2502

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MODEL 25O2ATECHNICAL MANUAL

?000-0503

II. SPECIFICATIONS

MODEL 2502 POSITION COMPUTER

Image Quality:	
Resolution:	256 x 256 pixels
Linearity:	5% Relative displacement of any point in image. Output monotonic over entire image
Dead Time□	300 ns per event <400 ns dead time plus peak time, (effective dead time for paralyzable dead-time correction)
Background Rate:	<10 Events/s over image
Outputs:	
Sum Monitor: (On position analyzer unit)	Sura of all preamps for observing and calibrating MCP gain level.iO.4 Volts bipolar
X and Y pos i t ion:	0 to 3.75 Volts analog r-c')res(?r)t.<jI ion of pulse pos 11 ion
Z axis:	Oscilloscope display blanking (0 V on, ⊦5 V blanking)
Strobe:	TTL pulse (300 ns) during each accepted event
Rate:	TTL signal that toggles with each input event exceeding "fast" threshold level
Digital Interface:	Digital interface directly compatible with 2420B PC/AT interface.
Power Requirements:	Selectable volage ranges; 100/120/220/240 VAC, 50 Watts

II. OVERVIEW

A- System Considerations

The 2502A electronics unit receives charge pulses from a microchannel plate (MCP) and resistive anode position encoder assembly. The position data are stored digit/illy in an internal buffer memory. The memory contents are sent to the host PC/AT coniputer via a Model 2420B PCIO in ter face. Analog ouLpuls arc provided for monitoring pulse positions, MCP pulse amplitude□ and count-rate. 八 digital rate output is also provided. The preamp and position decoder electronics are packaged in a small box that should be mounted near the sensor. The power supply, monitoring circuits, FIFO interface and buffer memory are contained in a separate chassis unit. The typical system configuration is shown in Figure 1.

Vacuum feedthroughs. Most conventional feedthroughs can be used for the microchannel plate HV bias electrodes and resistive anode signal outputs. AlLhough it is not necessary to use coaxial RF feedthroughs for the signal leads, it *is* important to minimize inter-electrode and stray capacitance between the signal leads.

Vacuum Lends. In systems operating at pressures greater than IO"0 torr that are not baked at Lemperatures higher than 150°C, low capacitance teflon insulated coaxial wire such as RG-187 A/U is recommended for signal and IIV leads. Signal leads should be kept as short as possible and the total length from detector to preamp input should not cxacod 15 inches. Tho signal lead lengths should not differ by more than 1 inch. Higher input capacitance will degrade resolution. In UHV Kyslcnis, l.ho leads should be bare or ceramic ifisulaled wire. Leuds should be shielded from each other and from any other poLcnLuil noisu sources.

Grounding and Bypassi叫 The pulse amplifiers are extremely sensitive to high frequency signals, so careful grounding and shielding practices are* essential. Other electronic equipment that is interconnected with the position computer electronics should bo powered from the same electrical circuit, and should be isolated as much as possible from electric motors, SCRa and other sources of electrical noise. The signal lead shields should be grounded to the vacuum chamber at one point as near to the detector as possible. All components near the anode should be con- nected to this ground. The position computer electronica box should be electrically grounded to the vacuum chumber. One of the four mounting holes on the box bracket has the painted surface removed to provide a good electrical contact. The analog nioniLor ouLput provides a convenient check on the input noise lovel. Some experimentation with different grounding techniques should bo tried to find the lowest noise configuration.

Decoupling. Th© pre-amp inputs are direct coupled and cannot tolerate any DC voltage. If the resistive anode is operated at other than ground potential, it is necessary to decouple the anode with 1000 pf capacitors. (This isolation is standard on most SSL open face sensors.)

B. ElccLi-icul ConnccLions

Sensor inpul. coniioctions. The lead a from tho vacuum chamber fecdlhroughii to tho preamp inputs should be RG 187 A/U coaxial cable. These leuds should bo kept as short us practical and of equal length.

Analog monitor output. An analog monitor output is a available at a BNC connector on the position analyzer unit. This output should be used only for teut purposes and should not have a cable attached during normal oporation. The sum monitor signal is the combined pulse ainpliludo from the four preamp outputs. This signal is used when udjusting the MCP high voltaic and for measuring noise level.

