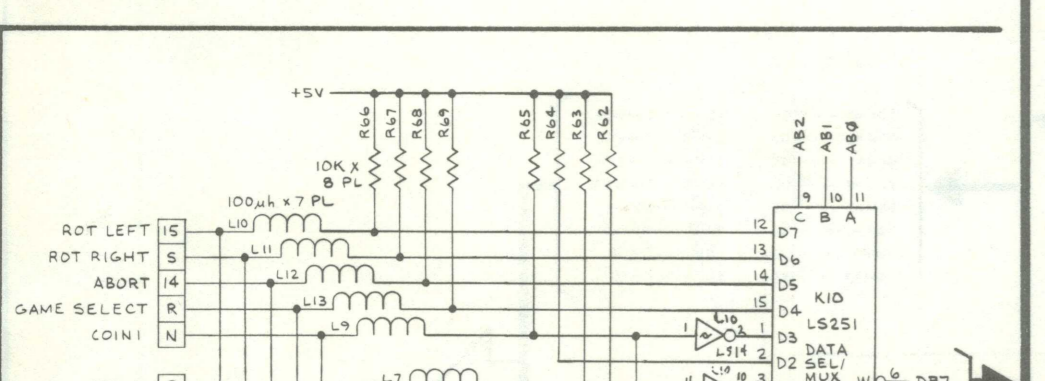
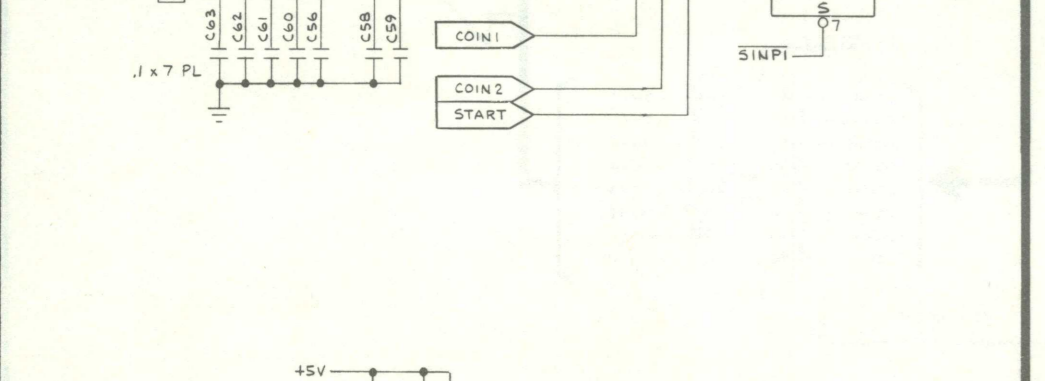


The game option switches are read by the MPU when OPTS (option switch enable) is low. Switch toggles to be read are selected by AB0 and AB1 from the MPU. Switch toggles 1, 3, 5, and 7 are read on data line DB0 and toggles 2, 4, 5, and 8 are read on DB1. Toggle inputs are "on" when pulled to ground.

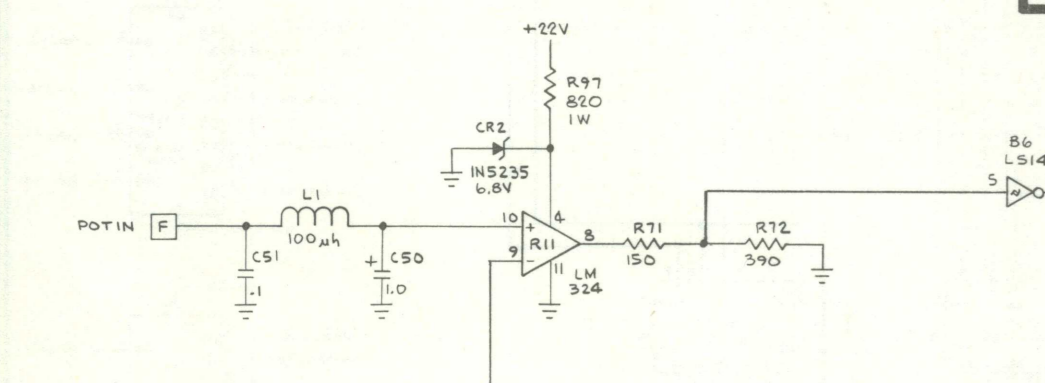


The coin door and control panel switches are read by the MPU when SINPI (switch input one enable) is low. Switches to be read are selected by AB0 thru AB2 from the MPU. All inputs are read on data line DB7. Switch inputs are "on" when pulled to ground.



DIAG STEP (diagnostic step), 3 KHz, SELF-TEST, SLAM, and HALT inputs are read by the MPU when SINP0 (switch input zero enable) is low. Inputs are directly read by the MPU on data lines DB7, DB6, DB1, DB2, and DB0 respectively. Switch inputs are active when pulled to ground. DIAG STEP, 3 KHz, and SELF-TEST are signals read by the MPU to initiate and control the game's self-test procedure. SLAM is a signal read by the MPU to indicate the status of the antislam switch mounted on the coin door. The MPU reads HALT to determine the state of the vector generator.

