
Sonicator[®] Plus 940

Maintenance Manual



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Section 1—Introduction

Sonicator Plus 940 servicing should be done at the factory. Refer to the Instruction Manual for information about the operation of this device.

If it is not possible to return the Sonicator Plus 940 to the factory, this maintenance manual may be used to troubleshoot to the major subassembly level. Discrepant subassemblies can then be repaired by ordering them from the factory as an alternative to returning the complete system.

This manual is intended for service technicians who perform preventive and corrective maintenance on medical devices using appropriate electronic test and measurement equipment. It should be read in its entirety before attempting to service the Sonicator Plus 940.

For technical assistance, call our Service Department at:

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Figure 1.1—Sonicator Plus 940

Section 2—General

This service manual covers remedial actions for malfunctions of a generic nature that are likely to occur after the unit is shipped out. The fundamental method of remedial action is based on replacement of PCB modules in accordance with the mode of failure. This unit is a an electrical stimulator (ES) and therapeutic ultrasound device for physiotherapy, also capable of providing therapy through a combination of these two types of therapy.

The PCBs of the unit consist of the following 11 Cards, numbered 1 through No. 7:

PCB (Card) Name	Description of PCB	Qty. Used
No. 1 (ES)	2CH electro stimulation output module PCB	2
No. 2 (US)	1CH ultrasound output module PCB	1
No. 3 (DCN)	Control PCB for LCD display, touch-panel, ES and US modules	1
No. 4 (ES output)	Electro stimulation output connector PCB	4
No. 5 (US output)	Ultrasound stimulation output connector PCB	1
No. 6 (Probe, main)	Main PCB in ultrasound probe	1
No. 7 (Probe, sub)	Sub- and LED PCB in ultrasound probe	1

* Note: Cards No. 6 and No. 7 are required one for each ultrasound probe, as shown above.

The system produces the four channels of electro stimulation output and one channel of ultrasound output shown in the block diagram on page 15, with the LCD indicator and touch-panel controlled by the DCN PCB. The PCBs are controlled via serial communication. The circuitry consists mainly of surface-mounted components and DIP components, such as transformers, connectors, etc.

When investigating PCB module malfunctions, use the explanation of operations in the specifications section for guidance.

Section 3—Specifications

Power supply: 100 to 240 VAC 50/60Hz (The voltage listed on the labels differs from that listed on the power cords.)

Power consumption: 95 VA

Therapeutic modes: 4-pole interference potential (IF4), 2-pole interference potential (IF2), IF2_EMS, Russian, TENS, HV, Micro Current, DC, combination, ultrasound stimulation

Form and degree of protection against electric shock: Class I BF-type

Electrical Stimulation Section

Output voltage: 150 V (peak) $\pm 15\%$

Output current: 300 mA (peak) $\pm 15\%$

Ultrasound Section

Ultrasound output: Continuous mode (CW): Max. 2.00 W/cm²

(Total output:	1-MHz L-type: 11 W, S-type: 1.8 W)
		3-MHz L-type: 12 W, S-type: 1.8 W	

Pulse mode: Max. 3.00 W/cm²

(Total output:	1-MHz L-type: 8.25 W, S-type: 1.35 W)
		3-MHz L-type: 9 W, S-type: 1.35 W	

Oscillation frequency: 1 MHz, 3 MHz

Pulse frequency: 100 Hz fixed, variable duty (50%, 40%, 30%, 20%, 10%, or 5%)

Section 4—Troubleshooting Table

This troubleshooting table indicates probable causes for problems that are presumed to result from wear and tear of accessory parts, aging of limited-life parts, and/or breakages due to shock, fall, etc., which are responsible for most malfunctions.

Malfunctions in PCBs are generally remedied through replacement of the faulty PCBs.

