F-14 ™
TOMCAT

INSTRUCTION MANUAL

Williams ® W
ELECTRONICS GAMES, INC.

F-14 TOMCAT ROM and Jumper Table

Game	System 11A CPU Rev.	P/N - U15 Game μP	P/N - U27 G. ROM 1	P/N - U26 G. ROM 2	P/N - U21 S. ROM 1	P/N - U22 S. ROM 2	P/N - U24 Sound μP	Jumpers
PIN-BOT	-, A	5400-09150-00	A-5343-549-2	A-5343-549-1	A-5343-549-4	A-5343-549-3	5400-09150-00	W1, 2, 4, 5, 7, 8, 11, 12, 13, 14, 16, 17, and 18
TIC TAC STRIKE	-, A		Not Used	A-5343-1919-1	A-5343-1919-3	A-5343-1919-2		W1, 2, 4, 5, 7, 8, 11, 12, 13, 14, 16, 17, and 18
MILLIONAIRE	-, A		A-5343-555-2	A-5343-555-1	A-5343-555-4	A-5343-555-3		W1, 2, 4, 5, 7, 8, 11, 12, 13, 14, 16, 17, and 18
F-14 TOMCAT	-, A	↓	A-5343-554-2	A-5343-554-1	A-5343-555-4	A-5343-554-3	↓	W1, 2, 4, 5, 7, 8, 11, 12, 13, 14, 16, 17, and 18

F-14 TOMCAT Solenoid Table

Sol. No.	Function	Solenoid Type	Wire [1] Color	Connections CPU Bd.	Connections Playfield/Cabinet	Driver Trans.	Solenoid Part Number / Flashlamp Type (b = Backbox, p = Playfield)
01A[3]	Outhole Kicker	Switched	{Vio-Brn}	1P11-1	8P3-1 (to B1 on	Q33	AE-23-800-01
01C[3]	Flasher 1	Switched	{Blk-Brn}	(Gry-Brn)	Diode Sw. Bd.)	Q33	#89 flashlamps 2p
02A[3]	Ball Shooter Lane Feeder	Switched	{Vio-Red}	1P11-3	8P3-2 (to B2 on	Q25	AE-23-800-03
02C[3]	Flasher 2	Switched	{Blk-Red}	(Gry-Red)	Diode Sw. Bd.)	Q25	#89 flashlamps 2p
03A[3]	Ball Popper (Launch)	Switched	{Vio-Orn}	1P11-4	8P3-3 (to B3 on	Q32	AE-23-800-12 [4]
03C[3]	Flasher 3	Switched	{Blk-Orn}	(Gry-Orn)	Diode Sw. Bd.)	Q32	#89 flashlamps 2p
04A[3]	Spare (Not Used)	Switched	{Vio-Yel}	1P11-5	8P3-4 (to B4 on	Q24	
04C[3]	Flasher 4	Switched	{Blk-Yel}	(Gry-Yel)	Diode Sw. Bd.)	Q24	#89 flashlamps 2p
05A[3]	Center Right Eject	Switched	{Vio-Grn}	1P11-6	8P3-5 (to B5 on	Q31	AE-23-800-11 [4]
05C[3]	Flasher 5	Switched	{Blk-Grn}	(Gry-Grn)	Diode Sw. Bd.)	Q31	#89 flashlamps 2p
06A[3]	Knocker	Switched	{Vio-Blu}	1P11-7	8P3-6 (to B6 on	Q23	AE-23-800-02
06C[3]	Flasher 6	Switched	{Blk-Blu}	(Gry-Blu)	Diode Sw. Bd.)	Q23	#89 flashlamps 2p
07A[3]	Right Eject	Switched	{Vio-Blk}	1P11-8	8P3-7 (to B7 on	Q30	AE-23-800-11 [4]
07C[3]	Flasher 7	Switched	{Blk-Vio}	(Gry-Vio)	Diode Sw. Bd.)	Q30	#89 flashlamps 2p
08A[3]	Spare (Not Used)	Switched	{Vio-Gry}	1P11-9	8P3-8 (to B8 on	Q22	
08C[3]	Flasher 8	Switched	{Blk-Gry}	(Gry-Blk)	Diode Sw. Bd.)	Q22	#89 flashlamps 3p
09	Flasher 9	Controlled	Brn-Blk	1P12-1	8P3-9	Q17	#89 flashlamps 2b, 1p
10	Center Left Eject	Controlled	Brn-Red	1P12-2	8P3-10	Q9	AE-23-800-11 [4]
11	General Illumination Relay	Controlled	Brn-Orn	1P12-4	3P7-1	Q16	5580-09555-01 [5]
12	Line Of Death Kickback	Controlled	Brn-Yel	1P12-5	8P3-12	Q8	AE-23-800-11 [4]
13	Rescue Kickback (left outlane)	Controlled	Brn-Grn	1P12-6	8P3-13	Q15	AE-23-800-11 [4]
14	Solenoid A/C Select Relay	Controlled	Brn-Blu	1P12-7	8P3-14	Q7	5580-09555-01 [4]
15	Flasher 10	Controlled	Brn-Vio	1P12-8	8P3-15	Q14	#89 flashlamps 2b, 1p
16	Rotating Beacons (backbox)	Controlled	Brn-Gry	1P12-9	8P3-16	Q6	#1683 & mlr14-7946 [4]
17	Left Kicker	Special #1	Blu-Brn	1P19-7	8P3-17	Q75	AE-23-800-03
18	Right Kicker	Special #2	Blu-Red	1P19-4	8P3-18	Q71	AE-23-800-03
19	Spare (Not Used)	Special #3	Blu-Orn	1P19-3	8P3-19	Q73	
20	Jet Bumper	Special #4	Blu-Yel	1P19-6	8P3-20	Q69	AE-23-800-03
21	Upper Diverter - Launch Ramp	Special #5	Blu-Grn	1P19-8	8P3-21	Q77	AL-26-1500-02
22	Lower Diverter - Launch Ramp	Special #6	Blu-Blk	1P19-9	8P3-22	Q79	AL-26-1500-02
-	Upper Right Flipper	-	[Blk-Yel]		[7P1-14, 8P3-33]	-	FL11722-50VDC
-	Right Flipper	-	Orn-Vio [Blu-Vio]	1P19-1	7P1-15 [7P1-16,8P3-34][2]	-	FL11630-50VDC
-	Upper Left Flipper	-	[Blk-Blu]		[7P1-17, 8P3-31]	-	FL11722-50VDC
-	Left Flipper	-	Orn-Gry [Blu-Gry]	1P19-2	7P1-18 [7P1-19,8P3-32][2]	-	FL11630-50VDC

Notes: 1. Wire colors, except flipper Orn-Vio and Orn-Gry, are ground connections (to coil terminal with unbanded end of diode). Flipper Orn-Vio and Orn-Gry wires connect from CPU Board to flipper switch. 2. Flipper connections shown in braces are from flipper switch to flipper coil. 3. "A" coils are pulsed, when Sol. 14 is de-energized; "C" coils are pulsed, with Sol. 14 energized. Wire colors in brackets are those from respective A and C terminals corresponding to the B terminal connection listed for the Diode Switching Board, which controls the device pulsing by Sol. 14. 4. Relay (p/n 5580-09555-01) is mounted on Relay Snubber Bd. p/n C-11232 or C-11232-2, or Relay Bd. p/n C-11232-1. 5. Relay is mounted on Power Supply Bd. D-8345 in the backbox.

F-14 TOMCAT

INSTRUCTION MANUAL

- Game Operation & Test Information

- Game Parts Information

- Reference Diagrams & Schematics

Contents

Section 1 - Game Operation & Test Information

Contents

Section 2 - Game Parts Information

Section 3 - Reference Diagrams & Schematics

Game Operation

&

Test Information

- *F-14 TOMCAT* (System-11A) ROM Summary
- Pinball Game Assembly Instructions
- Game Play
- Game Status Displays
- Game Adjustment Procedure
- Game Pricing
- Test/Diagnostic Procedures

F-14 TOMCAT (System-11A) ROM Summary

IC	DESCRIPTION	TYPE	IDENTIFIER	BOARD	PART NUMBER
Game ROM 1	32K x 8 ROM	27256	U27	CPU	A-5343-554-2
Game ROM 2	16K x 8 ROM	27128	U26	CPU	A-5343-554-1
Sound ROM 1	32K x 8 ROM	27256	U21	CPU	A-5343-554-4
Sound ROM 2	32K x 8 ROM	27256	U22	CPU	A-5343-554-3
Background (B/G) Sound/Speech ROM 1	32K x 8 ROM	27256	U4	B/G Mus./Sp.	A-5343-554-5
B/G Snd./Spch. ROM 2	32K x 8 ROM	27256	U19	B/G Mus./Sp.	A-5343-554-6

NOTICE

To order a replacement ROM from your authorized WILLIAMS ELECTRONICS GAMES distributor, specify: (1) part number (if available); (2) ROM label color; (3) ROM level (number) on the label; (4) which game the ROM is used in.

CONNECTOR IDENTIFICATION

WILLIAMS ELECTRONICS GAMES uses a special technique to identify connectors. Each plug or jack receives a prefix number (which identifies the related circuit board or location within the game), a letter, and a number. J-designations refer to the male part of a connector. P-designations refer to the female part of a connector. For example, 1J1 designates jack 1 of board 1 (a CPU Board jack); 3P6 designates plug 6 of board 3 (a Power Supply Board plug).

Identifying the specific pin number of a connector involves a hyphen, which separates the pin number from the plug or jack designation. For example, 1J1-3 refers to pin 3 of jack 1 on board 1.

F-14 TOMCAT CIRCUIT BOARDS

All *F-14 TOMCAT* Circuit Boards are in the backbox. They are accessible by removing the backbox glass, unlatching the insert board, and swinging it open.

CPU BOARD. The System-11A CPU Board must be equipped with the ROMs specified in the *F-14 TOMCAT* (System-11A) ROM Summary. For this ROM complement and CPU Board (p/n D-11392-554) , jumpers W1, W2, W4, W5, W7, W8, W11, W12, W13, W14, W16, W17, and W18 must be connected. (Jumper W7 is cut/removed for West German games.)

BACKGROUND SOUND/SPEECH BOARD. The Background Sound/Speech Board is p/n D-11298-554, as supplied with ROM and microprocessor.

DISPLAY BOARD. The Alphanumeric Display Unit Board (p/n D-11415-1) is on the Speaker/ Display Assembly, D-11416-1, which is a part of the Speaker/Display Panel, D-11611.

POWER SUPPLY BOARD. The Power Supply Board is p/n D-8345-554.

Prefix numbers for *F-14 TOMCAT* System-11A circuit boards and major assemblies are listed below. A prefix number may precede a component designator to identify the unit (e.g., connector 1J1).

1	-	CPU	6	-	Backbox	11	-	B/G Music/Speech
2	-	(not assigned)	7	-	Cabinet	12	-	(not assigned)
3	-	Backbox Power Supply	8	-	Playfield	13	-	(not assigned)
4	-	Alphanumeric Display	9	-	Insert Board	14	-	(not assigned)
5	-	Player Score Displays	10	-	(not assigned)	15	-	Flipper Power Supply

F-14 TOMCAT GAME CONTROL LOCATIONS

The On-Off switch is on the bottom of the cabinet near the right front leg.

The Volume Control is on the left inner wall of the cabinet on the tilt mechanisms board. It is accessible by opening the coin box door.

The Credit switch is a pushbutton to the left of the coin door on the cabinet exterior.

GAME ADJUSTMENT/DIAGNOSTIC SWITCHES. *F-14 TOMCAT* allows the operator to program virtually all game adjustments, obtain bookkeeping information, and diagnose problems, using only three switches mounted on the inside of the coin door and the Credit button beside the coin door.

ADVANCE, AUTO-UP/MANUAL-DOWN, and HIGH-SCORE RESET are the switches located on the inside of the coin door. Refer to the Game Status Displays text and the Text/Diagnostic Procedures for details concerning their operation.

The Memory Protect switch is on the inside frame of the coin door. This interlock switch must be open to clear bookkeeping totals and to make game adjustments. It automatically opens, when the coin door opens.

F-14 TOMCAT GAME CONTROL LOCATIONS (Continued)

The <u>CPU Diagnostic switch</u> (SW 2) is the lower switch (of the two switches mounted on the left edge of the CPU Board) near a large, socketed microprocessor chip. This switch initiates the Memory Chip Test explained in the Diagnostic Procedures.

The <u>Sound Diagnostic switch</u> (SW 1) is the upper switch of the two mounted on the left edge of the CPU Board. This switch initiates the Sound Section Test. Refer to the Diagnostic Procedures.

PINBALL GAME ASSEMBLY INSTRUCTIONS

1. Open the shipping container; remove all cartons, parts, and other items, and set them aside.
2. Place cabinet on a support and attach rear legs (after installing leg levellers), using leg bolts. Leg levellers and leg bolts are both provided among the parts in the cash box.
3. Attach the front legs (after installing leg levellers), using leg bolts. See Figure 1 for details.
4. Open the coin door and remove keys from clip on the door.
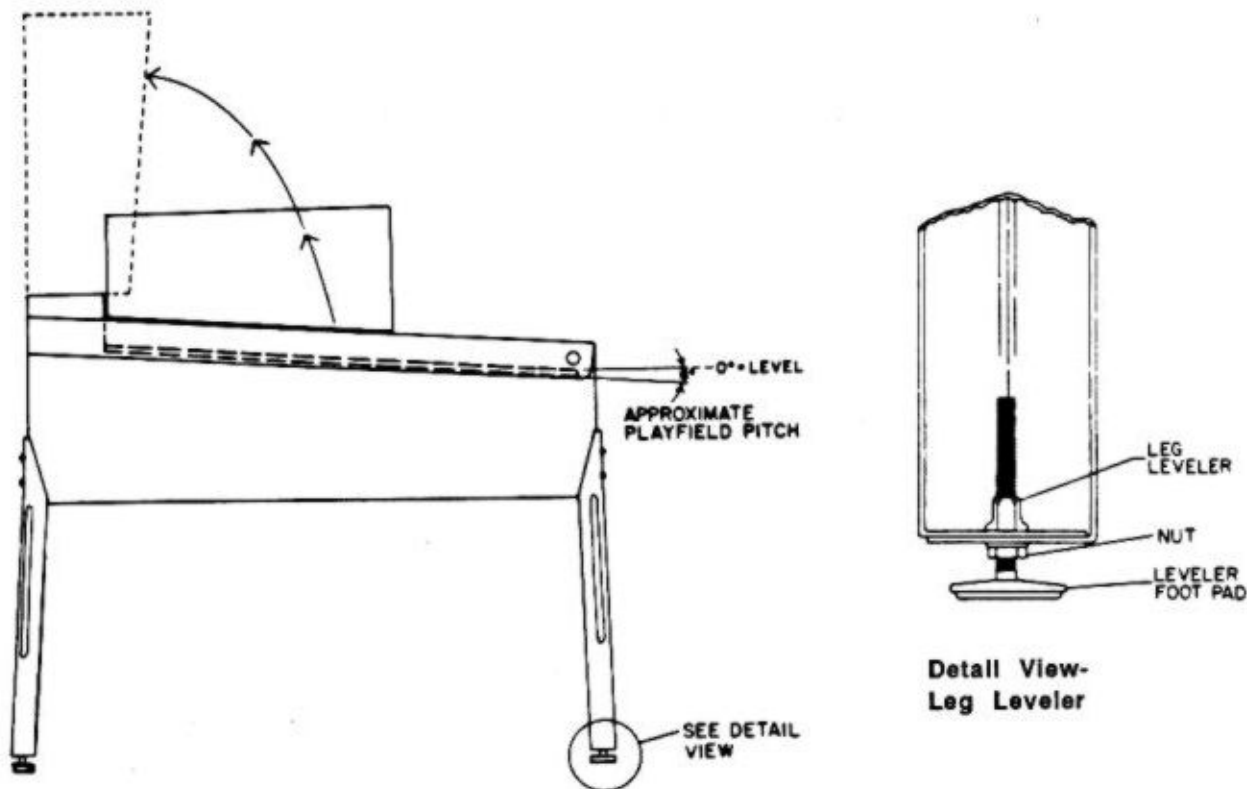
Figure 1. Pinball Assembly, Playfield Pitch Angle, and Leg Leveler Details.

5. Reach into the cabinet and backbox and check the mating of the interconnecting cables, matching several wire colors at each connector. Ensure that all connections are properly secure.

CAUTION
Ensure that the interconnecting cables are free to move (not kinked or pinched). Be careful not to damage wires at any stage of the assembly process.

6. Raise the hinged backbox upright and stabilize it into position, using the clamp on the back of the cabinet and backbox. Unlock the backbox, and remove the backbox glass, storing it carefully to avoid scratches. Remove the shipping block holding the Insert Board. Unlatch the Insert Board and open it, then lay the Speaker/Display Panel forward on the playfield cabinet. This allows access to the bolt holes used for securing the backbox upright. Install the mounting bolts and flat washers through the bottom holes of the backbox into the threaded fasteners in the cabinet to secure the backbox.

F-14 TOMCAT 3

PINBALL GAME ASSEMBLY INSTRUCTIONS (Continued)

7. Extend the rear leg levelers *slightly* below the leg bottom, so that all four foot pads are extended about the same distance. Remove the cabinet from its support and place it on the floor.
8. Remove the playfield cover glass to permit accurate measurement of the playfield level and pitch. Level (side-to-side) the playfield (preferably measured ON the playfield surface), and firmly tighten the nut on each leg leveler shaft to maintain this level setting, as shown in Figure 1.
9. Adjust the front leg levelers for proper playfield level (side-to-side) <u>and</u> playfield pitch angle (incline) of approximately 7 degrees. (Again, it is recommended that these measurements be made ON the playfield, not the cabinet nor the playfield cover glass.) Tighten the nut on each leg leveler shaft to maintain this setting.

CAUTION
Playfield pitch angle adjustments can affect the operation of the ball-roll tilt and the plumb bob tilt, inside the cabinet. The operator should adjust these tilt mechanisms for proper operation, after completion of the desired playfield pitch angle setting.

10. Move the game into the desired location; recheck the level and pitch angle of the playfield.
11. Verify that *required number* of balls are installed in the game (*F-14 TOMCAT* requires 4).
12. Clean and re-install the playfield cover glass. Prepare the game for player operation.

GAME OPERATION

WARNING
After assembly and installation at its site location, this game must be plugged into a <u>properly grounded</u> outlet to prevent shock hazard, and to assure proper game operation. DO NOT use a 'cheater' plug to defeat the ground pin on the line cord. DO NOT cut off the ground pin.

POWERING UP. With the coin door closed, plug the game in, and switch it ON, using the On-Off switch. In normal operation, the player 1 score display initially shows 00. Then, the game goes into the <u>Attract Mode</u> (Playfield and backbox lamps flashing, sounds being heard, etc.).

CAUTION
F-14 TOMCAT's System-11A game program has the <u>capability</u> to aid the operator and service personnel: At game Turn-On (and also when the operator is beginning the Test/Diagnostic Procedures), a display now signals when a switch has NOT been actuated during ball play for 60 balls (20 games). Up to three switches can be displayed during this Switch Problem reporting activity. Moreover, *F-14 TOMCAT* compensates the game play requirements affected by each disabled switch to allow 'nearly normal' play. This helps keep *F-14 TOMCAT* earning good profits! More information is available in the Diagnostic Procedures text describing the Switch Testing.

ATTRACT MODE*. Playfield and backbox lamps blink.   All player score displays exhibit a series of messages informing the player concerning:

    A. Recent highest scores*;
    B. A "custom message" ("**FLY F14 TOMCAT ... DEFEAT YAGOV ... OR DIE.**")*;
    C. The score to achieve to obtain a Replay award*;
    D. Brief game feature instructions.

