



ELECTRO-TECHNIC PRODUCTS INC.

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Model BD-20A HIGH FREQUENCY GENERATOR

OPERATING MANUAL



SECTION 1--GENERAL INFORMATION

1.1 Description

1.1.1 The Model BD-20A High Frequency Generator produces a high voltage, high frequency spark at the tip of an electrode. The electric field created around the electrode is used for a variety of industrial, scientific and clinical applications including the following:

- Check the quality of a vacuum in a tube or vacuum system.
- Start gas discharge tubes.
- Detect minute cracks and fissures which cannot otherwise be seen in materials such as tank linings.
- Mix small amounts of liquids quickly and without contamination, an application of importance in the analytical chemistry and clinical laboratories.

04/11

Leak Testers, Corona Treaters, Science Education Products

web site: www.electrotechnicproduct.com

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- 1.1.2 The Generator and associated electronic and mechanical assemblies are housed in a durable, Bakelite case which can be held comfortably in the hand. It is provided with a 6 ft. (1.8m) cord to permit ample movement over the work surface. Power is supplied by a transformer which is housed in a separate unit allowing better heat dissipation. This case is finished in a durable, silicone-painted surface which is resistant to scratches. Metal tabs are incorporated into the case for permanent mounting.
- 1.1.3 The Model BD-20A Power Supply is furnished with a polarized plug of the US style with ground pin, and the cord is 6 ft. (1.8 m) in length. Operation is from 115 volts, 50/60 Hz.
- 1.1.4 The Model BD-20AV is identical to the Model BD-20A except that operation is from 230 volts, 50/60 Hz. A polarized and grounded line cord plus and 6 ft. line cord designed for operation from 230 volts is attached to the Power Supply, and is of the type and style for the country of use.
- 1.1.5 Included with either model is the Model 12201 Spring Electrode Tip which produces a softer corona discharge than that from a blunt end electrode. Also, the spring tip electrode is less likely to damage fragile glass surfaces if accidentally bumped against them.

1.2 Packing List

- 1.2.1 Carefully remove the instrument from the packing materials. Check to make certain that the 12201 Electrode, Spring Tip, is removed from the packing material. It is illustration below. Alert the factory or distributor of any shortages.

**Model 12201
Electrode, Spring Tip**



1.3 Specifications

Output Voltage	10,000 to 45,000 volts
Frequency	4.5 MHz
Output Current	Approx. 1 mA maximum
Operating Duration	Continuous
Input Voltage	115 V, 50/60 Hz (BD-20A) 220 V, 50/60 Hz (BD-20AV)
Generator (1xd)	11 x 2-1/2 in. (28x6.4 cm)
Power Supply (h x w x d)	4-1/8x7-3/4x3-1/8 in. (10.5x19.7x8 cm)
Shipping Weight	BD-20A: 6 lbs (2.7 kg) BD-20AV: 7 lbs (3.2 kg)

1.4 Warranty Repair / Replacement Information

- 1.4.1 If the unit requires repair, forward it freight prepaid to Electro-Technic Products, Inc. Please request a Return Authorization Number prior to sending it in.
- 1.4.2 Electro-Technic Products, Inc. reserves the right to repair or replace any unit sent in for warranty repair.
- 1.4.3 If found to be out of warranty, or damaged due to improper use, it will be repaired for a minimal labor and parts charge. We will advise the customer prior to any work being done.

SECTION 2 - INSTALLATION

2.1 Installation

2.1.1 For best results the instrument should be located away from sources of heat or air conditioners. Avoid areas of high humidity or highly corrosive atmospheres; if operation is required under any of these conditions, use intermittently and remove to another location for storage.

2.1.2 Do not use near flammable liquids or explosive gases.

2.2.2 The instrument is designed for operation from either 120 volts or 240 volts, 50/60 Hz, as marked on the instrument. Connect the power line cord to its matching three wire power line receptacle. This provides power properly polarized and grounded. Operation in any other way will result in a potential shock hazard and may affected the performance of the instrument.

