INSTRUCTION MANUAL

MODEL 6060

PULSE LINK EXTENDED RANGE

NEUTRON AREA MONITOR

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Version 2A

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INTRODUCTION

The model 6060 is an extended range neutron area monitor. It is designed to be powered by a HPI Pulse link Receiver. The 6060 produces a pulse output. The instrument has many adjustments and features to make it easy to set up and use.

II. DESCRIPTION AND CONTROLS

The model 6060 consists of two sections; the electronics/detector and the moderator. All of the controls and connections are on one side of the electronics package (see Fig. 1).

Digital Counter: This is a 6 digit up counter that counts up with every pulse that is transmitted on the Pulse Link.

Counter Reset: Reset for the Digital Counter.

Pulse Link Connection: This is a BNC connector that should be connected to the input to a Pulse Link Receiver through coax. Both power and data are transmitted on this connection.

Accessory Connector: This connector contains signals for testing and operating the instrument. The connections are detailed below.

III. INSTALLATION

The model 6060 is installed by plugging it into a Pulse Link Receiver. The BNC on the panel of the 6060 should be mated to the input on the Pulse Link Receiver through a patch cord with a BNC on each end. The counter should be reset after turn on to make it count properly.

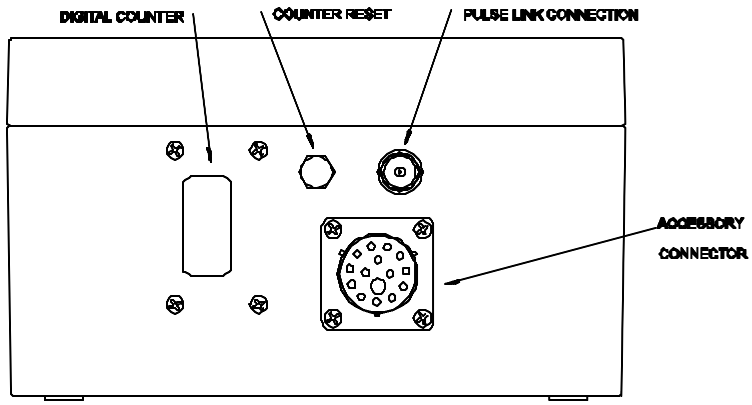


Figure 1 Location of Controls

IV. ACCESSORY CONNECTION

The accessory connection is a window into the instrument. All of the normal adjustments can be made from outside the 6060 without having to remove the cover. The pin definitions are:

PIN #	DESCRIPTION
A	Discriminator +
B	Discriminator -
C	Test pulse input
D	HV Monitor
E	Amplifier output
F	RS232 Transmit
G	RS232 Receive
H	Reset
J	Wakeup
K	Output pulse
L	Ground
M	External power
N	+5 VDC output

Connector type:
Cannon KPT, 15 pin. Part Number KPT06J14-15P

PIN FUNCTIONS AND DESCRIPTIONS:

Discriminator: This is an output of the discriminator level. It is measured between pin A and B. If you are using a DVM put the negative lead on B and the positive lead on A. A negative value indicates that the discriminator is below the signal level.

Test pulse input: This is a test pulse input. Connect a pulse generator or a mercury pulser to this input. The test pulse should be negative going. It is terminated in 51 ohm.

HV Monitor: This is a buffered output that is proportional to the high voltage. Its sensitivity is 1.00 volt output per 1000 volt high voltage applied to the detector.

Amplifier Output: This is a buffered output of the signal before the discriminator.

RS232 Transmit: This is an RS232 output. Baud rate is 9600.

RS232 Receive: This is an RS232 input. Baud rate is 9600.

Wakeup: This is an input that is used to keep the microprocessor alive. The microprocessor will turn itself off after turn on or reset if this pin is open. Grounding this pin will keep the microprocessor alive and the RS232 communications open. Whenever the pin is no longer grounded, the microprocessor will turn itself off which will terminate the RS232 communications.

Reset: This is an input that resets the microprocessor. When this pin is brought high by connecting it to the +5VDC output (pin N) the microprocessor will be reset. This is usually done with a push-button. When the microprocessor is reset it sets the High Voltage, Discriminator, and Gain to the stored values.

Output pulse: This is an LSTTL positive going output pulse for each discriminated event. This is not a buffered signal, however it will drive 1 LSTTL load.

Ground: Signal and power ground. This is the negative input for external power.

External Power: This is the positive input for external power. It can power the instrument instead of or with the Pulse Link. The external power should be above 9 volts. The instrument can be powered continuously by connecting external power to this input before removing the Pulse Link connection.

+5 VDC Output: This is an output of 5 volts. This is the positive connection. The Ground pin is the negative connection. It is used for the external reset switch and if needed to power external devices.

V. TEST BOX

Interrogation and adjustment of the 6060 depends on connections to the accessory socket. A schematic of a recommended test box is shown in figure 2. The model 6120 Breakout box is available from HPI. The user may wish to construct whatever test box or connections they may need. To calibrate the instrument all you need is to wire pin J to L, provide a push-button switch from pin H to N and connect an RS232 to pin F,G and L. If you want to provide test points for the various signals, they can also be included.

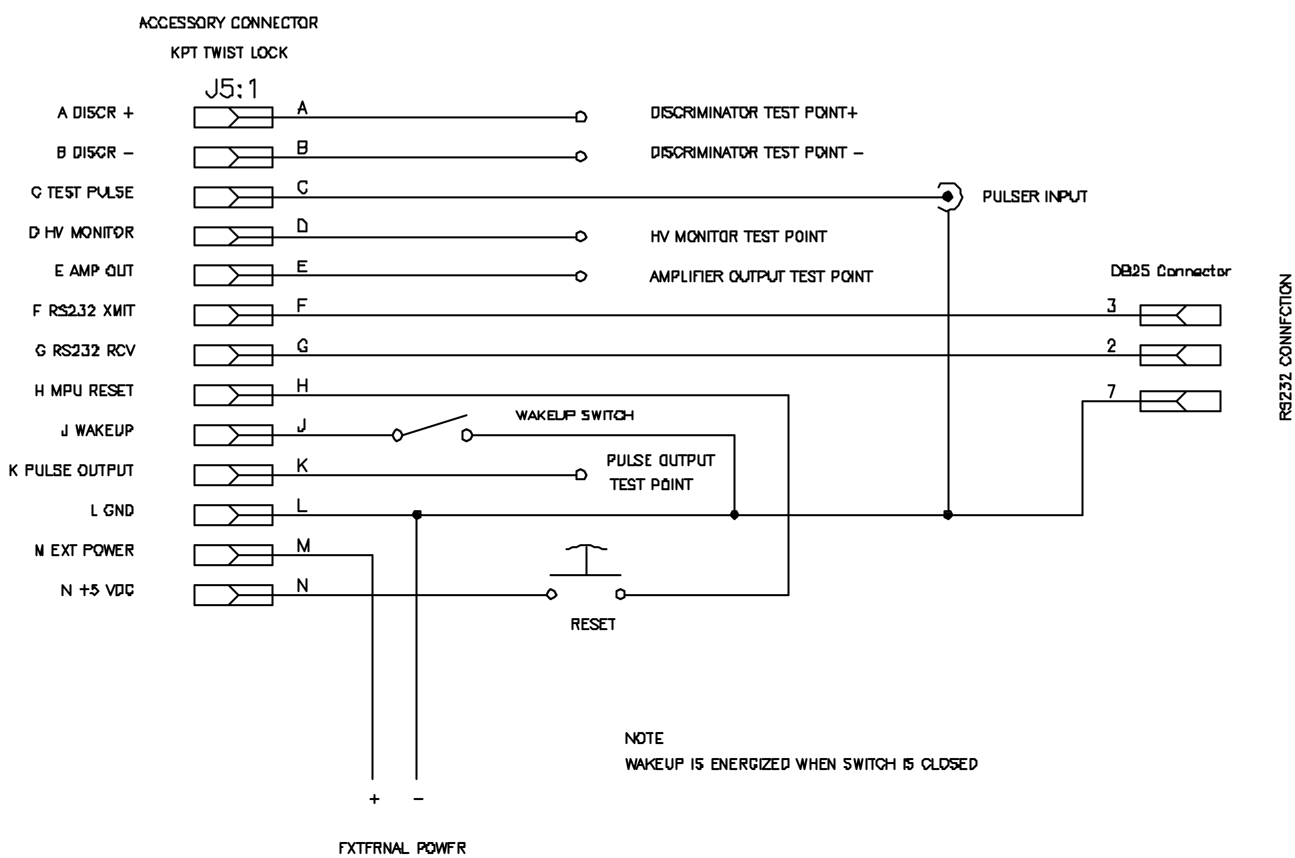


Figure 2 Test Box Schematic

VI. OPERATION

Once you have a test box you can begin to interrogate the instrument. Plug it into the 6060 with either power from the Pulse Link or external power connected to the test box itself.
A. Connect the serial port to a terminal or terminal emulator. The setting is 9600 baud, 8 bits, no parity, 1 stop bit.
B. Switch the wakeup switch so that pin J (wakeup) is connected pin L (ground).
C. Turn the power on. The terminal should show a screen similar to the following:

```
HPI 6060/6020 MONITOR VER 1.0
HV:   0200
DISC: 1C
GAIN: 04
LOG:  1234
LOGE: 5678
*
```

