Since 1964, the leader in effective, safe and reliable products for fisheries conservation.
Knowledgeable biologists depend upon Smith-Root equipment.

USER'S MANUAL
LR-20B
BACKPACK ELECTROFISHER



SMITH-ROOT, INC.
Products for Fisheries Conservation

Includes model LR-20 (200w)

09441.04

LR-20B BACKPACK ELECTROFISHER
Operation and maintenance

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Items manufactured by companies other than Smith-Root carry the original manufacturer's warranty. Please contact product manufacturer for return instructions.

All Smith-Root, Inc. manufactured products are covered by a one-year warranty.

Credit & Refund Policy: Customers returning equipment, in new condition, will be given credit within five days from the date of the return. A return authorization must accompany returns. Valid equipment returns include, but are not limited to, ordering incorrect equipment, funding deficits, and defective equipment returned for reimbursement. All returns are subject to a restocking fee and applicable shipping charges. The restocking fee is figured at 10% of the purchase price but not less than $20.00. Customers receiving equipment in damaged condition will be referred to the shipping company for insurance reimbursement.

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LR-20 & LR-20B
BACKPACK ELECTROFISHER

INTRODUCTION



The LR-20 Backpack Electrofisher offers the safety and ruggedness of the **LR-24** with the reliability of our classic **Model 12**, while using the accessories of our standard **LR-24**. The **LR-20B** is an ideal transitional unit from our classic Model 12; it shares many conventions as well as the safety and reliability and accessories of the LR-24.

Use them for light-duty electrofishing or in conjunction with LR-24 units for wider field applications. The LR-20B is a good addition to your collection of Electrofishers in order to cover all field conditions.

THE LR-20B COMBO CONSISTS OF:

1 - Electrode Pole 6' 2PC 07575
1 - 11" Aluminum Electrode Ring 03297
1 - Rattail Electrode 06821
2 - 24V 7 Ah Battery 06681
1 - UBC-24 Battery Charger (USA) 06815
1 - Case w/Wheels & Retractable Handle 09540

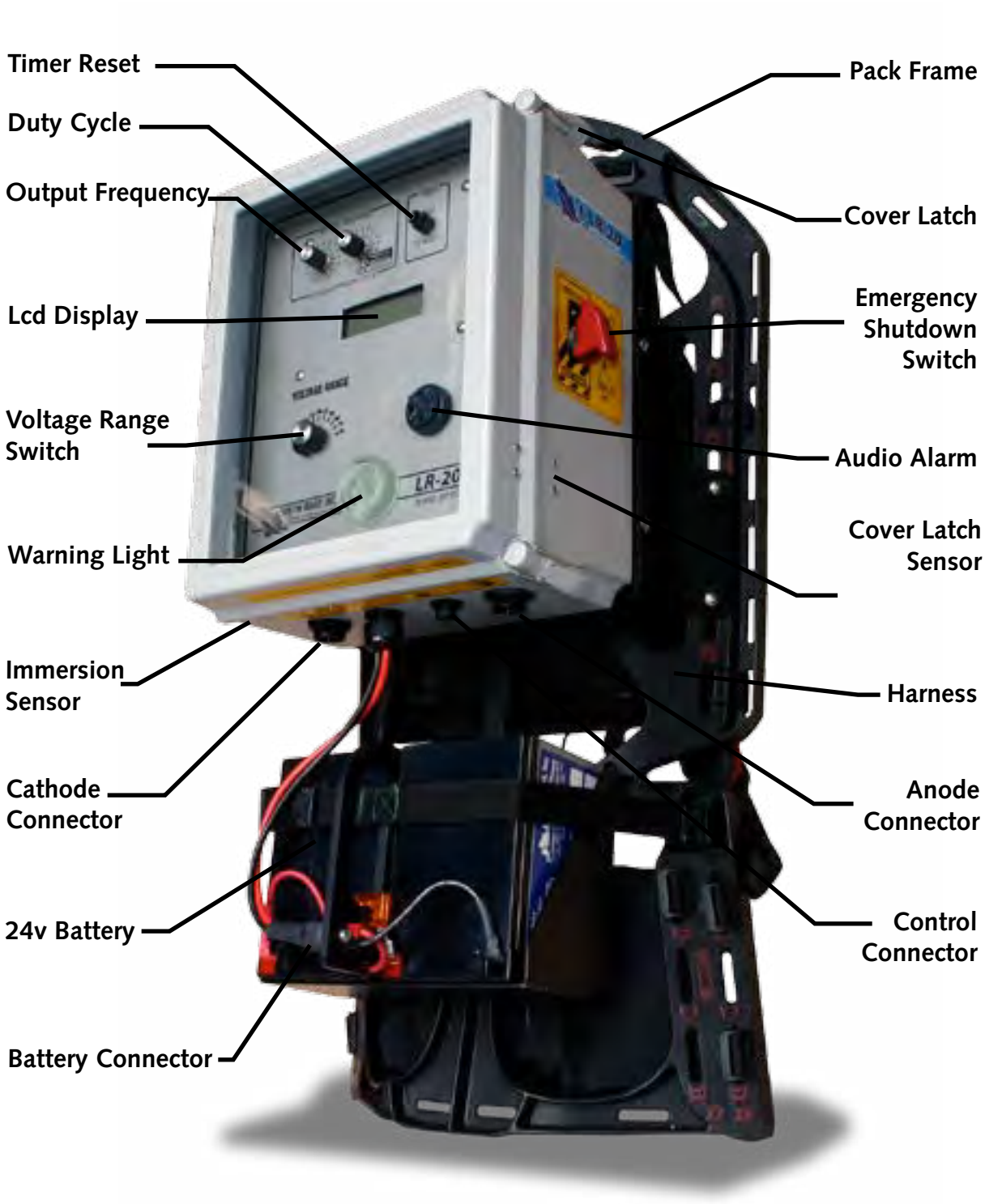
SAFETY FEATURES:

- Emergency shut-down switch disables the unit
- Flashing red output warning light
- Audible output warning system
- Tilt sensor
- Water immersion turns output off
- Electrode out of water output off
- Pole mounted operator switch
- Non-conductive case
- Quick release shoulder harness and waist belt

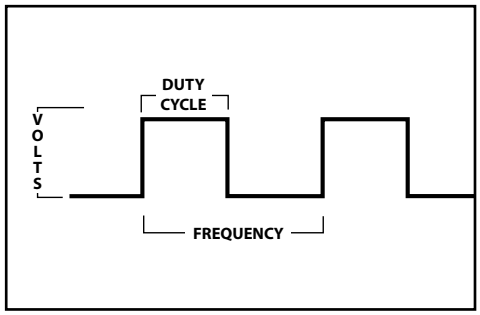
OVERVIEW

CONTROLS AND FEATURES

Take the time to familiarize yourself with the LR-20's features before beginning electrofishing.



