

Williams Games to JAMMA Conversion

For Defender, Stargate, Robotron, Joust, Sinistar, Bubbles and Splat!

This document was originally downloaded from:

WWW.ROBOTRON-2084.CO.UK

Disclaimer: Although I have done my best to ensure that all the information contained on this page is correct, I can take no responsibility if you fry your game, its boards or yourself! If you spot any errors or omissions please [Email me](#).

Introduction

Conversion of a Williams game to JAMMA is not exactly simple, nor is it complex. Most conversions consist of merely the cables, a few switches to access the setup and test menus and a volume pot. If you follow this illustrated guide you should easily be able to get your Williams game up and running in a JAMMA cab in just a few hours. This document aims give you all the information you need to convert a Williams boardset, finishing with an example Robotron to JAMMA Conversion.

All the connectors used on Williams boards are designated with a three-letter code, for example the power connector on the CPU is 1J1. The first '1' meaning the CPU, the 'J' meaning it is the male connector on the board (which will mate with female connector 1P1) and the second '1' meaning that it is the first connector on the CPU board. All connectors will be referred to using this method.

This page assumes that you know what boards you have and that they will work together properly. You can identify you boards on my [Williams Hardware Identification and Compatibility Page](#).

Parts Required

For your Williams JAMMA adapter you will need:

- 1x JAMMA fingerboard
- 1x 50Kohm Logarithmic Volume Pot rated at 1w
- 3x 10 Way Female Molex .156" connectors and pins
- 4x 9 Way Female Molex .156" connectors and pins
- 1x 7 Way Female Molex .156" connector and pins
- 1x 6 Way Female Molex .156" connector and pins
- 4x 4 Way Female Molex .156" connectors and pins
- 3x sub-miniature toggle switches
- Suitable wire in assorted colours

JAMMA STANDARD PINOUT

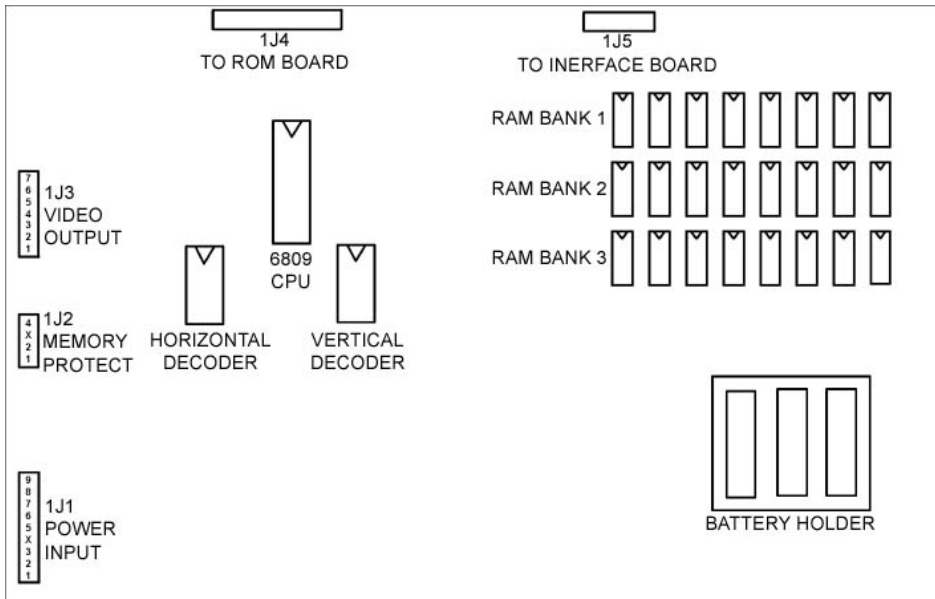
Solder Side	Pin No	Pin No	Component Side
Ground	A	1	Ground
Ground	B	2	Ground
+5v	C	3	+5v
+5v	D	4	+5v
-5v	E	5	-5v
+12v	F	6	+12v
Key	H	7	Key
Coin Counter 2	J	8	Coin Counter 1
Coin Lockout 2	K	9	Coin Lockout 1
Speaker -	L	10	Speaker +
No Connection	M	11	No Connection
Video Green	N	12	Video Red
Video Sync	P	13	Video Blue
Service	R	14	Video Ground
Tilt	S	15	Test
Coin 2	T	16	Coin 1
Player 2 Start	U	17	Player 1 Start
Player 2 Up	V	18	Player 1 Up
Player 2 Down	W	19	Player 1 Down
Player 2 Left	X	20	Player 1 Left
Player 2 Right	Y	21	Player 1 Right
Player 2 Button 1	Z	22	Player 1 Button 1
Player 2 Button 2	a	23	Player 1 Button 2
Player 2 Button 3	b	24	Player 1 Button 3
Player 2 Button 4	c	25	Player 1 Button 4
No Connection	d	26	No Connection
Ground	e	27	Ground
Ground	f	28	Ground

Part One: Power Wiring

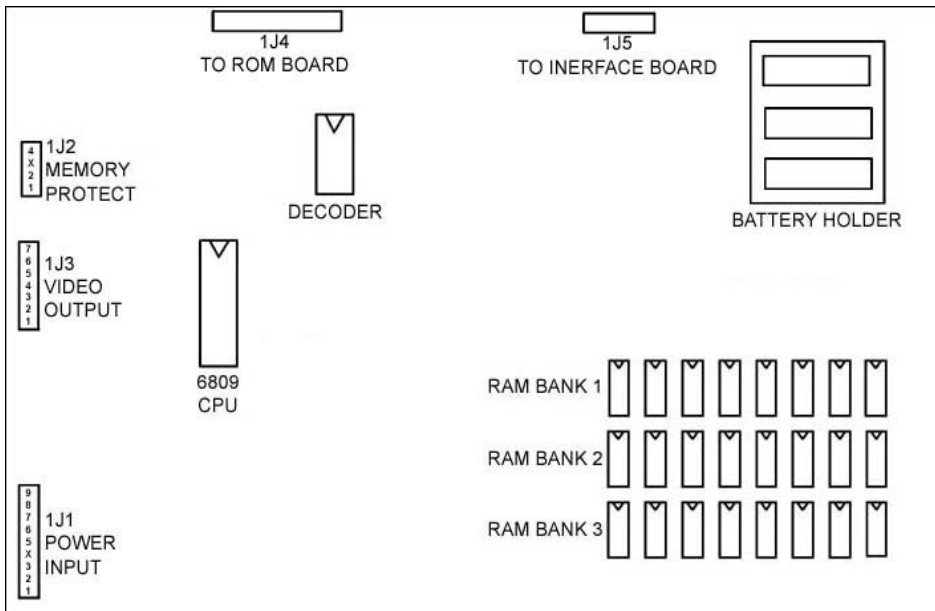
The CPU, ROM and sound boards all need various voltages to power them. The Sinistar speech board and the interface board do not need power as they obtain it through their ribbon cable, though the inputs to the interface board will need grounding, but that will be covered in the controls section. If you wish to replace the Williams PSU in your game with a modern switching PSU, this part of the JAMMA conversion is all you need.