The * is the prompt. The values may be different depending on the settings of that unit. If you do not receive this display try toggling power again. The instrument will always send out a message even if the wakeup switch is not activated. Pushing the reset switch does the same thing as turning on the power. (You can also use the internal reset switch. See the section on Internal Adjustments and Controls.) If the instrument has power and the reset button is pushed it should send out a message. If
the wakeup switch is not energized it will send out:

```
Sleep Mode
```

It also sends out this message whenever it goes into the sleep mode. To be able to interrogate the instrument you need to have the wakeup switch in the closed position. This allows communication with the instrument. Use the Commands listed in the next section to talk to the instrument to change the High Voltage, Set the Discriminator, Set the Gain or use it as a Scaler/Counter.

VII. COMMANDS

The following table contains a brief listing of the commands. Following this table is a complete description of the commands. There is also a help command that will display the help menu.

KEY	Action
Hxxx	Sets HV xxx is 3 hex bytes: range 0 to max
U	Increments HV
N	Decrements HV
Dxx	Sets Discriminator xx is 2 hex bytes: range 0 to 3F
R	Increments Discr
C	Decrements Discr
Gx	Sets Gain x is one byte: range 0 to 7
Y	Increments Gain
B	Decrements Gain
S	Shows all variables
O	Reads EEPROM
P	Programs EEPROM with current settings
Q	Presets HV, DISCR and Gain w/ defaults
L or E	Logs 4 hex digits
T	Test routine
Xxxxxxxxx	download HV,Discr,Gain
Zxx	Count for xx hex seconds and report counts

ESC cancels a command, ? or / for Help
A Displays maximum HV (#xxxx sets)

A. Command Structure

The High Voltage, Discriminator and Gain all have a similar command structure. You can change them two ways. The first way is to set them directly. To change the high voltage, for example, type the letter H followed by the new setting. H200 would set the high voltage to 200. The other way to set it is to increment or decrement the high voltage. If the high voltage is at 200 and you push U then the high voltage will go to 201. Every time you push U it will increment. Likewise N will decrement it by one.
The location of the keys is important. The changes to High Voltage, Discriminator, and Gain can all be set by typing the first letter of their names. H for High Voltage, D for Discriminator and G for Gain. Likewise the keys to increment the values are all above them, and the keys to decrement the values are all below them. Of course in a QWERTY keyboard the keys are not arranged exactly above and below each other, they are skewed so we took some liberty in their locations. The increment and decrement keys are actually above and to the right, and down and to the right.

B. Numeric format.

All settings and values are in HEX. Setting High Voltage to 200 will set it to 200 HEX or 512 Decimal. Setting it to 1EB will set it to 1EB HEX which is 491 Decimal.

C. Data Entry.

The data that is entered is all entered right digit justified. This allows you to make a mistake and just keep typing until the values are correct. Thus H10234 would set High voltage to 0234. H12310122 would set High voltage to 0122. The entry also does not need leading zero's. Thus H5 would set it to 005. All the values have limits. Trying to set the value above the limit or below 0 will set them at their respective limits. Upper and lower case are both accepted. ESC will cancel any command.

D List of commands:

1. Setting High Voltage

Hxxx This sets the <u>H</u>igh voltage to the value xxx. Where xxx is from 0 up to max. The max is set under the A or HV max command. After changing the HV allow a few seconds for it to settle to its new value.

U Increments the High voltage by 1.
N Decrements the High voltage by 1.

2. Setting the Discriminator

Dxx Sets the <u>D</u>iscriminator to the value xx. Where xx is from 0 to 3F.
R Increments the Discriminator by 1.
C Decrements the Discriminator by 1.

3. Setting the Gain

Gx Sets the <u>G</u>ain to the value x. Where x is from 0 to 7.
Y Increments the Gain by 1.
B Decrements the Gain by 1.

4. Showing the current value of the variables

S This will <u>S</u>how the current settings of High Voltage, Discriminator and Gain.

5. Reading the stored values of the variables.

O This will show the values of the High Voltage, Discriminator and Gain that are stored in the EEPROM. You may want to think of this as the old readings if you have changed them.

6. Programming the EEPROM with the current values.

P This will <u>P</u>rogram the EEPROM with the current settings of High Voltage, Discriminator and Gain.

7. Presetting the Variables

Q This Sets up the variables as follows:
High Voltage: 100
Discriminator: 1C
Gain: 03
This is useful with a new EEPROM as a starting point. It does NOT save the values in EEPROM. Think of this as Querying the EEPROM.

8. Test Routine

T This is for Testing the circuitry. It will do the following:
A. Turn off the high voltage.
B. Continuously increment the High Voltage DAC until it reaches the maximum then reset it to zero. This can be observed on test point TP7.
C. Continuously increment the discriminator DAC until it reaches the maximum then reset it to zero. This can be observed on test point TP8. The staircase will be U shaped because of the influence of capacitor C13.
To exit the routine type anything. High voltage and the discriminator will be restored to their EEPROM values when it goes back to normal operation.

9. Help Menu

? or / This is the help menu. No variables are changed.

10. Downloading the data.

X0xxxxx0x Downloads the settings of the variables and sets them into EEPROM.
X is the command to start the download. The first four hex digits, 0xxx are the High voltage setting. The next two hex digits, xx are the discriminator level, and the last two hex digits, 0x are the gain. Send a 0 where noted. The values will not be echoed on the screen as they are typed. To exit this routine it is necessary to type all 8 hex digits. ESC will not work.
NOTE: high voltage is checked against the maximum to prevent accidents.

11. Count for specified time.

Zxx This turns the 6060 into a scaler that will count for xx seconds. xx is from 0 to FF. After the xx seconds it will send the number of counts it accumulated during that time. The number of counts is reported as six hex digits that will count modulo 01XXXX hex. Thus it will count up to 01FFFF and the next count will round it over to 000000. Entering 00 as the time will make it count continuously until it receives another character, then it will send the number of counts. This allows extended counting time. Typing ESC while it is counting will terminate the count and not show the counts.

12. Log a reference number.

Lxxxx or Exxxx This logs the two 4 digit hex numbers xxxx for log, and xxxx for logE and puts them into EEPROM. They are displayed every time the S menu is displayed. You do not have to push P to save this data. This can be used for serial numbers or anything else you want.

13. Max HV Setting.

A#xxxx This sets a maximum value that the high voltage can be set. It should be set from 0 to 3FF since this is the range of the high voltage power supply. Changing this value to a value lower than the current high voltage will not change the high voltage until the high voltage is changed. Nor will it alter a higher number in the eeprom until the eeprom is changed. Check if the high voltage is higher than the setting when changing this value. It does use this value with the download command to prevent accidents.
Typing A alone will not allow you to change the value, it just reports the value. This is to keep from accidentally changing the value. To change the value, after typing A type "#" followed by the 4 hex digits of the maximum level then <ENTER>. This puts the values in EEPROM for permanent storage.

E. High Voltage Values.

The high voltage setting is directly proportional to the high voltage. 200 hex is 1000 VDC and 3FF hex is 2000 VDC. This means that each bit is about 1.95 volts. Use only the voltage necessary to operate the detector properly. Too high a voltage on the detector may cause it to malfunction.

