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**Asteroids Deluxe Multigame Kit**

Step 0: Make sure the Asteroids Deluxe game is fully working!

Before installing this kit, make sure the Asteroids Deluxe game is fully functional. **The Asteroids Deluxe Multigame kit can only work on a fully functional unmodified Atari Asteroids Deluxe board.** If the game board has any special modifications such as speed up hacks, input swaps, it is possible this kit will not function correctly. This is a good time to enter test mode, make sure the RAM test passes, make sure the test mode screen does not indicate any other failures. Make sure the game can enter and exit testmode. Verify that all the game play functions, switches, LEDs, and all game sounds are working correctly. Pay close attention and make sure all the vectors are displayed correctly without any flickering or glitches. It is

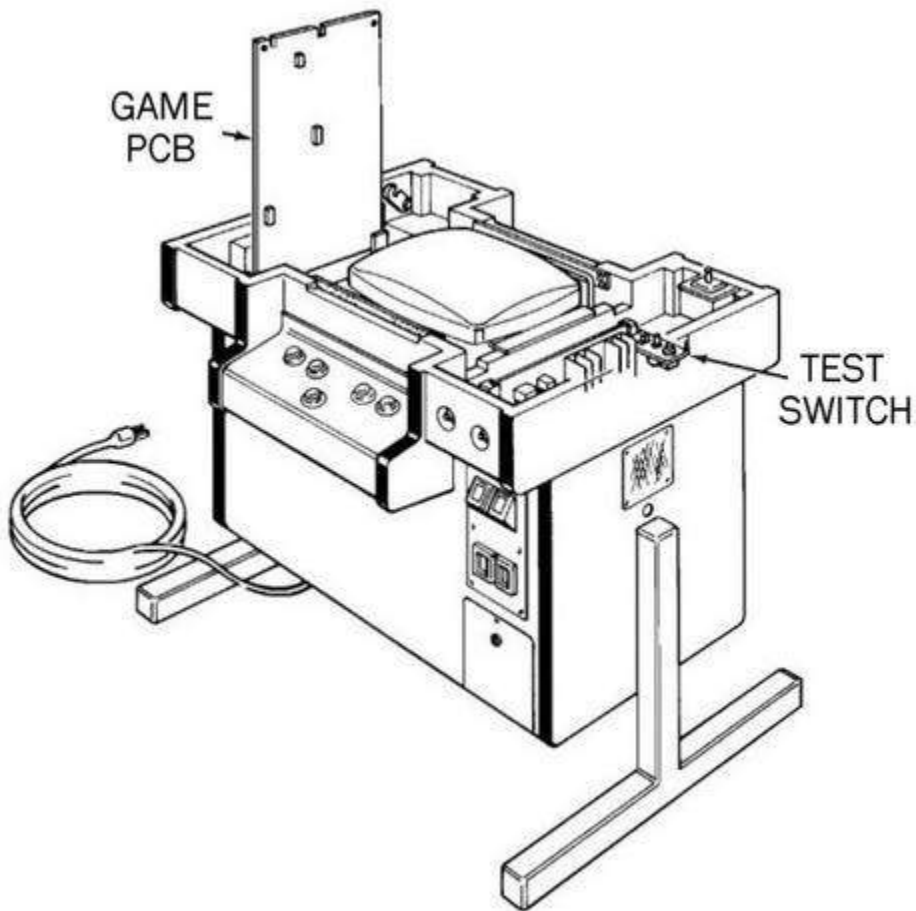
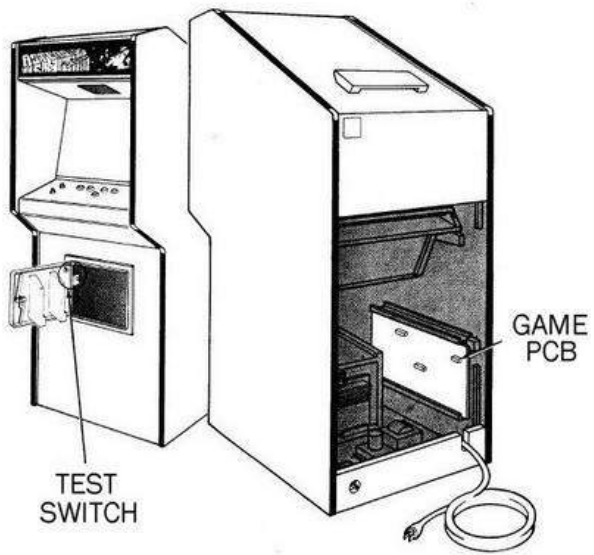
important to have a solid stable working Asteroids Deluxe game before installing the kit.

You are now ready to start the installation.

