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Model 11 or 12 Electrofisher

Battery Powered Backpack

OPERATION MANUAL

For older Model 11 & 12, before POW

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SMITH -ROOT, INC.

INSTRUCTION MANUAL

MODEL 12 ELECTROFISHER

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1.0 INTRODUCTION TO ELECTROFISHING

For many years, it has been known that fish react to electric currents passed through water. These currents either frighten, lead, stun or kill fish, and it is these aspects that have interested fisheries biologists.

Smith-Root has produced the Type V* through the Model 15-A electrofishers. Our electrofishers represent the state of the art in design and electronic components. Smith-Root electrofishers are manufactured with the highest quality electronic components and material available insuring maximum reliability and performance. The following discussion should help you to get the most from your electrofisher.

1.1 OUTPUT PARAMETERS

Alternating Current (A.C.) is the term given to electrical current in which the direction of current flow reverses a specified number of times per second.

When a fish enters an A.C. field of sufficient strength, it is stunned and can be easily picked up with a net for examination. There is usually a very strong contraction of the body muscles, which accounts for the rigid condition of the fish when they are picked up. When using alternating current, care must be taken not to ues too high of a voltage or the larger fish may be killed. The muscular contractions are sometimes so severe that vertebrae are fractured and/or brain damage may occur.

Direct Current (D.C.) is the term given to electrical current when it flows only in one direction. The current is defined as flowing from the negative electrode (cathode) to the positive electrode (anode).

The reaction of fish to direct current is quite different from their reaction to alternating current. The first reaction of the fish is to swim towards the positive electrode. This reaction is know as "galvanotaxis". The fish will continue to swim towards the anode until it either reaches the anode or encounters a current sufficiently strong to cause it to turn on its side and become incapable of any further forward movement. This reaction is known as "galvanonarcosis". The severe and often harmful muscle contractions encountered with alternating current do not occur and the fish recovers quicker from a direct current shock. The mortality rate is much lower with DC than with AC.

*Smith-Root no longer manufactures the Type V Electrofisher.

2.2 ADJUSTING THE OUTPUT VOLTAGE

It has been found that by adjusting the output voltage, the effects of the water's conductivity on electrofishing can be reduced.

Generally in lower conductivity water, higher voltage is needed to shock the fish. Voltages as high as 1200 volts are commonly used. It also helps to maintain a large cathode while keeping the anode ring surface area less than 100 square inches. The smaller anode has a more intense current field near the anode while a larger anode distributes the current over a larger area.

The current flowing through the water is directly related to the voltage applied. The higher the voltage, the greater the current will be.

In high conductivity water, lower voltages are used, but the currents are much greater. Currents as high as 60 amps are commonly used. The main limiting factor is the power rating of the generator supplying the power to the electrofisher. The power needed is directly related to the current and the voltage applied. Electrofishing in saltwater is possible, but the amount of power needed to shock the fish would be quite high and is not considered to be practical.

A major consideration to be aware of when adjusting the output voltage is the power being used. This is especially true for battery powered electrofishers. Power is equal to the voltage times the current. When figuring the power for an electrofisher, the fact that it is usually putting out pulsed DC must be taken into consideration. The instantaneous power during a pulse may be quite high, but if the electrofisher is only producing pulses at 25% of the time (25% duty cycle), the average power would be approximately 25% of the instantaneous power.

2.3 THE EFFECTS OF FISH SIZE

Among fish of the same species and of similar size, small variations in their sensitivity to electric currents may be noticed. Generally however, the larger fish are more sensitive to electrical currents. Fish absorb power as a function of body surface area in the water. This is an important thing to remember if you are shocking for small fish and large fish are also present. The large fish are going to receive a much greater shock than the small fish.

3.0 ELECTROFISHING TECHNIQUES

A person engaged in electrofishing must either wade or float, depending on the depth or swiftness of the water. In suitable waters, the operators wade and can probe the anode into likely fish habitat. Wading upstream eliminates the effects of turbidity caused by bottom sediment and the fish are less likely to be swept downstream. If turbidity and the loss of fish downstream are unimportant, collections can be made more efficiently and less strenuously when moving downstream. The fish are normally oriented upstream towards the the descending electrical field. The shocked fish initially bolt upstream into higher voltage densities, where they can be captured. Fish that manage to escape are often captured a short distance downstream. Seine nets are commonly used to partition off a study area to prevent fish from escaping.

