Tempest Multigame

Installation and User's Manual

Notice Regarding this Upgrade

To perform this upgrade you should:

- Be familiar with safe handling procedures for electronic components.
- Be able to remove and replace socketed IC's (chips) without causing damage.
- Have some experience soldering with electronic components.
- Be able to follow directions.
- Have a low-wattage (~15-20W) soldering iron. (The "blue" Radioshack iron is fine.)
- Have some fine solder (.3" diameter or so—Radioshack has this too.)
- (If installing the Reset Adapter) Have a few feet of stranded wire. (18-22 gauge—Yep, Radioshack has this as well.)
- About 1" of black electrical tape.
- Understand how to count pins numbers on chips.

Arcade games are rugged equipment, but anytime you start messing around with something (particularly something electronic) you accept a certain amount of risk that you may break something.

This kit carries with it no guaranty of compatibility to your particular game. Although this kit has been tested in numerous Tempest arcade games and CPU boards, there's a remote possibility that some of them are different. If you carefully follow these instructions, you should do fine and everything will work. I'll try to help walk you through any problems you have, but if this looks like it's above your confidence level please recruit someone locally to install the kit for you!

Please read these instructions completely through before starting. If at any point your PCB looks significantly different than what you see in here, contact clay@yahoo.com before continuing!

This upgrade should ONLY be used on a genuine Tempest (Vortex on early units) game circuit board.

Introduction:

The Tempest Multigame consists of a daughter card and a smaller satellite board that plugs into your Tempest boardset. An optional "Reset Adapter" is also available.

Once the Tempest Multigame is installed in your boardset you will have an on-screen menu built into your game with which you can select up to any of seven different games and variations to play!

These instructions describe how to install the kit into a working Tempest arcade game and how to operate the Multigame. Some minor soldering is required (three wires for basic install, six more for the Reset Adapter). All operations are fully reversible. Please read all these instructions thoroughly before starting the conversion.

Games Included with the Tempest Multigame	Description
Tempest Rev. 3	The latest production version of Tempest. Very little different from Rev. 2
Tempest Rev. 2	The second release of Tempest. Very little different from Rev. 3. Included for completeness.
Tempest Rev. 1	The original version of Tempest. Included for Completeness.
Tempest Tubes	The "Tubes" ROM of different mazes for Tempest. This is based on the Rev. 3 version of Tempest.
Vortex	Tempest the way Tempest was originally to be! Vortex is the original prototype game before it was renamed to Tempest. Subtle changes (watch the title screen!) but very similar to Tempest Rev. 1
Vector Breakout	It's Breakout for your Tempest machine! 2900 lines of hand-crafted assembly code. And what good's a classic without some Easter Eggs?
Aliens	A very early version of Tempest. Numerous differences. VERY hard. Very early in development, but playable and an interesting piece of history.
Tempest Multigame Menu	Your one-stop shop for all of the above. Another 1200 lines of assembly code. ☺

Notes:
1) Be a little careful with Vortex and Aliens. They're still pre-release software and might crash or have other problems. I wouldn't leave Aliens running unattended for very long since it's such early code and needs to run with the watchdog disabled.
2) Vector Breakout stores its "all time high score" separately from Tempest high scores. You can clear the "all time high score" by holding down P2-Start and Fire when you select V-BREAKOUT from the menu.
3) Vortex and Aliens do not save high-scores. Vortex allows you to enter them, but it does not write to EAROM. Aliens doesn't even allow modification of the high score table.
4) All the Tempest variants (Rev. 1-3, Tubes) share a common high score table.
5) Aliens must be explicitly "enabled" by dip switch to appear in the menu. It also requires that the watchdog be disabled.
6) If you run the self-test in Tempest with the watchdog disabled, the only way to leave Tempest's self-test mode is by resetting the machine with the Menu button or Reset Adapter or by turning the power off and back on.

The Kit:

The Tempest Multigame kit consists of the following pieces:

- This manual
- The Tempest Multigame daughtercard (has the Tempest logo and serial number on it)
- The Tempest Multigame satellite board (VRAM Expander—attached to the above)
- A 40 pin dual-wipe IC socket
- A 24 pin dual-wipe IC socket

Preparing the game board:

Start with the machine turned off and unplugged from the wall. Open your game to gain access to the game circuit board. You will need to remove the cables connected to the game board. **Make *SURE* you mark or somehow identify where the cables need to re-connect to the board!**

Remove any screws or other fasteners holding the game board in place. Remove the board from the machine. Depending on the game you should have a two-board "sandwich" that looks like this:

| Tempest Main Board	Tempest "Aux" Board
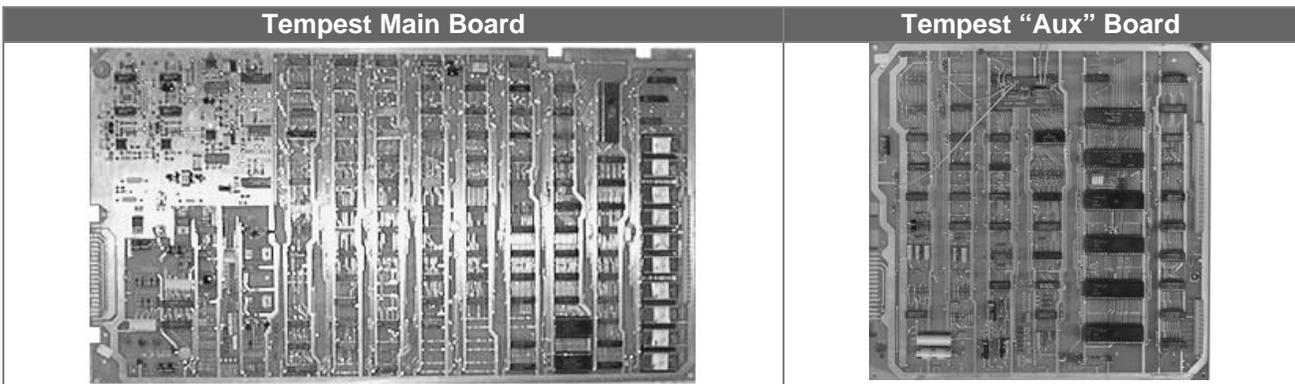
Upgrading the board:

We'll be removing several items from the Tempest board in preparation for installing the Tempest Multigame modification. Follow these steps:

- Locate the IC at location C2 (the 6502A processor). Carefully remove it from its socket and place it on some anti-static material. (Some aluminum foil is fine.) The CPU will be used on the Multigame daughtercard. (Be sure you didn't bend any pins—if you did, bend them back carefully.)
- Identify the Program ROMs: D1 (ROMX), E1 (ROM0), F1 (ROM1), H1 (ROM2), J1 (ROM3), K1 (ROM4), L/M1 (ROM5), M/N1 (ROM6), P1 (ROM7), and R1 (ROM8). Carefully remove them and store them for safe-keeping. They will not be used in the Multigame, and removing them will help reduce the power consumed and the heat given off by the game board.
- Identify the Graphics ROMs: N/P3 and R3. They may be EPROMs or Mask ROMs. Carefully remove them and store them for safe-keeping. They will not be used in the Multigame.