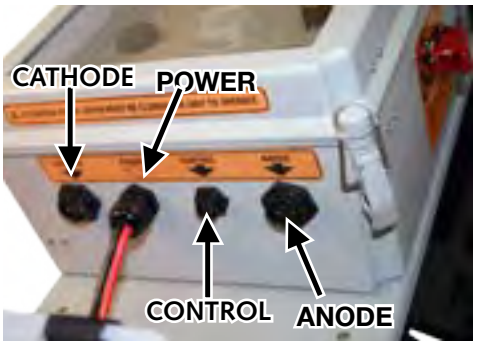
OVERVIEW (Cont.)



Duty cycle and Output Frequency



Clockwise: LCD display; Power/ Emergency Shutdown Switch; Output Frequency and Duty Cycle switches; Cover Latch.



Left to right: Cathode connector; power cord; control connector; anode connector.

OUTPUT FREQUENCY- controls the output frequency or pulses per second of the electrofisher.

DUTY CYCLE- Controls the percentage of time the output pulse is on out of the time from the start of one output pulse to the start of the next output pulse.

TIMER RESET- Resets the seconds counter display to zero.

LCD DISPLAY- Shows the number of seconds the output of the unit has been active since the last timer reset, the peak output voltage and current, the average battery voltage and current, a fuel gauge type display of the battery voltage, heat-sink temperature and waveform settings.

AUDIO ALARM- Provides loud audio warning whenever 30 volts or more are present between the anode and cathode and also when the unit is first switched on.

WARNING LIGHT- Flashes once per second whenever 30 volts or more are present between the anode and cathode and also when the unit is first switched on.

EMERGENCY SHUTDOWN SWITCH- Turns unit on when the red cover and switch are in the up position. Also serves as an emergency shutdown switch by means of red flip-down cover.

VOLTAGE RANGE SWITCH- Controls the output voltage of the electrofisher. Voltages between 50 and 990 volts may be selected.

IMMERSION SENSOR - Automatically turns the output off when water bridges the sensing contacts.

ANODE CONNECTOR - Provides the high voltage connection for the anode electrode.

CONTROL CONNECTOR- Provides the low voltage control connection to the pole switch.

CATHODE CONNECTOR- Provides the high voltage connection to the cathode electrode.

BATTERY CONNECTOR- Provides power to the unit from the battery.

COVER LATCH AND SENSOR- Two over-center toggle latches secure the front cover. Cover must be closed and latched before the output of the unit can be activated.

CONTROLS & CONNECTORS

EXTERNAL CONTROLS, CONNECTORS AND SENSORS



ON/OFF SWITCH: Located on the right side of the electrofisher under the red emergency off cover. To turn the unit on, raise the cover and push the switch up to the on position. To turn the unit off, press down on the red emergency off cover.

ANODE CONNECTOR: Located on the bottom right corner of the electrofisher the large black 2 socket connector provides the high voltage connection for the anode electrode. This connector has a locating lug that assures the anode pole can only be connected one way. The proper connection for the anode pole is with the cable pointing away from the backpack.

BATTERY POWER CONNECTOR: Located on the bottom left center of the electrofisher this red and black color coded connector provides power to the unit from the battery*. To connect a battery to the electrofisher, match the colors on the battery connector to the colors on the battery's connector, red to red and black to black**.

***CAUTION:** Before connecting or disconnecting a battery to the unit, make sure the power switch is in the off position, failure to do so may cause damage to the battery and the electrofisher.

****WARNING:** Reversing the connectors will damage the electrofisher and may cause serious injury or death.

CATHODE CONNECTOR: Located on the bottom left corner of the electrofisher the large black 2-socket connector provides the high voltage connection to the cathode electrode. This connector has a locating lug that assures the cathode can only be connected one way. The proper connection for the cathode is with the cable pointing away from the backpack.

CONTROL CONNECTOR: Located on the bottom right center of the electrofisher the small black 4-socket connector provides the low voltage control connection to the pole switch. This connector has a locating lug that assures that the control connector can only be connected one way. The proper connection for the control connector is with the cable pointing away from the backpack.

IMMERSION SENSOR: Located on the bottom left corner of the enclosure behind the cathode connector. The output of the electrofisher is automatically deactivated when these contacts come in contact with water.

NOTE: Although the immersion sensor is located above the battery tray of the LR-20, do not submerge the battery; doing so will cause damage to the battery and the electrofisher.

FRONT COVER: The clear window cover of the control panel allows easy observation of the controls and display. To open the cover, release the over-center latches at the top and bottom right corners of the electrofisher.

NOTE: The front cover must be closed and latched before the output of the unit can be activated.

CONTROLS & CONNECTORS (Cont.)

FRONT PANEL CONTROLS AND INDICATORS

TIMER RESET: Located on the upper right corner of the front panel. This switch allows the user to reset the 6 digit seconds timer back to 0.

DUTY CYCLE: Located on the upper left center of the front panel. This switch controls the percentage of time the output pulse is on out of the time from the start of one output pulse to the start of the next output pulse. When the duty cycle is set to DC, the electrofisher puts out a constant DC voltage determined by the voltage range switch.

FREQUENCY: Located on the upper left of the front panel. This switch controls the output frequency or pulses per second of the electrofisher. When the duty cycle switch is set to DC, Gated Burst 2 pulse or Gated Burst 3 pulse, this switch has no effect on the output of the electrofisher.

DISPLAY: Located in the top center of the front panel. The display shows the number of seconds the output of the LR-20 has been active since the last timer reset, the output voltage and current and a fuel gauge type display of the battery voltage. The backlight of the LCD display is always on when the electrofisher is on; this allows easy viewing of the display even in deep shadows without the need to open the front cover and turn on another switch.



LR-20/LR-20B FRONT PANEL - Top to bottom, left to right: Frequency, Duty Cycle knobs; Timer Reset Button; Display Window; Voltage Range Switch; Audio Alarm; Warning Light.

VOLTAGE RANGE SWITCH: Located on the left side of the front panel. This 11-position switch controls the output voltage of the electrofisher. Voltages between 50 and 990 volts may be selected.

WARNING LIGHT: Located in the bottom center of the front panel. Wide viewing angle, high brightness red LED's flash once per second whenever 30 volts or more are present between the anode and cathode and also when the unit is first switched on.

AUDIO ALARM: Located on the right side of the front panel. A high volume audio alarm with volume shutters provides additional warning whenever 30 volts or more are present between the anode and cathode. In addition, the beep rate gives an indication of the power being drawn by the unit. It also sounds when the unit is first switched on.

