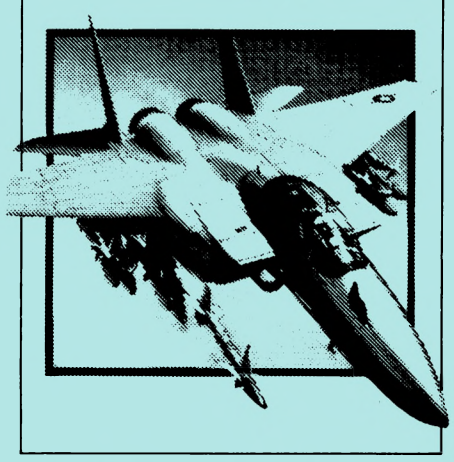
FIGHTER PILOT



Loading:
CASSETTE: LOAD ""
(if 128K put into 48K mode first)

DISK: From POWER UP or RESET
insert disk and press ENTER.
From +3 BASIC insert disk and
type LOAD "*" and press ENTER.

FIGHTER PILOT is a real-time flight simulation based upon the F15 Eagle, USAF air-superiority jet fighter. This supreme simulation offers many of the features found on modern flight simulators including 3-D view from the cockpit, fully aerobatic performance, air-to-air combat, crosswinds, turbulence, and blind landing. The program offers training modes for each option and a pilot skill rating for varying difficulty levels.

OPTIONS

(1) Landing Practice – Your aircraft is positioned at an altitude of 1700 ft, 6 miles from touchdown at runway BASE. The undercarriage is lowered, ready for landing. Use the throttle, flaps and elevator controls to adjust your rate of descent and approach speed. Guidance may be taken from the Instrument Landing System (ILS) or the Flight Computer. Once you have landed, reduce the thrust to zero and apply the brakes.

(2) Flying Training – Your aircraft is positioned at the threshold of runway BASE, facing due North. Take off by opening the throttle, typically to 100% or full reheat, and pulling back on the joystick (or key 6) when you reach take-off speed. Maximum acceleration on take-off is achieved by applying the brakes until full thrust is reached. Raise the undercarriage shortly after take-off if you intend to exceed 300 kts. Take-off is possible at a lower speed with full flaps. Steer on the ground by using the rudder controls, easiest if your speed is below 10 kts.

(3) Air-to-Air Combat Practice – You are positioned 2 miles behind the enemy aircraft at the same altitude. Select Combat Mode and the Flight Computer to obtain a readout of enemy bearing, range and altitude. The enemy will be flying at 550 kts and will not return fire during the dogfight. Manoeuvre your aircraft when you see the enemy and open fire as he passes through your sights.

(4) Air-to-Air Combat – In this final option, you are responsible for defending the four airfields BASE, TANGO DELTA and ZULU. Your mission begins with a scramble from runway BASE. Use your radar and flight computer to determine the location of the enemy aircraft, and after assessing his likely target, fly your aircraft on an intercept course. Visual contact will occur at less than 1 mile and less than 5000 feet altitude difference and the dogfight begins with the enemy manoeuvring to gain advantage. Damage to your own aircraft is indicated by a colour change of the aircraft symbol on your radar. A fourth strike by the enemy is fatal! If you wish to break-off during the dogfight because of extensive damage or no ammunition left, the enemy will cease to attack once you are over 1 mile away or more than 5000 ft altitude difference. At this stage he will lock-on to his original ground target and pursue his ultimate objective of destroying all airfields. This will leave you free to return to any remaining runway for repairs, re-armament and refuelling.

(5) Blind Landing – This option simulates landing and take-off in fog. No visual display is given whenever the aircraft is above 50 ft and the horizon is not displayed at any time. Navigate by using your radar, flight computer and map. Press key 5 to switch this option on or off.

(6) Crosswinds and turbulence – This option gives crosswind effects and random aircraft disturbances due to turbulence. Selection of this option will make flying and navigation more difficult and is recommended after a little practice. Press key 6 to switch this option on or off.

(7) Pilot rating – Skill levels increase from trainee to ace. This feature varies the skill of the enemy pilot during combat e.g. how soon he will detect your approach, the types of manoeuvres he can execute, how quickly he can get you into his sights, and how close you have to get to shoot him down. Your pilot rating does not affect the flight characteristics of your own aircraft. Beware, an ace enemy pilot is very mean!

(8) Controls – Select your joystick type by pressing key 8. The AGF option corresponds to keys 5,6,7,8 and 0.

CONTROLS

During flight, your aircraft is manoeuvred using the elevator, aileron and rudder controls. The ELEVATORS are operated using keys 6 and 7 (back and forward on a joystick) to pitch the aircraft up and down. The AILERONS are on keys 5 and 8 (left and right on a joystick) used to roll the aircraft left and right. Finally, the RUDDER control uses keys Caps Shift and Z for left and right rudder. The rudder gives both a heading change and a roll change. During aerobatic manoeuvres, the effectiveness of the controls will vary. For example, at near 90 degrees roll, the elevator control will have a primary effect on heading, not pitch. The aircraft will also tend to pitch nose-down when in a steep turn. Your pitch rate, roll rate and yaw (heading) rate will all increase in proportion to how long the control is applied. This feature gives a good approximation to the feel of a real aircraft.

The THROTTLE control uses keys Q and A; Q to increase engine THRUST, and A to decrease thrust. As well as affecting the aircraft speed, your pitch angle will vary when changing the thrust setting. The amount of thrust required to maintain a particular speed depends primarily on pitch angle and altitude. At low speeds, for example on the approach, the aircraft must adopt a nose-up attitude to maintain lift on the wings. This generates more drag and will require more thrust as a result. At higher speeds, this nose-up attitude is no longer necessary and the same thrust will maintain a higher speed. Your maximum speed will increase with altitude because of the decreasing air density.

The FLAPS are on keys W (up) and S (down) next to the throttle controls. The flaps are used to give a slower runway approach speed and a reduced rate of descent. The stall speed varies with flap setting, and operation of the flaps during flight will affect the pitch angle. Operation of the flaps at speeds above 472 kts will cause them to fail.

The UNDERCARRIAGE is raised and lowered using the key U. Lowering the undercarriage will have a small effect on aircraft speed. BRAKES remain on whenever the key B is pressed, indicated by the panel BRAKES light. The brakes do not function when airborne.

The GUNS are fired by pressing key 0 (zero) after selecting COMBAT mode with key C. The ammunition status is shown at the bottom right hand corner of the instrument panel. The 3 lightning symbols above the ammo indicate that enemy aircraft are present. The number of enemy aircraft destroyed is to the right of these.

One final point .. flying a fighter aircraft is not easy and will take a little practice – particularly air-to-air combat!

INSTRUMENTS

Artificial Horizon – This instrument, in the centre of the panel, shows the roll angle and pitch angle of your aircraft, and is particularly useful during aerobatic manoeuvres or air-to-air combat when you will frequently lose your view of the horizon. The small aircraft symbol rotates to show your roll angle relative to the ground, and the roll angle, Left or Right, is shown underneath. A roll angle over 90 degrees equates to inverted flight. The pitch angle is shown on a "moving tape" with blue to indicate nose-up (skywards) and yellow to indicate nose-down, towards the ground. 90 degrees equates to a vertical climb or dive.

Speed – To the left of the artificial horizon is your speed, in knots.

Altitude – Aircraft height, in feet.

Vertical Speed Indicator, VSI – This gives your rate of climb or descent in feet per second. When your aircraft is gaining height the arrow will point upwards, and when you are losing height the arrow will point downwards. Your rate of descent on the approach should be approximately 20 ft per sec.

Flaps – Flaps may be set at any angle from zero to Full. The stall speed varies from 130 kts at zero flaps, to 120 kts at full flaps.

Thrust – The engine thrust indicator is a bar scale running along the bottom of the instrument panel. The green region represents 0% to 100% engine thrust, and the red region indicates reheat. Reheat gives a considerable boost to your thrust at the expense of heavy fuel consumption.

Radar and Compass – This is the instrument on the far left of the panel. The readout above the aircraft symbol is your compass heading. At the bottom of the instrument is shown the bearing and range of the beacon on which you are currently logged. As you select the Next Beacon by pressing N, the beacon identifier will change and new range and bearing information will be displayed. The flashing cross shows the bearing of the beacon relative to your own aircraft. To fly to the beacon, bank your aircraft until your heading matches the beacon bearing. You should now see the flashing cross at the nose of the aircraft symbol on the radar.

Combat Mode – Switch to Combat Mode using key C. This switches on your sights, activates the guns, and locks your radar and flight computer onto the enemy. Combat mode is shown on your radar by the lightning symbol. The range and bearing is now that of the enemy, and his bearing is shown as the flashing cross. Select the Flight Computer to find his altitude.

ILS /Flight Computer – To the right of your altitude and VSI is a dual-purpose instrument used for landing guidance and air-to- air combat. Switch between the two modes by pressing Symbol Shift ("symbol change").

(a) Instrument Landing System – This mode gives the pilot direction guidance when approaching a runway and may be demonstrated by selecting the "landing practice" option. By keeping the flashing square in the centre of the instrument, you will be flying on the correct glideslope to the runway at the correct rate of descent (3 degrees) for a good landing. As the flashing square drifts from the centre of the instrument, turn towards it and you will return to the correct approach. For example, if the square drifts left and up, bank your aircraft to the left and pull back on the joystick (or key 6) and the flashing square will slowly return to the centre.

(b) Flight Computer – Select the Flight Computer by pressing Symbol Shift. This displays your precise ground position, in units of feet, North, South, East or West of any runway with a beacon within a radius of 6 miles. The distances are relative to the beacon currently indicated on your radar. However, if the runway has been destroyed or it is out of range, the computer will be inactive, shown by black and yellow stripes.

The Flight Computer will also display the altitude of enemy aircraft when the radar is in combat mode. During a dogfight, try and keep your altitude roughly equal to that of the enemy, pointed to by the arrow on the flight computer.