Position analyzer to main chassis connoctions. Two cables connect the posiLion analyzer to the main chassis. Digital data are carried over the 37 pin connector cable, and the 9 pin connector cable provides the power interface.

Computer iriLorface Tho computer interface is a 50 conductor cable that connects the main chassis to a 2420B interface board installed in Lhe PC/AT computer.

Chassis (n) Lpul.s. Several ontpuL signal are available on BNC connectors on the chassis baclc panel. X and Y axis analog signals and a Z axis strobe bi^nai can be conne(:l.(j(l lo nn oscilloscope to provide a real time <i is play *of* lh(image. Th<? logarithmic count rate and MCP level iiignuls that can b(; selected for uiclcr display are also available on back panel conncccors. Digital event pulses (TTL level) representing both total and accepted even Is are provided.

III. INITIAL SETUP AND ADJUSTMENTS

WiLh the detector installed in a vacuum chamber, uso the following procedure for the initial turn-on. The chamber should have a signal source such as an ultraviolet lamp, ionization gauge, or filament (a flashlight bulb filament makes a convenient source). It need not be evacuated for the preliminary checks.

1. The detector high voltago should not be turned on in pres- sures higher than 10"^{5} torr.

2. With an oacilloscope connected to the "sum monitor" of the position electronics unit, turn on its power (detector HV remains off). A few niillivolLs of "whiLe" noise should be visible. Check for any spikes and transients. The threshold for accepting events is 60 mV, ao all noise should be substantially below that level. Try to improve grounding configuration if ncino is excessive.

3. Evacuate chamber und slowly turn on the detector HV supply to a convenient low voltage (100 - 500 V). Check for any additional noise on the "sum" monitor. If the IIV supply is properly filtered and isolated, no change should be seen. If any large increase in noise level is observed, check for possible sparking or discharge in the system.

4. Slowly increase the HV supply to 1700 V while continually monitoring the "sum" signal. Stop if there is any sudden jump in noise level. Opce the HV is set, illuminate the detector with a small flux of charge particles or photons. Pulses should be visible above the noise level on the "sum" monitor. Signal pulses havo a bipolar shape with a total pulse width of about 250 ns. Adjust the HV until the mean pulse height is about 200 mV. The pulse electronics will clip pulses at about 400 mV. It should not be necessary to increase the HV above 2 kV for this adjustment. The "input level" meter should read near mid-acale when the MCP gain is correct.

5. Check the ^{H}position monitor'^{1} to see that pulses are being dotected. The position output ahould be jumping to levels between 0 and 3.75 V.

6. Turn off the illumination ^source and note the number of background counts (i.e./'sum'^{1} pulses >0.06 V). This rate should be 10/second or fewer. If the rate is substantially higher than this, there may be a source of electrons, ions or photons in the chamber. Possible spurious sources are corona from a HV lead, ion gauges, or a source, of ionizing radiation. Observe the spatial distribution of the back- ground counts on the "position monitor^{H} (a storage oscilloscope is

convenient for storing these low rates). These events should be randomly diaLribuled. A concentration of counts in one area indicates either a "hot spot'* on tho MCP, or electronic transients being picked up by one or bolli preamps (a common manifestation of transient pick-up prob.loma is an apparent "hot apol'[1] in the center of the image due to n sigruil picked up (Hjually l》y both prcmtips). A test that usually disliii^uish<js transicriLn from real hoi spots is to decrease Lhc high vol Lage ko real MCP pulses dccrczisc below Lhc discriminator threahold and disappear.

IV. TKCHNIC八i□l)HSCPHrriON

A. Pulse Position Analyzer

The Model 2502 detector system includes a resistive anode image converter, shaper amplifiers and position analysis electronics,, and a buffer me mor y with computer interface. The resistive anode is placed behind two microchannel plates having approximately 5xlO[6] gain, so that each incident particle produces a charge pulse on the anode that can be analyzed by the position electronics. The operational function of each component is described briefly in the next section and is followed by a technical desription.

1. The resistive anode is a diffusive RC transmission line that divides charge between output electrodes in proportion to the proximity of the input pulse.