2.3 Accessory Information

2.3.1 Push the Spring Tip Electrode into its matching socket in the Generator. To remove the electrode, firmly grasp the metal base of the electrode which protrudes about 1/4 in.(6mm) from the case and gently rock back and forth while pulling it out. Do not grasp by the spring. Do not install or remove electrode while in operation.

2.3.2 Do not use the Model 12201 Spring Tip Electrode in any other model High Frequency Generator.

SECTION 3-OPERATION

3.1 Operation Controls

3.1.1 Power ON/OFF Switch. Located on the side of the Power Supply case. In the ON position, circuitry is energized.

3.1.2 High Voltage Adjust Knob. Located on the end of the Generator case opposite the electrode. Adjusts the spark length by changing the spacing between the tungsten contacts inside. A counterclockwise rotation increases the spark length.

3.2 Calibration

3.2.1 The instrument requires no user calibration.

3.3 Operation

- 3.3.1 Once the power line cord plug has been properly connected to the source of power, the unit is ready to use. Bring the electrode tip near a large metal object or a ground connection. Turn the Power Switch to the ON position. If no spark is seen to jump from the electrode, the spark is being confined between the two internal tungsten contacts in the Generator. An associated electric field can be felt near the location of the tungsten contacts located opposite the electrode side of the Generator.
- 3.3.2 Turn the High Voltage Adjust Knob **counterclockwise** until the spark is seen to jump from the electrode to the metal surface. Continuing to turn the knob counterclockwise will increase to output until the maximum output is achieved. Continuing to turn the knob counterclockwise beyond this point will cause the circuitry to go out of resonance, and the output will abruptly go to zero. If this occurs, turn the knob **clockwise** until the resonance is reestablished, and the maximum output is attained. Continuing to turn the knob clockwise will decrease to output until the circuitry is again out of resonance, at which point the output will again abruptly go to zero. The travel of the knob from minimum to maximum output is about 1-3/4 turns.
- 3.3.3 Continue to adjust the output of the spark until the desired length (output) is attained. A nearly linear relationship exists between spark length and spark voltage. A one inch (m) spark represents peak voltages of approximately 50,000 volts, with a one half inch (13mm) spark a proportional 25,000 volts. Adjust the length of the spark most suitable for the application. Usually the proper spark length is determined through experience; however, the shortest possible spark length should be used to achieve the desired effect.
- 3.3.4 The basic principle of operation is that of a tesla coil which is a special type of induction coil generating a high frequency, high voltage. Refer to the Schematic Wiring Diagram at the end of this instruction manual. The power transformer T1 sets up a high voltage which causes a spark gap to break down at the rate of twice the line frequency (100 or 120 Hz). The spark gap charges capacitors C1 and C2 which are connected to the primary windings of the resonator coil T2 which is an air core rather than the iron core found in standard transformers. Because of the inductance of the primary windings of T2 and the capacitors, an oscillating current of very high frequency is set up in the circuit. When the spark gap is adjusted to the resonant frequency of the circuit (of the order of megahertz) frequency, high voltage is induced in the secondary windings of T2. This voltage is brought out to the electrode.
- 3.3.5 It has been found that for the various applications of this device, the high frequency of the output is much more effective than simply a static DC high voltage spark.