HIGH VOLTAGE SETTINGS IN HEX					
VOLTAGE	HEX SETTING	VOLTAGE	HEX SETTING	VOLTAGE	HEX SETTING
500	100	1000	200	1500	300
563	120	1062	220	1564	320
625	140	1125	240	1627	340
687	160	1187	260	1690	360
750	180	1250	280	1753	380
812	1A0	1312	2A0	1815	3A0
875	1C0	1375	2C0	1878	3C0
937	1E0	1437	2E0	1940	3E0

F. Discriminator Values.

The discriminator setting is directly proportional to the discriminator voltage. Each discriminator bit is about 0.042 volts. When the discriminator is set to zero it measures about -.3 volts across the two outputs on the test box. With it set to 3F it measures about 1.95 volts.

G. Gain Values.

The gain of the first stage correlates to the gain setting as follows:

GAIN SETTING	GAIN
0	3.25
1	4.875
2	6.5
3	9.75
4	13
5	User installed resistor
6	1
7	0 Input tied to VCC selected during turn on and during reset.

We recommend that the gain be set to 0, 1, 2, 3, or 4. If the user wants to install a resistor then a setting of 5 may be used. Gain setting 6 while indeed a DC gain of 1 will result in ringing on large pulses and should not be used in this application.

H. Saving the data.

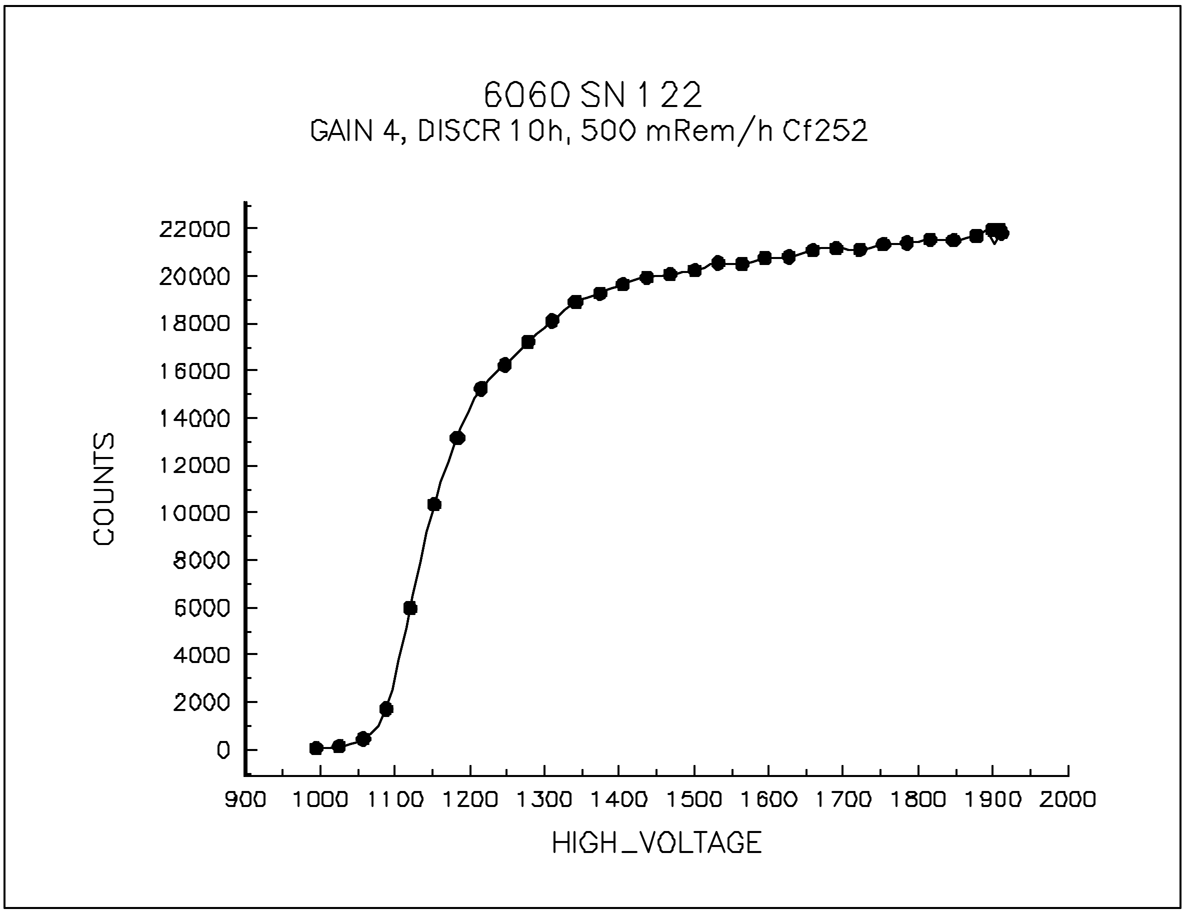
When you change the High Voltage, Discriminator, or Gain, you are just changing the value in the RAM memory of the instrument. This is not the permanent EEPROM memory. When you first turn the instrument on the values that are in the EEPROM are the ones used to set the High Voltage, Discriminator and gain. When you change these values you are not changing them in the EEPROM, just in the RAM. This permits you to try different things without altering the permanent settings. If you want to save the values in the EEPROM then you need to do a P for program the EEPROM. This puts the values in RAM into the EEPROM so the next time it is powered up or reset it will use those values. If you decide you don't like the changes, just do an O instead of the P. This will read back the original stored values.

Downloading data is assumed to be permanent and is stored both in RAM and in EEPROM. It is not necessary to do a P.

VIII. CALIBRATION/SETUP

The output of the 6060 and thus the 6014 Pulse Link receiver is a series of pulses. These pulses are uncalibrated. Each pulse in the detector that is above the threshold will be output from the 6060 and 6014. It is necessary to adjust all the parameters until the instrument has an output that is adjusted

for the specific detector. This is accomplished by adjusting all the parameters until they are optimized for this detector. Only when the detector is optimized can the counts per mrem be determined.
The normal procedure for testing the instrument is to adjust the high voltage while the gain and discriminator are fixed at their operational values. Normal operation is with the gain set to 4 and the discriminator set to 10 hex. The high voltage is adjusted in 10 hex increments from 200 hex to 3F0 hex while the instrument is exposed to around 500 mrem/h of neutrons. Count the counts from the detector for 10 seconds at each high voltage setting and note the counts. Plot the data in graphical form and set high voltage just above the knee of the curve. The example on Graph 1 shows this plot and the high voltage would be set at around 1300 volts. This assures that the high voltage is as low as possible for environmental reasons, but also high enough that a change in high voltage will not produce a significant change in the count rate of the instrument. Set this high voltage into the instrument and expose it to a known doserate of neutrons and not the counts/mrem/h. This is the calibration of the output of the 6060 and also of the 6014.



Graph 1 High Voltage Plateau

PROCEDURE TO CALIBRATE THE MODEL 6060

1. Connect the instrument to a power supply through the 15 pin accessory connector on the front panel or through the test box.
2. Connect the instrument to a terminal with the RS-232 signals available on the 15 pin accessory connector on the front panel of through the test box.
3. Turn the instrument on with the wakeup switch on the test box closed or with pins J and L .
4. Verify that the terminal is connected to the instrument by hitting <ENTER>. a couple of times. Each time the screen should show an *.

5. Push S for show and look at the current settings.
6. Set the discriminator to 10 hex by typing D10 <ENTER>.
7. Set the gain to 4 by typing G4 <ENTER>.
8. Set the high voltage to its lowest value for this test by pushing H200 <ENTER>.
9. Turn on the source and expose the instrument to around 500 mrem/h.
10. Start a 10 second count by typing ZA <RETURN> and note the result along with the high voltage for that result.
11. Increment the high voltage by 10 hex. Repeat step 9 and 10 until the high voltage is at 3F0 hex.
12. Plot the high voltage and counts on a graph and set the high voltage to the value that represents a short way up the knee of the curve.
13. Expose the instrument to a known radiation field. Calculate the counts/mrem/h. This is the calibration for the instrument. Make sure before turning off the instrument that you push P to program the values in EEPROM so that these are the values that the instrument will use from now on. The exposure rate can be lower than 500 mrem/h but it is not a good idea to go over 1000 mrem/h. Adjust the time so that you scale over 10,000 counts when the high voltage is set to its higher values.

IX. CONSTRUCTION

The electronics is all housed inside the cast aluminum case. The case is gasketed and sealed. To gain access to the circuit boards, remove the four large screws on top of the case and remove the top. The small circuit board containing the microprocessor is hinged on the end with the ribbon connector, the other end is screwed with two screws to two standoffs. Removing these two screws will permit the board to be raised to a vertical position. Remove the three screws on the larger circuit board to loosen it. To remove the large board hold the small board vertically and slide the large board out away from the controls on the front panel.

