BERTAN
High Voltage

HIGH VOLTAGE POWER SUPPLIES

MODEL 214 and MODEL 215

485214

BERTAN ASSOCIATES, Inc. 121 New South Rd., Hicksville, NY 11801 • (516) 433-3110 • TWX 510-221-2144

CAUTION: THIS UNIT PRODUCES HAZARDOUS VOLTAGE. DO NOT APPLY LINE VOLTAGE INPUT UNLESS ADEQUATE GROUND IS CONNECTED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN PROPERLY CONNECTED.

SECTION I INTRODUCTION

1.1 SCOPE OF MANUAL

1.2 This manual contains instructions for the installation, operation and maintenance of the -BA- MODEL 214 and MODEL 215 high voltage power supplies.

1.3 PURPOSE OF EQUIPMENT

1.4 The MODEL 214/215 is a general purpose bench top laboratory instrument. It is meant for use with positive or negative polarity photomultiplier tubes, high resolution CRT displays, solid state detectors, ionization chambers, proportional counters, lasers, ultrasonic transducers, deflection amplifiers and other devices requiring an accurate and stable source of high voltage.

1.5 Positive or negative polarity output voltage is available, either via appropriate connections to the output terminals on the MODEL 214 or via a polarity selector switch on the MODEL 215. A front panel METER provides a continuous reading of the output voltage.

1.6 GENERAL

1.7 A MODEL 214/215 consists of a dc power supply which converts 115/230V ac line power to a low dc voltage, and a dc-dc converter which converts the low dc voltage to a high dc voltage. The circuitry that accomplishes these functions is more fully described in Section III of this manual.

1.8 All of the electronic circuitry is mounted on a plug-in printed circuit board and on a high voltage and chassis assembly. A MODEL 214/215 is a mechanically rugged and electrically reliable assembly. The completely solid state unit uses reliable and conservatively rated components throughout. Correctly operated, it will perform over long periods of time with minimum maintenance and down time.

1.9 A MODEL 214/215 is a fully enclosed unit. The line cord, polarity switch (MODEL 215) and 115/230V line voltage selector switch are accessible at the rear of the unit. The ON/OFF switch, LED polarity indicators (MODEL 215), METER, OUTPUT VOLTAGE control, and HIGH VOLTAGE OUTPUT connector are on the front panel.

1.10 SPECIFICATIONS

Output Voltage:	0 to 1000V (MODEL 214), 0 to ±3000V (MODEL 215)
Output Current:	0 to 15mA (MODEL 214), 0 to 5mA (MODEL 215)
Line Regulation:	0.001%
Load Regulation:	0.005%
Ripple:	15mV pk-pk
Calibration Accuracy:	0.25% of dial reading plus 0.05% of max. voltage
Resolution:	200mV
Stability:	0.01%/hr., 0.02%/8 hrs.
Temperature Coefficient:	50ppm/°C over range 0-50°C
Line Voltage:	115/230V ±10%, 50-400Hz
Fuse:	115V - 1/2A, 230V - 1/4A, Type 3AG Slow Blow
High Voltage Output Connector:	3 binding Posts (+, -, GND) (MODEL 214), UG-931/U (MODEL 215)
Weight:	8 pounds (3.6 kg)
Protection:	Short circuit proof, arc protected, self restoring

SECTION II OPERATION

2.1 SCOPE OF SECTION

2.2 Section II contains information for installing and operating a MODEL 214/215.

2.3 INSTALLATION

2.4 The outline drawing (Fig. 1) illustrates clearance dimensions for the MODEL 214/215.

2.5 INPUT POWER

2.6 Input ac line voltage required is 115/230V ±10%, 50-400Hz. The recessed line voltage selector switch on the rear panel selects either 115V or 230V operation.

DO NOT OPERATE UNIT UNTIL IT IS DETERMINED THAT SELECTOR SWITCH IS SET FOR PROPER LINE VOLTAGE.

2.7 The toggle switch on the front panel is used to turn the unit on. A LED indicator light is illuminated when the unit is under power.

2.8 POLARITY

2.9 The dc output of the MODEL 214 is floating, allowing the unit to be used as either a positive or negative source. The terminals for +OUT, -OUT and GND are provided on the front of the unit. Either the positive or negative terminal may be grounded or the unit may be operated floating at up to 1000V above ground.

2.10 The MODEL 215 is a reversible polarity unit. The polarity selector switch is located on the rear panel. Front panel LED indicators indicate the position of the polarity switch.

