



**SPI-MODULE SPUTTER COATER  
WITH ETCH MODE**

**Instruction Manual**

**SPI Supplies Division of STRUCTURE PROBE, iNC.**

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# WARRANTY

The SPI Supplies unit you have purchased is guaranteed to be free of defects in workmanship on the day of shipment. This warranty covers parts and labor for a period of one year, excluding shipping charges or consumables.

breakage of glassware is specifically excluded from this warranty.

Proper use of your unit, according to this instruction manual, should result in trouble-free operation. Any improper use of the SPI Supplies unit through modifications or unreasonable operating procedures will void this warranty.

## DISCLAIMER

SPI Supplies instruments are designed for simplicity of installation and operation. This manual provides full and complete information in both these areas. SPI Supplies therefore assumes no liability or responsibility of any kind for damage or injury resulting from incorrect installation or operation of the machine. If questions arise, call SPI Supplies TOLL FREE at 800-2424 SPI (USA only). FAX at 1-610-436-5755 or EMAIL at SPI2SPI@2SPI.COM FOR ASSISTANCE.

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**CAUTION: THIS UNIT GENERATES HIGH VOLTAGE. THERE EXISTS A POTENTIAL SHOCK HAZARD IF NOT PROPERLY INSTALLED.**

Please read the manual carefully prior to setting up and operating unit. If assistance is needed please contact our Technical Service Department at SPI Supplies (800-2424-SPI) or E-Mail at

**General Description**

The SPI-Sputter Coater with Etch Mode Module is a sputtering power supply generating more than 1000 volts DC and a diode magnetron sputtering head with a high voltage cable and is shipped with a 3MIL gold cathode and instruction manual and an allen wrench suitable for replacing the cathode.

Figure 1 and Figure 2 show the module as installed on the Vacuum Control Base. The front panel controls are the Timer Set Knob in the upper right hand corner this sets the amount of time in seconds (from 10 to 120) the sputtering continues thus the thickness of the layer of gold applied. The Sputter-Off-Etch switch this selects the mode of operation either sputtering or etching. The "TEST" button initiates sputtering for as long as the button is held depressed this is useful for setting the sputtering current initially. The "START" button which initiates sputtering and the time is determined by the setting on the timer. Two pilot lamps are used to indicate primary power is on this is labeled "READY" and the other indicates sputtering is in progress it is labeled "TEST-START". Also included are the main power switch labeled "POWER" and a milliampere meter (0-50 ma) labeled "PLASMA CURRENT" this is used to monitor and set the plasma by adjusting the vacuum via the needle valve on the Vacuum Control Base.

On the rear panel the modules power cord exits. There is the high voltage terminal and the ground jack and there are two fuseholders one for the main power and the other the high voltage transformer, both are 1x1/4" glass fuses 2amps and 3/4 amps respectively.

**INSTALLATION**

The unit consists of the following components:

- 1 SPI-SPUTTER COATER MODULE
- 2 Sputtering Head with 3Mil gold cathode mounted
- 3 High Voltage cable
- 4 Allen wrench
- 5 Instruction Manual

Unpack the SPI-SPUTTER COATER MODULE and place it on top of the right side of the SPI-VACUUM CONTROL BASE. Place the glass chamber on the base plate of the VACUUM CONTROL BASE it should fit snugly into the groove and seal against the "O" ring in the bottom of the groove. The sputter head is mounted on the top of the chamber in the groove and seal against the "O" ring in the groove refer to the illustrations figures 1&2. Connect the high voltage cable white connector to the central banana plug on the sputter head and the other end into the jack on the back of the SPI-SPUTTER COATER MODULE the green ground wire is inserted into the hole on the sputter head and goes to the green jack on the back of the SPI-SPUTTER COATER MODULE \*. The SPI-SPUTTER COATER MODULE power cord is connected to the module power receptacle on the rear of the VACUUM CONTROL BASE. The SPI SPUTTER COATING SYSTEM is now ready to use.

