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ELECTRONICS, INC.

DEFENDER

This booklet provides operation, auditing, adjustment, and diagnostic procedures for DEFENDER.

POWER TURN ON

With power first applied, a sound is produced, general illumination comes on, and random patterns appear on the CRT as the game sequences through RAM, ROM, and battery checks. The game then comes up in game over. Messages are displayed for RAM or ROM failures; refer to Power Up and Reset RAM/ROM Tests. If the game comes up in Bookkeeping, turn the game OFF and back ON.

a. If the game now sequences through the tests and then comes up in game over, the book-keeping totals have been reset to zero.

b. If the game still comes up in bookkeeping, open coin door and turn the game OFF and ON. The game will now sequence through the tests and come up in bookkeeping. This is an indication of battery failure and the game has reverted to factory settings. To return to game over:
1. Set switch to MANUAL-DOWN
2. Depress ADVANCE to display Function 28
3. Set switch to AUTO-UP and depress ADVANCE.

GAME OPERATION

GAME START- Insert coins - credits are displayed on CRT. Press 1- or 2-player start.

PLAYER CONTROLS

UP-DOWN Switch - maneuvers player ship.

REVERSE Switch - reverses player ship direction.

THRUST Switch - controls player ship speed.

FIRE Switch - activates laser gun.

HYPERSPACE Switch - warps rocket to another quadrant with danger of possible annihilation.

SMART BOMB Switch - destroys all alien ships on screen. A maximum of 3* smart bombs per play.

GAME PLAY

Destroy alien ships and missiles. Rescue humanoids, pick them up, and return to surface. Destroy all enemy ships for humanoid bonus and additional alien waves. Bonus ships and Smart Bombs provided every 10,000* points.

HIGH SCORE SIGNATURE- Use UP/DOWN to select letters and FIRE button to lock in letter.
* Indicates adjustable features.

BOOKKEEPING AND EVALUATION TOTALS (Functions 1-7)
1. In game over mode, set switch to AUTO-UP and depress ADVANCE. The CRT indicates Function 1 and total left chute coins.

2. Record audit totals and depress ADVANCE for functions 1-7. To review a total that has been advanced past, set switch to MANUAL-DOWN and depress ADVANCE. Functions are displayed one at a time as follows:

Function	Total*	Description
1	0	(Total) COINS LEFT
2	0	(Total) COINS CENTER
3	0	(Total) COINS RIGHT
4	0	TOTAL PAID (Games)
5	0	(Total Bonus) SHIPS WON
6	0	TOTAL (Play) TIME (Minutes)
7	0	TOTAL SHIPS (Played)

* Factory setting.

3. Operate ADVANCE to display Function 28, SPECIAL FUNCTION. From Function 28 you can return to game over or zero audit totals <u>and</u> return to game over.

4. With switch set to AUTO-UP, perform a. or b. as desired.
   a. To return to game over depress ADVANCE.
   b. To zero audit totals and return to game over, operate HIGH SCORE RESET to indica[...]
   "35" on CRT for Function 28 and then depress ADVANCE.

GAME ADJUSTMENTS (Functions 8-27)
1. In game over mode set switch to AUTO-UP and depress ADVANCE. The CRT indicates Function 1 and total left chute coins.

2. <u>To raise</u> Function number on CRT, operate ADVANCE pushbutton with switch set to AUTO-UP. <u>To lower</u> Function number operate ADVANCE with it set to MANUAL-DOWN.

3. With desired Function indicated, <u>raise</u> adjustment value by operating HIGH SCORE RESET with switch set to AUTO-UP; <u>lower</u> value by operating HIGH SCORE RESET with it set to MANUAL-DOWN. Value left on CRT is new setting. For values, see below and, for pricing, Table 1.