The CPU Board

The CPU board requires +5v regulated, -5v regulated, +12v regulated, ground and +12 unregulated power supplies. Since the CPU will work fine if you use +12 regulated instead of the +12 unregulated a JAMMA PSU will work fine here. All the power connections to the CPU board are made to connector 1J1, which is a 9 pin Molex connector. See the diagrams below for exact wiring details:



CPU Board Layout (NOT Early Series Defenders)



CPU Board Layout for Early Series Defenders

1J1

TOP

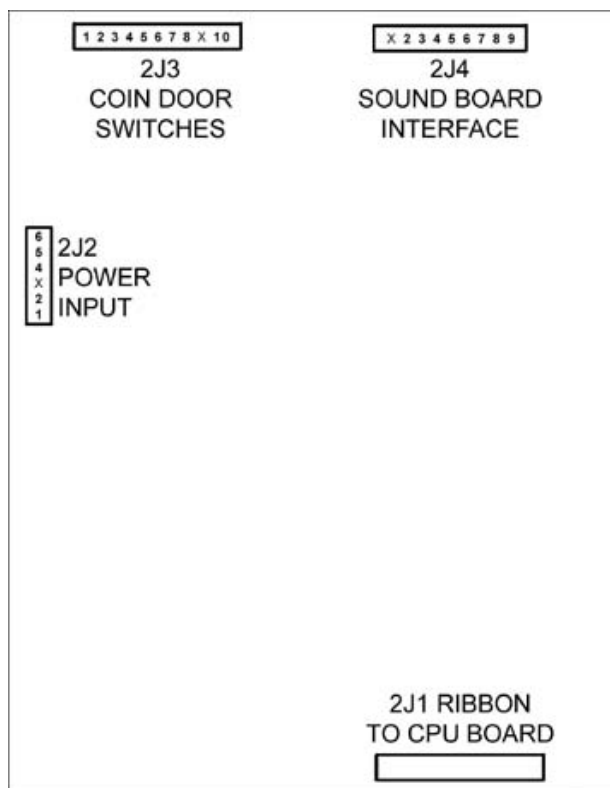
- Pin 9 -5v DC
- Pin 8 +12v DC
- Pin 7 +5v DC
- Pin 6 +5v DC
- Pin 5 +12v DC
- Pin 4 Key
- Pin 3 Ground
- Pin 2 Ground
- Pin 1 Ground

BOTTOM

CPU Board Power Connector 1J1 Wiring

The ROM Board

The ROM board requires +5v regulated and ground so a JAMMA PSU will also work fine here. All the power connections to the ROM board are made to connector 2J2, which is a 4 pin Molex connector on Defender and Stargate boards and a 6 pin Molex connector on all other boards. Since the pins that are used are the same for all games we can still make a loom that will work for all games. See the diagrams below for exact wiring details:



ROM Board Layout

2J2

TOP
 Pin 4 +5v DC
 Pin 3 Key
 Pin 2 No Connection
 Pin 1 Ground
 BOTTOM

**ROM Board Power Connector 2J2 Wiring
 Defender & Stargate**

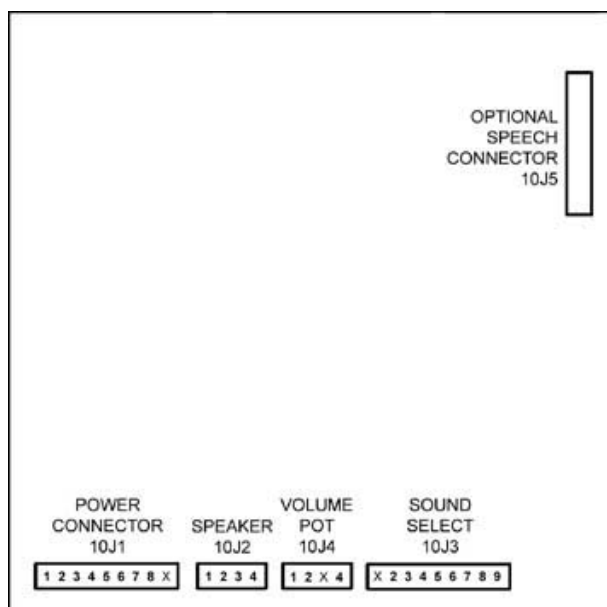
2J2

TOP
 Pin 6 +5v DC (Optional)
 Pin 5 No Connection
 Pin 4 +5v DC
 Pin 3 Key
 Pin 2 No Connection
 Pin 1 Ground
 BOTTOM

**ROM Board Power Connector 2J2 Wiring
 Robotron & Later Games**

The Sound Board

The sound board requires +12v unregulated, -12v unregulated and ground. The +12v and -12v are rectified on the sound board to produce its own regulated +5v supply. If you use -5v and +12v from the JAMMA PSU it will work fine. All the power connections to the sound board are made to connector 10J1, which is a 9 pin Molex connector. See the diagrams below for exact wiring details:



Sound Board Layout

10J1

RIGHT
 Pin 9 No Connection
 Pin 8 -5v DC
 Pin 7 Key
 Pin 6 No Connection
 Pin 5 Ground
 Pin 4 No Connection
 Pin 3 No Connection
 Pin 2 +12v DC
 Pin 1 No Connection
 LEFT

Sound Board Power Connector 10J1 Wiring

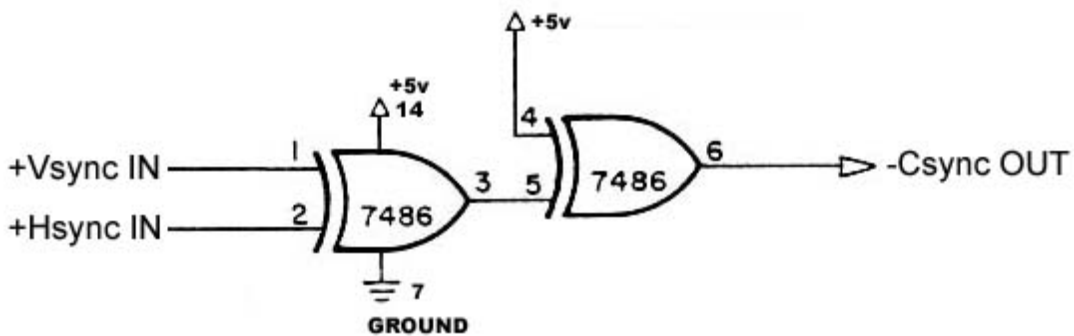
Note: Some sound boards do not have the keying pin removed!