BATTERY INSTALLATION

To ensure operator and unit safety, as well as the life of the battery, care must be taken to make sure that the battery is installed correctly.

The easiest way to install the battery is to place the electrofisher on the ground (or similar safe, dry surface), rather than on the operator's back.

A. Start by placing the LR-20B on the ground, orienting the battery inside with its bottom on the wall towards the packframe and centering it towards the bottom.

B. Lay the battery inside the battery tray handle up, so that the power connectors are closest to the control box.

C. The handle should fit inside the corresponding notch in the front of the tray.

Pass the battery strap through the oval handle cutout and secure the clasp while taking up any slack in the strap. It should be snug and not allow the battery to move.







PACKFRAME

The packframe allows for various positions of the shoulder straps and waist belt to fit most people. The straps and belt all have quick release latches that allow the Electrofisher to be removed quickly if the operator falls into deep water or becomes injured*.

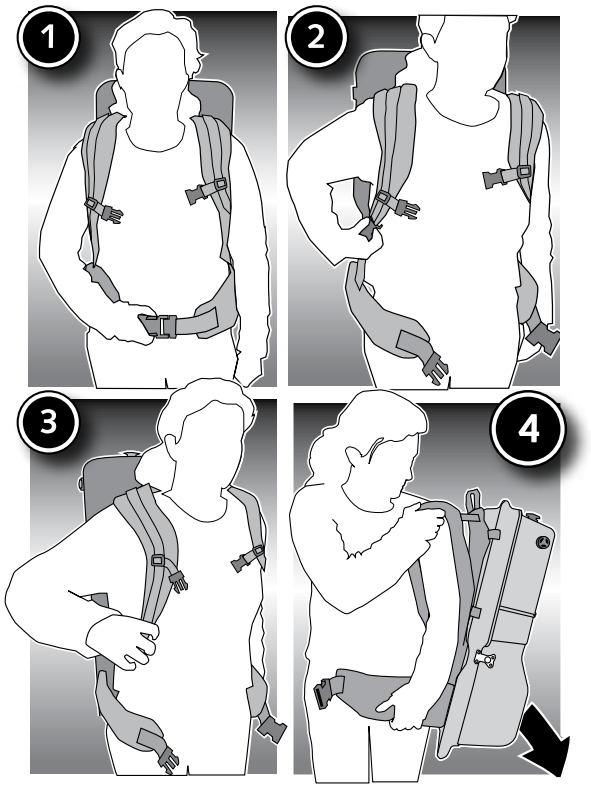


***WARNING:** Always unfasten the chest strap of the pack before crossing or entering the water. Should you fall into deep water, the chest strap may prevent you from removing the electrofisher quickly.

QUICK RELEASE SYSTEM

It may be necessary in some circumstances to remove the electrofisher backpack quickly.
The LR-20 has an integral quick release pack frame. Just press the latch tabs on the waist belt **(1)** and shoulder straps **(2)** and the entire unit falls away.
The following procedure illustrates how the quick release system is designed to work:

1. **Squeeze the release tabs on hip belt buckle to remove hip belt.**
2. **Squeeze the release tabs on either shoulder strap.**
3. **With strap detached, shrug off opposite shoulder strap.**
4. **This will allow the pack to fall away from you very quickly! Move away from pack as it falls**.



CABLE STRAIN RELIEF CLIPS

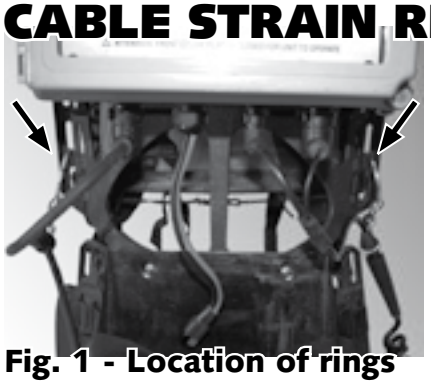


Fig. 1 - Location of rings



Fig. 2 - Right side



Fig. 3 - Left side

These clips are designed to prevent the anode and cathode cables from traveling beyond their recommended range of motion and to relieve undue strain on the connector plugs.

Make sure that the ring-mounted swivel clip on either side of the packframe is attached to the electrode cables as shown in Figs. 1-3.

Using the rings and clips in the manner indicated will transfer the weight of the electrode cables to the packframe and offset the possibility of damaging either cable or their respective connectors.

WARNING: **Without Cable Strain Relief Clips, the anode and cathode connectors or their cords could become damaged.**

OPERATION

Make sure the Electrode ring is clean and shiny. A cloudy, dull-gray Electrode ring will reduce your catch per unit effort and will increase the injury rate of fish. Initial setup of voltage, frequency, and duty cycle should be done outside of your sample area to avoid influencing your statistics.



1. Make sure the power switch on the side of the control unit is in the off position (pressed down).

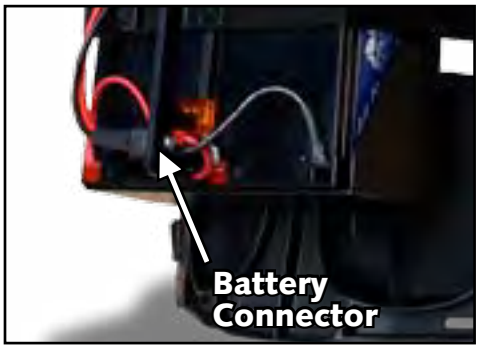
2. Attach the anode and cathode to their output connectors.

3. Attach the smaller connector on the anode cable to the control connector of the unit.



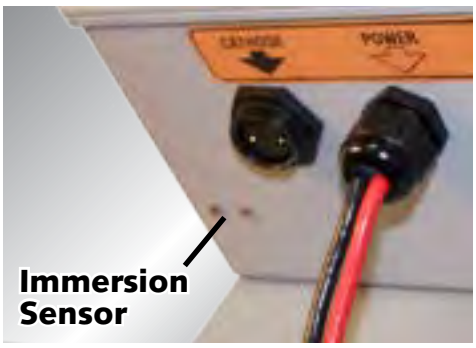
4. Be sure you know the location of the quick release buckles for the backpack, and unlatch the chest strap before entering or crossing the water.

5. Check with each crew member to be sure they know you are ready to turn on the power.



6. Connect the battery.

7. Turn on the power. Do not press the anode switch. Check the operation of the tilt switch by bending forward until the tilt switch activates, (about 55 degrees), and the tilt message appears on the display. Straighten up and the status display should return. If the tilt message does not appear, do not use the electrofisher; send it to Smith-Root for repair.