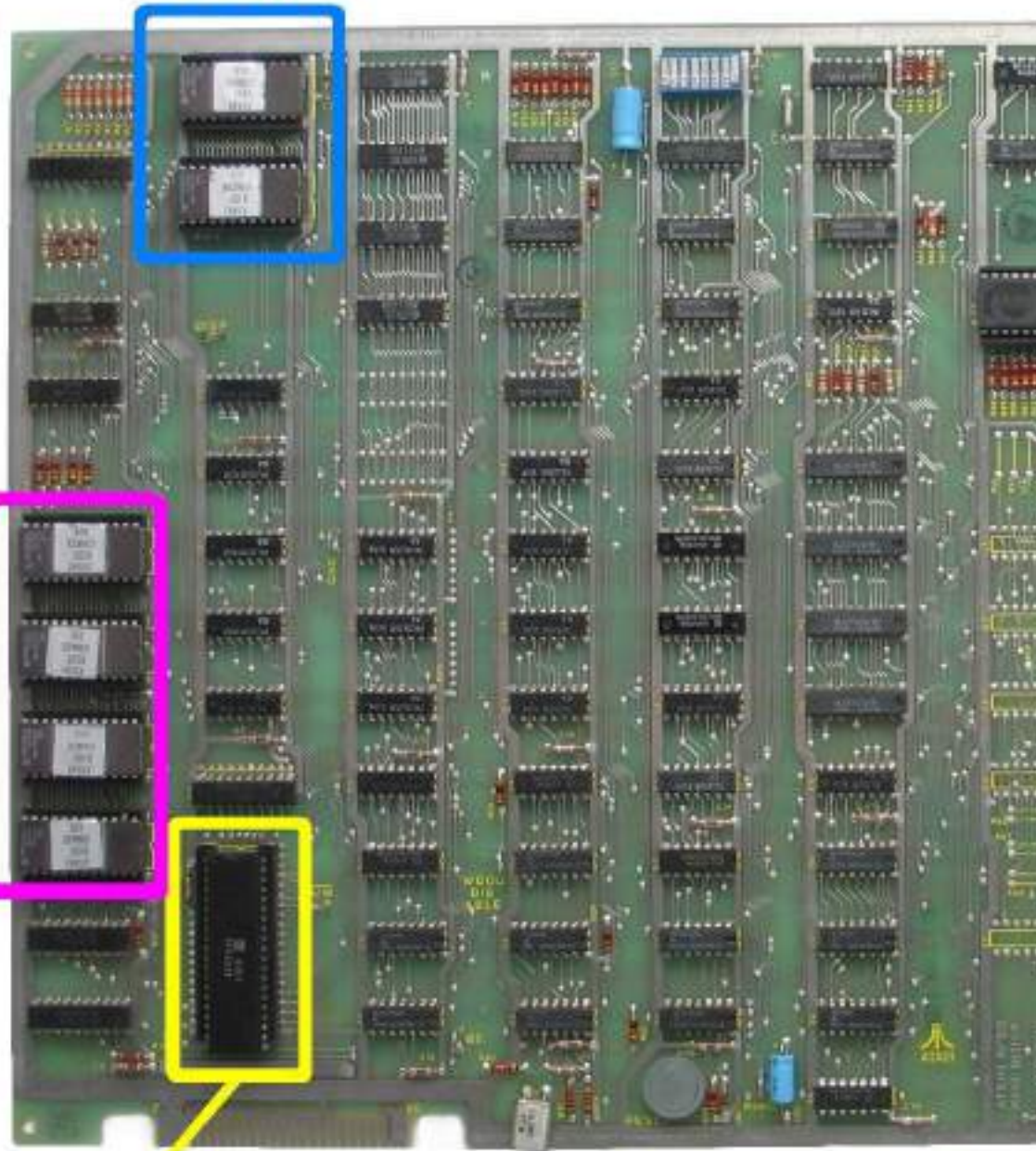
### Step 1: Remove the game PCB from the cabinet

Turn your game off and locate the main game PCB. Refer to the Asteroids Deluxe manual for the location of this boardset. For upright and caberat, the game PCB is attached to the right hand side of the cabinet (as viewed from the back). For cocktail, the game PCB is mounted to the back of the access panel. The board may have one more screws attaching the boardset to the side of the cabinet. You will need to be remove these so that the boardset can be safely removed for easy access. When removing the boardset it is recommended that you label the connector faces with something like "parts side" or "solder side" to insure when re-installing the boardset that everything gets hooked up correctly.

Tip: **Take your time!** Remove the gameboard so the work can be done in a well lighted area. Do not attempt to install this kit without removing the gameboard from the cabinet.



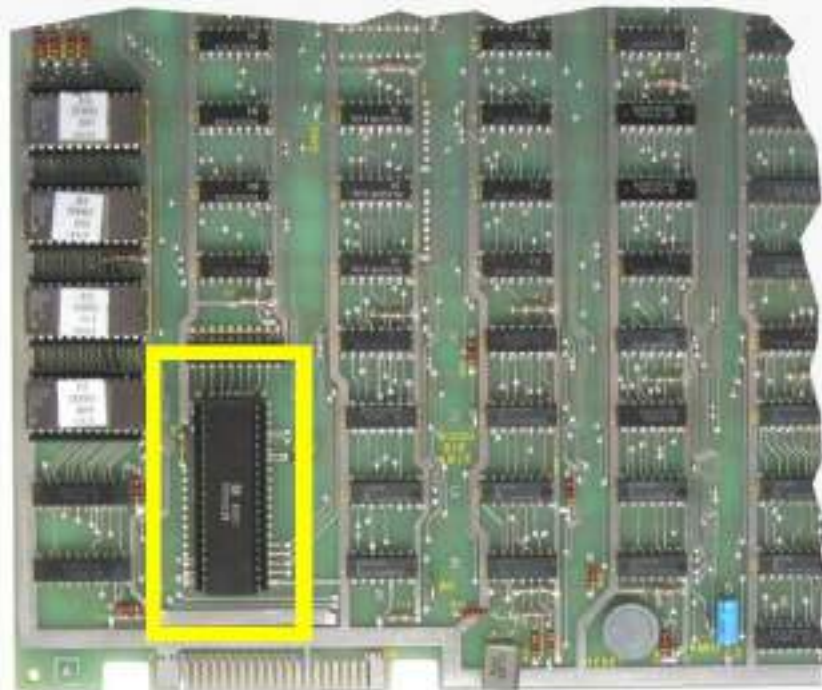
**VECTOR  
ROMS**



**CPU  
ROMS**

**6502 CPU**

## Step 2: Locate and remove the 6502 CPU chip



**6502 CPU**

Locate and remove the 6502 CPU chip on the boardset. Use the images below to assist in locating it. See 6502 Chip Identification for additional information. The 6502 CPU chip is a 40 pin (large) chip, located in the corner of the board at location **C3**. It is the only 40 pin chip on the boardset and on some earlier revisions is located in column 2. See the yellow square in the picture above. It is adjacent to the smaller "catbox" connector.