The floating method of electrofishing is used when the stream is too deep or swift to wade in. The anode is clamped rigidly ahead of the boat, extending into the water. The cathode is typically clamped to each side of the boat. One person guides the boat with oars while one or two operators dip fish as the boat dirfts with the river.

In lakes the use of electrofishing boats is quite common. Boats have the advantage of being able to carry larger generator powered electrofishers and holding tanks for the stunned fish. The typical electrofishing boat will have two insulated booms that extend from the bow of the boat. From the end of the booms, electrodes are attached and dropped into the water. Usually one boom is used as the anode and the other as the cathode. Boat electrofishing is usually done at night with the use of flood lights on the bow of the boat to attract the fish and to help in locating stunned fish. The methods vary, but typically the boat operator will guide the boat in and out of the shoreside while the electrofishing crew activates the electrofisher when approaching likely habitat.

The electric field in a body of water can be broken into 3 separate areas. The outer area, or peripheral area, has a weak electrical field that frightens the fish, causing them to bolt or penetrate deeper into cover. The next area, closer to the electrodes, has a stronger electrical field, but not enough to stun the fish. In this area, the involuntary swimming action will occur and the fish will swim towards the anode. The inner most area has the strongest electrical field and the fish within it are usually stunned and immobile.

Electrofishing can be improved by introducing the element of surprise through intermittent fishing. It is better not to move through a body of water with the power on continuously, but rather to fish only in likely habitat. Fish can be extracted from areas of heavy cover or from under shore ice by inserting the anode, turning the power on and withdrawing the anode slowly and smoothly. Fish will follow the anode under the influence of galvanotaxis into the open, where they can be captured. If the stream velocity is appreciable, the electrical power can be left on during floating without loss of efficiency.

Night fishing with lights has proven to be exceedingly productive in lakes. In streams the reflection and refraction of the spotlight caused by the ruffled stream surface impairs sighting of the fish. Headlamps are useful for electrofishing when wading at night. For daytime fishing, the use of polarized sunglasses reduces glare and helps in locating stunned fish.

4.0 SAFETY PRECAUTIONS FOR ELECTROFISHING

The operator of an electrofisher must always keep in mind that his chances of receiving an electrical shock is multiplied when dealing with electric currents in or near water more than any other place. Using an electrofisher is like using a firearm; if used properly and with good judgement, it is perfectly safe. Have respect for electricity and it is easily controlled; lose respect and you could lose your life.

SMITH-ROOT ELECTROFISHERS HAVE A HIGH VOLTAGE OUTPUT AND CERTAIN SAFETY PRECAUTIONS MUST BE OBSERVED TO PROVIDE SAFE OPERATION AND PREVENT POSSIBLE DANGEROUS ELECTRIC SHOCK.

Electricity needs to have a complete electrical circuit in order for current to flow. The only way that you can get shocked is if you become the electrical conductor to complete the circuit. In the output circuit, the current flows from the cathode to the anode through the water. The water is the electrical conductor. If you were to grab both the anode and the cathode you would become an electrical conductor and complete the circuit path and get a severe electrical shock. If you were to touch only one of the electrodes, you would not complete the electrical circuit and not get shocked.

WARNING: This is not recommended and unless all conductive objects you may come into contact with are also connected to the electrode, you may be shocked to find a current path that is not obvious (ie, water, aluminum boat, etc.)

Many aluminum electrofishing boats use the boat hull as the cathode and the boom electrodes as the anode. This is perfectly safe as long as you never come in contact with the anode and complete the electrical circuit. The National Safety Council in their Data Sheet #1-696-85 rejects the use of the boat hull as the cathode, but we have yet to hear of any accidents occuring because of it.

The following things must be done to insure against electrical shock on an electrofishing boat:

1. Ground the generator to the boat hull.

2. Be sure that all of the metal parts on and in the boat are all bonded to each other electrically.

3. Run all high voltage cables through electrical conduit or use heavy-duty rubber covered cord of a type recommended for wet locations.

4. Make all electrical connections in water-tight junction boxes.

5. Each dip netter should have his own foot switch to control the output and they should be wired in series with each other and with the emergency off switch of the boat operator.

