# TECHNICAL MANUAL

# METRON SPORTSONIC/SONIC

## SP100/SP300

### ULTRASOUND THERAPY UNITS

CONTENTS

# SPECIFICATIONS

| | |
|---|---|
| **MAINS SUPPLY REQUIREMENTS:** | |
| Voltage | 120/240 Volts AC |
| Frequency | 50/60 Hz |
| Power | 60VA |
| **FUSES:** | |
| Primary External 120V units | 2 of 1A 5*20mm Delay DA205 |
| Primary External 240V units | 2 of 500mA 5*20 Delay DA205 |
| Secondary | 2 of 2A 5*20 M205 |
| **ULTRASOUND OUTPUT:** | |
| Frequency | 1.1 MHz +/- 10% |
| Output Power,Continuous Modulation | 15 Watts +/- 10% Maximum |
| Power Intensity Meter | Accurate to +/- 10% of Reading for Output in excess of 1 Watt |
| **ULTRASOUND MODULATION:** | |
| Modulation Modes | Continuous<br>Pulsed |
| Pulsed Modulation | |
| Pulse Frequency | 50 Hz |
| Pulse Width | 10 milliseconds |
| Pulse Duty Cycle | 1:1 |
| **TREATMENT TIMER** | |
| Maximum Treatment Time | 30 Minutes |
| **DIMENSIONS:** | |
| Width | 360mm |
| Height | 120mm |
| Depth | 325mm |
| **WEIGHT** | |
| Packed | 4.8kg |
| Unpacked | 4.3kg |

## 2. INTRODUCTION

This Manual present all the relevent technical information for the Metron Sportsonic Ultrasound Therapy Unit. The information is provided as a service to medical, paramedical, engineering and technical personel. This information is intended for the fair purposes of valuation, maintenance and repair of the Metron Sportsonic Unit. Refer to the Metron Sportsonic Operator Manual for operator information.

All schematic diagrams are described. Necessary preventive maintenance and calibration adjustments are presented in tabular step-by-step format. Recommended electrical safety inspection procedures are discussed. All schematics and parts list information is provided.

While every attempt has been made to ensure that this Manual is accurate and complete, no responsiblity is taken for any errors or omissions. Specifications and component types are subject to change without notice.

The Sportsonic generates continuous or pulsed wave ultrasound. the ultrasonic transducer in the treatment applicator is driven by an approximately sinusoidal voltage generated by a 1.1 MHz oscillator and tuned power amplifier. The transducer voltage amplitude determines the output ultrasonic power. the transducer voltage amplitude is controlled by the power supply voltage to the tuned power amplifier - output ultrasonic power is proportional to the square of the power supply voltage.

The power supply voltage is generated by a monolithic switch-mode voltage regulator.

The machanical timer allows a maximum of 30 minutes treatment time to be selected and incorporates a DPDT switch to switch mains power on/off.

# 3. SCHEMATIC DIAGRAM DESCRIPTIONS

## 3.1 MAIN PRINTED CIRCUIT BOARD

### 3.1.1 OSCILLATOR TRANSDUCER DRIVER

Trasistor Q1 and associated components for a 1.1MHz sinewave oscillator. Trasistor Q1 operates in common base configuration with emitter drive. Positive feedback, to maintain oscillation, to the emitter from the collector is derived from a capacitive voltage divider formed by capacitors C5 and C6. These capacitors, together with the tuned transformer T1, largely determine the frequency of oscillation. Transistor Q2 is switched by the GATE signal from the power supply transistor Q6. This provides the pulsed ultrasound output mode, which is derived from the 50Hz mains frequency.

The oscillator output is buffered by transistor Q2 which operates in common collector configuration with a voltage gain of one.

Transistors Q3 and Q4 for a complementry emitter follower amplifier with a voltage gain of one driving the gate of transistor Q5.