THRUST INPUT

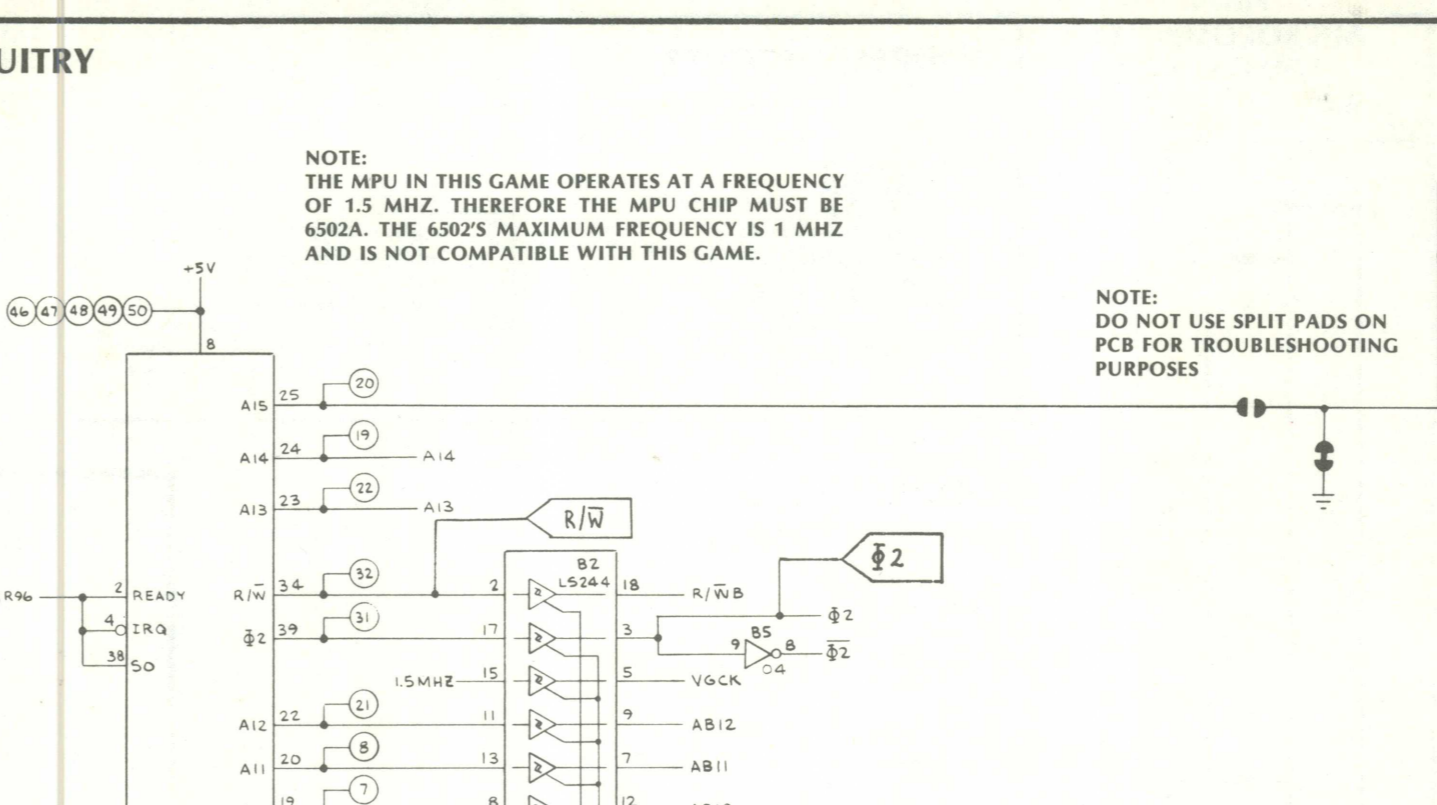
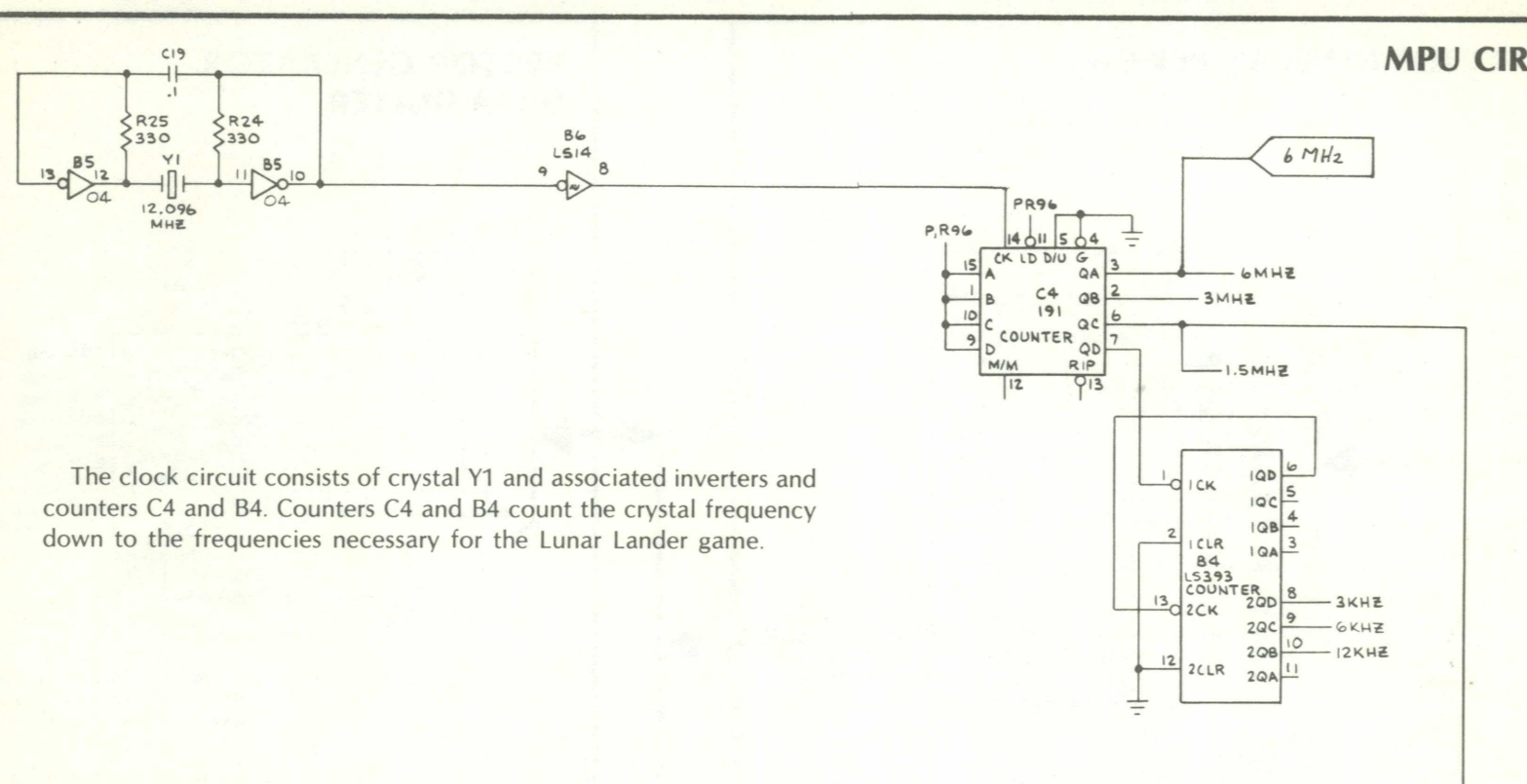


Player thrust control input POTIN is from the wiper of a 5 K-ohm potentiometer connected between +5 VDC and ground. The POTIN signal varies from +2 to +3.5 VDC, depending on the position of the thrust control. This voltage is compared with the output of digital-to-analog (D/A) converter N10 at the pin 9 and 10 inputs of comparator R11. If the POTIN voltage (R11, pin 10) is greater than the D/A converter output (R11, pin 9), pin 8 of R11 goes high. If the POTIN voltage is lower than the D/A converter output voltage, pin 8 of R11 goes low.

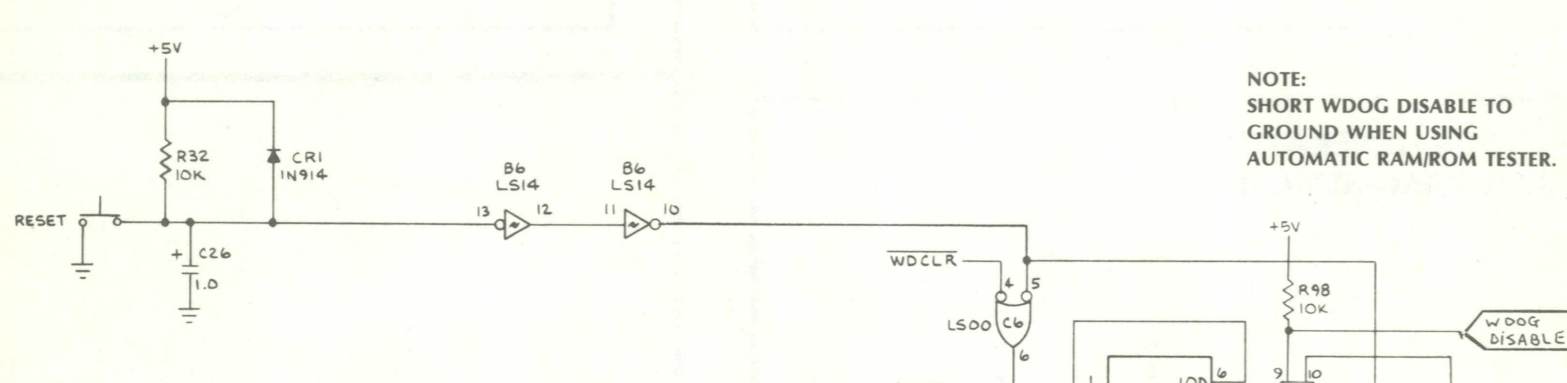
The D/A converter output voltage is controlled by the digital input (IND0 thru IND7) from down/up counters P9 and P10. The counters count up when pin 8 of R11 is low and count down when pin 8 of R11 is high. This feedback loop results in a self-calibrating "pot voltage seek" circuit. The counters continuously count up or down as they "seek" the count which will cause the D/A output voltage to be equal to the POTIN voltage.