The picture below shows the board before and after and helps identify the chip locations:.

Board Before IC Removal	Board After IC Removal
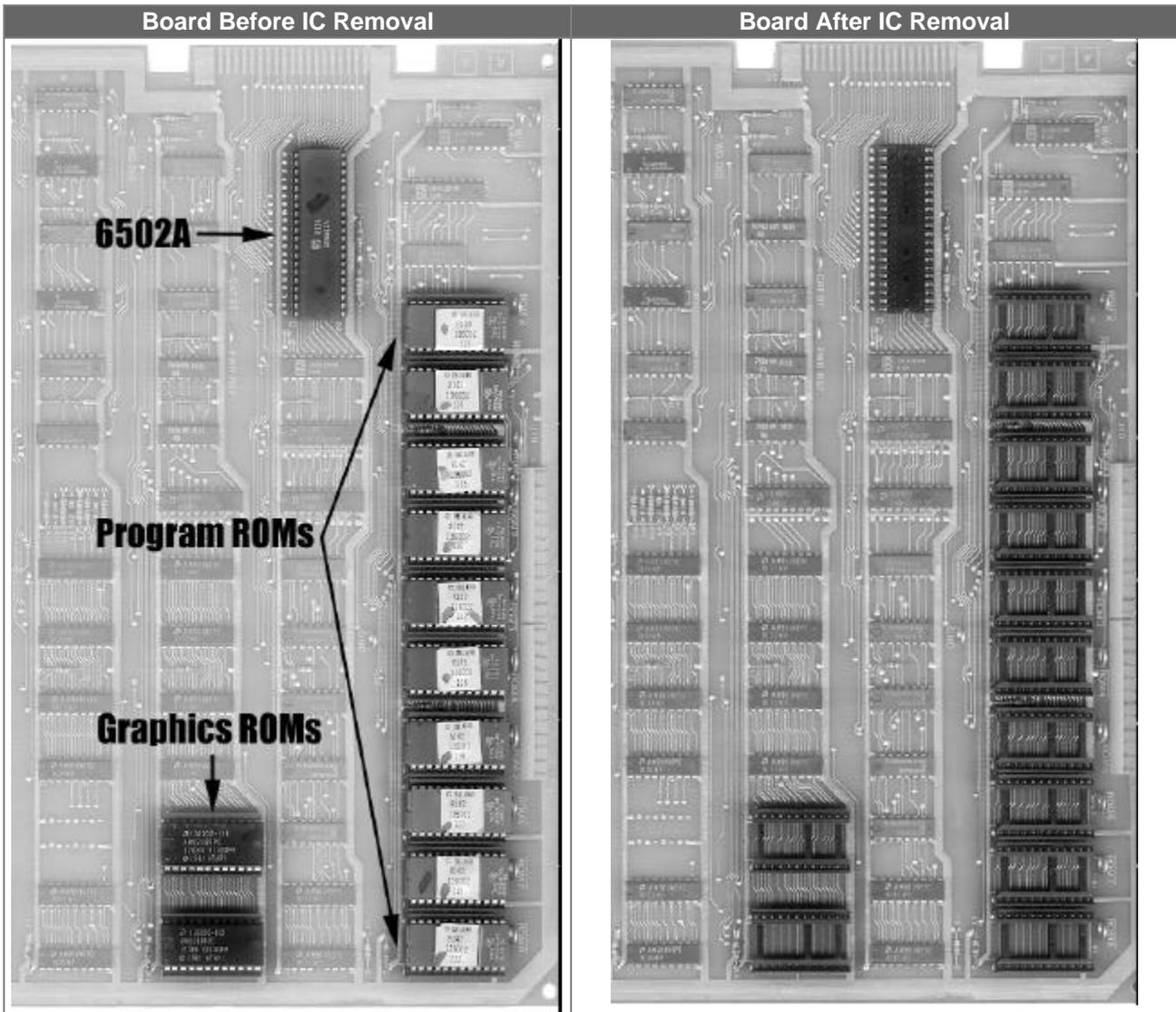
Installing the 6502A:

You need to put a 6502A into the 40-pin socket on the Tempest Multigame. You can use the 6502A you removed from socket C2 on the game board or any other known-good 6502A.

Locate the notch on the end of the 6502A chip and match it up to the notch at the end of the 40-pin socket on the Tempest Multigame daughtercard. Gently press the 6502A into the socket on the daughtercard. Be careful to get all the pins in the socket and not to bend any pins out.

Install the Tempest Multigame boards:

You're now ready to install the Tempest Multigame boards onto your game board. Place the dual-wipe 40 pin socket in the socket at C2 (yes, plugging the socket into the socket). Then take the largest Multigame board (with the 6502A on it) and orient it so that the notch on the 6502A is pointing towards the empty EPROM sockets. (The square surface-mount chips on the daughtercard should be closest to the corner of

the Tempest board.) Press down carefully and the Multigame board should seat into the socket on the Tempest board. Make sure you didn't bend any pins out or damage the connector or socket.

The VROM Expander satellite card needs to plug into socket N/P3. Place the replacement 24 pin dual-wipe socket in the socket at N/P3. Orient the board so that the EPROM on the VROM Expander is closest to the edge of the Tempest board. The notch on the EPROM should be facing the same direction as all the other chips on the main Tempest board. Carefully press the VRAM Expander board into socket N/P3. Be sure to line the pins up properly. Make sure you didn't bend any pins out or damage the connector or socket.