8. Place a dampened cloth on the immersion sensor contacts located on the lower left-hand corner of the control unit's box, behind the cathode connector. The display should show the immersion warning. When the cloth is removed and the power is turned off and back on, the display should return to the status screen. If the immersion message does not appear, do not use the electrofisher; send it to Smith-Root for repair.

9. Set the frequency, duty cycle, and voltage switches to the values you wish to use. If you don't know what values to use, set the switches as shown below and follow the procedure in the next step. NOTE: The front cover of the electrofisher must be closed to activate the output.

   Frequency 15 Hz.

   Duty cycle 10 percent.

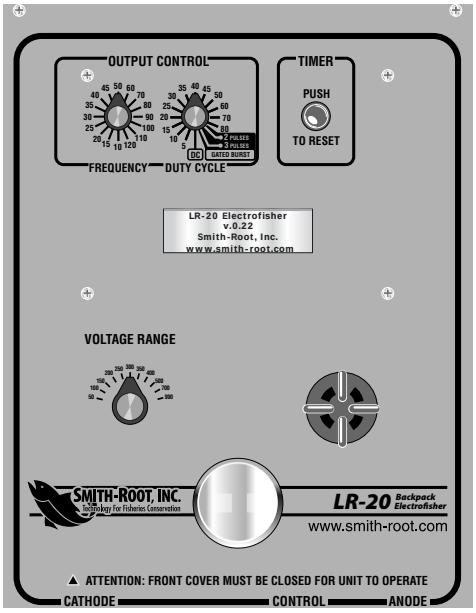
   Voltage 50 volts.

10. Duty cycle and frequency can have a huge impact on taxis. Do not be timid about changing these settings. In general, lower frequencies are safer for larger fish than higher frequencies. If you are not getting any response from fish at all, then change the settings as follows:

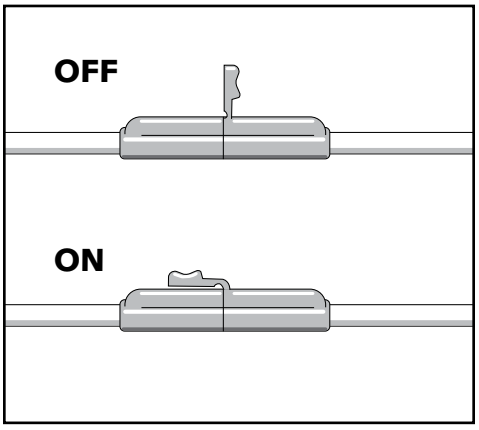
    a. Increase the voltage switch one position, and try again. Stop increasing voltage when you begin getting a forced response (twitch) from the fish when you press the anode pole switch.

    b. If fish are not showing taxis, then increase the duty cycle switch one position, and try again. If necessary, repeat this step until you elicit taxis in the fish. If you increase the duty cycle to maximum and still are not getting taxis, then reduce the duty cycle back to 10% and go to the next step.

    c. Increase the frequency switch one position, and try again. If necessary, go back to step "a" before increasing frequency again.



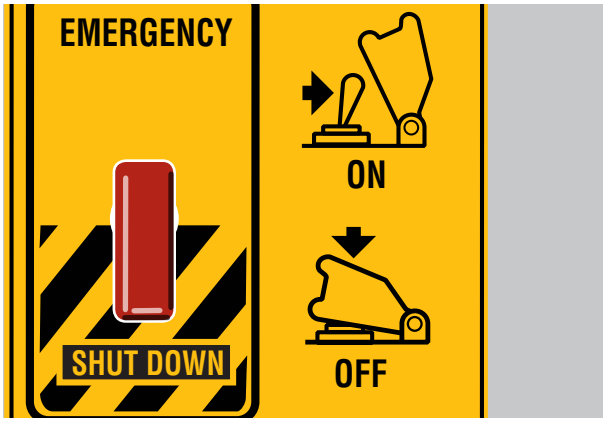
Front Panel details



Electrode Pole Safety Switch

SAFETY FEATURES

EMERGENCY SHUTDOWN SWITCH



The red flip-down toggle switch located on the right side of the control unit is the Emergency Shutdown Switch. This switch is also the main on/off switch for the Electrofisher. To turn the power on, the user must lift the red cover upwards and manually flip the exposed toggle switch to the up position. Since the red cover must first be lifted, it helps to prevent accidentally powering up the unit. Flipping the red cover down will immediately turn the unit off.



FLASHING RED LIGHT

Bright, long-life LED lamps flash whenever the unit is turned on and 30 volts or more is present between the anode and cathode.

AUDIO ALARM

The audio alarm indicates 2 different operating conditions:

1. **Presence of high voltage in the water:** Whenever the anode and cathode are in the water and more than 30 volts is present while the unit is on, there will be an audible tone emitted by the alarm.

2. **Average power output level:**

   From 0 to 49 watts the audio tone pulses once per second.

   From 50 to 99 watts the audio tone pulses twice per second.

   From 100 to 149 watts the audio tone pulses three times per second.

   From 150 to 200 watts the audio tone pulses four times per second.

PACK FRAME QUICK RELEASE

The LR-20 and LR-20B have an integral quick release pack frame. Simply lift one of the two tabs on the shoulder straps while unlatching the waist belt and shrug the entire unit away.

CAUTION!: Always unlatch the chest strap of the pack before entering or crossing water. If left latched, this strap may prevent the user from quickly removing the LR-20B in the event of an emergency, such as falling into deep water.

SAFETY



ELECTROFISHING SAFETY

SAFETY QUICK LIST

1. At least two members of the crew must have current first aid and CPR cards.
2. Make sure every member of your crew knows where the nearest hospital is and how to get there or where to go to get help.
3. All members of the crew should have completed an electrofishing course.
4. Before loading up equipment and heading into the field, make sure every member of the crew knows your evacuation routes in case of an accident.
5. Check the equipment for damaged or missing parts and for proper operation. Never use an electrofisher that is in poor condition or not working correctly as it can present a severe shock hazard.
6. Check the cathode cable for wear and burrs that may cause injury or tear holes in protective clothing. Check the insulation for damage. Replace the cathode as necessary.
7. Check the anode pole for cracks in the fiberglass and handle assembly. Replace as necessary.
8. Check the curl cord for cracks and abrasion. Do not use a cracked pole or a pole with a damaged curl cord.
9. Check your boots and high voltage gloves for holes. Boots and gloves must be watertight and without any holes. Repair or replace as necessary.
10. If you are using chest waders, you should use a wading belt.
11. Check all batteries for damage. Never use a damaged battery, as the gelled electrolyte in these batteries is a strong acid and can cause severe chemical burns and damage clothing and the electrofisher.
12. Use only dip nets with non-conductive handles. Never use an anode as a net as it is extremely dangerous to other members of the crew and can cause severe injury to any fish caught with it.
13. Never electrofish alone.
14. Never electrofish when you are tired.