The power Mosfet Q6 operates in common source configuration in class C mode as a tuned power amplifier. The broadband low Q transformer T2 and polystyrene capacitors C11 and C12 produce appropriate bandpass characteristics and provide impedance matching to the ultrasonic transducer. The power supply voltage to the power amplifier is generated by the switch mode regulator U2. The output ultrasonic power is proportional to the square of the power supply voltage.

### 3.1.2 POWER SUPPLY

The AC voltages from the mains step-down trasformer are full-wave rectified by diode bridge BR1 and are filtered by electrolytic capacitors C13 and C14 to produce two unregulated DC supplies: +46VDC and +23VDC. The +23VDC unregulated supply is regulated to +15VDC by linear voltage regulator U1. The +15VDC regulated supply powers both oscillator/buffer circuits and the pulsed mode circuits.
The +46VDC unregulated supply is regulated to 0 to +25VDC by U2. The 0 to 25VDC regulated supply powers the transducer driver power amplifier.
The 0 to 25VDC supply is controlled by the voltage divider network VR1 and VR2

The voltage regulator U2 is a monolithic power switching regulator capable of delivering 2.5A at a voltage variable from 5V to 40V in step down configuration. Regulator U2 features current limiting, soft start and thermal protection. Capacitor C17 determines the soft start time constant and the average short circuit output current. The parallel RC network R13 and C18. Determines the switching frequency of approximately 100Kz. The parallel/series RC network consisting of R14,C19 and C20 determines the regulation loop gain characteristics.
The junction of the resistor divider network VR1 and VR2 is connected to the feedback input of U2, this voltage is compared with the internal 5.1V internal referance to control the switching duty cycle and the regulated voltage.

The output intensity is controlled by sampling the output voltage VP from U2. Trim potentiometer VR2 sets the maximum output voltage . VR1 controls the Cutput from 5.1V to maximum set by VR1.

### 3.1.3 OUTPUT INTENSITY METER

The output intensity meter is controlled by the current thru VR3 and R15. Diodes D4 and D5 are used to linearize the meter scale.

### 3.1.4 PULSE CIRCUIT

The gate signal is generated by transistor Q6, this is a simple squaring circuit which is used to square up the AC waveform from TX1. A square wave pulse width of 10ms at a rate of 50Hz is used to disable the oscillator in the pulsed mode.

## 3.2 ULTRASONIC TREATMENT APLICATOR

The ultrasonic treatment aplicator consists of a plastic and aluminium assembly with the ultrasonic transducer bonded in position. the transducer is of a disc type made of lead zirconate with a resonant frequency of approximately 1.1Mz.

## 3.3 TREATMENT TIMER

The treatment timer is a mechanical device with a clock movement, maximum treatment time is 30 seconds. The timer incorporates a DPDT switch which closses when the timer control knob is rotated clockwise, this action applies mains power to the transformer, when the treatment time has elapsed the switch opens and mains power is removed from TX1.

# 4. PREVENTIVE MAINTENANCE AND QUALITY ASSURANCE

## 4.1 DISASSEMBLING/ASSEMBLING THE UNIT

Disassembly and assembly of the unit should be undertaken with care.

Disassembly of the unit is achieved as follows. Remove the power cord from the mains power outlet socket. Remove all items from the storage compartment. Place the unit upside down on a soft surface. Remove the 6 screws , place the unit right side up and remove the front panel assembly.
Place the front panel upside down and remove the two counter sunk screws from the base panel, gently lift the base panel up and remove the four coloured secondary transformer wires from the printed circuit board connector, unclip the two transformer primary wires coloured brown and blue from the timer and withdraw the base panel.
To remove the printed circuit board, remove the two meter nuts and washers, remove the intensity control knob and remove the securing nut from the mode switch. The printed circuit board can now be gently withdrawn from inside the front panel.

Assembly is a reverse procedure of the above with several precautions. Observe that any connections, cables or wires removed are reinstated correctly.