The MPU can then read the count output of counters P9 and P10 (via tri-state buffer N9 and the POTIN address), determine the relative position of the thrust control, and output data to the vector generator circuit for the thrust picture and to the audio circuit for the thrust sound.

PLAYER INPUT CIRCUITRY



CLOCK CIRCUIT



The clock circuit consists of crystal Y1 and associated inverters and counters C4 and B4. Counters C4 and B4 count the crystal frequency down to the frequencies necessary for the Lunar Lander game.

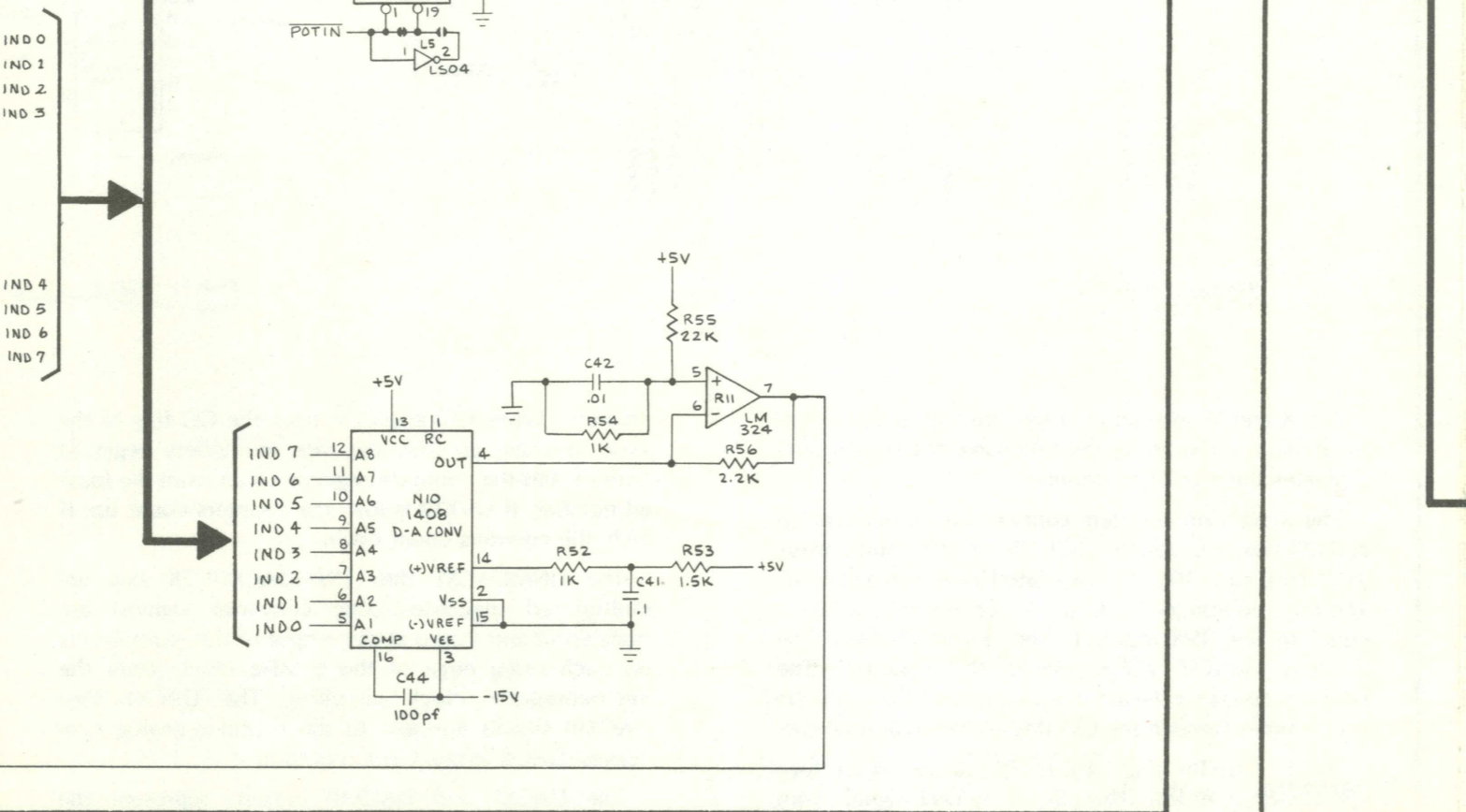
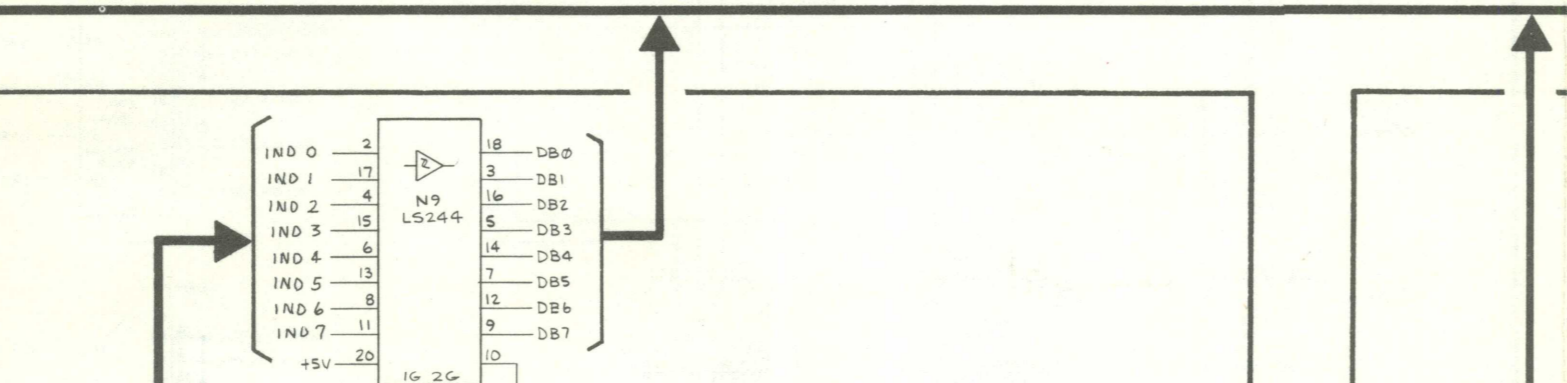
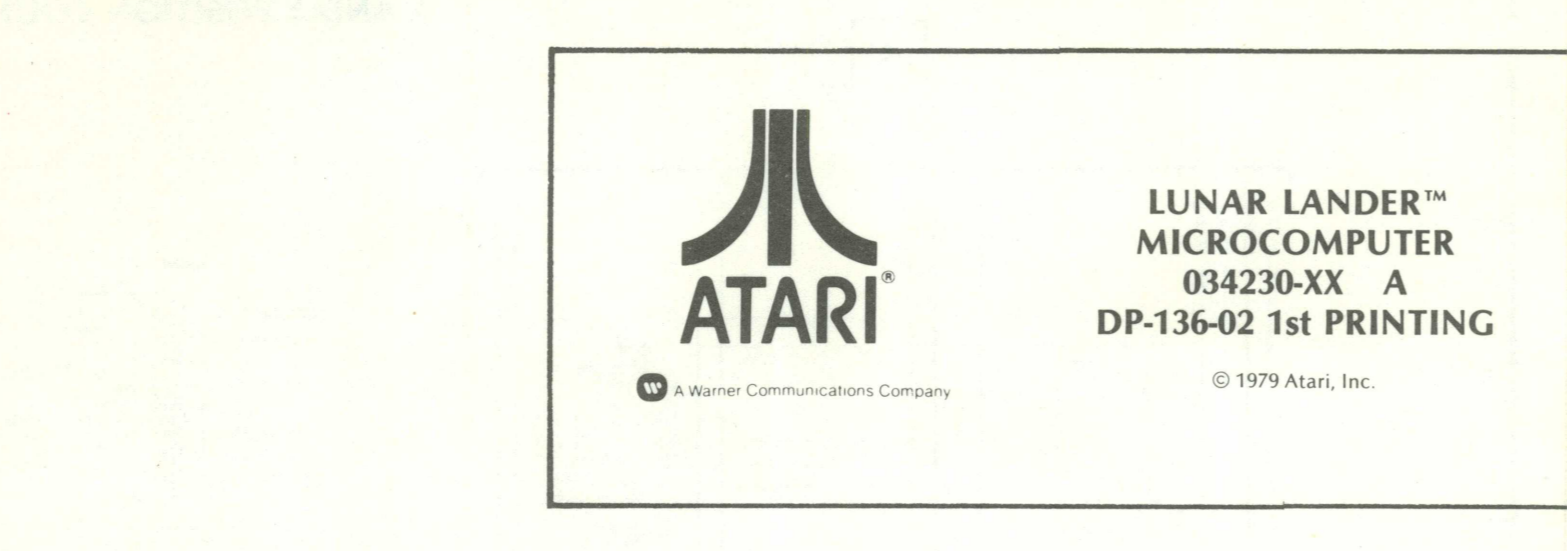
During initial power-up, the charging of capacitor C26 causes a preset of flip-flop D4 and a clear of counter D5. This results in holding RESET input to MPU low. When charge of C26 reaches about 1.5 VDC, preset and clear inputs are removed. Counter D5 counts to 128 at 3KHz rate and RESET is removed (goes high) from the input of MPU. This allows the logic power input to the PCB to stabilize before allowing the MPU to begin its initialization routine.

