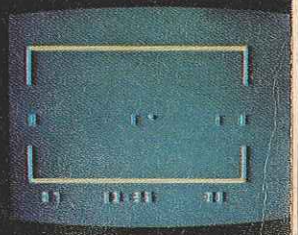
$1.00 ■ DEC. 1976

Radio-Electronics®

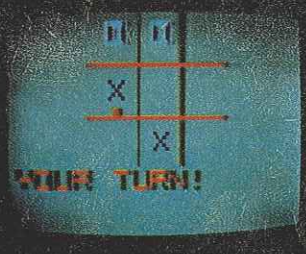
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

inside
TV GAMES
for '77

color
TV PROJECTION
systems

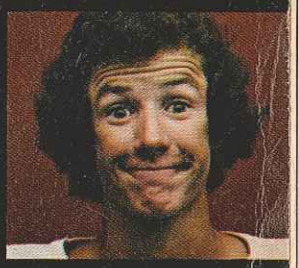


how to
INSTALL CB
in your car

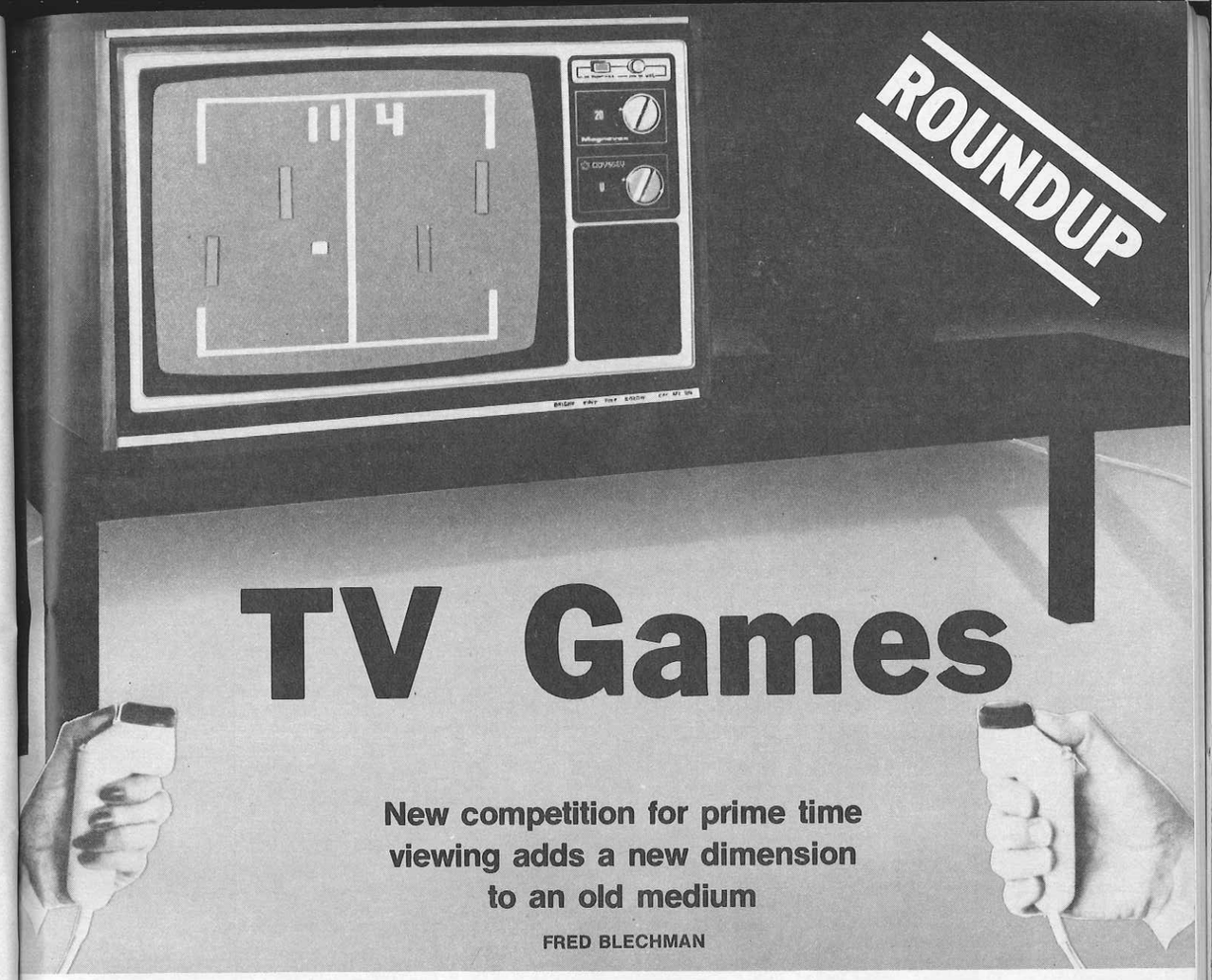


what's new in
CAR STEREO
sound systems

build IC
ANTI-THEFT
circuits



PLUS: Build Electronic Roulette ★ Add Functions to Your Calculator ★ How Timeshare Computers Work ★ [illegible] Nakamichi Cassette Deck & Heath Equalizer ★ Jack Darr's Service Clinic ★ Komputer Korner ★



ROUNDUP

TV Games

New competition for prime time viewing adds a new dimension to an old medium

FRED BLECHMAN

DURING 1975, THE MARKET FOR ELECTRONIC TOYS, GAMES AND amusements expanded abruptly into one of the most exciting and potentially profitable segments of the consumer electronics industry. This was due largely to the success of the home video-game, introduced by Magnavox in 1972 under the *Odyssey* name. Atari, a leader in the coin-operated video game field, introduced *Pong* through Sears and Roebuck stores in 1974.