Item	Issue	Cause	Remedy
Power Supply	Power does not come on.	Dislocation of PCB connector	Plug in the connector properly.
		Poor contact with power supply harness	Replace the power supply unit or harness.
		Faulty power switch	Replace the power switch.
		Faulty power supply unit	Replace the power supply unit.
Display issues	There is no output from the LCD.	Power has not been switched on.	Check the above items related to power supply.
		Dislocation of No. 3 Card connector	Plug in the connector properly.
		Dislocation of No. 3 Card flexible cable or dislocation of LCD from cabling	Insert the cable properly.
		Poor contact with flexible cable	Replace the cable or No. 3 Card.
		Faulty LCD backlight PCB	Replace the PCB.
		Faulty LCD	Replace the LCD unit.
	Abnormal LCD output (missing pixels, etc.)	Faulty No. 3 Card	Replace the PCB.
		Faulty LCD	Replace the LCD unit.
	Output of the coupled ultrasound probe is incorrect.	Wire breakage in the ultrasound probe cable	Replace the ultrasound probe.
		Poor contact between connector and No. 2 Card	Replace the harness.
		Faulty No. 2 Card	Replace the PCB.
		Faulty No. 5 Card	Replace the PCB.
	Control issues	Touch-panel does not function.	Dislocation of No. 3 Card flexible cable from cabling
Poor contact with flexible cable			Replace the LCD unit or No. 3 Card.
Abnormal communication with module PCB			Follow the procedure described in the Error-Handling Table.
