THYMATRON® System IV
SERVICE MANUAL

WARNING:
THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING UNLESS YOU ARE QUALIFIED TO DO SO.

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Check our website at least once a year for updated User's Manual and Service Manual. Downloads are available there.

Technical Support, USA and Canada: +1-800-642-6761
Telephone: +1-847-234-6761 Fax: +1-847-234-6763
E-Mail: sales@thymatron.com Web Site: www.thymatron.com

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Class 1, Type BF

 Is the International symbol for ***Type BF*** and Defibrillator protected.

 Is the International symbol for **CAUTION !**

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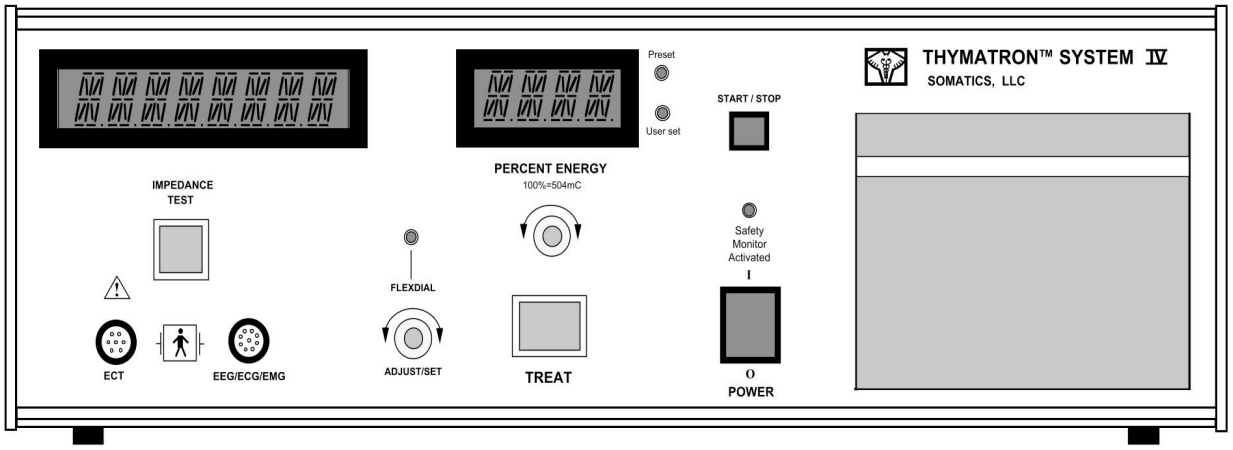
fig. 1.1


THYMATRON™ SYSTEM IV
SOMATICS, LLC
Preset
User set
START / STOP
PERCENT ENERGY
100%=504mC
IMPEDANCE TEST
FLEXDIAL
Safety Monitor Activated
I
O
POWER
ECT
EEG/ECG/EMG
ADJUST/SET
TREAT

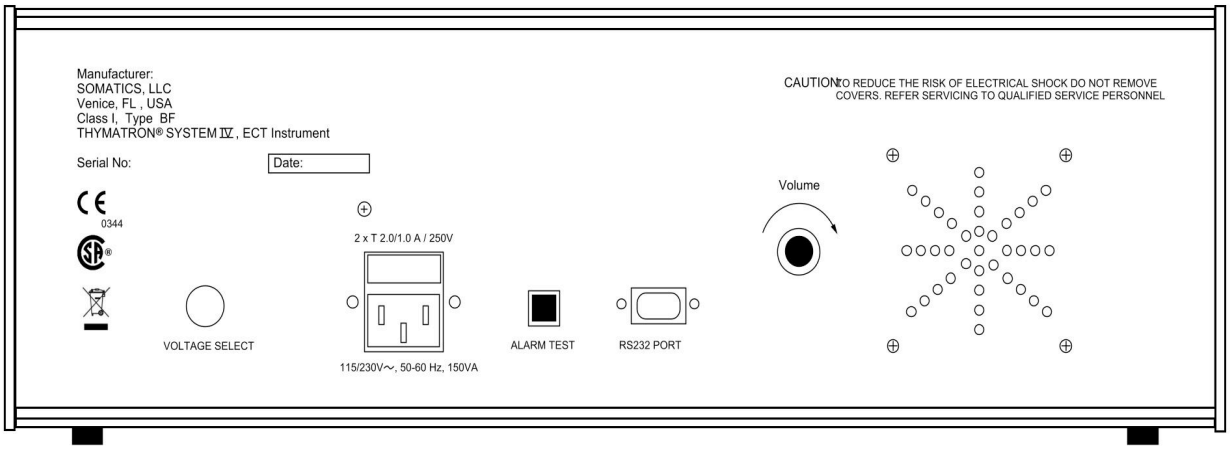

Manufacturer:
SOMATICS, LLC
Venice, FL , USA
Class I, Type BF
THYMATRON® SYSTEM IV , ECT Instrument
Serial No:
Date:
CAUTION: TO REDUCE THE RISK OF ELECTRICAL SHOCK DO NOT REMOVE COVERS. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL
0344
2 x T 2.0/1.0 A / 250V
Volume
VOLTAGE SELECT
115/230V~, 50-60 Hz, 150VA
ALARM TEST
RS232 PORT

fig. 1.2

1. EXPLANATIONS OF OPERATING CONTROLS

FRONT PANEL
See fig. 1.1

1.1 POWER SWITCH

The power switch is an alternate position switch. When activated it connects both the hot and the neutral into the power circuits.

1.2 IMPEDANCE SWITCH

The impedance switch is a momentary switch. When depressed, it signals the processor to start the impedance test sequence. After a second, an impedance readout is displayed. The display is on for the duration of the switch activation.

1.3 IMPEDANCE/TIME READOUT

The impedance readout is an 8 digit alphanumeric LED (Light Emitting Display) which indicates the impedance of the stimulus electrodes when the impedance test switch is depressed. If the impedance is over 3000 Ohms the display blinks. After the treatment is delivered the same 8 digit LED is used to display time elapsed since the end of treatment. It is also used during the Flexdial setup mode to alter parameters.

1.4 PERCENT ENERGY READOUT

The percent energy readout is a 4 digit alphanumeric LED (Light Emitting Display) which indicates the setting of the energy dial. It is also used to indicate the treatment program that is being used.

1.5 DOSAGE ADJUSTMENT DIAL

The dosage adjustment dial sets the number of pulses in the stimulus pulse train. It's a continuously rotating optical encoder. In the default program setting of LOW 0.5 the lowest setting gives 28 pulses. Each increase in the setting of the dial adds 28 more pulses to the stimulus. The maximum setting is 560 pulses. The dial is calibrated in PERCENT ENERGY of its maximum for ease of use. After each change there is 1 second display of the millicoulomb value before the display returns to the percent display. If the dial is pressed the display will indicate the treatment program that is being used.

1.6 TREAT SWITCH

The TREAT switch is a momentary switch which controls the delivery of the stimulus. It has a special protective cover which prevents accidental activation. As an additional safety feature there is a one second warning tone before the stimulus begins whenever the TREAT button is depressed. The yellow indicator light inside the button lights up only when the electrical stimulus is being delivered. The switch must be depressed for the duration of the stimulus. The delivery of the stimulus is indicated by the TREAT button light and a warbling sound. If the button is released, the stimulus will be immediately terminated.

1.7 ECT CABLE JACK

The ECT cable jack is a keyed round 7 pin plastic lock connector. The ECT cable plug is connected to this jack.