Proper orientation of Daughtercards (and location of wire connections)
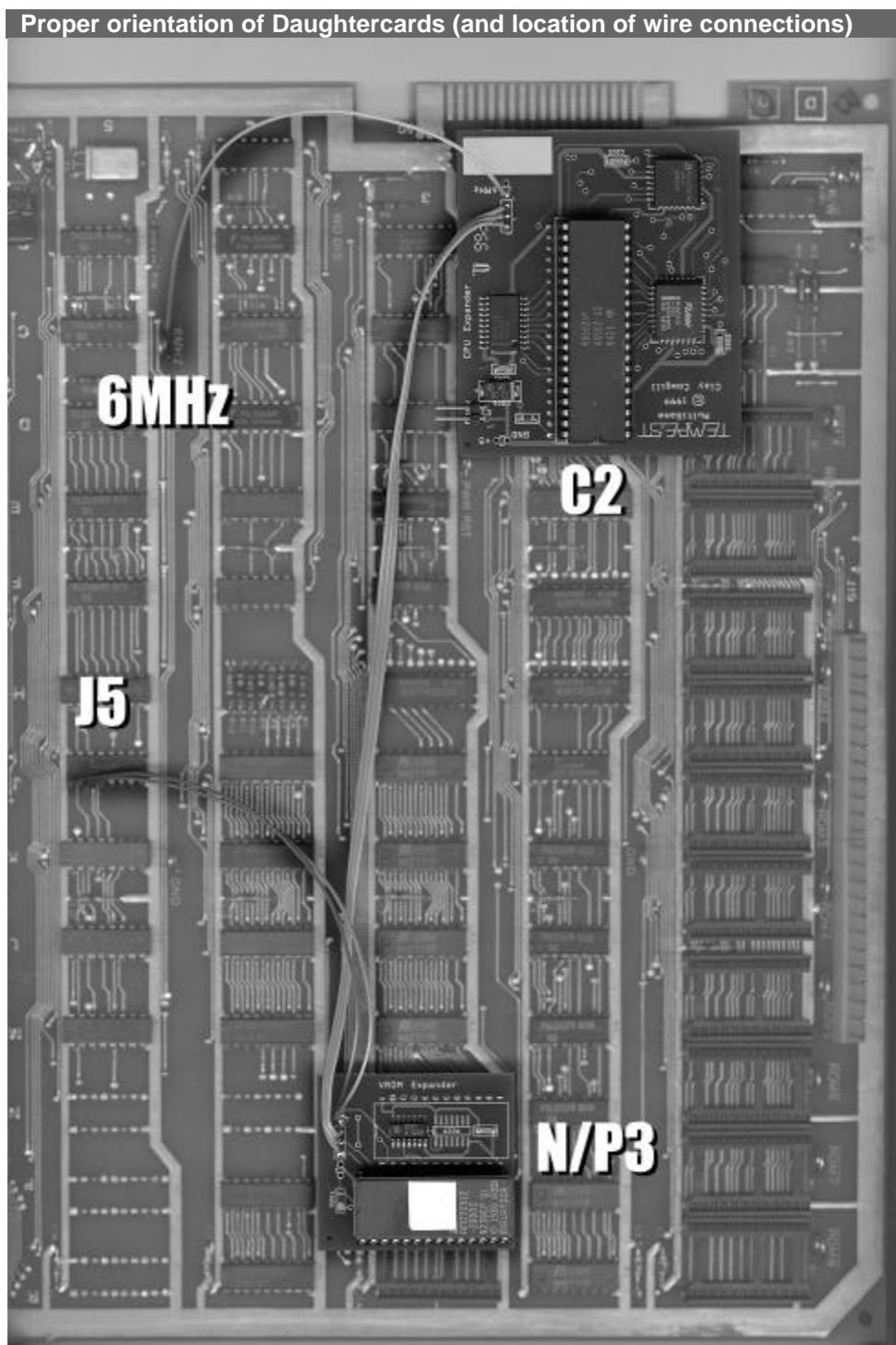
Time for some soldering:

You've probably noticed the three wires (Brown, Orange, and Red) that are hanging loose from the Multigame daughtercards. In the next steps we will be soldering those to points on the main Tempest board. If when soldering to the chip (listed below) you are having problems or can't get the wire connected, stop and let the chip cool off and then try again. Try not to leave the soldering iron on the pin of the chip for more than a few seconds. (Get the chip too hot for too long and it might die!)

Brown Wire: Solder the end of the brown wire to the "6MHZ" test point on the Tempest board. It's easiest to put a little dab of solder at the base of the test point and then add the wire to it to solder it down.

Orange Wire: Locate pin 3 on IC "J5" (It's a 74LS139) Put a small dab of solder on the pin and then attach the orange wire.

Red Wire: Locate pin 1 on IC "J5". (Same chip as for the orange wire.) Put a small dab of solder on the pin and then attach the red wire.

The pictures on the next page show the above steps graphically. You can use them as reference to make sure things are going right.
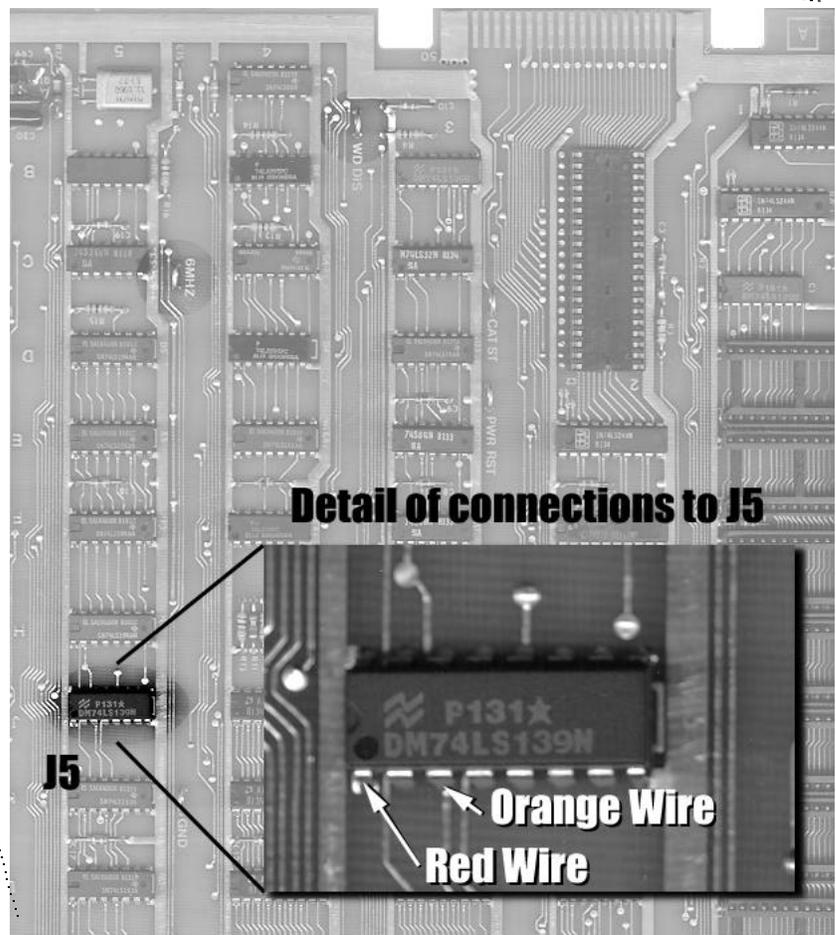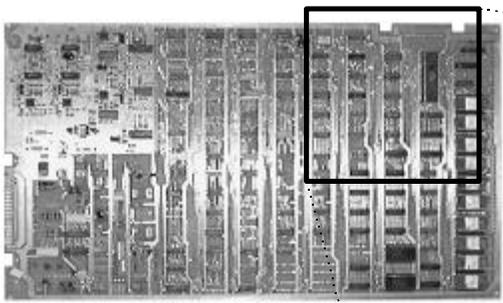