Faulty No. 3 Card			Replace the PCB.
Faulty touch-panel			Replace the LCD unit.

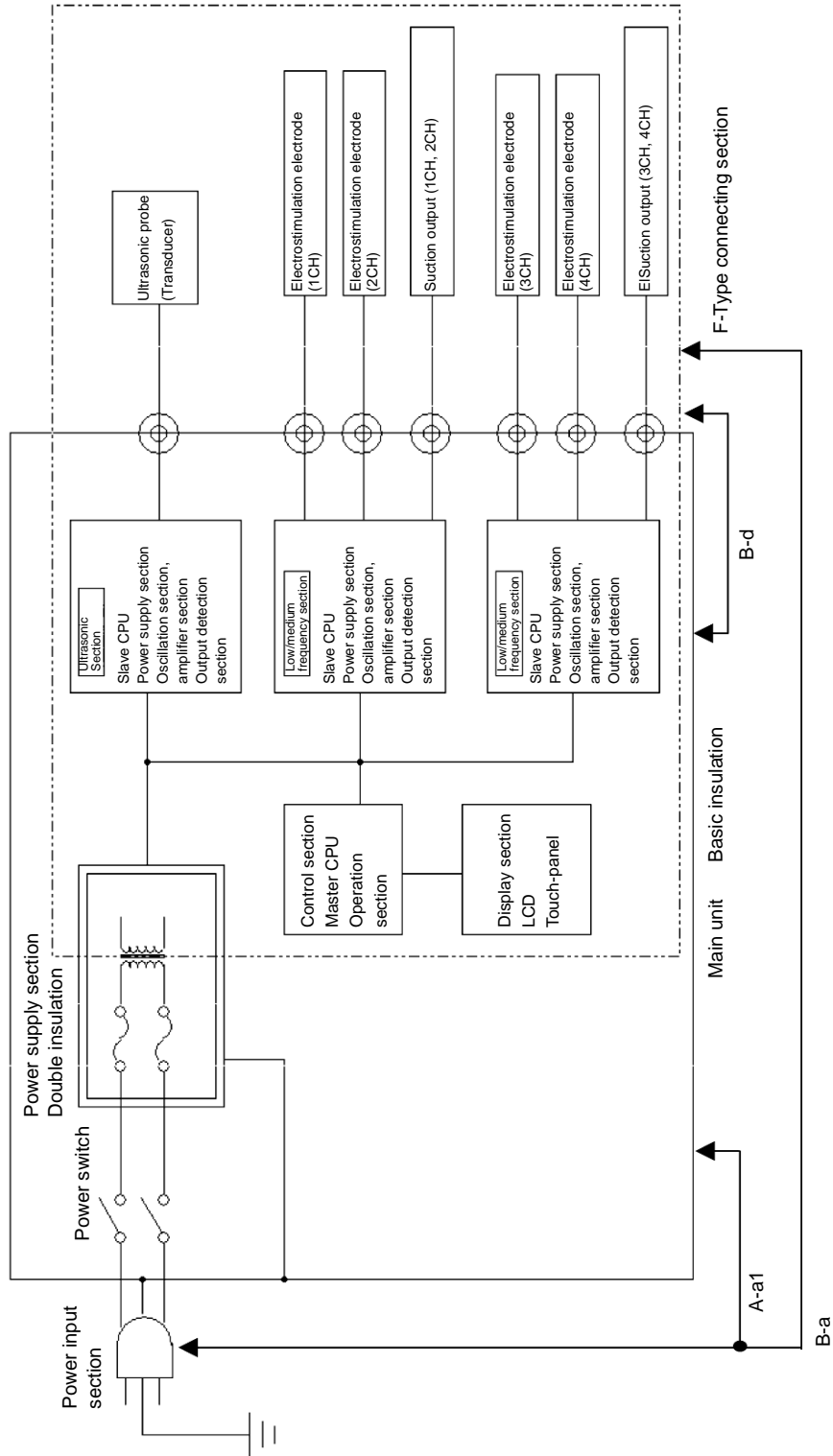
Item	Issue	Cause	Remedy
Control issues	△, ▽ keys do not react.	Faulty No. 3 Card	Replace the PCB.
		Abnormal communication with module PCB	Follow the procedure described in the Error-Handling Table.
	ON/OFF control of ultrasound output is abnormal.	Wire breakage in cable	Replace the ultrasound probe.
		Faulty No. 2 Card	Replace the PCB.
Output	Open error is issued.	Wire breakage in electrode cable	Replace the electrode cable.
		Faulty probe pad	Replace the probe pad.
		Dislocation of harness from No. 1 Card	Insert the harness properly.
		Faulty No. 4 Card	Replace the PCB.
	Electro stimulation output is interrupted.	Faulty No. 1 Card	Replace the PCB.
		Poor contact between harness and No. 1 Card	Insert the harness properly.
		Faulty No. 4 Card	Replace the PCB.
	Electro stimulation output is not obtained properly.	Faulty No. 1 Card	Replace the PCB.
	Output to suction unit is interrupted. <i>(Not available on domestic units)</i>	Dislocation of connector from No. 8 Card to No. 1 Card	Plug in the connector properly.
		Poor contact of connector harness between No. 8 Card and No. 1 Card	Replace the harness.
	Ultrasound output is interrupted.	Faulty No. 2 Card	Replace the PCB.
	Ultrasound output is abnormal.	Faulty No. 5 Card	Replace the PCB.