3.4 Applications

- 3.4.1 Check for cracks in a lamp, vial, or glass enclosed vacuum system. To test for cracks, adjust the High Voltage Adjust Knob to the desire output voltage, then place the electrode tip on the surface of the glass object which is under a vacuum. If a pinhole, crack or fissure is encountered, a bright concentration of the spark will be visible at this point.
- 3.4.2 Check for vacuum in a lamp, vial, or glass enclosed vacuum system. To test for a good vacuum, adjust the High Voltage Adjust Knob to the desire output voltage, then place the electrode tip on the surface of the glass object which is under a vacuum. If a good vacuum is detected, the gas inside will ionize, exhibits a blue or purple glow. The amount of ionization is determined by the pressure within the container.
- 3.4.3 The High Frequency Mixer is used to mix small amounts of liquids quickly and without contamination. The procedure outlined here is used in clinical laboratories to mix sera and small amounts of aqueous solutions added to the sera. This technique is equally applicable to mixing other types of small amounts of solutions in other procedures in both the clinical and analytical laboratories.
- 3.4.4 This method of mixing has been successfully used in various clinical laboratories. The specific procedure used is to test for certain antigens in blood sera by using the MICRODROPLET lymphocyte cytotoxicity test. Briefly, this procedure consists of placing antisera into the wells of a typing tray and covering each well with a layer of mineral oil to prevent the evaporation of the antisera. Microdroplets of lymphocytes are added to each well in the tray. The High Frequency Mixer is used to insure that each of the wells is mixed properly.
- 3.4.5 A complete explanation of the procedure can be found in an article written by Dr. Paul I. Terasaki, Ph.D., entitled "Microdroplet Testing for HLA-A,-B,-C, and-D Antigens," published in the February, 1978 issue of The American Journal of Clinical Pathology. What follows is an explanation of specifically how the High Frequency Mixer is used in this procedure. Refer to this article or others found in the literature for information regarding the clinical procedure involved.
- 3.4.6 After the various sera are added to the wells of the typing trays, a thin layer of mineral oil is added to each well. The mineral oil, being less dense than the aqueous sera solution, floats on the top of the sera in each well, acting as a seal to prevent evaporation of the sera. This layer of mineral oil creates a problem, however, whenever small-sized droplets of any aqueous solution are added to the wells. Even though the droplet added may be more dense than the oil, the surface tension of the oil layer and the small size of the droplet often prevent the droplet from penetrating through the lighter oil layer and mixing with the sera solution underneath.

- 3.4.7 If a small wire is used to mechanically agitate the two aqueous layers into mixing, this procedure would be very time consuming as there may be many as 60 to 96 wells per tray to mix. There is also a risk of contaminating one well with the contents of another, even though the wire is washed after mixing each well. The High Frequency Mixer is used to mix the contents of each well quickly, thoroughly and without risk of contamination.
- 3.4.8 To use the High Frequency Mixer, place a grounded metal plate underneath the tray to be mixed. This plate directs the field generated to the wells, in a perpendicular direction to them. Apply power to the Mixer and adjust for a spark as explained in Section 3.3.2. Adjust the spark gap to an intermediate setting which seems to give acceptable results. This setting is not very critical, as long as it is within a reasonable setting. Pass the tip of the electrode about 2 to 3 inches (5 to 7.5cm) above the wells in a crisscross pattern, covering all of the wells in a few passes over the tray. The contents of each well should be seen to mix. Do not allow the spark to enter any of the wells directly as the pH of the solution in the well may be altered slightly. It should take only a few seconds to mix the entire tray. If a few wells are not mixed, pass the electrode over them again. In a few instances, a thin wire will have to be used to mechanically mix a well if the contents do not respond to electro mixing.
- 3.4.9 The basic principle of operation involved in the electro mixing process is that the surface tension of the oil is temporarily reduced, allowing the heavier droplet to fall through to the lower aqueous layer. Also, the water molecules in the aqueous layers, being electric dipoles, flip from one orientation to another as the electric field oscillates. This causes agitation of the aqueous layers which contributes to the mixing effect of the oscillating electric field.

3.5 Hazards

- 3.5.1 This instrument emits a high frequency, high voltage spark. Keep the electrode tip away from the body. Care should be taken to avoid letting the spark be attracted to metal objects worn on the body such as rings and jewelry. A spark to the body will not cause harm, but might cause a slight discomfort, like the sensation felt when a spark jumps from the finger tip to a metal object after having walked across a carpet on a dry day. The output of the instrument is at a very low current. Also, the skin of the body has a very high resistance to the high frequency current, causing any current to flow harmlessly over the skin.
- 3.5.2 Do not operate around flammable liquids or gases as the spark may ignite them.
- 3.5.3 Ozone gas is generated around the tip of the electrode when oxygen in the air is ionized. The gas has a pungent odor, but is harmlessly dissipated in a normally ventilated area. Do not use in a confined area where high concentrations of ozone gas can develop.
- 3.5.4 This instrument generates an output at the radio-frequency level. Users who wear a pacemaker or other medical electronic device which might be affected by radio-frequency waves are advised to consult a physician before using this instrument.



