#### **ATARI 2600 HARDWARE REFERENCE GUIDE**

#### **Hardware Registers Quick Reference**

## TIA - Write

\$00	
\$02 WSYNC - S T R O B E - Wait for start of horizontal sync. \$03 RSYNC - S T R O B E - Reset sync (chip testing). \$04 NUSIZO M M - P P P Number / size of Player 0 Size of Missile 0 \$05 NUSIZI M M - P P P Number / size of Player 1 \$06 COLUPO C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$07 COLUPI C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$08 COLUPF C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$09 COLUBK C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$09 COLUBK C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$09 COLUBK C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$09 COLUBK C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$09 COLUBK C C C C C L L L X Colour / Lum. player 0, PF score I Size of Missile 1 \$00 C REFPI B B - P S R Playfield control: Ball size, Playfield priority, Score, Reflect. \$00 REFPO 1 1 Reflect player 1 \$00 PF0 1 1 1 1 1 Playfield register 0 (bits 4-7) \$00 PF0 1 1 1 1 1 1 1 1 1 1 1 Playfield register 0 (bits 4-7) \$00 RESPO - S T R O B E Reset player 1 horizontal position S11 RESP1 - S T R O B E Reset player 1 horizontal position S11 RESP1 - S T R O B E Reset player 1 horizontal position S13 RESM1 - S T R O B E Reset missile 0 horizontal position S14 RESBL - S T R O B E Reset ball horizontal position S15 AUDC0 1 1 1 1 1 Audio control channel 0 \$14 RESBL - S T R O B E Reset ball horizontal position S16 AUDC1 1 1 1 1 Audio control channel 0 \$15 AUDV1 1 1 1 1 1 Audio volume channel 0 \$16 AUDC1 1 1 1 1 1 Audio volume channel 0 \$17 AUDF0 1 1 1 1 1 Audio volume channel 0 \$18 AUDV1 1 1 1 1 1 Craphics player 1 \$19 ENAMO 1 1 Enable missile 0 \$10 ENAMO 1 1 Enable missile 0	
\$02	
\$03	
\$04	
Size of Missile 0   Size of Missile 0	
\$05	
Size of Missile 1   Size of Missile 1	
\$06	
\$07 COLUP1 C C C C L L L X Colour / Lum. player 1, PF score response to the colour of	
\$08 COLUPF C C C C L L L X Colour / Lum. playfield (PF), Ball (\$1	eft
\$09 COLUBK C C C C L L L X Colour / Luminance background \$0A CTRLPF - B B - P S R Playfield control: Ball size, Playfield priority, Score, Reflect. \$0B REFP0 1 Reflect player 0 \$0C REFP1 1 1 Reflect player 1 \$0D PF0 1 1 1 1 1 Playfield register 0 (bits 4-7) \$0E PF1 1 1 1 1 1 1 1 1 1 Playfield register 0 (bits 4-7) \$0F PF2 1 1 1 1 1 1 1 1 1 Playfield register 1 (bits 7-0) \$0F RESP0 - S T R O B E Reset player 1 horizontal position \$11 RESP1 - S T R O B E Reset missile 0 horizontal position \$12 RESM0 - S T R O B E Reset missile 1 horizontal position \$13 RESM1 - S T R O B E Reset missile 1 horizontal position \$14 RESBL - S T R O B E Reset missile 1 horizontal position \$15 AUDC0 1 1 1 1 Audio control channel 0 \$16 AUDC1 1 1 1 1 Audio control channel 0 \$18 AUDC1 1 1 1 1 Audio requency channel 0 \$18 AUDV1 1 1 1 1 Audio volume channel 0 \$19 AUDV0 1 1 1 1 Audio volume channel 0 \$10 REP0 1 1 1 1 1 1 1 1 Graphics player 1 \$10 REP0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ght
\$0A CTRLPF - B B - P S R Playfield control: Ball size, Playfield priority, Score, Reflect.  \$0B REFPO 1 - Reflect player 0  \$0C REFP1 1 - Reflect player 1  \$0D PFO 1 1 1 1 1 1 - Playfield register 0 (bits 4-7)  \$0E PF1 1 1 1 1 1 1 1 1 1 Playfield register 1 (bits 7-0)  \$0F PF2 1 1 1 1 1 1 1 1 1 Playfield register 1 (bits 7-0)  \$0F PF2 1 1 1 1 1 1 1 1 1 Playfield register 2 (bits 0-7)  \$10 RESPO - S T R O B E - Reset player 1 horizontal position  \$11 RESP1 - S T R O B E - Reset player 1 horizontal position  \$12 RESMO - S T R O B E - Reset missile 1 horizontal position  \$13 RESM1 - S T R O B E - Reset missile 1 horizontal position.  \$14 RESBL - S T R O B E - Reset missile 1 horizontal position.  \$15 AUDCO 1 1 1 1 Audio control channel 0  \$16 AUDC1 1 1 1 1 Audio frequency channel 0  \$18 AUDF1 1 1 1 1 Audio frequency channel 0  \$18 AUDF1 1 1 1 1 Audio requency channel 0  \$19 AUDVO 1 1 1 1 Graphics player 0  \$10 REPP	3L)
SOB   REFPO	
SOB         REFPO         - </td <td></td>	
SOC         REFP1         -         -         -         1         -         -         Reflect player 1           \$OD         PF0         1         1         1         1         1         -         -         -         Playfield register 0 (bits 4-7)           \$OE         PF1         1	
\$0D PF0	
\$0E PF1	
\$0F PF2	
\$10 RESP0	
\$11 RESP1 - S T R O B E - Reset player 1 horizontal position \$12 RESMO - S T R O B E - Reset missile 0 horizontal position \$13 RESM1 - S T R O B E - Reset missile 0 horizontal position \$14 RESBL - S T R O B E - Reset missile 1 horizontal position \$15 AUDCO 1 1 1 1 Audio control channel 0 \$16 AUDC1 1 1 1 1 Audio control channel 1 \$17 AUDFO 1 1 1 1 1 Audio frequency channel 0 \$18 AUDF1 1 1 1 1 1 Audio frequency channel 0 \$19 AUDVO 1 1 1 1 1 Audio frequency channel 1 \$19 AUDVO 1 1 1 1 1 Audio requency channel 1 \$19 AUDVO 1 1 1 1 1 Graphics player 0 \$10 GRP1 1 1 1 1 1 1 1 Graphics player 0 \$11 GRP1 1 Enable missile 0 \$12 ENAM1 1 Enable missile 1	