These displays (or variations of them) reappear occasionally, accompanied by sounds and music, until a player initiates game play by inserting a coin or, when credits are available, pressing the Credit button.

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* - operator-adjustable feature

CREDIT POSTING. Insert coin(s). A sound is heard for each coin, and the Credits display shows the number of credits purchased. So long as the number of maximum allowable credits* are *NOT* exceeded by coin purchase or high score, credits are posted correctly. However, after this maximum credits value is reached, posting of additional credits won (not purchased) by the player does *not* occur. ONLY posting of *purchased* credits occurs beyond the maximum credits value.

STARTING A GAME. Press the Credit button once. A startup sound plays, and the amount shown in the Credit display decreases by one. Player display 1 flashes 00 (until the first playfield switch is actuated), and the Player 4 display shows **ball 1**. Additional players may enter the game by pressing the Credit button once for each player, before the end of play on the first ball.

TILT. Actuating the Slam Tilt switch on the coin door inside the cabinet ends the current game; *F-14 TOMCAT* then proceeds to the Game Over Mode. With the actuation of the ball-roll or playfield tilt switches, or the third closure* of the plumb bob tilt switch, the player loses the remaining play of that ball, but can complete the game.

END OF GAME. All earned scores and bonuses are awarded. If a player's final score exceeds the specified value, the player receives a designated award for achieving the current highest score. A random digit set* appears in the Match display. Credit* may be awarded, when the last two digits of any player's score display (1 through 4) match the random digits of the Match display. Match, high score, and game over sounds are made, as appropriate.

GAME OVER MODE. The player 1 and 2 score displays show **GAME OVER** . Then, the high scores flash on the appropriate player score displays. The game proceeds to the Attract Mode.

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* - operator-adjustable feature

F-14 TOMCAT GAME STATUS DISPLAYS

F-14 TOMCAT utilizes a new format for the display of information concerning the game's bookkeeping and game play feature adjustment. Basically, three classes of information now become available to the game owner/ operator: Id (Identification); Au (Audit); Ad (Adjustment). Each of the underscored two-letter abbreviations for these classes appears in the Credits display, while the system microprocessor for the *F-14 TOMCAT* game is displaying the items within each class in the status display mode.

Identification Information--Id

With the game turned on, the coin door open, and the AUTO-UP/MANUAL-DOWN switch in the AUTO-UP position, the operator can press the ADVANCE switch once, briefly. *F-14 TOMCAT's* displays immediately change from the Attract Mode to the Game Status Display Mode. This is evident by the following display, shown in columnar form. The column headings refer to the various backbox displays.

Player 1	Player 2	Player 3	Player 4
F-14	TOMCAT	Id 00	554 r-#*

* # - indicates ROM revision level; e.g., 1 is initial issue; 2, 3, etc. for later revisions.

The game is named in the player score 1 and 2 displays. The game's identification number and the ROM revision level appears in the player 4 display. The Player 3 display shows the status display mode in abbreviated form, **Id**. The Player 3 display also shows the status display mode item (**00**) for this particular display.

Identification Information--Id (Continued)

Pressing ADVANCE once more causes the **Id 01** display to appear. This display describes which of the "Install" options is currently in effect. For example, if the YES option of the INSTALL FACTORY Adjustment Item (Ad 70) was last selected, *FACTORY SETTING* appears on the Player Score displays.

Changing the setting of any other game adjustment item, after selecting the YES option for Ad 70 causes the display to change to *FACTORY ALTERED*. Similarly, if the operator selects the YES option for INSTALL HARD (Ad 65), the display indicates *HARD SETTING*. Changing a game adjustment item later then causes the display to show *HARD ALTERED*.

Audit Information--Au

While the AUTO-UP switch remains in the Up position, the operator can press the ADVANCE switch once, briefly, to begin the backbox displays of Audit (sometimes called "bookkeeping") Information. Forty-four audit entries are now available. Calculation of the various factors is no longer necessary because the *F-14 TOMCAT's* System-11A game program now performs all the computations. This information is intended to aid the owner/operator in evaluating how the game is performing in each location, by providing knowledge about which game features are receiving the most play. With this information, the owner/operator can determine whether adjusting the game features to other settings will contribute to increased game earnings.

The operator can press the ADVANCE button once to view each Audit Information display item. To proceed more rapidly through this information, the operator only has to press *and hold* the ADVANCE button. If a desired item is passed, the operator can use the MANUAL-DOWN switch position with the ADVANCE button to back up to the desired item.

The *F-14 TOMCAT* **Audit Table** lists the 44 items of the Audit Information portion of the *F-14 TOMCAT* Game Status Displays. Presentation of this Audit Information again utilizes the player score displays; however, the player 1 and 2 displays are combined as a descriptive phrase. The light type below the table's column headings names the respective backbox displays where the information appears. Because the player 4 display contains information which depends on game play, only a few example entries are shown in the table. The Player 3 display shows **Au** for all 44 audit items, so its entry is omitted from the tabular listing. Detection of erroneous data affecting any of the counters used in these audit items causes the message, ERROR, to be displayed in the player 3 display, during display of any audit item associated with that particular counter. (The program does not analyze the cause of the error; it merely alerts the operator of the error's existence by the message.)

F-14 TOMCAT Audit Table

Audit Item (Player 3)	Descriptive Phrases (Player 1 and 2 Displays)	Audit Factor [1] Value (Player 4)
AU 01	LEFT COINS [chute next to coin door hinge]	432
02	CENTER COINS	0
03	RIGHT COINS	398
04	PAID CREDITS	830
05	TOTAL PLAYS	
06	TOTAL FREE (Total Free Plays)	
07	PERCENT FREE (% Free Plays)	
08	REPLAY AWARDS	
09	PERCENT REPLAY (% Replay Awards)	
10	SPECIAL AWARDS	
11	PERCENT SPECIAL (% Special Awards)	
12	MATCH AWARDS	
13	HSTD (High Score to Date) CREDITS	
14	PERCENT HSTD (% HSTD Credits)	
15	EXTRA BALLS	
16	PERCENT EX. BALL (% Extra Balls)	
17	AV. BALL TIME (Average Time in Seconds)	
18	MIN. OF PLAY (Minutes of Play)	
19	BALLS PLAYED	
20	REPLAY1 AWARDS	
21	REPLAY2 AWARDS	
22	REPLAY3 AWARDS	
23	REPLAY4 AWARDS	
24	1 PLAYR. GAMES	
25	2 PLAYR. GAMES	
26	3 PLAYR. GAMES	
27	4 PLAYR. GAMES	
28	BURN IN CYCLES	
29	MULTI BALL (# of M. Ball Plays Achieved)	
30	BONUS X	
31	LANDING (# of Landings)	
32	KILLS (# of Kills)	
33	KILL LT XBALL (# of Ex. Balls lit by Kills)	
34	MULT LT XBALL (Ex. Balls lit by Bonus Multipliers)	
35	FLIGHT INS COL (# of times Flight Insurance was 'collected')	
36	LEFT DRAINS (# of times thru Left Drain lane)	
37	RIGHT DRAINS (# of times thru Right Drain lane)	
38	KILL GEN. YAGOV (# of times kickback was hit)	
39	H.S.RESET COUNTER	
40	AUT. PCT. DATA 1	
41	AUT. PCT. DATA 2	
42	AUT. PCT. DATA 3	
43	AUT. PCT. DATA 4	
44	AUT. PCT. DATA 5	

NOTE:

1. The numbers shown in this column for Items 1 through 4 are examples. Entries for all items depend on the amount of play; thus, they will vary from location to location.

Adjustment Information--Ad

At end of the Audit Information presentation, with the AUTO-UP switch in the Up position, the operator can press the ADVANCE button to proceed to the Adjustment Information portion of the *F-14 TOMCAT* Game Status Displays.

The operator can press the ADVANCE button once to view each Adjustment Information display item. To proceed more rapidly through this information, the operator only has to press *and hold* the ADVANCE button. If a desired item is passed, the operator can use the MANUAL-DOWN switch position with the ADVANCE button to back up to the desired item.

The *F-14 TOMCAT* **Game Adjustment Table** lists the 70 items of the Adjustment Information portion of the *F-14 TOMCAT* Game Status Displays. Presentation of the displays is similar to that for the Audit Information (that is, the player 1 and 2 displays combine as a descriptive phrase; the light type below the column headings names the respective backbox displays where the information appears, etc.). The Player 3 display shows **Ad** and the item number for all 70 adjustment items.

F-14 TOMCAT Game Adjustment Table

Adjustment Item (Player 3)	Descriptive Phrases (Player 1 and 2 Displays)		Factory Setting (Player 4)
Ad 01	AUTO REPLAY (%) (or FIXED REPLAY SCORES) [1]		10 (%)
02	REPLAY START (or REPLAY LEVEL 1) [1]		1,000,000
03	REPLAY LEVELS (or REPLAY LEVEL 2) [1]		01
04	(REPLAY LEVEL 3) [1]		OFF
05	(REPLAY LEVEL 4) [1]		OFF
06	REPLAY AWARD		Credit
07	SPECIAL AWARD		Credit
08	MATCH FEATURE		08%
09	BALLS / GAME		03
10	TILT WARNING		03
11	MAXIMUM EX. BALL		04
12	MAXIMUM CREDITS		10
13	HIGHEST SCORES		On
14	BACKUP HI. SCR1		4,000,000
15	BACKUP HI. SCR 2		3,800,000
16	BACKUP HI. SCR 3		3,600,000
17	BACKUP HI. SCR 4		3,400,000
18	HI. SCR1 CREDITS		03
19	HI. SCR2 CREDITS		01
20	HI. SCR3 CREDITS		01
21	HI. SCR4 CREDITS		01
22	H. S. RESET EVERY (3,000 PLAYS) [2]		
23	FREE PLAY		NO
24	U.S.A. 1 COINAGE (1 COIN 1 PLAY) [2,3]		
25	LEFT UNITS		01
26	CENTER UNITS		04
27	RIGHT UNITS		01
28	UNITS/ CREDIT		01
29	UNITS/ BONUS		00
30	MINIMUM UNITS		00
31	TOMCAT MEMORY	[YES = retained; NO = not retained]	YES
32	RESCUE TIMER	[0 - 5; duration of Rescue period]	04
33	MLTIBAL MODE	[0 - 4; lighting TOMCATs for Mul. Ball]	00
34	KILL MEMORY	[YES = retained; NO = not retained]	YES
35	RESCUE INIT	[ON = initially ON; OFF = initially OFF]	ON
36	SPECIAL SPOTS	[0 - 16; No. of targets initially spotted]	06
37	LAUNCH SPOT TC	[YES = spots one TOMCAT target; NO = no target spotted]	YES
38	CT KILL SPOT TC	[YES = Kill target spots TOMCAT,w/l; NO = no spot]	NO
39	KILL SPOTS	[0 = 0 lamps ON; 1 = 1 lamp ON; 2 = 2 ON]	01
40	INSUR THRESH	[1 - 99 sec; or None]	30 sec

F-14 TOMCAT Game Adjustment Table (Continued)

Adjustment Item (Player 3)	Descriptive Phrases (Player 1 and 2 Displays)	Factory Setting (Player 4)
41	INSUR MIN TIME [1 - 30 sec., or None]	10 sec
42	LITE FL LANES [0 - 5; Bonus X value which lites flipper lanes]	00
43	BONMULT XTRABAL [10 = Off; 9=Lit at >8X; 8=Lit at 8X; 7=Lit at 7X]	08
44	KILL XTRA BAL [0 at >7 kills; 1 at 7 kills]	01
45	YAGOV KICKER [Off - 04; 1=weak kick; 2=hard kick;3=weak	03
46	UNUSED ADJUST kick w/ Flt Ins; 4=hard kick w/ Flt Ins]	OFF
47	ATTRACT BEACON [OFF - ON]	ON
48	ATTRACT SOUNDS [OFF - ON]	ON
49	CUSTOM MESSAGE [4]	ON
50	SW. ALARM KNOCKER	YES
51	ENGLISH TEXT	
52	UNUSED ADJUST	00
53 [5]	INSTALL GERMAN 1 [6]	
54 [5]	INSTALL GERMAN 2 [6]	
55 [5]	INSTALL GERMAN 3 [6]	
56 [5]	INSTALL GERMAN 4 [6]	
57 [5]	INSTALL GERMAN 5 [6]	
58 [5]	INSTALL GERMAN 6 [6]	
59 [5]	INSTALL ADDABAL	NO
60 [5]	INSTALL 5 BALL	NO
61 [5]	INSTALL NOVELTY	NO
62 [5]	INSTALL EX. EASY	NO
63 [5]	INSTALL EASY	NO
64 [5]	INSTALL MEDIUM	NO
65 [5]	INSTALL HARD	NO
66 [5]	INSTALL EX. HARD	NO
67	AUTO BURN-IN	NO
68	CLEAR COINS	NO
69	CLEAR AUDITS	NO
70	INSTALL FACTORY [7]	NO

NOTES:

1. Automatic Replay percentage value range is adjustable from 5 to 50%, via the Credit button. Item 02 permits changing the factory setting value for Replay Start Level (valid for next 500 games played). Item 03 permits setting up to four replay levels, with values as detailed in text describing item 03.

   For Fixed Replay Scores, set Auto Replay value to 1 less than 5(%) via the Credit button. Go to items 02, 03, 04, and 05 to install their replay level scores. Turn off any replay score level by setting 00 as its value.

2. Phrase in parentheses is Factory Setting. Phrase appears in (player) 3 and 4 displays. Press Credit button to change setting of item 22, or the game pricing of item 24.

3. To change country OR coinage setting, press Credit button to obtain 16 Standard settings, followed by a Custom Setting. The Custom Setting activates items 25 through 30. When a Standard Setting is used, items 25 through 30 are set automatically, and cannot be changed.

4. To install Custom Message, press flipper button for alphabet and special characters. Press Credit button for next message letter or character.

5. Special Preset Adjustment, whose effects are noted in the Game Adjustment text.

6. Refer to **Pricing Table** and Game Adjustment text describing these items.

7. Approximates Ad 64, yet includes all factors listed in Factory Setting column , not just Ad 31 through 46 provided by Ad 64.

GAME ADJUSTMENT PROCEDURE

Adjustment Items 01 through 70

The coin door must be open to access the Game Adjustment/Diagnostic switches. All readings and adjustments require operation of these coin door switches. Some adjustments utilize the Credit button; some also use the flipper button(s). Additional text describing the game adjustment items follows this procedure.

1. Use AUTO-UP and press ADVANCE. The Id 00 display initially appears. Press ADVANCE until the player 3 display indicates **Ad 01**. (The player 1 and 2 score displays indicate AUTO REPLAY.) If the factory setting has not been changed, the player 4 display shows 10%, indicating a 10% replay percentage. (The game program adjusts itself automatically, as discussed in the following text concerning the 'details' about Adjustment Item 01.)

2. To reach a higher item number (in the player 3 display), use AUTO-UP and press ADVANCE. To return to a previous item number, use MANUAL-DOWN and press ADVANCE.

3. With the desired item number (refer to the *F-14 TOMCAT* **Game Adjustment Table**) showing in the player 3 display, increase the value (or select another option) shown in the player 4 display by using AUTO-UP and pressing the Credit button. Repeat this step for each item, until all changes to the factory settings for Game Adjustments have been made.

    (The same procedure can be used for Audit Items. To zero **Au 01 - 04** (concerning the coin chutes and the total coins), the operator can proceed to item 68, Clear Coins, and press the Credit button to obtain the YES option. The operator then presses the ADVANCE button and notes the "COINS CLEARED" display, which verifies that the entry values for items 01 through 04 of the Audit Items are now reset to zero.)

    For example, the operator may desire to change the degree of game play difficulty from the Factory Setting (equivalent to the Install Medium [Ad 64] difficulty, along with a number of other automatically installed settings, as shown in the right column of the **Game Adjustment Table**) to another difficulty more suitable for the players at a particular game site. Four other 'automatic' play difficulty settings (Ad 62 - Ad 66) are available, each of which, if selected, installs all the adjustments listed for that item in the following 'details' text.

4. To proceed rapidly through the entire adjustments series, press *and hold* ADVANCE, until **Ad 70** shows in the player 3 display. From item 70, you can: (A) return to the <u>Game-Over Mode</u>; or (B) restore factory settings and zero audit (bookkeeping) totals. Perform either of the following, as desired:

    A. To reach <u>Game-Over Mode</u>, use AUTO-UP and press ADVANCE once. *F-14 TOMCAT* now goes to the <u>Game-Over Mode</u>.

    B. To restore factory settings, zero all audit (bookkeeping) totals, *and* return to <u>Game-Over Mode</u>, use AUTO-UP or MANUAL-DOWN to display item 70 in the player 3 display. Press the Credit button to display the YES option in the player 4 display. Using AUTO-UP, press ADVANCE once. *F-14 TOMCAT* now zeroes ALL audit totals and changes ALL game adjustments back to those originally selected as Factory Settings. It then shows the operator a message ("FACTORY SETTING") that this has occurred. (A problem in the Memory Protection circuit or closing the coin door will cause the message "ADJUST FAILURE" to appear.) Press ADVANCE once more to return to the <u>Game-Over Mode</u>.

Details of Adjustment Items 01 through 70

01 Auto Replay (or Fixed Replay)

Of the two options, AUTO REPLAY is the <u>Factory Setting</u>. The percentage of replays automatically awarded has a Factory Setting of *10%* (German games have a Factory Setting of *15%*).

GAME ADJUSTMENT PROCEDURE (Continued)

01 Auto Replay (or Fixed Replay) (Continued)

The game program aids a game's initial installation by performing a comparison of the value of the Replay Level to the player's score 16 times during the first 800 games. At each comparison, the program increases (or decreases) the Replay Level by 100,000 to achieve the replay percentage specified either via the factory setting or later operator adjustment. (After the first 800 games, the comparison occurs after every 500 games.) Use the Credit button to change the percentage within the range of *5 to 50* (%), with the value increasing using AUTO-UP (or decreasing using MANUAL-DOWN). The next Credit button change <u>below</u> 5% selects the FIXED REPLAY option.

For AUTO REPLAY, Ad 02 provides the Starting Replay Level (player 1 and 2 displays show RE-PLAY START). Ad 03 provides the number of replay levels (01, 02, 03, or 04). *F-14 TOMCAT* then proceeds to Ad 06 automatically.

For FIXED REPLAY, Ad 02 is the first replay level (REPLAY LEVEL 1). Ad 03, 04, and 05 are the other replay levels.

02 Starting Replay Level (or Replay Level 1)

For AUTO REPLAY (refer to Ad 01), the <u>Factory Setting</u> is 1,000,000 (German games have a Factory Setting of 1,500,000). The range of settings is *800,000* through *2,000,000* (by increments of 100,000 with AUTO-UP or decrements of 100,000 with MANUAL- DOWN).

For FIXED REPLAY, the operator can enter the value to be used for the first fixed replay score level via the Credit button. The range of settings is: *OFF; 100,000* through *9,900,000* (by increments of 100,000 with AUTO-UP, or decrements of 100,000 with MANUAL-DOWN).

03 Replay Levels (or Replay Level 2)

For AUTO REPLAY (refer to Ad 01), the <u>Factory Setting</u> is 01 (one replay level). The option range is *one, two, three, or four* replay level(s). When the operator chooses two replay levels, *F-14 TOMCAT* automatically adjusts the second replay level to be twice the value selected for Ad 02, the starting replay level. Choosing three or four replay levels automatically adjusts their replay levels to three times or four times the Ad 02 value.

For FIXED REPLAY, the technique of value entry and the range of settings are identical to those of Ad 02.

04 (Replay Level 3)

For AUTO REPLAY, this Adjustment Item is not applicable. *F-14 TOMCAT* automatically bypasses this adjustment.