The diagram at right shows an expanded area of the main Tempest board.

Remember—no more than a few seconds of soldering time on each pin of the chip. If you have trouble take a break and let the chip cool completely before trying again.

Detail of connections to J5

Orange Wire
Red Wire

J5
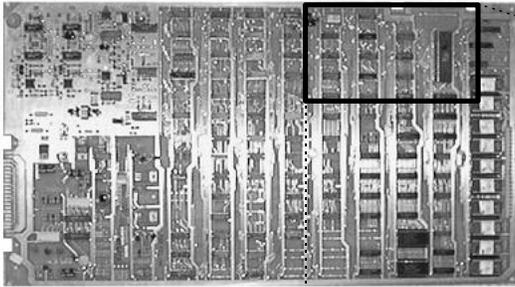
The Brown wire goes to the 6MHz test point. (WDDIS needs to be grounded for Aliens to play. You can use an alligator clip to a "GND" test point, or you can simply solder it directly to ground with a piece of wire. Details in the text below.)
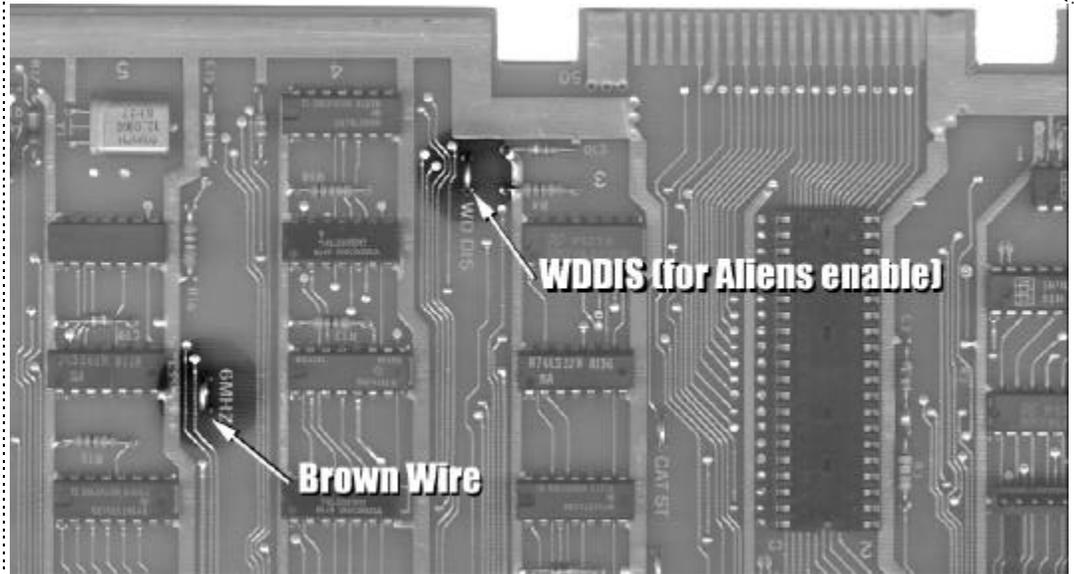
Enable/Disable Aliens:

Aliens is very early code and as such it doesn't clear the watchdog timer regularly like the other games. In order for Aliens to run, the watchdog must be disabled. Disabling the watchdog means that in theory a game could crash and leave the machine in a state that could cause damage to the monitor. I think it would be exceedingly rare, but it is possible. With this in mind, disabling the watchdog is entirely up to you. If you want to run Aliens, all you need to do is connect a wire from the "WDDIS" testpoint to a "GND" testpoint on the Tempest main board. I use a little alligator-clip jumper wire so it's easy to add and remove.

If you decide not to disable the watchdog, selecting Aliens from the menu will just pop right back to the menu (of the default game). If you'd rather not have Aliens appear in the menu *at all* you can set the dipswitch at location N13, position 1 to "OFF".

To show Aliens game in Menu	To remove Aliens game from Menu
Set DIPSWITCH N13, position 1 to "ON"	Set DIPSWITCH N13, position 1 to "OFF"

Quick Test:

At this point if you've followed the steps above correctly you have a fully functional Tempest Multigame! If you're eager to try things out go ahead and install it back in your cabinet, turn on the "test" switch inside the coin door, and turn the machine on. You should have the Tempest Multigame Menu screen. If not, go

back and check your work—be particularly sure that you didn't bend any pins over on the daughtercards, or short anything out while soldering. If you don't get a picture, don't leave the machine on for long…

Assuming you have a menu on-screen, turn off the "test" switch. You can choose a game by moving the spinner and pressing the "Fire" button. You'll notice that you can't change games except by turning the machine on and off, or by hitting the reset button on the game PCB.

If you ordered the "Reset Adapter", skip the next section and resume at the "Adding the Reset Adapter" section. Otherwise…

Installing a Menu Switch:

If you want to be able to call the menu without turning the power off and on (or hitting "reset") you can add a "Menu" button to your game.