\$12 RESMO	
\$13 RESM1 - S T R O B E - Reset missile 1 horizontal position \$14 RESBL - S T R O B E - Reset ball horizontal position. \$15 AUDCO 1 1 1 1 Audio control channel 0 \$16 AUDC1 1 1 1 1 Audio control channel 1 \$17 AUDF0 1 1 1 1 1 Audio frequency channel 0 \$18 AUDF1 1 1 1 1 1 Audio frequency channel 1 \$19 AUDV0 1 1 1 1 1 Audio frequency channel 1 \$19 AUDV0 1 1 1 1 Audio frequency channel 1 \$18 GRP0 1 1 1 1 1 1 1 1 Graphics player 0 \$10 GRP1 1 1 1 1 1 1 1 Graphics player 1 \$11 ENAMO 1 - 1 Enable missile 0 \$12 ENAM1 1 Enable missile 1	
\$14         RESBL         -         S         T         R         O         B         E         -         Reset ball horizontal position.           \$15         AUDC0         -         -         -         1         1         1         Audio control channel 0           \$16         AUDC1         -         -         -         1         1         1         Audio control channel 1           \$17         AUDF0         -         -         -         1         1         1         Audio frequency channel 0           \$18         AUDF1         -         -         -         1         1         1         1         Audio volume channel 0           \$1A         AUDV0         -         -         -         -         1         1         1         1         Audio volume channel 0           \$1A         AUDV1         -         -         -         1         1         1         1         1         1         1         1         1         1         Audio volume channel 0         Audio volume channel 0         Audio volume channel 1         S1D         S1D         GRP0         1         1         1         1         1         1         1         1 <td></td>	
\$15 AUDC0	
\$16         AUDC1         -         -         -         1         1         1         Audio control channel 1           \$17         AUDF0         -         -         -         1         1         1         1         Audio frequency channel 0           \$18         AUDF1         -         -         -         1         1         1         1         Audio requency channel 1           \$19         AUDV0         -         -         -         1         1         1         1         Audio volume channel 0           \$1A         AUDV1         -         -         -         1         1         1         1         1         Audio volume channel 1           \$1B         GRP0         1	
\$17 AUDF0	
\$18         AUDF1         -         -         -         1         1         1         1         Audio frequency channel 1           \$19         AUDV0         -         -         -         1         1         1         Audio volume channel 0           \$1A         AUDV1         -         -         -         1         1         1         1         1         1         Audio volume channel 1           \$1B         GRP0         1	
\$19         AUDV0         -         -         -         1         1         1         Audio volume channel 0           \$1A         AUDV1         -         -         -         1         2         1         2         2         2         2         1         2         2         2         2         1         2         2         3         2         3         3         3         3         3         3         3         4         3         4         3         4         4         3         4         4         4         4         4         4         4         4         4         4	
\$1A         AUDV1         -         -         -         -         1         1         1         1         Audio volume channel 1           \$1B         GRP0         1         2         1         2         2         2         -	
\$1B         GRPO         1         2         3         2         3         2         3         2         3         2         4         3         4 <td></td>	
\$1C         GRP1         1         1         1         1         1         1         1         1         1         1         Graphics player 1           \$1D         ENAMO         -         -         -         -         -         1         -         Enable missile 0           \$1E         ENAM1         -         -         -         -         -         1         -         Enable missile 1           \$1F         ENABL         -         -         -         -         -         1         -         Enable ball.	
\$1D ENAMO 1 - Enable missile 0 \$1E ENAM1 1 - Enable missile 1 \$1F ENABL 1 - Enable ball.	
\$1E ENAM1 1 - Enable missile 1 \$1F ENABL 1 - Enable ball.	
\$1F ENABL 1 - Enable ball.	
\$20 HMP0 1 1 1 1 Horizontal fine motion player 0	
\$21 HMP1	
\$22 HMM0 1 1 1 1 Horizontal fine motion missile 0	
\$23 HMM1	
\$24 HMBL 1 1 1 1 Horizontal fine motion ball	
\$25 VDELP0 1 Vertical delay player 0	
\$26 VDELP1 1 Vertical delay player 1	
\$27 VDELBL 1 Vertical delay ball	
\$28 RESMP0 1 - Reset missile 0 to player 0	
\$29 RESMP1 1 - Reset missile 1 to player 1	
\$2A HMOVE - S T R O B E - Apply horizontal motion.	
\$2B HMCLR - S T R O B E - Clear horizontal motion registers	
\$2C CXCLR - S T R O B E - Clear collision latches	