If the MPU is operating properly, the MPU outputs an address that is decoded by the address decoder for the WDCLR (watchdog clear) input to the watch dog counter. This clears the counter and it starts counting again from zero.

POWER RESET AND WATCHDOG COUNTER

The NMI (non-maskable interrupt) counter causes an interrupt at the NMI input of the MPU every 4 msec. The interrupt is derived by dividing 3 KHz by a factor of 12 through counter C5. The interrupt occurs when pin 6 of inverter B5 goes low. During power-up, the NMI counter is disabled by RESET. During Self-Test, the NMI is disabled by TEST.

NMI COUNTER

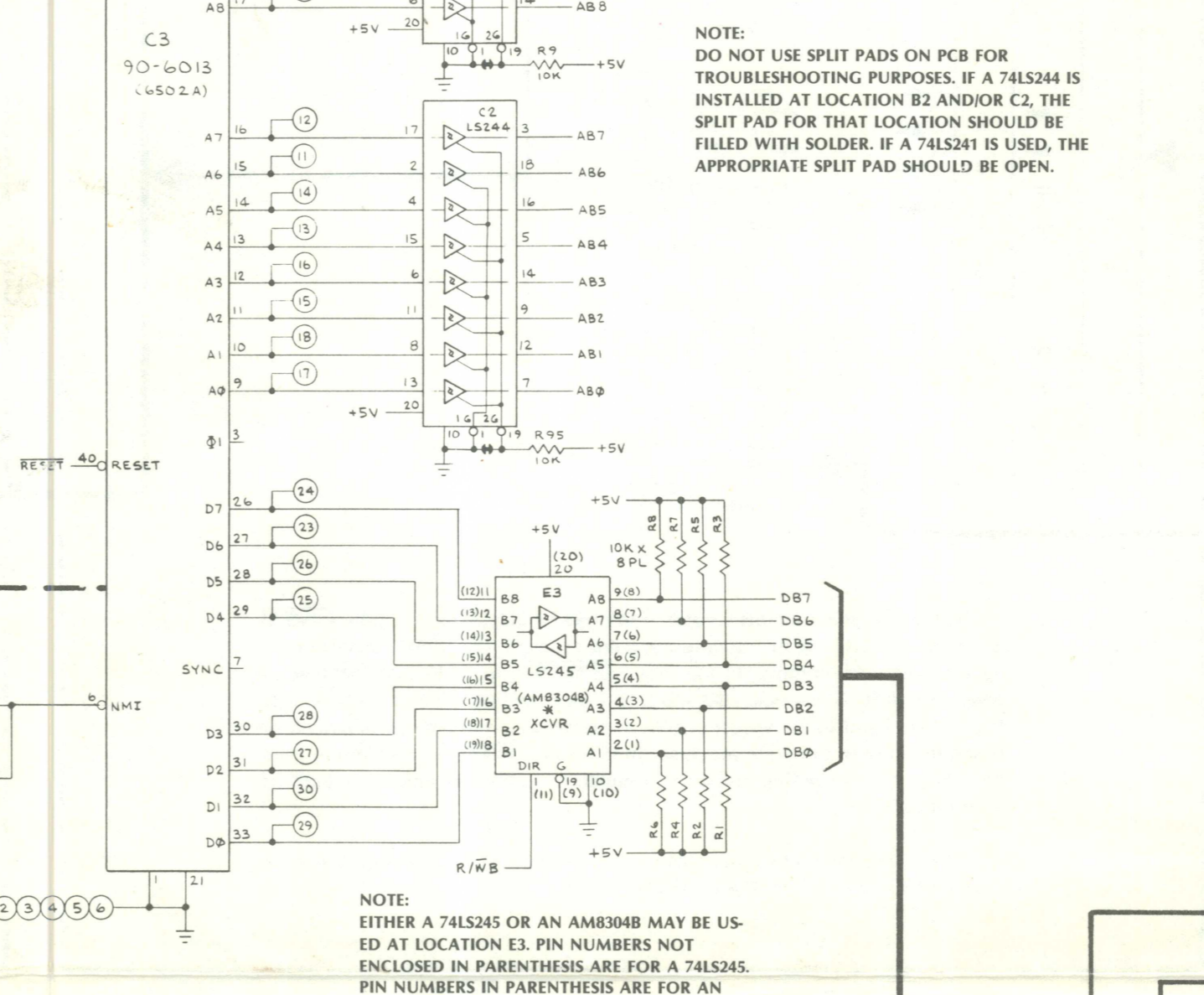


ROM PROM CIRCUITRY

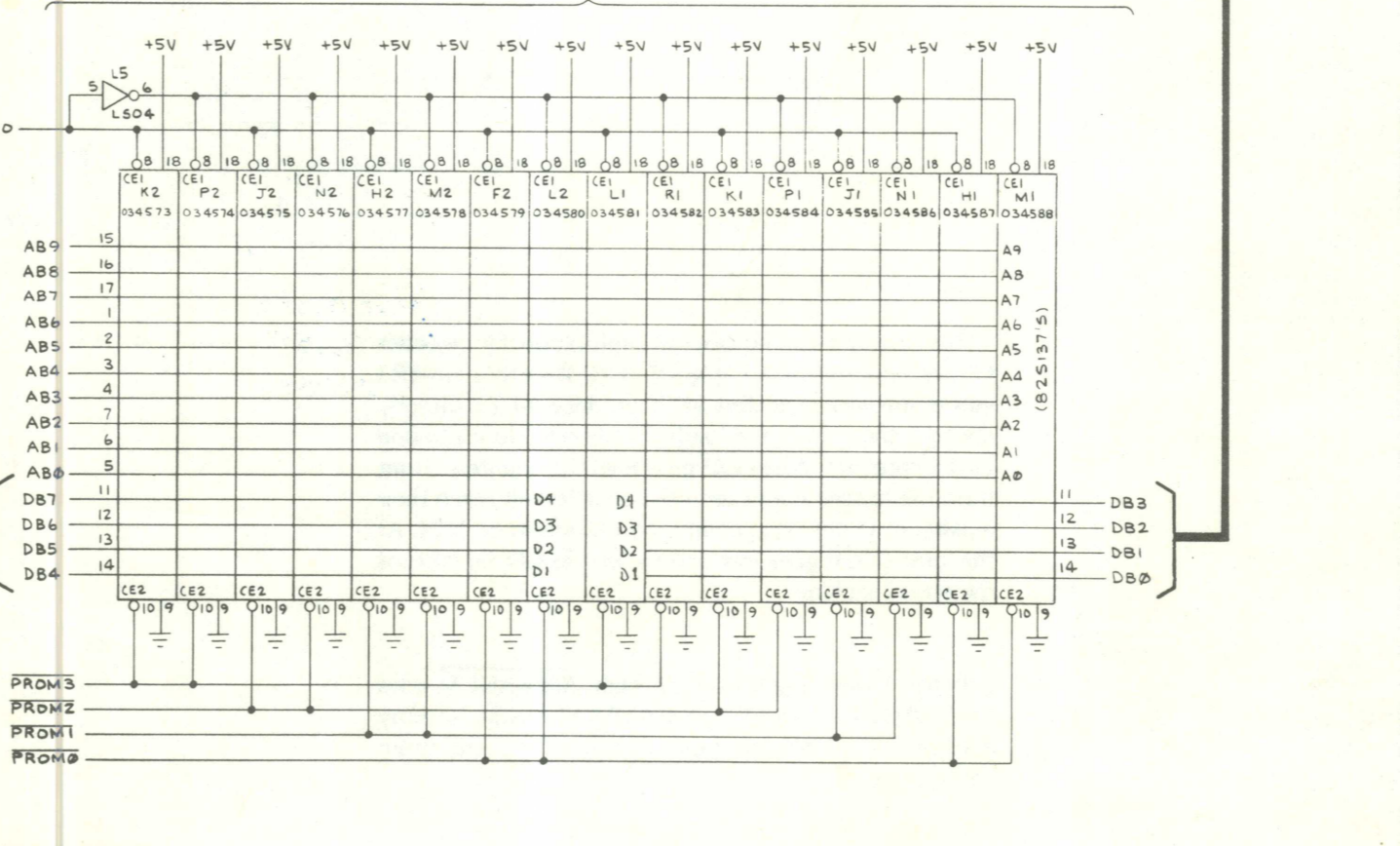
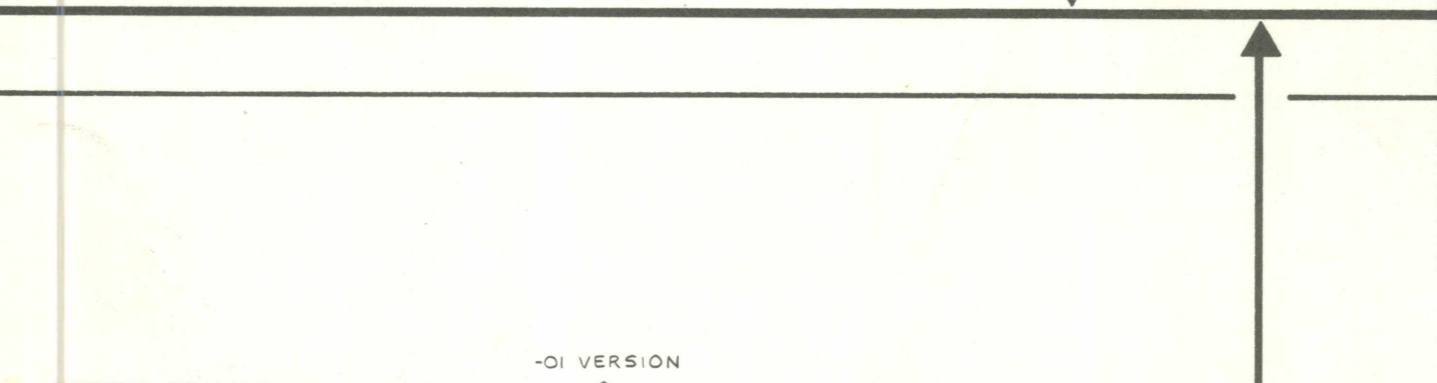
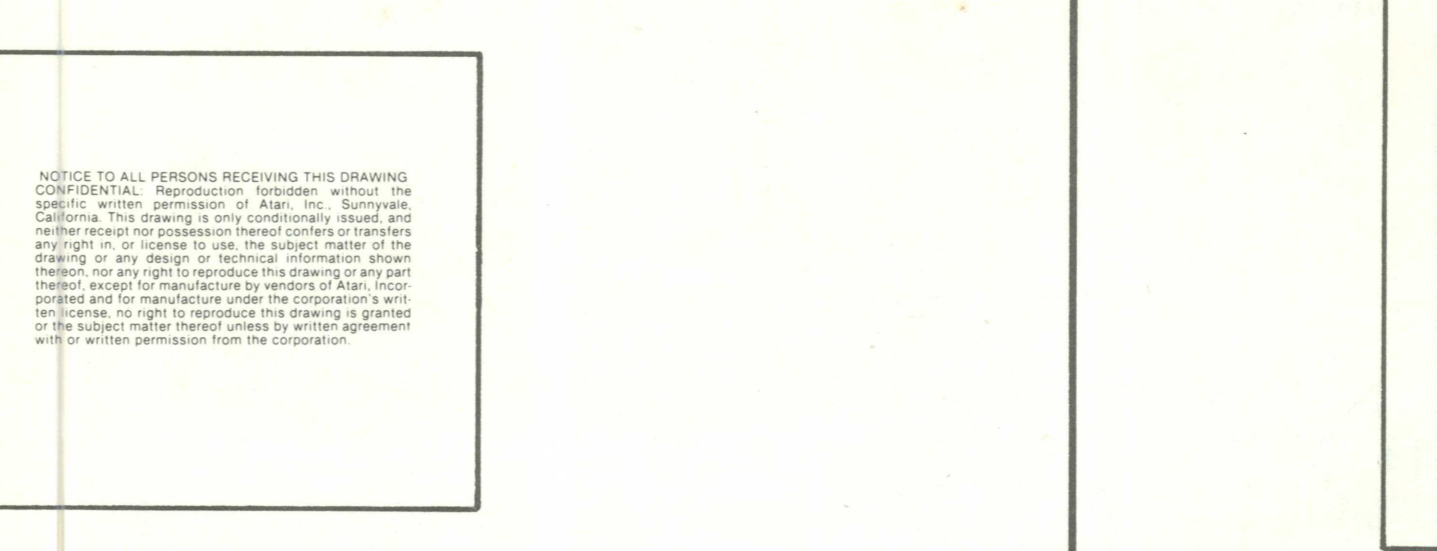
**LUNAR LANDER™
MICROCOMPUTER
034230-XX A
DP-136-02 1st PRINTING**