Occurrences often misinterpreted as malfunctions:

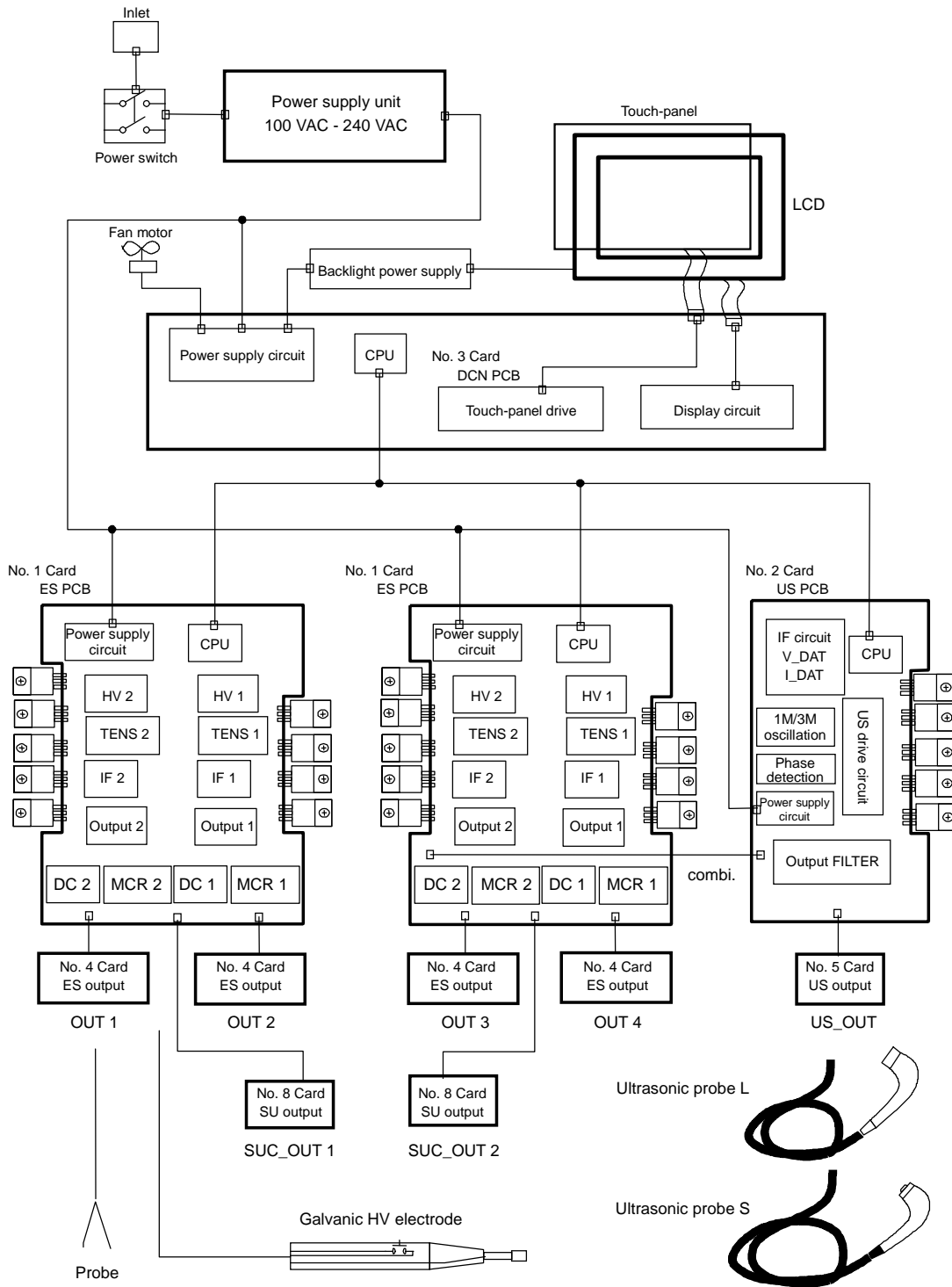
Item	Issue	Cause	Remedy
Operational issues	Part of the touch-panel does not function.	Disabled for operation	Try again after stopping operation, or refer to the instruction manual.
	△, ▽ keys do not react.	Disabled for operation	Certain functions are restricted while the unit is delivering output. Try again after stopping operation, or refer to the instruction manual.
Display Issues	Buzzer does not sound, or the sound is very quiet.	Buzzer is set to OFF or Low.	Change the setting in the LCD setup menu.
	LCD display appears dark or light brown.	Power is being diverted away from the LCD display.	Change the setting in the LCD setup menu.
Output	Output to suction unit is interrupted. <i>(Not available on domestic units)</i>	Because the suction unit is not powered on, its connection is not recognized by the main unit. <i>(Not available on domestic units)</i>	Turn on power to the suction unit. <i>(Not available on domestic units)</i>
		If there is an electrode cable connected to the output side of the main unit, the output of that channel is delivered from the main unit side. Meanwhile, if an operation mode designed to work essentially with two channels is active, such as Co-Cont/Alt mode, etc., of IF4, IF2_EMS, RUSSIAN, TENS and HV, no output is delivered from the main unit side unless both channels are connected. To switch over the output delivery side, the output must first be stopped.	Remove the electrode cable from the output side of the main unit.

Section 5—Block Diagram

Insulation Block Diagram



Functional Block Diagram



Section 6—Explanation of Overall Operation

This unit is composed of a power supply unit and a total of 11 cards (PCBs) from No. 1 to No. 7. The electro stimulation output PCBs: No. 1 Cards (ES PCBs) and the ultrasound output PCB: No. 2 Card (US PCB) can be controlled individually, and control of the display and control PCB: No. 3 Card (DCN PCB) is exercised via serial communication.