6. Use only dip nets with insulated handles.

The following things must be done to prevent electrical shock when using backpack electrofishers:

1. Use water-tight wading hip boots, or chest waders. If they become wet inside, stop electrofishing and let them dry out throughly.

2. Use electrical linemen gloves of 5000 volt rating or better.

3. Take care not to touch anyone else with the anode probe or cathode probe.

4.1 DO'S AND DON'TS FOR ELECTROFISHING

<u>DO:</u>

1. Always be sure that all personnel are clear of the anode and cathode before turning on the power.

2. Know how to administer first aid treatment for electrical shock.

3. Wear a floatation device.

4. Have electrical circuits checked only by qualified technicians.

5. Disconnect the battery when the electrofisher is not in use.

DON'T:

1. Don't continue to electrofish if your boots or gloves get wet inside.
2. Don't operate an electrofisher if you have had any prior heart ailment.
3. Don't operate an electrofisher alone.
4. Don't operate generators without covers or screens.
5. Don't operate generators without spark arrestors.

LOW BATTERY INDICATOR The L.E.D. indicator comes on, and the output is disabled when the battery voltage drops to 20 volts. Low battery conditions are cleared by switching the input power switch to off and replacing the battery with a fresh battery.

CAUTION: FAILURE TO SWITCH THE INPUT POWER SWITCH TO OFF BEFORE CONNECTING OR DISCONNECTING BATTERY MAY CAUSE DAMAGE TO THE POWER CONNECTOR.

SELF TEST INDICATOR The L.E.D. indicator comes on to give positive indication that the anode and cathode wiring and switches are OK. Failure of this indicator to come on when the anode pole switch(es) are pressed indicates that there is a problem with the anode, cathode or the tilt switch.

TIMER The 6 digit timer totalizes seconds of shocking time while the anode pole switch is closed and the output is activated. It accumulates time in fractional seconds to give a more accurate indication of true shocking time. A view window is located at the top of the left side of the instrument case. The timer is resettable by placing a magnet over the word ***reset*** next to the timer. The magnet is found on its keeper on the left side of the shocker near the battery box. It is also possible to use the anode pole switch magnet to reset the counter.

INPUT POWER CONNECTOR The input power connector is a rugged, quick-twist, positive locking connector with index tabs for proper polarization of the connector halves.

INPUT POWER SWITCH The input power switch is a 25 amp toggle type circuit breaker switch that protects the Model-12 from excessive input currents.

6.0 USING THE MODEL-12 ELECTROFISHER

The following procedure is used when setting up the electrofisher for use in field.

6.1 SET-UP PROCEDURE

A. Make sure the power switch is in the ***off*** position. Place the battery in the battery box and connect the input power plug to the battery.

B. Plug the anode pole and cathode into their respective connectors on the bottom of the instrument case. Located inside the pole is a sealed, magnetically operated reed switch. The reed switch is activated by a magnet within the rubber flapper. By simply pressing the flapper forward against the pole, the reed switch will close and the output is activated. Release the rubber flapper and the reed switch will open and the output is deactivated.

C. Select the desired voltage and frequency ranges. When water conductivity is unknown, place the electrodes in the water and set the voltage range switch to the lowest voltage setting. Select the desired frequency range and press the anode pole switch. Observe the reaction of the fish. If this setting is not satisfactery then release the anode pole switch and increase the voltage setting one range. Press the anode pole switch and again observe the reaction of the fish. Repeat this procedure until satisfactory results are obtained. ***Never change voltage ranges while the anode pole switch is pressed,*** **doing so may damage the electrofisher.**

CAUTION; If you have been shocking small fish, reduce the voltage range 2 or 3 positions before shocking large fish. Large fish are more sensitive to being shocked than small fish. In general, low frequencies are more effective for large fish and high frequencies for small fish.

7.0 IN CASE OF DIFFICULTY

The Model-12 electrofisher has been designed to provide years of trouble free operation, but problems can occur. The following section should help you to correct some of the more common problems and prevent others from occuring.

7.1 TROUBLE SHOOTING

A. Check the input power switch and the battery connector. If the power switch turns off by its self, either the switch is defective or there is a short circuit within the electrofisher.