Fuel This is a simple fuel gauge showing the amount of fuel left.

Undercarriage The indicator for the undercarriage is below the fuel gauge.

3 reds and an UP arrow = undercarriage UP
3 greens and a DOWN arrow = undercarriage DOWN

MAP – Switch between the map and normal visual display using key M. Your instruments are displayed at all times enabling safe flight to continue.

SUMMARY OF CONTROLS

5 – Joystick LEFT
6 – Joystick BACK
7 – Joystick FORWARD
8 – Joystick RIGHT
Caps Shift – RUDDER LEFT
Z – RUDDER RIGHT
Q – Increase THRUST
A – Decrease THRUST
W – Flaps UP
S – Flaps DOWN
U – Undercarriage UP and DOWN
B – Brakes ON
N – Next Beacon
M – Map
Symbol Shift – ILS /Flight Computer
O – GUNS (active only in Combat mode)
H – Hold
J – Release
XVYI – To return to menu

PILOT'S NOTES

Take-off speed: zero flaps – 140 kts, full flaps – 130 kts
Stall speed: zero flaps – 130 kts, full flaps – 120 kts
Flaps: Vmax full flap – 352 kts Vmax any flap – 472 kts
Undercarriage: Vmax = 300 kts
Vmax on ground = 250 kts
Performance: Vmax = 802 kts, at sea level, full reheat
Vmax = 1439 kts at 60,000 ft., level flight
Ceiling: approx 65,000 ft.
Approach:

Thrust	Flaps	U/C	Pitch	VSI	Speed, kts
74%	Full	Down	+3	↓9	125
62%	Zero	Down	+6	↓12	135

Technical Data – McDonnell Douglas F15 Eagle

Role: Air superiority fighter
Performance: Max. speed 800 kts at sea level, (Mach 1.2)
1440 kts at 60,000 ft (Mach 2.54)
Landing speed: 130 kts
Take off run: 900 ft., 8 secs with reheat
Ceiling: 65,000 ft
Initial climb rate greater than 50,000 ft/min.
Engines: 2 Pratt & Whitney F100–PW–100 turbofans
Each giving 17600 lbf thrust, dry
25000 lbf thrust, reheat
Dimensions: Wing span: 42 ft. 9 in.
Length: 63 ft. 9 in.
Wing area: 608 sq. ft.
Weight: Intercept mode, full internal fuel: 41,500 lbf

All of the above information is approximate and widely published. Although considerable effort has been given to achieving a realistic simulation, approximations have been made due to the limitations of the Spectrum and certain technical data not being available to the public.

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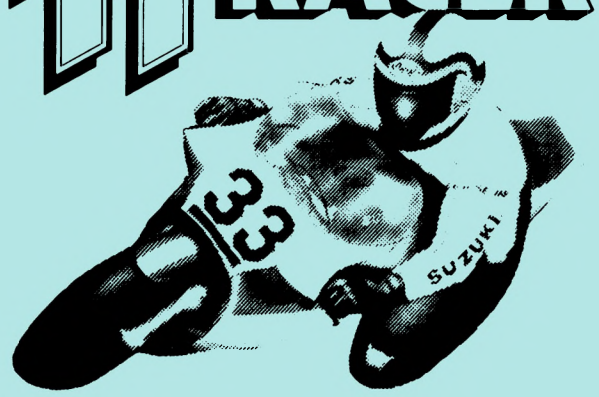
TT RACER



RIDING CONTROLS

For maximum control and enjoyment it is recommended to play this game with a joystick
JOYSTICK FORWARD or KEYS 7, O, P, ↑
OPEN THROTTLE – increases engine power to accelerate and increase speed
JOYSTICK BACKWARD or KEYS 6, O, L, ↓
APPLY BRAKE – slows bike down
JOYSTICK LEFT or KEYS 5, A, Z, ←
LEAN LEFT – turns bike to the left
JOYSTICK RIGHT or KEYS 8, S, X, →
LEAN RIGHT – turns bike to the right
FIRE BUTTON or KEY SPACE
CHANGE GEAR & CLUTCH OPERATION – momentary pressing will change up a gear if the brake is off and the engine is less than 2500 RPM from maximum revs, or change down a gear if the brake is applied or the engine is more than 2500 RPM from maximum revs. Holding the fire button will pull in the clutch disconnecting the engine from the back wheel. This allows the engine revs to change very rapidly which is useful for doing quick starts and pulling wheelies.
SYM-SHIFT & B
RESET – aborts the race and returns to title page.
H – HOLD – freezes the race.
F – INVERT SKY & TRACK COLOURS – set track and sky colours.
G – CHANGE TRACK COLOUR – stops attribute contention.

Loading:
CASSETTE: LOAD ""
(if 128K put into 48K mode first)

DISK: From POWER UP or RESET
insert disk and press ENTER.
From +3 BASIC insert disk and
type LOAD "*" and press ENTER.

When the program is first loaded the user is prompted for a softlock security code. The code is found in the Softlock security table by finding the number on the screen in the left hand column and then entering the number in the right hand column using keys 0-9 and ENTER. The game is now ready for playing.

MAIN MENU

A–Z SET RIDERS INITIALS – the players initials are used on the race positions table. If a mistake is made, this may be corrected by returning to the title page and repeating the entry procedure.

1 ENGINE SIZE – the four solo Grand Prix classes.

2 RACING COMPETITION – this sets the speed of the computer controlled opposition riders, and how difficult it is to crash your bike. CLUB level has been made very easy to enable the novice to get used to the controls and the different tracks. This difficulty increases on each level so GRAND PRIX racing is as realistic as possible.

3 SELECT TRACK – all 12 tracks for the 1986 Grand Prix season.

4 NUMBER OF LAPS – this can be from a short 1 lap race to a long 99 laps. When the Grand Prix distance option is selected the number of laps for this track and engine size are set. If the track does not hold this Grand Prix race then the lap length is set to one.

5 EVENT –
TRACK sets racing on the selected track.
SEASON will take you racing in the correct order on all of the tracks for this engine size and build up a world championship points total.
PRACTICE allows you to set up your bikes performance and handling variables and set a practice lap time to improve your position on the starting grid.

6 NUMBER OF EXTERNAL BIKES ON NETWORK – this selects the number of friends you are racing against. Each external rider requires a Sinclair Spectrum and an Interface 1. The computers are connected together by the Interface 1 network.

7 TERMINAL NUMBER ON NETWORK – each external bike on the network must be given a different terminal number. Terminal 1 is used as the controlling terminal for setting the menu page and holding or resetting the game.