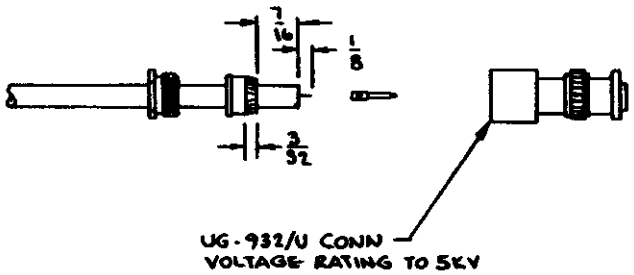
2.11 METER

2.12 A front panel METER provides a continuous reading of the output voltage with an accuracy of ±5%.

2.13 CONNECTORS

2.14 Connections to the MODEL 214 are made via 3 binding posts. Either the +OUT or the -OUT post may be grounded through an adjacent GND terminal provided for that purpose, or the supply may be operated floating at up to 1000V above ground.

2.15 The MODEL 215 is provided with an MHV type UG-931/U high voltage output jack on the front panel. A mating UG-932/U plug is provided. Assembly instructions for the mating plug are shown below.



SECTION III THEORY

3.1 GENERAL

3.2 Section III describes the overall functional operation and circuitry of the MODEL 214/215, and gives background information to assist in the application and maintenance of the equipment.

3.3 FUNCTION DESCRIPTION

3.4 A functional schematic and block diagram is shown in Figure 2 for the MODEL 214, and in Figure 3 for the MODEL 215. The units are basically a dc-dc converter which converts low voltage dc power to a high voltage dc output. This output voltage is highly regulated and filtered and can be varied by the front panel control. The input to the dc-dc converter is obtained from internal low voltage power supplies powered by the ac line input.

An oscillator determines the high frequency (approximately 20kHz) at which all amplification, high voltage transformation, rectification, and filtering occurs. The amplification is a function of a control voltage which performs the function of control and regulation. A sample of the output voltage is compared against a reference voltage in the sensing circuit. The sensing circuit generates the the control voltage to set and maintain a fixed high voltage output.

3.5 CIRCUIT DESCRIPTION (See Fig. 2, 3, and 4 for PCB 100)

3.6 The input ac line is connected to the B+ (36V dc) supply and regulated ±12V low voltage power supplies. The B+ supply is a simple full wave bridge rectifier circuit located on the chassis. The regulated low voltage power supply circuit (±12V) consists of a standard full wave center tap rectifier circuit located on the chassis and a dual output regulator (IC 107) located on PCB 100.

The output of the oscillator circuit (IC 104B) is amplified in the AGC integrated circuit, IC 106. The gain of IC 106 is a function of the control voltage developed at the output of the amplifier, IC 104A. The output of IC 106 is amplified and buffered in IC 105 to drive the power transistors, Q1 and Q2.

The encapsulated high voltage assembly includes a high voltage power transformer, rectifier circuit, ripple filter, and sensing circuit. These are all critical custom designed and encapsulated components. It is recommended that trouble-shooting be avoided by personnel who are not thoroughly familiar with highly regulated high voltage techniques.

A sample of the high voltage dc output is fed to the sensing circuit and is compared to a reference voltage. The sensing circuit consists of differential operational amplifier, IC 101. Output voltage control is obtained by varying the command voltage fed to IC 104A. This command voltage is controlled by the front panel VOLTAGE CONTROL.

IC 103A and potentiometer R 15 (front panel VOLTAGE CONTROL) provide a continuous linear command variation appropriate for obtaining a 0 to 1000V output. For the MODEL 215, the front panel 1kV control switch provides incremental step changes in the command voltage appropriate for obtaining incremental output variation of 1kV. IC 103B sums the effect of the voltage controls.

IC 102 and reference diode CR 2 perform the generation, control and buffering of the -5V internal reference voltage.

SECTION IV MAINTENANCE

CAUTION: THIS UNIT PRODUCES HAZARDOUS VOLTAGE. DO NOT APPLY LINE VOLTAGE INPUT UNLESS ADEQUATE GROUND IS CONNECTED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN APPROPRIATELY CONNECTED.

4.1 GENERAL

4.2 Section IV contains information required for the maintenance of the MODEL 214/215. It is organized around the approved performance test procedures used to determine that the equipment is operating to specifications.