Function	Factory Setting	Description
08	10000	BONUS SHIP LEVEL(0=No Bonus ships)
09	3	SHIPS PER GAME
10	3	COINAGE SELECT
11	1	LEFT COIN MULT
12	4	CENTER COIN MULT
13	1	RIGHT COIN MULT
14	1	COINS FOR CREDIT
15	0	COINS FOR BONUS
16	0	MINIMUM COINS
17	0	FREE PLAY (Set to 1 for Free Play)
18	0	STARTING DIFFICULTY: 0=LIB; 1=MOD; 2=CONS
19	10	PROGRESSIVE WAVE DIFFICULTY LIMIT, 4-25 e.g. 5=LIB; 10=MOD; 15=CONS
20	1	BACKGROUND SOUND 0 =OFF 1 = ON
21	0	NOT USED
22	0	NOT USED
23	0	NOT USED
24	0	NOT USED
25	0	NOT USED
26	0	NOT USED
27	0	NOT USED
28	0	SPECIAL FUNCTION

4. Repeat steps 2 and 3 until all desired adjustments have been made.

5. Operate ADVANCE until 28 0 SPECIAL FUNCTION is indicated on CRT. From Function 28 you can return to game over or <u>restore factory setting</u>. Perform step 6 or 7 as desired.

6. To return to game over, depress ADVANCE with switch set to AUTO-UP.

Table 1. Standard and Custom Price Settings

COIN DOOR MECHANISM	CREDITS	FUNCTION						
		10	11	12	13	14	15	16
	1/25¢, 5/$1	00	01	04	01	01	04	00
	2/50¢, 5/$1	00	01	04	01	01	04	02
	•1/25¢, 4/$1	03	01	04	01	01	00	00
	2/50¢, 4/$1	00	01	04	01	01	00	02
	1/50¢, 3/$1, 4/$1.25	00	03	12	03	04	15	00
	1/50¢, 3/$1, 7/$2	00	12	48	12	14	96	24
	•1/50¢, 3/$1, 6/$2	01	01	04	01	02	04	00
	•1/50¢	05	01	04	01	02	00	00
1DM, 5DM	•1/1DM, 6/5DM	02	06	00	01	01	00	00
20-Cent, 50-Cent	1/20¢, 3/50¢	00	01	00	01	02	00	00
1 Franc, 5 Franc	•1/2F, 3/5F only	04	01	16	06	02	00	00
25 Cent,	•1/25¢, 4/1G	06	01	00	04	01	00	00
1 Guilder,	1/25¢, 5/1G	00	01	00	04	01	04	00
5 Franc,	•1/5F, 2/10F	07	01	00	02	01	00	00
10 Franc	•1/10F	08	01	00	02	02	00	00
1 Franc, 2 Franc	•2/1F, 5/2F	02	00	04	01	04	00	00
100 Lire, 200 Lire	1/200 Lire	00	01	00	02	02	00	00
Twin Coin	•1/1 Coin	03	01	04	01	01	00	00
	•1/2 Coins	05	01	04	01	02	00	00
	1/3 Coins, 2/5 Coins	00	02	00	02	05	00	00
1 Unit, 5 Unit	•1/2, 3/5	04	01	00	06	02	00	00
	1/1, 5/5	00	01	00	05	01	00	00
	1/3, 2/5	00	02	00	10	05	00	00

•Indicates standard price settings by adjusting only Function 10. For other price settings, set Function 10 to 00 and set Functions 11 through 16 to the values indicated in the chart.

7. To restore factory settings and zero audit totals:
   a. Operate HIGH SCORE RESET in AUTO-UP to indicate "45" on CRT for Function 28.
   b. Depress ADVANCE. The game returns to Audit Function 1.
   c. Set switch to MANUAL-DOWN and depress ADVANCE to indicate Function 28 on the CRT.
   d. Set switch to AUTO-UP and depress ADVANCE.

RESETTING HIGH SCORE FEATURE
To reset the high score to the factory setting and erase signatures, depress HIGH SCORE RESET in game over mode.