Now video games are hitting the home market in a big way, with some industry officials estimating sales of 12 million units annually by 1980! It's no wonder that over 40 firms are manufacturing completely ready-to-operate home video-games for use with television receivers, and several others are offering kits or plans to build your own.

FCC regulations

A black cloud hovering over this potentially lucrative market, however, is the Federal Communications Commission. Home TV games are essentially miniature television transmitters whose video output ideally should be connected directly into the video input circuitry of the receiver being used to display the game. Unfortunately, most TV sets don't have a video input jack, and adding one requires a qualified technician. (See **Radio-Electronics**, August 1976 issue, page 57, for how this can be done). For this reason, ready-made TV games designed for home use contain a low-powered video modulated RF transmitter, usually operating on Channels 2 through 6 of the VHF TV-band. This TV signal is fed to the antenna terminals of the TV receiver through a switch that disconnects the regular TV antenna during game play. The FCC requires that these games—considered a Class-1 TV Device under Part II, Paragraph 15, Subpart H, of the FCC *Rules and Regulations*—not emit more than 15 microvolts-per-meter of RF energy. Many of the designs submitted for approval under these regulations radiated between 40 and 80 microvolts-per-meter! Furthermore, the Regulations have no provision for approval of a separate video-modulated oscillator—the entire game must be submitted and approved as a unit. Even the antenna switch must satisfy FCC isolation requirements (at least 60-dB attenuation) to prevent the game signal from "leaking" out the TV antenna and being broadcast all over the neighborhood!

With game interference complaints on the increase, the FCC is taking an even harder look at their approval specifications, and may soon tighten them further. It doesn't take much imagination to see the threat this places on the manufacturers. At this time, many units still have not received FCC approval and they may not legally be announced, advertised or sold before such approval. Violators are being aggressively dealt with by the FCC. Doing any of the following may cause interference to nearby television sets and is against FCC regulations: using longer-than-supplied twin lead wires from