Gently remove the 6502 chip by using a flat head screwdriver to pry it out of its socket from each end.

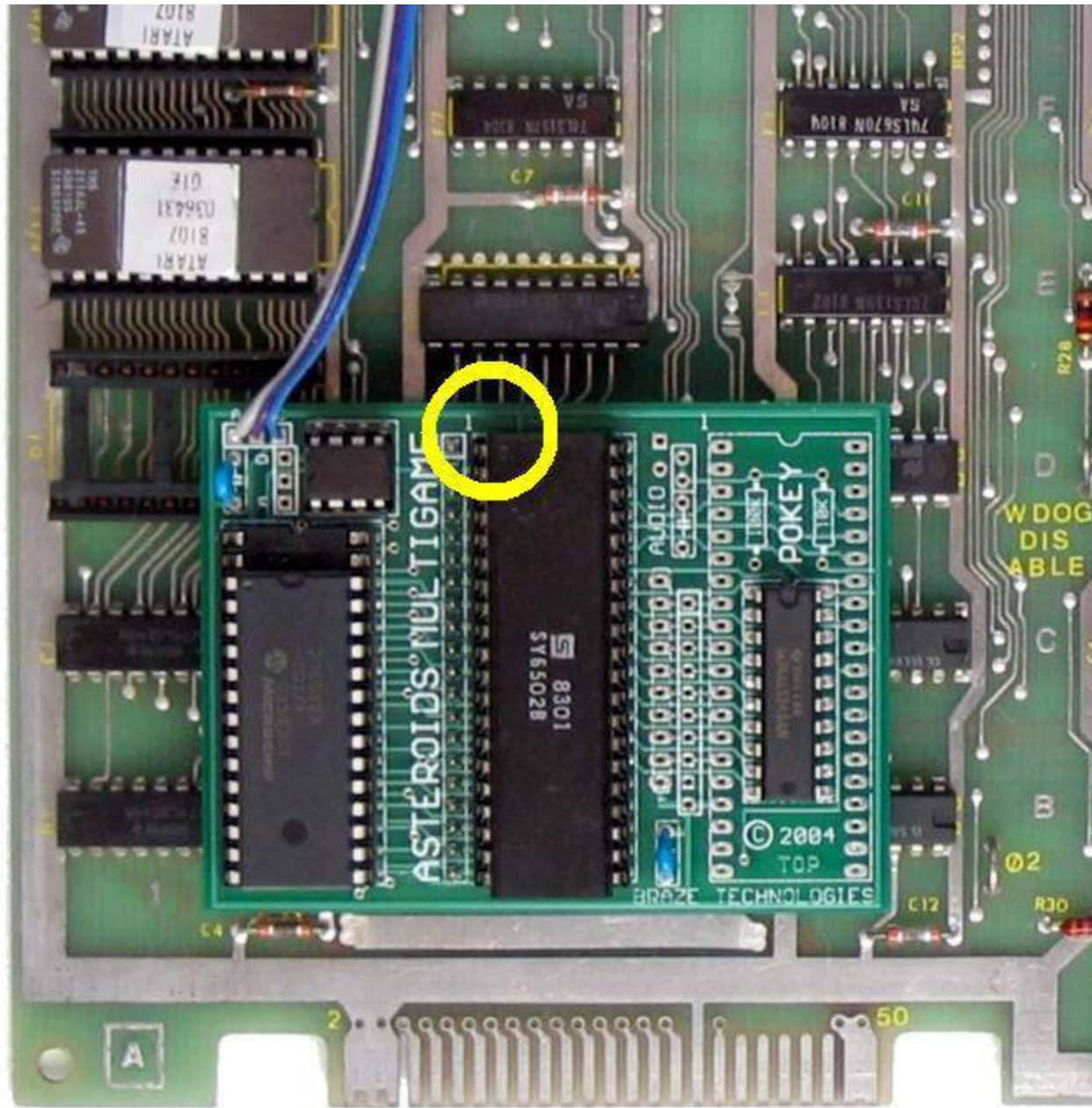
**Caution:** Some of the Atari boardsets have open frame sockets which do not protect the PCB traces. **Be careful not to scratch any of the PCB traces underneath the socket.** Be careful not to bend any of the pins. If any pins do get inadvertently bent they will need to be straightened out before the next step.

Step 3: Insert the 6502 CPU into the Multigame Kit



Insert the just removed 6502 CPU into the empty 40 pin socket on the Multigame Kit. Make sure pin-1 is correctly oriented. Pin-1 is marked on the 6502 CPU chip by some type of indentation or circle molded into the plastic. The end of the chip with the marking, needs to match up with the socket on the daughter card that also has a marking on the plastic. Pin-1 is also labelled on the kit pcb with a large "1". **If the 6502 chip is installed backwards it may cause permanent damage to the 6502 chip or the multigame.**