POWER-UP AND RESET RAM/ROM TESTS
Test initiated at power turn-on and after depressing RESET pushbutton on CPU/Video Board.

RESULT	CRT INDICATION	LED INDICATION	CORRECTIVE ACTION
PASS	INITIAL TESTS OK	4 LEDs blink twice.	–
FAIL RAM	RAM TEST FAILED	○●○○ 2nd LED blinks for 30 seconds	Perform RAM Diagnostics
FAIL ROM	ROM TEST FAILED	●○○○ 1st LED blinks for 30 seconds	Perform ROM Diagnostics

ROM DIAGNOSTICS - TEST 1
From game over, depress ADVANCE IN MANUAL-DOWN.

RESULT	CRT INDICATION	LED INDICATION	CORRECTIVE ACTION
PASS	ALL ROMS OK	●○○○ 1st LED blinks twice	–
FAIL	ROM TEST FAILED X (X = 1 - 12)	●○○○ 1st LED lights. Chip indicated:	Replace ICX on ROM Board or Depress ADVANCE in MANUAL-DOWN; replace:
		○○○●	IC1
		○○●○	IC2
		○○●●	IC3
		○●○○	IC4
		○●○●	IC5
		○●●○	IC6
		○●●●	IC7
		●○○○	IC8
		●○○●	IC9
		●○●○	IC10
		●○●●	IC11
		●●○○	IC12

RAM DIAGNOSTICS - TEST 2
From ROM Diagnostics depress ADVANCE in AUTO-UP.

RESULT	CRT INDICATION	LED INDICATION	CORRECTIVE ACTION
TESTING	Random Pattern	–	Depress ADVANCE in AUTO to bypass test
PASS	ALL RAMS OK	○●○○ 2nd LED blinks twice	–
FAIL	RAM FAILURE XY (X= bank, Y= chip no.)	○●○○ 2nd LED lights Bank indicated:	Replace RAM (See following) or depress ADVANCE in MANUAL-DOWN
		●○○○ = 1	Depress ADVANCE in MANUAL-DOWN
		○●○○ = 2	
		○○●○ = 3	

		LED INDICATION	CORRECTIVE ACTION		
			Replace in bank:		
		Chip indicated:	1	2	3
		○○○● = 1	4L	5L	6L
		○○●○ = 2	4M	5M	6M
		○○●● = 3	4N	5N	6N
		○●○○ = 4	4O	5O	6O
		○●○● = 5	4P	5P	6P
		○●●○ = 6	4Q	5Q	6Q
		○●●● = 7	4R	5R	·6R
		●○○○ = 8	4S	5S	6S

CMOS RAM DIAGNOSTICS - TEST 3
From RAM Diagnostics depress ADVANCE in AUTO-UP.

RESULT	CRT INDICATION	LED INDICATION	FAULTY AREA
PASS	CMOS RAM TEST PASSED	○○●○ 3rd LED blinks twice	—
FAIL	CMOS RAM FAILURE	○○●○ 3rd LED lights	CMOS RAM 1I memory protect gates 2H, 1K, or address decoder 2F, 4E.
	CMOS INTERLOCK FAILURE	○○●○ 3rd LED lights	Coin door interlock, Memory protect gates 1J, 1K, 2H, or CMOS RAM 1I.

COLOR RAM TEST - TEST 4
From CMOS RAM test depress ADVANCE in AUTO-UP.

CRT SEQUENCES THROUGH 8 COLORS, 2 SECONDS EACH
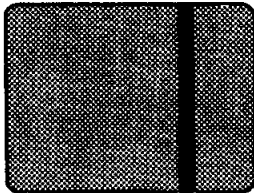
VERTICAL BAND
INDICATES COLOR
RAM FAULT.
○○○●
4th LED REMAINS
ON DURING TEST

COLOR SEQUENCES	FAULT	
	RAM 1L	RAM 1O
1 LIGHT RED 2 RED 3 DARK RED	Band of red intensity variance or washout	Band of magenta
4 LIGHT GREEN 5 GREEN 6 DARK GREEN	Band of yellow	Band of cyan
7 LIGHT BLUE 8 BLUE	Band of magenta	Band of blue intensity variance or washout
4 LIGHT GREEN	Band of green	Band of dark green or washout
5 GREEN	Band of light green	Band of faint green, Band of darker green
6 DARK GREEN		Band of washout
Note that a blank sequence or two sequences with same shade indicate 1L or 1O RAM or color analog circuit faulty.		