B. Check the overload indicator. If the overload light turns on when the output is activated, reduce the voltage selector until the overload indicator no longer turns on when the output is activated. The overload is automatically reset each time the anode pole switch is released.

C. Check the low battery indicator, if the low battery indicator is turned on, the battery is discharged and should be exchanged with a fresh battery. The low battery indicator is reset when the power switch is turned off.

D. Check the self-test indicator. The light should turn on when the anode pole switch is activated. If the light fails to turn on make sure the unit is in an upright position then check the anode and cathode connectors on the box, to be sure that they are properly seated. If you are sure that the connectors are hooked together properly and the self-test indicator still doesn't turn on, check the switch circuit on the anode and cathode with an ohm meter. By measuring from pin B to pin C you should measure aprox. zero ohms when the anode pole switch is activated and zero ohms, at all times, on the cathode pull behind. If you don't measure zero ohms there is either a broken wire or a bad switch in the electrode.

E. The Model-12 contains a safety tilt switch that renders the electrofisher inoperatable if the unit is tipped beyond most normal operating positions. The normal operating position for the electrofisher is vertical.

8.0 BC-24-A AUTOMATIC BATTERY CHARGER;

The BC-24-A battery charger is used to charge the 24 volt battery pack supplied with the Model-12 electrofisher.

8.1 INDICATORS AND FEATURES

A. Input power cord; The input power cord is wired for standard U.S. 120 volt A.C. outlets with ground.

B. Output cord and connector; The connector on the end of the cord is wired to plug directly into the quick disconnect connector on the battery pack.

C. Front panel indicators; The two front panel indicator lamps are labeled "charging" and "charged". The "charging" indicator will glow when the battery is taking a charge. When the battery is fully charged the "charged" lamp will turn on and the "charging" lamp will turn off.

8.2 BC-24-A OPERATION

1. The battery pack should be recharged as soon as practical after discharging.

2. Connect the chargers power plug to an 110 volt 3 pin outlet.

3. Connect the quick disconnect plug to the battery.

4. The "charging" lamp should turn on. The battery is now taking a charge.

5. The battery pack should be fully charged after approximately 14 hours of charging time.

6. Do not leave batteries connected to the charger longer than 1 week.

9.0 BATTERIES

The Model-12 uses a 24 volt gell cell battery pack. Knowing the proper care and understanding the limitations of batteries will help to avoid having problems in the field.

BATTERY CARE - Batteries should never be allowed to remain in a discharged state and should be recharged as soon as possible after use. Batteries should be charged until the green lamp on the charger comes on.

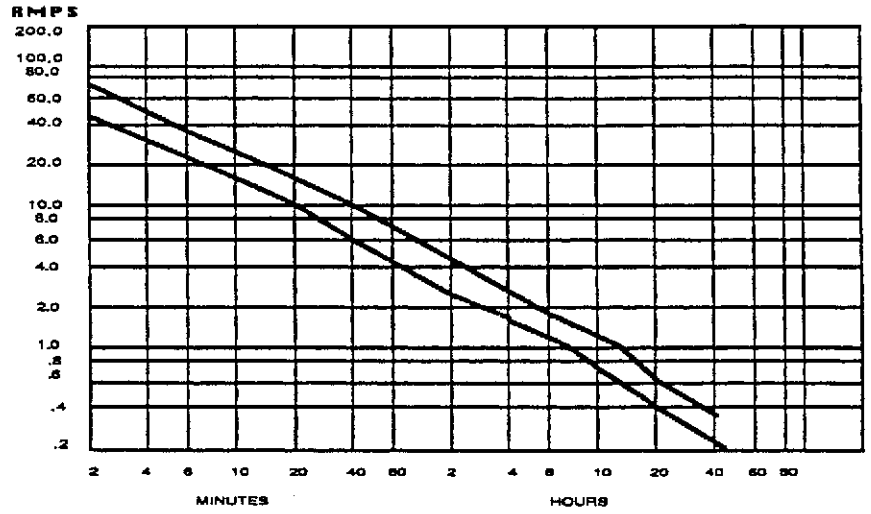
CHARGING PROBLEMS - Some older batteries may not charge within 24 hours. Do not continue to charge these batteries as this may cause drying of the electrolyte and damage the battery. Check the battery on an electrofisher to determine how much field time may be expected from it. If the discharge time is sufficient for your uses, mark the battery so that it doesn't get left on a charger for more than 24 hours, otherwise discard the battery. If a battery has been left in a discharged condition for a while, it may not take a charge. If you suspect that the battery has been left discharged, charge it for 24 hours and then discharge it with the electrofisher. If the battery is not taking a charge it will not operate the electrofisher for very long. Sometimes by cycling the battery a few times it will start taking a charge again.