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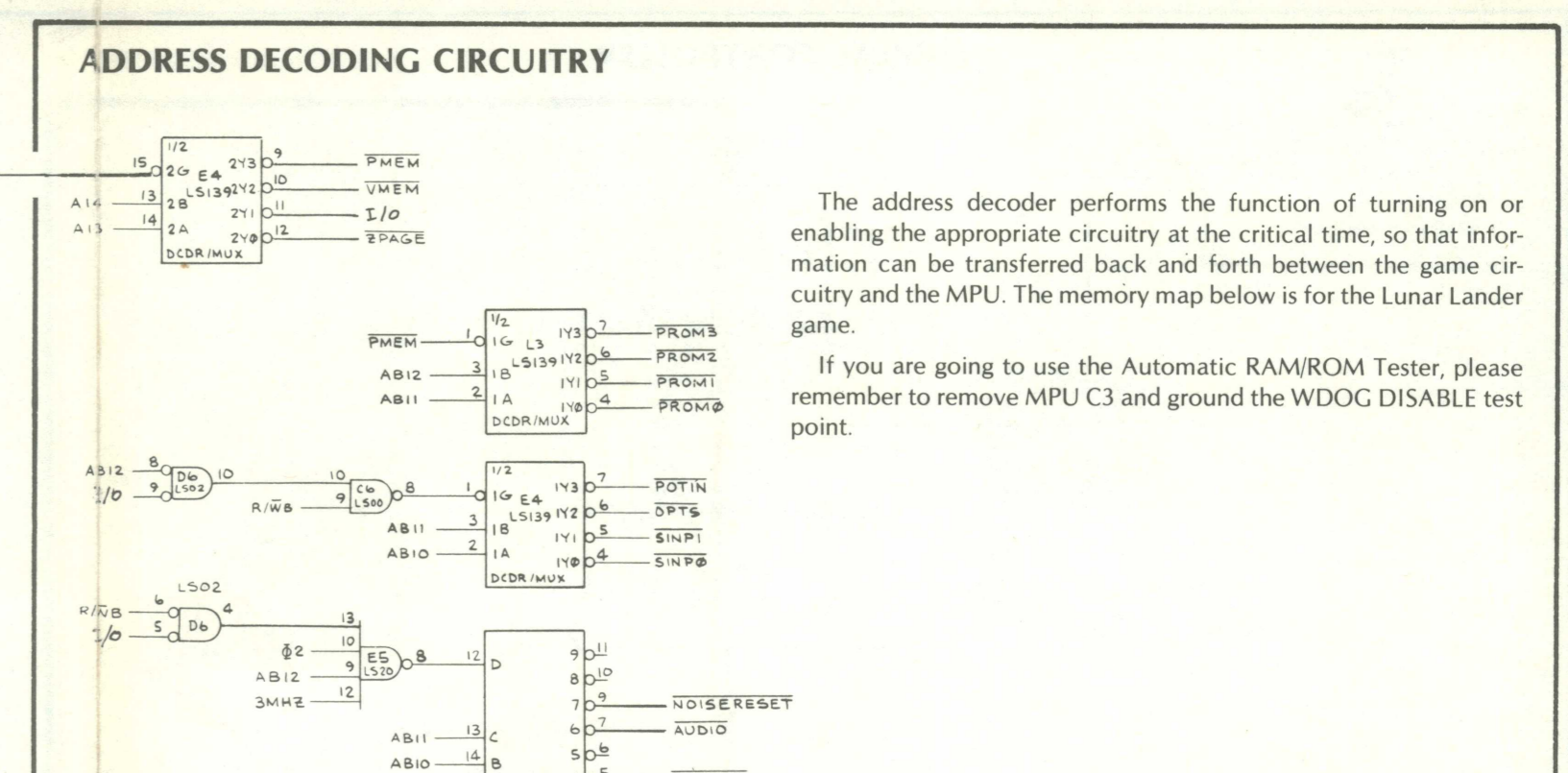
MPU CIRCUITRY