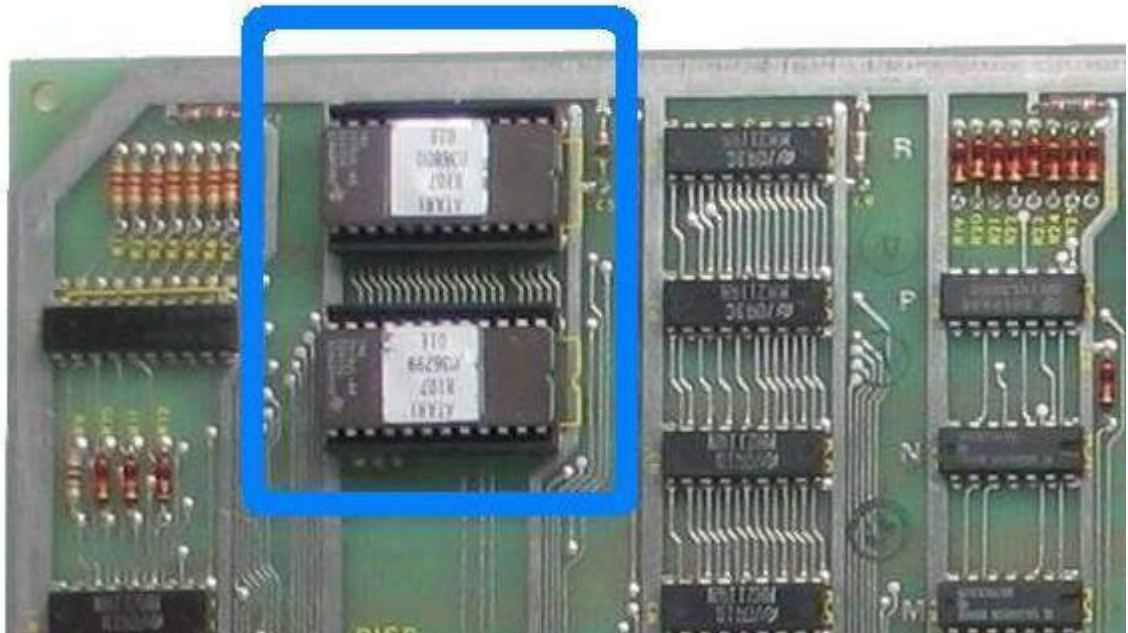
Step 4: Insert the Multigame CPU into the boardset



Insert the multigame CPU daughter card into the 6502 CPU socket on the Asteroids boardset where the 6502 CPU chip was originally removed from. Check to make sure pin-1 of the 6502/daughter card is oriented to correctly match pin-1 on the boardset. Use the photos as a guide. Be careful not to bend any of the tiny pins on the multigame. Do not force the multigame into the socket.

Step 5: Locate and remove the two vector ROM chips

# VECTOR ROMS



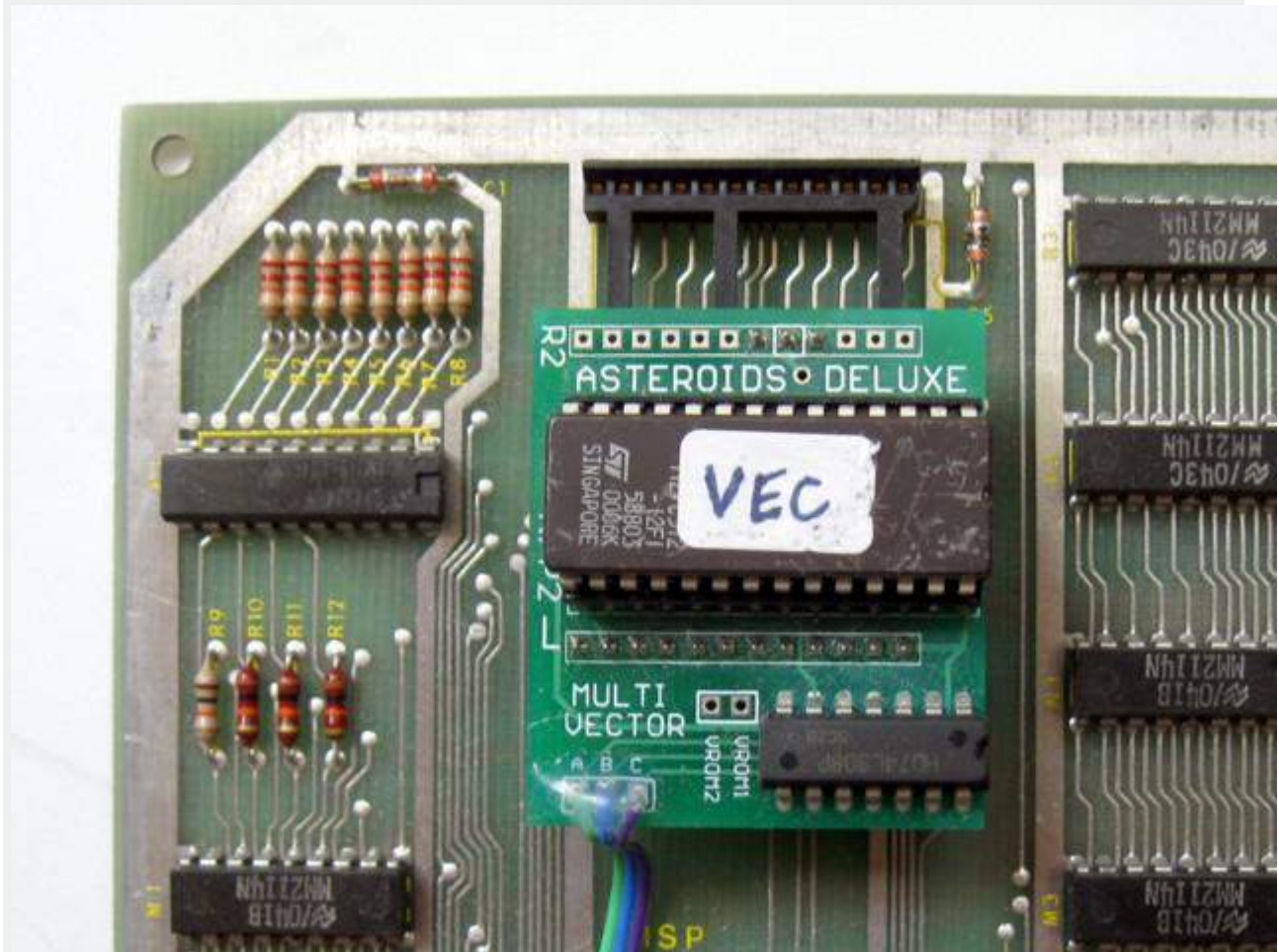
Locate and remove the two vector ROM chips on the boardset. The vector ROMs are located at grid location **N/P2** and **R2**. They are 24 pin devices usually on the same column as the 6502 CPU.