Special Notice Regarding CE Marking. The Model BD-20AV generates a high voltage corona of approximately 2.5 MHz. However by the very nature of its design, it will produce electromagnetic interference (EMI) as a result of its operation.

Electric arc welders, for example, are another product that by its very nature and mode of operation produces EMI.

As a result, the Model BD-20AV cannot meet the European Union Electromagnetic Compatibility (EMC) Directive 89/336/EEC, and cannot be CE marked. It does, however, meet EN61010-1:1993 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, following the provisions of the Low Voltage Directive 73/23/EEC, as amended by 93/68/EEC

Because of the risk of EMI, a risk assessment should be carried out prior to use of this equipment. The power output of the Model BD-20 is limited. The effective range of EMI is less than about 1 meter on so in all directions. Metal objects nearby may bend or deflect this radiation. Therefore, there is some risk that it might interfere with electronic equipment 1 meter or so from this apparatus. This might include telephones, computers, cell phones, for example. Operators who wear pacemakers may also wish to consult with a physician prior to using this equipment.

SECTION 4 - MAINTENANCE

4.1 MAINTENANCE / INSPECTIONS

4.1.1 If the output level of the Model BD-20A is required to be verified when this instrument is in use, check the output with a Model 12701 Peak Voltage Calibrator, shown below.



4.1.2 The High Frequency Mixer contains no user adjustable components inside either the Power Supply or Generator. Any attempt at repair while the instrument is in warranty may result in any future in warranty service being denied.

4.1.3 Several components will exhibit wear with extended use and will eventually require replacement. The failure modes of several of these components are very similar to what causes the failure of a tungsten-filament incandescent light bulb after extended use.

4.1.4 Due to a combination of corona discharge, high voltage and high temperature, the insulation in the capacitors and resonator coil may fail. Corona discharge develops around microscopic bubbles within the insulation material. Within time the corona discharge creates larger bubbles, the process accelerating until eventually a voltage breakdown occurs.

4.1.5 In time the tungsten contacts will require replacement in order to maintain the proper setting of the high voltage output.

4.1.6 When used continuously or for an extended period of time, the tungsten contacts will begin to evaporate and condense on the plastic molded base of the 035-0002 Generator Mechanical Assembly, causing a short to develop across this component.

4.1.7 It is recommended that whenever this instrument requires service, it be returned to the factory or distributor postpaid, with a statement concerning the problem. The instrument will be repaired promptly for a small labor and parts charge.

4.2 Repair



CAUTION. Take precautions not to touch any wires, as power to be unit may have to be applied with the cover removed to perform certain of this operations.

4.2.1 Only personnel familiar with electronic circuitry should attempt repair. If it is necessary to repair while either the Power Supply cover or Generator housing are removed, be cautious as high voltage will be present at various locations in the circuitry. Refer to the Schematic Wiring Diagram at the end of this manual.

4.2.2 The Power Supply cover is removed as follows:

- a) Remove the two screws from the side flap of the cover.
- b) Carefully lift the cover from the case and move to the side. The wiring to the generator is attached to the transformer by two quick-disconnect terminals. Carefully disconnect these terminals.

4.2.3 The Generator housing is disassembled as follows:

- a) Remove the electrode from the socket.
- b) Carefully remove the recessed hex nut holding the electrode socket to the threaded nylon stud attached to the resonator coil. A special nit driver is available from Electro-Technic for this purpose. It is SKU 049-0025-1. Remove the electrode socket.
- c) Turn the High Voltage Adjust Knob fully counter clockwise. Place a small wrench on the flattened portion of the shaft to hold it from turning while the knob is turned counterclockwise and removed from the shaft.
- d) Note the number of washers around the shaft and remove. Washers are placed on the shaft to prevent the possibility of the two tungsten contacts inside the housing from shorting whenever the High Voltage Adjust Knob has been turned fully clockwise. The number of washers will vary from unit to unit, from none at all to as many as three.
- e) Remove the insulating wax covering the two screws on the Generator housing near the High Voltage Adjust Knob and remove the screws. Save this wax.
- f) The Generator housing is in two parts. Grasp the grooved portion and turn the other portion counter-clockwise to remove.