For FIXED REPLAY, the technique of value entry and the range of settings are identical to those of Ad 02.

05 (Replay Level 4)

For AUTO REPLAY, this Adjustment Item is not applicable. *F-14 TOMCAT* automatically bypasses this adjustment.

For FIXED REPLAY, the technique of value entry and the range of settings are identical to those of Ad 02.

06 Replay Award

For either AUTO REPLAY or FIXED REPLAY (Ad 01), the operator can select the form of the award automatically provided when the player exceeds any Replay Level (Automatic or Fixed). The choices are:

Credit - Reaching each replay level obtains a credit (free game). This is the <u>Factory Setting</u>.

06 Replay Award (Continued)

Ball   -   Reaching each replay level obtains an extra ball.

Audit   -   Reaching each replay level obtains nothing to the player; it does increase the entry value of the Audit Item(s) maintaining a tally of these awards (Au 08, and Au 20 through 23, as applicable).

Coil   -   Reaching each replay level causes the Knocker coil to activate once per free play won (instead of awarding a credit for each level exceeded).

NOTE

A ticket dispenser or token dispenser can be activated by the Knocker coil driver to provide an alternative award for each free play achieved by the player.

07 Special Award

The operator can select the form of the award automatically provided when the player scores a Special. The choices are:

Credit   -   Scoring each Special, when lit, obtains a credit (free game). This is the <u>Factory Setting</u>. A variation to this award occurs, when the setting of Ad 06 is Coil. (This permits a ticket or token dispenser to provide the award, when applicable.)

Ball   -   Scoring each Special, when lit, obtains an extra ball.

Score   -   Scoring each Special, when lit, obtains a score advance of 100,000 points to the player.

08 Match Award

The operator can select (via the Credit button) the desired percentage for the Match action occurring at the completion of each game. The choices are:

1%-50% -   1% is 'hard'; 50% is 'extremely easy'. 8% is the <u>Factory Setting</u>. During Match action, the game selects a random two-digit number at end of game and compares each player's score for an identical two digits in the rightmost two positions. A matching of the two digits results in the award of a credit (or a ticket/token, if a dispenser is attached, and the setting of Ad 06 is Coil).

Off   -   The MATCH display does not operate at completion of the game; no award is given.

09 Balls / Game

The operator can define a "game" by specifying the number of balls to be played. The <u>Factory Setting</u> is 3. The range of settings is 1 through 9.

10 Tilt Warning

The operator can specify the allowable number of total actuations of the plumb bob and playfield tilt mechanisms that can occur before the game is "tilted". The range of this setting is 1 through 5. The <u>Factory Setting</u> is 3.

11 Maximum Extra Ball

The operator can specify the maximum number of Extra Balls to be accumulated at any time. The range of this setting is 00 (which allows NO extra ball play, and displays a message, NO EX. BALL) and 1 through 9. The <u>Factory Setting</u> is 4.

12 Maximum Credits

The operator can specify the maximum number of credits the game can accumulate, either through game play awards or coin purchases. The range of settings is 5 through 99. The <u>Factory Setting</u> is 10 (Factory Setting for German games is 30). Reaching the specified setting prevents the award of additional credits by game play. <u>Coin purchases do continue to accumulate and are displayed.</u>

GAME ADJUSTMENT PROCEDURE (Continued)

12 Maximum Credits (Continued)

NOTE

Whenever the number of credits is less than the specified maximum credits, any credits obtained by coin purchase or game awards (High Score, Match, Replay Levels, etc.) will be accumulated, even though they exceed the maximum value. Thereafter, no additional credits can be accumulated, until the credit total is reduced below the specified maximum setting.

13 Highest Scores

The operator can allow the game to maintain a record of the four highest scores achieved to date. The Factory Setting is On. The optional alternative is *Off*, which deactivates this adjustment item.

14 Backup High Score 1

The operator can set the Backup High Score value in the player 1 score display, using the Credit button. The Factory Setting is 4,000,000. The game automatically restores the value set, when the operator presses, and holds, the HIGH SCORE RESET switch, or when an automatic High Score Reset event (Ad 22) occurs.

15 Backup High Score 2

This adjustment is similar to Ad 14, except that this applies to the player 2 score display. The adjustment technique is identical to Ad 14. The Factory Setting is 3,800,000. It is also restored as described for Ad 14.

16 Backup High Score 3

This adjustment is similar to Ad 14, except that this applies to the player 3 score display. The adjustment technique is identical to Ad 14. The Factory Setting is 3,600,000. It is also restored as described for Ad 14.

17 Backup High Score 4

This adjustment is similar to Ad 14, except that this applies to the player 4 score display. The adjustment technique is identical to Ad 14. The Factory Setting is 3,400,000. It is also restored as described for Ad 14.

18 Credits for Highest Score 1

The operator can select the number of credits to be awarded, by using the Credit button, whenever a player exceeds the previous Highest Score. The range of this setting is *00* through *10*. The Factory Setting is 03. A variation to this award occurs, when the setting of Ad 06 is Coil. (This permits a ticket or token dispenser to provide the award, when applicable.)

19 Credits for Highest Score 2

This adjustment is similar to Ad 18, except that this applies to the player's exceeding the second highest score. The Credit button adjustment technique is the same as for Ad 18. The range of this setting is *00* through *03*. The Factory Setting is 01.

20 Credits for Highest Score 3

This adjustment is similar to Ad 18, except that this applies to the player's exceeding the third highest score. The Credit button adjustment technique is the same as for Ad 18. The range of this setting is *00* through *03*. The Factory Setting is 01.

21 Credits for Highest Score 4

This adjustment is similar to Ad 18, except that this applies to the player's exceeding the fourth highest score. The Credit button adjustment technique is the same as for Ad 18. The range of this setting is *00* through *03*. The Factory Setting is 01.

22 Automatic High Score Reset
The operator can specify (via Credit button) that the game will provide an automatic reset of the displayed "Highest Scores", and the number of games to be played before the reset occurs. The values provided upon reset are those selected by the operator in Ad 14 through 17, the Backup High Scores. The range of this setting is *Off* (to disable this adjustment), and *1,000* to *99,000* games (in increments of 1,000). The <u>Factory Setting</u> is 3,000. (Audit item 39 displays the number of games remaining before the reset.)

23 Free Play
The operator can select (via the Credit button) whether a player can operate the game without a coin (free play) or with a coin. The optional alternatives are *No* (a coin is necessary) or *Yes* (game play is free; no coin is required). The <u>Factory Setting</u> is No.

24 Coinage Selections
The operator can specify (via the Credit button) any of the 16 Standard Settings for game pricing, each of which exhibits a message identifying the country and the number of coins required and the number of games that the coin requirement purchases. Choosing a Standard Setting permits the game to omit items Ad 25 through 30, which are adjustments allowing for a special custom coinage setting. The <u>Factory Setting</u> is U.S.A. 1 : 1 COIN 1 PLAY, as shown by the backbox display. (For German games, the <u>Factory Setting</u> is GERMAN2 : 7 PLAY 5 dm.)

Following the last Standard Setting is a Custom Coinage Setting, which allows the operator to utilize Ad 25 through 30 in establishing a special coinage setting. A message, CUSTOM COINAGE, indicates that the operator can enter the appropriate values into the Ad 25 through 30 adjustment items.

The values for Ad 25 through 30 of each Standard Setting, as well as other possible values for the Custom Coinage Setting are shown in the **Pricing Table.**

25 Left Chute Coin Units
The operator can specify (via the Credit button) the number of coin units purchased by a coin passing through the left coin chute.

26 Center Chute Coin Units
The operator can specify (via the Credit button) the number of coin units purchased by a coin passing through the center coin chute.

27 Right Chute Coin Units
The operator can specify (via the Credit button) the number of coin units purchased by a coin passing through the right coin chute.

28 Units Required for Credit
The operator can define (via the Credit button) the number of coin units required to obtain 1 Credit. A coin unit counter in the game program totals the number of coin units purchased through all coin chutes prior to each game. If the total number of coin units purchased exceeds the 1 Credit factor by a multiple (or more, coin units) of the specified Units per Credit value, the Credits display shows the proper number of Credits. The coin unit counter retains any remaining coin units, until the start of a game; then, the coin unit counter is cleared (its contents are zeroed). The <u>Factory Setting</u> is 01.

29 Units Required for Bonus
The operator can specify (via the Credit button) that 1 additional Credit is to be indicated in the Credits display, when a certain number of coin units are accumulated. The <u>Factory Setting</u> is 00.

30 Minimum Units Required for any Credits Posted
The operator can specify that NO Credits are to be posted (indicated in the Credits display), until the credit units counter reaches a particular value. The Factory Setting is 00.

31 Tomcat Memory
The operator can choose (via the Credit button) whether the lighted letters of T-O-M-C-A-T are stored in memory for the 'next ball'. The choices are No (Lamps are turned off at the start of a ball) or Yes (Lamps are stored and recalled for the player's next ball. The Factory Setting is Yes.

32 Rescue Timer
The operator can choose (via the Credit button) the amount of time that the center Rescue lamps remain lighted. The range of this setting is 00 (Hardest) through 05 (Easiest). The Factory Setting is 04.

33 Multi-Ball™ Mode
The operator can choose (via the Credit button) the degree of difficulty of achieving Multi-Ball™ play from lighting the TOMCAT targets. The choices are 00 (Scoring TOMCAT lights 2 Locks (red ramp lamps) the first time and then 1 Lock thereafter); 01 (Scoring TOMCAT lights 2 Locks on last ball only; 1 Lock otherwise); 02 (Scoring TOMCAT lights 1 Lock at a time); 03 (Scoring TOMCAT lights 1 Lock at a time; player must then score TOMCAT again to light RELEASE); 04 (Same as 03, except that player must score TOMCAT twice to light the first Lock). The Factory Setting is 00.

34 KILL Memory
The operator can choose (via the Credit button) whether the lighted Kill lamps are stored in memory for 'next ball' play. The choices are No (Lighted lamps are NOT stored in memory for 'next ball' play) or Yes (Lighted lamps are stored and recalled for the player's next ball). The Factory Setting is Yes.

35 Rescue Initial Conditions
The operator can choose (via the Credit button) whether the Rescue kickback is operable at the beginning of the ball. The choices are On (the kickback IS operable at the beginning of the ball) or Off (the kickback is NOT operable at the ball start). The Factory Setting is On.

36 Special Spots
The operator can choose (via the Credit button) the number of targets initially 'spotted' (lit) for Multi-Ball™ Special. To light the Special during Multi-Ball, the player must score the center targets 1 - 6, as well as the upper and lower TOMCAT targets. A setting of 6 spots targets 1 - 6; the player only needs to hit the upper and lower TOMCAT targets to light SPECIAL. A setting of 12 spots both targets 1 - 6 and the lower TOMCAT targets; the player then must hit the six top TOMCAT targets during Multi-Ball play to light the Special. The range of this adjustment is 0 - 16. The Factory Setting is 06.

37 Launch Spots TOMCAT Targets
The operator can choose (via the Credit button) whether a shot up the Launch lane (to the Ball Popper) spots (lights) the next sequential TOMCAT target lamp. The choices are Yes (Launch spots next TOMCAT target) or No (Launch does not spot target). The Factory Setting is Yes.

38 Center Kill Spots TOMCAT Targets
The operator can choose (via the Credit button) whether hitting the lighted center Kill target spots the next sequential letter of the TOMCAT targets. The choices are No (No spot of the next TOMCAT target) or Yes (The next sequential TOMCAT target is lighted). The Factory Setting is No.

39 Initial Kill Spots

The operator can choose (via the Credit button) the number of Kill lamps that are initially lit at ball start. The range of this setting is 00 (No Kill lamps are lit); 01 (Alpha Kill lamp is lit); 02 (Alpha and Bravo Kill lamps are lit). The Factory Setting is 01.

40 Flight Insurance Threshhold

The operator can choose (via the Credit button) the average ball time required to activate the Flight Insurance feature. Flight Insurance lights on the last ball, if the player fails to exceed the average ball time specified as the Flight Insurance Threshhold. If the player drains, while Flight Insurance is lit, an extra ball is provided. The range of this setting is 1 - 50 seconds, or 0, which disables the Flight Insurance feature. The Factory Setting is 30 seconds (40 seconds for German games).

41 Flight Insurance Minimum Time

The operator can choose (via the Credit button) the minimum length of time the Flight Insurance lamp remains lighted on the player's last ball, if the average ball time is less than that specified by Ad 40. The range of this setting is 0 - 30 seconds. The Factory Setting is 10 seconds (15 seconds for German games).

42 Lite Flipper Lanes

The operator can choose (via the Credit button) what value of Bonus Multiplier is necessary to light the Lights Kill lamp in the flipper lanes. The range of this setting is 00 (light flipper lanes initially); 01 (light flipper lanes initially on last ball, and at 2X Bonus on other balls); 02 (light flipper lanes at 2X Bonus); 03 (light flipper lanes at 3X Bonus); 04 (light flipper lanes at 4X Bonus); 05 (light flipper lanes at 5X Bonus). The Factory Setting is 00.

43 Bonus Multiplier Extra Ball

The operator can choose (via the Credit button) the value of Bonus Multiplier that lights the Extra Ball lamp in that lane. The range of this setting is 10 (Off - NO Extra Ball lamp lighted); 09 (The Bonus Multiplier lane Extra Ball lamp is lighted, when the Bonus Multiplier value is greater than 8X); 08 (Extra Ball lamp lights for Bonus Multiplier of 8X); 07 (Extra Ball lamp lights for Bonus Multiplier of 7X). The Factory Setting is 08.

44 Kill Extra Ball

The operator can choose (via the Credit button) the number of Kills at which an Extra Ball lamp is lit. The choices are 00 (Hard - Extra Ball lamp is lit for Kills exceeding 7) or 01 (Easy - Extra Ball lamp is lit for 7 Kills). The Factory Setting is 01.

45 Yagov Kicker

The operator can select (via the Credit button) the force of the Yagov Kickback. The range of this adjustment is Off (No kickback action); 01 (Weak Kick); 02 (Hard Kick); 03 (Weak kick with Flight Insurance lighted); 04 (Hard kick with Flight Insurance). For the Flight Insurance options (03 and 04), the Flight Insurance lamp lights briefly as the Yagov Kicker fires; if the ball goes to the Outhole quickly, the game awards an Extra Ball. However, if either the Extra Ball or Ripoff lamp is lit, no Flight Insurance award occurs. The Factory Setting is 03.

46 UNUSED ADJUST

This adjustment is not used for F-14 TOMCAT.

47 Attract Beacon

The operator can select (via the Credit button) whether the rotating beacons atop the backbox operate during the Attract Mode. The choices are:

    On   - Beacons flash periodically during the Attract Mode sequence.
    Off - No beacons operate during the Attract Mode. The Factory Setting is On.

48 Attract Mode Sounds

The operator can select (via the Credit button) whether sounds occur during the Attract Mode. The choices are:

On - Sounds occur during the Attract Mode sequence.

Off - No sounds occur during the Attract Mode. The Factory Setting is On.

49 Custom Message

The operator can choose (via the Credit button) whether to display a message during the Attract Mode. (When display of a message is selected, the operator can either utilize the message provided or change the message.) Three choices are available:

1 - Display a message during the Attract Mode. The player 4 display shows this choice as ON. This is the Factory Setting. The 3-line message provided is:

FLY F14 TOMCAT ... DEFEAT GEN. YAGOV ... OR DIE.

2 - Do NOT display a message during the Attract Mode. (Player 4 shows OFF.)

3 - The player 4 display shows this choice as CHANGE. The operator can enter a special ("custom") message, as follows:

A. Press ADVANCE once. The operator can now enter as many as three 14-character lines for display during the Attract Mode.

B. Use the flipper button(s) to select each message character (alphabet, numbers, and special symbols are available). In case of error, enter a "back arrow" (just before "space") to correct, followed by correct character. For a period after any letter, use letters with periods (following the special symbols). The entire character set is the following:

ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789<>?-/*'
A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z. _

C. Move to the next character via the Credit button. No entirely blank lines will be displayed.

50 SW. ALARM KNOCKER

The operator can choose (via the Credit button) whether the knocker operates, sounding an alarm to signal a switch problem, at the time of game Turn-On and at the beginning of the Test/Diagnostic Procedures. Two choices are available:

YES - The knocker sounds, signalling a switch problem, at game Turn-On and at the beginning of the Test/Diagnostic Procedures. This is the Factory Setting, and is shown in the player 4 display.

NO - The knocker does NOT sound. (Player 4 shows NO.)

51 ENGLISH TEXT

The operator can choose to display the message, audit, adjustment, and Test/Diagnostic information in English or German (Deutsch) via the Credit button.

52 UNUSED ADJUST

This adjustment is not used for *F-14 TOMCAT*.

SPECIAL PRESET ADJUSTMENTS CAUTION

Adjustments 53 through 66 are Special Preset Adjustments to enable the operator to perform the setting of multiple adjustments at once. They permit the operator to: (1) modify a game for a specific area (special German coinage settings, for example, Ad 53 through 58); (2) change a group of adjustments to conform with laws of certain localities (Ad 59 through 61); and (3) to change the degree of difficulty of game play (Ad 62 through 66). A list of the preceding individual Adjustments affected accompanies each of these Special Preset Adjustments. Whenever the operator chooses to use any Special Preset Adjustment, the operator can later access any or all of the individual Adjustments affected by that Special Adjustment for subsequent changes.

A similar technique is recommended in the event of error or uncertainty concerning any Special Preset Adjustment, after the operator selects it: The operator can restore the factory setting of each individual Adjustment, then select the desired Special Preset Adjustment, and then return to any of the preceding individual adjustments to determine whether use of the Special Adjustment has had the desired effect.

The Backbox displays for each Special Preset Adjustment indicate whether the operator has selected it, by identifying the Adjustment in the player 1 and 2 displays by name and the selection choice of NO, meaning Not Selected (this is the Factory Setting), or YES, meaning Selected, in the player 4 display. Selection occurs by using the Credit button to choose YES and then pressing ADVANCE.