1.8 EEG/EKG CABLE JACK

The EEG/EKG cable jack is a keyed round 9 pin plastic lock connector. The EEG/EKG cable plug is connected to this jack.

1.9 FLEXDIAL

The Flexdial enables the user to change all parameters by pressing and turning the dial and following the attached flow diagram. The settings are remembered in the battery-backed RAM. The Flexdial LED blinks whenever the user enters the Flexdial mode. To exit, press the START/STOP button.

1.10 START/STOP BUTTON

START/STOP button is used to control the operation of the printer. Pressing the button will start the printer; another press will stop it. It is also used to terminate the Flexdial mode. When the Flexdial mode is exited with the START/STOP button the system will printout all the parameters.

1.11 100 MM THERMAL PRINTER

The printer is used to print out all graphic and alphanumeric data. I uses 100 mm fanfold paper. To open the paper storage press the tab above the printer roller.

1.12 PRESET AND USER SET LED

Whenever the system is in the factory preset mode the PRESET LED is on. If the user sets any treatment parameter to a setting different from the preset the USER SET LED is lit.

1.13 SAFETY MONITOR ACTIVATED LED

A separate safety monitoring microprocessor is used to monitor the output. It reads the energy level and if the level is exceeded by 20% it trips an audio alarm and sets off the LED. It also disables the output. The only way to reset this is to turn off the system.

REAR PANEL
See fig. 1.2

1.20 VOLUME KNOB

The volume knob controls the volume of the EEG activity tone. Clockwise direction increases the volume. If the EEG audio channel is not being used turn the knob all the way counter-clockwise for no sound. This knob does not control the stimulus warning tone or the stimulus delivery tone, both of which are factory preset.

1.21 RS232 CONNECTOR

A 9 pin miniature connector is used to connect the system to an external PC. It enables the user to download data and upload the name of the institution. It can also be used to upload previously downloaded data for reprint. It's best to use a battery powered portable PC; if a desktop is used make sure it's properly isolated.

1.23 LINE FUSES

For 115V lines this instrument uses two 2.0 amp 250V T type 5x25 mm fuses.
For 230V lines this instrument uses two 1.0 amp 250V T type 5x25 mm fuses.
Do not replace with a different type of fuse.

1.24 IEC POWER CONNECTOR

Use the cable supplied and plug this instrument only into a well grounded three prong receptacle, making sure you select the correct input voltage.

1.25 INPUT VOLTAGE SELECTOR

Use the selector to choose between 115V and 230 volts. Use a screwdriver to align the arrow with the desired voltage. Remember to use the correct fuses.

1.26 ALARM TEST BUTTON

Alarm test button is used to test the independent output monitor. Depressing the Alarm Test button before a test treatment will cause the system to add additional 5% to the treatment total and the alarm system should set off. To perform this test you must use a dummy load (200 ohms, 10 watts resistor).

CAUTION: Never use a two prong power adapter as it is unsafe.

2. SAFETY CHECK PROCEDURE

NOTE: THIS PROCEDURE SHOULD BE PERFORMED AT LEAST ONCE A YEAR

2.1 Upon unpacking check for any frayed or damaged cord or cable.

2.2 Check for ground continuity by connecting a DMM between the ground contact on the power plug and any convenient ground on the chassis e.g. screw or connector. The reading should be below 1 ohm.

2.3 Check for isolation of the ECT electrodes by measuring the resistance between either of the ECT electrodes and the ground. The reading should be greater than 20 Megohms.

2.4 Check AC leakage by using a commercial leakage tester or by using a test box constructed so as to permit disconnecting ground, neutral and reversing AC polarity as in figure 2.1. Test leakage under any combination of the switch settings. All current readings should be less than the maximum reading in µamps RMS read according to chart below between any chassis or electrode point and the test box.

Leakage to Ground (Source)

GROUND	POWER	POLARITY	LEAKAGE (µA)
ON	ON	Normal	_____ (<1.0)
ON	ON	Reverse	_____ (<1.0)
ON	OFF	Reverse	_____ (<1.0)
ON	OFF	Normal	_____ (<1.0)
OFF	ON	Normal	_____ (<100)
OFF	ON	Reverse	_____ (<100)
OFF	OFF	Reverse	_____ (<100)
OFF	OFF	Normal	_____ (<100)

Leakage to Patient (Sink), use the isolated voltage source in series with the probe.

GROUND	POWER	POLARITY	LEAKAGE (µA)
ON	ON	Normal	_____ (<20)

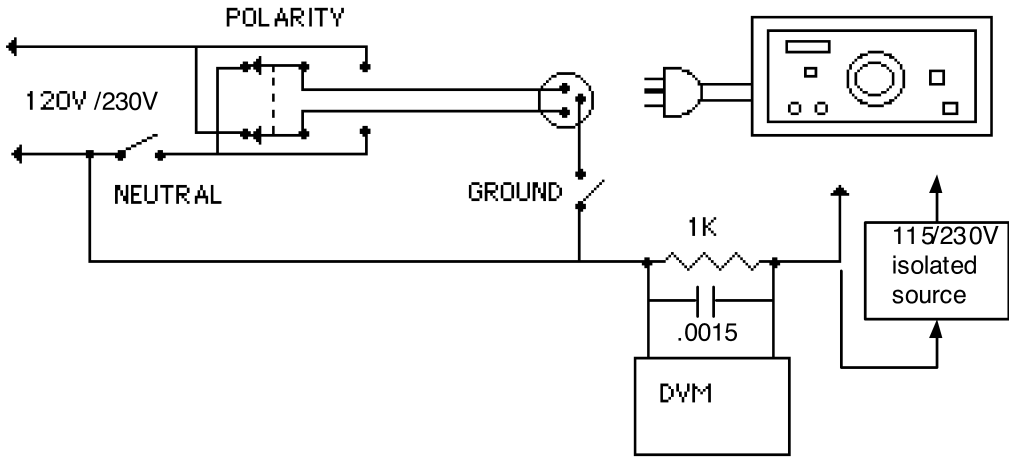


Fig 2.1

3. CALIBRATION CHECK

NOTE: THIS DEVICE SHOULD BE CHECKED FOR CALIBRATION AT LEAST ONCE A YEAR

3.1 Connect DUMMY LOAD (200 ohms 10W resistor) to the ECT banana plugs. See Fig. 3.1

fig. 3.1

3.2 Connect Oscilloscope across the dummy load. Be sure the scope can measure up to 500 volts. If not, construct a high impedance divider such as in fig. 3.2.

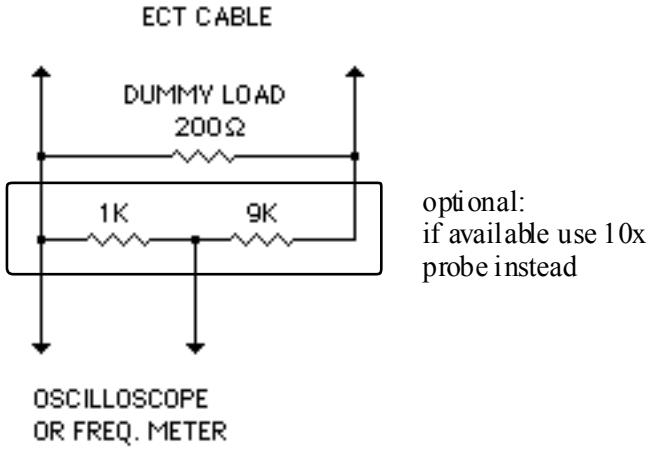


fig. 3.2

⚠ CAUTION: HIGH VOLTAGES ARE PRESENT DURING TESTING. EXERCISE CAUTION TO PREVENT INJURY.