Remove both of the vector chips gently by using a flat head screwdriver to pry it out of its socket from each end just like done in step 2 when removing the 6502 chip.

The Asteroids Deluxe vector ROM chips are not used once the multigame is installed. It is suggested to save these chips in the Multigame antistatic bag. They may be needed for trouble shooting and if ever the Multigame kit is to be uninstalled and reverted back.

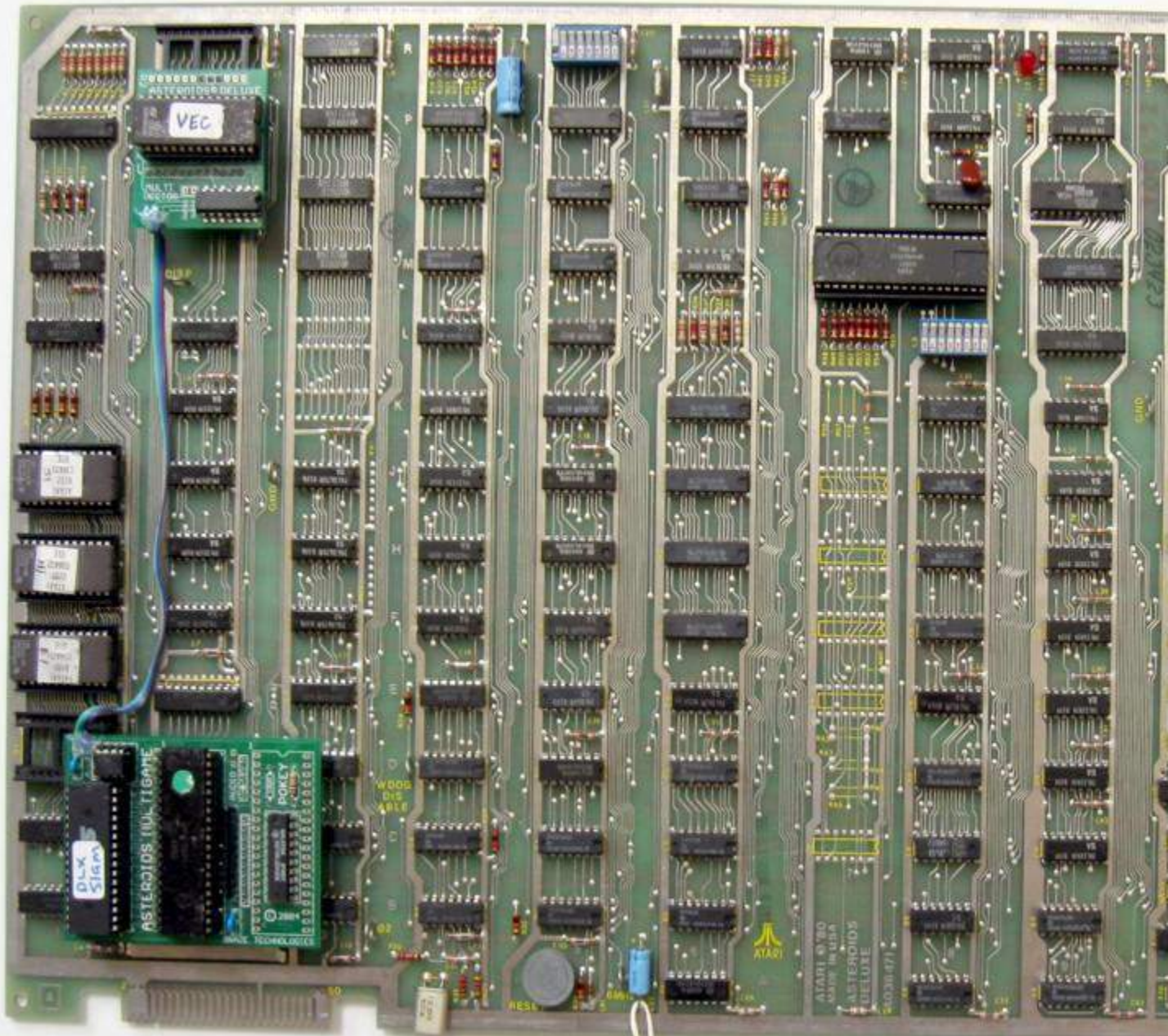


## Step 6: Insert the Vector board into the boardset



Install the vector daughter card into the **N/P2** socket. Note: there are 3 extra pins on the multigame vector daughtercard which install into one row of socket **R2**. Carefully line up these 3 rows of headers. Make sure no pins get inadvertently bent and make sure that no pins overlap the ends of the socket. At this point both Multigame pcbs should be installed into their respective sockets. You may want to use a few strips of tape to secure the wires to the board so that they do not easily get caught or snag on something.