8 JOYSTICK CONTROLS – keyboard or appropriate joystick interface.

SOFTLOCK SECURITY TABLE

1: 596	43: 584	85: 643	127: 915	169: 737	211: 988	253: 84	295 635	337: 992	379: 585	421: 765	463: 396
2: 673	44: 268	86: 595	128: 878	170: 748	212: 919	254: 277	296: 126	338: 400	380: 642	422: 527	464: 13
3: 907	45: 529	87: 159	129: 602	171: 2	213: 97	255: 790	297: 802	339: 139	381: 294	423: 180	465: 594
4: 673	46: 752	88: 421	130: 375	172: 957	214: 630	256: 958	298: 998	340: 526	382: 65	424: 956	466: 755
5: 52	47: 382	89: 707	131: 493	173: 202	215: 397	257: 596	299: 584	341: 643	383: 915	425: 737	467: 988
6: 504	48: 949	90: 677	132: 795	174: 2	216: 34	258: 894	300: 198	342: 217	384: 435	426: 684	468: 246
7: 178	49: 626	91: 790	133: 342	175: 953	217: 479	259: 907	301: 529	343: 159	385: 602	427: 2	469: 97
8: 336	50: 71	92: 542	134: 317	176: 173	218: 990	260: 78	302: 21	344: 224	386: 537	428: 413	470: 454
9: 981	51: 676	93: 711	135: 27	177: 368	219: 256	261: 52	303: 382	345: 707	387: 493	429: 202	471: 397
10: 386	52: 880	94: 658	136: 22	178: 161	220: 231	262: 655	304: 711	346: 519	388: 172	430: 786	472: 506
11: 720	53: 513	95: 766	137: 645	179: 591	221: 408	263: 178	305: 626	347: 790	389: 342	431: 953	473: 479
12: 894	54: 735	96: 607	138: 679	180: 732	222: 8	264: 235	306: 766	348: 79	390: 230	432: 805	474: 274
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14: 757	56: 629	98: 328	140: 425	182: 339	224: 258	266: 351	308: 556	350: 954	392: 763	434: 869	476: 913
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16: 603	58: 867	100: 752	142: 767	184: 977	226: 543	268: 272	310: 113	352: 203	394: 977	436: 318	478: 947
17: 945	59: 717	101: 637	143: 301	185: 684	227: 816	269: 215	311: 103	353: 105	395: 494	437: 939	479: 183
18: 895	60: 452	102: 353	144: 124	186: 119	228: 734	270: 962	312: 802	354: 514	396: 274	438: 162	480: 735
19: 906	61: 787	103: 295	145: 917	187: 729	229: 585	271: 289	313: 297	355: 83	397: 525	439: 988	481: 861
20: 708	62: 756	104: 406	146: 308	188: 115	230: 968	272: 192	314: 456	356: 853	398: 674	440: 777	482: 977
21: 702	63: 927	105: 949	147: 704	189: 292	231: 899	273: 945	315: 717	357: 637	399: 301	441: 684	483: 816
22: 502	64: 645	106: 333	148: 277	190: 218	232: 607	274: 50	316: 657	358: 947	400: 594	442: 11	484: 553
23: 971	65: 560	107: 92	149: 239	191: 113	233: 634	275: 906	317: 787	359: 295	401: 917	443: 729	485: 585
24: 780	66: 199	108: 739	150: 712	192: 73	234: 262	276: 866	318: 862	360: 255	402: 35	444: 589	486: 947
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27: 300	69: 9	111: 724	153: 252	195: 694	237: 183	279: 971	321: 560	363: 92	405: 239	447: 113	489: 634
28: 230	70: 755	112: 40	154: 721	196: 682	238: 853	280: 101	322: 941	364: 185	406: 397	448: 454	490: 280
29: 289	71: 741	113: 138	155: 238	197: 63	239: 81	281: 18	323: 157	365: 107	407: 565	449: 540	491: 276
30: 570	72: 298	114: 556	156: 688	198: 571	240: 153	282: 791	324: 401	366: 189	408: 288	450: 347	492: 177
31: 217	73: 801	115: 125	157: 431	199: 365	241: 283	283: 300	325: 9	367: 724	409: 252	451: 694	493: 183
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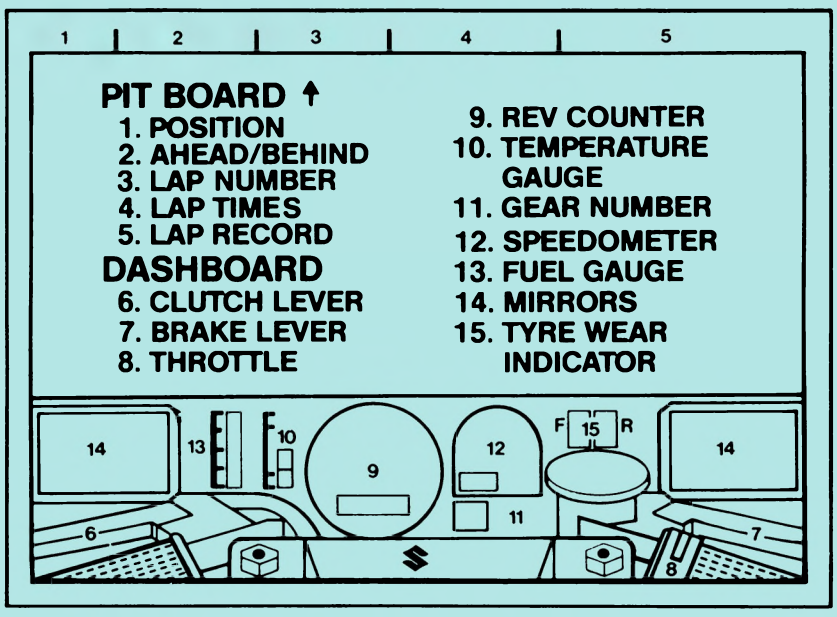
33: 693	75: 552	117: 538	159: 627	201: 957	243: 911	285: 289	327: 741	369: 138	411: 238	453: 63	495: 81
34: 368	76: 242	118: 919	160: 663	202: 599	244: 804	286: 855	328: 71	370: 231	412: 728	454: 650	496: 26
35: 712	77: 368	119: 259	161: 848	203: 133	245: 836	287: 217	329: 801	371: 125	413: 431	455: 369	497: 283
36: 995	78: 407	120: 990	162: 610	204: 989	246: 594	288: 882	330: 923	372: 87	414: 456	456: 576	498: 271
37: 575	79: 342	121: 148	163: 129	205: 180	247: 610	289: 693	331: 552	373: 538	415: 627	457: 957	499: 911
38: 661	80: 384	122: 972	164: 396	206: 568	248: 648	290: 43	332: 425	374: 37	416: 653	458: 635	500: 4
39: 635	81: 992	123: 585	165: 765	207: 396	249: 656	291: 712	333: 368	375: 259	417: 848	459: 133	
40: 853	82: 955	124: 500	166: 780	208: 392	250: 436	292: 846	334: 314	376: 519	418: 623	460: 459	
41: 802	83: 139	125: 294	167: 180	209: 594	251: 440	293: 575	335: 342	377: 148	419: 129	461: 180	
42: 115	84: 795	126: 506	168: 829	210: 49	252: 82	294: 195	336: 470	378: 256	420: 906	462: 307	

PIT BOARD AND INSTRUMENT PANEL



9 SOUND CONTENT –
ALL – gives title page and game sound.
GAME – sound in game.
NONE – no sound.
0 SAVE/VERIFY/LOAD – this saves, verifies and loads the lap record tables, bike performance characteristics and the menu selection to allow you to save and resume a racing session at any time. Loading or verifying can be aborted at any time by pressing the SPACE key.
Note: Changing your name (KEYS A-Z), engine size (KEY 1) or competition level (KEY 2) all reset the practice lap time.

INSTRUMENTS

PITBOARD – is displayed on the top line of the screen and holds the following information:

POS 14 – gives your current position compared to the other riders.

A/B 23/16 – is updated once per lap, displaying the time in seconds to the nearest rider ahead and behind you. The ahead time is updated as you cross the start line and the behind time when the next rider crosses the line.

LAP 10/28 – displays the lap number you are on and the total number of laps for the race

TIME 1:04.08 – indicates your current lap time

REC 1:38.42/1:28.20 – Your best lap time in this race or during practice and the tracks' lap record

DASHBOARD – The basic racing instrument panel consists of handlebars with clutch and brake levers, twistgrip throttle, rev counter and temperature gauge. The additional instrument of gear number has been added as it makes racing on a computer far easier. If the road instrument option is selected this adds speedometer, fuel gauge, mirrors and tyre wear indicator.

CLUTCH LEVER – animated lever on the left handlebar to show when the clutch is pulled in. This disconnects the engine from the back wheel.

BRAKE LEVER – animated lever on the right handlebar to show when the front brake is applied.

THROTTLE – the throttle opening is displayed as a red line next to the throttle twistgrip on the right hand handlebar.

REV COUNTER – displays the engine revs per minute (RPM) as an analog dial with needle and a digital readout. When the engine revs are below the maximum permitted by 1000 RPM or less the dial changes to yellow. It changes to red when the maximum permitted RPM is exceeded.

TEMPERATURE GAUGE – gives engine temperature. When the top of the bar is yellow the temperature is normal. If it is blue or red care must be taken not to exceed maximum RPM or the engine may seize.

GEAR NUMBER – displays the gear the bike is in.

SPEEDOMETER – displays the bikes speed in miles per hour (MPH), as an analog dial and a digital readout.

FUEL GAUGE – amount of fuel in fuel tank

MIRRORS – when an opposition bike is less than 64 feet behind you, it is displayed in the appropriate mirror

TYRE WEAR INDICATOR – gives front and back tyre wear by changing colour as the tyres wear. When the colour is dark blue the tyre is almost worn out. The indicator will flash when the tyre has blown out and you will crash.

PITSTOP – RACING

R – REFUEL – fills the bikes petrol tank.
T – CHANGE TYRES – changes the bikes tyres.

PITSTOP – PRACTICE

1–6 – SET UP GEAR RATIOS – sets each of the six gears individually with a new ratio. 1 = lowest (slowest top speed, fastest acceleration), 5 = highest (fastest top speed, slowest acceleration).
S – SET STEERING SPEED – alters the bikes steering head angle which changes the speed the bike leans at. 1 = slowest, 5 = fastest.
T – SET UP TYRE TYPE – selects the tyre type. 1 = most grip, fastest wear, 5 = least grip, slowest wear.
A – AUTOMATIC GEAR CHANGE – switches on and off the automatic gear change.
R – ROAD INSTRUMENTS – switches between racing and road bike instrument panel.

RACING

STARTING

The start light sequence is red when there is less than 10 seconds to the start and green to start. When the light changes to green the engine can be started by pushing forward the joystick which opens the throttle. When the engine has started, high engine revs can be quickly built up by holding down the fire button which pulls in the clutch. If the engine revs stay at zero the engine has not started, which means the fire button must be released and the start procedure repeated. When the engine revs are about 10,000 RPM let out the clutch by releasing the fire button and the bike will accelerate forwards rapidly. When the rev counter reaches the red line change gear by momentarily pressing the fire button. Over revving the engine will make the engines temperature rise. If the engine overheats, there is a danger it will seize and make you crash the bike. Most of a racing engines power is developed over quite a narrow rev band (9000–12500 RPM on 500cc), which means that if the revs drop below this level in a high gear, even opening the throttle to the maximum, will not stop the revs from dropping as there is not enough power to accelerate. To speed up, you will need to change down one or more gears.

CORNERING

When approaching a corner pull back on the joystick to apply the brakes and change down the gears by momentarily pressing the fire button. The bike is then leaned over left or right to take the corner by pushing the joystick left or right.

Corners of more than 90 degrees have been highlighted with a trackside arrow at their start, showing the corners direction. The screen's border flashing red and cyan indicates that you are on the edge of the track and grass. This is bumpy as you can see from the horizon pitching and the edge friction is greater than the track's which means you will tend to slow down. Persistantly sitting on the track edge may also result in you crashing the bike.

CRASHING

Failure to negotiate a corner may result in you crashing. Your bike will go on its side, engine revs will go up to maximum where the back wheel is off the ground and dirt will fly past. If there are no lines across the screen your bike is not too badly damaged which means you can continue the race. To restart, close the throttle so the engine revs die. After the engine has stopped, pick up your bike with the joystick, so the horizon becomes flat, change into first gear, lean away from the track edge and start the bike. If there are lines across the screen, your bike is too badly damaged for you to carry on, and this is the end of your race.

OPPOSITION BIKES

There are 15 opposition bikes, which can all be computer controlled, or up to 7 of them can be your friends by networking Spectrums together. The computer controlled opposition bikes are determined top riders who rarely crash and will take evasive action to stop you crashing into them whenever possible as they are keen to finish the race.