2. Charge sensistive preamps and shaper amplifiers convert the low lcvol chargo pulses into high level bipolar signals suitable for driving the position analyzer circuit. The amplifier shaping network has been matched to the resistive anode for optimum signal to noise ratio, short pul3e duration, and low baseline shift.

3. The posiLion analyzer electronics generato a digital output proportional to the pulse position coordinates of the form

$$X = B/(A + B)$$

The position analyzer logic selects acceptable pulses that have amplitudes between the upper and lower level discriminators. Accepted events are stored in tho output register and an output strobe signal is generated.

Circuit Details

The major functional blocks of the pulse position analyzer are the four input amplifiers, a threshold amplifier, summing power amplifiers ratioing A/D converters, and control logic. The following discription refers to the schematic diagram.

The input amplifiers consist of transistors Q1-Q14, Q19-Q32 and their associatod resistors and capacitors. The four amplifiers are identical so Lhis description refers only t.o Lhe "A" amplifier. The input stage is a common base charge amplifier followed by a two stage emitter follower. The second stage is a four transistor voltage amplifier (Q5-Q8) that drives the main LCR shaping network. A second voltage amplifier <Q9, Q10) drives the second shaping network. Tho final stage is a voltage araplifier/driver (Q11-Q14).

A Hep'".'山 : /linplificf with very C□u;l. slwiping i« uhc<1 for Lho thrcKholcj signal. Tho oulpuL:> of the four cha(•/<(; aniplifioi-s *uro* sumniod and amplified by Q15-Q18. Tin? output pulse? of lliis amplifier has a duration of about 50 ns, which *in* much shorter than the main amplifier pulse durutlon and facilitates effective pulse pile-up rejection by the control logic. The threshold level *is* set by tho comparator U6, which also comprises a one-shot Tnultivibrntor with a time constant of 50 ns. Two identical power amplifiers are U3cd to drive the inputs to each of the ratio A/D converters U9. Tho "numcraLor'[1] or "A" power amplifier is made up of Q33, Q34, Ul, and half of U2. The transistors and the LH0002 comprise a unity gain pulse amplifier having low output impedance. The LM136OO provides baseline restoration to maintain a stable de output lovol for tho pulse amplifier. Diodes D15 and D16 clnmp tho positive and negative output swing to protect the ADC. The "denominator" signal is formed by summing "ABCD". Tho power stage for this signal consists of Q35, Q36, U3, and half of U2.