SAFETY DO'S AND DON'T'S

DO'S:

1. Always be sure that all personnel are clear of the electrodes before turning on the power.
2. Know how to administer first aid treatment for electrical shock.
3. Wear flotation devices.
4. Have electrical circuits checked only by qualified technicians.
5. Disconnect the power supply when the electrofisher is not in use.

DON'TS:

1. Don't electrofish alone!
2. Don't continue to electrofish if your boots or gloves get wet inside.
3. Don't operate an electrofisher if you have had any prior heart ailments.
4. Don't electrofish when you are tired.

15. Never try to reach into deeper pools with the electrodes. If you can't safely wade in an area, it cannot be electrofished with a backpack electrofisher.
16. Only one person on a crew can order the power for the electrofisher to be turned on, and that person is the crew leader. The crew leader is responsible for the safety of everyone on the crew.
17. Any member of the crew can call for or turn off the power to the electrofisher.
18. If an accident occurs, stop electrofishing and turn off the power to the Electrofisher. The person wearing the backpack Electrofisher should leave the water and take the Electrofisher to shore. The remaining members of the crew should help or attend to the accident victim. Get help for the injured person if necessary. Evaluate what happened and make the necessary procedural or equipment changes before proceeding.
19. Never electrofish with spectators on shore. Electric fields can travel large distances through buried pipes, metal culverts, and metal sheet piling. If spectators show up during electrofishing, stop the operation and explain what you are doing. Explain the risks to them being there and ask them to please leave for their own safety. If they refuse to leave, stop electrofishing, load your equipment, and leave the area.
20. WARNING: Operating this equipment in a manner not specified in this manual or with accessories not approved by Smith-Root, Inc. may impair the protection offered by the equipment

ELECTRICAL SHOCK

It is the current that passes through the human body that does the damage. The voltage is relevant, because it is the force that "pushes" the current through the body. Experiments show that 20 to 500 Hz AC current is more dangerous than DC, or higher frequencies of AC.
The voltages used by electrofishing gear cause can death by one of three means:

Ventricular Fibrillation
Ventricular fibrillation is uncoordinated contraction of the muscles of the heart. The heart quivers rather than beats. Electrical current through the chest can cause this condition. Once a person goes into ventricular fibrillation, the only way to stop the quivering is to use a defibrillator that applies a pulse shock to the chest to restore heart rhythm. Cardiopulmonary resuscitation may help to keep a victim alive until he can be defibrillated.

Respiratory Arrest
The respiratory center is at the base of the skull. Thus, shocks to the head can cause the breathing to stop. Artificial respiration by the mouth-to-mouth method should be used in this case.

Asphyxia
Asphyxia is caused by contraction of the chest muscles.

When a current is above a certain level, a person cannot let go of an electrically hot wire. Currents above this level may not cause ventricular fibrillation but may be enough to cause contraction of the chest muscles. If the current is not stopped, or the victim is not removed from the point of electrical contact, asphyxia will result. Artificial respiration or cardiopulmonary resuscitation may be necessary.

PREVENTING ELECTRICAL 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. The current flows from the cathode to the anode through the water. The water is the electrical conductor. If you touched 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 touch only one of the electrodes, you would not complete the electrical circuit and not get shocked.

WARNING: Touching any electrode is not recommended. Unless all conductive objects you come into contact with are connected to the same electrode, you will be shocked to find a current path that is not obvious, e.g., the water, or the boat.

Preventing electrical shock means preventing electrical current from entering and flowing through parts of the body. The skin is a partial but variable barrier because it offers resistance to the passage of electrical current. Tough skin has more resistance than tender skin, and dry skin more than wet skin. But tough, dry skin alone does not offer enough protection for electrofishing. Rubber lineman's gloves rated 1,000V minimum should always be worn.

Even while wearing rubber gloves and waders, never touch an electrode while the circuit is energized.

Do not work on the electrical system while the generator is running. Do not enter the water while the current is on during boom shocking operations.

A severe electrical shock from electrofishing gear may result in the need for artificial respiration; therefore, it is imperative that no one ever works alone.

To prevent electrical shock, all electrical equipment should be carefully inspected before each field operation. With all electrical equipment in good operating condition, and all insulation, junction boxes, bonding, and connections intact, there is much less danger of receiving an electrical shock.

BATTERY CARE AND MAINTENANCE



Battery Care and Maintenance



UBC-24 SPECIFICATIONS

Input ..... 120 Volts AC 60Hz, 200 VA
Output .....5A DC 24V
Dimensions .....6.5"W x 5.25"H x 6.0"D
Weight .....9.5 lbs.

UBC-24 Charger....04954

CHARGER DESCRIPTION

The **UBC-24 Battery Charger** is designed to charge Batteries for the **LR-24**, **LR-20 Series** (and earlier Smith-Root 24V models) Electrofisher Systems.
The UBC-24 is a truly automatic charger tailored for maintenance-free batteries as well as other types of lead acid batteries.

The UBC-24 has a fully automatic, three stage charge sequence with an electronically timed routine and a desulfation mode.

STAGE 1 - Constant Current Mode. The charger starts with maximum current until the battery reaches a preset voltage.

STAGE 2 - Timed Constant Voltage Mode. The charge is electronically controlled with a fixed voltage ceiling which prevents excess battery gas emission and over-charging.

STAGE 3 - Float/Standby Mode. In this mode a fixed ceiling of 2.3 volts per cell will be maintained by monitoring and replacing battery standing losses as necessary.

Full electronic protection is provided against short circuit and reverse battery connection.

READ THESE INSTRUCTIONS BEFORE USING THE CHARGER

The battery charger is only designed for indoor use and should not come into contact with water or dust. In order to avoid overheating, the charger should not be covered when it is in use.

Chargers filled with molding material are splash-proof, but must not be immersed in water over long periods of time.

The mains socket should be easily accessible. If an operational error occurs, the plug should be immediately removed from the socket.

The charger contains dangerous voltages and the cover should not be removed. All service or maintenance work should be carried out by qualified personnel who can get assistance by contacting the manufacturer's agent.

A fuse protects the product against short-circuiting and overloading.

The charger is designed for charging lead batteries. For safety reasons, individual battery types should have a minimum capacity. Recommended battery capacity: 6V 4-12Ah, 12V 3-12Ah, 24V 1.5-12Ah. Contact the battery manufacturer for the specific battery. Do not attempt to charge batteries that are not rechargeable.