When several computers are networked together a game cannot be started until the network has been correctly configured with regard to the number of terminals and each one having a unique number. If there is an error the computers will give an error message on the bottom line of the menu page. "NO TERMINAL(S) n" means that the terminal number "n" is missing from the network. "MULTIPLE TERMINALS n" means that more than one terminal has the number "n". When the up is correct the message "MASTER TERMINAL GAME SELECTION" appears on a green background. Terminal 1 is the master terminal that controls the game. It sets all the other terminal's menus so that you are all racing on the same track under the same conditions. It also controls the Hold, Continue and Reset commands during racing. Each rider has a view of the track and the other riders. When you are line first. When a season of racing has been selected world championship points are awarded as follows: 1st = 15 pts, 2nd = 12 pts, 3rd = 10 pts, 4 = 8 pts, 5th = 6 pts, 6th = 5 pts, 7th = 4pts, 8th = 3 pts, 9th = 2 pts, 10th = 1 pt and 11th to 16th = 0 pts. As the season progresses, a running total of world championship points are built up in the race positions table. The rider with the most points at the end of the season is the World Champion.

PIT STOPS

When you are in a long race it may be necessary to call into the pits to refuel or fit new tyres to the bike. A call into the pits is made by pulling up alongside them, less than 4 feet from the right hand side of the track. When your speed is zero the pit menu page will be displayed. If you pull into the pits during practice, the bike performance set up page will be displayed instead of the refuelling and tyre change page.

PRACTICE AND BIKE SET UP

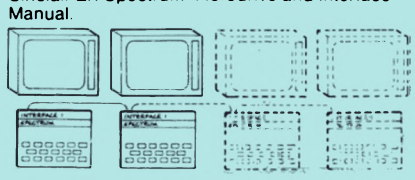
This is used to obtain a good practice lap time and set up your bikes performance. The better your practice lap record the nearer you will be placed to the front of the starting grid. To achieve pole position your practice time will need to be better than the current lap record.
Each racing track places different demands on a racing bike. In order to get the best from it, it has to be set up for that track. On the tracks with many slow curves the emphasis will be on fast acceleration, hence low gearing, and tracks with a few fast curves and long straights the reverse is true as top speed is more important for fast lap overtaking your friend, his bike will pass from in front to behind you and will appear in front on his display. At the end of the race the master terminal compiles all of the bike positions, the fastest lap time and transmits this to all terminals.

WINNING

The first rider to cross the finishing line on the last lap is the winner of the race. All rider positions are displayed in the race positions table at the end of the race and if you have achieved a new lap record this is displayed on the lap table. Your position on the pit board may differ slightly at the end of the race from your finishing position if any other bike has finished at the same time as you. This is because the computer will double check a close finish to determine who crossed the finish times. Fast steering is not as stable or controllable as slow steering but it enables changes of direction to be made more quickly which is important on twisty circuits, particularly on "S" bends. The choice of tyres will be largely decided by the length of your race and how many pit stops for tyre changes you make.

NETWORKING

TT Racer offers the unique option on the Sinclair Spectrum of connecting up to 8 machines together, so you can race against your friends. The computers are networked using Sinclair Interface 1's as shown in the diagram. For further connection information please refer to the Sinclair ZX Spectrum Microdrive and Interface 1 Manual.



1 2 3 8

ACKNOWLEDGEMENTS

Digital Integration would like to thank Heron Suzuki Racing for their invaluable assistance during the design and development of TT Racer. We would like to thank in particular Garry Taylor and Paul Lewis for their help.

All information stated herein is accurate to the best of our knowledge. Although considerable effort has been used in achieving a realistic simulation, approximations have been made due to the limitations of the computer and certain technical data not being available to the public.

REFERENCES

The following books provided much useful information and knowledge for the development of TT Racer and are recommended for further reading on racing technology and techniques.

The Art and Science of Motor Cycle Road Racing, by Peter Clifford. Hazleton, ISBN 0 905138 24 4.

A Twist of the Wrist (The Motorcycle Road Racers Handbook), by Keith Code. Acrobat, ISBN 0 918226 08 2.

Speedbikes, by Mick Wollett. B. T. Batsford, ISBN 0 7134 1294 1.

Motorcycle Chassis Design (The Theory and Practice), by Tony Foale and Vic Willoughby. Osprey, ISBN 0 85045 560 X.

Motocourse 1984–85, Hazleton, ISBN 0 905138 33 3.

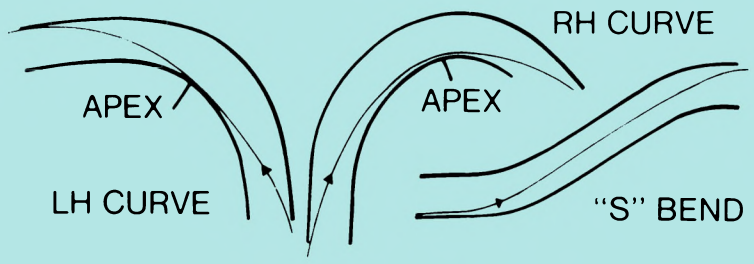
Motocourse 1985–86, Hazleton, ISBN 0 905138 39 2.

RACING TECHNIQUES

The way to win races is to consistently achieve the fastest lap time. The most important way to achieve this is by taking corners correctly. Cornering consists of the co-ordination of several different actions.

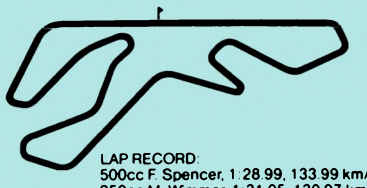
i) Positioning yourself at the entrance of the corner for the fastest line through.
ii) Braking to a suitable cornering speed and selecting the appropriate gear.
iii) Leaning to take that line.
iv) Accelerating as you exit from the corner.

The correct points for carrying out each of these operations have to be found by trial and error. The track side objects and the centre line are useful reference points for repeating cornering conditions consistently. The diagrams show several different corners and the fastest lines through them.



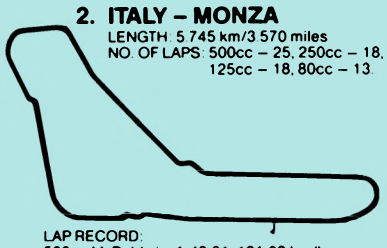
TRACK DIAGRAMS

1. SPAIN – JARAMA
LENGTH: 3.312 km/2.058 miles
NO. OF LAPS: 500cc – 37, 250cc – 31, 125cc – 28, 80cc – 22.



LAP RECORD:
500cc F. Spencer, 1:28.99, 133.99 km/h.
250cc M. Wimmer, 1:31.05, 130.97 km/h.
125cc F. Gresini, 1:35.47, 124.90 km/h.
80cc J. Martinez, 1:38.50, 121.05 km/h.

2. ITALY – MONZA
LENGTH: 5.745 km/3.570 miles
NO. OF LAPS: 500cc – 25, 250cc – 18, 125cc – 18, 80cc – 13.

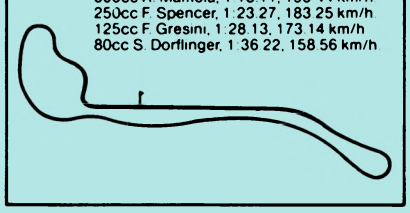


LAP RECORD:
500cc M. Baldwin, 1:49.31, 191.03 km/h.
250cc S. Pons, 1:57.16, 178.22 km/h.
125cc F. Gresini, 2:04.57, 167.90 km/h.
80cc I. McConnachie, 2:10.90, 159.50 km/h.

3. WEST GERMANY – NEW NURBURGRING

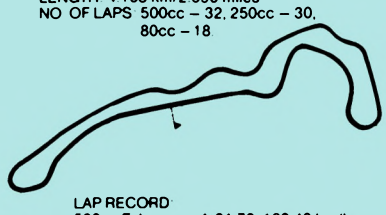
LENGTH: 4.542 km/2.822 miles
NO. OF LAPS: 500cc – 30, 250cc – 25, 125cc – 23, 80cc – 18
LAP RECORD:
500cc E. Lawson, 1:43.24, 159.18 km/h.
250cc A. Mang, 1:46.90, 152.97 km/h.
125cc L. Cadalora, 1:51.73, 146.35 km/h.
80cc I. McConnachie, 1:57.01, 139.74 km/h.

4. AUSTRIA – SALZBURGRING
LENGTH: 4.241 km/2.635 miles
NO. OF LAPS: 500cc – 30, 250cc – 25, 125cc – 23, 80cc – 18.
LAP RECORD:
500cc R. Mamola, 1:18.11, 195.44 km/h.
250cc F. Spencer, 1:23.27, 183.25 km/h.
125cc F. Gresini, 1:28.13, 173.14 km/h.
80cc S. Dorflinger, 1:36.22, 158.56 km/h.



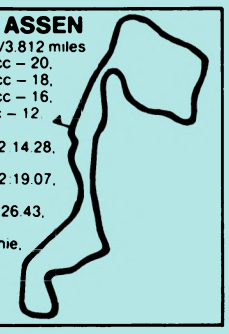
1 km = 0.621 miles

5. YUGOSLAVIA – RIJEKA
LENGTH: 4.168 km/2.590 miles
NO. OF LAPS: 500cc – 32, 250cc – 30, 80cc – 18.



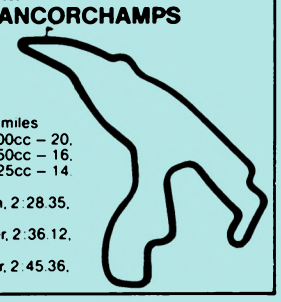
LAP RECORD:
500cc E. Lawson, 1:31.78, 163.48 km/h.
250cc C. Lavado, 1:33.43, 160.60 km/h.
80cc J. Martinez, 1:40.14, 149.80 km/h.

6. HOLLAND – ASSEN
LENGTH: 6.134 km/3.812 miles
NO. OF LAPS: 500cc – 20, 250cc – 18, 125cc – 16, 80cc – 12.



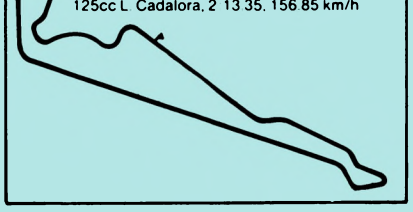
LAP RECORD:
500cc W. Gardner, 2:14.28, 164.44 km/h.
250cc M. Wimmer, 2:19.07, 158.78 km/h.
125cc F. Gresini, 2:26.43, 150.01 km/h.
80cc I. McConnachie, 2:30.79, 146.43 km/h.