9.1 BATTERY SPECIFICATIONS - Batteries are rated at the current which will reduce the voltage per cell to 1.67 volts in 20 hours. The efficiency and relative capacity decrease as the discharge current is increased.

SPECIFICATIONS - 24 VOLT, 12 AMP HOUR
Nominal voltage -- 24 volts (12 cells in series)
Nominal capacity of battery to a cutoff voltage of .4 volt per cell below initial closed circuit voltage:

			RELATIVE CAPACITY
At 20 hours	rate load of	0.60 A	12.0 amp hours
At 10 hours	rate load of	1.05 A	10.5 amp hours
At 5 hours	rate load of	1.95 A	9.7 amp hours
At 1 hour	rate load of	7.20 A	7.2 amp hours
At 30 minutes	rate load of	12.00 A	6.0 amp hours
At 15 minutes	rate load of	20.00 A	5.0 amp hours

DISCHARGE CURVES FOR 8AH AND 12AH GELLCELL BATTERIES

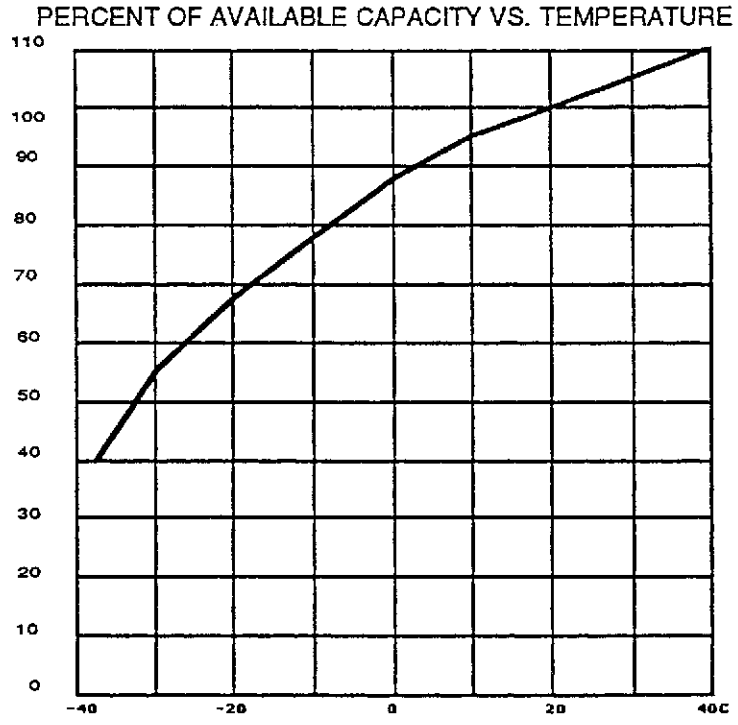


BATTERY LIFE - Each time you cycle a battery it loses some of its ability to take a charge. Gellcell batteries are capable of being charged and discharged from 100 up to 1000 times depending on the depth of the discharge and the type of charger used. Service life and shelf life are both adversely affected by warmer temperatures as shown in the chart below.

temp deg. C	20	30	40	50
normal life %	100%	50%	25%	12%

BATTERY STORAGE - Batteries stored at room temperature will self-discharge at approx. 3% to 6% per month. Storage temperature above 20 deg. C should be avoided. Shelf life can be increased by storing at lower temperatures. Batteries should be stored at above -30 deg. C to prevent freezing. Batteries should be fully charged before storing and they should be recharged every 4 months.

EFFECTS OF TEMPERATURE - The temperature at which a battery is used also affects the relative capacity of the battery. The chart below shows the percent of available capacity vs. temperature. The chart shows that a cold battery will have less capacity and the shocking time will be less when the unit is used in cold weather.