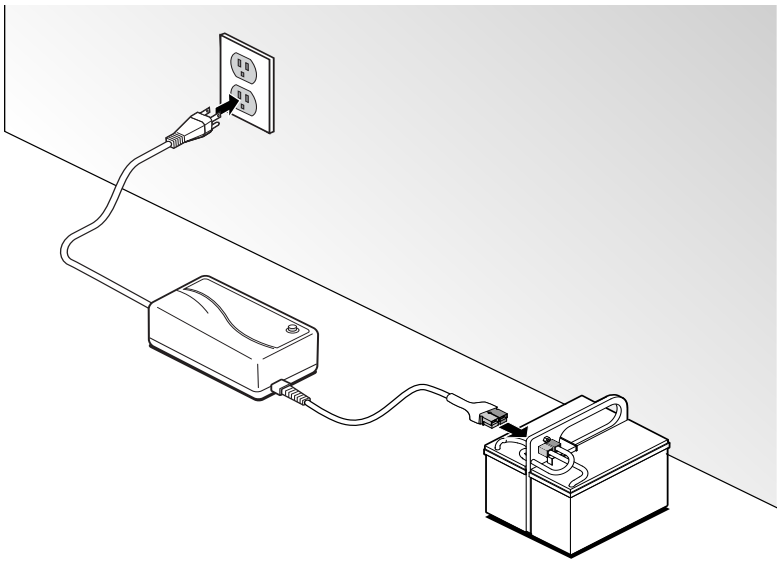
CAUTION: Old, sulphated batteries usually have a reduced capacity and are difficult to charge. The charge current will fall quickly as if the battery had received a full charge.

Even though a battery in this condition should be replaced, it will retain a small charge.

If mounted in a vehicle, the charger can only be used when the vehicle is not in use.

HOW TO CHARGE BATTERIES

1. The charger and battery should be placed in a well-ventilated area during charging.
2. Do not connect the charger to the mains before it is connected to the battery.
3. Verify that the polarity is correct and connect the charger cable: Red to red; black to black.
4. Connect the charger to the mains.
5. When charging is finished, disconnect the charger from the mains before you disconnect the charge from the battery.



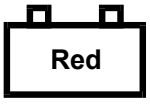
WARNING: Explosive gases can arise while charging. Avoid sparks and open flames. Verify that there is adequate ventilation while charging. The charger should not be used in the vicinity of flammable gases. Avoid chargers with plastic casing coming into contact with oils, grease, etc., as most types of plastic can be broken down by chemicals and solvents.

LED'S INDICATE FOLLOWING CHARGE STATUS



FAST CHARGE
The charger is in constant current mode.
Charge current is at its maximum.

FINAL CHARGE
The charger is in constant voltage mode.
Charge current is less than its maximum.
The battery is normally 80-95% charged.
The charger stays in this mode until the charge current decreases to charge termination level.



FLOAT (STANDBY/READY)
The charger is in standby mode.
The battery is fully charged. The LED changes to green.
The charge voltage is at standby level, which means the charger can continue to be connected to the battery.
The charger can return to rapid charging if the battery is used.

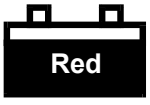






Fig. 7.2: **24V-12Ah**



Fig. 7.3: **24V-7Ah**



Fig. 7.4: **24V-2.2Ah**

24V-12AH Battery.....**06682**
24V-7AH Bat-

BATTERIES

The electrofisher uses a 24 volt sealed deep cycle battery. Understanding the proper care of this battery will reduce problems in the field.

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. 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 48 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.

Note that all batteries should be charged after each use even if the battery was only slightly discharged (these batteries do not have a memory). Total number of charge/discharge cycles possible varies inversely with depth of discharge on each cycle. Over-discharging or completely discharging the battery will greatly reduce the cycles possible and a battery left in a discharged condition may be ruined. For this reason, batteries should never be allowed to remain in a discharged state. Recharge as soon as possible after each use.

Service Life: Batteries which have been properly maintained should last 3 to 5 years depending on ambient temperature, depth of discharge (D.O.D.) and number of cycles (for Smith-Root batteries to maintain at least 80% of original capacity, they are rated 230 cycles for 100% D.O.D., 470 cycles for 50% D.O.D. or 1100 cycles for 30% D.O.D.). Batteries which have reached this end of life condition may still be useful where shorter operating times are appropriate.

Shipping: These batteries conform to the UN2800 classification as "Batteries, wet, non-spillable, electric storage". They conform to the International Air Transport Association (I.A.T.A.) Special Provision A67, classifying them as non-dangerous goods and are therefore exempt from the subject regulations for dangerous goods and are acceptable for transport on both cargo and passenger aircraft.

Reference: I.A.T.A. Dangerous Goods Regulations, 35th Edition, Jan 1, 1994 Section 4.4, Special Provisions:

Battery Maintenance & Diagnostic Equipment

BATTERY TIPS & PRECAUTIONS

1. Keep the battery charged! The most frequent cause of battery failure is not recharging after each use.
2. Heat kills batteries. Avoid storage in exceedingly warm areas. Recommended operating temperatures are between 5 and 35 degrees C (maximum - 15 to 50 degrees C). The energy available on a given discharge cycle decreases at low temperatures and increases at higher than normal temperatures. Increased temperatures increase the gradual processes of very slow corrosion which normally occur in all lead acid batteries.
3. Avoid heavy vibrations or shocks, which may cause internal damage. Foam packing is cheap insurance.
4. Avoid contact with oils or solvents which may attack the battery case (ABS plastic resin). Clean with soap and water only.
5. Do not crush, incinerate or dismantle the battery. The electrolyte contains sulfuric acid which can cause serious damage to eyes and skin. Dispose of old batteries at a battery recycler.

Life	Load	Capacity
20 hr	0.60A	12.0Ah
10 hr	1.05A	10.5Ah
5 hr	1.95A	9.7Ah
1 hr	7.20A	7.2Ah
30 min	12.00A	6.0Ah

Fig. 7.5: Relative capacity of 12Ah deep cycle battery.

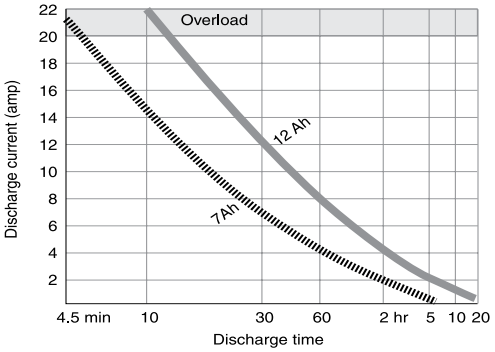


Fig. 7.6: Discharge curves for 12Ah and 7Ah batteries.