All that is needed is a "normally open, push-button momentary switch". You can get one from RadioShack, or use pretty much any "push-button" switch you desire. (Do not use a "toggle" type switch.)

There is a two-pin header on the Tempest Multigame daughtercard that you can attach your switch to. (The header is located near the corner of the daughtercard and is labeled "Menu".) You will want to run several feet of wire from the two pins and connect it to the switch. I find that mounting the switch inside the coin-door is convenient, although you can place it anywhere you want. You can solder the wires directly to the pins on the Multigame, or use a .1" header to connect to the pins instead. (A reset switch from an old PC case works well and has the right connector on the end, by the way.)

With the "menu" button installed, the Tempest Multigame menu will appear whenever the menu button is pressed. Note that *any game in progress or any credits on the machine are lost when the menu is called*.

If you didn't order the Reset Adapter you can skip the next section and go onto "Using the Multigame".

Adding the Reset Adapter:

The Reset Adapter is a small circuit board that generates a "hard" reset to the main game board when two buttons are pressed. For use on the Tempest Multigame we will connect it to the player one start button and the player two start button. All connections will be done on the main Tempest main board and "aux" board..

Power and inputs to the Reset Adapter:

The Reset Adapter needs +5V to operate. Holding the Reset Adapter so that the text is "right side up" you should see four holes in the upper left-hand corner. They're labeled "+5", "GND", "IN1", and "IN2". We need to connect "+5" to a +5Vdc source on the Tempest boards, "GND" to ground on the Tempest boards, and "IN1" and "IN2" to the inputs from the P1 and P2 start switches. These signals are all easily accessed from the "TEMPEST AUX" board. (The smaller board on the back of the main Tempest board.)

Placement of the Reset Adapter is not critical, so you may locate it where-ever you like. You will probably want to place a small piece of electrical tape over the back of the Reset Adapter so it can't short against anything. I chose to attach it to the "aux" board with a little hot-glue.

Looking at the "aux" board so that the six larger chips are on the right hand side, find the 5 small capacitors near the "top" edge of the board—C54, C36, C25, C17, and C8. You'll notice that one end of each capacitor connects to the wide band of metal around the edge of the board. That's ground. The other end of the capacitors are connected to +5Vdc. Using some insulated wire connect "+5" on the Reset Adapter to the +5Vdc side of a capacitor (the picture shows this done on C25). Use some more wire to connect "GND" on the Reset Adapter to the ground side of the capacitor.

Connecting "IN1" and "IN2" is tougher to explain, so check the pictures to be sure. "IN1" should be connected to where "R64" and "R63" connect together on the "aux" board. (Left hand edge of the board about 2.5 inches up from the card-edge connector.) "IN2" should be connected to where R45 and R44 connect together on the "aux" board. (Top edge of the board, about 2.5 inches in from the left.)
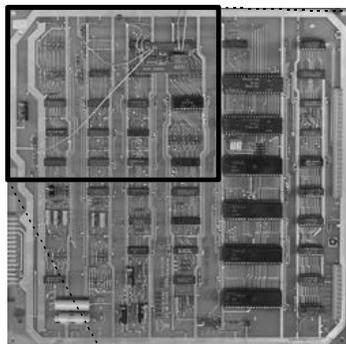

The wires which will run to the reset button should be attached to the Reset adapter in the holes shown—pins two and three by the relay. If those contacts ever wear out, you can switch the wires to the other side of the relay on pins two and three as well.

The picture to the right shows the detail of the solder connection to R44 and R45.
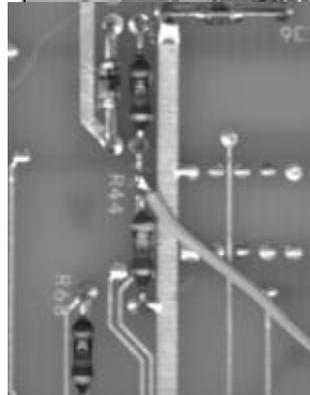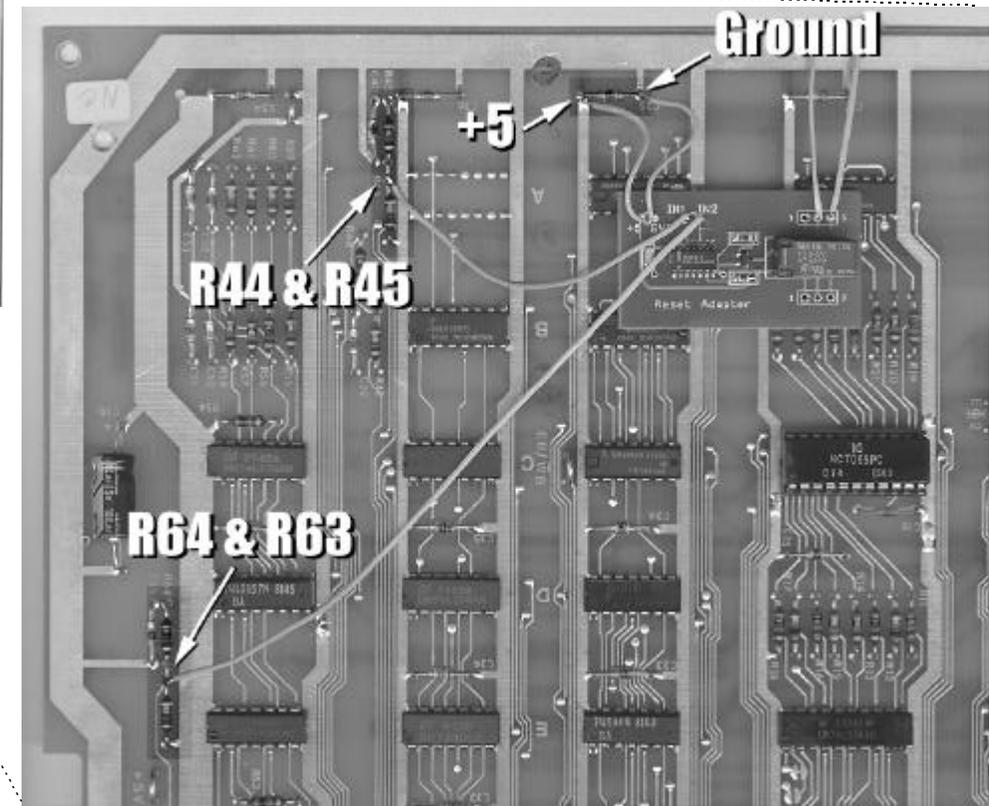
The picture to the right shows the detail of the solder connection to R64 and R63.
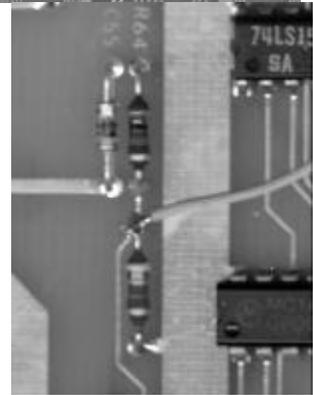
Connecting the Reset Adapter outputs:

On the right-side of the Reset Adapter is the output relay. You'll notice six more holes—three on the top, three on the bottom of the relay. They're numbered "1" through "3". The outputs we need are on "2" (the middle hole) and "3" (the far right). Connect two pieces of wire long enough to reach around to the main Tempest board. Solder one end of each piece of wire to holes "2" and "3" by the relay. (See picture above for reference.)

The next step takes place on the Tempest main board. Near the large card-edge connector (where the board plugs into the cabinet) there is a round switch. That's the reset button. We need to connect the two wires from the Reset Adapter to the switch. You can either solder them directly to the contacts on the back of the Tempest main board where the button is mounted, or solder the wires to the front of the board. If you want to solder them to the front of the board, follow the picture below:
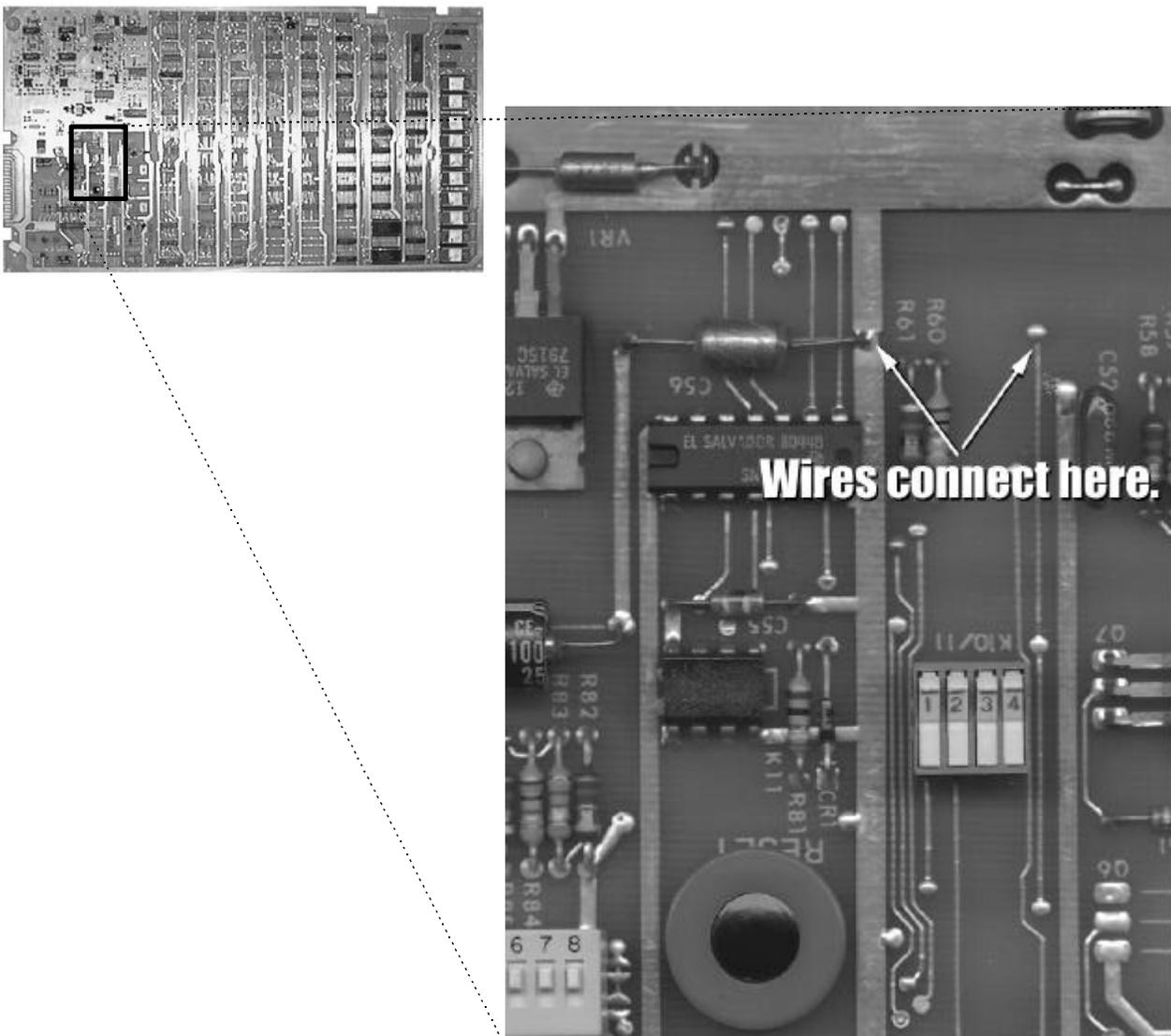
That's it for the Reset Adapter! Now when you push the P1 and P2 start buttons simultaneously the game will reset (and call the menu if you don't have a default game selected).

Using the Multigame:

First power-up:
When first turning on the Multigame it's wise to watch the "spot killer" LED on the monitor. If it comes on solid and you don't hear and "chatter" from the monitor turn the machine off and refer to the trouble-shooting section.

Before you turn on the Tempest Multigame for the first time, place the self-test switch in the "on" ("up" on an upright cabinet) position. When the self-test switch is in the "on" position the Multigame will always start in the game selection menu. The LEDs on the Player 1 and Player 2 start buttons will blink to alert you that the self-test switch is on. Return the self-test switch to "off" and the LED's will stop blinking and the Multigame is ready for use.

The Multigame can be used in two modes.