NOTE

Games in which the CPU jumper W7 is cut ("German games") automatically have certain Adjustment Items preset:

Ad	Name	New Setting	Ad	Name	New Setting
01	Auto Replay	15 %	20	Hi Scr 3 Credits	00
02	Replay Start	1,000,000	21	Hi Scr 4 Credits	00
03	Replay Levels	3	22	Hi Scr Reset	00
12	Maximum Credits	30	24	German 2 Coinage	7Plays/5DM
14	Backup Hi Scr 1	4,000,000	32	Rescue Timer	05
15	Backup Hi Scr 2	3,800,000	40	Insur. Threshhold	40
16	Backup Hi Scr 3	3,600,000	41	Insur. Min. Time	15
17	Backup Hi Scr 4	3,400,000	51	Deutsch Text	Deutsch
18	Hi Scr 1 Credits	03			
19	Hi Scr 2 Credits	00			

53 Install German 1

The operator can modify the game pricing selection of Standard Setting 09 in the **Pricing Table** to permit Credit Award play with 10 games for 5 DM. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Credit	17	Backup Hi Scr 4	3,400,000
07	Special Award	Credit	18	Hi Scr 1 Credits	03
08	Match Feature	10%	19	Hi Scr 2 Credits	00
14	Backup Hi Scr 1	4,000,000	20	Hi Scr 3 Credits	00
15	Backup Hi Scr 2	3,800,000	21	Hi Scr 4 Credits	00
16	Backup Hi Scr 3	3,600,000	24	German 2 Coinage	7 Plays/5DM

54 Install German 2

The operator can modify the game pricing selection of Standard Setting 09 in the **Pricing Table** to permit Ticket/Token operation with 10 games for 5 DM. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Coil	17	Backup Hi Scr 4	3,400,000
07	Special Award	Ball	18	Hi Scr 1 Credits	03
08	Match Feature	10%	19	Hi Scr 2 Credits	00
14	Backup Hi Scr 1	4,000,000	20	Hi Scr 3 Credits	00
15	Backup Hi Scr 2	3,800,000	21	Hi Scr 4 Credits	00
16	Backup Hi Scr 3	3,600,000	24	German 1 Coinage	10 Plays/5DM

55 Install German 3

The operator can modify the game pricing selection of Standard Setting 09 in the **Pricing Table** to permit Keyset Mode operation with 10 games for 5 DM. Individual Adjustments are affected, as follows:

55 Install German 3 (Continued)

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Audit	17	Backup Hi Scr 4	00
07	Special Award	Score	18	Hi Scr 1 Credits	00
08	Match Feature	Off	19	Hi Scr 2 Credits	00
14	Backup Hi Scr 1	00	20	Hi Scr 3 Credits	00
15	Backup Hi Scr 2	00	21	Hi Scr 4 Credits	00
16	Backup Hi Scr 3	00	24	German 1 Coinage	10 Plays/5DM

56 Install German 4

The operator can modify the game pricing selection of Standard Setting 09 in the **Pricing Table** to permit Credit Award play with 7 games for 5 DM. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Credit	17	Backup Hi Scr 4	3,400,000
07	Special Award	Credit	18	Hi Scr 1 Credits	03
08	Match Feature	10%	19	Hi Scr 2 Credits	00
14	Backup Hi Scr 1	4,000,000	20	Hi Scr 3 Credits	00
15	Backup Hi Scr 2	3,800,000	21	Hi Scr 4 Credits	00
16	Backup Hi Scr 3	3,600,000	24	German 2 Coinage	7 Plays/5DM

57 Install German 5

The operator can modify the game pricing selection of Standard Setting 09 in the **Pricing Table** to permit Ticket/Token operation with 7 games for 5 DM. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Coil	17	Backup Hi Scr 4	3,400,000
07	Special Award	Ball	18	Hi Scr 1 Credits	03
08	Match Feature	10%	19	Hi Scr 2 Credits	00
14	Backup Hi Scr 1	4,000,000	20	Hi Scr 3 Credits	00
15	Backup Hi Scr 2	3,800,000	21	Hi Scr 4 Credits	00
16	Backup Hi Scr 3	3,600,000	24	German 2 Coinage	7 Plays/5DM

58 Install German 6

The operator can modify the game pricing selection of Standard Setting 09 in the **Pricing Table** to permit Keyset Mode operation with 7 games for 5 DM. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Audit	17	Backup Hi Scr 4	00
07	Special Award	Score	18	Hi Scr 1 Credits	03
08	Match Feature	Off	19	Hi Scr 2 Credits	00
14	Backup Hi Scr 1	00	20	Hi Scr 3 Credits	00
15	Backup Hi Scr 2	00	21	Hi Scr 4 Credits	00
16	Backup Hi Scr 3	00	24	German 2 Coinage	7 Plays/5DM

59 Install Add-A-Ball

The operator can utilize this option to delete all Free Play awards and replace them with Extra Ball awards. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
06	Replay Award	Ball	19	Hi Scr 2 Credits	00
07	Special Award	Ball	20	Hi Scr 3 Credits	00
08	Match Feature	Off	21	Hi Scr 4 Credits	00
18	Hi Scr 1 Credits	00			

60 Install 5 Ball

The operator can change the game to 5-Ball play, including the changing of certain features to the recommended 5-Ball play difficulty level. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
02	Replay Start	1,600,000	39	Kill Spots	00
09	Balls / Game	05	42	Lite Flipper Lanes	01
33	Multi-Ball Mode	01			
34	Kill Memory	Yes			

61 Install Novelty

The operator can remove all Free Play and Extra Ball awards. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
01	Fixed Replay	Scores	08	Match Feature	Off
02	Replay Level 1	Off	11	No Extra Ball	00
03	Replay Level 2	Off	18	Hi Scr 1 Credits	00
04	Replay Level 3	Off	19	Hi Scr 2 Credits	00
05	Replay Level 4	Off	20	Hi Scr 3 Credits	00
06	Replay Award	Audit	21	Hi Scr 4 Credits	00
07	Special Award	Score			

62 Install Extra Easy

The operator can change the game play difficulty adjustments to a combination that is extremely easy (sometimes called "liberal"). Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
31	TOMCAT Memory	Yes	39	Kill Spots	02
32	Rescue Timer	05	40	Flt Ins Threshhold	40
33	Multi-Ball Mode	00	41	Flt Ins Min Time	15
34	Kill Memory	Yes	42	Lite Flipper Lanes	00
35	Rescue Initial	On	43	Bonus X Ex. Ball	07
36	Special Spots	10	44	Kill Ex. Ball	01
37	Lnch Spots TC	Yes			
38	Ct Kill Spots TC	Yes			

63 Install Easy

The operator can change the game play difficulty adjustments to a combination that is slightly easier than the Factory Settings. Individual Adjustments are affected, as follows:

Ad	Name	New Setting	Ad	Name	New Setting
31	TOMCAT Memory	Yes	39	Kill Spots	01
32	Rescue Timer	05	40	Flt Ins Threshhold	35
33	Multi-Ball Mode	00	41	Flt Ins Min Time	12
34	Kill Memory	Yes	42	Lite Flipper Lanes	00
35	Rescue Initial	On	43	Bonus X Ex. Ball	07
36	Special Spots	09	44	Kill Ex. Ball	01
37	Lnch Spots TC	Yes			
38	Ct Kill Spots TC	No			

64 Install Medium

The operator can change the game play difficulty adjustments to a combination that matches the Factory Settings. Individual Adjustments are affected, as follows:

64 Install Medium (Continued)

Ad	Name	New Setting		Ad	Name	New Setting
31	TOMCAT Memory	Yes		39	Kill Spots	01
32	Rescue Timer	05		40	Flt Ins Threshhold	35
33	Multi-Ball Mode	00		41	Flt Ins Min Time	12
34	Kill Memory	Yes		42	Lite Flipper Lanes	00
35	Rescue Initial	On		43	Bonus X Ex. Ball	07
36	Special Spots	09		44	Kill Ex. Ball	01
37	Lnch Spots TC	Yes				
38	Ct Kill Spots TC	No				

65 Install Hard

The operator can change the game play difficulty adjustments to a combination that is more difficult than the Factory Settings. Individual Adjustments are affected, as follows:

Ad	Name	New Setting		Ad	Name	New Setting
31	TOMCAT Memory	Yes		39	Kill Spots	00
32	Rescue Timer	03		40	Flt Ins Threshhold	30
33	Multi-Ball Mode	01		41	Flt Ins Min Time	10
34	Kill Memory	Yes		42	Lite Flipper Lanes	01
35	Rescue Initial	On		43	Bonus X Ex. Ball	08
36	Special Spots	04		44	Kill Ex. Ball	01
37	Lnch Spots TC	Yes		45	Yagov Kicker	03
38	Ct Kill Spots TC	No				

66 Install Extra Hard

The operator can change the game play difficulty adjustments to a combination that is much more difficult than the Factory Settings. Individual Adjustments are affected, as follows:

Ad	Name	New Setting		Ad	Name	New Setting
31	TOMCAT Memory	Yes		39	Kill Spots	00
32	Rescue Timer	03		40	Flt Ins Threshhold	30
33	Multi-Ball Mode	02		41	Flt Ins Min Time	10
34	Kill Memory	Yes		42	Lite Flipper Lanes	02
35	Rescue Initial	Off		43	Bonus X Ex. Ball	09
36	Special Spots	02		44	Kill Ex. Ball	00
37	Lnch Spots TC	Yes		45	Yagov Kicker	03
38	Ct Kill Spots TC	No				

67 Auto Burn-in

The operator can choose the YES option for this Special Preset Adjustment to perform certain automatic testing of the game, as used in the factory. It does not affect the game operation, but merely provides for a cyclic testing of most of the game's mechanisms.

68 Clear Coins

The operator can request the clearing of the coinage audits (Au 01 through 04) by selecting (via the Credit button) the YES option, as shown in the player 4 display. This adjustment zeroes the counters tallying the number of coins through each slot, the Paid Credits counter, and the Credits display.

After the YES option is displayed, the operator must press the ADVANCE button. The game then displays COINS CLEARED.

69 Clear Audits

The operator can request the clearing of the non-coinage audits (Au 05 through 38) by selecting (via the Credit button) the YES option, as shown in the player 4 display. This Adjustment zeroes the counters tallying the remaining Audit factors. Please note that this does NOT affect the Automatic Replay Percentaging data nor the automatic High Score Reset counter.

After the YES option is displayed, the operator must press the ADVANCE button. The game then displays AUDITS CLEARED.

70 Install Factory

The operator can request the game to provide the normal Factory Settings to restore the game to its 'factory condition'. This Adjustment clears all Audits, resets all Game Adjustments to the respective Factory Settings, and provides a restart of the Auto Replay (Ad 01).

After the YES option is displayed, the operator must press the ADVANCE button. The game then displays FACTORY SETTING.

Closing of the coin door before appearance of the FACTORY SETTING message or a problem in the Memory Protect circuit will cause the game to display ADJUST FAILURE.

A loss of battery power or improper treatment of the Game Adjustments will cause the game to attempt to restore Factory Settings. The game announces the results of this reset process with the appropriate message, FACTORY SETTING or ADJUST FAILURE.

RESETTING THE HIGH SCORES

The challenge of exceeding the High Score (either the factory setting or a higher score by another player) is the goal of many pinball game players. To keep a pinball game challenging requires a method of resetting the High Score value for those occasions when a skilled player registers a truly excellent score. Other players note this score and may decide not to play simply because their skill is not adequate to exceed an extremely high score.

For *F-14 TOMCAT*, in fact, three methods of resetting the High Score values are available. The simplest method involves allowing Game Adjustment Item Ad 22 to reset the High Score values automatically after the specified number of plays designated by the operator. The second method requires pressing the High Score Reset switch on the inside of the coin door in the Attract Mode. This action simply erases the previous high score values and replaces them with the Backup High Score values. The third method establishes new values replacing the factory setting values or previous operator setting values; it requires performing the following steps:

1. Using AUTO-UP or MANUAL-DOWN, reach item Ad 14 (and items Ad 15, 16, and 17, if desired). The High Score value of the factory setting (or previous operator-adjusted setting) appears in the player 1 display. If this value is satisfactory, go to step 4 below.

2. If you wish to increase the High Score value from that displayed in the player 1 display, use AUTO-UP, and press the Credit button, until the desired value shows in the player 1 display.

3. If you wish to decrease the High Score value, use MANUAL-DOWN, and press the Credit button, until the desired value shows in the player 1 display.

4. Using AUTO-UP, press and hold down ADVANCE, until the Player 3 display shows **Ad 70** Press ADVANCE once, to return to Game- Over Mode.

5. Press the High Score Reset switch (on coin door), and listen for the sound signifying that the score reset action is complete. Observe player score displays (player 1, player 2, etc.) to verify that the new High Score values are displayed.

GAME PRICING

PRICING MADE EASY. Game Adjustment Item Ad 24 allows the operator an easy method of setting the pricing functions. Pressing the Credit button allows the operator a choice of one of the 16 "Standard" Settings, with associated automatic pricing (Player 1 and 2 displays show the Country identifier; player 3 and 4 displays show the games per coin(s) information for a country having more than one "Standard" Setting). In the *Pricing Table*, each "Standard" Setting is denoted by a 2-digit number (other than 00) in column 24. Automatic Pricing causes each of the other pricing items (columns 25 through 30) to change to the value shown in the table for that selected "Standard" Setting.

CUSTOM PRICING. Adjustment Item 24 must be set to the Custom Coinage Setting (player 1 and 2 displaying CUSTOM COINAGE) to enable the operator to enter desired custom pricing selections for Items 25 through 30, based on the *Pricing Table*. Item 25 is the left coin chute multiplier. Item 26 is the center coin chute multiplier. Item 27 is the right coin chute multiplier. Item 28 is the number of coin units equal to one Credit. (A Credit is usually equal to one game.)

The calculation of the ratio of Games : Price uses the ratio equation of $X : VC$, where:

$\quad\quad\quad\quad X$ = Coin Chute Multiplier (Item 25, 26, or 27 in *Pricing Table*);
$\quad\quad\quad\quad V$ = Value of coin;
$\quad\quad\quad\quad C$ = Coin units eqivalent to one Credit (Item 28).

For example, for 25¢ chutes at the factory setting, substituting values in the Games : Price ratio calculation gives $1 : 25 \times 1$, or one game for 25¢.

UNITS REQUIRED FOR BONUS CREDIT. Item 29 is the number of coin units that must pass through the coin chute(s) before an additional Credit (game) is posted (displayed). At the factory setting, the number in this item is 00. (This 00 means that NO bonus credit (free game) is awarded, although purchase of more than one game at a time occurs.)

MINIMUM COIN UNITS. Item 30 determines the number of coin units that must pass through the coin chute(s) before play may begin. The factory setting for this item is 00. (This 00 means that the Minimum Coin Units feature (Item 30) is disabled, by the factory setting.)

F-14 TOMCAT Pricing Table

Country	Coin Chute			Games/Coin	Pricing Functions						
	Left	Center	Right		24	25	26	27	28	29	30
USA and Canada	25¢	-	25¢	1/25¢, 4/$1 [1,2]	01	01	04	01	01	00	00
				1/50¢, 2/75¢, 3/$1 [2]	02	03	12	03	04	00	00
				1/50¢, 2/$1 [2]	03	01	04	01	02	00	00
				1/25¢, 3/50¢, 6/$1	00	01	04	01	01	02	00
				1/25¢, 5/$1	00	01	00	01	01	04	00
West Germany	1 DM	2 DM	5 DM	1/1 DM, 2/2 DM, 7/5 DMark [2,3]	10	06	12	30	05	30	00
				1/1 DM, 3/2 DM, 10/5 DM [2]	09	09	18	45	05	45	00
				1/1 DM, 3/2 DM, 9/5 DM	00	09	18	45	05	00	00
				1/2x1 DM, 1/2 DM, 3/5 DM	00	03	06	15	05	00	00
				2/1 DM, 5/2 DM, 14/5 DM	00	13	26	65	05	65	00
				Ticket/Token Mode [4]							
				Keyset Mode [4]							
France	1 F	5 F	10 F	1/3x1 F, 2/5 F, 5/10 Franc [2]	13	02	10	20	05	20	00
Antilles (Netherlands)	25¢	-	1G	1/25¢, 4/1 Guilder	00	01	01	04	01	00	00
Netherlands	25¢	-	1G	1/25¢, 5/1 Guilder	00	01	00	05	01	00	00
	1 HFl	2.5 HFl	2.5 HFl	1/1 HFl, 3/2.5 HFl [2]	11	06	15	15	05	00	00
Belgium	5 F	-	20 F	1/2x5 F, 2/20 Franc	00	01	01	04	02	00	00
	5 F	5 F	20 F	1/2X5 F, 1/2X5 F, 3/20 F [2]	08	03	03	12	04	00	00
	5 F	20 F	20 F	1/2x5 F, 2/20 F, 2/20 F	00	01	04	04	02	00	00
	5 F	5 F	20 F	1/2X5 F, 1/2X5 F, 2/20 F	00	01	01	04	02	00	00
Spain	25 P	-	100P	1/25 P, 5/100 Peseta [2]	15	01	00	05	01	00	00
Switzerland	1 F	2 F	5 F	1/1 F, 3/2 F, 7/5 Franc	00	02	06	14	02	00	00
	1 F	-	2 F	1/1 F, 3/2 F [2]	07	03	00	06	02	00	00
Japan	100 ¥	-	100 ¥	2/100 Yen	00	04	00	04	02	00	00
	-	100 ¥	-	2/100 ¥ [2]	16	01	04	01	02	00	00
Italy	500 L	-	500 L	1/500 Lire [2]	14	01	04	01	01	00	00
Australia	20¢	-	$1	1/2x20 ¢, 3/$1 [2]	05	01	00	06	02	00	00
United Kingdom	10 P	50 P	20 P	1/10 P, 5/50 P, 2/20 Pence	00	01	05	02	01	00	00
	10 P	50 P	10 P	1/10 P, 5/50 P [2]	06	01	05	01	01	00	00
Argentina	10¢	10¢	10¢	1/1 Token	00	01	01	01	01	00	00
Austria	5 Sch	-	10 Sch	2/5 Sch, 5/10 Schilling	00	02	00	05	01	00	00
	1 Sch	5 Sch	10 Sch	2/5x1 Sch, 2/5 Sch, 5/10 Sch	00	02	10	25	05	00	00
	5 Sch	10 Sch	10 Sch	1/2x5 Sch, 3/2x10 Sch [2]	04	03	06	06	04	00	00
Chile	Token	-	Token	1/1 Token [1,2]	01	01	04	01	01	00	00
Denmark	1 Kr	5 Kr	10 Kr	1/2x1 Kr, 3/5 Kr, 7/10 Krone	00	01	06	14	02	00	00
Finland	1 Mka	-	1 Mka	1/1 Markka [1,2]	01	01	04	01	01	00	00
New Zealand	20¢	-	20¢	1/2x20¢ [2]	03	01	04	01	02	00	00
Norway	1 Kr	-	1 Kr	1/2x1 Kr, 3/5x1 Krone	00	01	00	01	02	05	00
Sweden	1 Kr	-	1 Kr	1/2x1 Krona [2]	03	01	04	01	02	00	00
	1 Kr	5 Kr	5 Kr	1/3x1 Kr, 2/5 Krona [2]	12	02	10	10	05	00	00

Notes: 1. Factory Default. 2. Standard Setting - Change by pressing Credit button. 3. Default with jumper W7 cut/removed. 4. Other functions are also affected; see the explanations for Adjustment Items 53 through 58.

TEST/DIAGNOSTIC PROCEDURES

WILLIAMS ELECTRONICS GAMES provides a series of diagnostic tests to aid the operator in determining game condition (that is, whether the game's features and highlights are operating satisfactorily). These tests activate virtually all the electronic and electromechanical devices comprising the game, so that the operator can readily locate a malfunctioning device or simply verify that all devices are working properly. In order, these tests deal with the music, the displays, the game sounds, the lamps, the solenoids, and the switches.

In addition to the diagnostic testing, a feature called the <u>Auto Burn-in Mode</u> is available. Activating this mode enables the operator to observe the game while all of the diagnostic tests, *except the switch test,* occur. This can be very helpful in locating 'intermittent'problems.

Activating either the entire test series or one of the individual tests requires use of the Game Adjustment/ Diagnostic switches. Open the coin door for access to these switches. To proceed to the Diagnostic Tests, the operator must simply switch the game On, set the AUTO-UP/MANUAL-DOWN switch to MANUAL-DOWN, and press the ADVANCE button.

CAUTION

F-14 TOMCAT's System-11A game program greatly aids the operator and service personnel: When the operator is beginning the Test/Diagnostic Procedures (and also at game Turn-On), a display now signals that a switch has NOT been actuated during ball play for a lengthy period of time (60 balls, or 20 games). However, for the Switch Problem Reporting activity at the beginning of the Test/ Diagnostic Procedures, the display of problem switches is *not* limited to just three switches; it now includes *ALL* switches exhibiting problems. Refer to the text on Switch Tests for additional information. To proceed with the Test/Diagnostic Procedures, use AUTO-UP, and press ADVANCE.

DISPLAY TEST.

1. To initiate the Display Test, press ADVANCE. Observe that the player 1 and 2 displays briefly show the message, DISPLAY TEST, and that the Player 3 display shows 00 (the Display Test identifier).