3.3 TEST CURRENT OUTPUT

Set oscilloscope vertical deflection to 50V/div (5V/div when using the divider), horizontal deflection to 0.5 msec/div. Set trigger for positive phase. Turn power on. Make sure the system is in default setting. The program should be in LOW 0.5. Set PERCENT ENERGY dial to 100% and push TREAT button. Observe wave shape as in figure 3.3. Peak voltage reading should be 180 Volts ±7.5% which corresponds to 900 ma at 200 ohms. For other loads wave shapes see fig.3.4

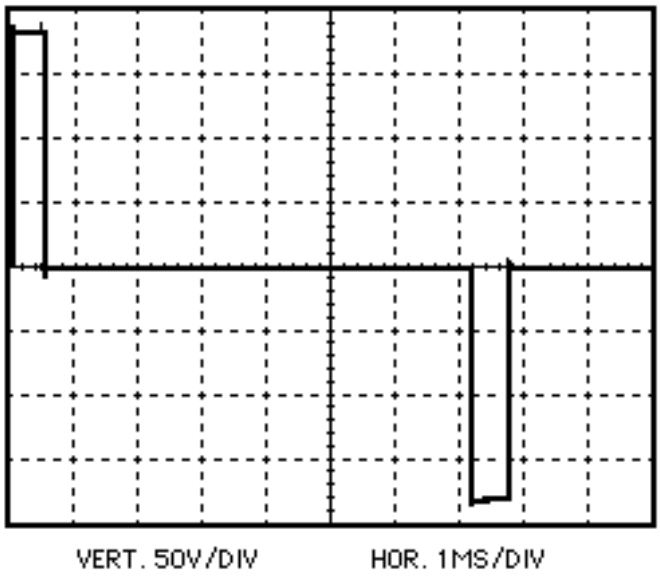
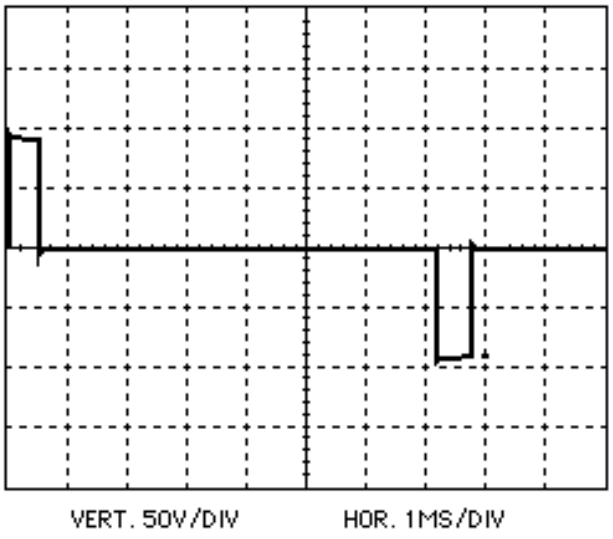
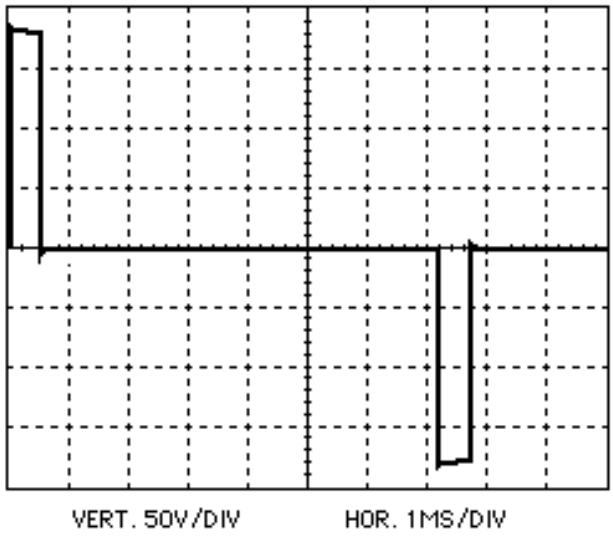


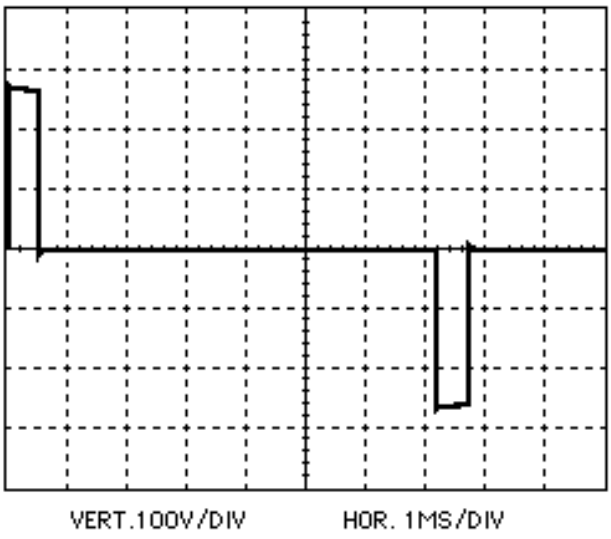
fig 3.3



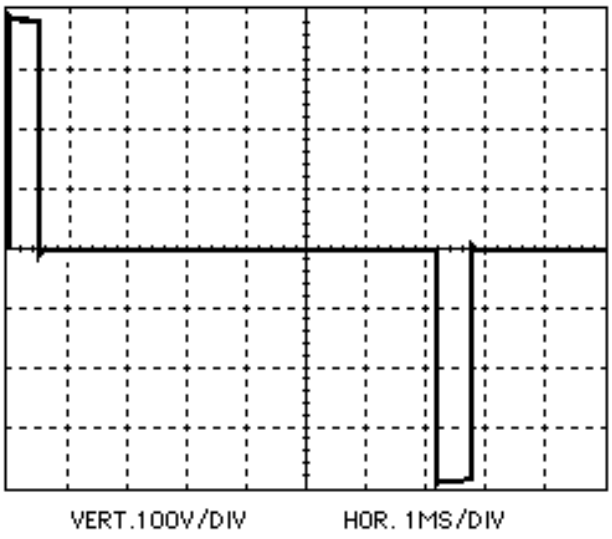
LOAD=100 OHMS



LOAD=200 OHMS



LOAD=300 OHMS



LOAD=500 OHMS

fig3.4

3.4 TEST PULSE WIDTH

Change horizontal deflection to 100 µsec/div and push TREAT button. Observe wave shape such as in fig. 3.5. The pulse width should be 0.5 msec ±5% from the start of the rising edge to the start of the falling edge of the pulse.