Comparison chart on pages 40 & 41
text continues on page 42

COMPARISON CHART – VIDEO GAMES AND KITS

MANUFACTURER OR DISTRIBUTOR	GAME NAME OR MODEL	GAME	KIT	PLANS	NUMBER OF GAMES	NUMBER OF PLAYERS	COLOR DISPLAY	PADDLES/PLAYERS: SIZE VARIABLE	MOVE VERTICAL	MOVE HORIZONTAL	KNOB	LEVER	JOYSTICK	REMOTE CONTROLS	BALL: DEFLECTION VARIABLE	SPEED VARIABLE	SCORING: ON-SCREEN DIGITAL	ON-SCREEN MARK	MANUAL	SERVE: AUTOMATIC	MANUAL	AUTOMATIC PLAY	SOUND	MONITOR BUILT-IN	POWER: BATTERIES	AC	AC ADAPTOR	IC USED	FCC APPROVED	PRICE ($)	NOTES & REMARKS
ADVANCED ELECTRONICS P.O. BOX 133 CORVALLIS, OR 97330	PONG			●	7	4		●	●	●			①		●	●	●			●			●			●			⑧	5	①②③④⑤⑦
	ANTI-AIRCRAFT 1 & 2			●	2	2			●	●	⑥						●			●			●			●			⑧	8	①②③④⑤⑦
	JAWS-2 & SPACE RACE			●	2	2			●	●			●				●			●			●			●			⑧	8	①②③④⑤⑦
ADVANCED MICROCOMPUTER PRODUCTS P.O. BOX 17329 IRVINE, CA 92713	6 TV GAMES ON ONE CHIP			●																									1	②
			●		6	2		●	●				①		●	●	●			●	●	●	⑨			⑩		GI	⑧	70	
ALLIED LEISURE INDUST., INC. 245 W. 7th PLACE HIALEAH, FL 33014	THE NAME OF THE GAME #I	●			6	4	●	●	●		●			●		●	●			●		●	●		?			⑪		98	
	THE NAME OF THE GAME #II	●			4	2	●		●		●			●			●			●		●	●		?			⑪		78	
AMCOR, LOS ANGELES, CA (ADDRESS UNKNOWN)	TABLE MODEL	●			1	4																						⑧	495	
	BAR MODEL	●			1	4																						⑧	495	
APF ELECTRONICS, INC. 444 MADISON AVE. NEW YORK, NY 10022	TV FUN® (MODEL 401)	●			4	2		●	●		●				●	●	●			●		●	⑨		●		●	GI	●	89	
ARS SYSTEMS P.O. BOX 1922 SUNNYVALE, CA 94088	BASIC TV PING PONG			●	1	2				●	●		①						●	●								⑤	⑧	12	⑦ ⑩
ATARI, INC. CONSUMER DIV. 1195 BORREGAS DR. SUNNYVALE, CA 94086	C-100 PONG™	●			1	2	●		●		●					●	●			●		●	●		●		●	AMI		80	
	C-140 SUPER PONG™	●			4	2	●		●		●					●	●			●		●	●		●		●			90	
	C-160 PONG DOUBLES	●			1	2	●		●		●					●	●			●		●	●		●		●	EI		80	
BROADMOOR (OLYMPIC INT'L) 26 GENERAL PLACE JERICHO, N Y 11753	FOUR-PLAY	●			2	4											●							●				⑧	199	
CAL KIT, INC. P.O. BOX 877 SEBASTOPOL, CA 95472	PING-PONGTRONICS		●		4	2					●	●			●	●		⑫		⑫	●	●	⑫		●			⑤	⑧	55	② ⑦
CHANNEL MASTER ELLENVILLE, N Y 12428	CHALLENGER	●			4	2			●								●						●					GI		80	DID NOT REPLY TO INQUIRY
COLECO INDUSTRIES, INC. 945 ASYLUM AVE. HARTFORD, CT 06105	6040 TELSTAR™	●			3	2		●	●		●					●	●			●			●		●		●	GI	●	60	⑨
	TELSTAR™ CLASSIC	●			3	2		●	●		●					●	●			●			●		●		●	GI	●	70	⑨
CONTINENTAL MICROSYSTEMS, INC. 11347 VANOWEN ST. NORTH HOLLYWOOD, CA 91609	V44B BANG	●			4	2		●	●			●		●	●	●	●			●	●	●	●			●		GI		70	⑨
	V44C BANG	●			4	2	●	●	●			●		●	●	●	●			●	●	●	●			●		GI		90	⑨
	V44C5 BANG	●			6	4	●	●	●			●		●	●	●	●			●	●	●	●			●		MOS		110	⑨
DYN 3095 NW 77th AVE. MIAMI, FL 33122	PADDLE-FOUR	●			4	2								●			●											GI	●	79	
	PADDLE-SIX	●			6	2								●			●													124	
ENTERPREX INTERNATIONAL CORP. 1231 NORTH BROADWAY LOS ANGELES, CA 90012	APOLLO 2001	●			4	2			●	●			●			●	●	●			●		●			●		●	GI	●	90	⑨
ENTEX 1016 E. BURGROVE CARSON, CA 90746	TELE-PONG	●			3	2				●	●	●					●			●	●		●			●			●	85	
EXECUTIVE GAMES, INC. DORCHESTER, MA 02124	TV TENNIS	●			3	2								●												●	●		●	69	DID NOT REPLY TO INQUIRY
	FACE-OFF	●			2	2			●	●	●			●																90	
FAIRCHILD CAMERA & INST. CORP. CONSUMER PRODUCTS GROUP 4001 MIRANDA AVE. PALO ALTO, CA 94303	VIDEO ENTER-TAINMENT SYSTEM	●			26	2	●							●									●					F8		under 150	⑬ ⑭
FANTASIA 1098 RANDOLPH AVE. RAHWAY, N J 07063	FANTASIA 101	●			4	2											●	●										GI		59	DID NOT REPLY TO INQUIRY
FIRST DIMENSION CORP. 708 BERRY RD. NASHVILLE, TN 37204	VIDEO SPORTS™ 76	●			4	2		●	●		●					●	●	●										GI		69	⑨
	VIDEO SPORTS™ 76C	●			4	2	●	●	●		●					●	●	●												79	⑨
	VIDEO SPORTS™ MARK IV	●			3	2	●	●	●			●					●	●					●		●		●	NS		79	
	MODEL FD 3000W	●			6	4											●		●			●	●		●		●			129	⑮
FRIED TRADING CO. 167 CLYMER ST. BROOKLYN, N Y 11211	GRANADA	●			4	2																						GI		79	DID NOT REPLY TO INQUIRY
GLOBAL VIDEO INDUST., LTD. 1818 WESTLAKE AV. NORTH, SEATTLE, WA 98109	CHALLENGE	●			1	4																		●				⑧			50" DIAGONAL SCREEN
HEATH COMPANY BENTON HARBOR, MI 49022	GD-1380 SPORTSCREEN™		●		6	2		●	●			●			●	●	●	●			●	●	●				⑱	GI	⑧	50	⑯ ⑰ ⑨
I.E.A. DOWNSVIEW ONTARIO, CANADA	TELETAINMENT II	●			7	2				●		●					●				●				●		●				
INTERFAB 27963 CABOT RD. LAGUNA NIGUEL, CA 92677	T V TENNIS		●		4	2		●	●	●	●		⑫	●			●	●			●	●			●			⑤	⑧	19	
INTERNET LOS ANGELES (ADDRESS UNKNOWN)	CONCERT HALL IV	●			4	2																								79	TELE-MATCH UNDER PRIVATE LABEL
INTERSTATE INDUST., INC. 111 SOUTH WASHINGTON BLVD. MONDELEIN, IL 60060	TELE-MATCH 4400	●			4	2		●	●		●			●	●	●	●	●			●	●		●		●		●	GI	●	70	⑨
	TELE-MATCH 7700	●			4	2		●	●		●			●	●	●	●	●			●	●		●		●		●	GI		80	DIFFERENT CASE ⑨
JADE CO. 2007 W. CARSON TORRANCE, CA 90501	VIDEO GAME KIT		●		5	2			●		●			●	●	●	●			●		●	●			●		⑤	⑧	19	4 SOUNDS 3 PROM'S

COMPARISON CHART – VIDEO GAMES AND KITS (Continued)