10.0 MODEL-12 SPECIFICATIONS

CONDUCTIVITY RANGE	10-600 MICROSIEMENS/CM^3
OUTPUT VOLTAGE	100-1000 VDC IN 100 VOLT STEPS
OUTPUT CURRENT	40 AMPS PEAK, 4 AMPS AVERAGE
OUTPUT FREQUENCY	DC, 15, 30, 60, 90, 120,PPS UP TO 5 ADDITIONAL CUSTOM FREQUENCIES (OPTIONAL)
OUTPUT PROTECTION	OUTPUT DISABLED ON OVERCURRENT CONDITION. AUTOMATICALLY RESET BY RELEASING ANODE POLE SWITCH OVERLOAD INDICATOR LED ON SIDE OF UNIT.
OUTPUT PULSE SHAPE	RECTANGULAR PULSED DC, 12 1/2% DUTY CYCLE
OUTPUT INDICATOR	AUDIO TONE FOR 30 VDC AND GREATER
ANODE & CATHODE SELF TEST	CONTINUITY OF ANODE AND CATHODE WIRES & SWITCHES INDICATED BY LED.
TILT SWITCH	AUTOMATICALLY SHUTS OUTPUT OFF WHEN ELECTROFISHER IS TIPPED BEYOND ALLOWABLE OPERATING ANGLE.
INPUT CURRENT INDICATOR	INDICATED BY AUDIO AMMETER ABOVE 4 AMPS. BEEP RATE CHANGES IN PROPORTION TO INPUT CURRENT.
LOW BATTERY	UNIT AUTOMATICALLY SHUTS OUTPUT OFF. CONDITION IS INDICATED BY LED ON SIDE OF BOX. UNIT MUST BE TURNED OFF TO RESET.
TIMER	0 - 999,999 SECONDS ACCURACY +-2.5%
CONSTRUCTION	SEALED WEATHERPROOF CASE
WEIGHT	14.25 kg., INCLUDING 12AH BATTERY AND BACKPACK
ANODE POLE	1.82m. LONG 2.5 cm. DIAMETER, FIBERGLASS WITH 1.82 m. CURL CORD.
ELECTRODE SUPPLIED	ROUND ALUMINUM RING, 30.5 cm DIAMETER.

CATHODE SUPPLIED..... RAT-TAIL, 2.44 m. LONG

PACKFRAME..... COLEMAN, REINFORCED PLASTIC WITH EMERGENCY QUICK RELEASE.

BATTERY PACK..... 24 VOLT, 12AH, SEALED, DEEP DISCHARGE 9.5 kg.

STANDARD EQUIPMENT SUPPLIED - Model-12 electrofisher mounted on a Coleman pack frame with single piece 1.82m Anode Pole, Anode Ring, pull-behind cathode, 12AH Gellcell battery and 24 volt battery charger.

OPTIONAL EQUIPMENT

METERING PACKAGE..... INPUT & OUTPUT CURRENT AND INPUT & OUTPUT VOLTAGES.

CUSTOM OUTPUT FREQUENCIES..... DC TO 250 HZ

ANODE ARRAYS ..... DIAMOND SHAPE, CAT WHISKER OR RING

ANODE OR CATHODE POLE

(1 piece)..... 1.82m, 2.5cm diameter
(2 piece)..... 1.82m, 2.5cm diameter
(2 piece)..... 2.74m, 2.5cm diameter
(3 piece)..... 2.74m, 2.5cm diameter