Normal Mode:
In "normal" mode the Multigame starts and runs the game selection menu. To choose a game, spin the spinner knob (the player icon will move and highlight the game to play). Pressing the "fire" button on the control panel will run the selected game. Turning the machine off and on; pressing the menu button; or pressing P1 and P2 Start buttons simultaneously (if you ordered and installed the Reset Adapter) will return you to the menu to select another game.

TEMPEST

MULTIGAME

SET DEFAULT WITH SUPER ZAPPER

◇ TEMPEST REV 3
TEMPEST REV 2
TEMPEST REV 1
TEMPEST TUBES
VORTEX PROTO
V-BREAKOUT
ALIENS DEMO

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Pressing the "Fire" button in the screen above would result in Tempest Rev. 3 running.

Default Mode:

In "default" mode the Multigame will automatically run a game of your choice when you turn the machine on. From the game menu, pressing the "superzapper" button will place a spinning "Spiker" icon next to the game. Pressing the superzapper again will remove the icon, or place it at a different game. *If the Spiker is listed next to a game on the menu—the next time the machine is turned off and back on or if it's reset by the Menu button or Reset Adapter the game selected with the Spiker will automatically run.* If a default game is selected and another game is selected by pressing "fire", the game selected with "fire" will run, but when the machine is reset the default game will run still take over.

Once a default value is chosen with the superzapper/Spiker the self-test switch must be in the "on" position to get the game menu back and clear the default value. Remember to set the self-test switch back to "off" before running a game (unless you want to run the game's self-test mode).
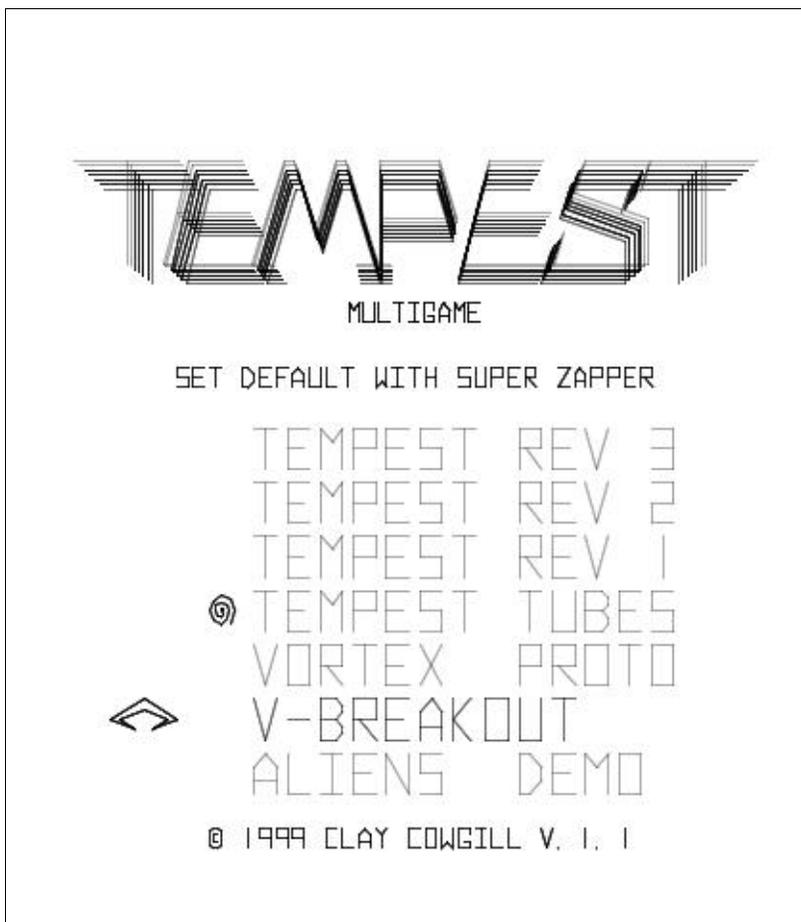
In the screen above, pressing fire would result in V-breakout being run until the machine is turned off and back on or until the machine is reset with the menu button or P1+P2 Start (Reset Adapter). If the machine is power-cycled or reset Tempest Tubes will run automatically. Pressing "superzapper" will change the default game from Tempest Tubes to V-Breakout (where the cursor is).

Aliens Menu Option:

As mentioned in the hardware section, depending on your preference you may want to either enable or disable Aliens on the Multigame. To recap:

To show Aliens game in Menu	To remove Aliens game from Menu
Set DIPSWITCH N13, position 1 to "ON"	Set DIPSWITCH N13, position 1 to "OFF"

Setting the number 1 dipswitch at N13 to "off" has the following effect on the menu:

In this example Aliens has been disabled from dipswitch 1 at N13. V-Breakout will run as the default game, and pressing "fire" will run Tempest Rev 3.

Vector Breakout:

Selecting V-Breakout from the game menu will run an entirely new game on your Tempest machine. Vector Breakout is a full featured version of the classic game "Breakout".

Features:
- Vector graphics version of the classic game, "Breakout"
- Coin or free play mode (selected same as Tempest)
- All-time high score save
- Sound effects
- Demo mode
- screen-cycling to prevent burn-in

Vector Breakout is one-player only. The first time you run Vector Breakout you will want to clear the all-time high score. This is accomplished by holding down the P2-Start button and the "fire" button when the game first starts.

Although Vector Breakout has been thoroughly tested, if you notice any bugs or problems please report them to: clay@yahoo.com (Yeah, I know the coin-drop sound can "stick" sometimes. Just coin it again or start the game… ;-)

Troubleshooting:

- All kits are 100% tested prior to shipment, so a "bad" board is fairly unlikely. The single greatest point of failure will be sockets. If your Tempest board has been worked on, or has different sockets than "usual" Atari boards, it may be necessary to remove and replace the sockets at C2 and N/P3 with the ones supplied with the kit.

- Double check your solder connections on the main Tempest board and Aux board. A tiny splash of solder onto the traces can cause problems if it shorts to a neighboring signal.

- Sometimes handling the Tempest boards can cause problems—you may need to resolder the connectors between the Main and Aux boards. The pin connections often separate with time and age.

- If double checking the installation doesn't fix any problems you can backtrack and remove the kit and try your original game ROMs and CPU in the boardset. If a problem persists with the board at that point, you should refer to one of the Tempest Troubleshooting references on the World Wide Web, or the Atari service/operators manual.

- If you're still stuck contact me at: clay@yahoo.com and I'll try to help debug the installation.