7. BELGIUM – SPA FRANCORCHAMPS



LENGTH: 6.940 km/4.312 miles
NO. OF LAPS: 500cc – 20, 250cc – 16, 125cc – 14.
LAP RECORD:
500cc E. Lawson, 2:28.35, 168.41 km/h.
250cc F. Spencer, 2:36.12, 160.03 km/h.
125cc A. Auinger, 2:45.36, 151.09 km/h.

8. FRANCE – PAUL RICARD
LENGTH: 5.180 km/3.610 miles
NO. OF LAPS: 500cc –21, 250cc –18, 125cc –16
LAP RECORD:
500cc E. Lawson, 2:01.52, 172.12 km/h.
250cc C. Lavado, 2:06.95, 164.76 km/h.
125cc L. Cadalora, 2:13.35, 156.85 km/h.

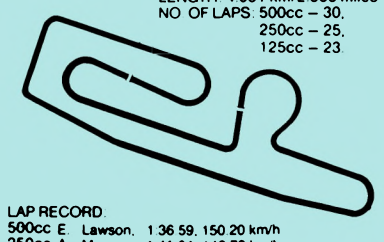


1 km = 0.621 miles

9. BRITAIN – SILVERSTONE

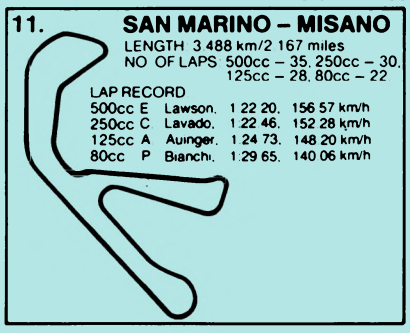
LENGTH: 4.711 km/2.927 miles
NO. OF LAPS: 500cc – 28, 250cc – 24, 125cc – 20, 80cc – 15
LAP RECORD:
500cc K. Roberts, 1:28.20, 192.27 km/h.
250cc C. Sarron, 1:33.40, 181.55 km/h.
125cc A. Nieto, 1:38.41, 172.31 km/h.
80cc S. Dorflinger, 1:43.13, 164.43 km/h.

10. SWEDEN – ANDERSTORP
LENGTH: 4.031 km/2.505 miles
NO. OF LAPS: 500cc – 30, 250cc – 25, 125cc – 23.



LAP RECORD:
500cc E. Lawson, 1:36.59, 150.20 km/h.
250cc A. Mang, 1:41.64, 142.78 km/h.
125cc L. Cadalora, 1:45.01, 138.11 km/h.

11. SAN MARINO – MISANO
LENGTH: 3.488 km/2.167 miles
NO. OF LAPS: 500cc – 35, 250cc – 30, 125cc – 28, 80cc – 22.
LAP RECORD:
500cc E. Lawson, 1:22.20, 156.57 km/h.
250cc C. Lavado, 1:22.46, 152.28 km/h.
125cc A. Auinger, 1:24.73, 148.20 km/h.
80cc P. Bianchi, 1:29.65, 140.06 km/h.



12. WEST GERMANY – HOCKENHEIM
LENGTH: 6.787 km/4.217 miles
NO. OF LAPS: 125cc – 14, 80cc – 11
LAP RECORD:
125cc L. Cadalora, 2:22.14, 171.81 km/h.
80cc S. Dorflinger, 2:30.72, 162.03 km/h.

ONLY THE BRAVEST FLY ...

TOMAHAWK*

Loading:
CASSETTE: LOAD ""
(if 128K put into 48K mode first)
DISK: From POWER UP or RESET insert disk and press ENTER.
From +3 BASIC insert disk and type LOAD "*" and press ENTER.

3D real-world display:
Features include landing pads, buildings, trees, transmission pylons, mountains, enemy tanks, field guns and helicopters. Ground texture is visible when flying below 500 feet to enhance the sensation of speed. It is possible, with practice, to fly between trees and mountain peaks.

MENU OPTIONS
MISSION 1 – FLYING TRAINING – used for helicopter familiarisation & developing ground attack skills. Enemy ground forces will not return fire.

MISSION 2 – COMBAT – a short mission to destroy invading ground forces and return to base.

MISSION 3 – COMBAT – Surrounded totally by enemy territory, your task is to liberate the entire map from enemy occupation. Each hostile sector becomes allied when enemy forces destroyed.

MISSION 4 – COMBAT – A strategic battle for occupation of the entire map. Your task is to support allied ground forces in their battle along the front line.

2 DAY OR NIGHT – Daytime: blue or overcast sky, green ground
Nightime: no horizon, computer-enhanced infra-red imaging. (Pilots' Night Vision System.)

3 CLEAR OR CLOUDY – option for overcast sky with selectable cloudbase for instrument flying.

4 CLOUDBASE – selectable from 50 ft to 1000 ft

5 CROSSWINDS & TURBULENCE – for the experienced pilot! Variable crosswind & turbulence effects.
6 SOUND – selectable ON or OFF.

7 PILOT RATING – TRAINEE
SQUADRON
INSTRUCTOR
ACE
The pilot rating is equivalent to difficulty level and varies potency of enemy. With each increase in pilot rating, the enemy's accuracy doubles!

8 CONTROLS – keyboard or joystick options.

INSTRUMENT PANEL LAYOUT
Bar scales, from left:
Collective lever position indicator – COL
Engine Torque – TORQ 0 to 130%
(power demanded from engines)
Turbine & Rotor RPM – 0 to 120%
Throttle position indicator – T
Fuel
Engine temperature

WEAPONS:
AMMO – 1200 rounds 30mm ammunition, 750 rounds/min, 38 unguided rockets (19 each side), 8 Hellfire missiles – laser guided, auto-tracking

Failure status lights: engines, weapons, nav. computer, TADS

INSTRUMENTS: (left to right)

TADS
Target Acquisition & Designation System – (small instrument above fuel indicator). Used to identify and track tanks, field guns and helicopters. Red = hostile, green = friendly. Includes range readout in feet when target is less than 10,000 feet away.

VDU – Visual Display Unit
Speed, in knots (yellow = forwards, cyan = backwards)
Altitude, feet
VSI – Vertical Speed, ft/sec (arrow UP = climb, arrow DOWN = descent)

TIME – Time to reach target, in hours and minutes (hashed if greater than 4 hrs, zero if less than 1 minute)
Ground position – autoranging navigation computer
Within 0.1 mls: resolution in feet
Within 4.9 mls: resolution in 0.1 mls
Over 5 mls: resolution 1 mile

ARTIFICIAL HORIZON
Roll symbol & roll angle readout
Pitch indicator – nose up/down attitude
Sideslip indicator – sideways "drift"

DOPPLER NAVIGATION/COMPASS – (rightmost instrument)
Readout of Heading, Bearing & Track
Heading: direction in which the helicopter is pointing.
Track: flight path direction
Bearing: heading required to point at objective

Note: a helicopter can be pointing in one direction (Heading) but moving in a different direction (Track) e.g. sideways! Match the heading to the target bearing to intercept target. The flashing cross indicates relative bearing of target

Four modes:
B: Beacon navigation (8 beacons)
H: Landing Pad guidance (4 pads per sector)
T: Ground target tracking (8 targets per sector)

Lightning symbol: enemy helicopter interception
Flashing symbol warns of approaching enemy helicopter

CONTROLS

THROTTLE – key W to open throttle
key S to close throttle

Controls engine/turbine rpm. Normally set to fully open unless practising engine-off landings. Assisted in flight by computerised autothrottle control.

COLLECTIVE LEVER – key Q increases lift
key A decreases lift

This is basically a vertical lift control used for take-off to the hover, and forward thrust control in straight & level flight.

CYCLIC CONTROL
joystick forward (cursor key 7) tilts nose down
joystick back (cursor key 6) tilts nose up
joystick right (cursor key 8) to roll right
joystick left (cursor key 5) to roll left

RUDDER – key Z to yaw right
key CAPS SHIFT to yaw left

TWIN JOYSTICK OPTION
Interface 2 (and equivalent joystick interfaces) have an optional twin joystick mode for enhanced helicopter control:

right hand joystick = cyclic control & weapon release
left hand joystick:
forward = key A = decrease collective
back = key Q = increase collective
right = key Z = rudder right
left = CAPS SHIFT = rudder left
fire button = key N, select next objective

DOPPLER MODE
Key C selects between beacon mode (B), landing pad mode (H), ground attack mode (T) or air-to-air mode (lightning symbol) on DOPPLER/COMPASS instrument.
key N selects "next objective" in each mode:
8 beacons (0 to 7)
4 landing pads per sector (0 to 3)
8 enemy targets per sector (0 to 7)
1 enemy helicopter

Press CAPS SHIFT and SPACE together to abort mission and return to the menu.

WEAPON SYSTEMS & TARGET ATTACK
When in ground attack or air-to-air mode, the weapons systems are activated. The helicopter must be airborne to fire its weapons. Select between gun, rockets or missiles using key P. The gun & rockets are manual tracking only i.e. the target must be in the sights when the weapon is launched or for the TADS to operate. The missile system locks on to any hostile target passing through the sights & lock-on is depicted by the dashed square becoming a solid outline. Tracking is automatic if the target remains on screen.

GUN – diagonal sights – range 2000 ft
ROCKET – vert/horiz sights – range 4000 ft
MISSILES – square sights range 3.1 mls
Fire button = key Ø or fire button on cyclic joystick.
The time for a weapon to reach a target will depend on how far the target is away. It is possible to locate and destroy enemy targets in both map mode and in cloud, but the weapon sights will not be displayed.