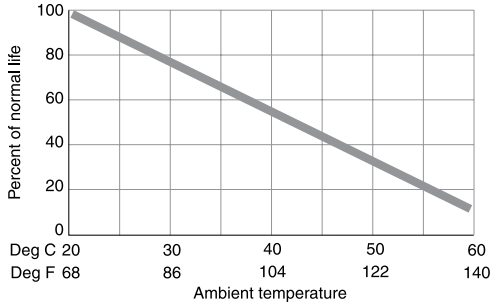


Fig. 7.7: Effect of temperature on battery life.

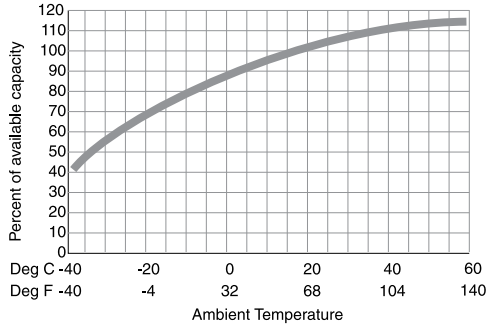


Fig. 7.8: Effect of temperature on capacity.

BATTERY SPECIFICATIONS

Rating: Batteries are rated at the current which will reduce the voltage per cell to 1.67 volts in 20 hours. The heavyweight battery has a 12 amp hour rating. However its life at 100 watt continuous would be only 120 minutes. As the discharge current is increased, the efficiency and relative capacity decrease.

BATTERY LIFE

Each time cycle a battery it loses some of its ability to take a charge. Deep cycle batteries are capable of being charged and discharged from 100 up to 1,000 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.

BATTERY STORAGE

3% to 6% per month. Storage temperature above 20°(68°F) should be avoided. Shelf life can be increased by storing at lower temperatures, but store at above -30°C to prevent freezing. Batteries should be fully charged before storing and should be recharged every four months.

EFFECTS OF TEMPERATURE

The temperature at which a battery is used also affects the relative capacity of the battery. **Figures 7.7 and 7.8** show that in cold weather the shocking time will be less and the battery will have less capacity.

Battery Maintenance & Diagnostic Equipment

MC-24 MAINTENANCE CHARGER

The Smith-Root MC-24 Maintenance Charger (sold separately) is specifically designed for proper battery maintenance and storage.

Trickle charging optimizes battery shelf life by reducing cell deterioration. Keeping batteries fully charged can greatly increase battery life. The MC-24 eliminates the hassle of shuffling batteries from shelf to charger and keeps batteries properly charged and ready for service. With the built-in battery evaluation load test function and maximum charge indicators, you can see the state of charge and condition of each battery and identify low charged and worn-out batteries. Charging batteries using the MC-24 takes between two and four days. It is also an excellent cost effective alternative to purchasing multiple battery chargers, because it can recharge four batteries at once.



Fig. 8.1: MC-24 Maintenance Charger

BAT-01 BATTERY ANALYSIS TOOL

The Battery Analysis Tool (sold separately) operates in conjunction with the BC-24PS Battery Charger. It tests all models of 24 V backpack batteries (adaptors included) and in a clear and concise manner gives the usable battery life remaining.

This tool is not to be used during each charge / discharge cycle, but rather is intended to be used a few times a year, just prior to actually using the batteries. It may also be used to accurately test any Smith-Root 24 Volt battery where the battery condition is either unknown or is questionable.

In practice, The Battery Analysis Tool is plugged into a standard Smith-Root BC-24PS and also the battery under test. The battery will begin to charge as soon as the charger is plugged in (Do not use an MC-24 Maintenance Charger for this test).



Fig. 8.2: BAT-01 Battery Analysis Tool

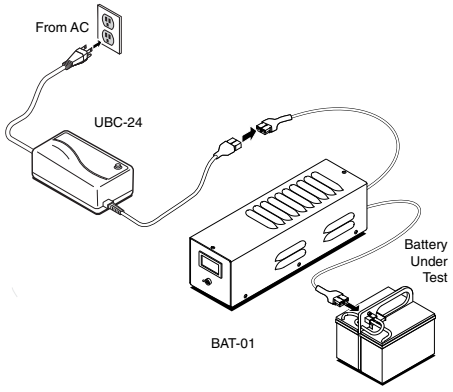


Fig. 8.3: BAT-01 Battery Analysis Tool hookup

MC-24 Maintenance Charger **06811**

ELECTRODE POLE AND CATHODE TESTER



Electrode Pole/Anode pole tester

ELECTRODE POLE & CATHODE TESTER

This test device allows customers using Smith-Root type LR-24, LR-20 and Model 12/15 backpack Electrofishers to test their anode poles and cathodes (rat-tails) in a simple, concise manner that requires minimal interpretation. The test device is designed to give a clear go – no go test of both anode poles and cathodes, as well as some limited indication of what is likely wrong with the item being tested. The Electrode/Cathode Tester is simple to use, and negates the need for any other test equipment (such as a volt-meter or continuity tester). It is self-contained and except for periodic replacement of the battery requires no service or calibrations. The tests can be performed by one person with no assistance.

Electrode/Cathode Pole Tester.....**08115**

LR-20 OPERATION HINTS

Make sure the Anode ring is kept clean. Anode rings are made from aluminum and will eventually develop an oxide coating that will give the ring a dull appearance. This coating impairs the transfer of electricity from the electrode to the water and can be removed with fine steel wool.

To maximize battery life, always connect batteries to their charger as soon as possible after use.

Resist the temptation to put a net on Anode rings. Nets have the following very undesirable characteristics:

1. They present a safety hazard since it can place the operator's hands unnecessarily close to the electrode when removing fish.

2. The intensity of the electric field increases as the fish to electrode distance decreases. Therefore, the risk of injury to the fish is greatly increased with the use of an Anode-ring net.

3. They make the Anode ring more difficult to clean.

CLEANING AND MAINTENANCE

The LR-20 enclosure and suspension system may both be cleaned with warm water and a mild soap solution. Spray the solution on the area to be cleaned and then wipe with a soft cloth.

CAUTION: Do not use solvents on the case of the LR-20 as they may cause permanent damage to the LR-20.

EXTENDED MAINTENANCE PROGRAM

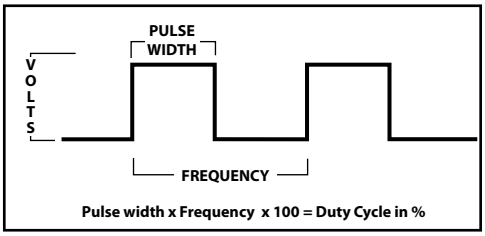
The extended maintenance program is a service contract offered to customers who have purchased SRI electrofishing equipment directly from our factory. It can be purchased for equipment that is past its standard one-year warranty. Older equipment is subject to eligibility parameters such as hours/years in service. Our Smith-Root factory technicians will perform cleaning of internal component parts, electronic repairs and calibration once (1) per year. During this maintenance period, upgrades to current specifications will be performed to factory standards. The unit will be recertified and issued an SRI certification label.
All labor and materials will be included in the yearly inspection.