## 4.2 CALIBRATION ADJUSTMENTS

### 4.2.1 Equipment Required

The following equipment is a minimum requirment for the calibration adjustment of the metron sportsonic.

Ultrasound power meter: Ohmic Instruments Co Model UPM-30
Bio-Tek Instruments Inc Model UW-11
or equivalent

### 4.2.2 CALIBRATION PROCEDURE

| STEP | PROCEDURE |
|---|---|
| 1 | Zero ultrasound power meter and position ultrasound treatment applicator in power meter appropriately. |

| STEP | PROCEDURE |
|---|---|
| 2 | Adjust all trim pots to mid position |
| 3 | Set operating controls: Timer: 30 minutes<br>Mode: cont.<br>Intensity: Maximum |
| 4 | Adjust oscillator coil T1 for maximum reading on ultrasound power meter |
| 5 | Adjust VR2 for 15 watts on ultrasound power meter |
| 6 | Adjust VR3 for 15 watts on sportsonic intensity meter |
| 7 | Select pulsed mode confirm output is 7.5 watts on ultrasound power meter +/-10% |
| 8 | Check ultrasound output at 5-10-15 watts. Measured power output should not deviate from indicated power output on intensity meter by more than +/-10% for outputs in excess of 1 watt. |

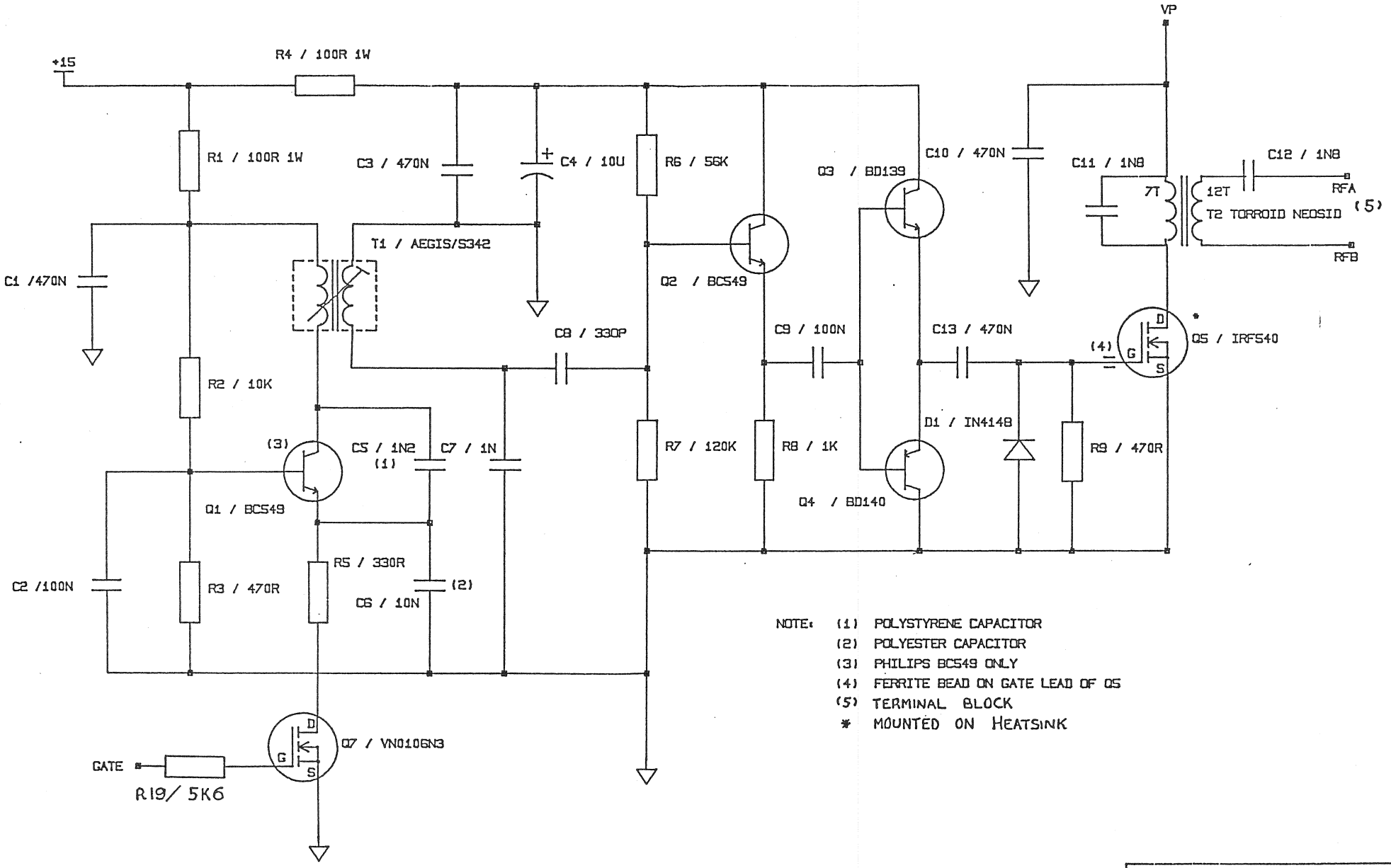
## 4.3 ELECTRICAL SAFETY INSPECTION

It is recommended that a program of regular and appropiate quality assurance including electrical safety inspections be instituted for this equipment. Imformation on the type and frequency of testing may be obtained from locally published standards. In Australia, the relevent standards published by the Standards Association of Australia are:

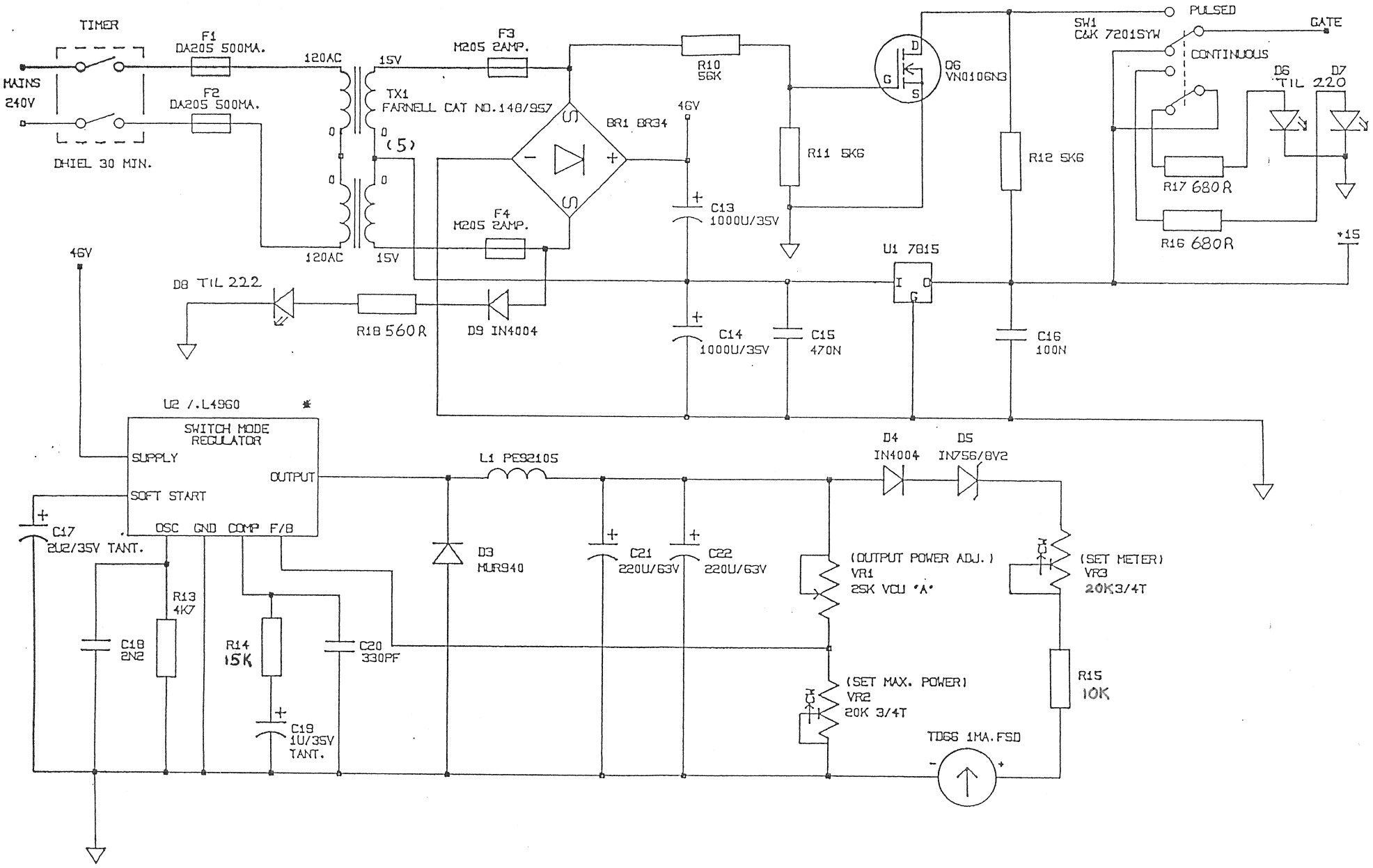
AS 2500-1986 Guide to the safe use of electricity in patient care
AS 3100-1985 Definitions and general requirments for electrical materials and equipment
AS 3208-1981 Approval and test specification - transformers in electromedical equipment
AS 3200-1986 Approval and test specification - electromedical equipment - general requirments
AS 3211-1986 Approval and test specification - ultrasonic therapy equipment
AS 3511-1988 Acceptance testing and in-service testing electromedical equipment