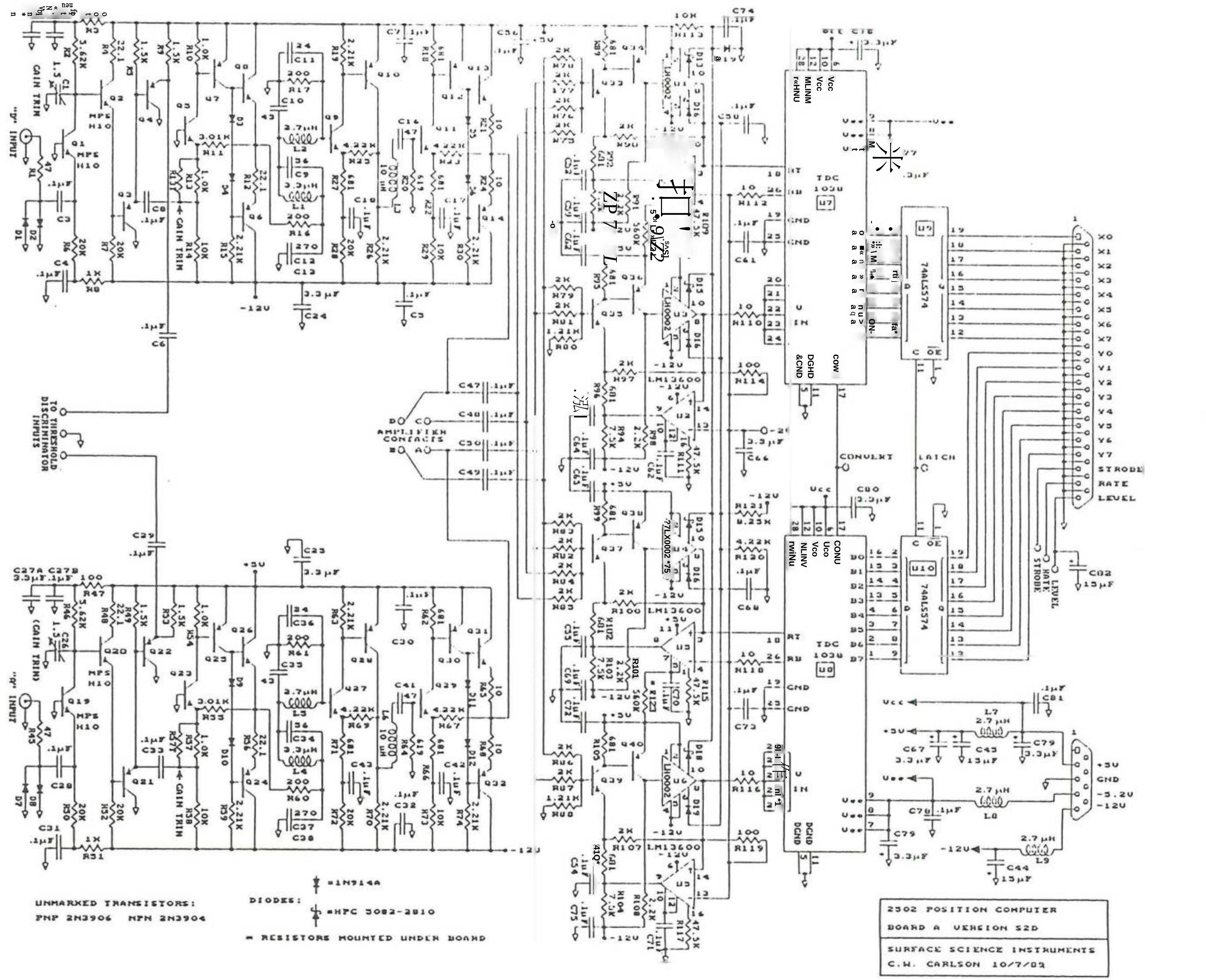
The actual position conversion is carried out by the A/D converter, U9. This is a ^lash[1] ADC containing 256 separate voltage comparators aLLached to laps on a volLago divider resistor string. The analog input signal is compared with thia reference voltage divider, and all comparators at taps below the inpuL voltage level are triggered. The comparator outputs are coded into a standard binary format. The digital output represents the raLio of the analog input and roference input signals. The ADC must be strobed when tho analog signal pulses are near their maximum value and the timing for this strobe signal is generated by the control logic.