Before removing the circuit board, it is a good idea to short the high voltage to ground to keep from destroying any part of the instrument by getting your hand between high voltage and any component. In the corner of the high voltage section, there is a 10 meg resistor mounted to a terminal. Touch the end of an insulated screwdriver between this terminal and the high voltage.

The desiccant is mounted in the lid. Make sure that it is replaced or baked out for 3 hours at 300 °F if it is pink. It can also be put in a vacuum to remove the moisture.

The detector is mounted to a long piece of wire. This wire has RTV around it where it protrudes through the insulator inside the box. This keeps moisture from entering the case. All controls and screws and openings are treated with RTV silicone sealant to keep the box from breathing with atmospheric pressure changes.

X. CIRCUITRY

A. Analog Circuitry (DWG 6060-001 to -003)

The incoming signal is amplified by U1B. This is a noninverting voltage amplifier. The current from the detector flows through R13 and creates the voltage that is amplified. The gain of this stage can be changed by the multiplexer, U5 that switches in different feedback resistors. The multiplexer has 3 inputs that control it. A,B and C select which resistor is to be included in the circuit.

A reference voltage created by R88 and R21 and filtered by C12 and C11 is used by all the op amp stages. It is in effect an artificial ground between true ground and VCC. All the op amps are decoupled from the power supply by series resistors and filter capacitors.

The next stage is capacitively coupled (C8) and has a gain of 7.5. It is a inverting amplifier. The stage after that, U4:A is direct coupled and is a noninverting amplifier with a gain of 13.

The next stage is the discriminator U3. This discriminates the signal on pin 3 from the threshold set on pin 2. The resultant pulses on pn 7 are capacitively coupled to U2, a multivibrator. This makes sure that the output pulses are of uniform proper width. The output pulses then go to Q2 to enter

them into the Pulse Link cable. The output of the amplifier is buffered by U4:B before going to the test point.
The High voltage power supply starts out as a multivibrator U9. The pulses from the multivibrator are amplitude modulated before being fed thru Q4 and Q3 to the transformer. This is a step up transformer that is followed by a voltage multiplier. The output is restively divided (R37, R49) and compared to a reference HVSET. The pulse heights from the multivibrator are thus controlled before going into the transformer to keep the HV output at the required level. The high voltage signal is buffered by U10:C before going to a test point.
The low voltage power supplies of 5 volts, and 6 volts are isolated from the pulse link by two chokes. Power is derived from the Pulse Link line. The two three terminal regulators U7 and U8 regulate the 5 volt and 6 volt supplies. Testpoints are provided for both.
The HVSET and DISCR signals are derived from the DACs made up of U11 and U12. These are serial to parallel converters that load the data onto their outputs. The R - 2R ladder networks convert this digital data into an analog value. For testing the DACs see the test routine under Commands.
The counter/display increments on every count. It has a panel mounted reset switch, S1.

B. Digital Circuitry (DWG 6060-001M)

The digital signals are handled by the microprocessor. It generates the signals for the DACs, and the gain. In addition it generates the RS232 signals for communication. The digital circuitry is on a separate circuit board.
The microprocessor U4 is connected to the address latch U1. The address lines, A0 to A7 are used by the EPROM U5 which contains the program. The EEPROM that stores the permanent data is U2. U8 is the RS232 driver and receiver. In addition it generates the voltages needed for RS232. The reset circuitry U9A and U9B is used to generate the Reset signal if VCC is too low to operate. When the microprocessor is reset all the output lines P10 to P17 and P30 to P37 go high. The resistor network
R2 pulls some of them up with more current than is supplied by U4 alone. U11, U7, U12, and U3 are not used but are available for future expansion.

XI. INTERNAL ADJUSTMENTS AND CONTROLS

A. ADJUSTMENTS

The High Voltage, Discriminator, and Gain are all controlled by the RS232 communications link. There is no way to adjust them without this link.
The only remaining adjustment is the reset voltage adjustment. It is factory set and should never need adjustment. This resets the microprocessor when the VCC voltage falls below a preset level. The adjustment is the 20 turn trimmer (R5) on the small digital circuit board mounted on top of the main board.
To set it, connect the unit to a variable power supply through the test box. Then connect a voltmeter between the ground (TP1) and +5 Volt (TP2) test points on the digital circuit board (the small one on top). We want to measure the actual voltage on the 5 volt supply. Turn the trimmer R5 Clockwise 20 turns or until you feel it clicking. This should turn on the microprocessor and take it out of reset. Then adjust the power supply voltage to the unit until the voltmeter decreases by .20 volts. Then turn the trimmer R5 counter clockwise 20 turns or until you feel it clicking. This will turn on the reset signal. Then slowly turn the trimmer R5 Clockwise until the signon message on the terminal appears. This should be the correct setting. This is the voltage where the microprocessor will go into reset. This is important for both power on and power off.

B. CONTROLS

The only control is the reset button located on one end of the small digital board mounted on top of the main board. Pushing it will reset the microprocessor and has the same effect as turning power off and back on or pushing the reset button in the external test box.

XII. MODIFICATIONS

There are several modifications that can be built into the instrument. On the digital side, the instrument is set up to handle an alphanumeric LCD. This can be plugged into U3. The LCD will usually need a negative supply for the contrast. This is supplied by U6. The contrast would be adjusted by R1.

Communications does not have to be RS-232. Built in is an RS-485 interface, U11 along with the terminating resistors and pull up/down resistors or the bus. The digital board can also be operated separately from the main board and has its own 5 volt regulator, U12. Expansion of the board can use the signal generated by U7:D. There is a jumper to permanently disconnect the RS-232 driver to reduce power consumption.

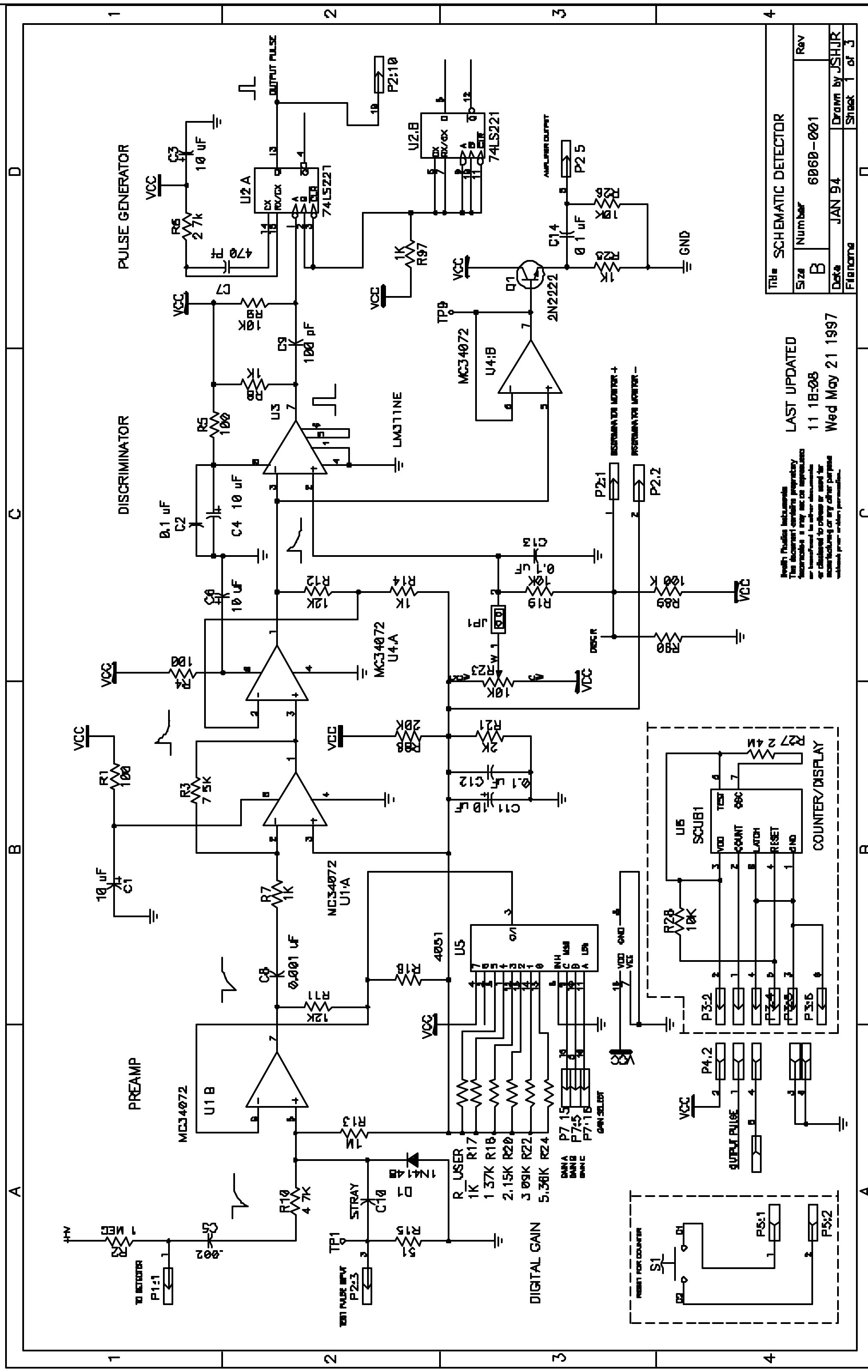
The main analog board also has some unused features. The high voltage and discriminator can both be changed from computer control to fixed trimmers, R54 and R23 respectively. There is a location for a user selected gain resistor, R_USER in the preamp. The high voltage can be turned on without the computer control by using JP4.