2. Use AUTO-UP. Observe that all displays begin a display cycle of all 0s through all 9s, one digit at a time. Verify that the proper comma segments light during display of the odd-numbered digits. Next, a special "all segments" character 'walks' from left to right across each display (player 1, 2, 3, 4).

3. To halt the display cycle, use MANUAL-DOWN. Then, press ADVANCE to step through the sequential digit display, digit by digit, and the subsequent "all segments" characters display test. Use AUTO-UP to resume cycling, and to proceed to the next test.

SOUND MUSIC TEST.

1. In the Sound-Music Test, observe that the player 1 and 2 displays show the message, SOUND MUSIC. Switching to AUTO-UP, observe that the message remains SOUND MUSIC, and that the Player 3 display shows 01 00 (01 designates the SOUND MUSIC test; 00 is the first step within the test). The Player 3 display then shows a series of test steps from 00 through 17 (Steps 00 through 07 are sounds; steps 10 through 17 are music). Verify that a different sound or tune is heard each time the number in the Player 3 display changes.

2. To repeatedly pulse a single sound, use MANUAL-DOWN. Verify that one particular sound repeats. Press ADVANCE to step to the next sound, which repeats until ADVANCE is pressed again. Use AUTO-UP to resume cycling the sounds, and to proceed to the next test.

TEST/DIAGNOSTIC PROCEDURES

LAMP TESTS.

1. All Lamps.

(From Sound Test) To initiate the first Lamps Test, press ADVANCE. Observe that the player 1 and 2 displays show the message, ALL LAMPS, and that the Player 3 display shows 02 (All LampsTest identifier) and that all feature lamps (playfield and backbox) blink on and off. (Note, however, that the General Illumination lamps remain lighted steadily.) To locate the wiring associated with a particular feature lamp, refer to the **Lamp-Matrix Table.** CPU Board connections at jacks 1J6 (columns) and 1J7 (rows) are also listed in the table.

2. Single Lamps.

From the All Lamps test, using AUTO-UP, press ADVANCE to initiate the Single Lamps Test. The player 1 and 2 displays initially show the message, SINGLE LAMPS, and the Player 3 display shows 03. Then, the Player 3 display shows 03 01, and the player 1 and 2 displays change to show LITES LOCK ON, the name of the lamp currently blinking. Press the Credit button to proceed through an ascending series of designator numbers (01 through 64), with the player 1 and 2 displays showing the individual lamp's name. Press and hold the Credit button to proceed rapidly to the desired lamp.

F-14 TOMCAT Lamp-Matrix Table

[2] Two Lamps

Lamps = #44 Bulb, p/n 24-6549

COLUMN / ROW	1 Q66 YEL-BRN 1J7-1	2 Q64 YEL-RED 1J7-2	3 Q62 YEL-ORN 1J7-3	4 Q60 YEL-BLK 1J7-4	5 Q58 YEL-GRN 1J7-6	6 Q56 YEL-BLU 1J7-7	7 Q54 YEL-VIO 1J7-8	8 Q52 YEL-GRY 1J7-9
Q80 1 RED-BRN 1J6-1	LITES LOCK ON 1	ALPHA KILL 9	1K 17	2X 25	T (lower left) 33	3 Target 41	T (upper left) 49	LOCK Top Ramp (red) 57
Q81 2 RED-BLK 1J6-2	LITES RELEASE 2	BRAVO KILL 10	2K 18	3X 26	O lower left 34	2 Target 42	O (upper left) 50	LOCK Middle Ramp (red) 58
Q82 3 RED-ORN 1J6-3	HOT STREAK 3	CHARLIE KILL 11	4K 19	4X 27	M (lower left) 35	1 Target 43	M (upper left) 51	LOCK Low Ramp (red) 59
Q83 4 RED-YEL 1J6-5	FLY AGAIN 4	DELTA KILL 12	8K 20	5X 28	T (lower right) 36	4 Target 44	T (upper right) 52	LANDING Top Ramp (blue) 60
Q84 5 RED-GRN 1J6-6	RESCUE (left center) 5	ECHO KILL 13	16K 21	6X 29	A (lower right) 37	5 Target 45	A (upper right) 53	LANDING Mid. Ramp (blue) 61
Q85 6 RED-BLU 1J6-7	KILL (center) 6	FOX KILL 14	32K 22	7X 30	C (lower right) 38	6 Target 46	C (upper right) 54	LANDING Low Ramp (blue) 62
Q86 7 RED-VIO 1J6-8	RESCUE (right center) 7	GOLF KILL 15	64K 23	8X 31	LITES KILL Flipper [2] Lanes 39	RELEASE (Ball Popper) 47	BONUS X (Right Loop) 55	RIPOFF (Line of Death) 63
Q87 8 RED-GRY 1J6-9	RESCUE (left outlane) 8	FLIGHT INSURANCE 16	SPECIAL [2] (left & right drain lanes) 24	BONUS X (Left Loop) 32	LANDING (Ball Popper) 40	LOCK ON (Ball Popper) 48	2000 Spinner 56	EXTRA BALL (Line of Death) 64

TEST/DIAGNOSTIC PROCEDURES (Continued)

SOLENOID TEST.

1. (From Lamp Test) Using AUTO-UP, press ADVANCE. Observe that the player 1 and 2 displays show the message, COIL TEST, the Player 3 display shows 04 (Solenoid Test identifier). Next, the Player 3 display shows a series of test steps from 01 through 22, while the player 1 and 2 displays show the solenoid/circuit name. During each of these steps, pulsing of the respective solenoid/circuit occurs. The test cycles repeatedly, unless halted via the MANUAL-DOWN switch. Refer to the **Solenoid Table** for solenoid numbers and wiring information. CPU Board connections at 1P11, 1P12, and 1P19 are also listed in the table.

To continuously pulse a single solenoid/circuit, use MANUAL-DOWN. Press ADVANCE to sequence through the switched, controlled, and special solenoids. Use AUTO-UP to resume test cycling, and to proceed to the next test.

F-14 TOMCAT Solenoid Table

Sol. No.	Function	Solenoid Type	Wire [1] Color	Connections CPU Bd.	Connections Playfield/ Cabinet	Driver Trans.	Solenoid Part Number Flashlamp Type b = Backbox p = Playfield	
01A[3]	Outhole Kicker	Switched	Vio-Brn	1P11-1	8P3-1 (to B1 on	Q33	AE-23-800-01	
01C[3]	Flasher 1	Switched	Blk-Brn	(Gry-Brn)	Diode Sw. Bd.)	Q33	#89 flashlamps	2p
02A[3]	Ball Shooter Lane Feeder	Switched	Vio-Red	1P11-3	8P3-2 (to B2 on	Q25	AE-23-800-03	
02C[3]	Flasher 2	Switched	Blk-Red	(Gry-Red)	Diode Sw. Bd.)	Q25	#89 flashlamps	2p
03A[3]	Ball Popper (Launch)	Switched	Vio-Orn	1P11-4	8P3-3 (to B3 on	Q32	AE-23-800-12 [4]	
03C[3]	Flasher 3	Switched	Blk-Orn	(Gry-Orn)	Diode Sw. Bd.)	Q32	#89 flashlamps	2p
04A[3]	Spare (Not Used)	Switched	Vio-Yel	1P11-5	8P3-4 (to B4 on	Q24		
04C[3]	Flasher 4	Switched	Blk-Yel	(Gry-Yel)	Diode Sw. Bd.)	Q24	#89 flashlamps	2p
05A[3]	Center Right Eject	Switched	Vio-Grn	1P11-6	8P3-5 (to B5 on	Q31	AE-23-800-11 [4]	
05C[3]	Flasher 5	Switched	Blk-Grn	(Gry-Grn)	Diode Sw. Bd.)	Q31	#89 flashlamps	2p
06A[3]	Knocker	Switched	Vio-Blu	1P11-7	8P3-6 (to B6 on	Q23	AE-23-800-02	
06C[3]	Flasher 6	Switched	Blk-Blu	(Gry-Blu)	Diode Sw. Bd.)	Q23	#89 flashlamps	2p
07A[3]	Right Eject	Switched	Vio-Blk	1P11-8	8P3-7 (to B7 on	Q30	AE-23-800-11 [4]	
07C[3]	Flasher 7	Switched	Blk-Vio	(Gry-Vio)	Diode Sw. Bd.)	Q30	#89 flashlamps	2p
08A[3]	Spare (Not Used)	Switched	Vio-Gry	1P11-9	8P3-8 (to B8 on	Q22		
08C[3]	Flasher 8	Switched	Blk-Gry	(Gry-Blk)	Diode Sw. Bd.)	Q22	#89 flashlamps	3p
09	Flasher 9	Controlled	Brn-Blk	1P12-1	8P3-9	Q17	#89 flashlamps	2b, 1p
10	Center Left Eject	Controlled	Brn-Red	1P12-2	8P3-10	Q9	AE-23-800-11 [4]	
11	General Illumination Relay	Controlled	Brn-Orn	1P12-4	3P7-1	Q16	5580-09555-01 [5]	
12	Line Of Death Kickback	Controlled	Brn-Yel	1P12-5	8P3-12	Q8	AE-23-800-11 [4]	
13	Rescue Kickback (left outlane)	Controlled	Brn-Grn	1P12-6	8P3-13	Q15	AE-23-800-11 [4]	
14	Solenoid A/C Select Relay	Controlled	Brn-Blu	1P12-7	8P3-14	Q7	5580-09555-01 [4]	
15	Flasher 10	Controlled	Brn-Vio	1P12-8	8P3-15	Q14	#89 flashlamps	2b, 1p
16	Rotating Beacons (backbox)	Controlled	Brn-Gry	1P12-9	8P3-16	Q6	#1683 & mtr14-7946 [4]	
17	Left Kicker	Special #1	Blu-Brn	1P19-7	8P3-17	Q75	AE-23-800-03	
18	Right Kicker	Special #2	Blu-Red	1P19-4	8P3-18	Q71	AE-23-800-03	
19	Spare (Not Used)	Special #3	Blu-Orn	1P19-3	8P3-19	Q73		
20	Jet Bumper	Special #4	Blu-Yel	1P19-6	8P3-20	Q69	AE-23-800-03	
21	Upper Diverter - Launch Ramp	Special #5	Blu-Grn	1P19-8	8P3-21	Q77	AL-26-1500-02	
22	Lower Diverter - Launch Ramp	Special #6	Blu-Blk	1P19-9	8P3-22	Q79	AL-26-1500-02	
·	Upper Right Flipper	·	[Blk-Yel]		[7P1-14, 8P3-33]	·	FL11722-50VDC	
·	Right Flipper	·	Orn-Vio [Blu-Vio]	1P19-1	7P1-15 [7P1-16,8P3-34][2]	·	FL11630-50VDC	
·	Upper Left Flipper	·	[Blk-Blu]		[7P1-17, 8P3-31]	·	FL11722-50VDC	
·	Left Flipper	·	Orn-Gry [Blu-Gry]	1P19-2	7P1-18 [7P1-19,8P3-32][2]	·	FL11630-50VDC	

Notes: 1. Wire colors, except flipper Orn-Vio and Orn-Gry, are ground connections (to coil terminal with unbanded end of diode). Flipper Orn-Vio and Orn-Gry wires connect from CPU Board to flipper switch. 2. Flipper connections shown in braces are from flipper switch to flipper coil. 3. "A" coils are pulsed, when Sol. 14 is de-energized; "C" coils are pulsed, with Sol. 14 energized. Wire colors in brackets are those from respective A and C terminals corresponding to the B terminal connection listed for the Diode Switching Board, which controls the device pulsing by Sol. 14. 4. Relay (p/n 5580-09555-01) is mounted on Relay Snubber Bd. p/n C-11232 or C-11232-2, or Relay Bd. p/n C-11232-1. 5. Relay is mounted on Power Supply Bd. D-8345 in the backbox.

"On" State Logic - Special Solenoid
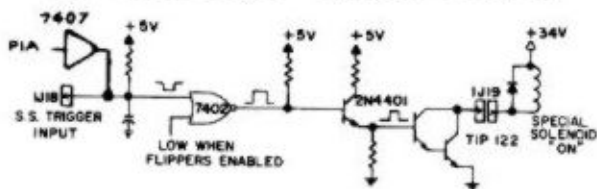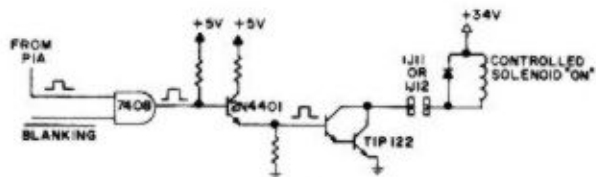
"On" State Logic - Controlled Solenoid

"Off" State - Special Solenoid:
The Special Switch Trigger Input goes low. Meanwhile, the PIA line remains high. The remaining sig...

"Off" State - Controlled Solenoid:
The Enable Input (from the PIA) goes low. Meanwhile, the BLANKING signal remains high. The rest of the...

"On" State Logic - Special Solenoid

"On" State Logic - Controlled Solenoid

"Off" State - Special Solenoid:

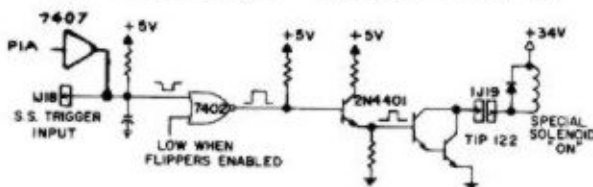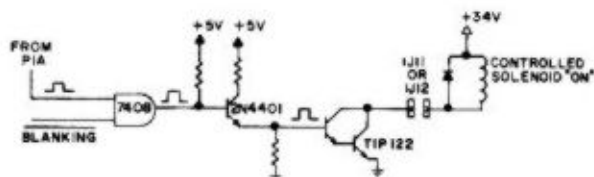The Special Switch Trigger Input goes low. Meanwhile, the PIA line remains high. The remaining signals reverse their states.

"Off" State - Controlled Solenoid:

The Enable Input (from the PIA) goes low. Meanwhile, the BLANKING signal remains high. The rest of the signals reverse their states.

NOTE

As directed by the game program, the Solenoid A/C Select Relay (solenoid 14) switches the solenoid B+ power between two power busses to permit actuating two groups of solenoids at the proper times. In its de-energized state, the Relay connects the 'circuit A power' to 16 "controlled" and "switched" solenoids (identified in the table with no suffix letter or the letter A, after the solenoid number). Individual solenoid operation then depends on the game program enabling the ground path for solenoid actuation via the driver transistor as- sociated with each solenoid circuit. For example, the game program can actuate the Center Right Eject solenoid (sol. 05A), via the driver transistor Q31.

When the game program determines that the Solenoid A/C Select Relay (sol. 14) must be energized, the relay connects 'circuit C power' to eight group C solenoids (01C through 08C). Now, driver transistor Q31 can actuate the Flasher 6 circuit (sol. 05C). Using this "multiplexing" technique, the same driver transistor can control actuation of two separate solenoid circuits.
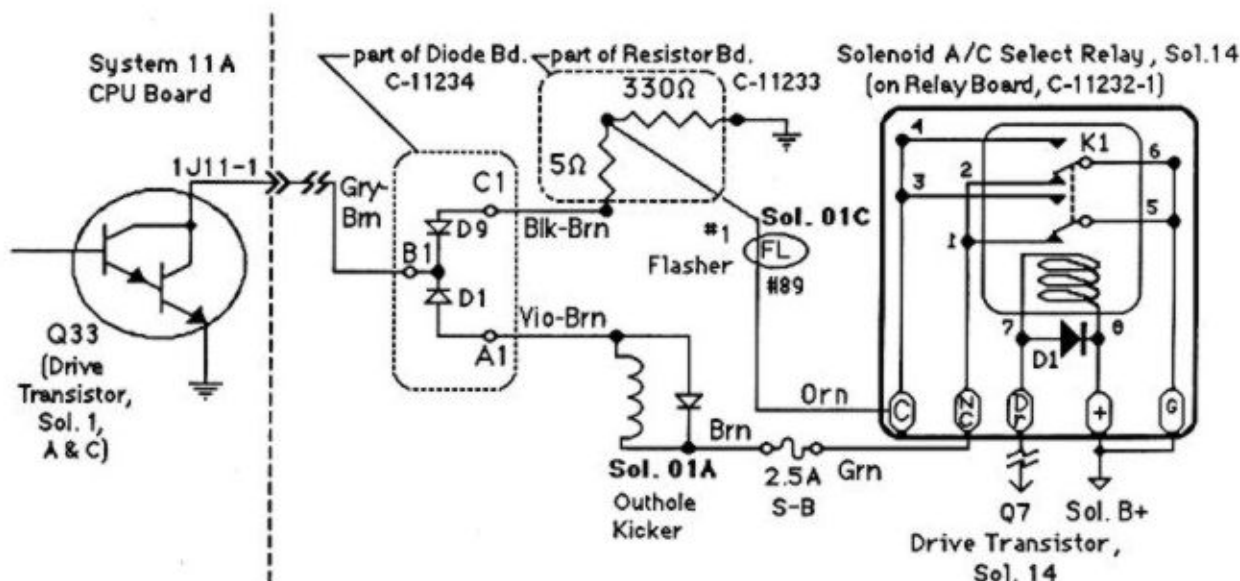

Figure 2. Typical Solenoid A/C Select Relay Circuit

SWITCH TESTS.

1. Switch Levels.

(From Solenoid Test) To initiate the Switch Levels Test, press ADVANCE. Observe that the player 1 and 2 displays show the message, SWITCH LEVELS, and the Player 3 display shows 05 (Switch Levels Test identifier). Normally, the right portion of the Player 3 display remains blank, indicating that no switch is actuated.

If, however, a switch *is* actuated (possibly stuck closed), the Player 3 display shows that switch's number, while the player 1 and 2 displays indicate the switch's name. A sound also accompanies the displays. (This is another facet of the *F-14 TOMCAT* System-11A's switch testing capability.) If more than one switch is closed, a series of displays show each actuated switch's name and number.

(In addition, either of these problems could result in the reporting of a switch problem (or problems) at game Turn-On or at the beginning of Diagnostic Tests.)

As soon as the operator opens a closed switch, its name and number are eliminated from the Switch Levels display series. For *F-14 TOMCAT*, switch numbers can range from 01 through 63. Refer to the **Switch-Matrix Table** for switch numbers and wiring information. CPU Board connections at jacks 1J8 (columns) and 1J10 (rows) are also listed in the table.

F-14 TOMCAT Switch-Matrix Table

COLUMN / ROW	1 Q45 GRN-BRN 1J8-1	2 Q49 GRN-RED 1J8-2	3 Q44 GRN-ORN 1J8-3	4 Q48 GRN-YEL 1J8-4	5 Q43 GRN-BLK 1J8-5	6 Q47 GRN-BLU 1J8-7	7 Q42 GRN-VIO 1J8-8	8 Q46 GRN-GRY 1J8-9
1 WHT-BRN 1J10-9	Plumb Bob Tilt 1	Playfield Tilt 9	Not Used 17	Left Center Target 25	Lower Left T Target 33	3 Target 41	Upper Left T Target 49	Left Kicker ("sling") 57
2 WHT-RED 1J10-8	Ball Roll Tilt 2	Outhole 10	Not Used 18	Right Center Target 26	Lower Left O Target 34	2 Target 42	Upper Left O Target 50	Right Kicker ("sling") 58
3 WHT-ORN 1J10-7	Credit Button 3	Right Ball Trough 11	Not Used 19	Not Used 27	Lower Left M Target 35	1 Target 43	Upper Left M Target 51	Left Flipper Return 59
4 WHT-YEL 1J10-6	Right Coin Chute 4	Right Center Ball Trough 12	Ramp Entry 20	Jet ("pop") Bumper 28	Lower Right T Target 36	4 Target 44	Upper Right T Target 52	Right Flipper Return 60
5 WHT-GRN 1J10-5	Center Coin Chute 5	Left Center Ball Trough 13	Right Eject 21	Not Used 29	Lower Right A Target 37	5 Target 45	Upper Right A Target 53	Left Drain "Rescue" Kickback 61
6 WHT-BLU 1J10-3	Left Coin Chute 6	Left Ball Trough 14	Left Center Eject 22	Lower Ramp 30	Lower Right C Target 38	6 Target 46	Upper Right C Target 54	Right Drain 62
7 WHT-VIO 1J10-2	Slam Tilt 7	Right Flipper E.O.S. 15	Right Center Eject 23	Middle Ramp 31	Not Used 39	Top Right Loop 47	Line of Death "Kill Gen. Yagov" 55	Left Flipper E.O.S. 63
8 WHT-GRY 1J10-1	High-Score Reset 8	Ball Shooter Lane 16	Ball Popper 24	Upper Ramp 32	Not Used 40	Spinner 48	Top Left Loop 56	Not Used 64

Row Problems. If a display of two (or more) switch numbers of a row occurs, although only one switch is closed, check for a short circuit between the column wires.