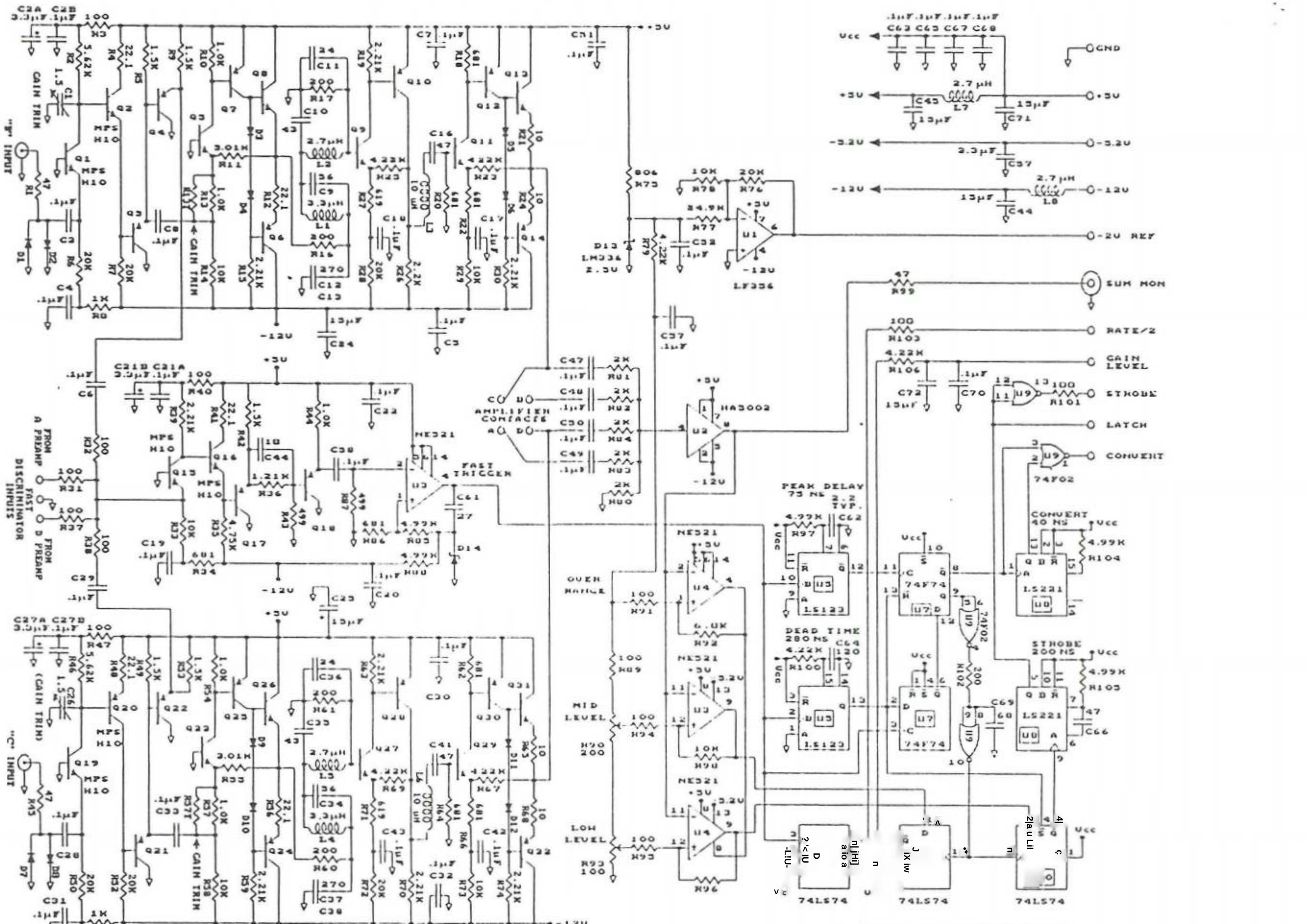
The control logic selects events for analysis and generates the required timing and strobe signals to operate the ADC and output register. To be accepted, a pulse must have an amplitude lying between the threshold and overload levels and must not overlap other pulses. Logic pulses from the "threshold'* comparator trigger the "peak delay"(and "dead time'* one-shots. The end of "peak delay[1]* clocks UlOb, whicK* starts a "convert" pulse and also triggers the "convert" one-shot Ulla. Thia first convert pulse actually initiates the A to D conversion by U9, but a second convert pulse is needed to transfer the data to the output buss of U9. The "convert" one-shot generates this double pulse by a combination of its trigger delay and the normal timeout. After a delay of about 50 ns the "convert" one-shot is set, inhibiting the "convert" signal. After an additional 40 ns the one-shot times out and the inhibit is removed, producing th© second "convert" pulse.

If a second threshold pulso arriv(»s before the end of [11] peak delay" □ UlOa will be set and no "convert/' pulaes will be produced when UlOb is clockod. Once Lhe A/D conversion has been initiated□ the output strobe will be generated if no "overload" condition is deLccled. The overload comparator is polled by U14 about 20 ns after the end of "peak delay". If "overload" is false, U14 will be set and subsequently reset by the timeout of "dead time". The falling edge of U14 triggers the "output strobe" one-ghot Ullb.

B. Interface board — /lx progress (6500 – a/?》 2

C. Buffer memory (see 2412 buffer memory manual) (6500-0189)


2502 POSITION COMPUTER
BOARD A VERSION S2D
SURFACE SCIENCE INSTRUMENTS
C.W. CARLSON 10/7/82
UNMARKED TRANSISTORS:
PNP 2N3906 NPN 2N3904
DIODES:
=1N914A
=HPC 5082-2810
* RESISTORS MOUNTED UNDER BOARD
"D" INPUT
"A" INPUT
GAIN TRIM
TO THRESHOLD DISCRIMINATOR INPUTS
AMPLIFIER CONTACTS
74ALS574
TDC 1050
LM13600
LH0002
CONVERT
LATCH
STROBE
RATE
LEVEL

