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Throughout The Years

**MANUALS — SCHEMATICS — TECHNICAL BULLETINS
DIP SWITCH SETTINGS — PIN-OUTS — TRAINING**

DEFENDER

This booklet provides operation, auditing, adjustment, and diagnostics 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 bookkeeping 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, danger of possible annihilation.

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

CREDITS IN GAME

Twenty or less credits are retained in memory after power down. To remove credits from game post 21 or more credits and depress ADVANCE in AUTO-UP two times in succession. Credits are also removed any time Function 28 is changed.

* 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. Records 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:

| <u>Function</u> | <u>Total*</u> | <u>Description</u> |
|-----------------|---------------|-----------------------------|
| 1 | 0 | (Total) COINS LEFT |
| 2 | 0 | (Total) COINS CENTRE |
| 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 Settings

3. Operate ADVANCE to display Function 28, SPECIAL FUNCTION. From Function 28 you can return to game over or zero audit totals and 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 indicate "35" on CRT for Function 28 and then depress ADVANCE.

GAME ADJUSTMENTS (Functions 8-21)

1. In game over mode set switch to AUTO-UP and depress ADVANCE. The CRT indicates Function 1 and total left chute coins.

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

3. With desired Function indicated, raise adjustment value by operating HIGH SCORE RESET with switch set to AUTO-UP; lower 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.

| <u>Function</u> | <u>Total*</u> | <u>Description</u> |
|-----------------|---------------|---|
| 8 | 10,000 | BONUS SHIP LEVEL(0=No Bonus ships) |
| 9 | 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 | 5 | STARTING DIFFICULTY: 0=LIB; 5=MOD; 10=CONS |
| 19 | 15 | PROGRESSIVE WAVE DIFFICULTY LIMIT, 5-30 e.g. 05=LIB; 15=MOD; 25=CONS |
| 20 | 1 | NOT USED |
| 21 | 5 | PLANET RESTORE WAVE NUMBER |
| 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 |

* Factory Settings

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 restore factory setting. Perform step 6 or 7 as desired.

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

| COIN DOOR MECHANISM | CREDITS | FUNCTION | | | | | | |
|-----------------------|-----------------------------|----------|----|----|----|----|----|----|
| | | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| All USA Variants | 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 Guilder | ●1/25¢, 4/1G 1/25¢, 5/1G | 06 | 01 | 00 | 04 | 01 | 00 | 00 |
| 5 Franc, 10 Franc | ●1/5F, 2/10F ●1/10F | 07 | 01 | 00 | 02 | 01 | 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.

Table 1. Standard and Custom Price Settings

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 SIGNATURES

To reset the "TODAYS GREATEST" signatures to factory settings, turn game OFF and ON or depress HIGH SCORE RESET in game over mode. To also reset "ALL TIME GREATEST" signatures to factory settings, set Function 28 to 15 and depress ADVANCE in AUTO-UP.

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 | ●○○● 1 st and 4 th LED's light | Depress ADVANCE in MANUAL-DOWN while failure message is displayed to enter Diagnostics. |
| FAIL ROM | ROM TEST FAILED | None | |

ROM DIAGNOSTICS - TEST 1

From game over, depress ADVANCE IN MANUAL-DOWN.

| RESULT | CRT INDICATION | LED INDICATION | CORRECTIVE ACTION |
|--------|--|---|--|
| PASS | ALL ROMS OK | ○●○○ 2 nd LED blinks twice. | None |
| FAIL | ROM FAILURE x (x=ROM No 1 - 12) | ○●○○ 2 nd LED lights. Chip Indicated: ○○● IC1 ○○● IC2 ○○● IC3 ●○○ IC4 ●○○ IC5 ●○● IC6 ●●● IC7 ○○○ IC8 ○●● IC9 ○●● IC10 ○●● IC11 ●●○ IC12 | Replace ICx on ROM Board or depress ADVANCE in MANUAL-DOWN; Replace: |