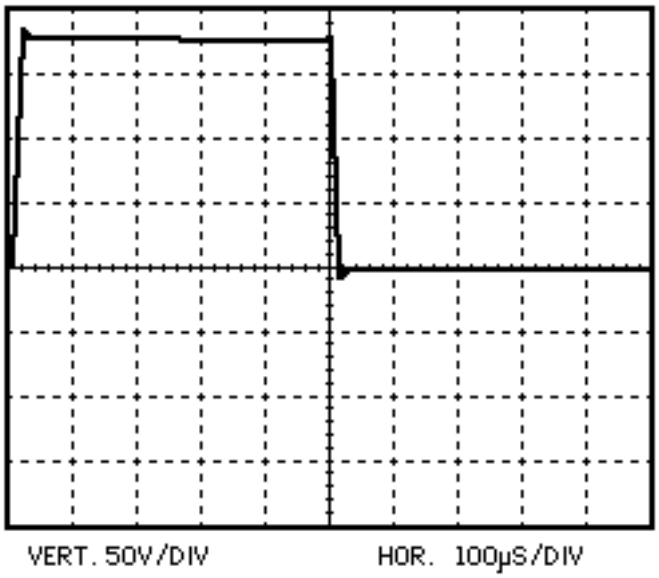


fig 3.5

3.5 TEST PULSE FREQUENCY

Connect a frequency counter to the dummy load divider as in fig. 3.2. Set up proper triggering. Make sure the overshoot does not double trigger the counter. Set the counter to period measure. Set PERCENT ENERGY dial to 100% and press TREAT button. The reading should be 14.28 msec ± 5% which corresponds to 70 Hz. Set PERCENT ENERGY dial to 50% and press TREAT button. The reading should be 25.00 msec ± 5% which corresponds to 40 Hz. Set PERCENT ENERGY dial to 20% and press TREAT button. The reading should be 50.0 msec ± 5% which corresponds to 20 Hz.

3.6 TEST STIMULUS DURATION

There are two ways to test stimulus duration. The more precise way uses an event counter (many frequency counters are capable of event counting). The less precise way uses an oscilloscope.

A) Connect an event counter across the dummy load (using the divider) and set to trigger properly. Make sure the overshoot does not double trigger the counter. Set PERCENT ENERGY dial to an appropriate setting and press the TREAT button. Note the counter reading and check for correspondence to table 3.1. Repeat procedure for rest of the settings.

dial set	read	dial set	read
5	28	10	56
15	84	20	112
25	140	30	168
35	196	40	224
45	252	50	280
55	308	60	336
65	364	70	392
75	420	80	448
85	476	90	504
95	532	100	560

table 3.1

B) Connect oscilloscope across the dummy load. Set vertical deflection to 50 v/div and horizontal deflection to 1.0 sec/div. Set proper trigger. Set PERCENT ENERGY dial to 100% and push the TREAT button. The duration of the stimulus should be 8 seconds as in fig. 3.6.

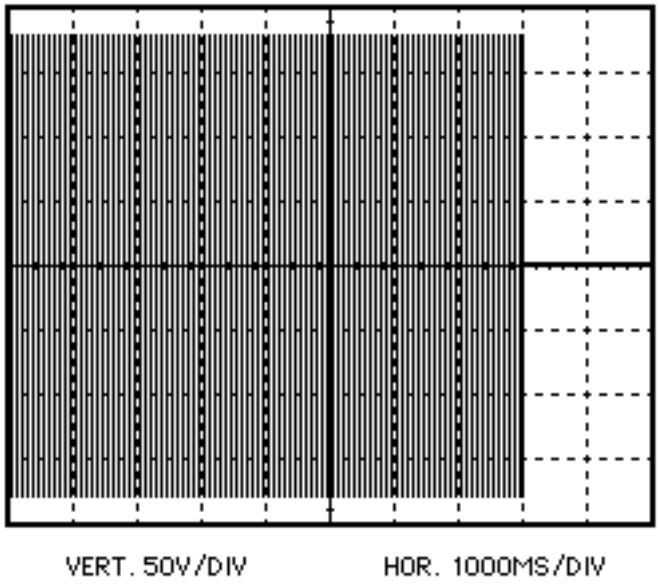


fig. 3.6

3.7 IMPEDANCE TEST

Connect a variable resistor box to the ECT stimulus cable. Set on zero ohms and push the impedance test button the readout should be 0_ ±100_. Repeat for 1000_ and 2000_. At impedances higher than 3000 _ the display will read >3000 and blink.

⚠ **CAUTION:** DO NOT PRESS THE TREAT BUTTON DURING THIS TEST. THE LARGE POWER OUTPUT COULD DESTROY YOUR RESISTANCE BOX.

3.8 CHANNEL 1-4 EEG AMPLIFIER GAIN TEST

Connect an oscillator through an 80db divider into the electrode inputs of the channel 1-4 amplifier according to fig. 3.7. Make sure the gain of the amplifiers is set at 200μv/cm. Adjust output of oscillator to 10 Hz and 2.0 volts p-p sinewave. Turn on THYMATRON®IV and note the EEG output should be 1 cm p-p sinewave on the printout. Check for 3db points by setting frequency to 1 Hz and then to 25 Hz and note 3 db drop in amplitude.

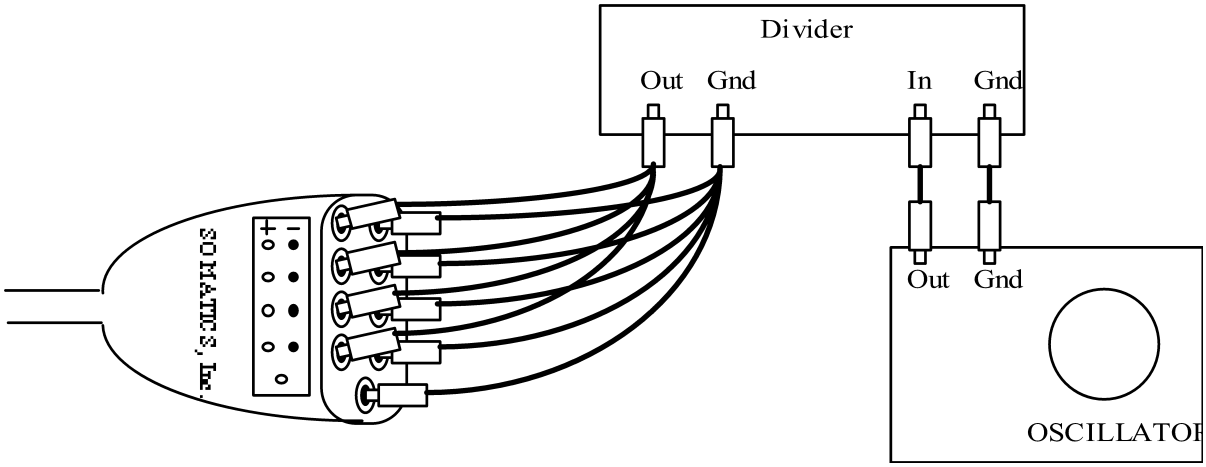


fig. 3.7

3.9 EEG AMPLIFIER NOISE TEST

Connect three 5K_ resistors into the electrode input of the EEG amplifier according to fig. 3.8. With the oscilloscope connected to the EEG output jack, note that output noise is no more than 50 mv (equivalent to 5μv at the input).

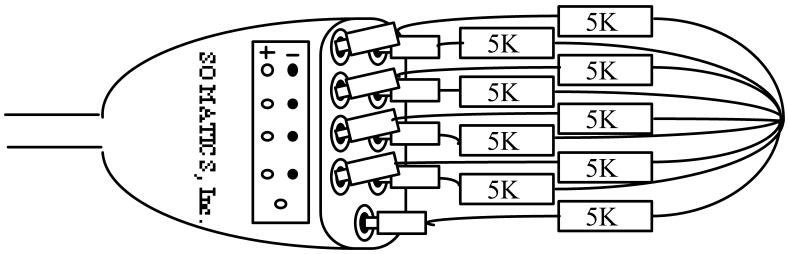


fig. 3.8

3.10 EEG AMPLIFIER SOUND TEST

With oscillator and oscilloscope connected, connect dummy load to the ECT output. Turn THYMATRON®IV on and press TREAT button. Right after the stimulus is delivered a modulated sound should be heard from the speaker. The volume knob on the back may be adjusted. Vary the frequency and amplitude of the oscillator and note the changes in the sound.