Part Two: Video Wiring

The video wiring is the most difficult part of a Williams to JAMMA conversion. The manuals state that the boards only output Vertical (Vsync) and Horizontal (Hsync) sync pulses with positive polarity, yet a true JAMMA monitor requires negative composite (Csync). However, in most cases we are lucky, as all boards except for early Defenders ([ID your Boards at this Web-page](#)) have positive Csync available. This can be either inverted or a simple modification can be carried out to give you the required negative Csync.

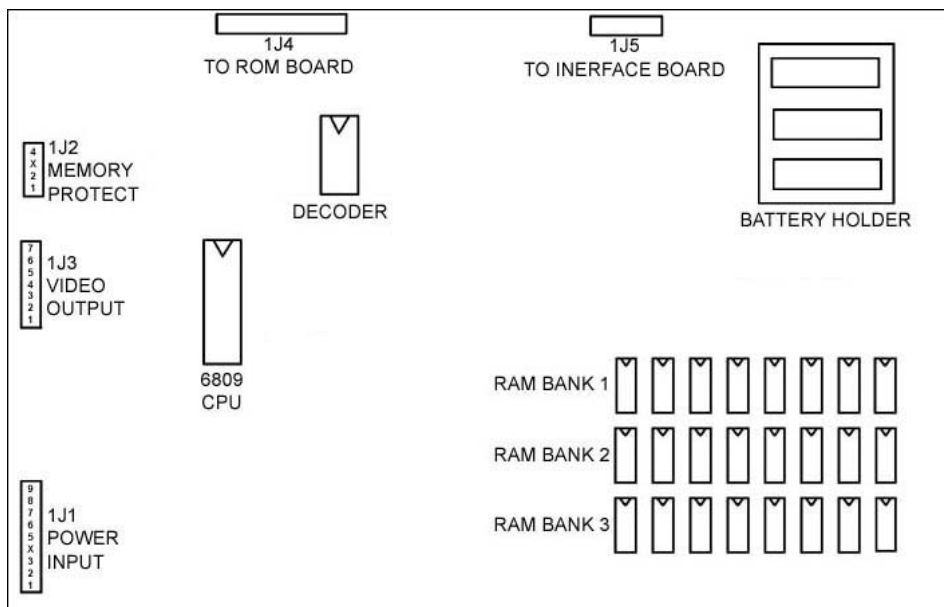
Video On Early Series Defender Boards

OK, so we don't have Csync at all so we must create it ourselves. In a nutshell we take the Hsync and Vsync and combine them to be Csync. Since the Csync we have created is the wrong polarity we then invert it. The circuit below shows how we achieve this:



Early Series Defender Composite Sync (Csync) Circuit.

Since we now have the means to make JAMMA friendly Csync on our early series Defender CPU, all we need to do is wire the connector up as shown in the diagrams below:



CPU Board Layout for Early Series Defender Games

1J3

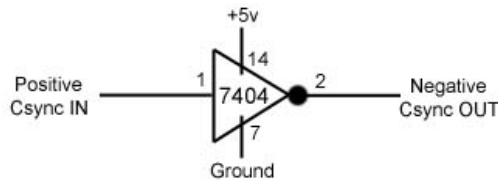
- TOP
- Pin 7 Key
 - Pin 6 Hsync
 - Pin 5 Vsync
 - Pin 4 Video Ground
 - Pin 3 Blue
 - Pin 2 Green
 - Pin 1 Red
- BOTTOM

CPU Board Video Connector 1J3 Wiring For Early Series Defender Games

Video On All Other Boards

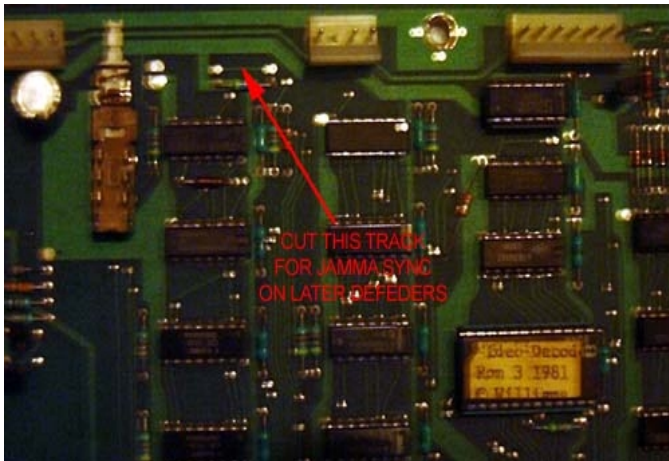
An undocumented feature of all the 2 Decoder Williams boards (i.e. later series Defender games onwards) is that pin 7 of the video connector 1J3 carries positive Csync. All we need to do to make this JAMMA friendly is invert it. There are two ways of doing this:

1. Invert the Csync video signal from 1J3 pin 7 using the circuit below:

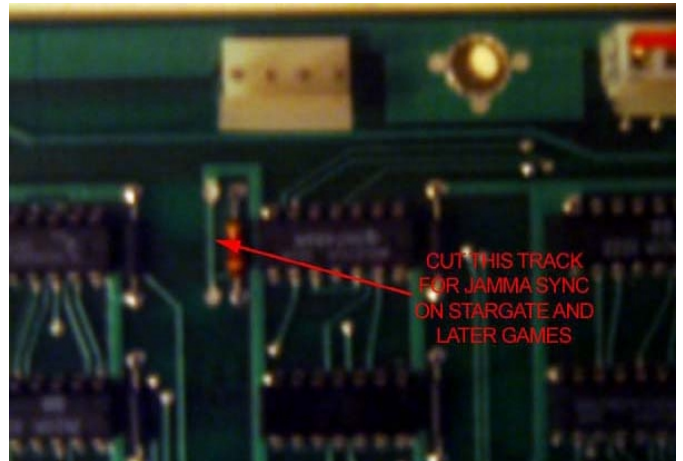


Composite Sync Inversion Circuit

2. Modify the CPU board to output negative Csync. This is easily achieved by removing link W1 from the CPU board. W1 is not so much of a link though as the schematics might suggest but a track on the PCB. There are holes on the PCB each side of the track though so you can easily reverse the modification by fitting a wire link or zero ohm resistor to bridge the gap. The two photos below show where you need to cut on later series Defender boards and Stargate and later games boards:

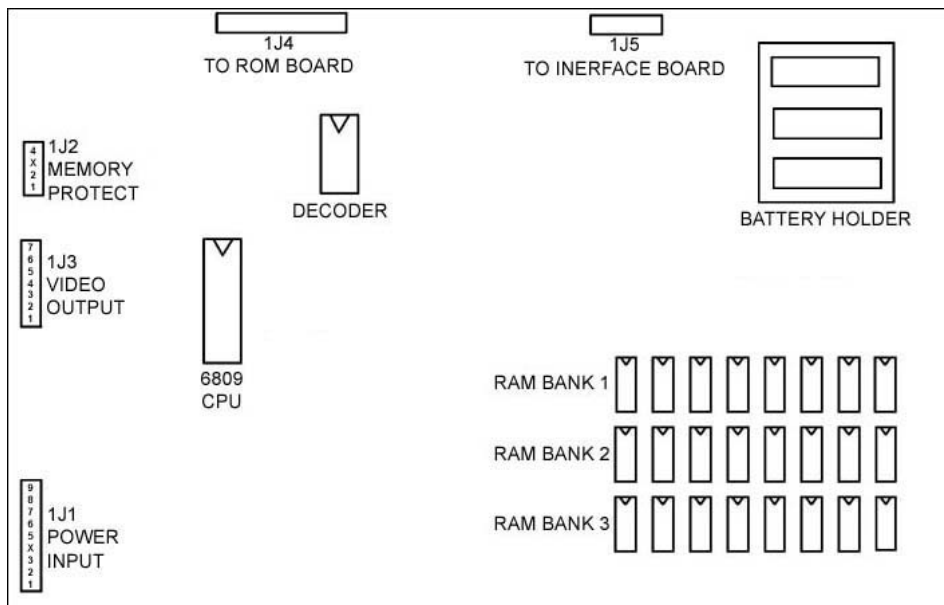


Composite Sync Inversion Modification For Later Series Defender CPU Boards



Composite Sync Inversion Modification For Stargate And Later Games

Since we now have the means to make JAMMA-friendly Csync on our CPU, all we need to do is wire the connector up as shown in the diagrams below:



CPU Board Layout (NOT Early Series Defenders)

1J3

- TOP
- Pin 7 Csync
- Pin 6 Hsync
- Pin 5 Vsync
- Pin 4 Video Ground
- Pin 3 Blue
- Pin 2 Green
- Pin 1 Red
- BOTTOM

CPU Board Video Connector 1J3 Wiring

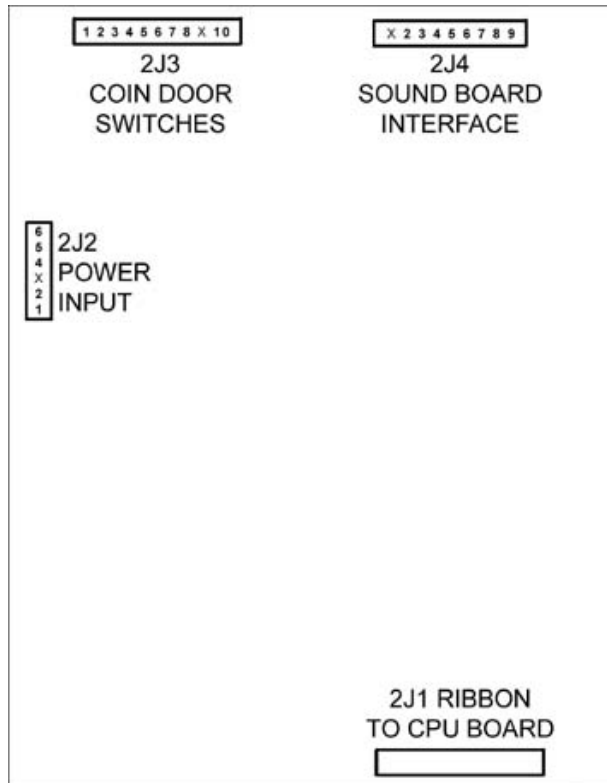
Part Three: Coin-Door Wiring

The coin-door controls consist of the inputs from the coin mechanisms and the three switches (Auto/Manual, Advance and High Score Reset) which are used to control the pricing, difficulty and bookkeeping of the game. Each switch should be normally open and wired to ground on one side and the input to the ROM boards coin door connector 2J3, which is a 10 pin Molex connector.

NOTES:

1. All the pinouts shown here assume that you are wiring up an upright game.
2. Defender boards are numbered from bottom to top, whereas the other games are numbered from top to bottom!

See the diagrams below for exact wiring details:



ROM Board Layout

2J3

RIGHT

- Pin 10 Auto/Man
- Pin 9 Advance
- Pin 8 Right Coin
- Pin 7 High Score Reset
- Pin 6 Left Coin
- Pin 5 Center Coin
- Pin 4 No Connection
- Pin 3 No Connection
- Pin 2 No Connection
- Pin 1 No Connection

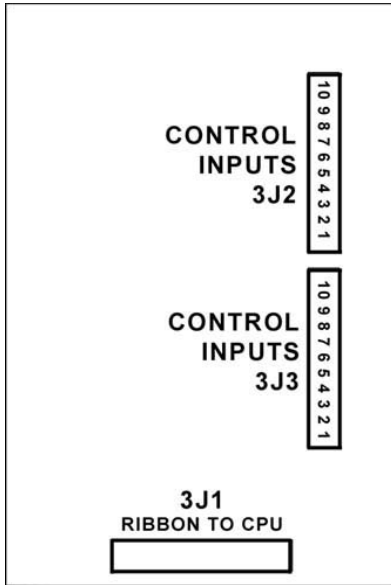
LEFT

ROM Board Coin Door Connector 2J3 Wiring

Part Four: Player Control Wiring

The player controls consist of the inputs from the control panel; each switch should be normally open and wired to ground on one side and the input to the interface board on the other. There are four types of interface board which are used in various games so the exact wiring for each will be dealt with separately below:

Defender Control Wiring



Defender Interface Board Layout

3J2

	TOP
Pin 10	Ground
Pin 9	No Connection
Pin 8	No Connection
Pin 7	No Connection
Pin 6	Key
Pin 5	No Connection
Pin 4	No Connection
Pin 3	No Connection
Pin 2	No Connection
Pin 1	Up
	BOTTOM

Defender Interface Board Connector 3J2 Wiring

3J3

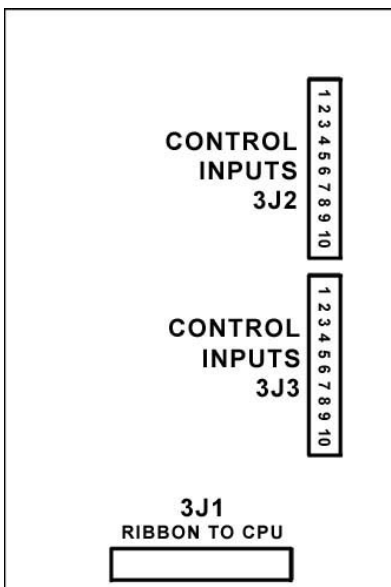
	TOP
Pin 10	Ground
Pin 9	Key
Pin 8	Down
Pin 7	Reverse
Pin 6	1 Player Start
Pin 5	2 Player Start
Pin 4	Hyper Space
Pin 3	Smart Bomb
Pin 2	Thrust
Pin 1	Fire
	BOTTOM