- g) Carefully remove the electronic and mechanical assemblies from the grooved portion of the housing. The high voltage cord set attached to the electronics will prevent the complete removal of the assemblies from the housing.

4.2.4 The factory maintains stock of replacement parts. Consult the Parts list. A Parts Price List is available upon request. .

4.2.5 Refer to Section 4.1.2 for assistance in troubleshooting possible failure modes. If the Generator were accidentally dropped on the High Voltage Adjust Knob, it may be necessary to replace the 059-0004 Bridge Yolk Assembly to repair the unit.

4.2.6 Once repair is completed, carefully reassemble the Power Supply cover and Generator housing.

- a) Reinstall the proper number of washers on the shaft of the Generator. When any of the mechanical components of the Generator are replaced, the number of washers required after repair may be different than before. Use a sufficient number of washers to preclude the possibility of the tungsten contacts from shorting.

- b) Using a soldering iron, replace the protective wax over the two screws on the Generator housing.

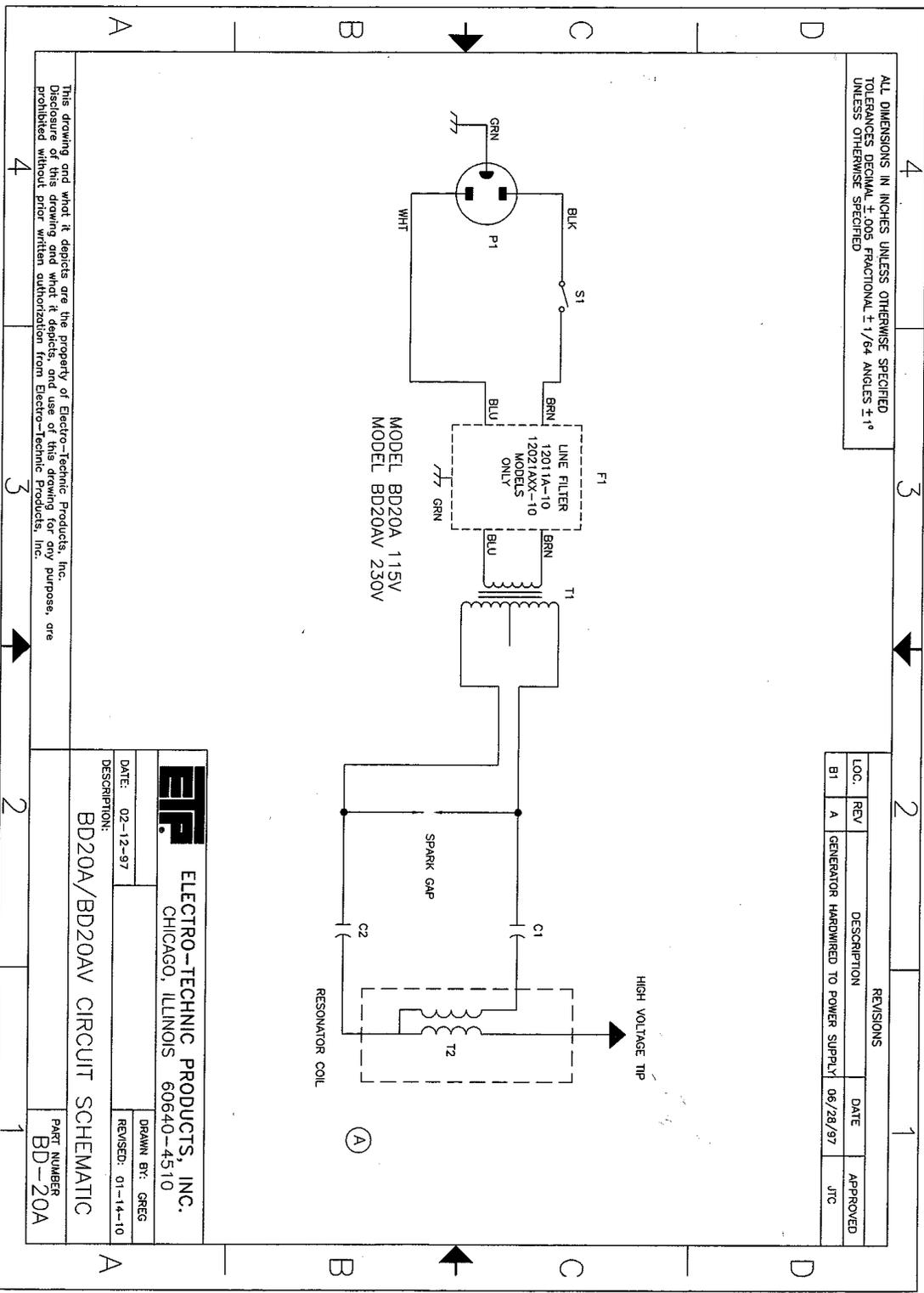
SECTION 5 - PARTS LIST

5.1.1 Contact Electro-Technic for parts price list, or visit our website at www.electrotechnicproduct.com, to check for current prices. To do so, enter the e-commerce section from the home page, and enter the part number in the search box.

Part Number	Schematic Code	Description
12201		Electrode Tip, Spring, BD-20
001-0012-1		Screw, 2-56 X 3/8
001-5085-3		Screw, Nylon, Resonator, 10-32 x 1-1/2
002-0005-1		Nut, 10-32, Hex, for Electrode Socket
002-0007-1		Nut, 2-56, Hex
010-0002-1	T1-115 V	Transformer, 115 V