4. THEORY OF OPERATION

General Description

The internal circuitry is contained on 4 PC boards and one printer module. These are:

4.1. Analog board
4.2. Control board
4.3. Power/ Output board
4.4. Display board
4.5. Printer module

See fig. 4.1 for Interconnection diagram.

4.1. Analog board

The analog board consists of EEG channel 1 and 2 amplifiers, EEG/EMG channel 3 amplifier, EEG/ECG channel 4 amplifier. isolation power supply, sound circuitry, impedance circuitry, output measurement circuitry, 13 bit serial A/D, optical isolators, microcontroller to move data between the main CPU and A/D, and two output protection monitor microcontrollers.

The analog channels consist of input overvoltage protection circuitry connected to an instrumentation amps. The signal is then amplified with two stages of amplification for total of x4000. The next stage is a three pole low pass filter set at 50 Hz as well as level shifter for the A/D.

A/D is a 13 bit serial A/D with 8 channel input. Channels 1-4 are the biological signals from the patient, channels 5-7 are impedance and output measurement channels. The digital data from and to the A/D are isolated with a high speed optical isolators. An isolated power supply provided ±5 V from the 5V power.

The impedance measurement is derived by injecting 6 μamp current into the treatment electrodes and using an isolated differential amplifier to amplify the difference voltage which is proportional to the impedance of the electrodes. A safety relay is added in the ECT path. This relay is controlled by the treat switch and one of the two safety monitors and is a backup safety system for patient disconnect in case of primary failure.

The output current and voltage measurements are achieved by using two isolating transformers that isolate the signals from the output and which are then amplified and coupled to the A/D.

The microcontroller is connected to the main bus via a slave port and is used to serially control the A/D as well as to pass data from the A/D. It also generates the impedance source signal and the EEG sound signal as well as the warning sounds.

The sound system consists of a 3" speaker and a volume potentiometer mounted on the rear panel. The amplifier sums up the various sources of warning signals as well as the EEG modulated sound. The EEG sound is the only one that can be controlled by the

volume control and is only active after the end of the treatment and until the START/STOP button is pressed.

The two output monitors are identical duplicates of each other. They monitor the output during the treatment and if the output charge value exceeds the preset by 15% they shut off the treatment delivery by releasing the relay as well as blocking the treatment pulses and they also sound the alarm and activate the "Safety monitor LED".

4.2. Control board

The control board contains the CPU and other digital circuitry such as DRAM and EPROM. A static memory chip combined with battery backed clock is used for real time clock and for parameter backup. Two crystal oscillators provides timing signals, one is running at 16.67 MHz and is used for 32 bit 68306 CPU clock and for the safety monitoring and peripheral PIC microcontrollers, the other is an 3.58 MHz and is used for timing of the pulses and data collection. All address and data lines are buffered.

4.3. Power/ Output board

The power/output board contains DC power supplies and the ECT output drive.
There are three power supplies.
a. The 5V power supply provides power for all digital and analog circuitry and for the digital circuitry on the printer.
b. The +24V power supply provides power for the positive half of the ECT output drivers and for motor and thermal head of the printer.
c. The -24V power supply provides power for the negative half of the ECT output drivers.
Each supply is individually protected by a fuse.
The ECT output section contains the constant current supply and two power drivers. One driver controls positive pulses while the other driver controls negative pulses. The ECT output is voltage boosted, as well as isolated, by T103 transformer

4.4. The User/Display board

The User/Display board contains all user displays and controls. One display is an 8 character alphanumeric and the other is 4 character alphanumeric. Both displays are driven by one microcontroller which is connected to the main bus by its slave port. It also controls the input dials and buttons consisting of Impedance, Treat, Start/Stop and Alarm Test. The two dials are both optical encoders, one controlling the Flexdial (setting of the parameters) and the other controls the energy level.

4.4. Printer module

The 100 mm thermal printer is used to record up to 4 channels of patient data as well as time and other alphanumeric data. It uses 100mm fanfold thermal paper. It is connected by a bi-directional parallel bus to the main processor. It is programmed to be able to run at three speeds: 5mm, 25mm and 50 mm/sec. The 5 V power for the digital circuitry and the 24 V power for the thermal head and the motor are supplied by the power board.