Multiple Switch Number Indications. Check the associated column wire for a short circuit to ground.

Column Problems. If display of two (or more) switch numbers in a column occurs (while only one switch is actuated), check for a short circuit between the row wires.

Use AUTO-UP to proceed to the next test.

SWITCH TESTS (Continued).

2. **Switch Edges.**
   From the Switch Levels Test, press ADVANCE. Observe that the player 1 and 2 displays show the message, SWITCH EDGES; the Player 3 display shows 06 (Switch Edges Test identifier). The right portion of the Player 3 display is blank, indicating that no switch is actuated.

   This test permits the operator to test whether actuating a switch provides the proper signal to the System-11A switch testing program. When actuating a switch, the operator should see the switch's name and number (in the player 1, 2, and 3 displays, respectively). If no indication appears at the time the switch is actuated, the operator then knows that there is a malfunction associated with that switch.

   Using this technique, the operator can test each switch appearing in the *F-14 TOMCAT* switch problem reporting displays (either at game Turn-On or at the beginning of the Diagnostic Tests) to determine whether the switch can be actuated. If the switch's name and number are displayed while the operator checks its operation, the operator then knows that the reported problem with that switch is NOT currently caused by a switch malfunction. The operator can then seek other causes for the reported problem, being almost certain now that the switch did not fail. *This test is also useful when the operator is adjusting the sensitivity of a particular switch's actuation mechanism.*

   Among the possibilities is the fact that the players have not actuated that switch because of some other problem; the operator should try to analyze what could cause the switch to be missed, and remedy that problem cause. With these new tests, switch problems are, therefore, more easily isolated.

3. *Playfield or CPU Board?* To determine whether a switch problem is in the playfield or the CPU Board, remove connectors 1P8 and 1P10 from the CPU Board. Begin the Switch Test. Use a jumper wire to simulate switch actuation. For example, placing a jumper between 1J10-9 and 1J8-2 should (based on the **Switch-Matrix Table**) should produce an indication of switch 09 being actuated.

ENDING THE DIAGNOSTIC TESTS.

To end the Diagnostic Tests, reach the Switch Edges Test (06 in the Player 3 display), use AUTO-UP and press ADVANCE. The backbox displays should show the *F-14 TOMCAT* game's Identification Information. Use MANUAL-DOWN, and press ADVANCE to reach Adjustment Item 70 (INSTALL FACTORY). Use AUTO-UP and press ADVANCE to obtain the Attract Mode.

AUTO BURN-IN MODE.

The Auto Burn-in Mode permits the operator to check intermittent (or nonrecurring) problems associated with most portions of the game's circuitry. Repeatedly cycling through a group of tests can sometimes bring a problem, which occurs only randomly or occasionally, to exhibit itself more frequently, thereby aiding in the isolation of the problem. To activate the Auto Burn-in Mode:

1. While in the Game Adjustments, reach Ad 67 and change the Factory Setting of NO to YES, via the Credit button. Set the AUTO-UP/MANUAL-DOWN switch to AUTO-UP.

2. Press ADVANCE to start the Auto Burn-in Mode. This mode repeatedly sequences through the Music Test, the Display Test, the Sound Test, the All Lamps portion of the Lamp Test, and the Solenoid Test.

3. To halt the Auto Burn-in Mode, switch the game Off and then On. *F-14 TOMCAT* now starts in the Attract Mode. (If a switch problem is now reported by the displays, perform the Switch Tests again to determine the nature of the problem; then, perform necessary repairs.)

SYSTEM-11A MEMORY CHIP TEST.

A new feature is now included in the Memory Chip Test for System 11A. During power-up, the CPU performs a self-testing routine. When all tests are satisfactory, the game proceeds to the Attract Mode, allowing players to use the game. Whenever a portion of the testing does not produce satisfactory results, the game displays a message, before proceeding to the next portion of the testing. ONLY after all tests are satisfactory does the game allow play.

In addition to the displayed message, when a test fails, the lower LED mounted on the CPU Board can be observed to determine the probable cause of the problem. The LED blinks, or flashes, a certain number of times to identify the probable cause, as described in the **CPU LED Indicator Codes Table**. The operator can also start the self-testing routine by pressing the CPU Diagnostic Switch (SW 2) on the edge of the CPU Board.

CPU LED Indicator Codes Table

Diagnostic LED		
Blinks/ Flashes	**Display Message**	**Explanation**
1	U25 RAM FAILURE	U25 RAM could not be used properly (NO other tests are performed; the game is locked here, until the game is turned off).
2	MEM. PROT. FAILURE	This message means that (A) the Coin Door may be shut; (B) the Memory Protect Switch may be stuck in the ON position; (C) the memory protect logic is protecting the memory; or (D) a U25 RAM failure is occurring. (See Note 1)
3	U51 PIA FAILURE	U51 has a malfunction. (See Note 2)
4	U38 PIA FAILURE	U38 has a malfunction. (See Note 2)
5	U41 PIA FAILURE	U41 has a malfunction. (See Note 2)
6	U42 PIA FAILURE	U42 has a malfunction. (See Note 2)
7	U54 PIA FAILURE	U54 has a malfunction. (See Note 2)
8	U10 PIA FAILURE	U10 has a malfunction. (See Note 2)
9	IRQ FAILURE	IRQ has a malfunction. It may be missing or too fast or too slow.
10	U27 ROM FAILURE	U27's internal checksums do not match. It may be a ROM failure, or its associated connections and connecting devices are causing it to appear to have a problem. (The following U26 test is skipped.)
11	U26 ROM FAILURE	U26's internal checksums do not match.

Notes: 1. This test assumes that the Coin Door is OPEN; it is initiated ONLY by pressing the CPU Diagnostic Switch (SW2).

2. Alternatively, its associated connections or connecting devices are causing the IC to appear to have problems.

SYSTEM-11A SOUND CIRCUITRY TESTS.

Tests of the System-11A Sound circuitry, including the Sound/Speech Board are possible, only after successful completion of the System-11A Memory Chip Test.

1. **Sound/Speech Board Test.** A brief check of the Sound/Speech Board (D-11298) circuitry occurs at game Turn-on; the game reports the test results by brief sounds, as follows: No sound = Sound/ Speech Board is not operating, or a failure is affecting the sound circuitry (broken cable; dead amplifier; etc.); 1 sound = system OK; 2 sounds = RAM problem; 3 sounds = U4 problem; 4 sounds = U19 problem.

2. **General System-11A Sound Test.** Press the Sound Diagnostic Switch (SW 1) on left edge of the CPU Board. Listen for the descending shriek of a diving F-14 TOMCAT, tshowing that both the CVSD (Continuously Variable Slope Delta) Modulator, which provides the voices for *F-14 TOMCAT*, and the DAC (Digital-to-Analog Converter) sound circuits are functioning properly.

TEST/DIAGNOSTIC PROCEDURES (Continued)

SYSTEM-11A SOUND CIRCUITRY TESTS (Continued)

If no sound is heard, refer to the text entitled "NO SOUND ...". If _one_ "ring" is heard, this indicates a malfunction of the U23 RAM Chip. If either _two_ or _four_ "rings" is heard, this indicates a problem associated with the U21 ROM Chip. If either _three_ or _five_ "rings" is heard, this indicates a problem with the U22 ROM Chip.

NO SOUND DURING THIS TEST (but sound can be heard during the Diagnostic Tests).
Check the sound-select inputs (pins 2 through 9 of U9) to see if they pulse during Sound Test 01. Also, check the -12 V supply voltage on the CPU Board. If this voltage is low (or AC ripple seems too high), perform the following checks:

1. The gray and gray-green transformer secondary wires for 19.4 VAC.
2. The CPU Board filter capacitor C26 for -12 VDC.
3. The filter capacitor C26 for excessive AC ripple (over 0.75VAC).

If the previous checks did not isolate the problem, turn the Volume Control for maximum output. Momentarily touch a powered-up AC soldering pencil on the center tap of the Volume Control.

CAUTION
DO NOT use a soldering iron over 40 watts. Note also that cordless soldering irons will NOT work for this test.

Hearing a low hum indicates that the power amplifier (U1, TDA2002), the Volume Control, and the speaker are operating satisfactorily, as is the sound circuit cabling. Not hearing a hum requires repeating the test with the Volume Control turned part way down, to determine whether the Volume Control is faulty. Also, check the cable connectors for proper mating, and that no broken wires affect this circuit .

FUSE LISTING.
The following fuses are used:

Part Number	Description	Circuit/Location
5730-09252-00	Fuse, 8A Slow-Blow (S-B), 125v	Input Power ("high voltage") Line/Cabinet Box*
5731-09651-00	Fuse, 5A S-B, 250v	Gen. Illumination/Upper Backbox fuseholder (4)
5731-09128-00	Fuse, 2-1/2A S-B, 250v	Outhole circuit/Lower Playfield fuseholder
5731-09128-00	Fuse, 2-1/2A S-B, 250v	Sol. 17 - Sol. 20 ckts/Upper Playfield fuseholder
5731-09128-00	Fuse, 2-1/2A S-B, 250v	Sol. 3A ,5A,7A,10,12,13 ckts/R. B'box fuseholder
5731-06314-00	Fuse, 4A S-B, 250v	Rotating Beacons ckt/Center Backbox fuseholder
5731-08761-00	Fuse, 1/4A S-B, 250v	F1, D-8345-554 Power Supply
5731-09071-00	Fuse, 8A, 32v	F3, D-8345-554 Power Supply
5731-06314-00	Fuse, 4A S-B, 250v	F2, F4; D-8345-554 Power Supply
5731-09432-00	Fuse, 7A S-B, 250v	F5, F6; D-8345-554 Power Supply

* One 4A S-B, 250v fuse (5731-06314-00) is provided for an overseas (220v) game installation.

Section 2

Game Parts Information

• **Parts Lists and Diagrams:**

Displays Information
Alphanumeric Display Unit Parts
Power Supply Board (D-8345-554)
CPU Board (D-11392-554)
B/G Sound/Speech Board (D-11298)
Backbox Parts
Rotating Beacons Assembly Parts
Flipper Assemblies
Ball Popper & Switch Assembly
Ball Shooter Lane Feeder
Playfield Pivot Parts
F-14 Launch Ramps Assemblies
Outhole & Ball Trough Switches
Miscellaneous F-14 TOMCAT Parts
Jet Bumper Assemblies
Launch Ramp Diverter Assembly
Playfield Parts
Solenoids/Flashers & Rubber Parts
Lamps
Switches
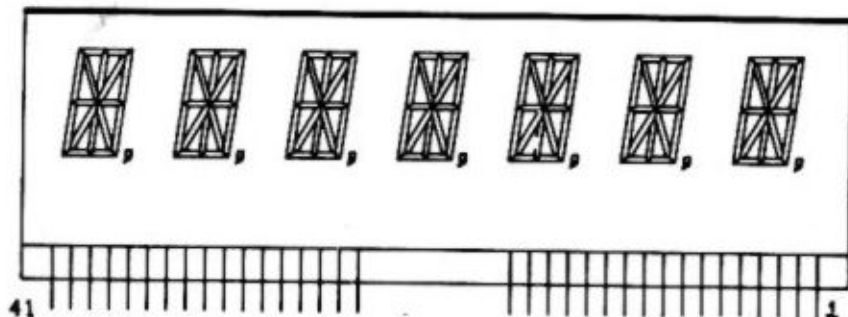
7-digit Alphameric Display Glass, p/n 5670-10873-00
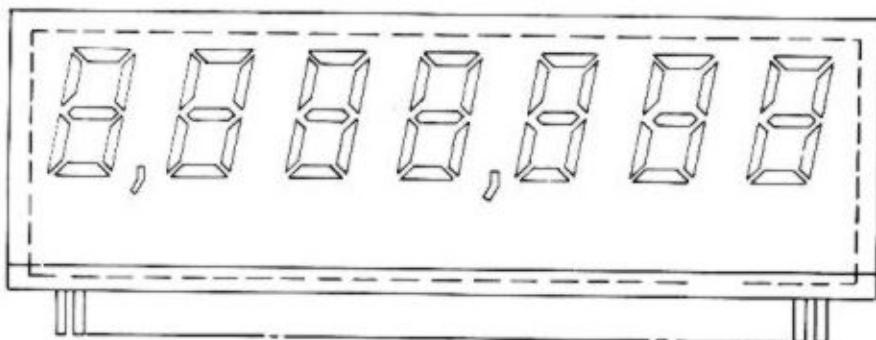
7-digit 7-segment Display Glass, p/n 5670-09439-00
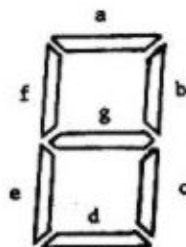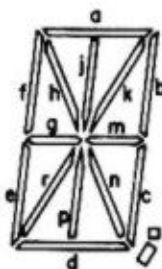
Display Characters Segment Designations

Alphanumeric Display Unit Board
including p/n D-11609 & associated parts

Part No.	Ckt Designator	Description	Part No.	Ckt Designator	Description
5760-12134-00		Bare P. C. Board	5010-08773-00	R1, R2, R8, R20, R23	Resistor, 18 K, 1/4 w, 5%
5680-08968-00	U8, U13, U14, U16	IC, Anode/Digit Driver, UDN6118A or 6184	5010-10927-00	R4, R6, R18, R19, R21, R22, R24, R25	Resistor, 8.2 K, 1/2 w, 5%
5310-09882-00	U4 - U7	IC, Quad NOR, 4001B	5010-10258-00	R27, R28, R30 - R35	Resistor, 1 M, 1/4 w, 5%
5680-08969-00	U11, U12, U15	IC, Cathode Seg. Driver, UDN7180A	5010-08981-00	R3, R5, R7, R9, R10, R12 - R17	Resistor, 10 K, 1/2 w, 5%
5310-09153-00	U1 - U3, U9, U10	IC, Hex Buffer, 4050	5010-08772-00	R11	Resistor, 15 K, 1/4 w, 5%
5075-09135-00	D1	Zener diode, 1N4740A, 10V, 1 w	5670-10873-00	DSPY1, DSPY2	Display, 7-character, A/N
5040-09343-00	C4	Capacitor, 10 μfd., 25v, ±5%, Axial	5670-09439-00	DSPY3, DSPY4	Display, 7-character, 7-segment
			5791-10851-00	J1	Connector, 26 pin (Hdr), Rt. Angle
5043-08996-00	C3	Capacitor, 0.1 μfd., 50v, ±20%, Axial	5791-10869-06	J2	Connector, 6 pin (Hdr), Rt. Angle
			5791-10869-09	J3 - J5	Connector, 9 pin (Hdr), Rt. Angle
5043-08980-00	C1, C2, C5 - C7	Capacitor, 0.01 μfd, 50v, Axial	03-8088-1	Support	Support, Display
5019-10387-00	SR1 - SR3	SIP, 18 K, 9R, 10P, 5%			
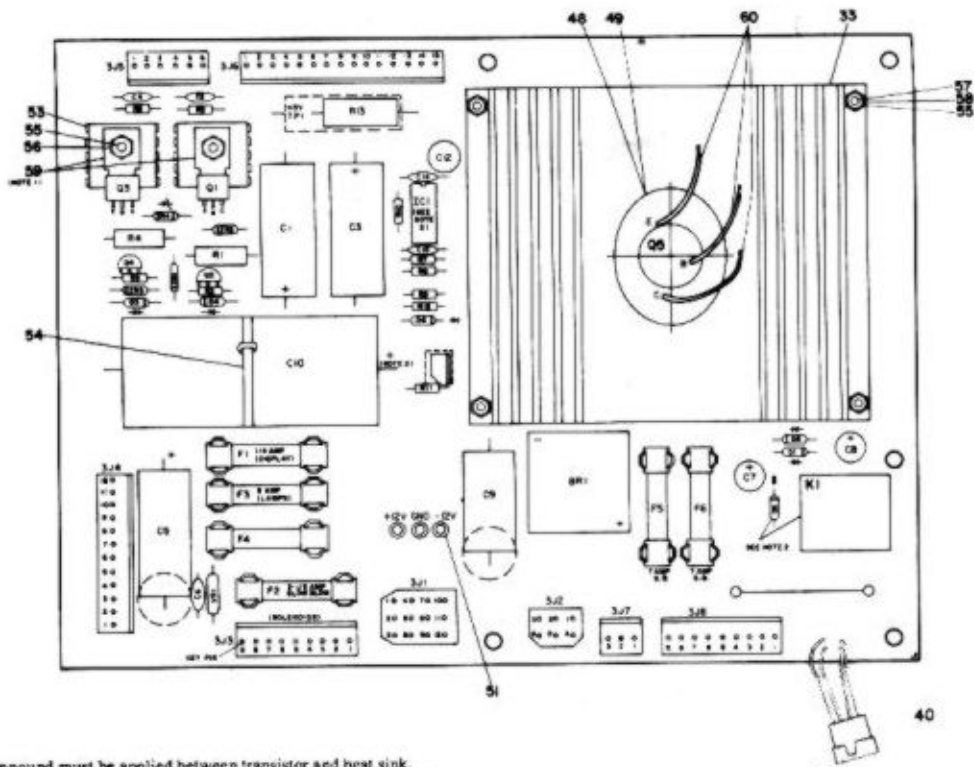
NOTES:
1. Heat sink compound must be applied between transistor and heat sink.
2. Observe index mark on integrated circuit, polarity of capacitors and diodes, and position of transistors.
3. The view of Q5 and its related heat sink and hardware is from the bottom of the heatsink, to clarify installation.