Defender Interface Board Connector 3J3 Wiring

Stargate, Robotron, Joust and Bubbles Control Wiring

Stargate, Robotron, Joust and Bubbles Interface Boards are all the same, merely wired up differently according to the games controls as shown below:

Stargate Control Wiring



Stargate, Robotron, Joust and Bubbles Interface Board Layout

3J2

	TOP
Pin 1	Up
Pin 2	No Connection
Pin 3	No Connection
Pin 4	No Connection
Pin 5	No Connection
Pin 6	No Connection
Pin 7	No Connection
Pin 8	No Connection
Pin 9	No Connection
Pin 10	Ground
	BOTTOM

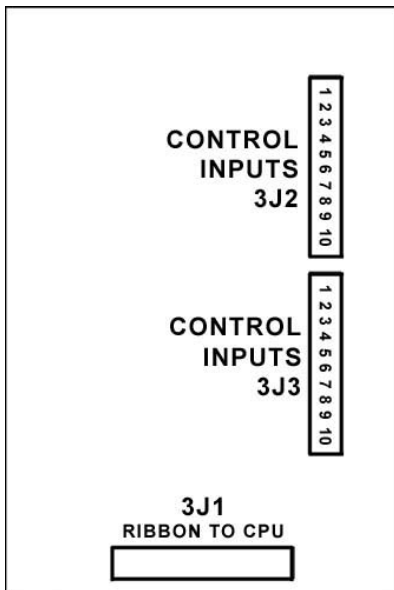
Stargate Interface Board Connector 3J2 Wiring

3J3

	TOP
Pin 1	Fire
Pin 2	Thrust
Pin 3	Smart Bomb
Pin 4	Hyper Space
Pin 5	2 Player Start
Pin 6	1 Player Start
Pin 7	Reverse
Pin 8	Down
Pin 9	Inviso
Pin 10	Ground
	BOTTOM

Stargate Interface Board Connector 3J3 Wiring

Robotron Control Wiring



Stargate, Robotron, Joust and Bubbles Interface Board Layout

3J2

TOP	
Pin 1	Fire Left
Pin 2	No Connection
Pin 3	No Connection
Pin 4	No Connection
Pin 5	No Connection
Pin 6	No Connection
Pin 7	No Connection
Pin 8	No Connection
Pin 9	No Connection
Pin 10	Ground
BOTTOM	

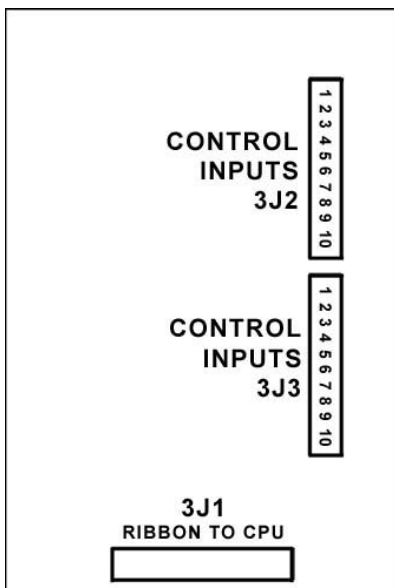
Robotron Interface Board Connector 3J2 Wiring

3J3

TOP	
Pin 1	Move Up
Pin 2	Move Down
Pin 3	Move Left
Pin 4	Move Right
Pin 5	2 Player Start
Pin 6	1 Player Start
Pin 7	Fire Up
Pin 8	Fire Down
Pin 9	Fire Right
Pin 10	Ground
BOTTOM	

Robotron Interface Board Connector 3J3 Wiring

Joust Control Wiring



Stargate, Robotron, Joust and Bubbles Interface Board Layout

3J2

TOP	
Pin 1	No Connection
Pin 2	Player 2 Move Left
Pin 3	Player 2 Move Right
Pin 4	Player 2 Flap
Pin 5	No Connection
Pin 6	No Connection
Pin 7	No Connection
Pin 8	No Connection
Pin 9	No Connection
Pin 10	Ground
BOTTOM	

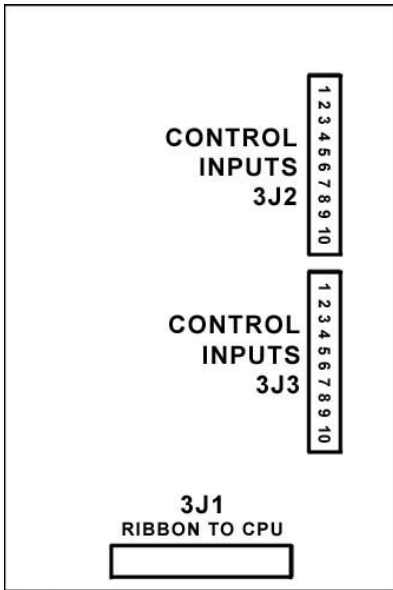
Joust Interface Board Connector 3J2 Wiring

3J3

TOP	
Pin 1	Player 1 Move Left
Pin 2	Player 1 Move Right
Pin 3	Player 1 Flap
Pin 4	No Connection
Pin 5	1 Player Start
Pin 6	2 Player Start
Pin 7	No Connection
Pin 8	No Connection
Pin 9	No Connection
Pin 10	Ground
BOTTOM	

Joust Interface Board Connector 3J3 Wiring

Bubbles Control Wiring



Stargate, Robotron, Joust and Bubbles Interface Board Layout

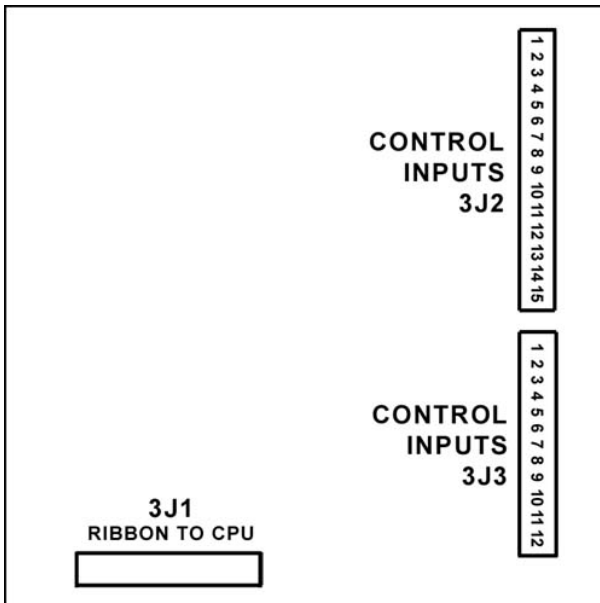
**Connector 3J2
NOT USED ON
Bubbles Games**

3J3

TOP	
Pin 1	Move Up
Pin 2	Move Down
Pin 3	Move Left
Pin 4	Move Right
Pin 5	2 Player Start
Pin 6	1 Player Start
Pin 7	No Connection
Pin 8	No Connection
Pin 9	No Connection
Pin 10	Ground
BOTTOM	