During combat, enemy fire is indicated by a flashing border. The whole display will flash if your helicopter is hit and also when ground forces destroy each other (Mission 4 only). Damage to helicopter systems is indicated on the failure status panel and structural damage is shown by the Doppler helicopter symbol turning red. A third structural hit is fatal! The chances of being hit by the enemy are decreased by swerving during the attack. You have a total of 3 helicopters per mission. Study the mission report for crash evaluation and performance report.
If an enemy helicopter is approaching, a warning symbol will be flashed on the Doppler instrument if you are not in air-to-air combat mode. You are advised to select air-to-air combat mode and destroy the enemy helicopter before he gets too close!

Scoring Scheme

Weapon Used	Target: Field gun	Tank	Helicopter
Gun	20	–	100
Rockets	10	20	50
Missiles	5	10	25

Points Scored

It is not possible to destroy a tank with the chain gun. Destruction of allied forces will result in total loss of score. Although it is much easier to hit a target with a missile, fewer points will be scored. The enemy will begin to fire back at a range between 4000 and 5000 feet, making it much more dangerous to use guns (range 2000 ft!) but the points scored will be higher.

MAP
Use key M to select map or to return to normal display. Your helicopter is shown by the flashing symbol with a tail. Enemy helicopters are shown without a tailplane. Beacons 0 to 7 are used for navigation purposes.
By selecting MAP mode when sitting on any allied pad, the helicopter may be moved to another allied sector by using cursor keys 5, 6, 7 or 8 (or joystick). This feature eliminates the need for lengthy straight and level flight to visit each sector.
When training (Mission 1), all sectors are allied and any landing pad may be used for refuelling, rearming or repairs. All sectors contain enemy tanks and field guns for target practice.
In combat missions, territory is distinguished by blue (Allied) sectors and red (Hostile) sectors. A flashing blue sector indicates the presence of enemy forces in allied territory. Likewise, a flashing red sector indicates the presence of allied forces in hostile territory. You will be captured by the enemy if you touchdown in hostile territory.
The destruction of all enemy forces in a hostile sector will result in the sector becoming allied. Likewise, if all allied forces in a sector are destroyed, the sector becomes hostile.
The map is designed to "wrap around" at the edges i.e. when flying off the map, the helicopter will reappear at the opposite edge.

COMPLETION OF MISSION
A mission is completed when all enemy ground forces have been destroyed and you have returned safely to a landing pad. After touchdown, close the throttle to bring the turbine and rotor rpm to zero. A complimentary mission report will follow.

PILOT'S NOTES
The controls in a real helicopter are "proportional", i.e. their effect is proportional to the displacement from centre. It is not possible to implement this feature on the Spectrum joystick since it contains simple on/off microswitches. By making the effect of each control proportional to how long the joystick is held, a simple approximation to "real" controls has been achieved, i.e. momentary operation of the joystick for fine control, and hold to build up a rapid rate. This does however mean that the joystick must be operated repeatedly for manoeuvres such as a steady turn or to hold a steady pitch angle.
Helicopters are naturally unstable and difficult to fly without autostabilisation. The Apache is fitted with Digital Automatic Stabilisation Equipment (DASE) making it far easier to fly than most modern helicopters.

Take-off procedure:
1 Ensure that collective indicator at minimum.
2 Select full throttle – key W – hold pressed until throttle indicator at maximum.
3 Wait for turbine rpm & rotor rpm to reach 100%.
4 Increase collective pitch by pressing key Q until lift-off occurs. VSI indicates vertical speed in ft/sec.
5 Reduce collective (key A) to achieve hover i.e. VSI = 0. The helicopter is now hovering above the helipad.
6 Turning on the spot is accomplished by applying left or right rudder (CAPS SHIFT or key Z).

Transition to forward flight from hover
1 Increase collective (key Q) to between 80% to 100% Torque. Reduce collective (key A) if overtorque warning sounds.

2 Tilt nose of helicopter downwards (key 7 or joystick forward) to between 15 and 30 degrees.
3 Speed will be seen to increase. Autostabilisers will slowly raise the nose of the helicopter to a level attitude.
4 Reduce collective (key A) to adjust for VSI = 0 ft/sec i.e. not climbing or descending.
The helicopter will now be cruising at a steady forward speed. The Apache is a very agile helicopter. From a stable hover, it can reach 100 kts in approx. 6 seconds by pulling 100% torque and tilting the nose downwards to approx. 30 deg.

Straight & Level Flight
Forward speed is related primarily to the torque setting & hence the collective lever setting, assuming the helicopter is not autorotating (explained later). Typical speed/torque settings are as follows:

Torque	Speed
44%	60 kts
60%	119 kts
75%	147 kts
100%	159 kts

These values will vary slightly with altitude and changes in helicopter weight resulting from fuel consumption and weapon release. The Apache is fitted with a computer-controlled stabilator which enables the helicopter to cruise at any speed with the fuselage level.

Turning Flight
Providing that the forward speed is greater than 60 kts, turning is achieved by simply banking left or right. Some vertical lift will be lost when banking and the helicopter will begin to descend. This may be counteracted by increasing the collective setting. The helicopter will tend to slow down in a turn unless the pilot dives to sacrifice height to maintain speed.

At speeds under 60 kts, the helicopter will tend to "drift" into the turn, shown by the sideslip ball at the bottom of the artificial horizon. Turns may be assisted by applying the rudder, but this will reduce forward speed.
Fluctuations in rotor rpm occur during a turn because of g force effects. The autothrottle will adjust the turbine rpm accordingly to keep the rotor rpm at approximately 100%.

Slowing down & returning to the hover
1 Gently raise the nose of the helicopter by pulling back on the joystick (key 6). The aircraft will begin to slow down and also climb. Maintain the nose-up attitude by repeatedly pulling back on joystick (gently!).

2 Reduce the rate of climb by reducing collective (key A) to keep VSI to approximately zero. As the forward speed drops below 60 kts, increase collective (key Q or 2nd joystick back) to counteract sink rate. Allow nose of helicopter to return to level flight as speed approaches zero.

3 Adjust collective as required to achieve a VSI of zero. The helicopter should now be in a stable hover.
4 The helicopter will also slow down when turning, providing that it is not in a dive. Banking repeatedly left and right is another common method of slowing down.

5 Providing that the forward speed is less than 60 knots, the pilot may apply rudder to increase sideslip (sideways drift). The helicopter will slow down dramatically as a result of the large drag forces generated.

Landing
The helicopter may be landed from the hover (vertical descent) or at forward speeds of less than 60 kts.

(a) From hover: Lower the collective lever to maintain a steady rate of descent. Maximum VSI at touchdown = 12 ft/s. Ground cushion effect will be experienced below 30 ft, resulting in reduction of the descent rate.

(b) Rolling touchdown: With a forward speed of less than 60 kts, gently lower the collective lever to begin descent. Max VSI at touchdown = 12 ft/s. After touchdown, the helicopter will slow down and eventually stop. Steer on the ground by using rudder control.

Taxiing on ground
The helicopter may be taxied on the ground, up to a maximum speed of 60 kts, providing that the engine/rotor rpm are at 100%. Assuming that the helicopter is stationary, raise the collective lever to produce about 20% torque. Pushing forward on the main joystick will accelerate the aircraft, and likewise pulling back will decelerate and eventually stop. Steer by using the rudder.

Refuelling/Rearming/Repairs
By landing or taxiing onto a helipad (not an enemy one!) the aircraft may refuel, reload with weapons, and be repaired. Once on the pad, close the throttle to bring turbine & rotor rpm to zero. The helicopter will be serviced and prepared for the next take-off immediately.

Backward & Sideways Flight
Starting from the hover, the helicopter may be flown backwards by raising the collective lever and raising the nose to approximately 10 deg. The speed readout will turn blue to denote backward flight. Keep the nose of the helicopter pitched up to sustain speed. Likewise, the helicopter may be flown sideways by rolling left or right and raising the collective lever. The speed readout does not show sideways speed and the pilot must watch the sideslip indicator on the artificial horizon in order to monitor sideways drift.

Torque Turn
This manoeuvre allows the pilot to perform a 180 deg turn with a dramatic climb & simultaneous turn.
With a forward speed of 100 kts or more, pull the nose of the aircraft up to approx 70 deg pitch. Hold this nose-up attitude until the speed drops to approx 60 kts. Release joystick & apply rudder until heading has changed by approx 160 deg. Release rudder, adjust roll to zero if necessary and accelerate with nose down attitude. During this manoeuvre, the helicopter will roll, pitch & yaw simultaneously, pulling down on a reciprocal heading.

Aerobatics
The Apache may be flown safely within the following limits:
Pitch ± 90 deg
Roll ± 110 deg
Control response may become unpredictable outside these limits i.e. loops & rolls are NOT recommended!

Autorotation
Autorotation is equivalent to the helicopter "gliding" through the air and is used when the pilot wishes to descend rapidly or after engine failure.
During autorotation, the rotor blades are being driven by airflow through the rotor disc as the helicopter descends. This reduces the power required from the engines and the engine RPM is automatically reduced to maintain 100% rotor speed and the "split" between turbine rpm & rotor rpm can be seen on the bar scales. Autorotation is best performed at approximately 60 kts. and above 500 ft. Entry into autorotation is made by gently lowering the collective lever:

(a) Engines active
As the descent rate builds up, the automatic throttle control will be seen to reduce the turbine rpm. Any fluctuations in rotor rpm will be compensated automatically by the autothrottle. As the altitude falls to below 200 feet, the pilot should begin to pull the collective lever up to reduce the rate of descent, accompanied by raising the nose of the helicopter if he wishes to slow down. With practice, the pilot will co-ordinate increasing the collective and adjusting the pitch angle in order to slow down to the hover just a few feet above the ground.

(b) Engine-off landings
In the event of failure of both engines or if the pilot deliberately closes the throttle in flight, engine rpm will reduce to zero. The pilot must respond quickly by lowering the collective lever before the rotor blades slow down too much. Rotor rpm is controlled during the descent by careful adjustment of the collective lever. Keeping the helicopter level and the speed between 50 & 60 kts, raise the collective lever just before touchdown to bring the rate of descent to below 12 ft/sec.