6060 PARTS LIST

DESIGN	QUAN	PART NO	TYPE	DESCRIPTION	MFG	SUPPLIER	DRAWING #
C01	1		Tantalum	Capacitor 10 uF 10V			6060-001
C02	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C03	1		Tantalum	Capacitor 10 uF 10V			6060-001
C04	1		Tantalum	Capacitor 10 uF 10V			6060-001
C05	1	570B1L202M	Film 20%	Capacitor .002uF 3KV	Ceramite		6060-001
C06	1		Tantalum	Capacitor 10 uF 10V			6060-001
C07	1		NPO Cer Mono	Capacitor 470 pF 50V			6060-001
C08	1		NPO Cer Mono	Capacitor .001uF 50V			6060-001
C09	1		NPO Cer Mono 5%	Capacitor 100 pF 50V			6060-001
C10	1		NPO Cer Mono 5%	Capacitor 100 pF 50V			6060-001
C11	1		Tantalum	Capacitor 10 uF 10V			6060-001
C12	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C13	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C14	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C15	1		Electrolytic	Capacitor 330 uF 25V			6060-001
C16	1		Tantalum	Capacitor 33 uF 10V			6060-001
C17	1		Electrolytic	Capacitor 330 uF 25V			6060-001
C18	1		Tantalum	Capacitor 33 uF 10V			6060-001
C19	1	Not Used		Capacitor			6060-001
C21	1	30GASS10	Y5V Cer Disk	Capacitor .01 uF 3KV	Ceramite		6060-001
C21	1	30GASS10	Y5V Cer Disk	Capacitor .01 uF 3KV	Ceramite		6060-001
C22	1	30GASS10	Y5V Cer Disk	Capacitor .01 uF 3KV	Ceramite		6060-001
C23	1	30GASS10	Y5V Cer Disk	Capacitor .01 uF 3KV	Ceramite		6060-001
C24	1	30GASS10	Y5V Cer Disk	Capacitor .01 uF 3KV	Ceramite		6060-001
C25	1	520BIL103M	Film 20%	Capacitor .01 uF 3KV	Ceramite		6060-001
C26	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C27	1		COG Cer Mono	Capacitor .1 uF 50V			6060-001
C28	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C29	1		NPO Cer Mono	Capacitor 470 pF 50V			6060-001
C30	1		NPO Cer Mono	Capacitor .022uF 50V			6060-001
C31	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C32	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C33	1		NPO Cer Mono	Capacitor .001uF 50V			6060-001
C34	1		Z5U Cer Mono	Capacitor .1 uF 50V			6060-001
C35	1		Tantalum	Capacitor 33 uF 10V			6060-001
CX1	1		Tantalum	Capacitor 10 uF 10V			6060-001
CX2	1		Z5U Cer Mono	Capacitor .047uF 50V			6060-001
CX3	1		Z5U Cer Mono	Capacitor .047uF 50V			6060-001
CX4	1		Z5U Cer Mono	Capacitor .047uF 50V			6060-001
CX5	1		Z5U Cer Mono	Capacitor .047uF 50V			6060-001
D1	1	1N4148	Hi Speed	Diode			6060-001
D2	1	1N4004	1000V 1A	Rectifier			6060-001
D3	1	BYV26EPH	1000V 1A	Rectifier,Ultra fast	Philips		6060-001
D4	1	BYV26EPH	1000V 1A	Rectifier,Ultra fast	Philips		6060-001
D5	1	BYV26EPH	1000V 1A	Rectifier,Ultra fast	Philips		6060-001
D6			Not used	Diode			6060-001
D7			Not used	Diode			6060-001
D8			Not used	Diode			6060-001
J1	1	CSC20G	20 Pin .1 x .1	Connector, Socket	CW INDSTR		6060-001
J2	1	22-01-3147	14 Pin	Connector, Housing	Molex		6060-001
J3	1	22-01-3047	4 Pin	Connector, Housing	Molex		6060-001
J4	1	22-01-3047	4 Pin	Connector, Housing	Molex		6060-001
J6	1	22-01-3027	2 Pin	Connector, Housing	Molex		6060-001
J7	1	CSC20G	20 Pin .1 x .1	Connector, Socket	CW INDSTR		6060-001
L1	1	434-05-103J	10 mH 90 mA	Choke	HiQ		6060-001
L2	1	434-05-103J	10 mH 90 mA	Choke	HiQ		6060-001
P2	1	22-23-2141	14 Pin	Connector, Header	Molex		6060-001
P3	1	22-23-206	6 Pin	Connector, Header	Molex		6060-001
P4	1	22-01-3027	2 Pin	Connector, Housing	Molex		6060-001
P4	1	22-23-2041	4 Pin	Connector, Header	Molex		6060-001
P6	1	22-23-2021	2 Pin	Connector, Header	Molex		6060-001
P7	1	2520-6002UB	20 Pin LP MT	Connector, Header	3M		6060-001
PCB1	1	6060-004	FR4	Pc Board Detector	HPI		6060-001
Q01	1	2N2222	NPN	Transistor			6060-001
Q02	1	2N2222	NPN	Transistor			6060-001
Q03	1	2N2905	PNP	Transistor			6060-001
Q04	1	2N3251	PNP	Transistor			6060-001
Q05	1	2N2222	NPN	Transistor			6060-001
Q06	1	2N2222	NPN	Transistor			6060-001
R01	1		CF 5% 1/4 W	Resistor, 100 Ohm			6060-001
R02	1		CF 5% 1/4 W	Resistor, 1M			6060-001
R03	1		CF 5% 1/4 W	Resistor, 7.5K			6060-001
R04	1		CF 5% 1/4 W	Resistor 100 ohm			6060-001
R05	1		CF 5% 1/4 W	Resistor 100 ohm			6060-001
R06	1		CF 5% 1/4 W	Resistor, 2.7K			6060-001
R07	1		CF 5% 1/4 W	Resistor, 1K			6060-001
R08	1		CF 5% 1/4 W	Resistor, 1K			6060-001
R09	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R10	1		CF 5% 1/4 W	Resistor, 4.7K			6060-001
R11	1		MF 1% 1/4 W	Resistor, 12.0K			6060-001
R12	1		MF 1% 1/4 W	Resistor, 12.0K			6060-001
R13	1		MF 1% 1/4 W	Resistor, 1.00M			6060-001
R14	1		MF 1% 1/4 W	Resistor, 1.00K			6060-001
R15	1		CF 5% 1/4 W	Resistor 51 ohm			6060-001
R16		Not Used		Resistor			6060-001
R17	1		CF 5% 1/4 W	Resistor, 1K			6060-001
R18	1		MF 1% 1/4 W	Resistor, 1.38K			6060-001