**\*DANGER: IF THIS GROUND CONNECTION IS NOT MADE, THERE EXISTS A POTENTIAL SHOCK HAZARD AT THE SPUTTER HEAD.**

## TEST PROCEDURE:

Having already tested the VACUUM CONTROL BASE the sputter coating test can be run.

Switch on the power to the VACUUM CONTROL BASE and the SPUTTER COATER MODULE. With the gas leak needle valve closed after 10 to 15 seconds the fall in pressure within the work chamber will register on the vacuum gauge on the front of the VACUUM CONTROL BASE. As the pressure falls below 600-400 millitorr the power and ready lamps will come on. The unit should be left running for at least one hour or till the gauge indicates 80 or less millitorr. Depress the test button, the plasma current will be very small or none, slowly open the gas leak valve observing the plasma current, it should begin to rise, set the current for 18ma. and release the test button. With the timer set at 10 seconds depress the start button. The plasma current will be somewhat more than 18 ma. but it will proceed to decrease and stabilize at 18 ma or lower, the gas leak valve may be used to set whatever current is desirable. After 10 seconds the discharge will cease, a small deposition of gold maybe observed. Redepressing the start button will give 10 seconds again or the timer can be set for a longer time. After sputtering both power switches are turned off, the gas leak valve closed and air admitted to the chamber by opening the vent valve on the top of the sputter head.

## COATING OF SPECIMENS

A specimen holder is provided for holding up to 6 specimen mounts (depending on the type of mounts being used). The holder is mounted to the stage by a screw.

A typical coating operation is as follows:

- a) Mount specimens onto the mounts by any of the conventional techniques. However, it should be noted that many adhesives have high vapor pressure solvents associated with them and these solvents should be allowed to evaporate thoroughly before sputtering. These materials can affect the long term vacuum chamber and of target disc.
- b) The specimen mounts may be secured to the holder by the set screws provided. Set the position of the stage so the specimen is approx. 50 mm from the bottom of the sputter head.
- c) Replace the glass work chamber and place the sputter head of top of the chamber.
- d) Turn timer to required setting ( for example, 120 seconds ).
- e) Check that the leak valve is fully closed.
- f) Set the argon pressure to around 5 psi.

- g) switch on both "POWER" switches. The rotary pump will start immediately and the vacuum will be indicated on the meter. The "READY" light will go on when the pressure falls to approx . 600 -400 millitorr.
- h) Partially open the gas leak valve to flush the work chamber with argon for about 10 to 15 seconds. Close the leak valve and allow the work chamber to pump down to approximately 80 millitorr.
- i) Open the the gas leak valve until the pressure just begins to rise and by intermittently depressing the test button and adjusting the leak valve set the plasma current to the required current ( typically 18 ma. ). A visible discharge will be observed in the chamber.
- j) Depress the start button and gold will be sputtered onto the specimen for the set time (120). The plasma will automatically extinguish at the end of this period.
- k) Switch off both "POWER" switches . Admit air to the chamber using the "VENT" valve on the top of the sputter head.

### THICKNESS OF COATING

Generally , a gold film thickness of between 100 and 300 angstroms is used for investigations. An experimentally determined measure of thickness can be obtained from the following equation:

$$d = KIVt$$

Where d is the thickness of coating in angstrom units. K is an experimentally determined constant which depends on the metal being sputtered, the gas being used and is based on a distance of approximately 5 cm between the target and the specimen.

I is the plasma current

V is the voltage applied in kilovolts (kV)

t is the sputtering time in seconds.

Now "K" is approximately 0.17 for gold used in conjunction with argon , whereas with gold in conjunction with air the constant falls to 0.07, thus , for a typical sputtering using gold in argon with a plasma of 18 ma. for 120s seconds:

$$d = KIVt = 0.17 \times 18 \times 1 \times 120 = 367 \text{ angstroms}$$

i.e. approximately 3 angstroms per second

The sputtering rate will depend on the cleanliness of the sputtering system. Traces of contamination which can originate from out gassing specimens, adhesives, rubber gaskets, etc., affect the rate of sputtering . care should be taken to keep the work chamber clean . Other targets give different sputtering rates, e.g. a platinum target gives approximately half the sputtering rate as gold.