Power Supply
p/n D-8345-554

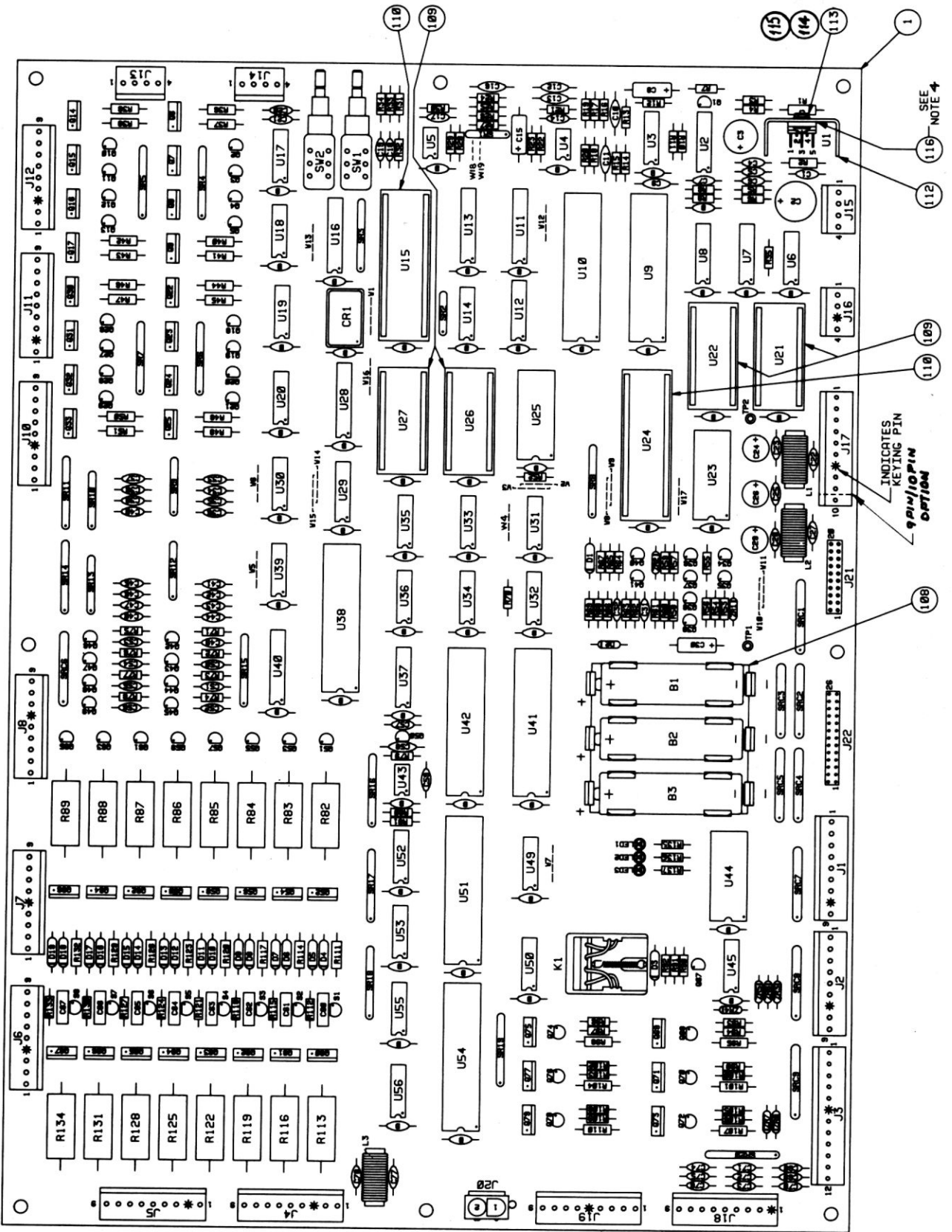| Item	Part No.	Ckt Designator	Description
1	5765-09466-01		Bare P. C. Board
2	5013-09426-00	R7	Resistor, 2.15K, 1%, 1/4w, Metal Film
3	5013-09427-00	R8	Resistor, 4.99K, 1%, 1/4w, Metal Film
4	5010-09428-00	R11	Resistor, 1.5K, 2%, 1/4w, C. Film
5	5010-09085-00	R10	Resistor, 1.5K, 5%,1/4w
6	5010-09541-00	R9	Resistor, 2.7K, 2%,1/4w
7	5010-09508-00	R12	Resistor, 270Ω, 2%, 1/4w, C. Film
8	5012-09429-00	R13	Resistor, 0.12Ω, 5%,5w
9	5010-09536-00	R1, R4	Resistor, 39K, 5%,1w
10	5010-09061-00	R2, R5	Resistor, 680Ω, 2w
11	5010-09069-00	R3, R6	Resistor, 330K, 5%,1/2w
12	5040-09419-00	C10	Capacitor, 18,000 mfd, electr, 20v, axial
13	5040-09420-00	C9	Capacitor, 1000 mfd, electr. 25v, axial or radial
14	5040-09423-00	C12	Capacitor, 330 mfd, electr. 10v, radial
15	5043-9065-00	C15	Capacitor, 470 pfd
16	5040-9053-00	C1, C3	Capacitor, 100 mfd, electr. 150v
17	5040-09070-00	C5	Capacitor, 100 mfd, electr. 100v, axial or radial
18	5043-09072-00	C2, C4	Capacitor, 0.1 mfd, 500v, disc
19	5043-09446-00	C14	Capacitor, 0.1 mfd, 50v, disc
20	5070-06258-00	D1, D2, D5, D6	Diode, 1N4001
21	5070-09054-00	D3, D4	Diode, 1N4004
22	5075-09059-00	ZR1, ZR3	Zener, 1N5990, 3.9v, 5%
23	5075-09060-00	ZR2, ZR4	Zener, 1N4764, 100v, 5%
24	5460-09424-00	IC1	IC, Volt. Reg., MC1723C
25	5043-09443-00	C6	Capacitor, 0.1 mfd, 200v, disc
26	5040-09421-00	C7	Capacitor, 100 mfd, 25v, radial
27	5040-09422-00	C8	Capacitor, 47 mfd, 50v, radial

Item	Part No.	Ckt Designator	Description
28	5164-09057-00	Q1	Transistor, SDS201, NPN
29	5164-09056-00	Q4	Transistor, MPSD02, NPN
30	5194-09058-00	Q3	Transistor, SDS202, PNP
31	5194-09055-00	Q2	Transistor, MPSD52, PNP
32	5162-09425-00	Q5	Transistor, 2N6057, NPN
33	5705-09431-00		Heak Sink
34	5791-09074-00	3J6	Connector, 15 pin (Hdr)
35	5791-09027-00	3J3, 3J8	Connector, 9 pin (Hdr)
36	5791-09038-00	3J2	Connector, 6 pin (Hdr)
37	5791-09067-00	3J5	Connector, 6 pin (Hdr)
38	5791-09043-00	3J4	Connector, 12 pin (Hdr)
39	5791-09435-00	3J7	Connector, 3 pin (Hdr)
40	H-11065	3J9	Cable/Connector Assembly
a)	5791-09400-00		Connector shell
b)	5820-09080-00		Connector pin
41	5791-09068-00	3J1	Connector, 12 pin (Hdr)
42	5321-09178-00		Fuseholder
43	5731-06314-00	F2	Fuse, 4A, 250v, S-B
44	5730-09071-00	F3	Fuse, 8A, 32v
45	5731-06314-00	F4	Fuse, 4A, 250v
46	5731-08761-00	F1	Fuse, 1/4A, 250v, S-B
47	5017-09064-00	VR1	Varistor
48	5700-09445-00		Socket
49	5701-09652-00		Mica Insulator
50	5580-09555-01	K1	Relay, 24VDC, 13A, DPDT
51	5824-09428-00	TP1 - TP3	Terminal, #1502-1 (Test Post)
52	5100-09418-00	BR1	Bridge Rectifier, 35A, 100V
53	5705-09042-00		Heat Sink
54	03-7947		Tie Wrap
55	4005-01016-07		Mach. Screw, 5-40 x 7/16, RH
56	4700-00004-00		Flatwasher, 0.146 x 3/8, 21 Ga.
57	4701-00023-00		Lockwasher, #5, split
58	4405-01117-00		Hex Nut, 5-40
59	20-9229		Heat sink Thermal Compound
60	HW-30118-4		Lead wire, 18 AWG, 3"
61	5731-09342-00	F6, F5	Fuse, 7A, 250V, S-B

F-14 TOMCAT 35

System 11A CPU Board (D-11392) Parts Information

Item	Part No.	Ckt Designator	Description
1	5764-12091-00		Bare P. C. Board
2	5370-09691-00	U3	IC, CVSD Mod., 55536
3	5370-09321-00	U4, U5	IC, Dual Op Amp, 1458
4	5281-09308-00	U16	IC, Octal Bus Xcvr, 74LS245
5	5430-08972-00	U9, U10, U38, U41, U42, U51, U54	IC, PIA, MC6820/6821
6	5340-10139-00	U25	IC, 2K x 8 CMOS Static RAM
7	5280-09010-00	U44	IC, 4-16 Decoder, 74154
8	5281-09246-00	U7, U8, U12	IC, 2-4 Decoder, 74LS139
9	5075-09406-00	ZR3 - ZR8	Diode, Zener, 6.2v, 0.5w
10	Not Used		
11	5281-09487-00	U6	IC, Dual D Flip-flop,74LS74
12	5431-09449-00	U43	IC, Timer, MC1455
13	5310-09236-00	U29	IC, 14-b Counter, 4020
14	5281-09743-00	U32	IC, Quad 2-Input AND, 74LS08
15	5281-09247-00	U14	IC, Quad 2-Input NOR, 74LS02
16	5281-09235-00	U35	IC, Triple 3-Input NAND, 74LS10
17	5280-09013-00	U36	IC, Hex Inverter, 7404
18	5281-09499-00	U31, U34	IC, Quad 2-Input NAND, 74LS00
19	5281-10014-00	U33	IC, Dual 4-Input NAND, 74LS20
20	5281-09486-00	U28	IC, Octal D Flip-flop, 74LS374
21	5371-09152-00	U2	IC, D/A Converter, MC1408
22	5281-09745-00	U37	IC, 3-8 Decoder, 74LS138
23	5340-09878-00	U23	IC, 2K x 8 Static RAM, 2016
24	5370-09156-00	U1	IC, Aud. Amp., TDA2002
25	5281-09687-00	U11, U13, U40	IC, Octal Buffer, 74LS244
26	5280-08973-00	U17-U20, U52, U53	IC, Quad 2-Input AND, 7408
27	5280-08974-00	U55, U56	IC, Hex Inverter, 7406
28	5310-09155-00	U30, U39	IC, Quad 2-Input NAND, MC14011
29	5280-08948-00	U45, U50	IC, Quad 2-Input NOR, 7402
30	5280-09309-00	U49	IC, Hex Buffer, 7407
31	5671-09019-00	LED1-LED3	LED, Red, Display
32	5521-10506-00	CR1	Oscillator, 4 MHz
33	5162-08976-00	Q51, Q53, Q55, Q57, Q59, Q61, Q63, Q65	Transistor, NPN Darl, 2N6427, TO-92
34	5191-08978-00	Q52, Q54, Q56, Q58, Q60, Q62, Q64, Q66	Transistor, PNP, TIP42, TO-220
35	5162-09410-00	Q6-Q9, Q14-Q17, Q22-Q25, Q30-Q33, Q69, Q71, Q73, Q75, Q77, Q79, Q80-Q87	Transistor, NPN, TIP122, TO-220
36	5160-08938-00	Q2-Q5, Q10-Q13, Q18-Q21, Q26-Q29, Q34-Q38, Q41, Q67, Q68, Q70, Q72, Q74, Q76, Q78	Transistor, NPN, 2N4401, TO-92
37	5160-10269-00	Q1, Q40, Q42-Q49	Transistor, NPN, 2N3904, TO-92
38	5190-09016-00	Q39, Q50	Transistor, PNP, 2N4403, TO-92
39	5130-09014-00	S1-S8	SCR, 30v, 0.8A, 2N5060
40	5070-06258-00	D3-D19	Diode, 1N4001
41	5070-08918-00	D2	Diode, 1N4148, 150mA
42	5070-09266-00	D1	Diode, 1N5817, 1.0A
43	5075-09018-00	ZR1	Diode, Zener, 1N5996A, 6.8v, 0.5w
44	5075-09059-00	ZR2	Diode, Zener, 1N5990, 3.9v, 0.5w
45	5010-08992-00	R94, R97, R100, R103, R106, R109	Resistor, 560Ω, 5%, 1/4w, C. F.
46	5010-09039-00	R56	Resistor, 10Ω, 5%, 1/4w, C. F.
47	5010-09534-00	W1, W2, W4, W5, W7, W8, W11, W14, W16, W17	Resistor, 0Ω, 5%, 1/4w, C. F.
48	5010-08991-00	R31, R32, R35, R52, R55, R68, R92	Resistor, 4.7KΩ, 5%, 1/4w, C. F.
49	5010-09358-00	R5, R6, R57, R58, R64, R66, R112, R115, R118, R121, R124, R127, R130, R133	Resistor, 1.0KΩ, 5%, 1/4w, C. F.
50	5010-09113-00	R79	Resistor, 33KΩ, 5%, 1/4w, C. F.
51	5010-08983-00	R7, R8, R10, R70, R80	Resistor, 3.3KΩ, 5%, 1/4w, C. F.
52	5010-09034-00	R11-R14, R25, R28, R53, R60, R65, R90	Resistor, 10KΩ, 5%, 1/4w, C. F.
53	5010-09086-00	R81	Resistor, 6.8KΩ, 5%, 1/4w, C. F.
54	5010-09363-00	R3	Resistor, 5.6KΩ, 5%, 1/4w, C. F.
55	5010-08997-00	R23, R24, R91, R93, R96, R99, R102, R105, R108	Resistor, 2.7KΩ, 5%, 1/4w, C. F.
56[2]	5012-09037-00	R113, R116, R119, R122, R125, R128, R131, R134	Resistor, 0.4Ω, 5%, 3w, Wire-Wnd.
57	5010-08993-00	R35-R51, R95, R96, R101, R104, R107, R110	Resistor, 68Ω, 5%, 1/2w, C. F.
58[2]	5012-10860-00	R82-R89	Resistor, 27Ω, 5%, 2w, C. F.
59	5010-09361-00	R1	Resistor, 220Ω, 5%, 1/2w, C. F.
60	5010-09181-00	R2	Resistor, 1.0Ω, 5%, 1/2w, C. F.
61	5010-09161-00	R4	Resistor, 2.2Ω, 5%, 1/4w, C. F.
62	5010-10003-00	R62, R63	Resistor, 390Ω, 5%, 1/4w, C. F.
63	5010-10171-00	R67	Resistor, 56Ω, 5%, 1/4w, C. F.
64	5010-10170-00	R69	Resistor, 47Ω, 5%, 1/4w, C. F.
65	5010-09160-00	R59, R61, W12, W13	Resistor, 220Ω, 5%, 1/4w, C. F.
66	5010-09416-00	R33, R34, R135-137	Resistor, 470Ω, 5%, 1/4w, C. F.
67	5010-09179-00	R9	Resistor, 3.3MΩ, 5%, 1/4w, C. F.
68	5010-09085-00	R71-R78	Resistor, 1.5KΩ, 5%, 1/4w, C. F.
69	5010-10361-00	R111, R114, R117, R120, R123, R126, R129, R132	Resistor, 1.2KΩ, 5%, 1/2w, C. F.
70	5010-08824-00	R15	Resistor, 43KΩ, 5%, 1/4w, C. F.
71	5010-09342-00	R16	Resistor, 36KΩ, 5%, 1/4w, C. F.
72	5010-08846-00	R17	Resistor, 220KΩ, 5%, 1/4w, C. F.
73	5010-09333-00	R18	Resistor, 180KΩ, 5%, 1/4w, C. F.
74	5010-09324-00	R19, R20, R22, R29, R30	Resistor, 27KΩ, 5%, 1/4w, C. F.
75	5010-08772-00	R21	Resistor, 15KΩ, 5%, 1/4w, C. F.
76	5010-09356-00	R27, R26	Resistor, 820Ω, 5%, 1/4w, C. F.
77	5019-09783-00	SR18	SIP, 9R, 10-pin, 6.8KΩ, .125w/R, 5%
78	5019-09362-00	SR3, SR15, SR17, SR19, SR20	SIP, 9R, 10-pin, 4.7KΩ, .125w/R, 5%
79	5019-09808-00	SR4, SR6, SR11	SIP, 9R, 10-pin, 560Ω, .125w/R, 5%
80	5019-09785-00	SR16	SIP, 9R, 10-pin, 2.2KΩ, .125w/R, 5%
81	5019-10472-00	SR14	SIP, 9R, 10-pin, 3.3KΩ, .125w/R, 5%
82	5019-09669-00	SR8, SRC6	SIP, 9R, 10-pin, 1.0KΩ, .125w/R, 5%
83	5019-09780-00	SR9, SR10, SR12, SR13	SIP, 4R, 8-pin, 1KΩ, 5%
84	5019-09786-00	SR1, SR2	SIP, 5R, 6-pin, 4.7KΩ, .125w/R, 5%
85	5019-09792-00	SR5, SR7	SIP, 9R, 10-pin, 2.7KΩ, .125w/R, 5%
86	5060-10396-00	SRC1 - SRC5, SRC7 - SRC9	SIP, 8R, 8C,10-pin, 4.7KΩ & 470pfd
87	Not Used		
88	5043-08980-00	C14, C17-C21, C31, C32, C49-C56, C59, + 54 Bypass, marked B	Capacitor, 0.01 µfd, 50v(+80,-20%), Axial
89	5043-09845-00	C6, C22, C23, C25, C27, C28	Capacitor, 1K pfd, 50v(±20%), Axial
90	5043-08996-00	C1, C4, C5, C70-75, C77, C78	Capacitor, 0.1 µfd, 50v(±20%), Axial
91	5040-09343-00	C8, C15	Capacitor, 10 µfd, Electr., 20v(±20%), Axial
92	5043-09844-00	C7, C41-C48	Capacitor, 47 pfd, 50v(±20%), Axial
93	5040-10974-00	C3, C24, C26, C29	Capacitor, 100 µfd, Electr., 25v(+50,-10%), Axial
94	5040-09776-00	C2	Capacitor, 470 µfd, Electr., 16v(+50,-10%), Radial
95	5045-09796-00	C60-C67	Capacitor, 0.1 µfd, Polycarbonate Rad., 100v(±10%)
96	5043-09065-00	C33-C40, C68, C69, C76	Capacitor, 470 pfd, 50v(±20%), Axial
97	5040-09545-00	C30	Capacitor, 22 µfd, Electr., 10v(+50,-10%), Axial
98	5041-09031-00	C9, C58	Capacitor, 1 µfd, Tant., 25v(±20%), Axial
99	5043-09030-00	C16, C57	Capacitor, 0.047 µfd, 50v(±20%), Axial
100	5046-09347-00	C10	Capacitor, 1800 pfd, Polystyrene,50v(±5%)
101	5046-09350-00	C11	Capacitor, 180 pfd, Polystyrene,100v(±5%)
102	5046-09346-00	C12	Capacitor, 1200 pfd, Polystyrene,50v(±5%)
103	5046-09348-00	C13	Capacitor, 4700 pfd, Polystyrene,50v(±5%)
104	5551-09822-00	L1-L3	Inductor, 4.7 µH, 3A
105	5641-09312-00	SW1, SW2	Switch, Pushbutton, DPDT, 100v, 5A
106	5880-09022-00	B1-B3	Battery, Alkaline, 1.5v, AA
107	20-9491	W18, W19	Bus Wire, Jumper
108	5861-09021-00		Battery Holder, #171
109	5700-10176-00		IC Socket, 28 pin
a)	A-5343-554-1	U26	IC, Game ROM 2, 27128
b)	A-5343-554-2	U27	IC, Game ROM 1, 27256
c)	A-5343-554-4	U21	IC, Sound ROM 1, 27256
d)	A-5343-554-3	U22	IC, Sound ROM 2, 27256
110	5700-08985-00		IC Socket, 40 pin
a)	5400-09150-00	U15	IC, µProcessor, 6802
b)	5400-09150-00	U24	IC, µProcessor, 6802
111	5824-09248-00	TP1, TP2	Test Point
112	5705-09199-00		Heatsink, #6030
113	4006-01003-06		Mach. Screw, 6-32 x 3/8", P-PH-S
114	4406-01117-00		Nut, Hex, 6-32
115	4703-00007-00		Lockwasher, #6
116	20-9229		Thermal Compound (see Note 4)
117	5580-08994-01	K1	Relay, 4-pole, 40Ω, 6v
118	5791-10862-09	1J1, 1J2, 1J4-1J8, 1J10-1J12, 1J17-1J19	Connector, 9 pin (Hdr)
119	5791-10862-04	1J13-1J16	Connector, 4 pin (Hdr)
120	5791-10862-12	1J3	Connector, 12 pin (Hdr)
121	Not Used		
122	5791-10850-00	1J22	Connector, 26 pin Ribbon (Hdr)
123	5791-09437-00	1J21	Connector, 20 pin Ribbon (Hdr)

NOTES:
1. For Schematic, refer to drawing #16-8993.
2. Items 56 and 58 (resistors) must be mounted 1/8" above PCB surface.
3. Standard Jumper: W1, W2, W4, W5, W7, W8, W11, W14, W16, W17.
4. Use thermal compound between item 24 (U1) and item 112 (heatsink).