4.3 TEST EQUIPMENT REQUIRED

4.4 The test equipment required to test and maintain a MODEL 214/215 is listed as follows:

A. Oscilloscope
B. Digital or differential voltmeter
C. Variable autotransformer
D. High impedance, high voltage 1000:1 precision voltage divider
E. Capacitive coupled ac viewing circuit
F. High voltage load resistor rated for maximum voltage and current of MODEL 214/215
G. High voltage shorting stick

4.5 PREPARATION FOR MEASUREMENTS

4.6 Connect the HIGH VOLTAGE OUTPUT of the MODEL 214/215 to the high voltage terminal of the dc voltage divider and to the capacitor input of the ac viewing circuit. The low voltage terminal of the dc divider should be connected to the digital voltmeter input, and the ac viewing circuit output connected to the oscilloscope input. Make sure that a good ground is connected to all instruments, viewing circuits, and the MODEL 214/215. After the ground has been checked, adequate safety precautions have been taken, and the output VOLTS controls set at zero, input power can be applied. The ac input should be applied thru the variable autotransformer, which should be initially set for 115 or 230 volts output, as appropriate.

4.7 ADJUSTMENTS

4.8 With the kV switch (MODEL 215) set at zero, adjust the VOLTS DIAL to read 1,000. Adjust the reference adjust potentiometer R 10 on PCB 100 for an output voltage of exactly 1,000V.

Readjust the VOLTS DIAL set to 10 (with the kV switch still at zero for the MODEL 215). Adjust the voltage sensing offset adjust potentiometer R 47 for an output voltage of 10V. Set the front panel voltage controls for maximum output voltage, and readjust the reference adjust potentiometer R 10 if necessary.

Adjustment is now complete. The following performance tests are used to determine that the unit meets all specifications.

4.9 PERFORMANCE TESTS

4.10 Check to assure that the procedures in Section 4.6 have been followed.

Turn the front panel output VOLTS controls fully clockwise until the reading on the digital voltmeter indicates maximum output from the MODEL 214/215.

Connect one end of the high voltage load resistor to ground and the other end to the shorting stick. Then, with the shorting stick, connect the load resistor across the HIGH VOLTAGE OUTPUT and observe the change in output voltage. During this no load to full load test, the digital voltmeter reading should not change by more than 0.005%.

With the load connected as above, observe the ac ripple voltage on the oscilloscope. The ripple should be less than the specified peak-to-peak ripple under this condition of full load and maximum output voltage.

Vary the autotransformer to produce an ac line input change of ±10% to the power supply and again observe the change in digital voltmeter reading. This change should be less than 0.001%.

Additional line and load regulation and ripple measurements may be performed at other voltage levels using the same procedure outlined above. This should not usually be necessary. Satisfactory test data at maximum output voltage and the full range of voltage control generally indicate that satisfactory test data will be obtained at all voltage levels. However, full range testing is performed at the factory on each unit prior to shipment.

4.11 TROUBLE-SHOOTING PROCEDURES

4.12 A MODEL 214/215 High Voltage Power Supply consists of one easily replaceable plug-in printed circuit board and a main chassis assembly which includes the high voltage circuitry. The basic trouble-shooting procedure consists of determining which of these assemblies is defective. Removal of the cover provides access to the printed circuit board and high voltage components. The printed circuit board is secured by a supporting bracket.

No further disassembly is required for trouble-shooting purposes. ONCE THE COVER HAS BEEN REMOVED, EXTREME CAUTION MUST BE EXERCISED AS POTENTIALLY DANGEROUS VOLTAGES ARE ACCESSIBLE. Make sure all test instruments are grounded, either to the high voltage connector shield or directly to the chassis prior to the application of input power to the unit. The following procedures should then be followed.

4.13 Remove PCB 100 from the unit. This leaves only the low voltage B+ and the unregulated ±20 volt power supplies operable. Turn on ac line power and measure the dc voltage obtained at the positive terminal of capacitor C 21 located on the chassis. This voltage should be approximately +41V dc. If this voltage differs by more than 15%, the power transformer, bridge rectifier or capacitor is probably defective.

If the B+ supply is operating properly, check for the unregulated ±20V dc output accessible at terminals 10 and 11 respectively of T-1. The ± voltages should be of equal magnitude to within 5% and within the range of 16 to 24V dc. If the magnitude and tracking are not within the range specified, this circuitry is probably defective.

4.14 If all of the low voltage power supplies are operating properly, turn off input power, insert PCB 100, turn all voltage controls to zero, follow the PREPARATION FOR MEASUREMENT procedure outlined in Section 4.5, and turn the line power back ON.

If output voltage can be obtained, but the unit does not properly regulate or the front panel control does not operate properly, PCB 100 is probably defective.

If no output voltage is obtainable, test for ac drive to the base of transistors Q1 or Q2 located on the rear of the unit. If drive is present, the high voltage assembly or transistors Q1 and/or Q2 are probably defective.