Tips:

- Remember to return the self-test switch to the "off" position when selecting a game from the menu after resetting a default selection—otherwise the game will enter self-test mode which will leave you with a "black" screen for several seconds.

- If the watchdog has been disabled to run Aliens, you will not be able to exit Tempest's self-test mode except by turning the machine off and on or resetting it from the Menu button or Reset Adapter.

- Remember to clear Vector Breakout's high score the first time you start the game. Also be sure to start the Multigame with the self-test switch "on" the first time you test the system to be sure you get the menu system.

That's all!

I hope you enjoy the Tempest Multigame and Vector Breakout. Please check out www.multigame.com for other multigame kits and developments!

Reference:

The following diagram shows the location of the N13 dipswitch and self-test switch for full-size upright games:
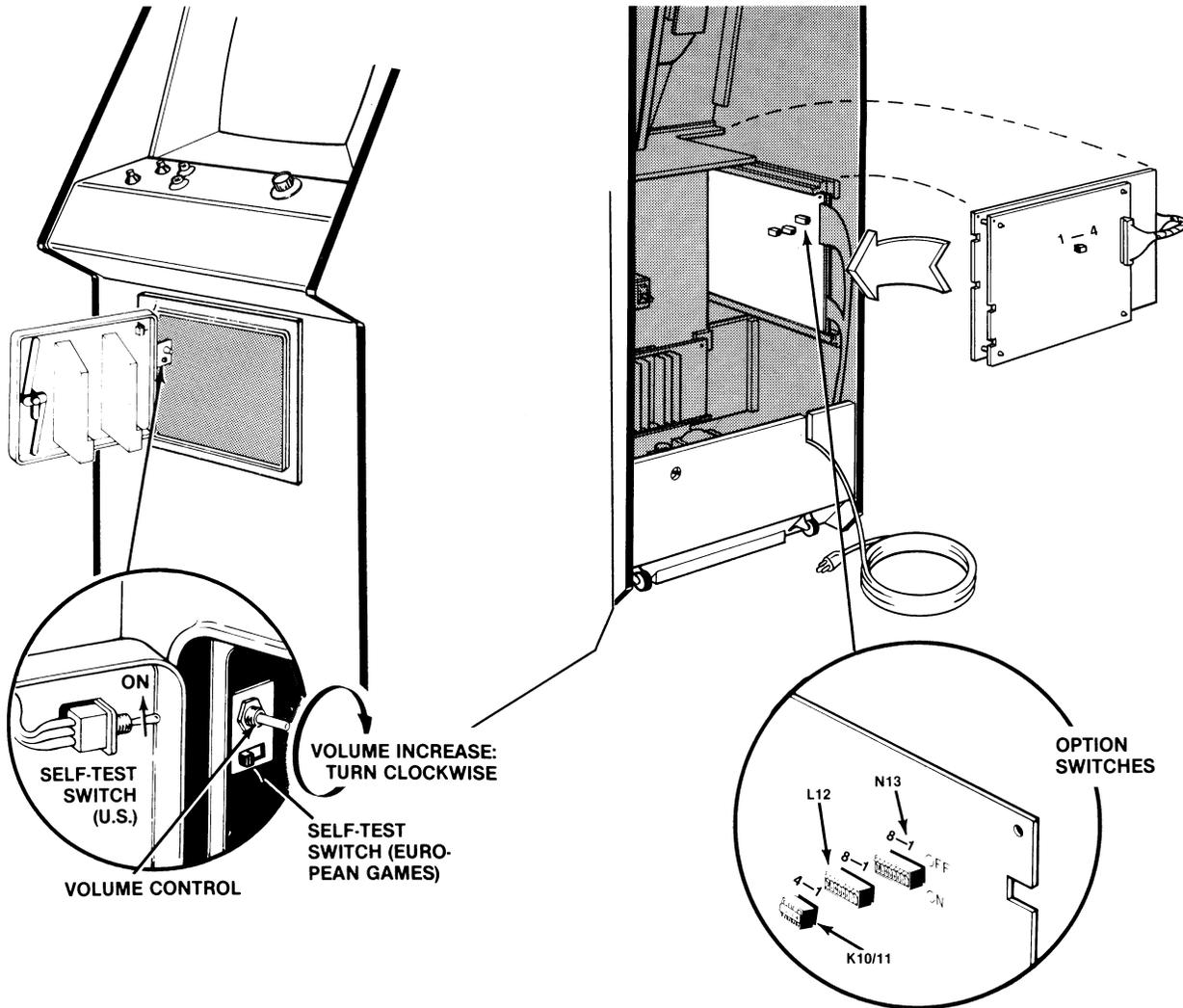
**Location of Self-Test Switch,
Volume Control and Option Switches**

Tempest Multigame Addendum:

1)   Aliens/Vortex DIP switch settings.

It seems as though Vortex and Aliens are somewhat finicky about DIP switch settings. If you have problems running Vortex and/or Aliens after installing the Tempest Multigame (the games won't start from the menu) try the following DIP switch settings:

Switch	1	2	3	4	5	6	7	8
K10/11	off	off	off	off	-	-	-	-
L12	on	on	on	on	off	on	on	on
N13	on	off	off	on	on	on	on	on

2)   Clearing the highscore in V-Breakout.

The manual is probably confusing for how to clear the highscore in V-Breakout. From the Multigame menu select V-Breakout with the spinner (V-Breakout is highlighted in the menu). Hold down the P2 Start Button. Then press and hold the Fire button. Once V-Breakout starts the highscore should be cleared to "0000".

The new Reset Adapter:

The Tempest Multigame now comes with a new version of the reset adapter. The installation procedure is the same as the original adapter, but the location of the connections on the reset adapter is slightly different than the pictures in the manual.

Inputs from
R64 and R44

Reset
Adapter

Outputs to main CPU
board

+5V DC
GND
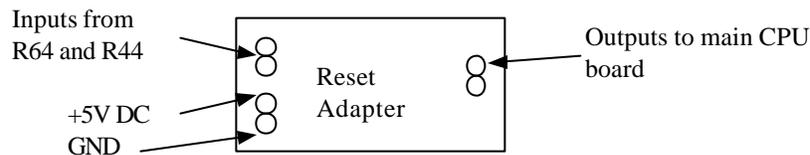
There is a color picture of the new reset adapter installed at:

http://www.multigame.com/pictures/new_reset.JPG