System 11A CPU Board (D-11392) Parts Information

F-14 TOMCAT 37
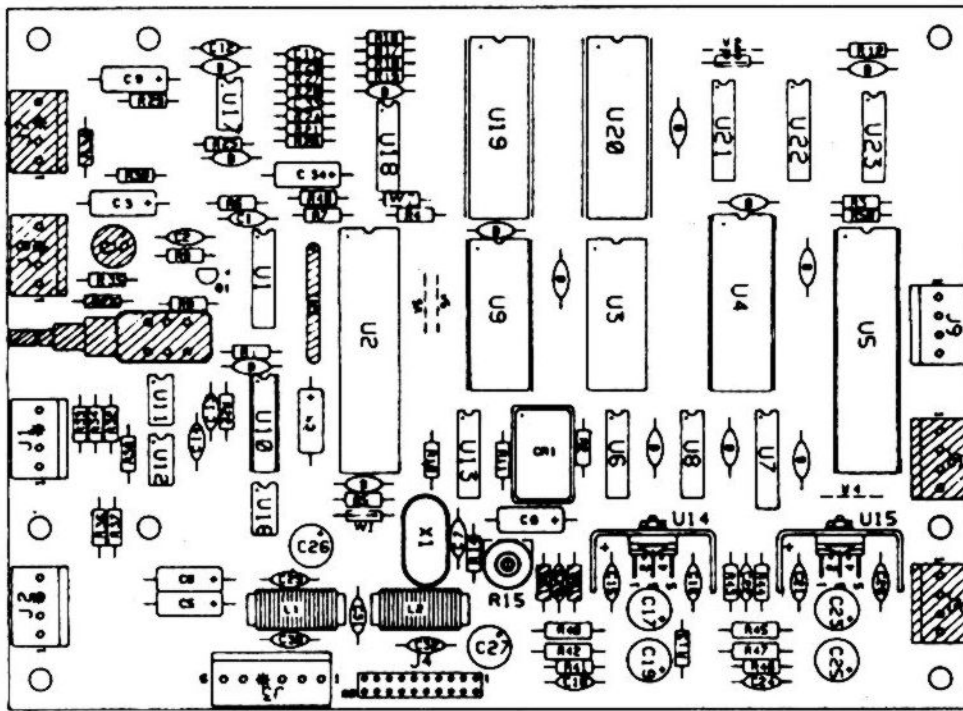
Background Sound & Speech Board
p/n D-11298-554

Item	Part No.	Ckt Designator	Description
1	5766-12057-00		Bare P. C. Board
2	5371-09152-00	U1	IC, D/A Convtr, MC1408
3	5430-10322-00	U2	IC, PIA, MC68B21
4	5340-09878-00	U3	IC, RAM, 2016
5	5281-09487-00	U6, U23	IC, Dual Flipflop, 74LS74
6	5281-09745-00	U7	IC, Dual Mux, 74LS138
7	5281-09235-00	U8	IC, Triple Nand, 74LS10
8	5370-09321-00	U11, U12, U16, U17	IC, Op Amp, MC1458
9	5281-09215-00	U13	IC, Hex Inv, 74LS04
10	5281-10043-00	U21	IC, 74LS175
11	5281-09246-00	U22	IC, 2-4 Dec, 74LS139
12	5370-09156-00	U14, U15	IC, Aud. Amp, TDA2002
a)	5705-09199-00		Heatsink, #6030B
b)	4006-01003-06		6-32 x 3/8 P-PH-S
c)	4406-01117-00		6-32 Hexnut
d)	4703-00007-00		#6 Ext. Lockwasher
13	5370-09691-00	U18	IC, CVSD, 55536
14	5160-10269-00	Q1	Transistor, 2N3904, NPN
15	5014-12061-00	R15	Potentiometer, 100K, Horiz.
16	5010-09181-00	R42, R47	Resistor, 1.0Ω, 1/2w.
17	5010-09161-00	R41, R46	Resistor, 2.2Ω
18	5010-09361-00	R13, R40, R45	Resistor, 220Ω
19	5010-09358-00	R43, R44	Resistor, 1K
20	5010-08998-00	R10, R11, R32	Resistor, 2.2K
21	5010-08983-00	R6 - R8	Resistor, 3.3K
22	5010-08991-00	R1 - R5, R12, R36, R48, R50	Resistor, 4.7K
22a	5013-09427-00	R30	Resistor, 4.99K, 1%
22b	5010-09086-00	R35	Resistor, 6.8K
23	5010-09034-00	R16 - R19, R33, R34, R38	Resistor, 10K
24	5010-08772-00	R28	Resistor, 15K
25	5010-09324-00	R22, R26, R27, R29, R37	Resistor, 27K
26	5010-09342-00	R21	Resistor, 36K
27	5010-08824-00	R20	Resistor, 43K
28	5010-09333-00	R24	Resistor, 180K
29	5010-08846-00	R25	Resistor, 220K
30	5010-10258-00	R14	Resistor, 1M
31	5010-09179-00	R9	Resistor, 3.3M
32	5010-09534-00	W1, W3, W7	Resistor, 0Ω
33	5043-09844-00	C1	Capacitor, 47 pfd
34	5043-09492-00	C7, C38	Capacitor, 100 pfd
35	5046-09350-00	C33	Capacitor, 180 pfd
35a	5043-09065-00	C35 - C37	Capacitor, 470 pfd
36	5046-09346-00	C11	Capacitor, 1200 pfd
37	5046-09349-00	C12	Capacitor, 4700 pfd
38	5043-09845-00	C20, C29 - C32	Capacitor, .001 µfd
39*	5043-08980-00	C2, C13, C14, C16, C22	Capacitor, .01 µfd
40	5043-08996-00	C18, C24	Capacitor, 0.1 µfd
41	5043-09365-00	C34	Capacitor, 1 µfd, 63V
42	5040-09343-00	C3 - C6, C8, C9	Capacitor, 10 µfd, electr., 20V, axial
43	5040-10974-00	C26, C27	Capacitor, 100 µfd, electr., 35V, radial
44	5040-09776-00	C17, C23	Capacitor, 470 µfd, electr., 16V, radial
45	5040-12006-00	C19, C25	Capacitor, 1000 µfd, electr., 16V, radial
46	5041-09243-00	C21	Capacitor, 10 µfd, tant., axial
47	5551-09822-00	L1, L2	Inductor, 4.7 µH, 3A
48	5791-10862-04	J1, J2, J8, J9	Connector, 4 pin (Hdr)
49	5791-10862-06	J3	Connector, 6 pin (Hdr)
50	5791-09437-00	J4	Connector, 20 pin, (Hdr) Ribbon Cable
51	5700-10176-00		IC Socket, 28 pin
a)	A-5343-554-5	U4	IC, B/G Sp. & Sound ROM 1
b)	A-5343-554-6	U19	IC, B/G Sp. & Sound ROM 2
52	5700-08985-00		IC Socket, 40 pin
a)	5400-10320-00	U5	IC, µProcessor, MC68B09E
53	5700-09004-00		IC Socket, 24 pin
a)	5370-11086-00	U9	IC, Sound Processor, YM2151
54	5700-09006-00		IC Socket, 16 pin
a)	5371-11087-00	U10	IC, D/A Conv, YM3012
55	5521-10931-00	CR1	Oscillator, 8 MHz
56	5520-09020-00	X1	Crystal, 3.58 MHz

Notes: * 14 capacitors (shown on diagram with "B" symbol) also provide +5VDC filtering for ICs.
All capacitors are ceramic, 50v, axial, unless otherwise noted.
All resistors are 5%, 1/4w, Carbon Film, unless otherwise noted.

F-14 TOMCAT 38
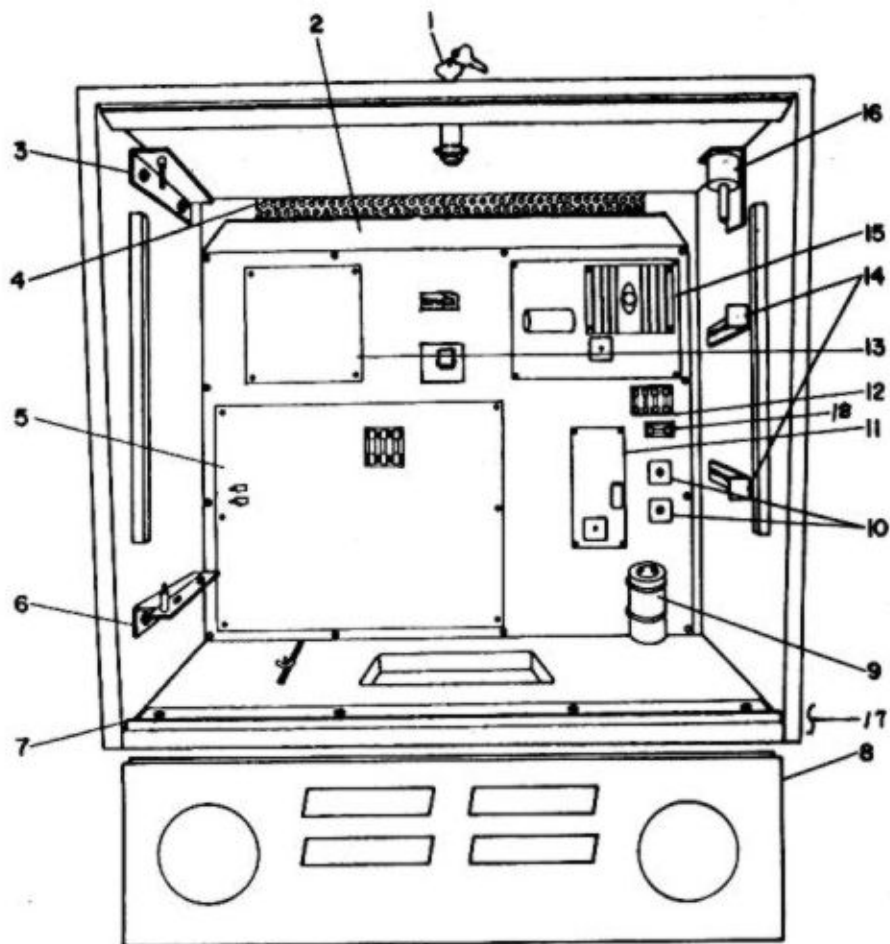
Backbox Parts Listing

| Item	Part No.	Description	Item	Part No.	Description
1	20-6542-TB	Cam Lock	9	5040-09051-00	Capacitor, 30,000 µFd., 25V
a)	01-7993-1	Lock Pawl, Backglass	10	5100-09418-00	Bridge Rectifier, 100v, 35A.
2	D-11419	PCB Plate Assembly	11	C-9939-554	Flipper Power Supply
3	A-7984	Upper Insert Bd. Hinge Assy	12	5733-10702-04	Fuse Holder, 4-Pos.
4	01-6645	Venting Screen	13	D-11581-554	B/G Speech & Sound Board
5	D-11392-554	CPU Board, F-14 TOMCAT	14	01-8084	Insert Stop Bracket
6	A-10815	Lower Insert Board Hinge Assy	15	D-8345-554	Power Supply Assembly
7	01-8569	Lower Speaker Panel Bracket	16	B-10686	Knocker Assembly
8	D-11611-554	Display/Speaker Panel Assy	17	20-9518	Backbox Hinge
a)	31-1420-554	Cover, Displ/Spkr Pnl Assy	18	5733-10702-01	Fuse Holder, 1-Pos.

Rotating Beacons Assembly
p/n C-11604

Item	Part No.	Description	Item	Part No.	Description
1	C-11606	Mounting Plate Assembly	11	02-4297	Shaft, Outer Beacon
2	20-8790	Shaft Bearing, O. Beacon	12	B-10917	Reflector Assembly
3	03-7869-1	Snap Bushing	13	24-8771	Bulb, #1683, 28V
4	02-4296-1	Spacer, Motor	14	03-7520-2	Nylon Ty-Wrap
5	4006-01005-18	Mach. Screw, 6-32 x 1-1/8	15	03-8041	L. Pulley Spacer
6	03-8086	Pulley	16	H-11618	Cable, Beacon Lights
7	14-7946	Motor	17	5791-09111-00	Connector, Lamps/Motor
8	20-9543	Drive Belt	18	5820-09080-00	Pin, Connector
9	4006-01076-04	Set Screw, 6-32 x1/4, SH-CP	19	4700-00072-00	Washer
10	20-8712-25	Retaining Ring			

F-14 TOMCAT 39

Flipper Assembly
p/n C-11626-R-4

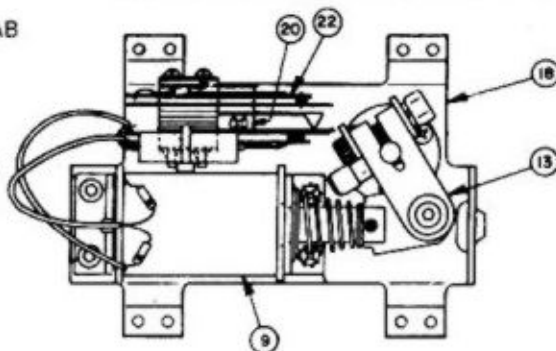| Item	Part No.	Description
1	HW-30018-6	Wire, 18 AWG, Blue
2	03-7520-2	Ty-Wrap, Nylon
3	20-6516	Speednut, Tinnerman
4	5045-12098-00	Capacitor, 2.2 μFd, 250V, 20%
5	RM-21-06	Sleeve, Vinyl (Cap. leads)
6	4010-01066-06	Cap Screw, 10-32 x 3/8, AH
7	4701-00004-00	Lockwasher, #10 split
8	A-10821	Flipper Stop Assembly
9	FL-11630/50V	Flipper Coil
10	4006-01017-04	Mach. Screw, 6-32 x 1/4, P-RH-S
11	01-7695	Solenoid Bracket
12	10-376	Coil Plunger Spring
13	B-10655-R	Crank Link Assembly
a)	02-4179	Link Spacer Bushing
b)	4010-01086-14	Cap Screw, 10-32 x 7/8, SH
c)	4700-00023-00	Washer, 5/8 o.d. x 13/64 i. d. x 16 ga.
d)	4701-00004-00	Lockwasher, #10 split
e)	4410-01132-00	Nut, 10-32 ESNA
f)	A-10656	Flipper Link Assembly
1.)	02-4219	Coil Plunger
2.)	20-9370-1	Spring Pin, 5/32 dia. x 7/16
3.)	03-8050	Flipper Link
g)	B-10657-R	Flipper Crank Assembly, Right
1.)	01-8073-R	Flipper Crank, Right
2.)	17-1037	Crank Washer
3.)	4010-01066-18	Cap Screw, 10-32 x 1-1/8, HCS
4.)	4410-01127-00	Nut, 10-32 Hex Hd.
5.)	4700-00107-00	Washer, 5/8 o.d. x 13/64 i. d. x 12 ga.
6.)	4701-00004-00	Lockwasher, #10 split
7.)	RM-23-06	Tubing, H. S. 1/4 DWP
14	23-6577	Bumper Plug
15	03-7568	Flipper Bushing
16	4006-01005-06	Mach. Screw, 6-32 x 3/8, P-PH
17	4406-01117-00	Nut, 6-32 Hex
18	C-11627-R	Flipper Base Assembly, R.
19	06-14G	Insulating Blade
20	01-8623-R	Bracket, Switch Mtg.
21	4006-01017-05	Mach. Screw, 6-32 x 5/16, P-RH-S
22	B-9951	Switch & Diode Assembly
a)	SW-1A-150	Switch, Lane Change
b)	5070-06258-00	Diode, 1N4001
23	01-3670-1	Plate, Switch
24	4105-01001-20	Sh. Metal Screw, #5 x 1-1/4, P-PH-AB
25	03-7811	End of Stroke (EOS) Switch
26	4701-00002-00	Lockwasher, #6 split
27		Not Used
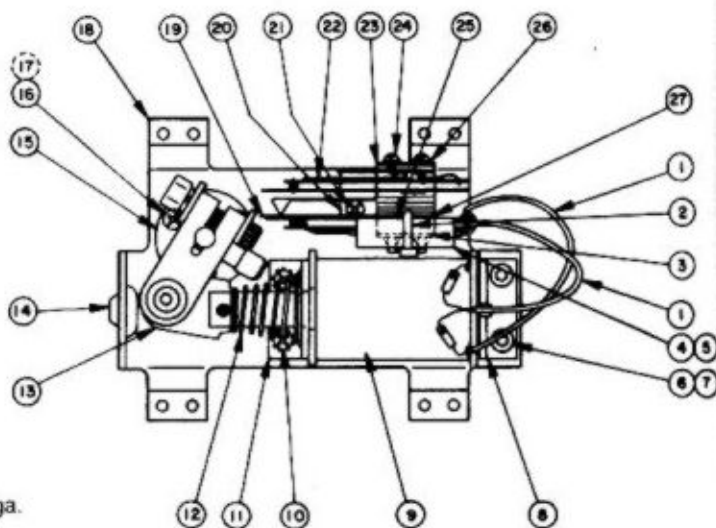
Flipper Assembly Notes

1 Each Flipper Assembly is mounted beneath the playfield, in conjunction with the plastic Flipper Paddle and Shaft (20-9250) and flipper Rubber (23-6519) on the upper side of the playfield.

2 The tip of the EOS Switch must travel 0.0150 (+ .010, - .000) inch, before the contacts fully open, with the flipper in the actuated position. The EOS Switch contacts must have a gap of 0.062 (± .015) inch. Adjustment of the EOS Switch must be made at a minimum distance of 0.25 inch from the switch body.

3 The Lane Change Switch must have a gap of 0.046 (±.015) inch, when fully open.

4 All moving elements of the assembly must operate freely, with no evidence of binding.

5 The large end of the Coil Plunger Spring must fit within the four lugs of the Solenoid Bracket.

6 For coil replacement, remove the Solenoid Bracket (item 3) to prevent screw damage.

7 Use Loctite™ 242 when reattaching screws to the Flipper Stop Assembly, the Solenoid Bracket, and the Flipper Bushing.

8 When using the Bumper Plug (item 13) on older flipper assemblies, readjust the flipper paddle and shaft position.

9 Solid color blue wire connects to the banded end of the diode, mounted on the connector end of the Flipper Coil (item 8). Trace color wire connects to the unbanded end of the diode.

Flipper Assembly →
p/n C-11626-L-4
(Parts listed replace same Items of C-11626-R-4)

Item	Part No.	Description
13	B-10655-L	Crank Link Assembly
g)	B-10657-L	Flipper Crank Assembly, Left
1.)	01-8073-L	Flipper Crank, Left
18	C-11627-L	Flipper Base Assy, L.
20	01-8623-L	Bracket, Switch Mtg.
22	B-9951-1	Switch & Diode Assembly
a)	SW-1A-150-1	Switch, Lane Change

Flipper Assembly
p/n C-11626-R-6 & -L-6
(Parts listed replace same Items of C-11626-R-4 & -L-4)

Item	Part No.	Description
9	FL-11722/50V	Flipper Coil
22		Omitted
23		Omitted
24	4105-01019-10	Sh. Metal Screw, #5 x 5/8, P-PH-AB