(1) Power supply unit

This power supply unit is capable of accommodating power sources worldwide, from 100 to 240 VAC, delivering an output power of 15 VDC, which is supplied to the component PCB modules.

(2) No. 1 Card (ES PCB)

This PCB incorporates the generation, control, and output circuits for medium-frequency stimulation (IF4, IF2, IF2_EMS, and Russian), low-frequency stimulation (TENS), high-voltage stimulation (HV), microcurrent stimulation (MCR), and DC stimulation (DC), as well as a CPU that manages system communications for the PCB. It also contains an EEPROM to store PCB information when parameter values are requested.

The PCB receives control information from the DCN PCB via serial communication.

(3) No. 2 Card (US PCB)

This PCB is equipped with an oscillation section compatible with two frequencies (1 MHz, 3 MHz), and constitutes a VCO that is voltage-controlled using the DA value for transducer resonance point search and the phase detection value from the CPU. For output power control, the PCB uses a system that controls the amount of power, as calculated by the CPU based on the detected amounts of I_DAT and V_DAT output, to be constant at the indication value transferred from the No. 3 Card (DCN PCB) via serial communication. The output section of the PCB is composed of the respective filter circuits at 1 MHz and 3 MHz, which are switched between according to mode.

The probe connector section contains an EEPROM designed to store the transducer information (oscillation frequency, auto-contact information, power information).

(4) No. 3 Card (DCN PCB)

This PCB handles display and control functions. In addition to system control, it performs LCD display data processing, touch-panel control and data loading, and buzzer sound generation. The PCB has a power supply of ± 5 V, mostly for operation of the CPU and peripheral circuits, and a +12V power supply for the fan motor.

(5) No. 4 Card (ES output PCB)

PCB equipped with output connector (8-pin) for electro stimulation and EMC-compliant parts.

(6) No. 5 Card (US output PCB)

PCB equipped with output connector (20-pin) for ultrasound-stimulation and EMC-compliant parts.

(7) Electro stimulation outputs (OUT1 - OUT4)

Electrode cables compatible with low-frequency probe pulses and a stick-shaped galvanic HV electrode with switch (used in high-voltage or DC stimulation-output mode) are coupled to these output ports.

(8) Ultrasound stimulation output (US_OUT)

Capable of accepting either the L-type probe or the S-type probe (differing in radiation area), when inserted separately. When the connector of either probe is inserted here, its type is recognized by the CPU.

The probes contain the No. 6 Card (Probe main PCB) and the No. 7 Card (Probe LED PCB), for installation of LED.

The No. 7 Card is soldered to the No. 6 Card, and serves to improve the recognition effect for LED lighting. Moreover, the No. 6 Card contained in the S-probe has an incorporated transformer for the conversion of S-type probe transducer impedance.

Section 7—Precautions Regarding Assembly of the Main Unit

Precautions to be taken during assembly are given below.

- (1) When joining the upper and lower cases, be sure to prevent the " ES Sheet " of the No. 4 Card and the " US Sheet " of the No. 5 Card from being peeled off or broken.
- (2) When inserting the flexible cable placed between the touch-panel and the No. 3 Card, take care not to bend it.
- (3) After inserting the flat cable laid between the LCD and the No. 3 Card into the connector, be sure to lock the connector.
- (4) When connecting the No. 1 Card and No. 4 Card to each other, insert their respective harnesses (No. 7 and No. 8) into the connectors reached by crossing the harnesses.
- (5) When connecting the No. 1 Card and No. 8 Card to each other, plug in their respective harnesses (No. 9 and No. 10) by linking the left-hand side of the No. 1 Card to the right-hand side of the No. 8 Card, and the right-hand side of the No. 1 Card to the left-hand side of the No. 8 Card, with both as viewed from the front of the main unit.