**Splat! Interface Board
Connector 3J3 Wiring**

Sinistar Interface Boards



Sinistar Interface Board Layout

3J2

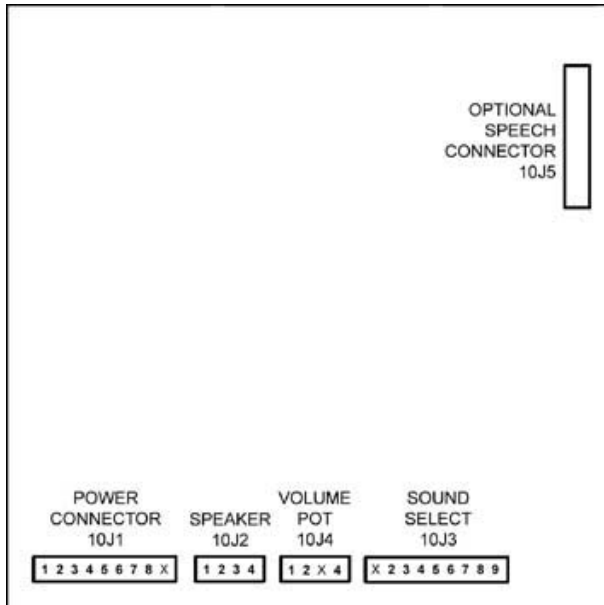
TOP	
Pin 1	Up/Down Switch A
Pin 2	Up/Down Switch B
Pin 3	Up/Down Switch C
Pin 4	Up/Down Direction
Pin 5	Left/Right Switch A
Pin 6	Left/Right Switch B
Pin 7	No Connection
Pin 8	Left/Right Switch C
Pin 9	Left/Right Direction
Pin 10	Fire
Pin 11	Sinibomb
Pin 12	No Connection
Pin 13	1 Player Start
Pin 14	2 Player Start
Pin 15	Ground
BOTTOM	

**Sinistar Interface Board
Connector 3J2 Wiring**

**Connector 3J3
NOT USED ON
Sinistar Games**

Part Five: Sound Board Wiring

The power supply for the sound board has already been dealt with, next we need to wire-up the speaker, volume control and the control inputs from the ROM board. All quite straightforward here, but make sure you use a 50Kohm Logarithmic 1Watt Potentiometer here. If you are wiring up a Sinistar then you'll also have to connect the Speech board to the Sound board via the 40 way ribbon cable. See the diagrams below for exact wiring details:



Sound Board Layout

10J2

TOP
 Pin 1 Speaker +
 Pin 2 No Connection
 Pin 3 No Connection
 Pin 4 Speaker -
 BOTTOM

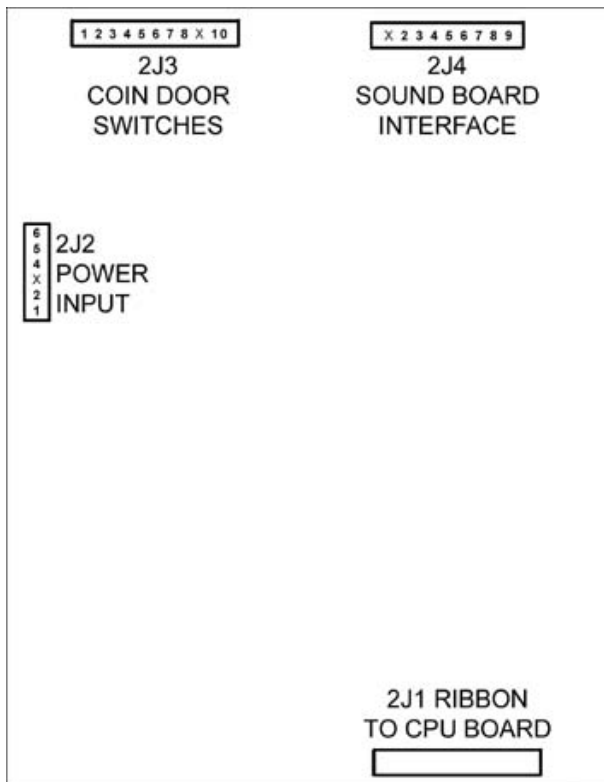
Sound Board Speaker Connector 10J2

10J4

TOP
 Pin 1 Sound IN (Pot Centre)
 Pin 2 Sound OUT (Pot Left)
 Pin 3 Key
 Pin 4 Ground (Pot Right)
 BOTTOM

Sound Board Volume Connector 10J4

The cable between the ROM board and the Sound board carries the binary signals that trigger each individual sound. Simply wire each of the 7 wires pin to pin between the boards as shown below:



ROM Board Layout

2J4

LEFT
 Pin 1 Key
 Pin 2 Sound Bit 1
 Pin 3 Sound Bit 2
 Pin 4 Sound Bit 3
 Pin 5 Sound Bit 4
 Pin 6 Sound Bit 5
 Pin 7 Sound Bit 6
 Pin 8 Sound Bit 7
 Pin 9 No Connection
 RIGHT

ROM Board Sound Output Connector 2J4

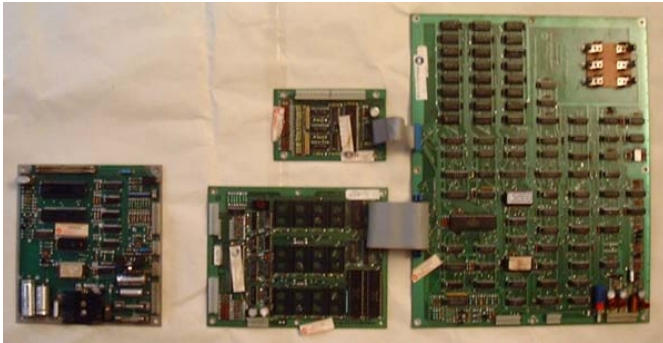
10J3

LEFT
 Pin 1 Key
 Pin 2 Sound Bit 1
 Pin 3 Sound Bit 2
 Pin 4 Sound Bit 3
 Pin 5 Sound Bit 4
 Pin 6 Sound Bit 5
 Pin 7 Sound Bit 6
 Pin 8 Sound Bit 7
 Pin 9 No Connection
 RIGHT

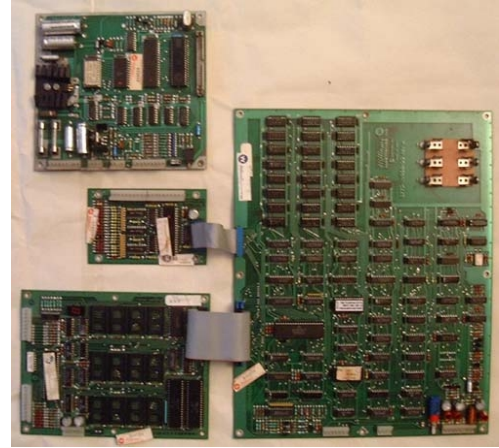
Sound Board Control Input Connector 10J3

Part Six: An example Robotron to JAMMA Conversion

In order to build a complete JAMMA loom the first thing we need to do is decide how we are going to lay out the boards. In a Williams cabinet the boards are mounted on a grounded metal plate making sure all the boards are bonded together, however if you do not have the metal plate this is not necessary since all the boards are grounded through their Molex connectors. You can either mount them on a piece of MDF, directly to the inside of the JAMMA cab or on a metal plate if you have one. The pictures below show two suggested layouts, though of course the final choice is up to you.