## USEFUL NOTES

### (a) REPLACEMENT OF THE TARGET

Disconnect unit from power source. Remove the sputter head and disconnect the h.v. leads from the head. Loosen the three allen set screws that retain the outer ring and remove the ring. Unscrew the target retaining ring. This should unscrew easily, but sometimes, after extensive use it may be necessary to lubricate the threads with Isopropanol. Remove the old target, replace with the new target and reverse above process to reassemble.

### (b) CLEANING SYSTEM

The glass work chamber can be cleaned easily using a dry mildly abrasive material. If a "wet" cleansing material is to be used, it should be confined to Isopropanol which, after evaporation, will not affect the vacuum performance of the system.

## USE OF ETCHING MODE

The use of the etch mode allows the cleaning of contaminants from the specimen prior to sputtering. The etching current is limited by internal resistance. Proceed as for the sputtering and after the plasma current is set turn the mode switch to etch and initiate the etching by depressing the start button with timer set for an appropriate time. When the etching stops, then switch to the sputtering mode and proceed with sputtering.

TROUBLESHOOTING THE SPUTTER MODULE

<u>Indication</u>	<u>Probable causes</u>	<u>Solutions</u>
1. Main / Ready pilot lamps not lit	power cord not plugged in main switch not on main fuse blown	check the power cord is plugged in and secure check main switch replace fuse
2. Main /Ready lights lit test/start light does not light when test button is pushed.	fu 2 fuse blown test switch faulty	replace fuse replace test switch *
3. Both pilot lights are lit but no current indication on the milliammeter.	H. V. xfmr faulty H. V. diodes faulty	replace xfmr * replace diodes*
4. Test button works, start button gives no current on the milliammeter and no test-start pilot lamp	faulty timer board faulty test switch	replace timer board* replace test switch*
5. TEST-START pilot lamp lit and excessive current on the milliammeter i.e. needle on meter all the way over to the right end of the scale and beyond	pressure too high in the work chamber sample out gassing chamber contaminated	reduce pressure with the gas leak needle valve leave on vacuum longer and try again clean chamber , base plate and stage

SPI Supplies has servic technician available during normal bussiness hours to assist you with your service problems. please call 800 2424 SPI.

\*These problems require the services of a qualified service technician. we recomend the instrument be returned to SPI Supplies , 569east Gay St. West Chester, Pa 19381



SPARE PARTS LIST

CATALOG NUMBER	DESCRIPTION
11453	Needle Valve
11455	Main Fuse 2 amp 1-1/4"x1/4" glass fuse pk/10
11456	HV Fuse 3/4 amp 1-1/4"x1/4" glass slo blo pk/10
11457	HV lead to chamber
11458	Moducell Pirani Guage Head
11459	Set of "o"rings for sputter head (3)
11468	H. V. transformer
11430TB	Timer Board complet