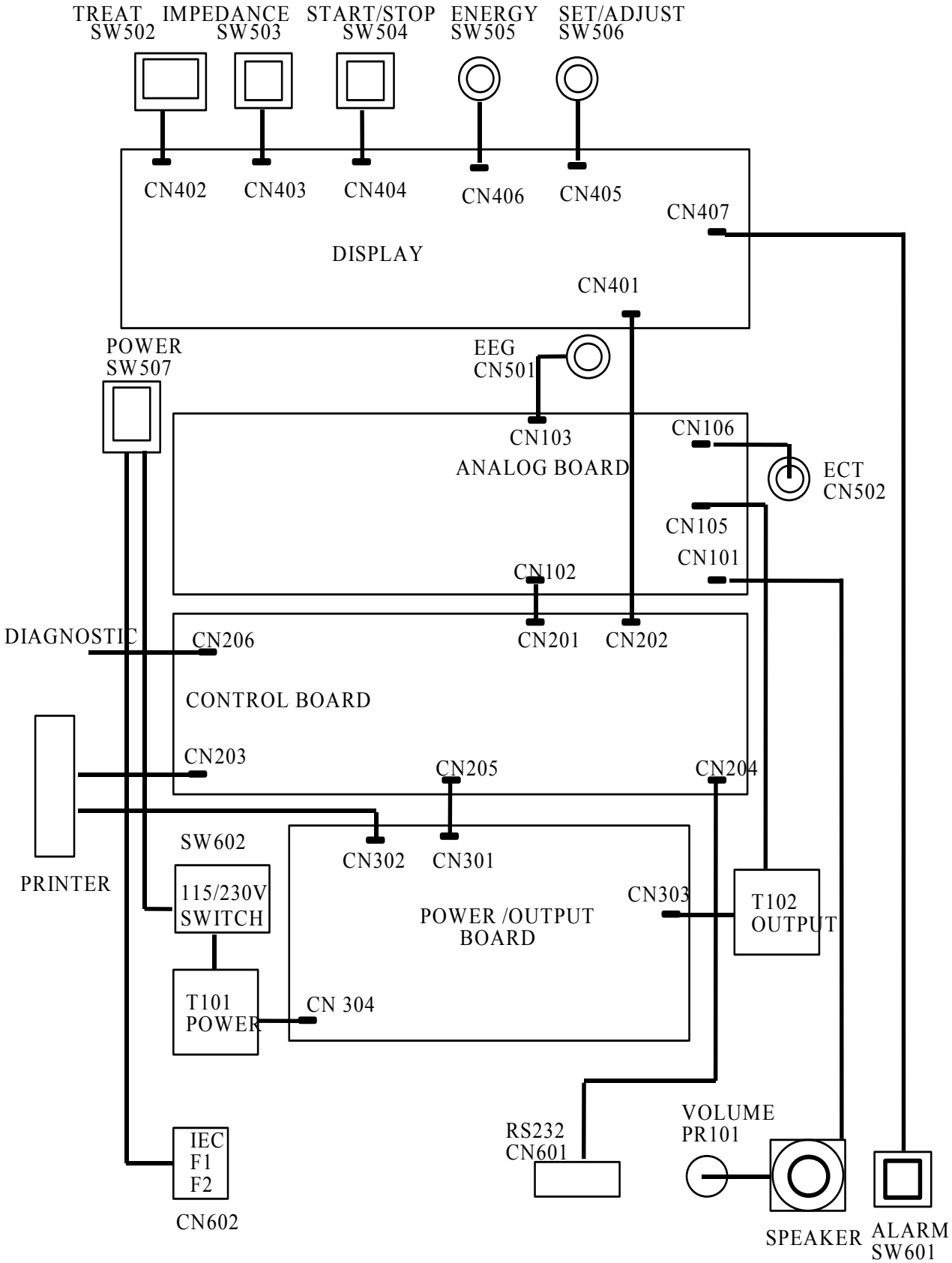

TREAT SW502
IMPEDANCE SW503
START/STOP SW504
ENERGY SW505
SET/ADJUST SW506
CN402
CN403
CN404
CN406
CN405
CN407
DISPLAY
CN401
POWER SW507
EEG CN501
CN103
CN106
ANALOG BOARD
ECT CN502
CN105
CN101
CN102
DIAGNOSTIC
CN206
CN201
CN202
CONTROL BOARD
CN203
CN205
CN204
PRINTER
SW602
CN302
CN301
115/230V SWITCH
CN303
T102 OUTPUT
POWER /OUTPUT BOARD
T101 POWER
CN 304
VOLUME PR101
RS232 CN601
IEC F1 F2
CN602
SPEAKER
ALARM SW601

fig 4.1

5. CALIBRATION AND FACTORY PRESETS

5.1 All adjustments require removal of the top panel. To do this, make sure the machine is off, remove the 2 screws from the back of the top panel and lift the top cover backwards until it clears the case. Refer to figure 5.1 for location of jumpers and connectors

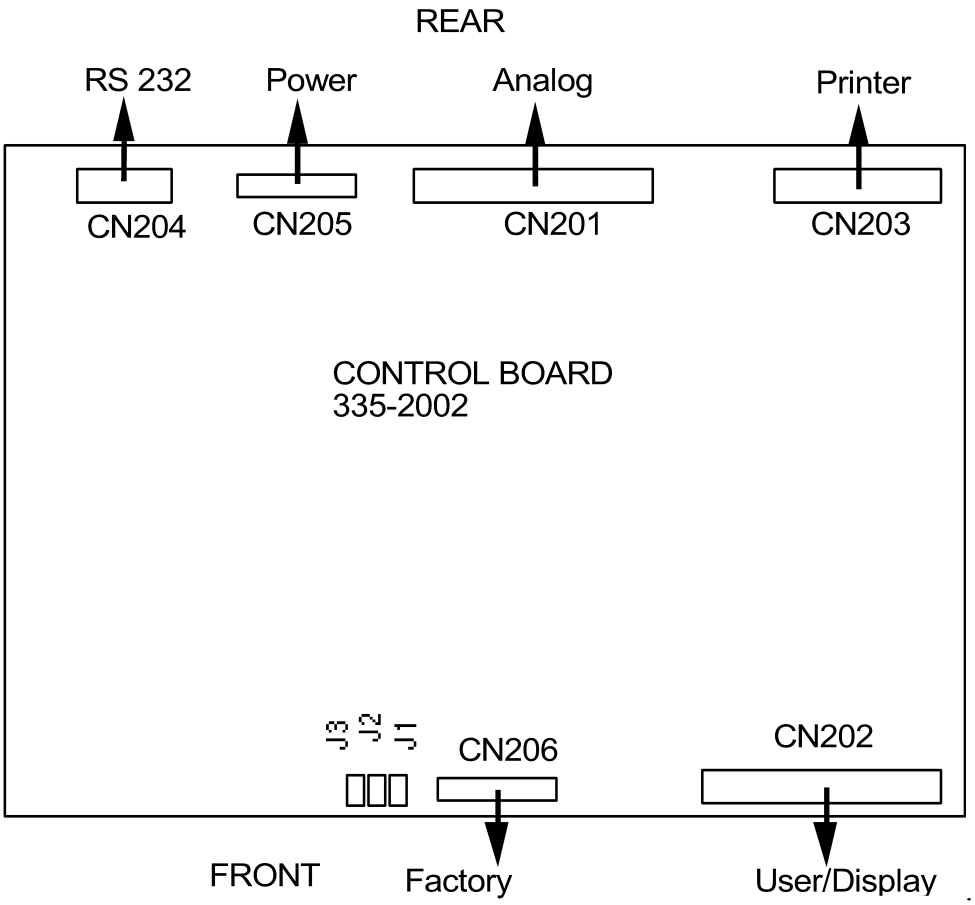


fig 5.1

⚠ **CAUTION:** WITH CASE OFF, HIGH VOLTAGES ARE EXPOSED. EXERCISE CAUTION TO AVOID INJURY.

5.2 With the system turned off install a jumper on J3 (test). Turn on the system and note that the display shows CALIBR.

5.3 EEG AMPLIFIER GAIN ADJUSTMENT

Set oscillator to 2V p-p and 10Hz. Use a calibrated meter to adjust the oscillator to .707 Volts. (It may help to temporarily set the oscillator to 30 Hertz but remember to reset it back down to 10 Hz when finished with adjusting of the volts). Connect all 4 channels to the oscillator according to fig. 3.7. Press the START/STOP button and let the system

collect 5 seconds of data then stop the collection by pressing the START/STOP button again. Note that the paper graph should have 4 traces of 10 Hz signal approximately 1 CM in size each. The main display should show "#1--xx.x", the value must be between 80.0 and 120.0. If it is, press the Flexdial button to calibrate, the display should show 100.0. Turn the Flexdial clockwise one click and the display should show "#2--xx.x". Repeat procedure for channels 2-4. If any channel is not in the range of 80-120 there is a fault that must be diagnosed and repaired before proceeding. If a calibration is attempted with out of range results the system will display "error" and will not recalibrate.
All the calibration values are stores in the battery backed memory and will remain there even with the power switched off. Press the START/STOP button to exit the EEG channels calibration and return to the main shell. The display will read CALIBR.

5.4 IMPEDANCE GAIN CALIBRATION

Connect 1500 ohm 1 % load across the treatment leads. This load can be rated at low wattage, 1/4 or 1/2 watt but be very careful not to press the TREAT button while using this load.
CAUTION: The low wattage load will be destroyed and possibly catch on fire if a treatment is initiated.
Press the IMPEDANCE button and hold until a value is displayed. Make sure the reading is between 1350 and 1650 ohms. If it is, press the Flexdial button to calibrate, the display should show 1500. Press the START/STOP button to exit the impedance calibration and return to the main shell. The display will read CALIBR.