The plug-in board, PCB 100, can be repaired in the field or returned to the factory for repair or replacement. Spare boards can be obtained from the factory. These boards are completely assembled and tested and can be directly utilized as replacements for a board that is believed to have malfunctioned. Specify model number and serial number in all correspondence with factory. It is recommended that the entire unit be returned to the factory for the repair of the high voltage assembly.

SECTION V SPARES

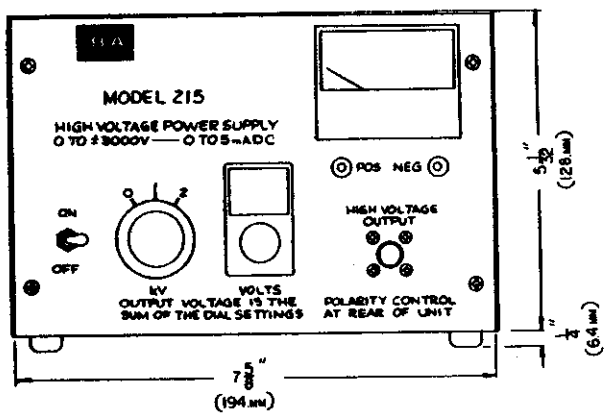
5.0 Operational spares to support the MODEL 214/215 are available from the factory. It is recommended that the common electronic components: i.e. resistors, capacitors, transistors, etc. be purchased from local electronics distributors. The values and descriptions of these components are indicated in Figures 2, 3, and 4. Specialized -BA- parts may be ordered directly from the factory and are indicated in the spares parts list below. Indicate the model number and serial number when ordering spare parts.

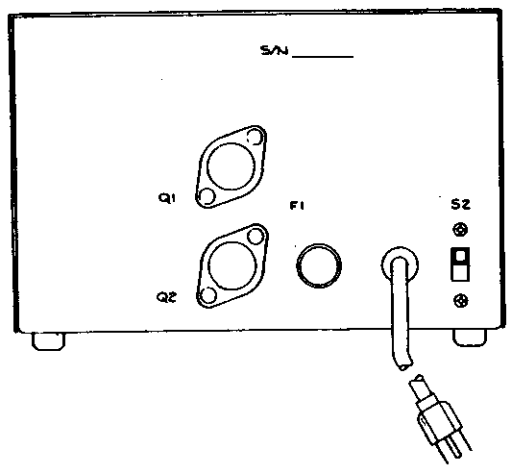
5.1 PARTS LIST - MODEL 214/215

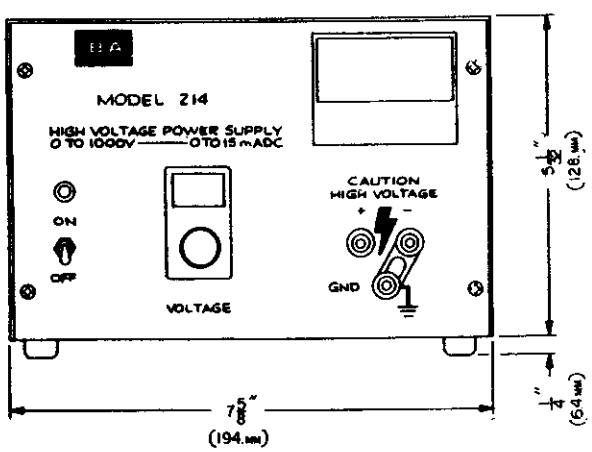
Description	-BA- P/N Model 214	215
Power Transformer T1	40113	40113
Bridge Rectifier CR 21	DBAPK 10	DBAPK 10
Panel Meter M1	303487-3	303487-1
Circuit Board PCB 100	204117-2	204117-3
High Voltage Assembly	303584	200778
HV Polarity Switch S4	---	300679
High Voltage Connector J1	---	UG931/U

WARRANTY

BERTAN ASSOCIATES, INC. warrants this instrument to be free from defects in material and workmanship for a period of one year from the date of shipment. This warranty does not apply to equipment that has been subjected to misuse or which has been repaired or altered in any way by the user. BERTAN ASSOCIATES, INC. is responsible only for the cost of materials and labor to repair or replace FOB our factory products proved to be defective during the warranty period. We are not liable for consequential damages incurred due to failure of this equipment. No other warranty is expressed or implied. All products returned under warranty must be shipped prepaid to the factory with documentation describing the malfunction noted. It is recommended that the factory be notified prior to shipment. The equipment will be evaluated, repaired or replaced and promptly returned if the warranty claims are substantiated. A nominal service charge will be made for unsubstantiated claims. Include the BERTAN ASSOCIATES, INC. model number and serial number in all correspondence with the factory.