## ILLUSTRATIONS AND SCHEMATICS

Figure 1      Front view of module on vacuum base

Figure 2      Rear view of module on vacuum base

Figure 3      Exploded section of the sputter head

## SCHEMATICS

DR-1          Circuit diagram of sputter module

DR-2          Circuit diagram of timer board

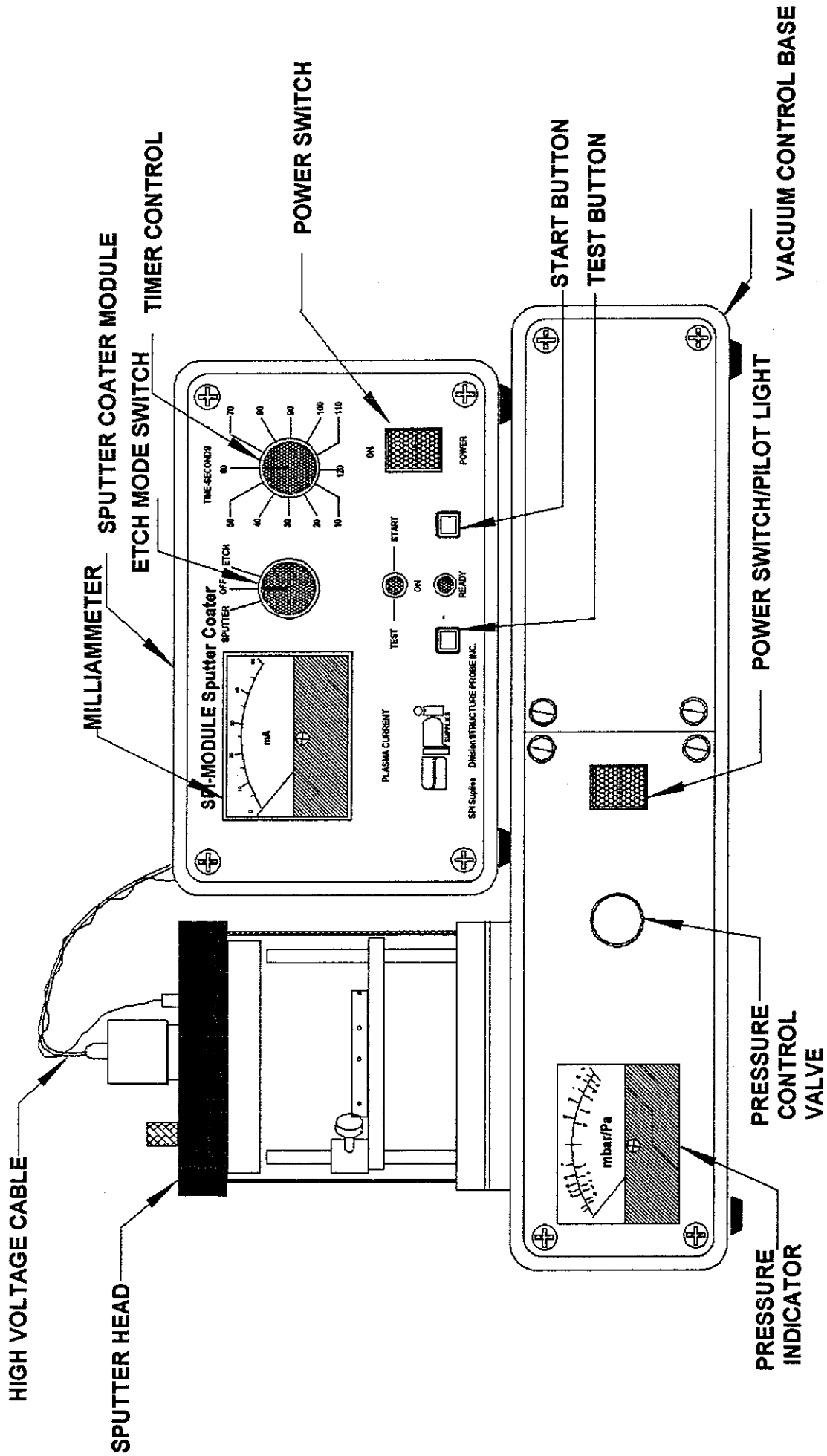
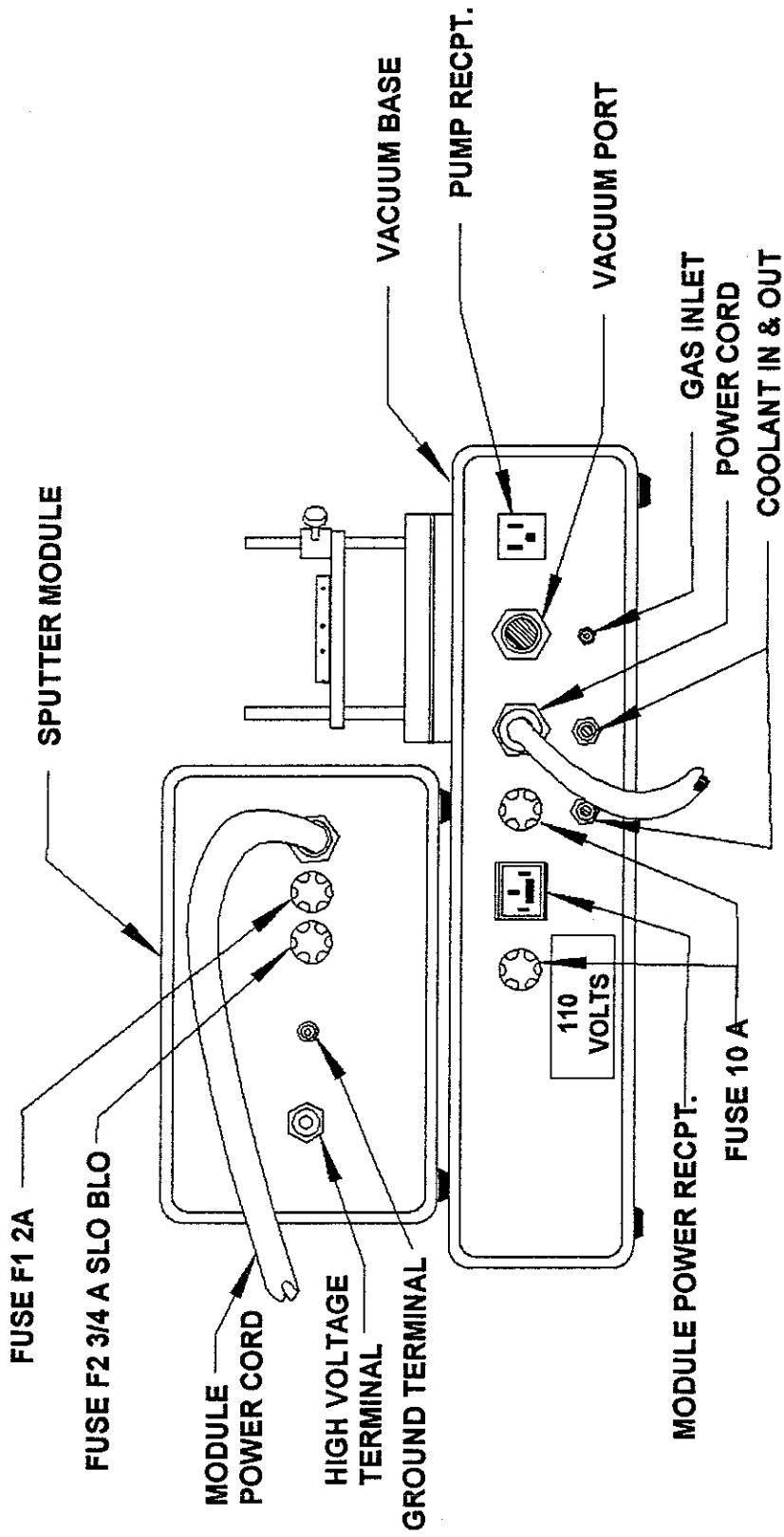
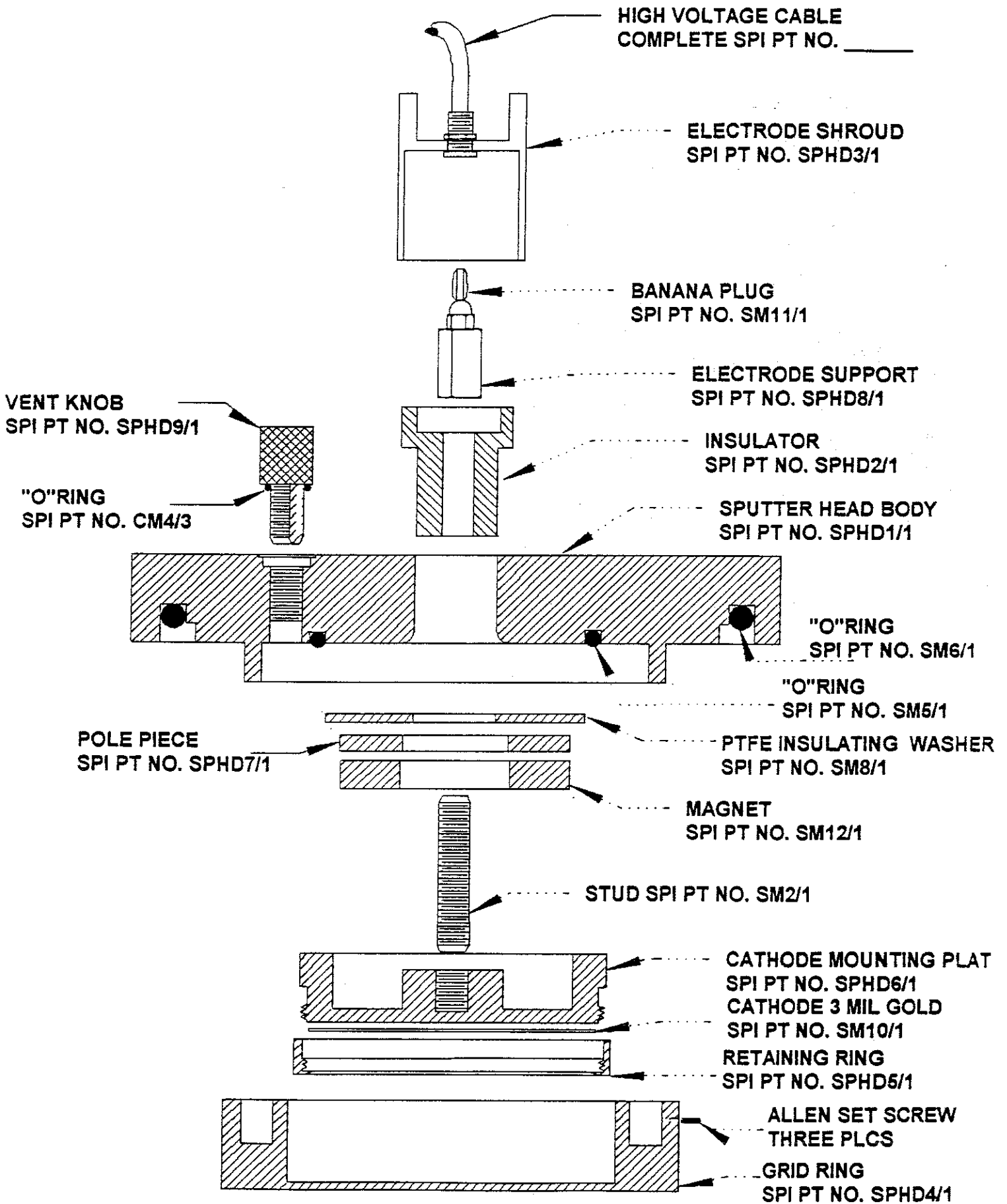