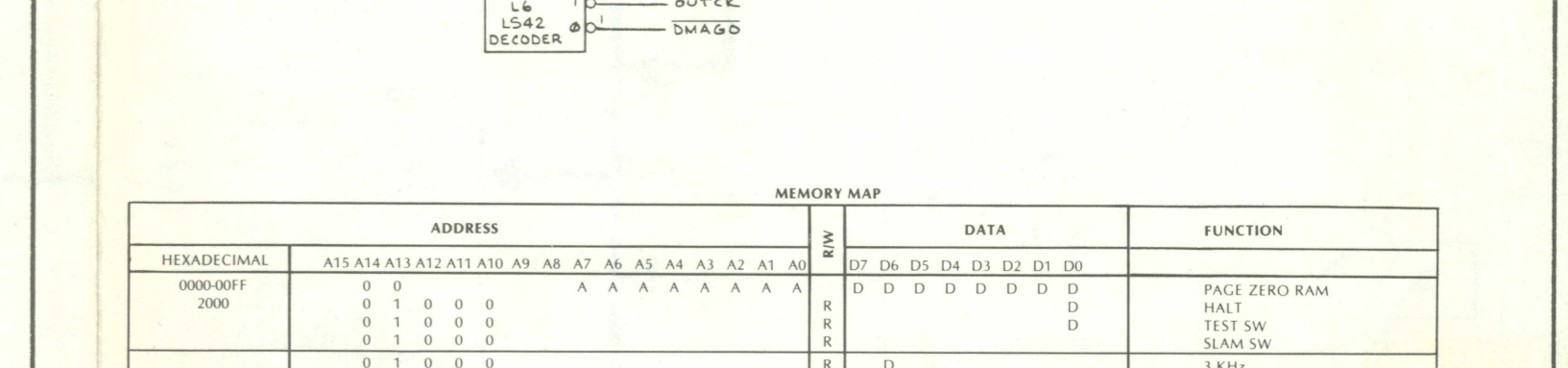
RAM CIRCUITRY



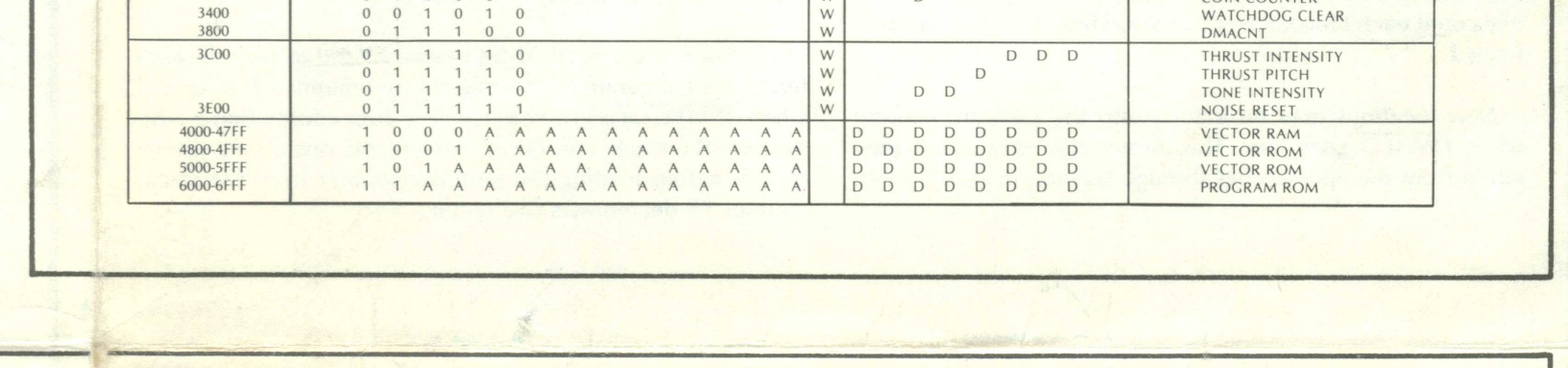
ROM PROM CIRCUITRY



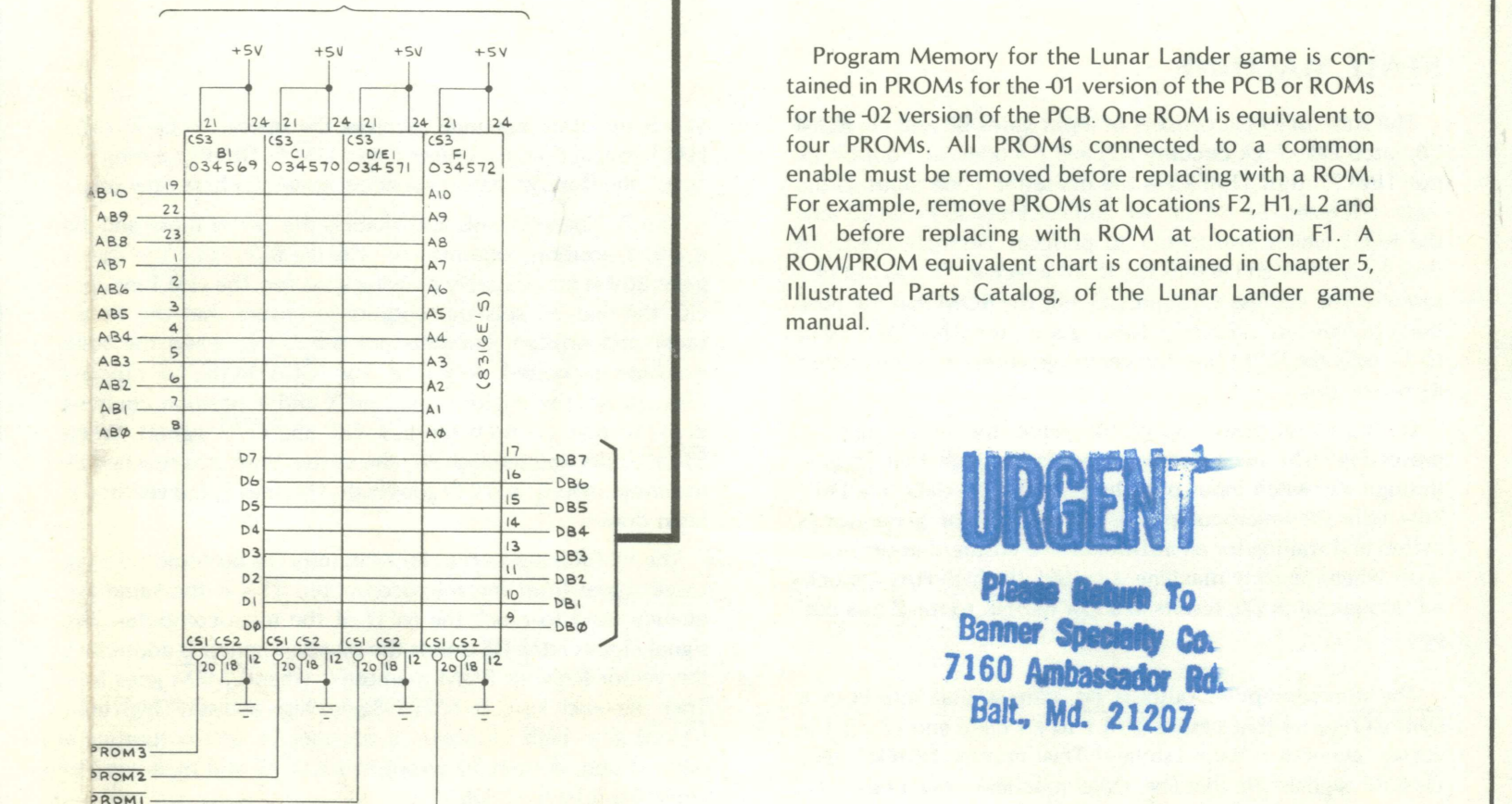
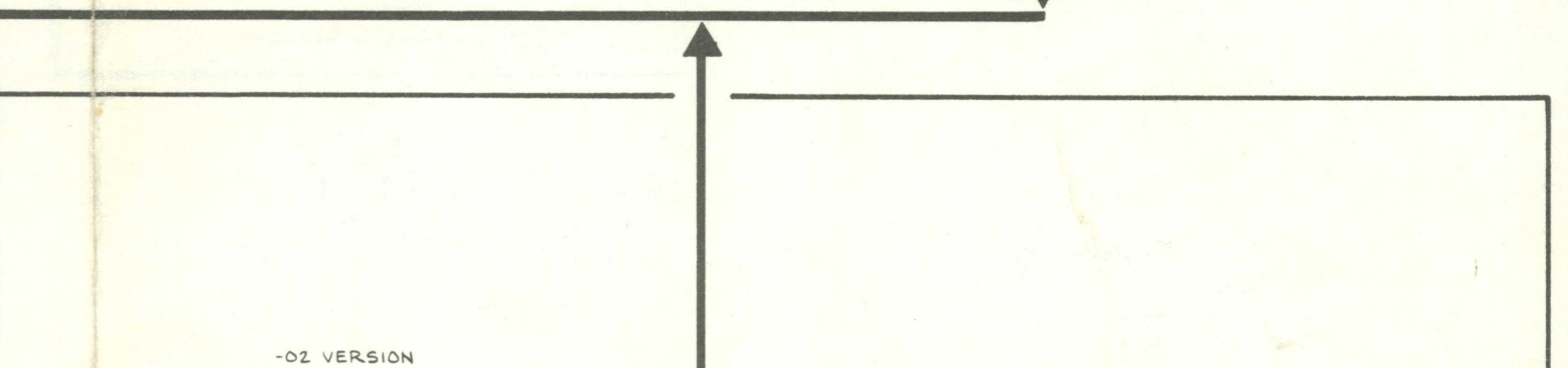
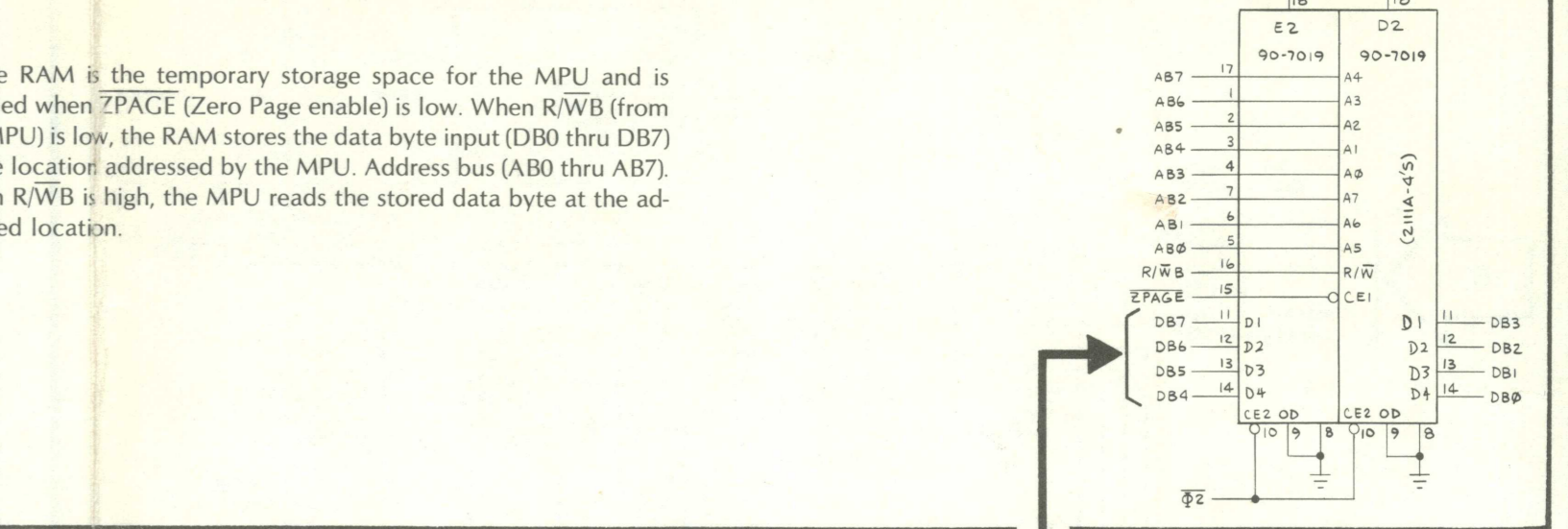
ADDRESS DECODING CIRCUITRY