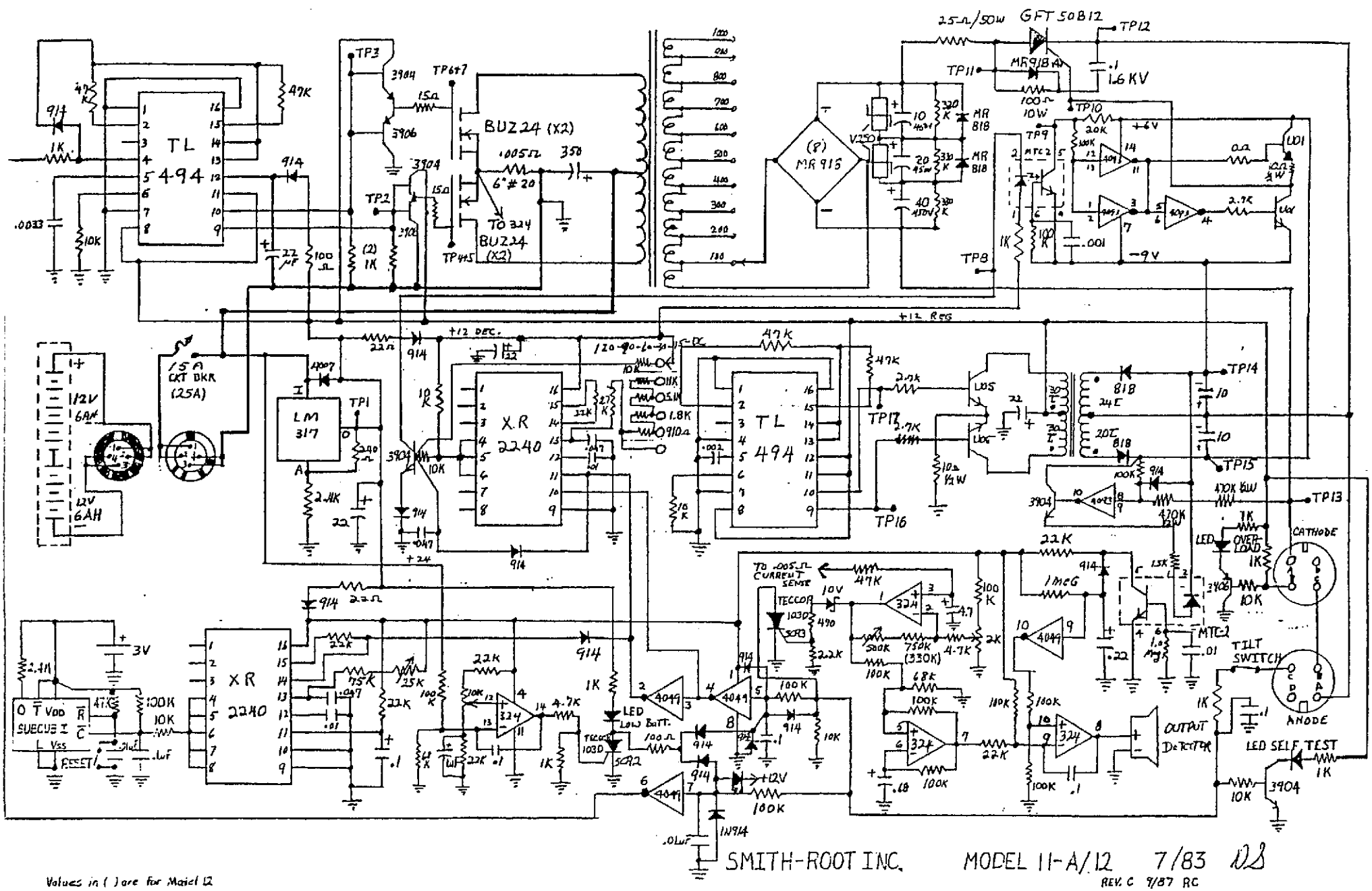
BATTERYPACK..... 24 VOLT, 6AH, 5.2kg
24 VOLT, 9AH, 8.2kg
24 VOLT, 12AH, 9.5kg

ELECTRO DIP-NETS ..... TEAR-DROP SHAPE
28cm-W x 46cm-L x 10cm-D, 47mm mesh, with protector and quick disconnect.

FIBERGLASS DIP-NET HANDLES

(1 piece)..... 1.82m
(2 piece)..... 1.82m
(2 piece)..... 2.74m

ELECTRICAL GLOVES..... 5000V AND 10,000V RATED


TL 494
XR 2240
LM 317
BUZ24 (X2)
TO 324
BUZ24 (X2)
MR 915
MR 818
GFT 50B12
MR918 40
12V 6AH
12V 6AH
15A CKT BKR (25A)
+12 DEC.
+12 REG
-9V
+6V
+24
TECCOR 103D
SCR2
LED LOW BATT.
LED OVER-LOAD
LED SELF TEST
TILT SWITCH
CATHODE
ANODE
OUTPUT DETECTOR
TO .005Ω CURRENT SENSE
1N914
SMITH-ROOT INC. MODEL 11-A/12 7/83
REV. C 9/87 RC
Values in ( ) are for Model 12

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