MANUFACTURER OR DISTRIBUTOR	GAME NAME OR MODEL	GAME	KIT	PLANS	NUMBER OF GAMES	NUMBER OF PLAYERS	COLOR DISPLAY	PADDLES/PLAYERS: SIZE VARIABLE	MOVE VERTICAL	MOVE HORIZONTAL	KNOB	LEVER	JOYSTICK	REMOTE CONTROLS	BALL: DEFLECTION VARIABLE	SPEED VARIABLE	SCORING: ON-SCREEN DIGITAL	ON-SCREEN MARK	MANUAL	SERVE: AUTOMATIC	MANUAL	AUTOMATIC PLAY	SOUND	MONITOR BUILT-IN	POWER: BATTERIES	AC	AC ADAPTOR	IC USED	FCC APPROVED	PRICE ($)	NOTES & REMARKS
JAMES ELECTRONICS P.O. BOX 822 BELMONT, CA 94002	PROFESSIONAL VIDEO GAME		●		4	4			●	●				●	●		●			●			●	●			●		⑤	⑧	19	IC'S ASSEMBLED TO PCB AND PRE-TESTED
KENDALE TECHNOLOGY 814 PONCE DE LEON BLVD. CORAL GABLES, FL 33134	KEN-TECH 3000	●			3	2																								100	DID NOT REPLY TO INQUIRY
LLOYD'S 180 RARITAN CENTER PKWY. EDISON, N J 08817	MONTE VERDE	●			6	2								●		●													●	100	DID NOT REPLY TO INQUIRY
	LLOYD'S	●			6	2																					●			100	
LTA 9615 COZYCROFT CHATSWORTH, CA 91311	HOMEMACHINE	●			4	4											●												⑧	1495	(DID NOT REPLY TO INQUIRY) FREE-STANDING SELF-CONTAINED UNITS. ADD-ON GAME MODULES @ $200 EACH.
	ATTACHE CASE MODEL	●			30	?																							⑧	3000	
MAGNAVOX 1700 MAGNAVOX WAY FORT WAYNE, IN 46804	ODYSSEY®100	●			2	2			●		●					●				●	●		●		●		●	●	TI	●	60	
	ODYSSEY®200	●			3	2			●		●					●				●			●		●		●	●	TI	●	80	
	ODYSSEY®300	●			3	2			●		●					●	●	●		●			●		●		●	●	GI		70	⑨
	ODYSSEY®400	●			3	2			●	●	●					●	●	●		●			●		●		●	●	TI		100	㉑ ㉒ ⑨
	ODYSSEY®500	●			4	2	●		●	●	●					●	●	●		●			●		●		●		TI		130	㉑ ⑨
	MODEL 4305	⑳			3	2	●		●		●			●		●	●	●		●			●		●		⑳		⑧		500	⑨ 19" COLOR TV WITH GAME BUILT-IN
MEGO (TOY CO.) (ADDRESS UNKNOWN)	PHASER BATTLE	●			1	1																							TI		40	
MICROLECTRONIC SYSTEMS CORP. ONE ELECTRONICS COURT MADISON HEIGHTS, MI 48071	RICOCHET™	●			4	2	●	●	●		●			●		●	●	●			●	●	●			●		●	GI	●	100	⑨ DID NOT REPLY TO INQUIRY
MORSE 101-10 FOSTER AVE. BROOKLYN, N Y 11236	ELECTROPHONIC SUPER-PRO	●			6	4								●												●		●	GI		99	DID NOT REPLY TO INQUIRY
NATIONAL SEMICONDUCTOR CONSUMER PRODUCTS DIV. 1177 KERN AVE. SUNNYVALE, CA 94086	ADVERSARY	●			3	2	●	●	●			●		●			●	●			●	●	●			●			NS		99	㉓
PHONE-MATE INC. 325 MAPLE AVE. TORRANCE, CA 90503	ZONK	●			4	2																							GI		99	DID NOT REPLY TO INQUIRY
	ZONK	●			6	2																									119	
QUADTRONICS (ADDRESS UNKNOWN)	MODEL Q476	●			4	2	●																						GI	●	80	
RADIO SHACK 2617 WEST SEVENTH ST. FORT WORTH, TX 76107	TV SCOREBOARD™	●			4	2	●	●	●		●			●	●	●	●			●	●	●	●			●		●	GI	●	100	⑨ SAME AS RICOCHET EXCEPT GAME NAMES
RADOFIN ELECTRONICS 10 B ENGLEHARD AVE. AVENEL, N H 07001		●			4	2								●															GI		50	DID NOT REPLY TO INQUIRY
SHARK ELECTRONICS LTD. 19 W. 44TH ST. NEW YORK, N Y 10036	MECCA	●			4	2																							GI		89	DID NOT REPLY TO INQUIRY
SOUTHWEST TECHNICAL PRODUCTS 219 WEST RHAPSODY SAN ANTONIO, TEXAS 78216	SPACE WAR GAME		●		1	2			●		●			●						●						●			⑤	⑧	39.50	VIDEO OUTPUT ONLY
TOKYO PHOENIX, INC. 375 SYLVAN AVE. ENGLEWOOD CLIFFS, N J 07632	MULTI HOME VIDEO GAMES	●			4	2			●	●	●					●	●	●			●	●	●			●		●	GI	●	80	㉓
UNISONIC PRODUCTS CORP. 1115 BROADWAY NEW YORK, N Y 10010	TOURNAMENT 1000	●																													99	DID NOT REPLY TO INQUIRY
	TOURNAMENT 2000	●			6	2								●					●										GI	●	119	
	TOURNAMENT 3000	●			6	4																								●	149	
UNIVERSAL RESEARCH LABS, INC. 2501 UNITED LANE ELK GROVE VILLAGE, IL 60007	VIDEO ACTION IIA™	●			3	4			●		●																				299	
	VIDEO ACTION III™	●			3	4	●		●		●																				199	㉕
	VIDEO ACTION IV™	●			4	4	●		●		●																				100	㉕ ㉖
	VIDEO ACTION GAME TABLE	●			4	4			●		●																			⑧	475	㉕ ㉖
	VIDEO ACTION™ FACT	㉗			7	2																									300	㉘
VIDEOMASTER AMERICAN CONSUMER ELECTRONICS 21 BREWSTER RD. CORNWALL, N Y 12518	VIDEOMASTER™ RALLY	●			4	2			●		●																				70	
	VIDEOMASTER™ OLYMPIC	●			7	2			●		●																				100	
	VIDEOMASTER™ 6000	●			6	2			●	●			●																	GI		150	
VISULEX P.O. BOX 4204 MOUNTAIN VIEW, CA 94040	SUPER SMASH		●		2	2			●	●	●			①				●			●	●				●			⑤	⑧	19	② COMPLETE INFO IN JUNE, JULY AND AUGUST, 1976 ⑦ ISSUES OF RADIO-ELECTRONICS ⑫