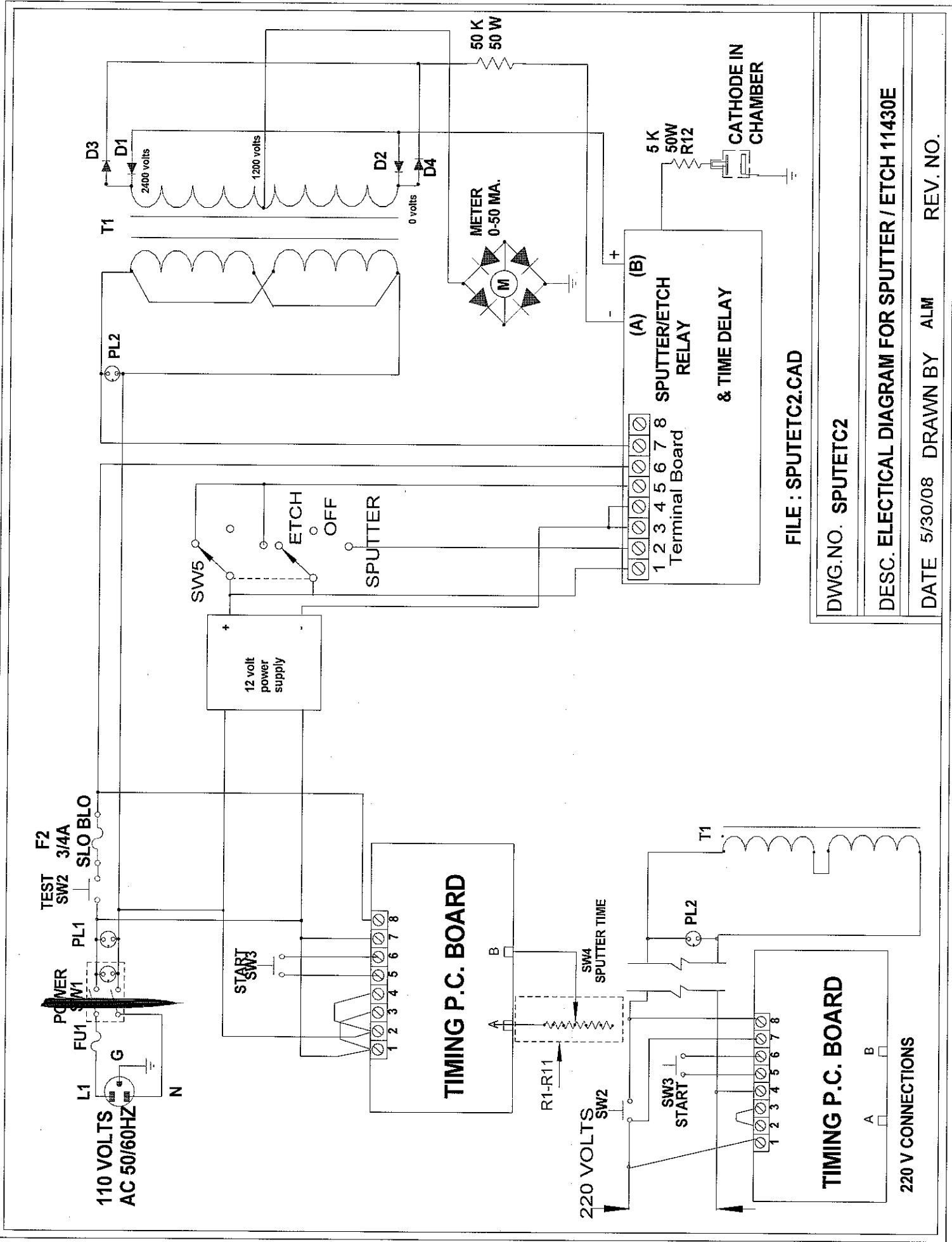
FIGURE 1



**FIG 2**



**SPUTTER HEAD CROSS SECTION / BLOW UP**



FILE : SPUTETC2.CAD

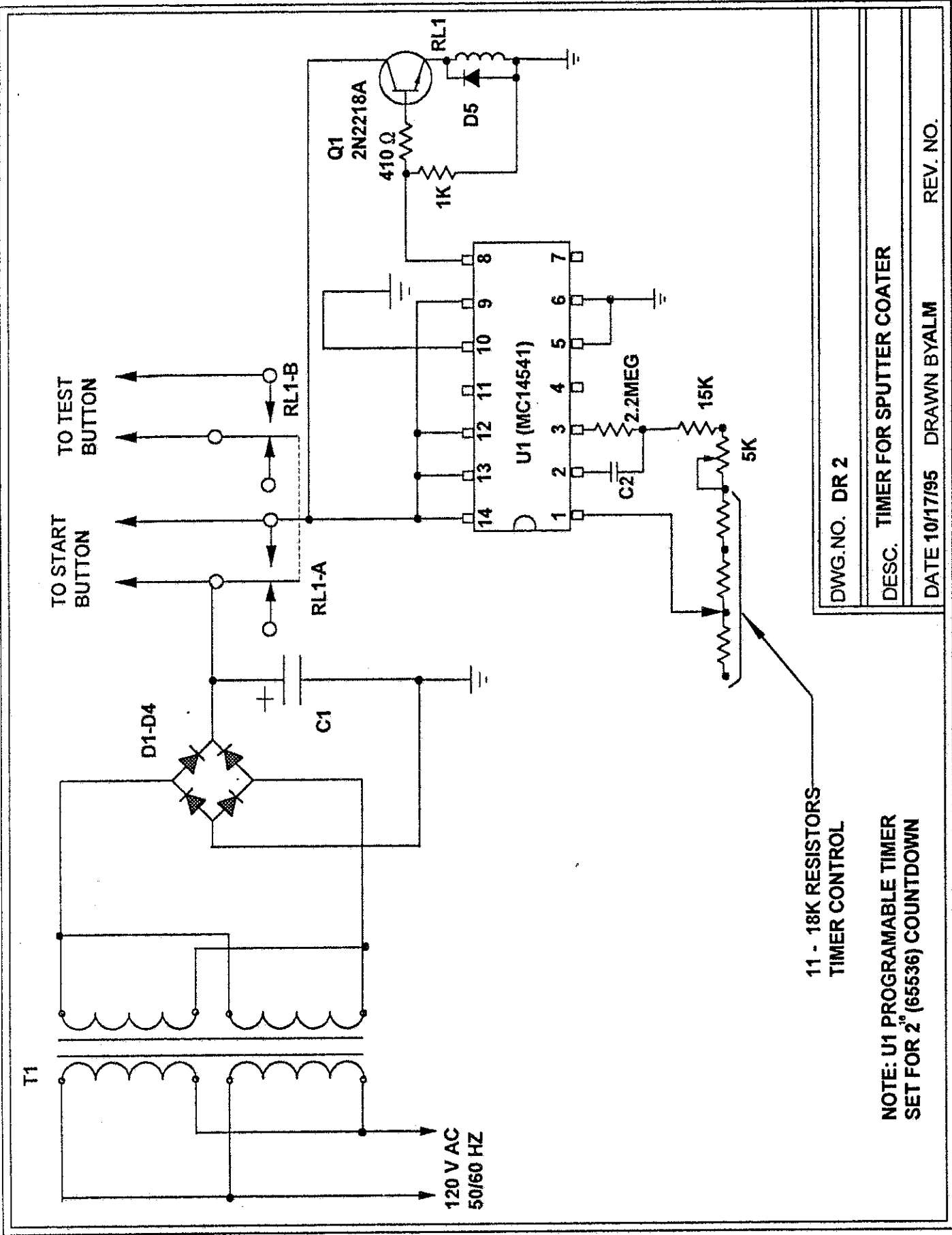
DWG.NO. SPUTETC2

DESC. ELECTRICAL DIAGRAM FOR SPUTTER / ETCH 11430E

DATE 5/30/08 DRAWN BY ALM REV. NO.

TIMING P.C. BOARD

220 V CONNECTIONS



11 - 18K RESISTORS  
TIMER CONTROL

NOTE: U1 PROGRAMMABLE TIMER  
SET FOR 2<sup>0</sup> (65536) COUNTDOWN

DWG. NO. DR 2

DESC. TIMER FOR SPUTTER COATER

DATE 10/17/95 DRAWN BY ALM

REV. NO.