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 | ●○○○ 1 st LED blinks twice. | - |
| FAIL | RAM FAILURE xy (x=Bank, y=Chip No) | ●○○○ 1 st LED lights. | Replace RAM (see following) or depress ADVANCE in MANUAL-DOWN |
| | | Bank Indicated: ○○○○ = 1 ●○○○ = 2 ○○●○ = 3 | Depress ADVANCE in MANUAL-DOWN |
| | | Chip Indicated: ○○○ = 1 ○○● = 1 ○○● = 2 ○○● = 3 ●○○ = 4 ●○○ = 5 ●○○ = 6 ●○○ = 7 ○○○ = 8 | Replace in bank: 1 2 3 1R 2R 3R 1S 2S 3S 1T 2T 3T 1U 2U 3U 1W 2W 3W 1X 2X 3X 1Y 2Y 3Y 1Z 2Z 3Z |

CMOS RAM DIAGNOSTICS - TEST 3

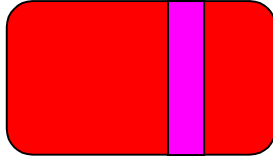
From RAM Diagnostics depress ADVANCE in AUTO-UP.

| RESULT | CRT INDICATION | LED INDICATION | FAULTY AREA |
|--------|------------------------|--|---|
| PASS | CMOS RAM TEST PASSED | ○○○ 3 rd LED blinks twice. | - |
| FAIL | CMOS RAM FAILURE | ○○○ 3 rd LED lights. | CMOS RAM 1E memory protect gates 4J, 6H, or address decoder 4K, 5P. |
| | CMOS INTERLOCK FAILURE | ○○○ 3 rd LED lights. | Coin door interlock, Memory protect gates 5B, 6H,4J, OR CMOS RAM 1E |

COLOUR RAM TEST - TEST 4

From CMOS RAM test depress ADVANCE in AUTO-UP.

CRT SEQUENCES THROUGH 8 COLOURS, 2 SECONDS EACH



VERTICAL BAND INDICATES COLOUR RAM FAULT.

○○○●
4th LED REMAINS LIT DURING TEST

| COLOUR SEQUENCES | FAULT | |
|------------------|---|--|
| | RAM 2C | RAM 1C |
| 1 LIGHT RED | Band of red intensity variance or washout | Band of magenta |
| 2 RED | | |
| 3 DARK RED | | |
| 4 LIGHT GREEN | Band of yellow | Band of cyan |
| 5 GREEN | | |
| 6 DARK GREEN | | |
| 7 LIGHT BLUE | Band of magenta | Band of blue intensity variance or washout |
| 8 BLUE | | |
| 9 DARK BLUE | | |
| 4 LIGHT GREEN | Band of green | Band of dark green or washout |
| 5 GREEN | | |
| 6 DARK 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 2C or 1C RAM or color analogue 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 through subtests.

SOUND TEST - TEST 5

From Color RAM test, depress ADVANCE in AUTO-UP.

Test sequences sounds 1 through 31, skipping 19, 27, and 28.

| 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 |

SWITCH TEST - TEST 6

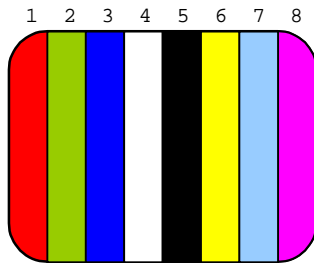
CRT indicates AUTO-UP closed and any stuck switches. Set switch to MANUAL-DOWN and clear any stuck switches. CRT should indicate no switches closed. Operate switches and check for display of switch name.

| <u>Coin Door</u> | <u>Player Panel</u> |
|------------------|---------------------|
| ADVANCE | UP |
| HIGH SCORE RESET | DOWN |
| LEFT COIN | REVERSE |
| CENTER COIN | 1 - PLAYER START |
| RIGHT COIN | 2 - PLAYER START |
| | HYPERSPACE |
| | SMART BOMB |
| | THRUST |
| | FIRE |

MONITOR SET UP TEST PATTERNS - TEST 7

From Switch Test depress ADVANCE in AUTO-UP.

| <u>Pattern</u> | <u>Alignment/Adjustment</u> |
|----------------|---|
| CROSS HATCH | Vertical and Horizontal Linearity, Convergence, Focus |
| RED | } Color Purity |
| GREEN | |
| BLUE | |
| COLOUR BARS | |



- 1 = RED
- 2 = GREEN
- 3 = BLUE
- 4 = WHITE
- 5 = BLACK
- 6 = YELLOW
- 7 = CYAN
- 8 = 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 2E, 1C, or 2C 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. The game sequences through ROM, RAM, Sound tests and monitor test patterns.
5. To exit the AUTO-CYCLE mode, 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.

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