## TIA - Read

Addr	Name	7	6	5	4	3	2	1	0	Function
\$00	CXM0P	1	1	-	-	-	-	-	-	Read collision: 7: M0 P1, 6: M0 P1
\$01	CXM1P	1	1	-	-	-	-	-	-	Read collision: 7: M1 P0, 6: M1 P1
\$02	CXP0FB	1	1	-	-	-	-	-	-	Read collision: 7: P0 PF, 6: P0 BL
\$03	CXP1FB	1	1	-	-	-	-	-	-	Read collision: 7: P1 PF, 6: P1 BL
\$04	CXM0FB	1	1	-	-	-	-	-	-	Read collision: 7: M0 PF, 6: M0 BL
\$05	CXM1FB	1	1	-	-	-	-	-	-	Read collision: 7: M1 PF, 6: M1 BL
\$06	CXBLPF	1	-	-	-	-	-	-	-	Read collision: 7: BL PF
\$07	СХРРММ	1	1	-	-	-	-	-	-	Read collision: 7: P0 P1, 6: M0 M1
\$08	INPT0	1	-	-	-	-	-	-	-	Read POT port 0 (paddle trigger)
\$09	INPT1	1	-	-	-	-	-	-	-	Read POT port 1 (paddle trigger)
\$0A	INPT2	1	1	-	-	-	-	-	-	Read POT port 2 (paddle tigger)
\$0B	INPT3	1	-	-	-	-	-	-	-	Read POT port 3 (paddle trigger)
\$0C	INPT4	1	-	-	-	-	-	-	-	Read input 0 (joystick left P0 fire)
\$0D	INPT5	1	-	-	-	-	-	-	-	Read input 1 (joystick right P1 fire)