Contact Smith-Root, Inc. for additional information.

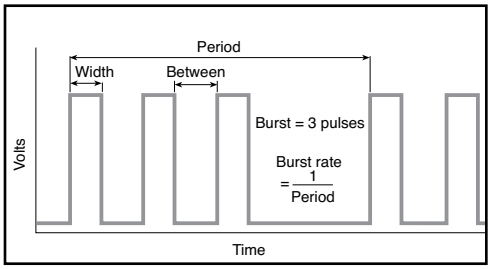
MODEL 12-B/15-D SETTING CHART

Use this chart to convert settings used with the 12-B or 15-D to settings on the LR-20.

Example: If H2 were used with the model 12-B, the corresponding settings for the LR-20 would be 50Hz at 5% Duty cycle. Note that the LR-20 does not have pulse width settings.



Duty cycle and Output Frequency



Gated Burst

Standard Pulses Model 12-B and 15-D							
Mode Switch		1	2	3	4	5	6
A	1Hz	2ms	3ms	4ms	6ms	7ms	8ms
B	5Hz	1ms	2ms	3ms	4ms	6ms	8ms
C	10Hz	500us	1ms	2ms	4ms	6ms	8ms
D	15Hz	500us	1ms	2ms	4ms	6ms	8ms
E	20Hz	500us	1ms	2ms	4ms	6ms	8ms
F	30Hz	500us	1ms	2ms	4ms	6ms	8ms
G	40Hz	500us	1ms	2ms	4ms	6ms	8ms
H	50Hz	500us	1ms	2ms	4ms	6ms	8ms
I	60Hz	500us	1ms	2ms	4ms	6ms	8ms
J	70Hz	500us	1ms	2ms	4ms	6ms	8ms
K	80Hz	500us	1ms	2ms	4ms	6ms	8ms
L	90Hz	500us	1ms	2ms	4ms	6ms	8ms
M	100Hz	100us	500us	1ms	2ms	4ms	6ms

See diagrams at left for an explanation of **Duty Cycle**, **Output Frequency** and **Gated Bursts**.

Duty Cycle Percent LR-20/LR-20B															
Frequency	5	10	15	20	25	30	35	40	45	50	60	70	80	GB 2 Pulse	GB 3 Pulse
10	5ms	10ms	15ms	20ms	25ms	30ms	35ms	40ms	45ms	50ms	60ms	70ms	80ms	4Hz	4Hz
15	3.3ms	6.7ms	10ms	13.3ms	16.7ms	20ms	23.3ms	26.7ms	30ms	33.3ms	40ms	46.7ms	53.3ms	62.5ms	62.5ms
20	2.5ms	5ms	7.5ms	10ms	12.5ms	15ms	17.5ms	20ms	22.5ms	25ms	30ms	35ms	40ms	@ 1Hz rate	@ 1Hz rate
25	2ms	4ms	6ms	8ms	10ms	12ms	14ms	16ms	18ms	20ms	22ms	24ms	26ms	125ms	187.5ms
30	1.7ms	3.3ms	5ms	6.7ms	8.3ms	10ms	11.7ms	13.3ms	15ms	16.7ms	20ms	23.3ms	26.7ms	12.50% Overall Duty	18.75% Overall Duty Cycle
35	1.4ms	2.9ms	4.3ms	5.7ms	7.1ms	8.6ms	10ms	11.4ms	12.9ms	14.3ms	17.1ms	20ms	22.9ms		
40	1.3ms	2.5ms	3.7ms	5ms	6.2ms	7.5ms	8.7ms	10ms	11.3ms	12.5ms	15ms	17.5ms	20ms		
45	1.1ms	2.2ms	3.3ms	4.4ms	5.6ms	6.7ms	7.8ms	8.9ms	10ms	11.1ms	13.3ms	15.6ms	17.8ms		
50	1ms	2ms	3ms	4ms	5ms	6ms	7ms	8ms	9ms	10ms	12ms	14ms	16ms		
60	0.8ms	1.7ms	2.5ms	3.3ms	4.2ms	5ms	5.8ms	6.7ms	7.5ms	8.3ms	10ms	11.7ms	13.3ms		
70	0.7ms	1.4ms	2.1ms	2.9ms	3.6ms	4.3ms	5ms	5.7ms	6.4ms	7.1ms	8.6ms	10ms	11.4ms		
80	0.6ms	1.3ms	1.9ms	2.5ms	3.1ms	3.8ms	4.4ms	5ms	5.6ms	6.3ms	7.5ms	8.8ms	10ms		
90	0.6ms	1.1ms	1.7ms	2.2ms	2.8ms	3.3ms	3.9ms	4.4ms	5ms	5.6ms	6.7ms	7.8ms	8.9ms		
100	0.5ms	1ms	1.5ms	2ms	2.5ms	3ms	3.5ms	4ms	4.5ms	5ms	6ms	7ms	8ms		
110	0.5ms	0.9ms	1.4ms	1.8ms	2.3ms	2.7ms	3.2ms	3.6ms	4.1ms	4.6ms	5.5ms	6.4ms	7.3ms		
120	0.4ms	0.8ms	1.3ms	1.7ms	2.1ms	2.5ms	2.9ms	3.3ms	3.8ms	4.2ms	5ms	5.8ms	6.7ms		

SPECIFICATIONS





SPECIFICATIONS	
Conductivity Range	10 – 1500 microsiemens per centimeter
Battery	24 volt 12AH sealed gel type
Output Voltage Ranges	50, 100, 150, 200, 250, 300, 350, 400, 500, 700, 990
Output Power	200W (**LR-20**) or 400W (**LR-20B**) maximum continuous
Output Frequency	10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 80, 90, 100, 110, 120
Output Duty Cycle	5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, GB 2 pulse, GB 3 pulse, DC
Overload Protection	15A (**LR-20**) or 25A (**LR-20B**) electronic breaker, and 40A safety fuse
Electrodes	6' 2-piece pole, adjustable 11 inch ring, Stainless steel rattail cathode
Timer	6 digit computer controlled seconds counter
Metering	• Peak output current • Peak output voltage • Battery voltage with fuel gauge type display • Battery current
Weight & Dimensions	• 33 lbs. • 13" L X 13 3/4" W X 29 3/4" H



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