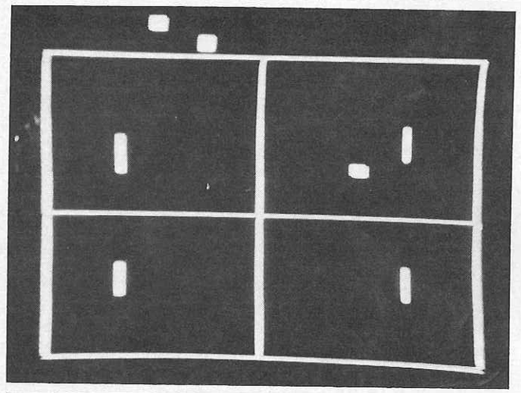
LEGEND

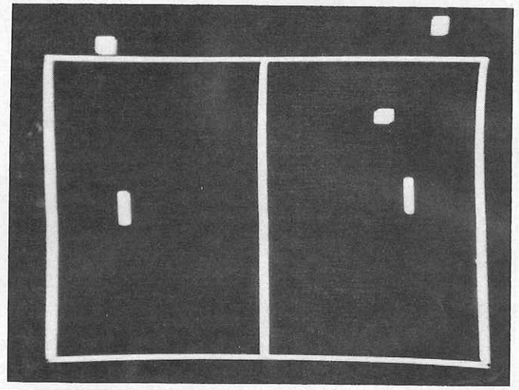
① BUILDER DETERMINES PLAYER CONTROLS
② IC'S & PC BOARDS OFFERED. SEE TEXT
③ SCORES UP TO 99 POINTS EACH
④ 7 MORE PONG OPTION PLANS–$7 EXTRA
⑤ DISCRETE IC'S USED. SEE TEXT
⑥ SWITCHES ARE USED FOR PLAYER CONTROLS
⑦ FOR ADVANCED BUILDERS ONLY
⑧ FCC APPROVAL NOT REQUIRED. SEE TEXT
⑨ THREE DIFFERENT SOUNDS. SEE TEXT
⑩ POWER SOURCE IS BUILDER'S OPTION
⑪ GI OR MPS CHIP USED
⑫ OPTIONS AVAILABLE. SEE TEXT
⑬ REPLACEABLE CARTRIDGES PROGRAM MICROPROCESSOR
⑭ ELAPSED TIME DISPLAYED
⑮ BOUNDARIES ADJUSTABLE
⑯ RIFLE AVAILABLE EARLY 1977
⑰ WIRES DIRECTLY TO HEATHKIT TV'S
⑱ DRAWS POWER FROM TV SET
⑲ SEE TEXT
⑳ GAME BUILT-IN TO COLOR TV SET
㉑ WALL CENTER CONTROL
㉒ TENNIS-DOUBLES SWITCH
㉓ SOUND THRU TV
㉔ RIFLE INCLUDED
㉕ VARIABLE ROBOT SKILL
㉖ ROAD RACE GAME INCLUDED
㉗ EDUCATIONAL GAME
㉘ INCLUDES 2 CARTRIDGES

the antenna switch to the TV; connecting the twin lead from the antenna switch to any television antenna or cable TV outlet; or attaching loose wires to your TV antenna terminals when the antenna switch is connected to your TV.

The kit builder

The necessity of FCC approval affects the consumer by cutting down the number of available choices—but there are still plenty to choose from and they are quickly and easily attached to the TV, legally. For the hobbyist or experimenter, however, who likes to "roll his own" from plans or a kit, the problem is that no units are sold in kit form with oscillator parts. The instructions might show a modulated oscillator circuit, however, and the builder finds himself in a dilemma: Readily available circuits in radio handbooks show typical VHF oscillators that he can build from easily obtained standard parts—but if he does so, he may be violating FCC regulations regarding transmission frequency or allowable radiated energy. It takes relatively sophisticated test equipment and procedures to assure compliance with FCC requirements.