A hospital biomedical engineering department or a third party service organisation nominated by the manufacturer or distributor should be capable of performing the necessary testing and test record documentation.

Programmed electrical safety inspections are recommended to confirm continued operator and patient safety. Mandatory, statutory requirments for electrical safety inspections may also apply.




| | |
|---|---|
| METRON MEDICAL AUSTRALIA PTY LTD | |
| SPORTSONIC OSC.TRANSDUCER DRIVER | |
| DRAWING NO: SPORTS.CSD | SHEET 1 OF 2 |
| DRAWN: D.T. CHECKED: M.P. | 23 AUG. 90 |




| | |
|---|---|
| METRON MEDICAL-AUSTRALIA PTY LTD | |
| SPORTSONIC POWER SUPPLY. | |
| DRAWING NO: SPPS.CSD | SHEET 2 OF 2 |
| DRAWN: D.T CHECKED: M.P. | 23 AUG. 90 |

# 6. PARTS LIST

## 6.1 OSCILLATOR TRANSDUCER DRIVER

| DRAWING REF. | DESCRIPTION | | QTY. |
|---|---|---|---|
| D1 | IN914 | DIODE | 1 |
| C1,C3,C10 | 470Nf 50V | CERAMIC CAPACITOR | 3 |
| C2,C9 | 100Nf 50V | CERAMIC CAPACITOR | 2 |
| C4 | 10UF 35V | TANTALUM CAPACITOR | 1 |
| C5 | 1N2 50V | POLYSTYRENE CAPACITOR | 1 |
| C6 | 10N 50V | POLYESTER | 1 |
| C7 | 1N 50V | CERAMIC CAPACITOR | 1 |
| C8 | 330P 50V | CERAMIC CAPACITOR | 1 |
| C11,C12 | 1N8 630V | POLYSTYRENE CAPACITOR | 2 |
| Q1,Q2 | BC549 | TRANSISTOR | 2 |
| Q3 | BD139 | TRANSISTOR | 1 |
| Q4 | BD140 | TRANSISTOR | 1 |
| Q5 | IRF540 | TRANSISTOR | 1 |
| Q7 | VNO1O6N3 | TRANSISTOR | 1 |
| R1,R4 | 100R IW | CARBON RESISTOR 5% | 2 |
| R2 | 10K 1/4W | CARBON RESISTOR 5% | 1 |
| R3,R9 | 470R 1/4W | CARBON RESISTOR 5% | 1 |
| R5 | 330R 1/4W | CARBON RESISTOR 5% | 1 |
| R6 | 56K 1/4W | CARBON RESISTOR 5% | 1 |
| R7 | 120K 1/4W | CARBON RESISTOR 5% | 1 |
