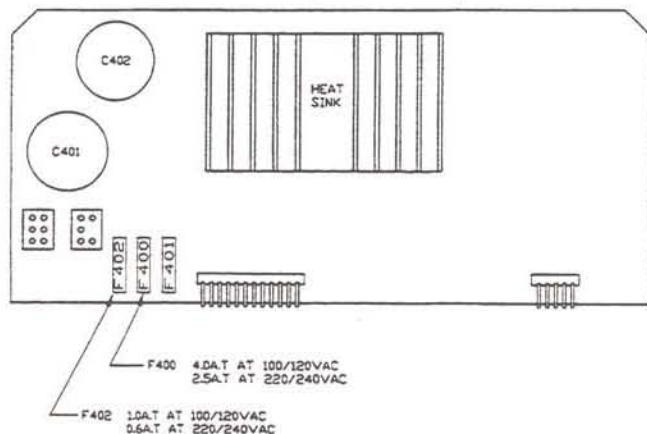


Figure 11. Changing Internal Fuses on Power Supply Board

6. Slide the board back into the card holders, ensuring the pins on the bottom of the board align with their connectors. Push the board down firmly until the pins seat properly in the connectors.

7. Replace the screw holding the board to the bracket. Replace the cover and six screws and washers.

WARNING: The supply power setting drum, located on the power receptacle at the rear of the generator, must also be set to the correct voltage and properly fused for the electrical outlet before turning on the generator.

8.0 MAINTENANCE

8.1 Bipolar Forceps

Proper care and maintenance of the bipolar forceps is essential to efficient cutting and coagulation. Dr. Malis states the following:

"While some sticking and charring of the bipolar cutting and coagulation forceps is unavoidable, the elimination of the initial overvoltage spike in the MALIS CMC-III waveform greatly reduces the incidence of sticking and charring. Coupled with additional waveform modifications, the MALIS CMC-III can be used with less irrigation (or no irrigation at all, if required) while reducing sticking and charring to levels lower than heavily-irrigated spark gap and solid state generators. Because the generator is effective at lower settings, pitting of the forceps tips which normally occurs is greatly reduced."

Remove coagulum deposits as often as necessary to keep working surfaces clean. This ensures the flow of current between forceps tips. We recommend Johnson & Johnson Medical's Electro-Surgical Tip

Cleaner (J&J Medical catalog no. 3415). If tips become pitted or misaligned, return the forceps to Codman Repair Service 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 isolated bipolar output jacks on the generator. Badly oxidized surfaces impede current flow. Use an abrasive cloth to gently clean plug surfaces. Inspect the bipolar cord before each use; replace it upon evidence of deterioration.

NOTE: Pulling plugs from the jacks of the MALIS CMC-III by grasping the cord may 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 Pneumatic Footpedal

Storing the pneumatic footpedal with the pneumatic tubing tightly wrapped around it may damage the tubing. Leave sufficient slack to prevent stress on the tubing. Inspect the tubing before each use and replace the footpedal upon evidence of deterioration.

8.4 Electric Footswitch

Storing the electric footswitch with the footswitch cord tightly wrapped around it may result in damage to the cord. Leave sufficient slack to prevent stress on the cord.

NOTE: DO NOT IMMERSE the footswitch in liquids during use. The pedals should operate freely with a positive mechanical action.

Inspect the footswitch cord before use for deterioration. Do not operate if the vinyl cover is damaged. The vinyl covered footswitch is not a repairable item. Replace the footswitch assembly as supplied by the manufacturer.

8.5 Power Cord

Never use extension cords, three-prong to two-prong power plug adaptors, or extra length power cords with the MALIS CMC-III. 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.

8.6 Remote Control

The remote control uses two 1.5v AA alkaline batteries. To open the battery compartment, press down on the lower portion of the remote's rear cover and slide it down. Remove the old batteries. Insert new batteries as illustrated within the compartment. Slide cover back on until it snaps into position.

9.0 ROUTINE CLEANING

The MALIS CMC-III generator cabinet may be cleaned 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 MALIS CMC-III generator or remote control in any liquid. Subjecting the generator to excessive moisture may damage the electronic components and violate the warranty.

The CMC-III footpedal may be washed with normally used hospital cleaning liquids. Do not allow liquid to enter the white plastic footpedal connector.

10.0 STERILIZATION

Never sterilize the MALIS CMC-III generator, pneumatic footpedal, electric footswitch, remote control, or connecting cable. Place the remote into a sterile plastic bag similar to those supplied for operating room cameras.

The Integrated Irrigation Tubing and Cord Set is a single-use device, sold sterile. Do not resterilize.

11.0 BLOCK DIAGRAMS