A way out of this dilemma is offered by ATV Research (13th and Broadway, Dakota City, NE 68731). They offer the *model PXV-2A Pixe-Verter* transistorized oscillator in kit form for $8.50 postpaid. This kit has been on the market for over 10 years with a perfect record for not causing interference when properly assembled in a metal box (or within existing shielded equipment) and operated according to the instructions. It is built on a printed-circuit board that contains a foil output-inductor; the builder selects operation on TV Channels 2 through 6 by tapping into the appropriate turn of this printed-circuit coil with a jumper.

A home-made antenna switch could also violate FCC regulations. If you are looking for a switch that has a very low insertion loss and meets the 60-dB isolation requirement of the FCC, consider the one made by Manu-Tronics, Kenosh, Wisconsin. This switch is sold by Atari dealers as a game accessory and is also available from Sears Roebuck as an Extra Antenna Switch, catalog No. 6-99726, $9.95.

Technology

While a few die-hards (mostly kit manufacturers or plan sources) still use individual IC's, most game manufacturers this year used dedicated IC's—IC's designed specifically to perform game functions. General Instruments (GI), National Semiconductor (NS), MOS Technology, American Microsystems Inc. (AMI) and some others offer dedicated IC's. But many industry observers feel that the demand for these games will dwindle unless more variety and sophisticated game formats are offered. Enter the microprocessor, ideally suited for this purpose!

The microprocessor, really a minicomputer on a chip (without the peripherals) is more expensive than the dedicated IC, but is far more flexible and versatile. It can be programmed to perform innumerable functions—it can even play chess! A dedicated IC is limited to a particular set of instructions that are established when it is made. Because of the wide-ranging capabilities of the microprocessor, a broad spectrum of game complexities can be introduced to the user.

A number of manufacturers are taking a "let's wait and see" attitude before committing themselves heavily to this largely-seasonal market. RCA and Rockwell International, usually in the forefront of new consumer electronic devices, have apparently chosen to watch others fight it out this year in the marketplace while they keep some exotic designs on the back burner under tight wraps. Fairchild, however, has taken the proverbial bull by the horns and bypassed current dedicated IC's to jump right into a system built around their F8 microprocessor! In Fairchild's Video Entertainment System, programming will be done by slip-in cartridges to be issued regularly—kind of a "game-of-the-month" plan.

It seems probable that the market for the higher-priced but much-more-challenging microprocessor units will grow, while the present-day units will end up in toy departments.

Comparison chart

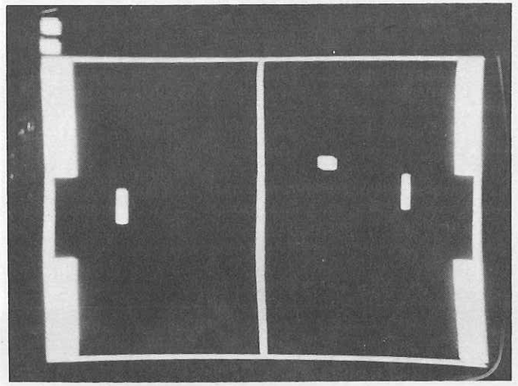
The Chart shows many features of the video games that were surveyed. A blank space in the chart does not necessarily mean that game does not have the listed feature, since information on some units was very limited. Since the terminology associated with these games may be new to many readers, explanations of some of the column headings are in order.

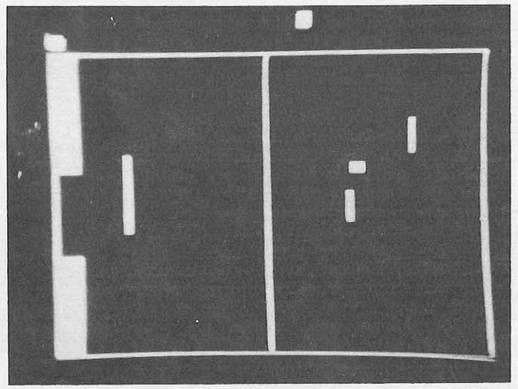
Number of Games: In the original *Odyssey* TV game, plastic overlays fit over the TV screen to establish playing boundaries, and 12 games could be played. All the units in this survey, however, use electronic borders for each game. Some borders may be off the screen, or not displayed, but they are there electronically. Most units offer a variety of games by just operating a switch. This sets the circuitry for the appropriate borders, paddles, ball and scoring sequence for the selected game. Some games are identical, but manufacturers assign them different names; for example, 2-player Handball seems to be identical to Squash; 1-player against the machine may be called Solitaire, Robot, Pelota, Automatic, 1-player Handball or Cybernetic-mode! Similarly, Target Shoot and Rifle are the same.

Number of Players: This is intended to mean the number of people who have individual controls. On some games, although 4 paddles may appear on the screen, they move in pairs and only two controls are available—these are listed as 2-player games.

Color Display: All games can be used on either color or black-and-white TV receivers or monitors. Some, indicated by a dot in this column, produce a color display on a color TV. This may be colored borders, paddles and ball, or different colored scoring digits, or different colored playing fields, or a "light show" between games (Atari), or a rainbow color pattern (*Video Action*), or some combination of these.