MODEL 215
HIGH VOLTAGE POWER SUPPLY
0 TO ±3000V —— 0 TO 5 mADC
POS NEG
ON
OFF
0
2
kV
VOLTS
HIGH VOLTAGE OUTPUT
OUTPUT VOLTAGE IS THE SUM OF THE DIAL SETTINGS
POLARITY CONTROL AT REAR OF UNIT
5 1/32" (128 MM)
1/4" (6.4 MM)
7 5/8" (194 MM)


S/N _____
Q1
Q2
F1
S2


MODEL 214
HIGH VOLTAGE POWER SUPPLY
0 TO 1000V ——— 0 TO 15 mADC
ON
OFF
VOLTAGE
CAUTION
HIGH VOLTAGE
+
−
GND
5 1/32" (128 MM)
1/4" (6.4 MM)
7 5/8" (194 MM)

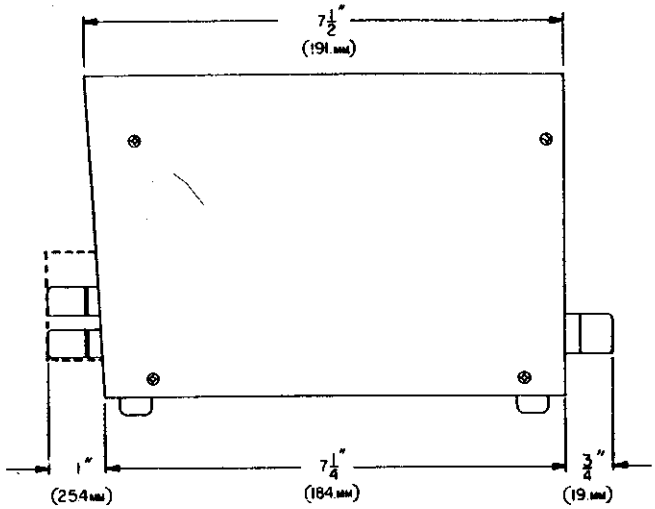

7 1/2" (191 MM)
1" (25.4 MM)
7 1/4" (184 MM)
3/4" (19 MM)