HEXADDECIMAL	ADDRESS								DATA	FUNCTION
	A15	A14	A13	A12	A11	A10	A9	A8		
0000-00FF	0	0	0	0	0	0	0	0	A A A A A A A A	PAGE ZERO RAM
0100	0	1	0	0	0	0	0	0	A A A A A A A A	HALT
0101	0	1	0	0	0	0	0	1	A A A A A A A A	TEST SW
0102	0	1	0	0	0	0	1	0	A A A A A A A A	SLAM SW
2400	0	1	0	0	0	0	0	0	0 0 0 0	3 KHz DIAG STEP
2401	0	1	0	0	0	0	1	0	0 0 0 1	COIN 1
2402	0	1	0	0	0	0	1	1	0 0 1 0	COIN 2
2403	0	1	0	0	0	0	1	1	0 0 1 1	COIN 1
2404	0	1	0	0	0	0	1	0	0 0 1 0	CAMP SELECT
2405	0	1	0	0	0	0	1	1	0 0 1 1	ABORT
2406	0	1	0	0	0	1	0	0	1 1 0 0	ROT RIGHT
2407	0	1	0	0	0	1	1	0	1 1 0 1	ROT LEFT
2408	0	1	0	0	0	1	1	1	1 1 1 0	OPTION
2409	0	1	0	0	0	1	1	1	1 1 1 1	OPTION
2000	0	1	0	1	0	0	0	0	1 0 0 0	OPTION
2001	0	1	0	1	0	0	0	1	1 0 0 1	OPTION
2002	0	1	0	1	0	0	1	0	1 0 1 0	OPTION
2003	0	1	0	1	0	0	1	1	1 0 1 1	OPTION
3000	0	1	1	0	0	0	0	0	0 1 1 0	ATTRACT LAMP 0
3001	0	1	1	0	0	0	0	1	0 1 1 1	ATTRACT LAMP 1
3002	0	1	1	0	0	0	1	0	0 1 1 0	ATTRACT LAMP 2
3003	0	1	1	0	0	0	1	1	0 1 1 1	ATTRACT LAMP 3
3400	0	1	1	0	1	0	0	0	0 1 1 0	START & SELECT LEDS
3401	0	1	1	0	1	0	0	1	0 1 1 1	COIN COUNTER
3402	0	1	1	0	1	0	1	0	0 1 1 0	WATCHDOG CLEAR
3403	0	1	1	0	1	0	1	1	0 1 1 1	DMAGGO
3800	0	1	1	1	0	0	0	0	1 1 1 0	THRUST INTENSITY
3801	0	1	1	1	0	0	0	1	1 1 1 1	THRUST INTENSITY
3802	0	1	1	1	0	0	1	0	1 1 1 0	THRUST PITCH
3803	0	1	1	1	0	0	1	1	1 1 1 1	NOISE RESET
4000-4FFF	1	0	0	0	0	0	0	0	A A A A A A A A	VECTOR RAM
4000-4FFF	1	0	0	0	0	0	0	1	A A A A A A A A	VECTOR RAM
5000-5FFF	1	0	1	0	0	0	0	0	A A A A A A A A	VECTOR RAM
5000-5FFF	1	0	1	0	0	0	1	0	A A A A A A A A	VECTOR RAM
6000-6FFF	1	1	0	0	0	0	0	0	A A A A A A A A	PROGRAM ROM
6000-6FFF	1	1	0	0	0	0	1	0	A A A A A A A A	PROGRAM ROM



RAM CIRCUITRY



ROM PROM CIRCUITRY

The address decoder performs the function of turning on or enabling the appropriate circuitry at the critical time, so that information can be transferred back and forth between the game circuitry and the MPU. The memory map below is for the Lunar Lander game.

If you are going to use the Automatic RAM/ROM Tester, please remember to remove MPU C3 and ground the WDOG DISABLE test point.

Program Memory for the Lunar Lander game is contained in PROMs for the -01 version of the PCB or ROMs for the -02 version of the PCB. One ROM is equivalent to four PROMs. All PROMs connected to a common enable must be removed before replacing with a ROM. For example, remove PROMs at locations F2, H1, L2 and M1 before replacing with ROM at location F1. A ROM/PROM equivalent chart is contained in Chapter 5, Illustrated Parts Catalog, of the Lunar Lander game manual.