5.5 CURRENT AND VOLTAGE MEASUREMENT ADJUSTMENT.

NOTE: Make sure that the output current is calibrated first as described below.
Connect 200 ohms 10 W resistor to the ECT stimulus cable, see fig 3.1. Set PERCENT ENERGY dial to 100% and push TREAT button. Hold the button until the indicator light goes off. The main display should show ".xxA xxxV", the values must be between 0.72-1.15A and 144-198V. If they are, press the Flexdial button to calibrate, the display should show "0.90A 180V" Press the START/STOP button to exit the impedance calibration and return to the main shell. The display will read CALIBR.

5.6 OUTPUT CURRENT ADJUSTMENT

Connect 200 _ Dummy load across the output and follow steps 3.1-3.3. If peak output is not 180 volts ± 7.5% peak, adjust VR301 for proper output. See fig. 5.2

5.7 POWER SUPPLY VOLTAGE ADJUSTMENT

Connect DMM probes between the case of LM338 +5V regulator and ground on the power board. Adjust VR302 to 5.0 Volts. Repeat for +24 V but adjust VR303. See fig. 5.2

5.8 Following items are not adjustable and their failure requires factory service:
Stimulus duration (pulse count)
Pulse width
Pulse frequency

fig. 5.2

5.8 FACTORY CONFIGURATION

In normal use these presets need not to be changed unless the system is moved to a different country using different line frequency or date display convention or language. To change any of the above items enter the calibration mode using jumper 3. Note that the display should show CALIBR. Now turn the Flexdial clockwise one click and the display should show CONFIG.

Press the Flexdial button and rotate the Flexdial to select 50 or 60 Hz notch filter depending on the frequency of the power mains.

Press the Flexdial button again and rotate the Flexdial to select the date format; either Day/Month/Year or Month/Day/Year.

Press the Flexdial button again and rotate the Flexdial to and select 24 hour or 12 hour format.

Press the Flexdial button again and rotate the Flexdial to select from the available list of languages which will be used to print out the report.

Press the Flexdial button again and CONFIG will be displayed. All the configuration settings are stores in the battery backed memory and will remain there even with the power switched off.

6. SPECIFICATIONS

6.1 ECT

Output current	900 ma constant current ±7.5%
Pulse shape	bi-directional brief pulse square wave
Maximum output voltage	450 volts ±7.5% into 500_ load
Pulse width	0.25, 0.5, 0.75, 1.0, 1.25, 1.5 ms ±5%
Pulse frequency	10,20,30,40,50,60 or 70 Hz ±5%
Stimulus duration	adjustable in 20 steps up to 8 seconds

6.2 EEG-channel 1, 2

Amplification	10-2000 μv/cm
Bandwidth	3 dB points at 2 Hz and 25 Hz
Notch filter	40 dB down at 60 Hz
CMRR	80 dB
EEG sound frequency (from channel 1)	500 Hz modulated

6.3 EMG-channel 3

Amplification	100-20 mv/cm ±5%
Bandwidth	3 dB points at 2 Hz and 50 Hz
Notch filter	40 dB down at 60 Hz
CMRR	80 dB

6.4 EKG-channel 4

Amplification	100-20 mv/cm ±5%
Bandwidth	3 dB points at 2 Hz and 50 Hz
Notch filter	40 dB down at 50 or 60 Hz
CMRR 80 dB	

6.5 Printer

Resolution	200 dots/inch
Adjustments	Position, Gain on each channel (use Flexdial)
Channels	1 -4 selectable
Time/Date	Battery backed

6.6 DIMENSIONS

Width	18 inches
Depth	13 inches
Height	5.25 inches
Weight	22 lbs.

CONNECTOR DEFINITION FOR T4

1. ANALOG BOARD

CN103-	10pin SIP	1-	+ch1
		2-	-ch1
		3-	+ch2
		4-	-ch2
		5-	+ch3
		6-	-ch3
		7-	+ch4
		8-	-ch4
		9-	isognd
CN106-	3pin SIP	1-	OUTAO
		2-	
		3-	OUTBO
CN105-	3pin SIP	1-	OUTAI
		2-	
		3-	OUTBI
CN101-	10pin SIP	1-	+speaker
		2-	-speaker
		3-	volume-high
		4-	volume-center
		5-	volume-low
CN102-	40 pin DIN	1-	warn sound
	To Control	2-	EEG sound enable [EEGS]
		3-	-ALARM
		4-	GAIN
		5-	BD0
		6-	BD1
		7-	BD2
		8-	BD3
		8-	BD4
		10-	BD5
		11-	BD6
		12-	BD7
		13-	-EADC
		14-	-RD
		15-	-WR
		16-	-RST
		17-	GND
		18-	CLK
		19-	GND
		20-	-ADERR

		21-	-ADEF
		22-	-ADDR
		23-	-ADTR
		24-	ENERGY0
		25-	ENERGY1
		26-	ENERGY2
		27-	ENERGY3
		28-	ENERGY4
		29-	2xEN
		30-	-TREATSW
		33-	GND
		34-	GND
		35-	GND
		36-	GND
		37-	5V
		38-	5V
		39-	5V
		40-	5V

2. CONTROL BOARD

CN201-	40 pin DIN	1-	warn sound
	To Analog	2-	EEG sound enable [EEGS]
		3-	-ALARM
		4-	GAIN
		5-	BD0
		6-	BD1
		7-	BD2
		8-	BD3
		8-	BD4
		10-	BD5
		11-	BD6
		12-	BD7
		13-	-EADC
		14-	-RD
		15-	-WR
		16-	-RST
		17-	GND
		18-	CLK
		19-	GND
		20-	-ADERR
		21-	-ADEF
		22-	-ADDR
		23-	-ADTR
		24-	ENERGY0
		25-	ENERGY1

		26-	ENERGY2
		27-	ENERGY3
		28-	ENERGY4
		29-	2xEN
		30-	-TREATSW
		33-	GND
		34-	GND
		35-	GND
		36-	GND
		37-	5V
		38-	5V
		39-	5V
		40-	5V
CN202-	40pin DIN	1-	warn sound
	To Display	2-	MENULED
		3-	GND
		4-	GAIN
		5-	BD0
		6-	BD1
		7-	BD2
		8-	BD3
		8-	BD4
		10-	BD5
		11-	BD6
		12-	BD7
		13-	-EAND
		14-	-RD
		15-	-WR
		16-	-RST
		17-	GND
		18-	CLK
		19-	GND
		20-	ENERGY0
		21-	ENERGY1
		22-	ENERGY2
		23-	ENERGY3
		24-	ENERGY4
		25-	2xEN
		26-	FLEX0
		27-	FLEX1
		28-	FLEX2
		29-	FLEX3
		30-	-RLTREAT
		31-	TRIND
		32-	PLED

		33-	GND
		34-	GND
		35-	GND
		36-	GND
		37-	5V
		38-	5V
		39-	5V
		40-	5V
CN203-	50pin HDDIN	1-	-PRRD
	To Printer	2-	GND
		3-	BD0
		4-	GND
		5-	BD1
		6-	GND
		7-	BD2
		8-	GND
		9-	BD3
		10-	GND
		11-	BD4
		12-	GND
		13-	BD5
		14-	GND
		15-	BD6
		16-	GND
		17-	BD7
		18-	GND
		19-	BA0
		20-	GND
		21-	BA1
		22-	GND
		23-	BA2
		24-	GND
		25-	BA3
		25-	GND
		27-	BA4
		28-	GND
		29-	BA5
		30-	GND
		31-	BA6
		32-	GND
		33-	BA7
		34-	GND
		35-	BA8
		36-	GND
		37-	-PRWR
		38-	GND
		39-	BUSY