DESIGN	QUAN	PART NO	TYPE	DESCRIPTION	MFG	SUPPLIER	DRAWING #
R19	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R20	1		MF 1% 1/4 W	Resistor, 2.15K			6060-001
R21	1		CF 5% 1/4 W	Resistor, 20K			6060-001
R22	1		MF 1% 1/4 W	Resistor, 3.09K			6060-001
R23		Not used		Trimmer			6060-001
R24	1		MF 1% 1/4 W	Resistor, 5.36K			6060-001
R25	1		CF 5% 1/4 W	Resistor, 1K			6060-001
R26	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R27	1		CF 5% 1/4 W	Resistor, 2.4M			6060-001
R28	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R29	1		CF 5% 1/4 W	Resistor, 2.7K			6060-001
R30	1		CF 5% 1/4 W	Resistor, 2.7K			6060-001
R31	1		CF 5% 1/4 W	Resistor, 51			6060-001
R32	1		CF 5% 1/4 W	Resistor, 10M			6060-001
R33	1		CF 5% 1/4 W	Resistor, 10M			6060-001
R34	1		CF 5% 1/4 W	Resistor, 10M			6060-001
R35		Not used		Resistor			6060-001
R36	1		CF 5% 1/4 W	Resistor, 4.7K			6060-001
R37	1	MOX-300	10%	Resistor, 1000M	Victoreen		6060-001
R38	1		CF 5% 1/4 W	Resistor, 560 Ohm			6060-001
R39		Not used		Resistor			6060-001
R40	1		CF 5% 1/4 W	Resistor 56K			6060-001
R41	1		CF 5% 1/4 W	Resistor, 680K			6060-001
R42	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R43	1		CF 5% 1/4 W	Resistor, 100 K			6060-001
R44	1		CF 5% 1/4 W	Resistor, 1K			6060-001
R45	1		CF 5% 1/4 W	Resistor, 22K			6060-001
R46	1		CF 5% 1/4 W	Resistor, 4.7K			6060-001
R47		Not Used		Resistor			6060-001
R48	1		CF 5% 1/4 W	Resistor, 200 Ohm			6060-001
R49	1		MF 1% 1/4 W	Resistor, 1.00M			6060-001
R50	1		CF 5% 1/4 W	Resistor 27K			6060-001
R51	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R52	1		CF 5% 1/4 W	Resistor, 4.7K			6060-001
R53	1		CF 5% 1/4 W	Resistor, 100 K			6060-001
R54		Not used		Trimmer			6060-001
R55	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R56	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R57	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R58	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R59	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R60	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R61	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R62	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R63	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R64	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R65	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R66	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R67	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R68	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R69	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R70	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R71	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R72	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R73	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R74	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R75	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R76	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R77	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R78	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R79	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R80	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R81	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R82	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R83	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R84	1		MF 1% 1/4 W	Resistor, 49.9K			6060-001
R85	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R86	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R87		Not Used		Resistor			6060-001
R88	1		CF 5% 1/4 W	Resistor, 20K			6060-001
R89	1		MF 1% 1/4 W	Resistor, 100.0K			6060-001
R90		Not Used		Resistor			6060-001
R91	1		CF 5% 1/4 W	Resistor, 10K			6060-001
R92	1		MF 1% 1/4 W	Resistor, 33.6K			6060-001
R93		Not Used		Resistor			6060-001
R94	1		CF 5% 1/4 W	Resistor 100 ohm			6060-001
R95	1		CF 5% 1/4 W	Resistor, 10 Ohm			6060-001
R96	1		CF 5% 1/4 W	Resistor, 10M			6060-001
R97	1		CF 5% 1/4 W	Resistor, 1K			6060-001
R_USER		Not Used		Resistor			6060-001
S1	1	MPE106F	Push NO, Waterproof	Switch	Alco		6060-001
SOC14	3		DIP	Socket, 14 pin			6060-001
SOC16	4		DIP	Socket, 16 pin			6060-001
SOC8	3		DIP	Socket, 8 pin			6060-001
T1	1	M8149	Switching	Transformer	Microtran		6060-001
U01	1	MC34072	Dual Hi Speed	Op Amp	Motorola		6060-001
U02	1	74LS221		Monostable Multivib			6060-001
U03	1	LM311	Single	Comparator			6060-001