010-0011-1	T1-230 V	Transformer, 230 V
011-0004-1	T2	Resonator Coil
021-0057-1	C1, C2	Capacitor, 0.0025 uF, 10 kV
023-0024-1		High Voltage Cord Set, 6-1/2 ft
025-0003-1	C1, C2	Printed Circuit Board and Capacitor Assembly
027-0055-1	F1	Power Line Filter
035-0002-1		Complete Top Mechanical Assembly
035-0003-1		Top Spring Rivet Contact Assembly
035-0004-1		Bottom Contact Assembly
035-0025-1		Bridge w/Posts, Ratchet Spring, Adjusting Screw with Tip (Top Assembly)
040-0004-1		Bracket, Right Angle, for Circuit Board
044-0002-1		Top Housing, Cone, with Eyelet
044-0004-1		Bottom Housing, Line Cord Side
044-0005-1		Adjusting Knob
044-3006-1		Top Mechanical Assembly Base
045-0003-1		Electrode Socket
049-0025-1		Nut Driver, 5/16 in.
050-0010-1		Contact Bushing
050-0037-1		Tungsten Screw Contact
059-0004-1		Bridge Yoke and Bushing
059-0008-1		Adjusting Screw Assembly
059-0040-1	S1	Switch, Toggle, SPST, w/leads attached
060-0002-1	P1-115 V	Line Cord Set, 3 Conductor, 115 V
060-000X-1	P1-230 V	Line Cord Set, 3 Conductor, 230 V, Specify Type
080-1203-1		Generator, w/o Power Supply, BD-20A, w/Terminals
080-1205-1		Power Supply, BD-20A, 115 V
080-1206-1		Power Supply, BD-20AV, 230 V, Specify Plug Type
083-0010-1		Housing, Bakelite

ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED
 TOLERANCES DECIMAL ± .005 FRACTIONAL ± 1/64 ANGLES ± 1°
 UNLESS OTHERWISE SPECIFIED

LOC.		REV	DESCRIPTION	DATE	APPROVED
B1	A		GENERATOR HARDWIRED TO POWER SUPPLY	06/28/97	JTC



MODEL BD20A 115V
 MODEL BD20AV 230V

ETP ELECTRO-TECHNIC PRODUCTS, INC.
 CHICAGO, ILLINOIS 60640-4510

DATE: 02-12-97
 DRAWN BY: GREG
 REVISION: 01-14-10

DESCRIPTION: BD20A/BD20AV CIRCUIT SCHEMATIC
 PART NUMBER: BD-20A

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