		40-	-RST
		41-	ERROR
		42-	-FEED
		43-	-SOUT
		44-	-SIN
		45-	INTRP
		46-	POST
		47-	BRDY
		48-	+SUP
		49-	ABUFF
		50-	-SUP
CN204-	10 pin DIN	1-	
	To RS232	2-	TXD
		3-	GND
		4-	RTS
		5-	
		6-	RDX
		7-	DTR
		8-	
		9-	CTS

CN205	12pin SIP	1-	+5V
	To Power	2-	+5V
		3-	+5V
		4-	+5V
		5-	+5V
		6-	GND
		7-	GND
		8-	GND
		9-	GND
		10-	GND
		11-	OUTA
		12-	OUTB

3 **POWER/OUTPUT BOARD**

CN301	12pin SIP	1-	+5V
	To Control	2-	+5V
		3-	+5V
		4-	+5V
		5-	+5V
		6-	GND
		7-	GND
		8-	GND
		9-	GND
		10-	GND
		11-	OUTA
		12-	OUTB
CN302	6pin SIP	1-	PGND
	To Printer	2-	PGND
		3-	+24V
		4-	+24V
		5-	+5V
		6-	LGND
CN303-	5pin SIP	1-	T305
		2-	
		3-	gnd
		4-	
		5-	T304
CN304-	10pin SIP	1-	5Vac-A
		2-	5Vac-A
		3-	5Vac-B
		4-	5Vac-B
		5-	+24Vac
		6-	+24Vac
		7-	-24Vac

		8-	-24Vac
		9-	24V CT
		10-	24V CT

4. **DISPLAY BOARD**

CN401-	40pin DIN	1-	warn sound
	To Control	2-	MENULED
		3-	GND
		4-	GAIN
		5-	BD0
		6-	BD1
		7-	BD2
		8-	BD3
		8-	BD4
		10-	BD5
		11-	BD6
		12-	BD7
		13-	-EAND
		14-	-RD
		15-	-WR
		16-	-RST
		17-	GND
		18-	CLK
		19-	GND
		20-	ENERGY0
		21-	ENERGY1
		22-	ENERGY2
		23-	ENERGY3
		24-	ENERGY4
		25-	2xEN
		26-	FLEX0
		27-	FLEX1
		28-	FLEX2
		29-	FLEX3
		30-	-TREATSW
		31-	TRIND
		32-	PLED
		33-	GND
		34-	GND
		35-	GND
		36-	GND
		37-	5V
		38-	5V
		39-	5V
		40-	5V
CN402-	5 pin SIP	1-	-TREATSW
		2-	GND

		3-	+5
		4-	TREATIND
CN403-	3 pin SIP	1-	-IMPSW
		2-	GND
		3-	
CN404-	3 pin SIP	1-	-STSTSW
		2-	GND
		3-	
CN406-	6 pin SIP	1-	GND
		2-	GND
		3-	ENERGYSW
		4-	ENOUTB
		5-	ENOUTA
		6-	+5V
CN405-	6 pin SIP	1-	GND
		2-	GND
		3-	SETSW
		4-	ADOUTB
		5-	ADOUTA
		6-	+5V
CN407-	3 pin SIP	1-	-ALARMSW
		2-	GND
		3-	

5 FRONT PANEL

CN501-	9pin Hyperion EEG	1-	+ch1
		2-	-ch1
		3-	+ch2
		4-	-ch2
		5-	+ch3
		6-	-ch3
		7-	+ch4
		8-	-ch4
		9-	isognd
CN502-	7pin Hyperion ECT	1-	
		2-	OUTAO
		3-	OUTBO
		4-	
		5-	RTREATA

		6-	RTREATB
		7-	
SW502-	Treat switch	1-	-TREATSW
		2-	GND
		3-	+5
		4-	TREATIND
SW503-	Impedance switch	1-	-IMPSW
		2-	GND
SW504-	Start/Stop switch	1-	-STSTSW
		2-	GND
SW505-	Energy switch	1-	GND
		2-	GND
		3-	ENERGYSW
		4-	ENOUTB
		5-	ENOUTA
		6-	+5V
SW506-	Adjust/Set switch	1-	GND
		2-	GND
		3-	SETSW
		4-	ADOUTB
		5-	ADOUTA
		6-	+5V
SW507	Power switch	1-	LINE
		2-	NEUTRAL
		3-	SWLINE
		4-	SWNEUTRAL

6 REAR PANEL

CN601-	9pin DB	1-	
	RS232	2-	RDX
		3-	TXD
		4-	DTR
		5-	GND
		6-	
		7-	RTS
		8-	CTS
		9-	
CN602	3pin IEC	1-	line
	Power	2-	neutral
		3-	gnd

SW602	115/230 Voltage switch	1- 2- 3- 4-	TR1 TR2 TR3
SW601-	Alarm test	1- 2-	-ALARMSW GND

PERCENT ENERGY TABLES

Frequency Chart (Hz) for Thymatron System IV

PercentDGx Energy	Lowest	Low .25		**Low .5**
5	30	10	10	**10**
10	30	20	20	**10**
15	30	30	30	**20**
20	30	30	30	**20**
25	30	40	40	**20**
30	50	50	50	**30**
35	50	50	50	**30**
40	50	60	60	**30**
45	50	70	70	**40**
50	50	70	70	**40**
55	70	40	80	**40**
60	70	50	90	**50**
65	70	50	100	**50**
70	70	50	100	**50**
75	70	60	110	**60**
80	70	60	120	**60**
85	70	60	120	**60**
90	70	70	130	**70**
95	70	70	140	**70**
100	70	70	140	**70**

Pulse width (ms) for Thymatron System IV---US version

PercentDGx Energy	Lowest Charge	Low .25 Charge	Charge	**Low .5 Charge**
5	1.0	0.25	0.25	**0.5**
10	1.0	0.25	0.25	**0.5**
15	1.0	0.25	0.25	**0.5**
20	1.0	0.25	0.25	**0.5**
25	1.0	0.25	0.25	**0.5**
30	1.0	0.25	0.25	**0.5**
35	1.0	0.25	0.25	**0.5**
40	1.0	0.25	0.25	**0.5**
45	1.0	0.25	0.25	**0.5**
50	1.0	0.25	0.25	**0.5**
55	1.0	0.5	0.25	**0.5**
60	1.0	0.5	0.25	**0.5**
65	1.0	0.5	0.25	**0.5**
70	1.0	0.5	0.25	**0.5**

75	1.0	0.5	0.25	**0.5**
80	1.0	0.5	0.25	**0.5**
85	1.0	0.5	0.25	**0.5**
90	1.0	0.5	0.25	**0.5**
95	1.0	0.5	0.25	**0.5**
100	1.0	0.5	0.25	**0.5**

2X Energy (Not available in the US)

Percent Energy	Pulsewidth ms	Frequency Hz
5	0.5	10
10	0.5	10
15	0.5	20
20	0.5	20
25	0.5	20
30	0.5	30
35	0.5	30
40	0.5	30
45	0.5	40
50	0.5	40
55	0.5	40
60	0.5	50
65	0.5	50
70	0.5	50
75	0.5	60
80	0.5	60
85	0.5	60
90	0.5	70
95	0.5	70
100	0.5	70
110	0.75	60
120	0.75	60
130	0.75	70
140	0.75	70
150	0.75	70
160	1.0	60
170	1.0	60
180	1.0	70
190	1.0	70
200	1.0	70