FIG 1

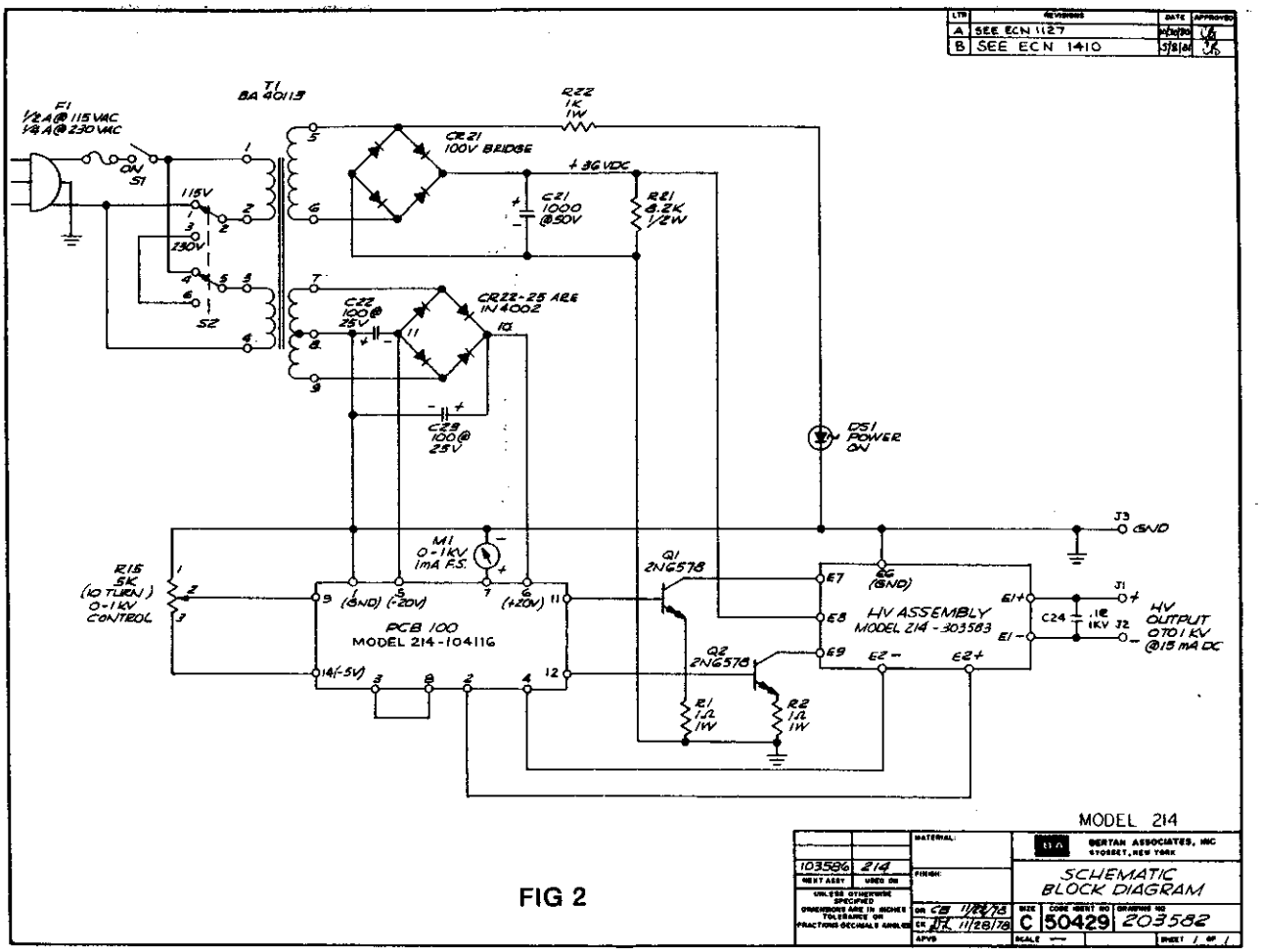

REVISIONS
A SEE ECN 1127
B SEE ECN 1410
F1
1/2A@115VAC
1/4A@230VAC
ON S1
T1
BA 40113
115V
230V
S2
CR21
100V BRIDGE
R22
1K
1W
+36VDC
C21
1000
@50V
R21
8.2K
1/2W
C22
100@
25V
CR22-25 ARE
IN4002
C23
100@
25V
DS1
POWER
ON
J3
GND
M1
0-1KV
1mA F.S.
R15
5K
(10 TURN)
0-1KV
CONTROL
PCB 100
MODEL 214-104116
(GND) (-20V)
(+20V)
14(-5V)
Q1
2NG578
Q2
2NG578
R1
1Ω
1W
R2
1Ω
1W
HV ASSEMBLY
MODEL 214-303583
E7
E6
(GND)
E8
E9
E1-
E1+
E2-
E2+
C24
.1E
1KV
J2
J1
HV
OUTPUT
0TO1KV
@1.5 mA DC
MODEL 214
103586
214
BERTAN ASSOCIATES, INC
SYOSSET, NEW YORK
SCHEMATIC
BLOCK DIAGRAM
DR CB 11/27/78
CK 11/28/78
C
50429
203582