Tests 5 and 7 provide sequential subtests. To stop
automatic cycling set switch to MANUAL/DOWN. Depress
ADVANCE in MANUAL-DOWN to step throuugh subtests.

AUDIO TEST - TEST 5
From Color Ram test, depress ADVANCE in AUTO-UP.

Sounds 1 through 31 are produced.

*Missing	Check
1	2P4/10P3 Pin 3
2	2P4/10P3 Pin 2
4	2P4/10P3 Pin 5
8	2P4/10P3 Pin 4
16	2P4/10P3 Pin 7
All	Perform Sound Board Diagnostics

*If one of five listed is missing but other
but other 30 are produced replace Sound ROM.
If none of five listed is missing but others
of remaining 26 are missing replace Sound ROM.

SWITCH TEST - TEST 6
CRT indicates AUTO-UP closed and any stuck switches. Set switch to MANUAL-DOWN and clear any
stuck switches. CRT should indicate no switches closed. Operate switches and check for dis-
play of switch name.

Coin Door	Player Panel
ADVANCE	UP
HIGH SCORE RESET	DOWN
SLAM TILT	REVERSE
LEFT COIN (Next to hinge)	1- PLAYER START
CENTER COIN	2- PLAYER START
RIGHT COIN	HYPERSPACE
	SMART BOMB
	THRUST
	FIRE

MONITOR SET UP TEST PATTERNS - TEST 7
From Switch Test depress ADVANCE in AUTO-UP

Pattern	Alignment/Adjustment
CROSS HATCH	Vertical and Horizontal Linearity, Convergence, Focus
RED	
GREEN	Color Purity
BLUE	
COLOR BARS	

1 2 3 4 5 6 7 8

RED	GRN	BLU	WHT	BLK	YEL	CYAN	MAGENTA
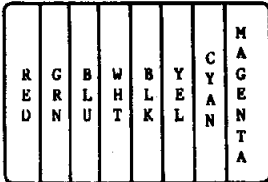
The color bar pattern is also analyzed to detect color RAM faults. If Color RAM Test 4
indicates no faults, a double-width band, half width bands, transposition or missing bands
indicates a fault in 2I, 1L, or 10 chips.

To return to game over:

1. Depress ADVANCE in AUTO-UP. Audit function 1 is displayed.
2. Set switch to MANUAL-DOWN and depress ADVANCE. Special Adjustment Function 28 is displayed.
3. Set switch to AUTO-UP and depress ADVANCE.

INITIATING AUTO-CYCLE MODE
1. Set switch to AUTO-UP and depress ADVANCE. Audit Function 1 is indicated on CRT.
2. Set switch to MANUAL-DOWN and depress ADVANCE to indicate SPECIAL FUNCTION 28 on CRT.
3. Set switch to AUTO-UP and operate HIGH SCORE RESET to indicate 15 on CRT for Function 28.
4. Depress ADVANCE.
5. To terminate the test and return to game over, depress ADVANCE in AUTO-UP.

SOUND BOARD DIAGNOSTICS
Depress DIAGNOSTIC pushbutton on the bottom of the Sound Board. A check is made of the Sound
ROM and sounds are produced if the check is good. If sounds are produced but not produced in
Audio Test 5 check for ROM board PIA outputs on Sound Board inputs that is stuck low. If no
sound is produced either the Sound Rom, input power, or other Sound Board circuitry is faulty.