Warnings – limits worth noting!
1. The maximum permissible speed of Apache is 197 kts, in a dive. If the speed should rise above this, the speed readout will flash red and the pilot will get an audible warning. If he continues to increase his speed, the helicopter will shed a rotor blade at 210 kts, resulting in catastrophic loss of control!
2. If the pilot demands too much power from the engines (overtorque), the torque readout will be in the red, the engine temperature will rise into the red,and an audible warning will occur. If this warning is ignored, the engines will overheat and eventually fail. It is possible to hover and fly on one engine but flying time is limited if both engines have failed!

HELICOPTER AERODYNAMICS
The following description is intended only as an introduction to the subject. We recommend the following book for further reading:
"The Helicopter – history, piloting & how it flies" by John Fay, Published by David & Charles
The rotor blades of a helicopter force air downwards as they pass through the air. This results in an upward lifting force. The pilot may increase this lift by "collectively" increasing the "angle of attack" of all the rotor blades and the helicopter will rise. In order to move forwards, the rotor blades are tilted forwards, thereby using part of the lift to accelerate the helicopter.
The amount of lift generated by the rotor blades increases with helicopter speed. This is called translational lift and results in the pilot requiring less collective as his speed increases. However, as the helicopter continues to accelerate, this extra lift is offset by the build up of large drag forces which in turn must be overcome with higher collective settings. This variation in "operating efficiency" can be visualised as a curve, with its peak at approximately 60 kts. A helicopter requires much more power for a vertical climb than it does for the same rate of climb with forward speed. Its hovering ceiling is much lower than its ceiling with speed. Both of these effects are due to translational lift.

SUMMARY OF CONTROLS

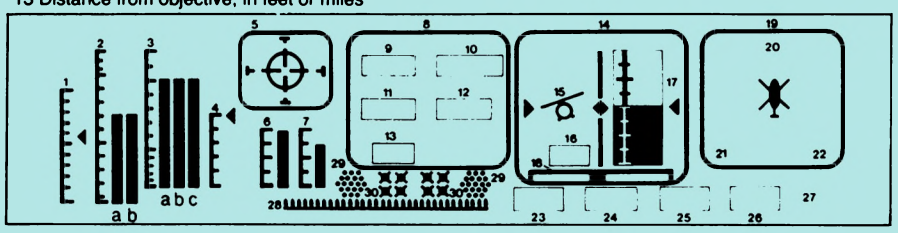
RH = right hand, LH = left hand

5	roll left	(RH joystick left)
6	pitch UP	(RH joystick back)
7	pitch DOWN	(RH joystick forward)
8	roll RIGHT	(RH joystick right)
CAPS SHIFT		
	LEFT rudder	(LH joystick left)
Z	RIGHT rudder	(LH joystick right)
C	change mode of Doppler	
N	Next objective	(LH joystick fire button)
P	Select weapon system	
Ø	FIRE button	(RH joystick fire button)
Q	increase collective	(LH joystick back)
A	decrease collective	(LH joystick forward)
W	open THROTTLE	
S	close THROTTLE	
M	MAP	
H	Pause	
J	Continue	

CAPS SHIFT and SPACE together to Abort mission & return to menu.

INSTRUMENT PANEL NOTATION

1 Collective lever
2 Torque % (a) Engine 1 (b) Engine 2
3 RPM % (a) Engine 1 (b) Rotor blades (c) Engine 2
4 Throttle indicator
5 TADS – Target Acquisition & Designation System
6 Fuel level
7 Engine temperature
8 Pilot's Visual Display Unit
9 Speed, in knots (yellow = forwards, cyan = backwards)
10 Altitude, in feet
11 Time to objective, hours & mins
12 Vertical speed indicator, VSI, feet per sec
13 Distance from objective, in feet or miles
14 Artificial Horizon
15 Roll symbol
16 Roll angle
17 Pitch angle
18 Sideslip (drift) indicator
19 Doppler Navigation/Compass
20 Heading
21 Bearing
22 Track
23 Engines
24 Weapons
25 Nav computer
26 TADS
} Failure Status Panel
27 Score
28 30mm chain gun ammo supply
29 Rockets
30 Hellfire Missiles



TECHNICAL DATA

Performance:
Maximum speed 197 kts
Maximum cruise speed 162 kts
Maximum vertical rate of climb: 1450 ft per min.
Service ceiling 20,000 ft.
Endurance: 1 hr 50 min to 2 hr 30 min, according to weapon load and mission profile.

Engines: Two General Electric T700-GE-701 turboshaft engines
Each rated at 1695 shp

Weight: Empty: 11,015 lb (4996 kg)
Primary mission gross weight: 14,694 lb (6665 kg)
Maximum take-off weight: 17,650 lb (8006 kg)

Armament:
One Hughes M230A1 chain gun 30 mm automatic cannon with up to 1200 rounds, rate of fire 750 rnds/min. Four underwing strongpoints to carry up to 16 Rockwell AGM-114A Hellfire laser-seeking anti-armour missiles or up to 76 2.75 inch rockets

Dimensions:
Rotor diameter 48 ft, tail rotor diameter 9 ft 2 in
Overall length 58 ft 3 in
Overall height 15 ft 3 in

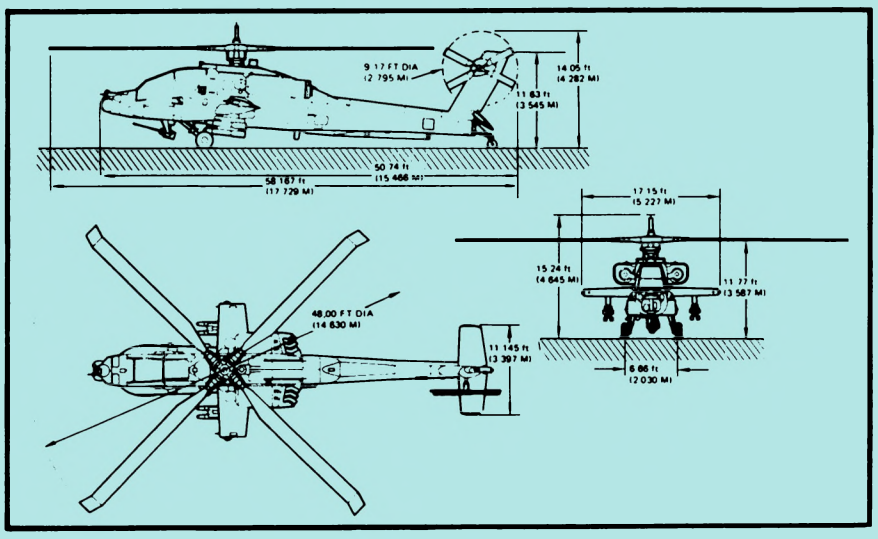
Crew:
Co-pilot/gunner and pilot in tandem

History:
First flight (YAH 64) 30th September 1975
Entered service with US Army in 1984.

All information stated herein is accurate to the best of our knowledge. Although considerable effort has been given to achieving a realistic simulation, approximations have been made due to the limitations of the computer and certain technical data not being available to the public.

Acknowledgements

Digital Integration would like to thank McDonnell Douglas Helicopters for their technical assistance during the design of TOMAHAWK. We would also like to thank the many pilots who kindly assisted in the testing and evaluation of this product.



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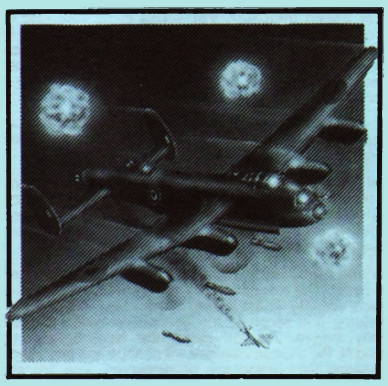
ONLY ACES SURVIVE IN ...

NIGHT GUNNER



NIGHT GUNNER is an action-packed arcade-style game based on a Second World War scenario. You are the gunner and bomb aimer whose task is to defend your plane against enemy attack and destroy the ground targets in 30 different missions. The rewards are high for the expert marksman, but beware, the going gets tougher on each new mission!

Loading:
CASSETTE: LOAD ""
(if 128K put into 48K mode first)

DISK: From POWER UP or RESET insert disk and press ENTER.
From +3 BASIC insert disk and type LOAD "*" and press ENTER.

When the program has loaded the user is prompted for a Softlock security code. The response code is found in the table on pages 4 and 5 of the instructions, and the reply is entered using keys 0 - 9 and ENTER. The program allows 3 attempts for the number to be entered correctly. The game is now ready for playing

OPTIONS

The game options on the menu page are controlled using keys 1 - 7.
1. Number of players 1 or 2.
2. Player 1 difficulty level, 1 to 4.
3. Player 2 difficulty level, 1 to 4.
4. Control type
   - Keyboard
   - Joysticks: Sinclair Interface 2, Kempston, AGF
5. Number of Joysticks 1 or 2.
6. High score table, blank or DI challenge.
7. Demonstrating title page sound ON or OFF.

CONTROLS

Top row of keyboard – Move sight/plane UP
Left five keys on second row – Move sight/plane LEFT
Right five keys on second row – Move sight/plane RIGHT
Third row of keyboard – Move sight/plane DOWN
Caps shift or space – Fire guns/release bombs
Symbol shift, B and N together – Hold
Symbol shift, X and C together – Reset

SCREEN DISPLAY

The score and number of lives left for each player is shown at the top of the screen, player 1 on the LEFT, player 2 on the RIGHT. The highest score of the day is displayed at the centre.

The plane's status panel at the bottom of the screen displays the following information:

TT: Time to Target or end of mission, in seconds
BT: Time remaining during ground attack, in seconds
HIT: Illuminated when your aircraft is hit by enemy aircraft or flak
CAPTAIN'S REPORT: Messages from the pilot during mission
DAMAGE: Indicated by the aircraft symbol, GREEN = all clear, YELLOW = damaged, RED = destroyed
WEAPONS: Ammunition, bombs and rockets shown to the right of the aircraft symbol.