## Step 7: Double check your work



Review the steps and double check that 6502 CPU is properly installed into the daughter card with no bent pins and that it is correctly oriented for pin-1. Check that the daughter card is also installed snug into the 6052 CPU

socket at **C3** with pin-1 matched up. Check to make sure the daughter card is not inadvertently off by one row such that one pin on each side is off the end of the socket. Repeat the checks for the vector board. **REPEAT: If any of these devices are incorrectly installed it may cause permanent damage to the boardset or kit.**

Step 8: Powerup the game and enjoy!

Re-install your board into the cabinet, hookup the edge connector with the original orientation and then powerup your game. This is a good time to enter testmode and to configure the game settings to your personal preferences. If the game does not come up, turn power off immediately, double check your work, and read over the trouble shooting section.

**Step 9: Optional - Remove the CPU ROMS - "ROM SAVER"**

**As a side note, if you want, you can also remove the original DLX CPU eproms, hence the expression "ROM SAVER". I personally like to remove the eproms so that the board will consume slightly less power and generate a little less heat. This however is optional. The four DLX CPU eproms are located at the edge of the board near the 6502 CPU location in row 1.**

It is suggested that this step is done after verifying the multigame is working. That is because in the trouble shooting section one of the procedures depending on the problem is to un-install the kit and revert it back to original asteroids deluxe for verification.

LUNAR LANDER



The implementation of Lunar Lander for the Asteroids Multigame required significant changes to the game software in order to work in the absence of the analog thruster control, absence of the mission indicator lamps, and absence of all the analog sounds. Additionally the original Atari implementation of free play was in need of some user interface improvements.

The Asteroids Multigame is based off the later **-02** ROM version of Lunar Lander. The -02 release has more configurable fuel options. Due to hardware limitations and other design considerations, English is the only language supported by the Asteroids Multigame.

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- Button Mapping
- Thrust Emulation
- Mission Lamps
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- Sounds
- External Thrust Control

## Lunar Lander Game Play

The following paragraphs contain excerpts from the original Atari Lunar Lander Manual. The section of interest is chapter 2 "Game Play".

Lunar Lander is a one-player coin-operated electronic game that simulates landing a manned spaceship on the moon. Various video-display phrases indicate score, time elapsed during this landing mission, fuel units consumed, altitude above the moon, and horizontal and vertical speed. The fuel consumption and both speed readings are important for the player to determine how to land the craft. Realistic engine rumble and crash sounds accompany game play. A high beep warns of an almost-depleted fuel supply, whereupon players can add coins to automatically extend the game and "fill up" their fuel tanks. Depending on the quality of the landing or the crash, various messages are displayed on the screen.

The Lunar Lander game has four basic modes of operation: attract, ready-to-play, play and the self-test. The *attract mode* starts after power-up, after the play mode, or after the self-test. It ends when a coin has been inserted into either coin slot. The *ready-to-play* mode follows the attract mode and begins after a coin has been inserted. It ends when with the pressing of the LED start switch.

The *play mode* begins immediately after the ready-to-play mode, when a player presses the start switch. (The game does not automatically start

after a certain time has elapsed. i.e. pressing the start switch is the only way Lunar Lander will begin the play mode.)

The attract mode is specifically programmed to attract potential players by displaying the basic sequence of game play. The lander module flies horizontally across the screen, drifting slowly toward the bottom right corner. At the end it "crashes" into a canyon wall.

The sequence is reset, and a new landscape panorama is displayed. The center of the screen display the message INSERT COINS and xxx FUEL UNITS PER COIN in English or one of the three foreign languages. The previous game score is displayed after the word SCORE for player encouragement.

Ready-to-play mode This mode starts when either coin switch is activated by a coin. The messages SELECT OPTION, PUSH START and xxx FUEL UNITS appear on the screen until a player pushes the LED start switch.

play mode. Similar to attract mode, actual game play begins with engine rumble and the lander drifting toward the bottom right corner of the screen. Horizontal and vertical speeds are constantly displayed, including two arrows to show the horizontal and vertical directions of travel. Altitude is measured in distance above the surface of the mountain - not above "sea level". The screen also shows the time in actual seconds, representing time elapsed in the current mission.

The scoring system gives 50 points for a good landing, plus 50 fuel units as a bonus. A hard landing earns only 15 points, and a crash earns 5 points. A crash happens when the vertical speed exceeds 15 and the horizontal speed exceeds 31. The number displayed after the SCORE is cumulative of all landings made in the current game. The point scores for a good or hard landing can be greatly increased by landing on an area with a flashing multiplier, for example 2X or 5X. Thus, a good landing on the very narrow 5X site would award that player 250 points.

As already mentioned in chapter 1, the operator can select from up to eight different settings for fuel units - 450, 600, 750, 900, 1100, 1300, 1550, or 1800 fuel units per coin (free play is also available). as the lander module flies over the landscape, it approaches the mountains and a landing site. At a certain point near the mountains, the game "zooms in" for a close-up view of the landing zone.

If a player realizes the speed is too fast and the landing looks hopeless, he or she can press the ABORT button on the control panel. This will give the lander extra thrust and make it fly up-wards at top speed. The abort feature

does consume 120 to 180 fuel units, though as a disincentive to overusing it. If the ABORT button is pressed too late, however, a crash cannot be avoided.

The four levels of mission difficulty are determined by the player and can be changed at anytime during the game or the ready-to-play mode. The difference between the four are printed on the mission select panels and are self-explanatory, except perhaps the rotational momentum. This feature causes the lander to tumble around when either ROTATE button is pushed. The longer either button is held down, the faster the lander module will spin in that direction. The player gains control of the lander by pressing the other ROTATE button for the same amount of time.

(scottb, fixme, finish this section)

### Lunar Lander Button Mapping

The following table shows how the Lunar Lander control panel buttons are mapped onto a Asteroids control panel.