DESIGN	QUAN	PART NO	TYPE	DESCRIPTION	MFG	SUPPLIER	DRAWING #
U04	1	MC34072	Dual Hi Speed	Op Amp	Motorola		6060-001
U05	1	CD4051		8 Input Multiplexer			6060-001
U06	1	SCUB-1000	6 Digit	Counter/Display LCD	Red Lion		6060-001
U07	1	LM340T-5.0	5 VOLT	Voltage Regulator			6060-001
U08	1	LM340T-5.0	5 VOLT	Voltage Regulator			6060-001
U09	1	CD4001		Quad Nor Gate			6060-001
U10	1	TLC27L4	Quad Low Power	Op Amp	Tex Inst		6060-001
U11	1	CD4094		S to P Sift Reg			6060-001
U12	1	CD4094		S to P Sift Reg			6060-001
U13	1	CD4013		D Type Flip Flop			6060-001
C01	1		NPO Cer Mono	Capacitor 22 pF			6060M-001
C02	1		NPO Cer Mono	Capacitor 22 pF			6060M-001
C03		Not Used		Capacitor			6060M-001
C04		Not Used		Capacitor			6060M-001
C05	1		Electrolytic	Capacitor 22uF 16V			6060M-001
C06	1		Electrolytic	Capacitor 22uF 16V			6060M-001
C07	1		Electrolytic	Capacitor 22uF 16V			6060M-001
C08	1		Electrolytic	Capacitor 22uF 16V			6060M-001
C09	1		Tantalum	Capacitor 10uF 10V			6060M-001
C10	1		COG Cer Mono	Capacitor .1 uF 50V			6060M-001
C11		Not Used		Capacitor			6060M-001
C12	1		Tantalum	Capacitor 10uF 10V			6060M-001
CX1	1		Z5U Cer Mono	Capacitor .047uF 50V			6060M-001
CX2	1		Z5U Cer Mono	Capacitor .047uF 50V			6060M-001
CX3	1		Z5U Cer Mono	Capacitor .047uF 50V			6060M-001
CX4	1		Z5U Cer Mono	Capacitor .047uF 50V			6060M-001
D1	1		1N4148	Diode, High Speed			6060M-001
P1	1	2520-6002UB	20 Pin LP MT	Connector, Header	3M		6060M-001
R01		Not Used		Trimmer			6060M-001
R02	1		10 Pin SIP Network	Resistor 10K x 9			6060M-001
R03	1		CF 5% 1/4W	Resistor 100K			6060M-001
R04	1		CF 5% 1/4W	Resistor 2.4K			6060M-001
R05	1		20 T 3/8 SQ	Trimmer 100K			6060M-001
R06	1		CF 5% 1/4W	Resistor 1M			6060M-001
R07		Not Used		Resistor			6060M-001
R08	1		CF 5% 1/4W	Resistor 10M			6060M-001
R09	1		CF 5% 1/4W	Resistor 10M			6060M-001
R10	1		CF 5% 1/4W	Resistor 100K			6060M-001
R11		Not Used		Resistor			6060M-001
R12		Not Used		Resistor			6060M-001
S1	1	EVQ Type		Pushbutton NO			6060M-001
U01	1	74HC573d		Octal Latch			6060M-001
U02	1	93C46	Cmos 4 Wire	EEPROM			6060M-001
U03		Not Used		LCD Display			6060M-001
U04	1	80C51	8 bit CMOS	Microprocessor			6060M-001
U05	1	27C256		EPROM			6060M-001