Paddles/Players: Promotional literature uses the term "players" almost interchangeably with "paddles" and "bats". On this chart, this refers to the controlled images. Confusion arises here because some new games actually display shaped figures on the screen, such as a shark, diver, fish, tennis player, racing car, tank or airplane. The majority of games, however, simply display small rectangles that are usually called paddles. To make the game easier for beginners, paddle size on some games is controllable and may be made larger to make a "hit" less difficult. A dot in this column means the game either has a switch or a potentiometer available to the players to change paddle size—internal adjustments are not considered.





All games offer vertical paddle control with either a knob that turns, or a slide-lever—both of which, of course, are potentiometers. The more sophisticated games provide a means of controlling horizontal movement as well, and some of these offer a joystick to allow control of both vertical and horizontal movement together!

The lower-priced games have all the controls and switches on a single console, so the players must be right at the console to play. Wired-remote controls are simply controls at the end of cables allowing the players to be more comfortable and relaxed—they can even play from an easy chair. *Wireless* remote controls may be offered in the future.

Ball Control: Even some of the most inexpensive games, because of the flexibility of the IC, offer switches to control ball speed and deflection to make the game tougher as you become more skilled. Normally, the paddles return a hit ball at some angle (called "english" by the ad men) unless it is hit with the center of the paddle, in which case it is returned straight back. This gives the player a degree of control in trying to outplay the opponent. A dot in the Deflection Variable column means that the game has a switch to *change* these return angles.

Some games have circuits that cause the ball to speed-up automatically after a certain number of "hits" in a volley. The Interfab unit has a *randomly* variable speed—the ball can speed up at any time, for any single shot—which is most realistic. A dot in the "Speed Variable" column means that either the ball speed changes automatically in some manner, or the players can control the speed with a switch or a pot.

Scoring: Early units used manual techniques (a scoring dial or marker to be moved by the players after each miss) and later units used marks or bars on the screen to indicate score. Most units now display the score for each player in digital numbers on the screen—some continuously, others only after a miss. Constant on-screen digital scoring is the most practical unless it takes up too much of the playing field. If the scoring appears outside the playing boundaries, as it does on the Interfab unit, it poses no problem. Usually 15 is "game", after which the paddles disappear and the ball randomly bounces around the court until a RESET button is pushed.

Serve: Most units serve the ball automatically. The ball is served to one of the players at the start of a game and is reserved after a miss to the one that last missed. Some games are strictly manual serve—you press a button to serve the ball; this allows you to take time out or to keep score if scoring is not automatic. Some games have a switch to allow you to select manual or automatic serve.

Automatic Play: This is a desireable feature for two reasons: It permits you to sharpen your skill with practice and it allows you to play against the game when you don't have a playmate. In this mode, you play against the machine's usually-infallible electronic brain—so you'll probably lose! Some games have a control to adjust the skill level in automatic play. If you build a kit, you can make the machine sluggish (see Interfab text) so you have a chance to win. A few units allow you to set up the machine controls so it will play a game against itself—which is interesting to watch and great for demonstration purposes if you're selling these games.

Sound: Virtually all the units provide sound through a built-in speaker rather than through the TV audio. This allows you to turn the TV audio off completely, so there is no hum or background noise. Also, games with built-in sound will "beep" while they're turned on, even if the TV is turned off, so there's no need for a game pilot light. Since most of the games are battery-operated, this can be important. Some games have *different* sounds for the ball hitting a boundary, the ball hitting the paddle, and the paddle missing the ball.

Monitor Built-In: Commercial units and some expensive home units have the video game connected directly to a video monitor, thus eliminating the need for FCC approval since the video is not modulating an RF output. One company, Magnavox, offers a 19-inch color TV with a video game built-in! Heath has avoided the necessity for FCC approval by providing instructions for its *Sportscreen* game to be wired directly into any solid-state Heathkit TV, thus using the TV as a video monitor.

FCC Approved: A blank in this column does not mean the FCC has rejected the game. When the information in this chart was compiled, many units were still pending approval and some had still not applied for approval. Some manufac-

continued on page 84

Projection TV Roundup

A new twist has been added to television in the form of large-screen projection systems for the home. Here's a look at the systems that are currently available

ROBERT GERSON

NOT EVEN RANKED AS A SERIOUS CONTENDER for the consumer market by industry experts as recently as three years ago, the big-screen home television projector has swept past the video tape recorder and the videodisc to become today's hottest new product.

An estimated 20,000 to 30,000 home-type television projection systems were sold in 1975, though admittedly the bulk of them went into taverns, discos and the like. Indications are that upwards of 50,000 will be sold in 1976 as the developing industry gears up to a claimed 100,000-unit annual production rate. With retail list prices averaging in the $1,000-$2,000 range, it's obvious that projection television is quickly moving into the big leagues.

Early Projection TV

This is the second go around for video projectors. Home video projectors came on the market at the very start of the current television craze in 1946. Most used the *Protelgram* 2.25-inch projection tube made by North American Philips to throw a somewhat murkey picture on a then-giant 25-inch screen. The screen was giant compared with the 7, 10 and 15-inch direct-view sets available at the time. The price for those projectors was about the same as is being charged today, that is in the $900 to $1,500 range. Incidentally, the prices for the small-screen monochrome direct-view sets, $300 to $1,000 for name brands, was about what the current-model color TV sets bring. Output of projection TV models peaked in 1948 at 18,500. North American Philips announced it was doubling tube production for 1949, but it needn't have bothered. That year the direct-view 19-inch picture tube became available in quantity for the first time and demand for the projection sets dwindled to virtually nothing.