Lunar Lander Button	Asteroids Button	Notes
COIN INPUTS	COIN INPUTS	Adds fuel units
START	P1-START	Starts a game. Asteroids Multigame enhancement: When configured for freeplay, during low-fuel warning, p1-start can be used to add more fuel units.
SELECT	P2-START	Mission select. Toggles through all 4 mission types. See section below about Asteroids Multigame enhancements to indicate

		the current selected mission.
ROTATE LEFT	ROTATE LEFT	Rotate left
ROTATE RIGHT	ROTATE RIGHT	Rotate left
ABORT	HYPERSPACE / SHIELDS	Aborts the current mission
(Analog) THRUST	THRUST and FIRE	Configurable. See Lunar Lander thrust section
SLAM	SLAM	Ignored by Asteroids Multigame
TESTMODE	TESTMODE	Resets the game, enters Asteroids Multigame testmode

### Lunar Lander Thrust

The original Lunar Lander used a large analog thrust controller for playing the game. The Asteroids control panel only has buttons. The Asteroids Multigame makes use of the "THRUST" and "FIRE" buttons to emulate the analog thrust controller. In order to provide flexibility, the Asteroids Multigame allows configuration of how these buttons control the Lunar Lander thrust, including how the buttons work and at what speed.

There are several different ways the multigame can be configured for thrust.

Type	Thrust Button	Fire Button	Notes
up/down up/down	up/down	up/down	Pressing (and holding) either the <b>thrust-button</b> or <b>fire-button</b> causes the game to increase thrust. When neither of the buttons are

			active, then thrust will decrease (decay). The configured rate determines how fast (sensitive) the buttons behave.
up/down kill	up/down	kill	Pressing (and holding) the <b>thrust-button</b> causes the game to increase thrust. When the <b>thrust-button</b> is not active, then thrust will decrease (decay). Pressing the <b>fire-button</b> causes thrust to be immediatly killed (set to minimum). The configured rate determines how fast (sensitive) the <b>thrust-button</b> behaves.
up/down hold	up/down	hold	Pressing (and holding) the <b>thrust-button</b> causes the game to increase thrust. When the <b>thrust-button</b> is not active, then thrust will decrease (decay). Pressing (and holding) the <b>fire-button</b> causes thrust to be frozen (held). It remains steady until the <b>fire-button</b> is released. The <b>fire-button</b> has priority, so if both buttons are pressed the game thrust remains in a held state. The configured rate determines how fast (sensitive) the <b>thrust-button</b> behaves.
up/down	up/down		notes.
kill up/down	kill	up/down	notes.



hold up/down	hold	up/down	notes.
up/down		up/down	notes.
up down (sticky)	up	down	Pressing (and holding) the <b>thrust-button</b> causes the spaceship to increase thrust. When the <b>thrust-button</b> is not active, then thrust will remain steady (held) ie. sticky. Pressing (and holding) the <b>fire-button</b> causes thrust the spaceship thrust to decrease. When the <b>fire-button</b> is not active, then thrust will remain steady (held) ie. sticky. If both buttons are active there is no change in spaceship thrust. The configured rate determines how fast (sensitive) the buttons behave.
down up (sticky)	down	up	notes.
external digital			EXPERIMENTAL at this time. External (digital) hardware connected to the POKEY ports POT0 through POT7 must provide 8 digital bits of spaceship thrust values. In digital mode the Asteroids Multigame samples the 8 bits of data using the pokey fast scan mode. In this mode the POKEY is simply acting as a mechanism for the game to read 8-bit digital values similar to how DIP switches are handled. It is the responsibility of the attached hardware (not part of the multigame) to

			provide the analog to digital conversion. See also <a href="#">External Thrust Control</a>
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At the start of each mission the internal thrust level is reset to the MINIMUM.

Unfortunately there is no accurate indicators of the current thrust level other than the size of the flame coming from the spaceship and how loud the thrust sound is. Neither of which is very accurate. Because Lunar Lander has so many vectors to draw it was not possible for the Asteroids Multigame to add any visual indicators because that would greatly reduce the effective video frame rate causing flicker and would alter the timing of the game. Lunar Lander already uses a slower video frame rate than asteroids to compensate for the extra vectors being drawn. For those reasons, the Asteroids Multigame does not indicate the emulated thrust level.

### Lunar Lander Mission Lamps



Lunar Lander game has 4 different mission types that can be selected (Training, Cadet, Prime, and Command). On an original Lunar Lander cabinet this mission is indicated by the game lighting one of 4 mission lamps. Since asteroids does not have these lamps several software modifications where done to the Asteroids Multigame to show visual feedback of what the current mission is.

When "P2-START" is pressed, a splash screen similar to the 'ready-to-play' screen is displayed. This screen will show one of 4 boxes similar to the original Lunar Lander lamps indicating the current mission. When "P2-START" is pressed again WHILE THE SPLASH SCREEN is displayed, the Asteroids Multigame will toggle to the next mission and display it. After about 12 seconds where "P2-START" has not been pressed, the Asteroids

Multigame will revert back to attract mode. Pressing "P2-START" again will again bring-up the splash screen showing the currently selected mission.

Lunar Lander does allow the player to change missions mid-stream in a game by pressing P2-START. When the mission is changed during gameplay, the mission splash screen is NOT displayed, however, the mission is changed. This is consistent with how original Lunar Lander functions in terms of allowing mid-stream mission changes.

Below are 4 screen shots of the Asteroids Multigame mission splash screen. In addition to showing the current mission, it also shows the characteristics of that particular mission. The missions are summarized in this table.