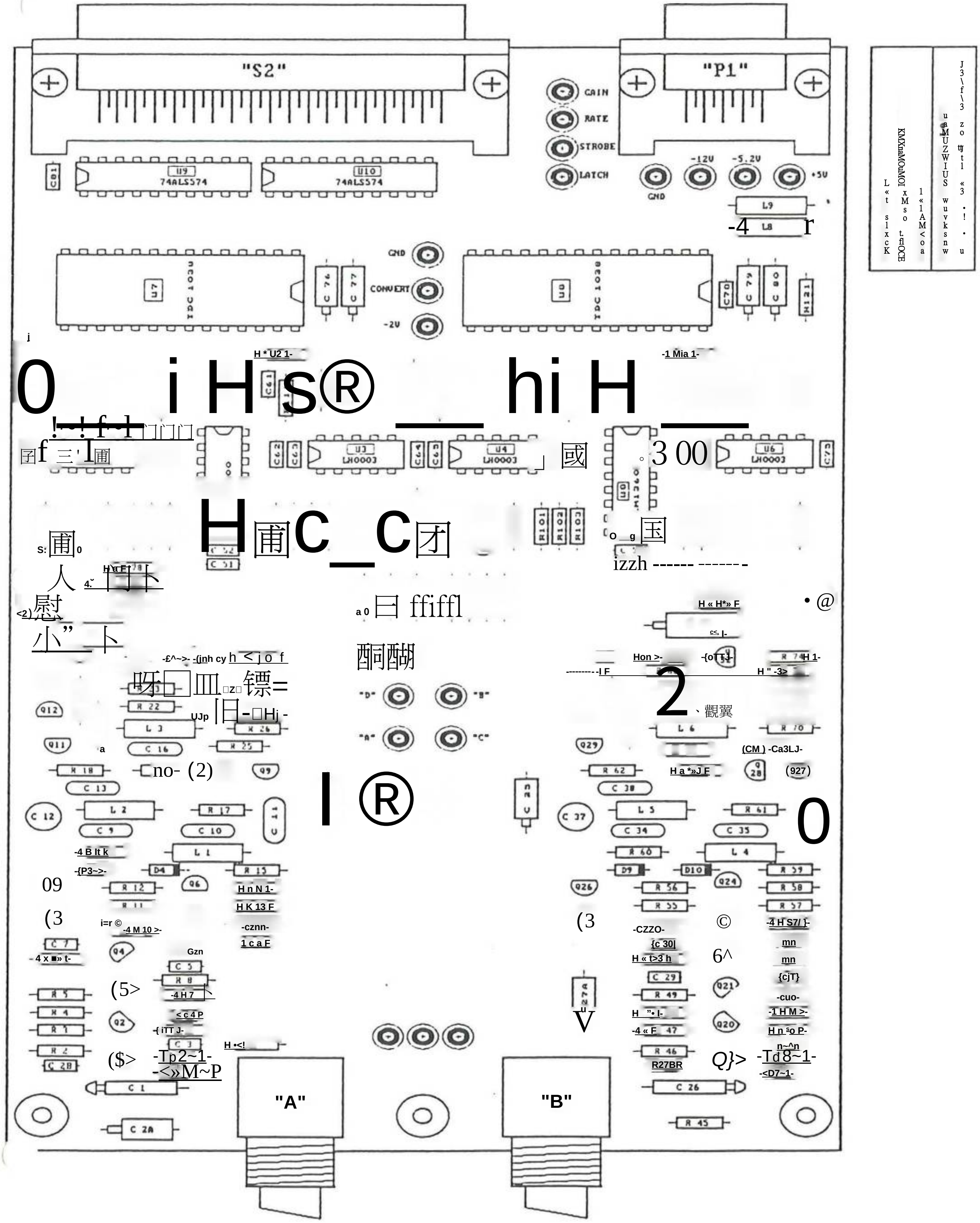


UNMARKED TRANSISTORS:
PNP 2N3906 NPN 2N3904

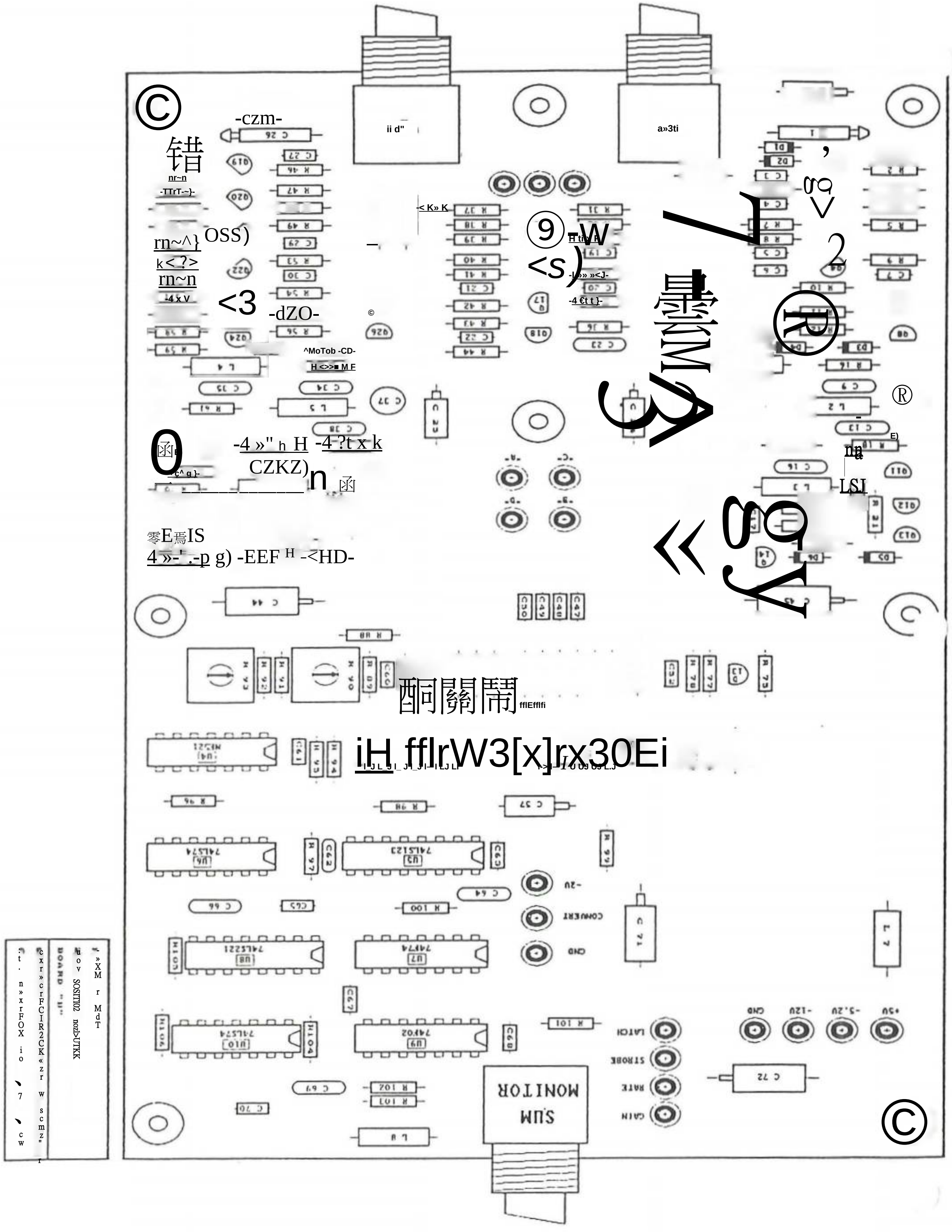
DIODES: = 1N914A
= HPC 5082-2810

2502 POSITION COMPUTER
BOARD B S/N > 9537

SURFACE SCIENCE INSTRUMENTS
C W CARLSON 10/7/89



"S2"
"P1"
GAIN
RATE
STROBE
LATCH
GND
-12V
-5.2V
+5V
L9
L8
U9
74ALS574
U10
74ALS574
CONVERT
-2V
U7
TDC 1018
U8
TDC 1018
U3
LH0003
U4
LH0003
U6
LH0003
"D"
"B"
"A"
"C"
"A"
"B"


SUM MONITOR
GAIN
RATE
STROBE
LATCH
CONVERT
GND
+5V
-5.2V
-12V
-2V
74LS74
74LS123
74F74
74LS221
74F02