Appendix A— Measuring Ultrasound Power Output

Test each applicator as specified below. Verify proper frequency and power ranges are selected for each applicator. Adjust Variac to 120 VAC for domestic units or to 220 VAC for CE units. Verify output frequency on counter is in range for applicator being tested. Verify output power is within allowable range.

Large appl. x 1 MHz	Watts: Indicated	Watts: Measured
Model 9401	0.0	0.0 - 0.4
Model 9401	2.7	2.2 - 3.2
Model 9401	5.5	4.4 - 6.6
Model 9401	11.0	8.8 - 13.2
Large appl. x 3 MHz	Watts: Indicated	Watts: Measured
Model 9401	0.0	0.0 - 0.4
Model 9401	3.0	2.4 - 3.6
Model 9401	6.0	4.8 - 7.2
Model 9401	12.0	9.6 - 14.4
Small appl. x 1 MHz	Watts: Indicated	Watts: Measured
Model 9402	0.0	0.0 - 0.4
Model 9402	0.5	0.4 - 0.6
Model 9402	0.9	0.7 - 1.1
Model 9402	1.8	1.4 - 2.2
Small appl. x 3 MHz	Watts: Indicated	Watts: Measured
Model 9402	0.0	0.0 - 0.4
Model 9402	0.5	0.4 - 0.6
Model 9402	0.9	0.7 - 1.1
Model 9402	1.8	1.4 - 2.2

Appendix B— Parts List

Part Number	Description
QT6-04	No. 1 card - ES/electrical stim PCB (2 ch.)
QT6-05	No. 2 card - US/ultrasound PCB (1 ch.)
QT6-06	No. 3 card - DCN/display control PCB
QT6-07	No. 4 card - Electrical stim output PCB
QT6-08	No. 5 card - Ultrasound output PCB
QT6-10	Inverter
QT6-11	Power supply unit
LJ5-12	Shield mesh
HG1-40	Switch panel
HH2-24	Ac inlet
HH1-06	Power switch
HG1-41	Touch panel
TD3-26	LCD assembly
WKR9-28	Probe holder
WKR9-29	Front handle
WKR9-30	Top panel
WKR9-31	Lower case
WKR9-32	Upper case
2000	4 Sponge electrodes (2" x 2")
2001	24 Sponge inserts (2" x 2")
2002	4 Sponge electrodes (4" x 4")
2003	24 Sponge inserts (4" x 4")
2004	1 Sponge electrode (3.5" x 7")
2005	12 Sponge inserts (3.5" x 7")
2006	1 Sponge electrode (8" x 10")
2007	12 Sponge inserts (8" x 10")
2008	4 Electrode straps (24")
2009	4 Electrode straps (48")
2027	Pin to banana adapter plug set to be used with ME 2260 or 2201 electrode cables. Four each, gray.
2221	EZ Trode – 2" diameter round self-adhering, reusable electrodes with lead wires; case of ten pkg. (4/pkg.)
2222	EZ Trode – 3" diameter round self-adhering, reusable electrodes with lead wires; case of ten pkg. (4/pkg.)
2223	EZ Trode – 2" x 5" self-adhering, reusable electrodes with lead wires, case of 10 pkg. (2/pkg.)
2224	EZ Trode – 2" square self-adhering, reusable electrodes with lead wires; case of 10 pkg. (4/pkg.)
2266	Electrode cable for the Sonicator Plus 940
2267	Optional high volt / DC probe, pin-to-banana adapter and 3 ½" x 7" sponge electrode for the Sonicator Plus 940
2702	V Trode –2" diameter round electrodes with lead wires, case of 10 pkg. (4/pkg.)
2703	V Trode –2.75" diameter round electrodes with lead wires, case of 10 pkg. (4/pkg.)

2704	V Trode -2" x 4" oval electrodes with lead wires, case of 10 pkg. (4/pkg.)
2705	V Trode -2" square electrodes with lead wires, case of 10 pkg. (4/pkg.)
9401	Sonicator Plus 940, applicator (5 cm ² / 1 or 3 MHz)
9402	Sonicator Plus 940 applicator (0.9 cm ² / 1 or 3 MHz)
9906	Sonicator Plus 940 Pocket Guide