<b>Mission</b>	<b>Gravity</b>	<b>Friction</b>	<b>Rotation</b>
Training Mission	Light Gravity	Friction From Atmosphere	Controlled Rotation
Cadet Mission	Moderate Gravity	No Friction	Controlled Rotation
Prime Mission	Strong Gravity	No Friction	Controlled Rotation
Command Mission	Moderate Gravity	No Friction	Rotational Momentum

<u>Training Mission</u>	<u>Cadet Mission</u>
Light Gravity Friction from Atmosphere Controlled Rotation	Moderate Gravity No Friction Controlled Rotation
<u>Training Mission</u>	<u>Command Mission</u>
Strong Gravity No Friction Controlled Rotation	Moderate Gravity No Friction Rotational Momentum

## Lunar Lander Sounds

Original Lunar Lander had dedicated analog circuits to produce its sounds. On Asteroids and Asteroids Deluxe boards, those exact analog sounds do not exist. The Asteroids Multigame has attempted to produce sounds that are similar to the original Lunar Lander sounds while working within the limits of the Asteroids and Asteroids Deluxe hardware. The Asteroids Multigame sounds are NOT an exact match. The sounds a Lunar Lander game makes include various volume levels in thrust, a low fuel beep, and an explosion sound. Asteroids and Asteroids Deluxe have similar sounds which are substituted for the Lunar Lander sounds, as well the Asteroids Multigame uses the POKEY chip to assist in generating these sounds as well.

## Lunar Lander External Thrust Controller

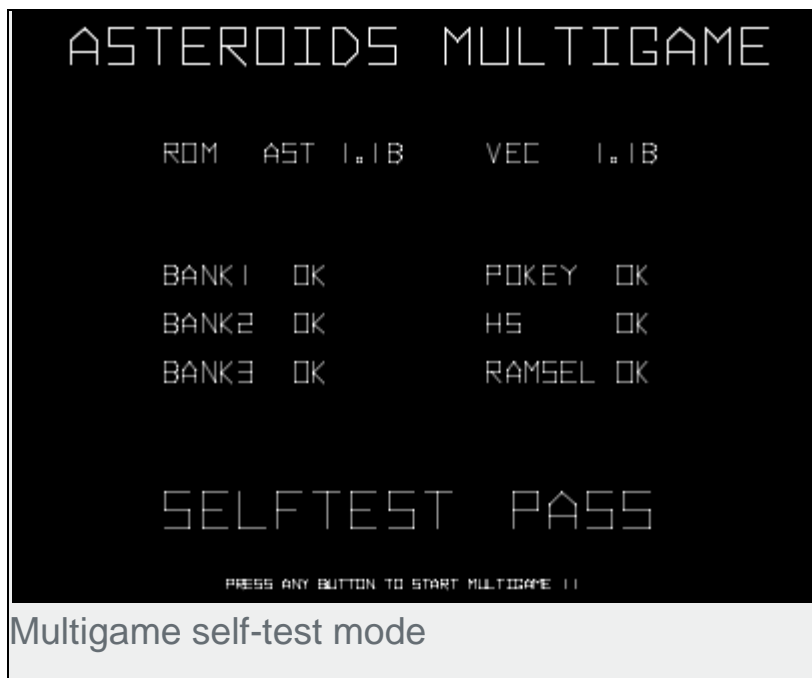
Currently the Asteroids Multigame does not support any type of external thrust controller. However, the hardware was designed in anticipation that some people might want to build a custom control panel which makes use of some type of (analog) thrust controller. The Asteroids Multigame has the ability to accept thrust inputs externally via an expansion header that can be added to the kit. Again, there is currently no hardware interface board to connect to the kit at this time and any such kit would require some minor software changes to be made to the Asteroids Multigame in order to support it and lots of testing.

## CONFIGURATION SETTINGS

The Asteroids Multigame on-screen configuration setup menu allows you to configure your personal game options without crawling into the cabinet to set dip switches and allows separate configuration for all three games. This is also where the high score tables can be erased.

To enter setup mode, place the game in self-test mode. For the upright cabinet, the self-test switch is located inside the cabinet accessible by opening the coin door. For the cocktail cabinet, the self-test switch is located behind the access panel on the left side.

Once in self-test mode, following the on screen instructions, press both start buttons buttons at the same time. The game should now be in configuration setup mode and a top-level menu structure will appear.



Once in the configuration setup mode, use the left and right buttons to move the selector up and down within the menus. The current selected item is indicated by a saucer icon character on the left side of the screen and the current line is also bold (brighter). If the current line is a menu item, pressing the fire button will open (or close) that particular sub-menu.

Within the sub-menu for each fire button press, the current selected field will advance through all of the possible settings for that particular sub item. In this example there are two options for coinage, namely freeplay and 1-coin 1-play.

To save the settings and return to main menu, scroll down to the bottom item **SAVE SETTINGS** and press the fire button. At this point the current active settings will be saved and the game will return to the main menu. It is at this point that high scores are erased if you selected that option.

If for some reason you wish to cancel your changes without saving them, simply take the game out of self-test mode **without executing the "SAVE SETTINGS" option!**

To return to game play mode, return to the main menu, then select **EXIT**. That will return you to the testmode screen. At that point take the game out of self-test mode. The new settings will now have taken affect and the configured powerup game will be started.

## Erasing High Scores

To erase high scores, select the game menu for Asteroids or Asteroids Deluxe, depending on which score table you want to erase. Within the game menu, select the **HIGH SCORES** sub item. Press fire to toggle through the 3 possible actions.

- **KEEP ALL** - No change to high score table
- **RESET ALL** - All high scores will be reset to 0
- **RESET LOW 7** - The low 7 scores will be reset to 0, the top 3 scores will be preserved

**The high scores will not be erased until you select SAVE SETTINGS.** If you wish to cancel your changes, simply exit test mode **WITHOUT** selecting SAVE SETTINGS