FIG 2

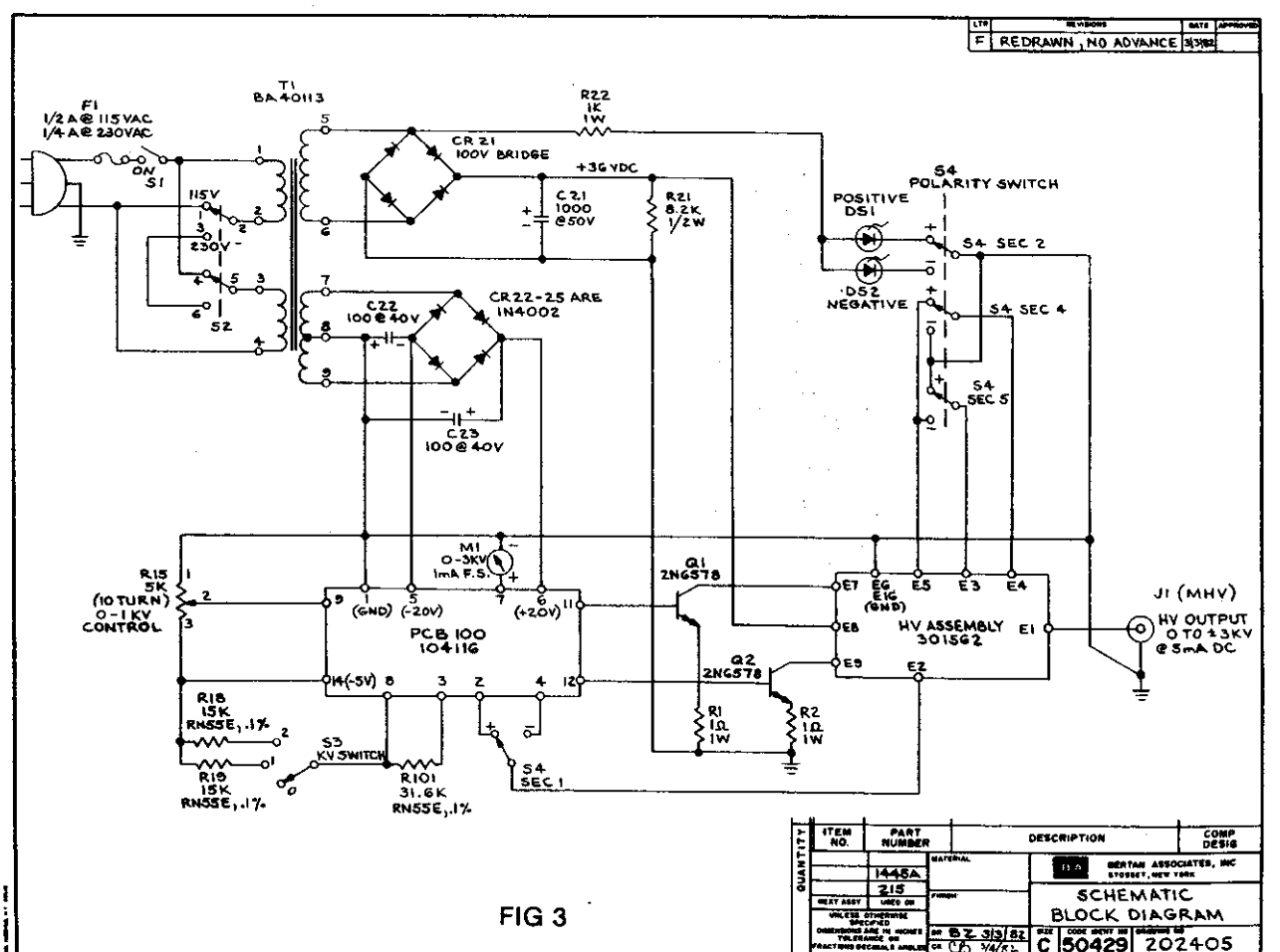
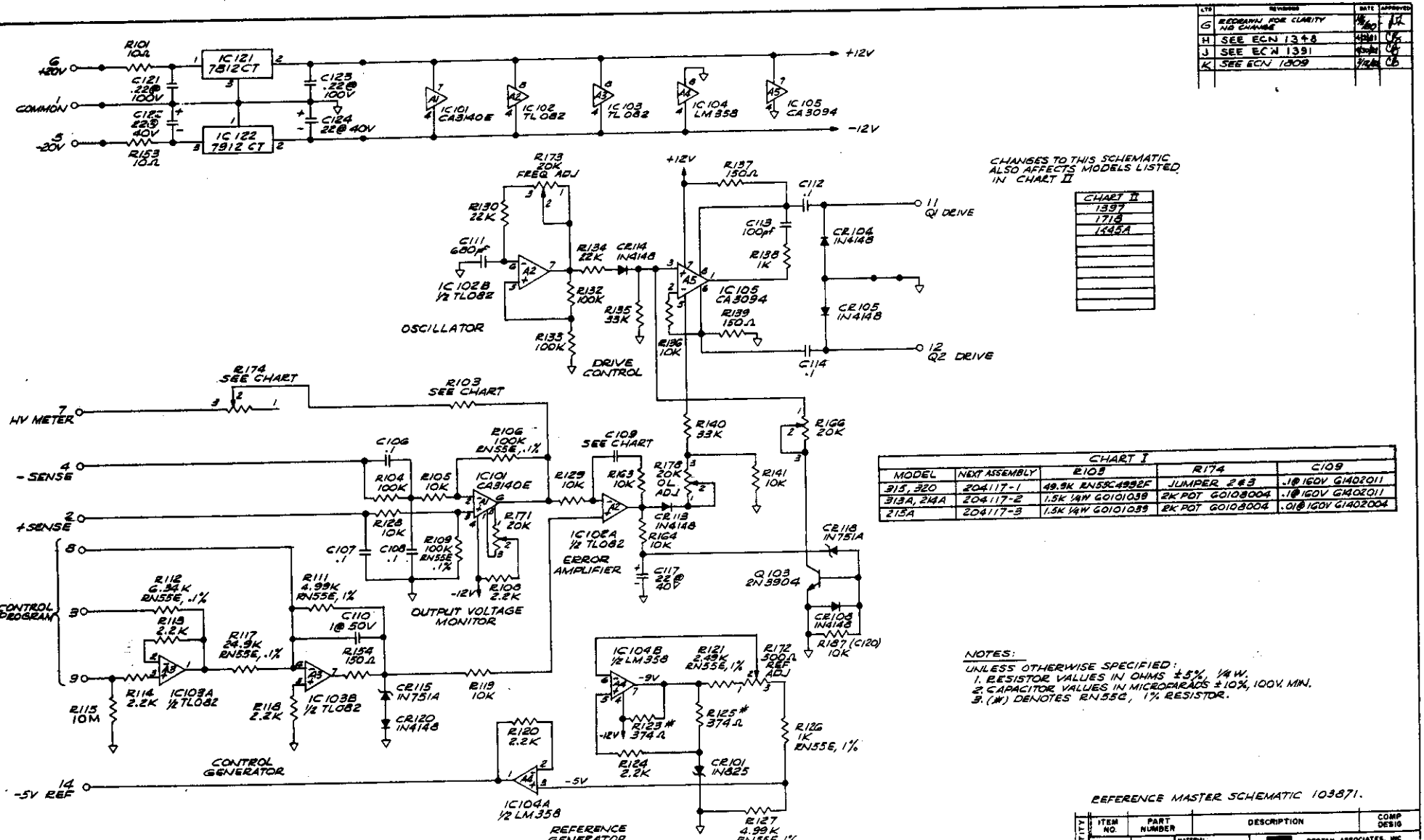