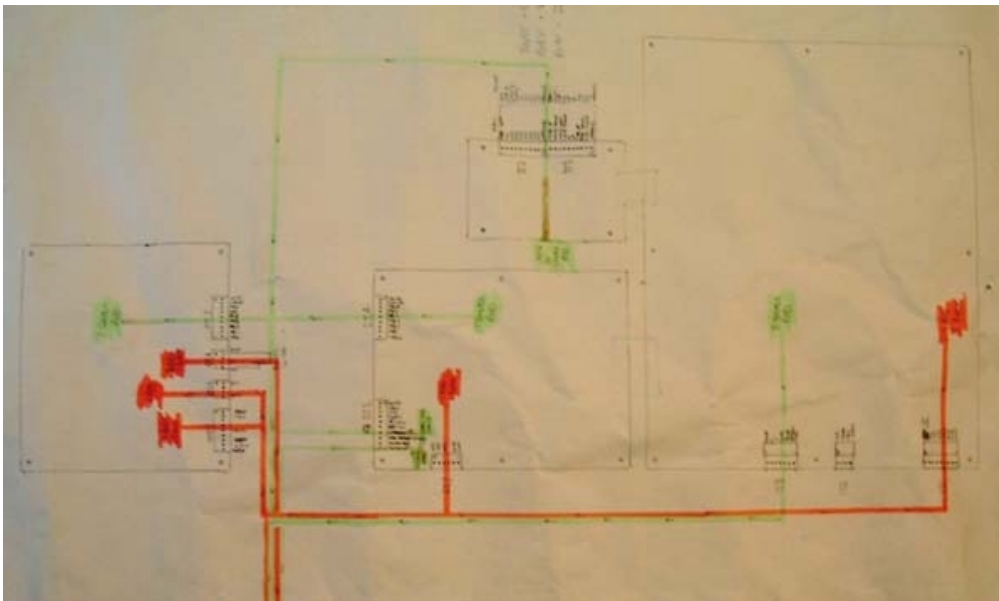


Suggested Board Layout



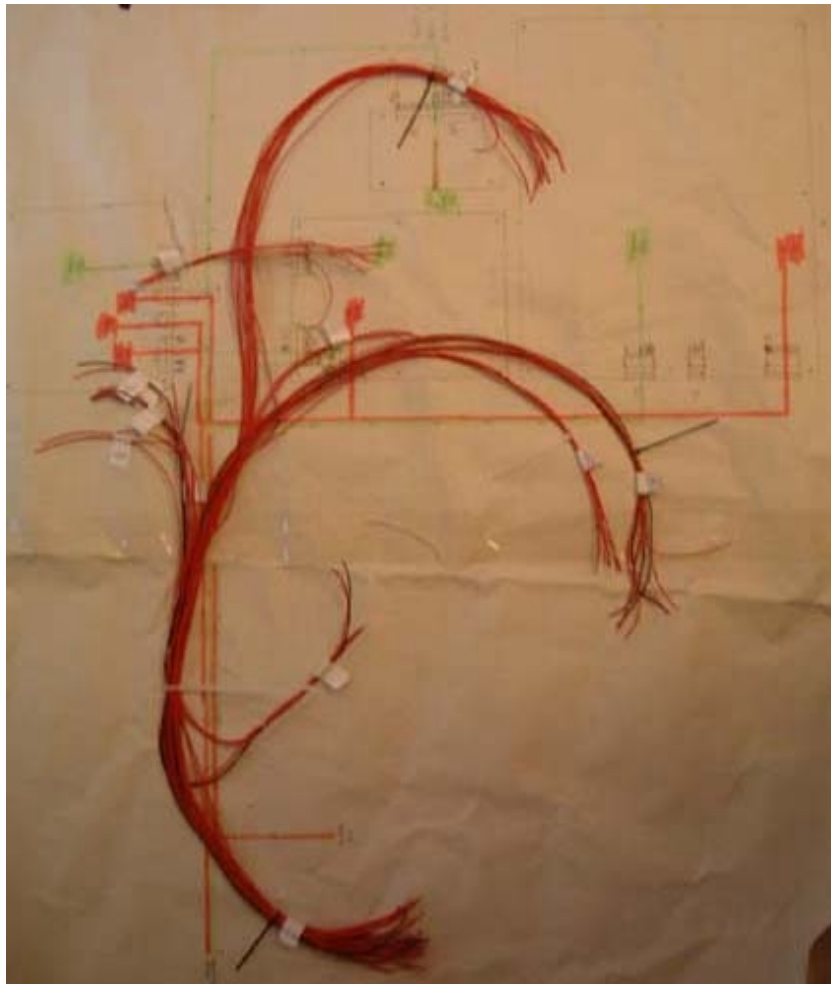
Alternative Suggested Board Layout

Once you have laid out the boards, mark out the cable routing, number of cables and length on some paper so you can cut all the wires to length.



Cable Length And Number Of Wires Marked Out On Paper

Now we are ready to make our loom. The best way is to cut all the cables first and make them into a rough loom using whatever colour scheme you have chosen. I just used red for everything except the ground wires which are black, however I have used a smaller gauge wire for economy on the controls and video wiring.



The Loom Cut And Laid Out Ready For Connectors To Be Fitted

Terminate the loom's Molex connectors one by one ensuring that the wires are going to the right place as detailed previously in this document. **DO NOT** terminate the JAMMA fingerboard, volume pot or set-up buttons at this point. Now connect the Molex connectors to the boards and take up any slack in your loom.