U06		Not Used	7660	Volt Converter			6060M-001
U07		Not Used	74HC00	Quad Nand Gate			6060M-001
U08	1	MAX232CP	RS232	Line Drvr/Rcvr			6060M-001
U09	1	TLC27L2	Dual Cmos	Op Amp	Tex Inst		6060M-001
U10	1	LM336-2.5		Volt Reference	National		6060M-001
U11	1	Not Used	75176	Octal Latch			6060M-001
U12		Not Used		Voltage Regulator			6060M-001
X1	1		7.3728 MHz	Crystal HC18			6060M-001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6060-001
JAN 94
LAST UPDATED
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Wed May 21 1997
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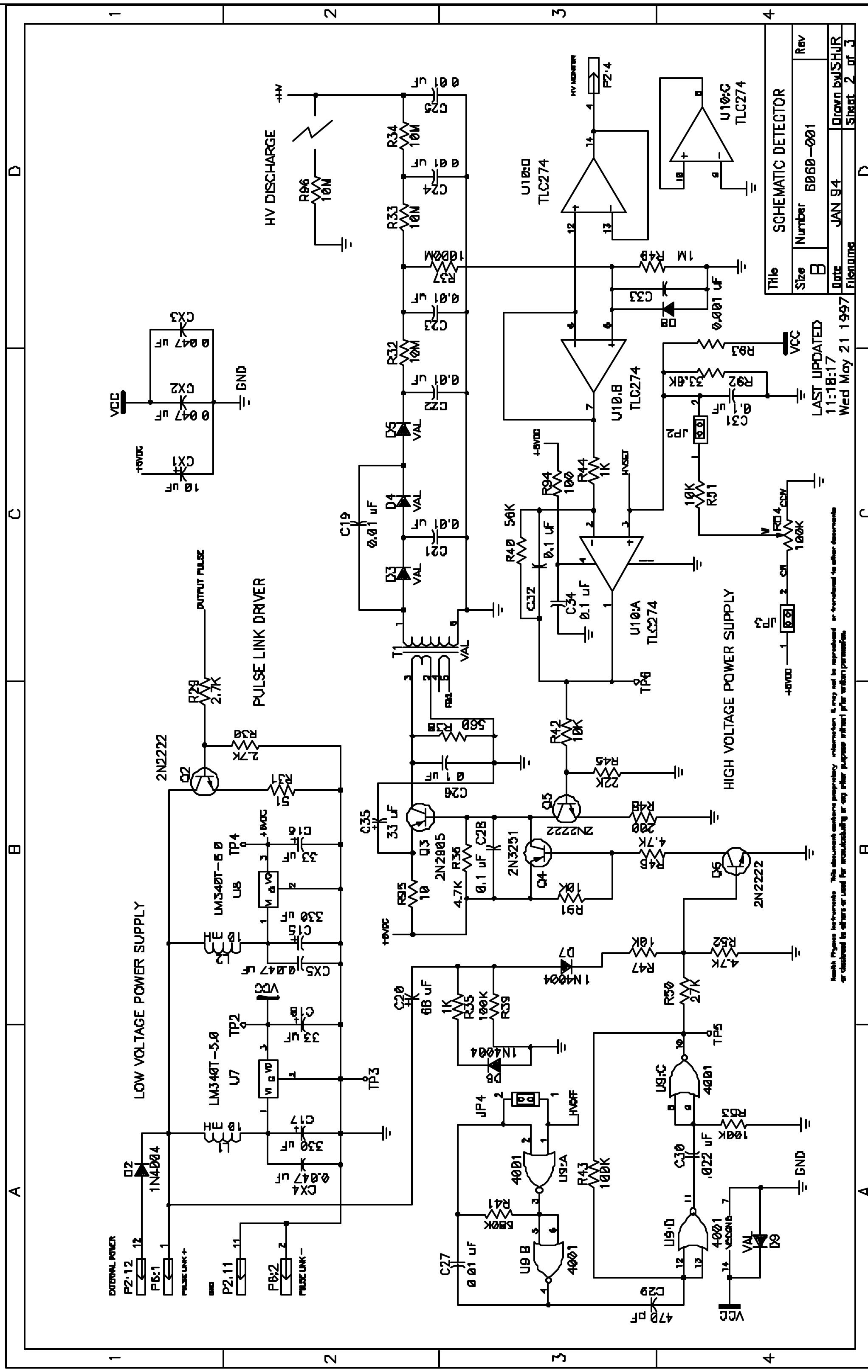
DISCRIMINATOR
PULSE GENERATOR
DIGITAL GAIN
COUNTER/DISPLAY
MC34072
LM311NE
74LS221
2N2222
4051
SCUB1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6060-001
JAN 94
Sheet 2 of 3
LAST UPDATED
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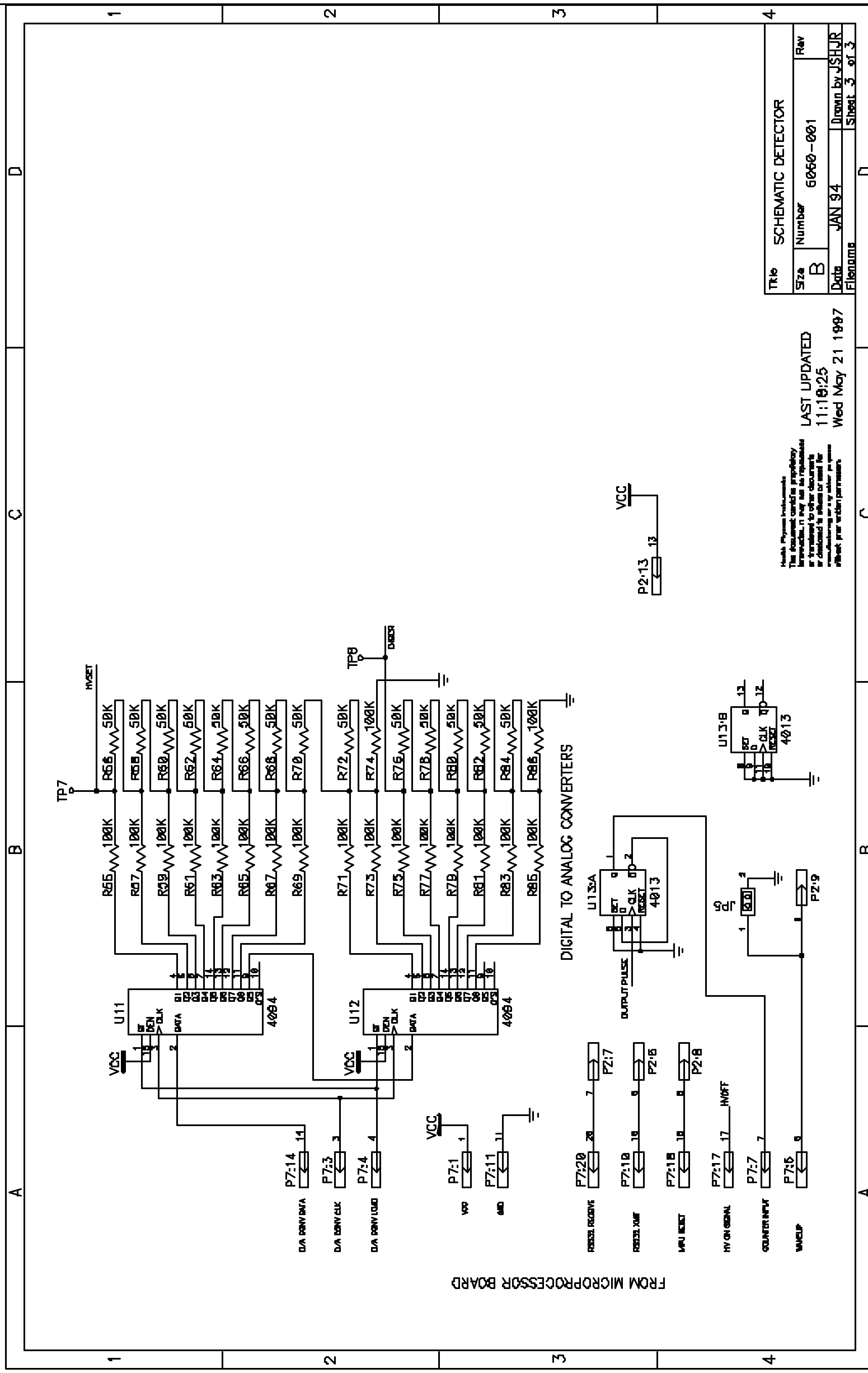
Wed May 21 1997
LOW VOLTAGE POWER SUPPLY
PULSE LINK DRIVER
HIGH VOLTAGE POWER SUPPLY
HV DISCHARGE
LM340T-5.0
LM340T-15.0
TLC274
2N2222
2N2905
2N3251
4001
1N4004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6060-001
JAN 94
Sheet 3 of 3
LAST UPDATED
11:10:25
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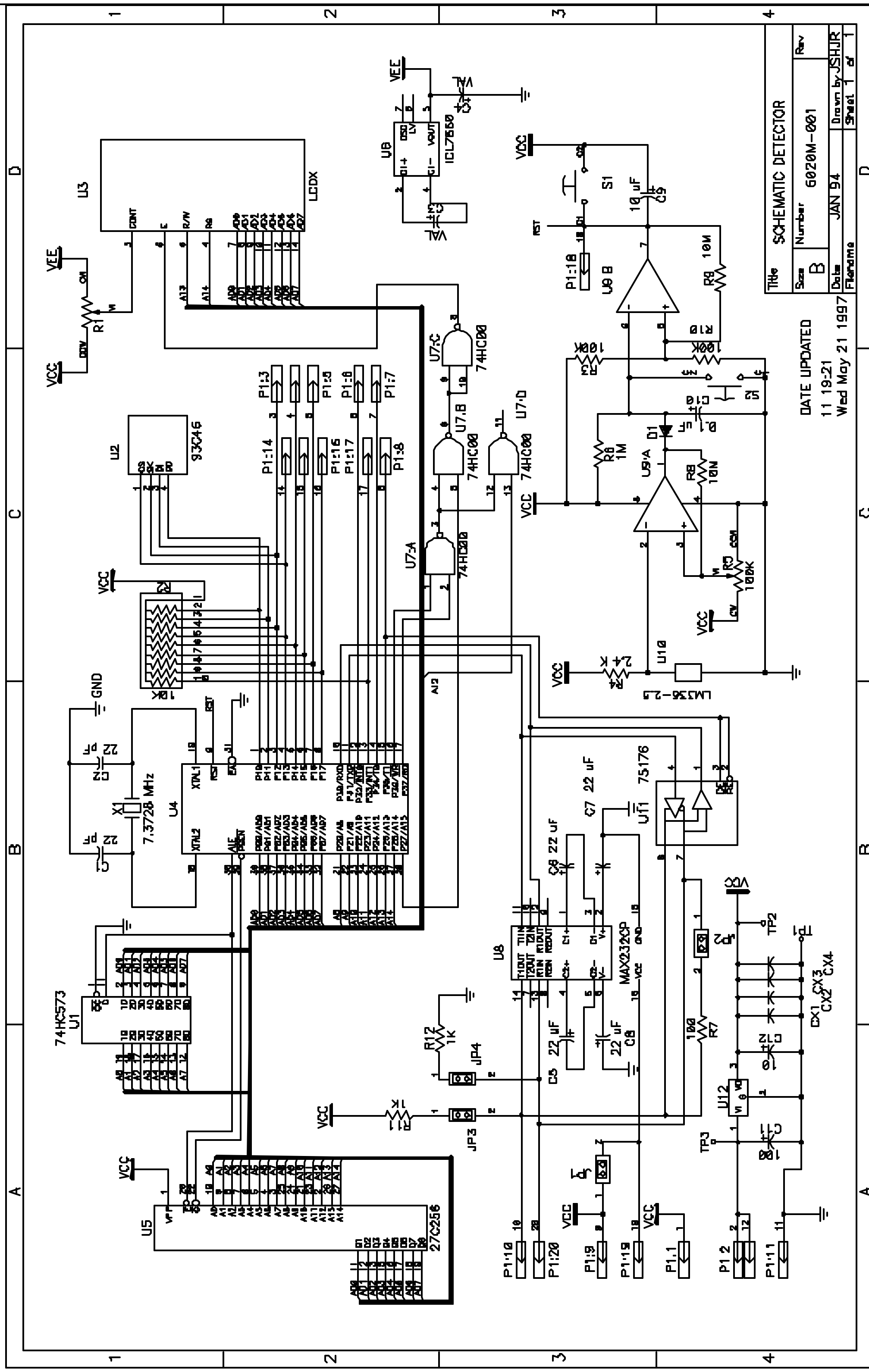
DIGITAL TO ANALOG CONVERTERS
FROM MICROPROCESSOR BOARD
U11
U12
4094
U13A
U13B
4013
JP5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6020M-001
JAN 94
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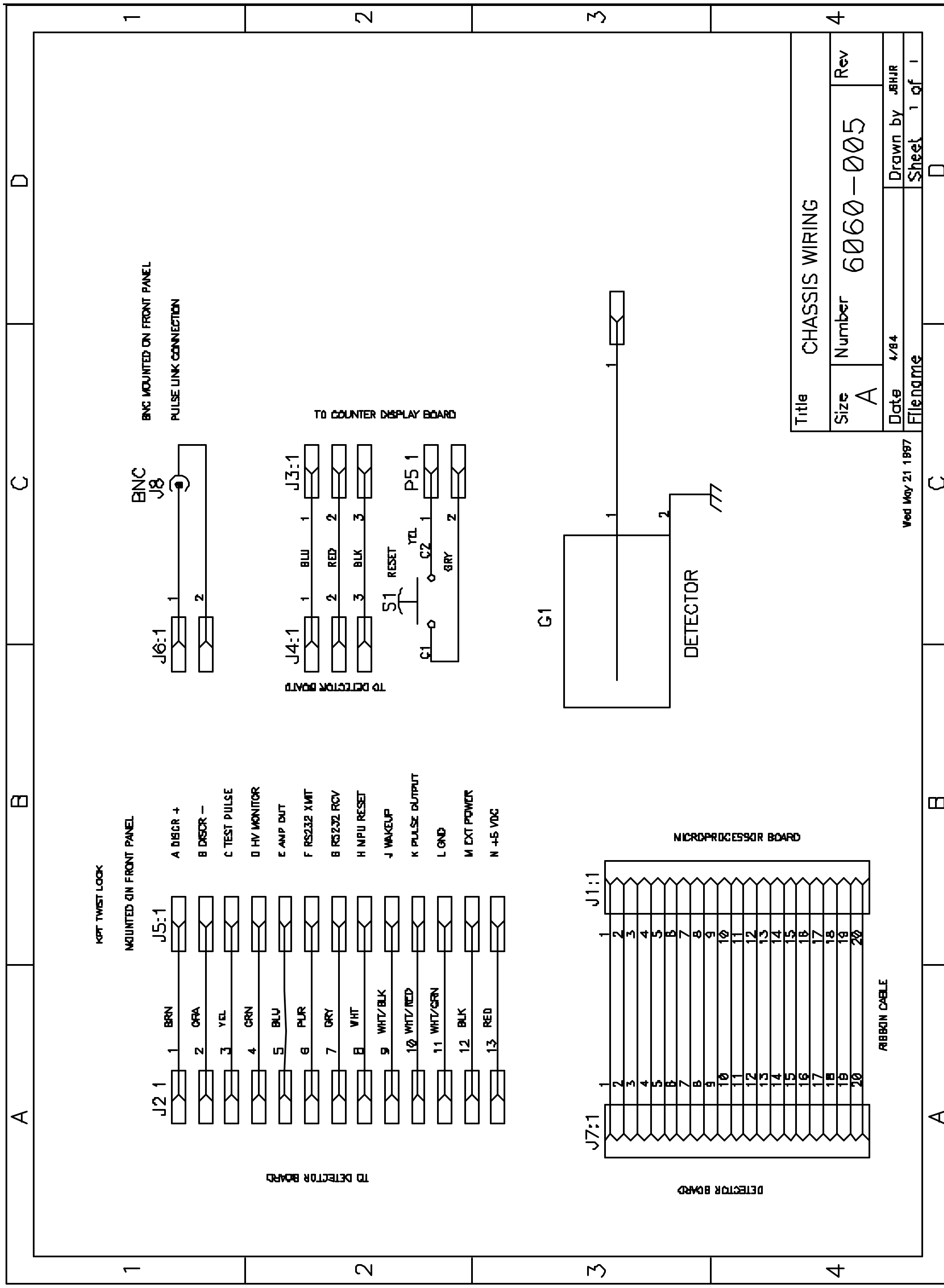
Wed May 21 1997


CHASSIS WIRING
Title
Size
A
Number
6060-005
Rev
Date
4/94
Drawn by
JBHJR
Filename
Sheet 1 of 1
Wed May 21 1997
BNC MOUNTED ON FRONT PANEL
PULSE LINK CONNECTION
BNC
J8
J6:1
TO COUNTER DISPLAY BOARD
J3:1
J4:1
BLU
RED
BLK
TO DETECTOR BOARD
S1
RESET
C1
C2
YEL
GRY
P5 1
G1
DETECTOR
KPT TWIST LOCK
MOUNTED ON FRONT PANEL
J5:1
A DISCR +
B DISCR -
C TEST PULSE
D HV MONITOR
E AMP OUT
F RS232 XMIT
G RS232 RCV
H NPU RESET
J WAKEUP
K PULSE OUTPUT
L GND
M EXT POWER
N +5 VDC
J2 1
BRN
ORA
YEL
GRN
BLU
PUR
GRY
WHT
WHT/BLK
WHT/RED
WHT/GRN
BLK
RED
TO DETECTOR BOARD
MICROPROCESSOR BOARD
J1:1
RIBBON CABLE
J7:1
DETECTOR BOARD