REVISIONS
F REDRAWN, NO ADVANCE
F1
1/2A@115VAC
1/4A@230VAC
ON S1
T1
BA 40113
115V
230V
S2
CR21
100V BRIDGE
R22
1K
1W
+36VDC
C21
1000
@50V
R21
8.2K
1/2W
C22
100@40V
CR22-25 ARE
IN4002
C23
100@40V
S4
POLARITY SWITCH
POSITIVE
DS1
DS2
NEGATIVE
S4 SEC 2
S4 SEC 4
S4
SEC 5
M1
0-3KV
1mA F.S.
R15
5K
(10 TURN)
0-1KV
CONTROL
PCB 100
104116
(GND) (-20V)
(+20V)
14(-5V)
Q1
2NG578
Q2
2NG578
R1
1Ω
1W
R2
1Ω
1W
R18
15K
RN55E, .1%
R19
15K
RN55E, .1%
S3
KV SWITCH
R101
31.6K
RN55E, .1%
S4
SEC 1
HV ASSEMBLY
301562
E7
E6
(GND)
E5
E3
E4
E8
E9
E2
E1
J1 (MHV)
HV OUTPUT
0 TO ±3KV
@5mA DC
QUANTITY
ITEM NO.
PART NUMBER
DESCRIPTION
COMP DESIG
1445A
215
BERTAN ASSOCIATES, INC
SYOSSET, NEW YORK
SCHEMATIC
BLOCK DIAGRAM
DR BZ 3/3/82
CK 3/4/82
C
50429
202405

FIG 3



CHANGES TO THIS SCHEMATIC ALSO AFFECTS MODELS LISTED IN CHART II

CHART II
1397
1718
1445A

CHART I

MODEL	NEXT ASSEMBLY	R109	R174	C109
315, 320	204117-1	49.9K RN55C4992F	JUMPER 2&3	.1@160V G1402011
313A, 214A	204117-2	1.5K ¼W G0101038	2K POT G0108004	.1@160V G1402011
215A	204117-3	1.5K ¼W G0101038	2K POT G0108004	.01@160V G1402004

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. RESISTOR VALUES IN OHMS ±5%, ¼W.
2. CAPACITOR VALUES IN MICROFARADS ±10%, 100V. MIN.
3. (*) DENOTES RN55C, 1% RESISTOR.

REFERENCE MASTER SCHEMATIC 103871.

LTR	REVISIONS	DATE	APPROVED
G	REDRAWN FOR CLARITY NO CHANGE	4/6/80	LT
H	SEE ECN 1348	4/30/81	CB
J	SEE ECN 1391	6/1/81	CB
K	SEE ECN 1809	7/12/82	CB

ITEM NO.	PART NUMBER	DESCRIPTION	COMP DESIG
	215A		
	313A		

MATERIAL:
FINISH:
NEXT ASSY | USED ON
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS DECIMALS ANGLES
DR RB 4/3/80
CH [illegible] 12/6/80
APPR

BERTAN ASSOCIATES, INC SYOSSET, NEW YORK

SCHEMATIC PCB 100

SIZE D | CODE IDENT NO 50429 | DRAWING NO 104116

SCALE — | SHEET 1 OF 1

FIG 4