The Molex Connectors All Terminated



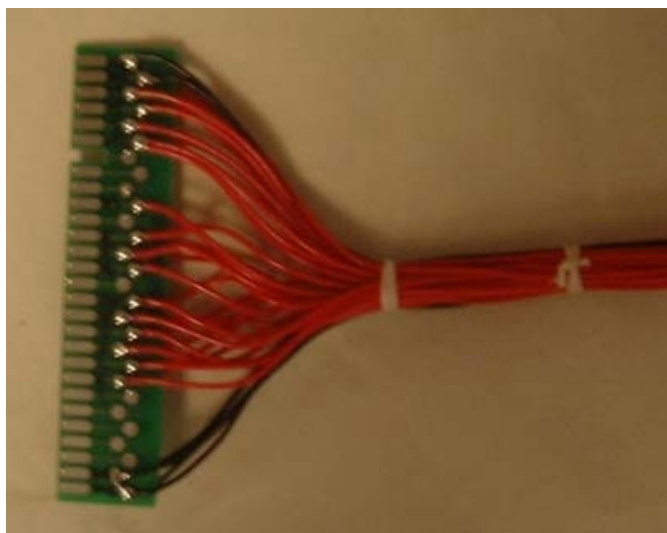
Take up the slack in the loom and tie the cables together. This is best done with the boards connected to the PCB's

Next we need to wire up the volume control and set-up switches. Remember that the Auto/Manual switch should be normally closed and latching, and the Advance and High Score Reset switches are normally open with non-latching switches preferred but not essential. The best method of mounting the switches is to build the three switches and volume pot into a small box, although you could add switches to your JAMMA cab and use the JAMMA loom.



The Control Box Built and Wired Up

Finally we need to wire up the JAMMA connector. The best way to do this is to use an ohmmeter to identify each wire from the Molex connector to the JAMMA loom. Identify and solder the wires in place one by one, being careful not to make any wrong connections.



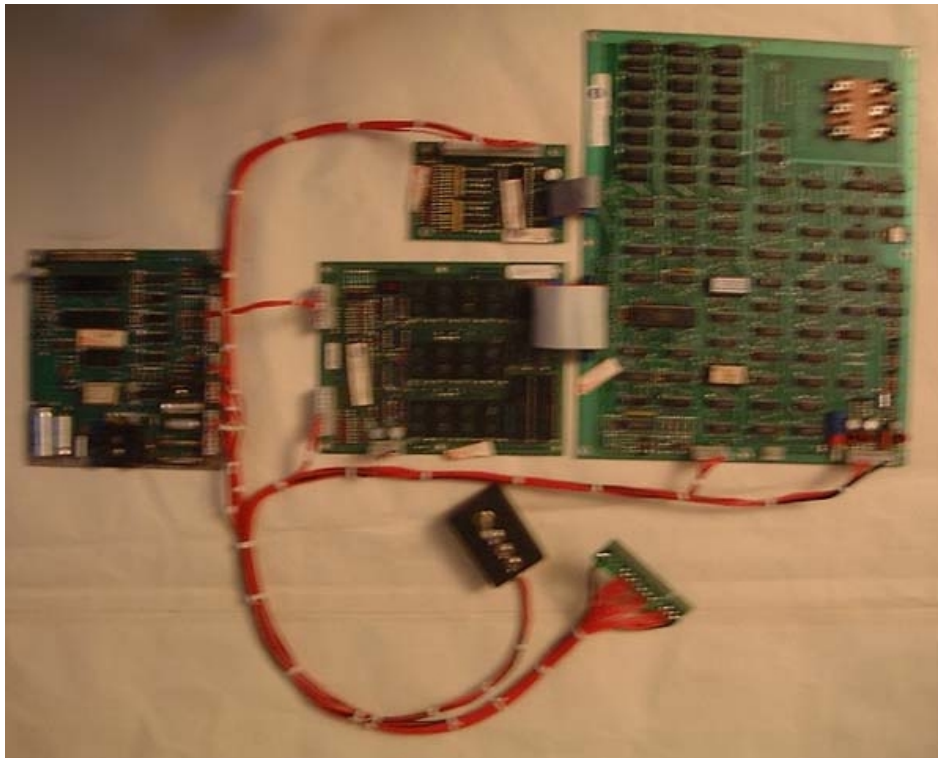
The JAMMA Connector



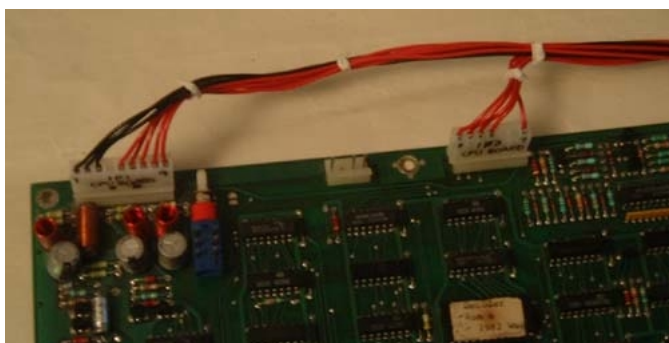
The Completed JAMMA Loom

Getting ready to power up your JAMMA adapter for the first time

Once our JAMMA loom is complete, and you are sure there are no mistakes you are ready to power it up. **IMPORTANT!** Just to be sure that you have not made any mistakes, power up the loom without any boards connected and measure the voltage at EVERY pin of the Molex connectors. (To ensure that all voltages are correct and there is no voltage present where there should not be any) Once this is done you are ready to go! **CONGRATULATIONS!**



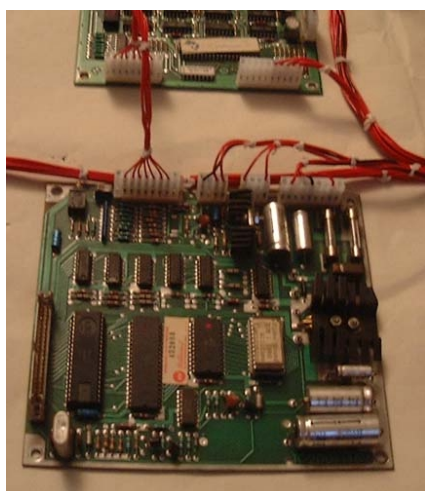
The Completed JAMMA loom connected to the PCBs.



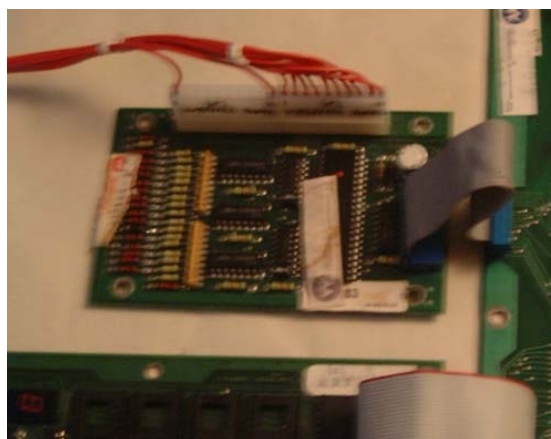
The CPU board connectors
Note that there is NO connection
to the 4 pin Molex connector



ROM Board Connectors



Sound Board Connectors



Interface Board Connections

Disclaimer: Although I have done my best to ensure that all the information contained on this page is correct, I can take no responsibility if you fry your game, its boards or yourself! If you spot any errors or omissions please Email me.