PLANE DEFEND

You must defend your plane against the attacking fighters on the flight to and from the bombing target by shooting them down. The gun sight is moved using the keyboard or joystick movement controls and guns fired using the fire buttons. Just like a real gun, there is a time delay from when the bullet is fired to when it hits the target. This has to be allowed for by aiming the gun in front of the moving target. This is called deflection shooting.

The bullet delay can be seen by moving the sight and firing the guns. The centre point of the bullets will be seen outside the centre square of the sight.

Your score will increase each time you shoot down an enemy plane, a barrage balloon or the bonus plane that occasionally crosses the sky.

BOMBING OR ROCKET GROUND ATTACK

All 30 of the ground attack missions are different, alternating between high level bombing targets and low level rocket attacks. The bombing/rocket sight allows for your plane's movement when aiming at the targets but you have to make an allowance for moving targets. The amount you score is dependent upon how close to the centre of the target your bomb or rocket hits and if the character is worth double score.

Flak will be fired at you during ground attack missions, its accuracy dependent upon how much you weave about the sky. Long periods of straight and level flight during a bombing mission will result in you being illuminated by a searchlight. This will obscure your target and put you under very heavy fire from flak. Escape from the searchlight by manoeuvering your aircraft.

During high level bombing, control your plane using the left, right, up and down controls. Climbing and diving will affect your aircraft speed. During rocket attacks, the pilot continually gives your height. Climb to get sufficient height and then dive onto your target, release a rocket and pull out of the dive. If you hit the ground you will lose a life.

The sight on the ultimate mission is different from all the others. Adjust your height so that the two spots on the screen form a figure 8, line up the two bars onto the centre of the towers and release your bomb.

PLANE DAMAGE

This is caused by attack from the enemy planes or being hit by flak on the bombing runs, the amount of damage being indicated by the aircraft status symbol. Yellow areas on the status plane indicate where the plane has been damaged, and red areas where it has been destroyed. If the damage is serious you will crash and lose a life. The damage can be divided into five areas; the flight deck, engines, wings, tailplane, and gun turret.

Flight deck: Damage will result in random movement of the plane during ground attack missions, making bomb and rocket aiming difficult. When the flight deck is destroyed the plane will crash.

Engines: If enough engines are destroyed or damaged before the bombing run then the bombs will be dropped. If 3 or more engines are destroyed then the plane will crash.

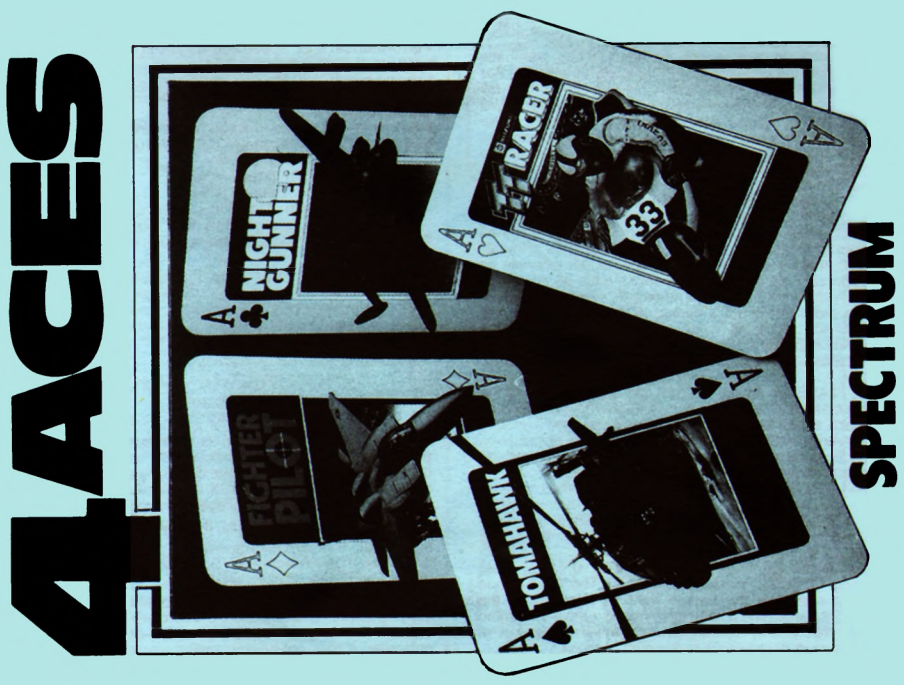
Wings or tailplane: If these are damaged it has no effect on the performance of the plane, but if they are destroyed then the plane will crash.

Gun turret: If this is damaged the sight will not move as quickly as normal. When it is destroyed the sight has no movement but the guns can still be fired.

Although the concept of NIGHT GUNNER is based upon the Avro Lancaster four engined bomber, it is not intended to be a simulation.

SOFTLOCK SECURITY TABLE ▼

1	282	51	664	101	14	151	138	201	961	251	578	301	459	351	477	401	206	451	533
2	905	52	216	102	9	152	907	202	211	252	406	302	533	352	664	402	769	452	533
3	648	53	391	103	333	153	217	203	76	253	907	303	541	353	724	403	608	453	594
4	962	54	325	104	23	154	981	204	15	254	967	304	271	354	514	404	148	454	919
5	987	55	660	105	81	155	721	205	980	255	19	305	725	355	157	405	966	455	91
6	515	56	394	106	645	156	968	206	144	256	258	306	154	356	403	406	142	456	323
7	917	57	671	107	713	157	398	207	772	257	393	307	2	357	844	407	908	457	145
8	331	58	781	108	464	158	339	208	325	258	322	308	338	358	962	408	657	458	796
9	15	59	604	109	796	159	284	209	527	259	136	309	787	359	520	409	577	459	462
10	283	60	926	110	906	160	449	210	9	260	920	310	142	360	220	410	3	460	283
11	859	61	653	111	843	161	799	211	130	261	778	311	194	361	69	411	9	461	728
12	662	62	149	112	5	162	208	212	520	262	989	312	520	362	455	412	29	462	705
13	664	63	399	113	19	163	787	213	147	263	668	313	265	363	9	413	280	463	401
14	384	64	667	114	908	164	137	214	720	264	2	314	604	364	902	414	522	464	337
15	327	65	283	115	711	165	663	215	331	265	649	315	88	365	475	415	455	465	78
16	708	66	159	116	595	166	606	216	597	266	402	316	466	366	150	416	93	466	772
17	145	67	668	117	203	167	413	217	461	267	201	317	597	367	282	417	791	467	281
18	979	68	604	118	772	168	411	218	833	268	777	318	412	368	195	418	908	468	984
19	139	69	588	119	138	169	899	219	206	269	471	319	847	369	666	419	208	469	475
20	788	70	713	120	602	170	409	220	798	270	784	320	22	370	153	420	981	470	517
21	663	71	461	121	660	171	542	221	963	271	272	321	88	371	977	421	277	471	652
22	525	72	599	122	331	172	923	222	835	272	597	322	662	372	768	422	516	472	397
23	536	73	540	123	904	173	966	223	145	273	986	323	603	373	71	423	722	473	152
24	648	74	777	124	787	174	786	224	71	274	899	324	705	374	451	424	16	474	74
25	474	75	918	125	270	175	196	225	321	275	130	325	902	375	969	425	581	475	903
26	450	76	394	126	403	176	723	226	910	276	136	326	512	376	130	426	467	476	798
27	198	77	593	127	583	177	926	227	455	277	794	327	130	377	90	427	330	477	522
28	151	78	709	128	262	178	919	228	153	278	645	328	730	378	794	428	602	478	215
29	721	79	337	129	278	179	320	229	525	279	783	329	21	379	665	429	924	479	398
30	642	80	24	130	834	180	850	230	543	280	654	330	981	380	525	430	401	480	856
31	717	81	850	131	579	181	525	231	859	281	395	331	138	381	95	431	17	481	523
32	734	82	468	132	848	182	461	232	849	282	967	332	71	382	726	432	897	482	588
33	0	83	351	133	841	183	540	233	791	283	143	333	966	383	907	433	339	483	729
34	257	84	980	134	259	184	771	234	197	284	336	334	906	384	278	434	202	484	202
35	706	85	335	135	149	185	22	235	137	285	724	335	82	385	217	435	220	485	974
36	917	86	791	136	844	186	912	236	987	286	75	336	387	386	406	436	975	486	72
37	395	87	140	137	520	187	705	237	279	287	667	337	345	387	730	437	463	487	326
38	925	88	523	138	328	188	590	238	799	288	384	338	137	388	664	438	23	488	769
39	94	89	403	139	776	189	861	239	990	289	211	339	466	389	596	439	525	489	458
40	389	90	136	140	396	190	404	240	857	290	600	340	980	390	595	440	343	490	279
41	925	91	775	141	386	191	142	241	847	291	784	341	910	391	344	441	399	491	275
42	594	92	397	142	524	192	643	242	587	292	66	342	282	392	856	442	479	492	64
43	469	93	336	143	715	193	259	243	768	293	475	343	21	393	513	443	781	493	66
44	269	94	599	144	5	194	285	244	516	294	154	344	923	394	88	444	900	494	512
45	336	95	389	145	592	195	798	245	156	295	536	345	520	395	640	445	651	495	448
46	89	96	781	146	969	196	601	246	85	296	453	346	344	396	409	446	793	496	962
47	911	97	523	147	145	197	585	247	987	297	855	347	391	397	771	447	223	497	915
48	76	98	780	148	669	198	150	248	324	298	260	348	281	398	458	448	844	498	835
49	257	99	325	149	798	199	914	249	394	299	208	349	527	399	717	449	531	499	324
50	79	100	666	150	159	200	906	250	129	300	960	350	717	400	141	450	569	500	156



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