## RIOT

Addr	Name	7	6	5	4	3	2	1	0	Function
\$280	SWCHA	1	1	1	1	1	1	1	1	Port A Data (Joystick / Controllers)
\$281	SWACNT	1	1	1	1	1	1	1	1	Port A Control (DDR) (write only)
\$282	SWCHB	1	1	1	1	1	1	1	1	Port B Data (Console Switches)
\$283	SWBCNT	1	1	1	1	1	1	1	1	Port B Control (DDR) (write only)
\$284	INTIM	1	1	1	1	1	1	1	1	Timer (read only)
\$294	TIM1T	1	1	1	1	1	1	1	1	Set timer 1 clock interval (write)
\$295	TIM8T	1	1	1	1	1	1	1	1	Set timer 8 clock intervals (write)
\$296	TIM64T	1	1	1	1	1	1	1	1	Set timer 64 clock intervals (write)
\$297	TIM1024T	1	1	1	1	1	1	1	1	Set timer 1K clock intervals (write)

## SWCHA (Joystick / Controller)

Bit	Direction	Player
7	Right	Left (P0)
6	Left	Left (P0)
5	Down	Left (P0)
4	Up	Left (P0)
3	Right	Right (P1)
2	Left	Right (P1)
1	Down	Right (P1)
0	Up	Right (P1)

#### SWCHB (Console Switches)

	orreriz (consens crimenes)										
Bit	Switch	Description									
7	Right (P1) difficulty	0 = (B)eginner/Easy/Novice, 1= (A)dvance/Normal/Pro									
6	Left (P0) difficulty	0 = (B)eginner/Easy/Novice, 1= (A)dvance/Normal/Pro									
5	Unused	Unused									
4	Unused	Unused									
3	Colour / B&W	0 = B&W, 1 = Colour (SECAM hard wired to ground)									
2	Unused	Unused									
1	Select	0 = Depressed									
0	Reset	0 = Depressed									

## NUSIZ0 / NUSIZ1

Bit	Bit	Bit	Vide	o Clo	cks						Player (PPP)	
2	1	0	8	16	24	32	40	48	56	64	72	Description
0	0	0										One copy
0	0	1										Two copies, Close gap
0	1	0										Two copies, Medium gap
0	1	1										Three copies, Close gap
1	0	0										Two copies, Wide gap
1	0	1										Double size (pixel width x 2)
1	1	0										Three copies, Medium gap
1	1	1										Quad size (pixel width x 4)

## NUSIZ0 / NUSIZ1 / CTRLPF

٠.	NOOILE / OTNER !											
	Bit	Bit	Vide	o Clo	cks					Missile (MM), Ball (BB)		
	5	4	1	2	3	4	5	6	7	8	Description	
	0	0									Standard size (pixel width x 1)	
	0	1									Double size (pixel width x 2)	
	1	0									Quad size (pixel width x 4)	
	1	1									Octo size (pixel width x 8)	

# Memory Map

Start	End	Hardware	Туре	Description
Addr	Addr	Integrated Circuit		
\$0000	\$002C	TIA	TIA	TIA
\$002D	\$007F			Unused / Shadow
\$0080	\$00FF	RIOT	RAM	128 Bytes RAM CPU Stack / RAM
\$0100	\$027F			Unused / Shadow
\$0280	\$0283	RIOT	1/0	I/O
\$0284	\$0284	RIOT	Timer	Timer
\$0285	\$0293			Unused / Shadow
\$0294	\$0297	RIOT	Timer	Timer
\$0298	\$0FFF			Unused / Shadow
\$1000	\$EFFF			Unused / Shadow
\$F000	\$F3FF	Cartridge	ROM	Software
\$F400	\$FFF9			Unused / Shadow
\$FFFA	\$FFFB	CPU	Vector	NMI
\$FFFC	\$FFFD	CPU	Vector	Reset
\$FFFE	\$FFFF	CPU	Vector	IRQ/BRK

Note: ROM - \$F000 to \$F3FF (4KB) shadow at any address with bit 12 set e.g. \$1000, \$3000, etc.

 DOCUMENT INFORMATION

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