From then until 1971, when Advent announced plans to market a home projection unit for $2,500, video projectors existed as high-priced ($15,000-and-up) curiosities relegated to use in theatres and at conventions. Experimental big-screen television sets were to be found in the research labs of most major television manufacturers. Among the more interesting were Zenith's three-laser projector (abandoned because of enormous power consumption) and Sony's eight-foot computer-controlled lightbulb display. Both units were shown late in 1968.

While the Advent projector revived interest in home projectors, it was considered to be too expensive for consumer use and its trio of special Schmidt optical projection tubes were not deemed suitable for mass production. The start of the current market growth can be traced to the 1972 demonstration by Sony of a projector using a single high-output Trinitron as a light source. This was followed in 1974 by a demonstration by Shannon Communications of New York of a system that threw an acceptable (in a darkened room) picture on a seven-foot screen using a special lens mounted on a standard Sony Trinitron color television.

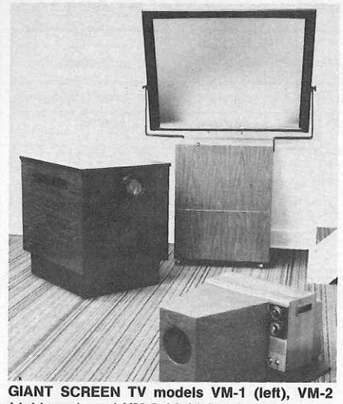
That opened the flood gates. By the end of the year a dozen companies had entered the field—some were dedicated pioneers planning to help write a new chapter in the history of television, others quick-dollar artists. Units available ranged in price from $2,750 for the Advent to the $19.95 a mail-order house charged for a plastic lens mounted in a cardboard box that, the marketer said, should be placed in front of an upside-down television set.

Today's systems

Today more than two dozen companies are known to be active in home video projectors, and there may be an equal number of local system builders. All of the models on the market today use light-amplifying Kodak or 3M screens. Except for the higher priced projectors that use three cathode ray or Schmidt optical tubes (one for each color), virtually all the units use standard color television sets as the picture source.

The most expensive of the latter is Theatervision from Worldwide Entertainment Systems, Inc. The complete system is housed in a furniture-styled highboy and uses mirrors and lenses to direct the light from the conventional receiver located in the base to the top-mounted screen. The less costly versions have a lens mounted on the front of a television receiver and a separate screen. The quality of the picture provided by the two-piece models varies from acceptable to terrible.

The coming of the home video projector age has created both a black market in the sale of television sets and concern about safety at the Food and Drug Administration. Television manufacturers and importers have generally refused to sell receivers directly to projector marketers. They say their sets weren't designed for such use and caution that operating them in cabinets without adequate ventilation could be dangerous. They also don't like the idea

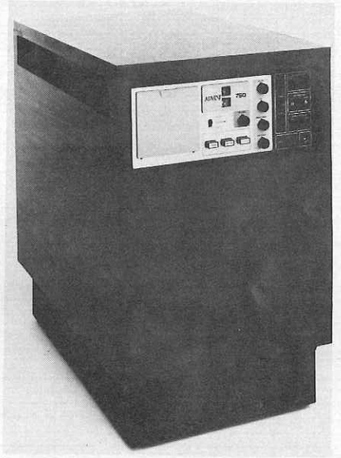


GIANT SCREEN TV models VM-1 (left), VM-2 (right rear), and VM-3 (right front).

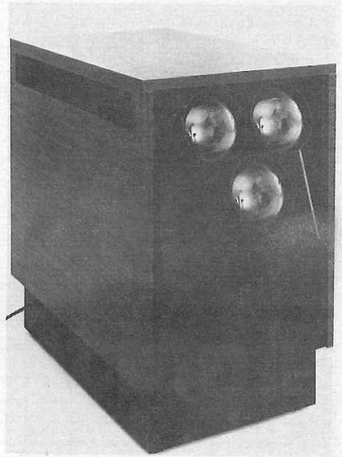
PROJECTION ELECTRONICS model 351-SI

MUNTZ ELECTRONICS

SONY model KP-4000



CONTROLS, Advent model 750



PROJECTION LENSES, Advent model 750

continued from page 43

turers, with their own test facilities and enough electronic experience to assure their designs would meet FCC approval, chose to freeze their designs early and file for FCC approval later.

Some units, as noted, don't need FCC approval if they are hard-wired to the video display.

Price: As with any new consumer item, prices are high at first, then drop. Calculators and digital wrist-watches are good examples of recent electronic devices that went through radical price adjustments in a short time after consumer acceptance. The fierce competition in the video game field can be expected to create drastic excursions in pricing, especially just before and after Christmas.

The prices shown in this column are the lowest prices quoted by any of the various sources used for this article, and should just be used as a guide. Some units at the high end of the price scale will have to reduce their prices to be competitive, and as production is increased—or a design breakthrough is incorporated into their production—others will drop their selling prices.

In regard to kit prices, it's best that you write for a current price list and order form. In most cases, shipping and tax must be added to the prices shown. **R-E**