| R8 | 1K 1/4W | CARBON RESISTOR 5% | 1 |
| 4 | FERRITE BEAD 35-002-31 | | 1 |
| 5 | TERMINAL BLOCK 950TDS-03 | | 1 |
| * | HEATSINK 7025 | | 1 |

# 6 PARTS LIST

## 6.2 POWER SUPPLY

| DRAWING REF. | DESCRIPTION | QTY. |
|---|---|---|
| BR1 | BR34 BRIDGE RECTIFIER | 1 |
| C13,C14 | 1000UF 35V ELECTROLYTIC CAPACITOR | 2 |
| C15 | 470NF 50V CERAMIC CAPACITOR | 1 |
| C16 | 100NF 50V CERAMIC CAPACITOR | 1 |
| C17 | 2U2 35V TANTALUM CAPACITOR | 1 |
| C18 | 2N2 50V POLYESTER CAPACITOR | 1 |
| C19 | 1UF 35V TANTALUM CAPACITOR | 1 |
| C20 | 330PF 50V CERAMIC CAPACITOR | 1 |
| C21,C22 | 220 65V ELECTROLYTIC CAPACITOR | 2 |
| D3 | MUR810 SCHOTTKY DIODE | 1 |
| D4,D9 | IN4004 DIODE | 2 |
| D5 | IN756 ZENER DIODE 8V2 500MW | 1 |
| D6,D7 | TIL220 RED L.E.D. | 2 |
| D8 | TIL222 GREEN L.E.D. | 1 |
| F1,F2 | DA205 500MA DELAY FUSE | 2 |
| F3,F4 | M205 2AMP FUSE | 2 |
| L1 | PE 92105 TORROIDAL INDUCTOR | 1 |
| M1 | TD66 1MA PANEL METER | 1 |
| Q6 | VN0106N3 TRANSISTOR | 1 |
| R10 | 56K 1/4W CARBON RESISTOR 5% | 1 |
| R11,R12 | 5K6 1/4W CARBON RESISTOR 5% | 2 |
| R13 | 4K7 1/4W CARBON RESISTOR 5% | 1 |
| R14 | 15K 1/4W CARBON RESISTOR 5% | 1 |
| R15 | 10K 1/4W CARBON RESISTOR 5% | 1 |
| R16,R17 | 680R 1/4W CARBON RESISTOR 5% | 2 |
| R18 | 560R 1/4W CARBON RESISTOR 5% | 1 |
| SW1 | C & K TYPE NO.7201SYW TOGGLE SWITCH | 1 |
| TX1 | FARNELL CAT. NO. 148/957 TRANSFORMER | 1 |
| TIMER | DIEHL 30 MIN. MECHANICAL TIMER | 1 |
| U1 | 7815 15VOLT LINEAR REGULATOR | 1 |
| U2 | L4960 SWITCHMODE REGULATOR | 1 |
| VR1 | 25K "A" VCU POTENTIOMETER | 1 |
| VR2 | 20K 3/4T TRIM POTENTIOMETER | 1 |
| VR3 | 20K 3/4T TRIM POTENTIOMETER | 1 |
| 5 | TERMINAL BLOCK 950TDS-03 | 1 |
| * | HEATSINK 7025 | 1 |