

Hardware Specification

S-7600A TCP/IP Network Stack LSI

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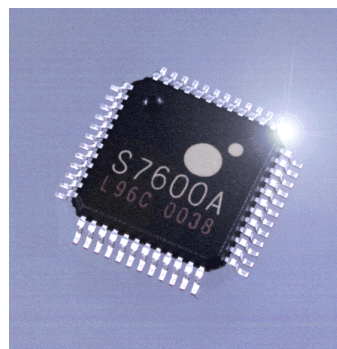


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1. Introduction

1.1. Product Overview

The S-7600A is a LSI that integrates TCP/IP network stack. It offers your devices a quicker and easier connectivity to a network with its on-chip serial interface and a static RAM that operates as a buffer. Implementing this LSI into your system can significantly reduce your software development cost. Also its low operating frequency gives benefits to the power consumption.

The S-7600A also supports a microprocessor interface via the iReady iAPI™ register set, and connection to Physical Transport Layer Interface. iAPI consists of a set of register and operating definitions that allow any micro controller system to interface with the internal modules.

1.2. Features

- Industry standard protocols support :
TCP/IP (Ver. 4.0)
PPP (STD-51-compliant)
UDP
- General purpose sockets :
Configured for two sockets
- MPU interface :
68k/x80(MOTO/Intel) bus interface or Synchronous serial interface
- Physical Transport Layer Interface :
Universal Asynchronous Receiver/Transmitter (UART)
- Low clock rate :
Multiplied four by the bit-rate
- Operating frequency :
256kHz typical
- Low power consumption :
Full-transmitting Operating current consumption : 0.9mA typ.
Non-transmitting Operating current consumption : 150μA typ.
Standby current consumption : 1.0μA typ.
- Stand-by mode :
held by RESET signal
- Wide operating voltage range :
2.4V to 3.6V
- Easier application development :
portable iAPI™ support

1.3. Benefits

- Off-loads MIPS allowing system to operate with low end and low cost processors.
- Consumes minimal power-up to 1/100 of competing solution.

1.4. Trademarks

iReady iAPI™ and iAPI™ is a trademark of iReady Corporation. All other products and brand names are trademarks and registered trademarks of their respective companies.

1.5. Definitions

- IP Internet Protocol
- PPP Point-to-Point Protocol
- TCP Transmission Control Protocol
- UDP User Datagram Protocol
- API Application Programming Interface

1.6. Applicable Documents

- S-7600A Functional Specification
- S-7600A API Application Manual

1.7. Cautions

1. DO NOT apply a voltage or current that exceeds the absolute maximum ratings to terminals. If applied, the IC may malfunction or be destroyed.
The standard values are set with sufficient margins, but use the IC within the recommended operating conditions to optimize device quality.
2. Measures against static electricity
 - 2.1 When transporting or storing ICs, use conductive containers or metal coated boxes.
 - 2.2 Check that there is no current leakage in electrical facilities, and be sure to ground them.
Also ensure that workbenches and people who handle ICs are grounded.
3. Excessive external noise to the power supply or I/O terminals of CMOS ICs causes latch-up, leading to faults and damage. If latch-up has occurred, immediately turn off the device, eliminate the cause, and turn on the device again.
4. Keep the IC away from mechanical vibration, shock, and sudden changes in temperature. These may cause wires to break.
5. Environment
 - 5.1 Use and store ICs below the absolute maximum rated temperature.
 - 5.2 DO NOT use or store ICs where condensation can occur.
 - 5.3 DO NOT use ICs where they are directly exposed to dust, salt, or acid gas such as SO₂.
These may cause leaks between element leads and cause corrosion.
 - 5.4 To store ICs for a long time, DO NOT process them. During storage, DO NOT apply any load to ICs.

2. Functional Block Diagram

Figure 2-1 shows a functional block diagram of the S-7600A. There are blocks of the Network Stack and other functions related to it. The S-7600A has the interface for a host MPU and a Physical layer for various data terminal equipment.

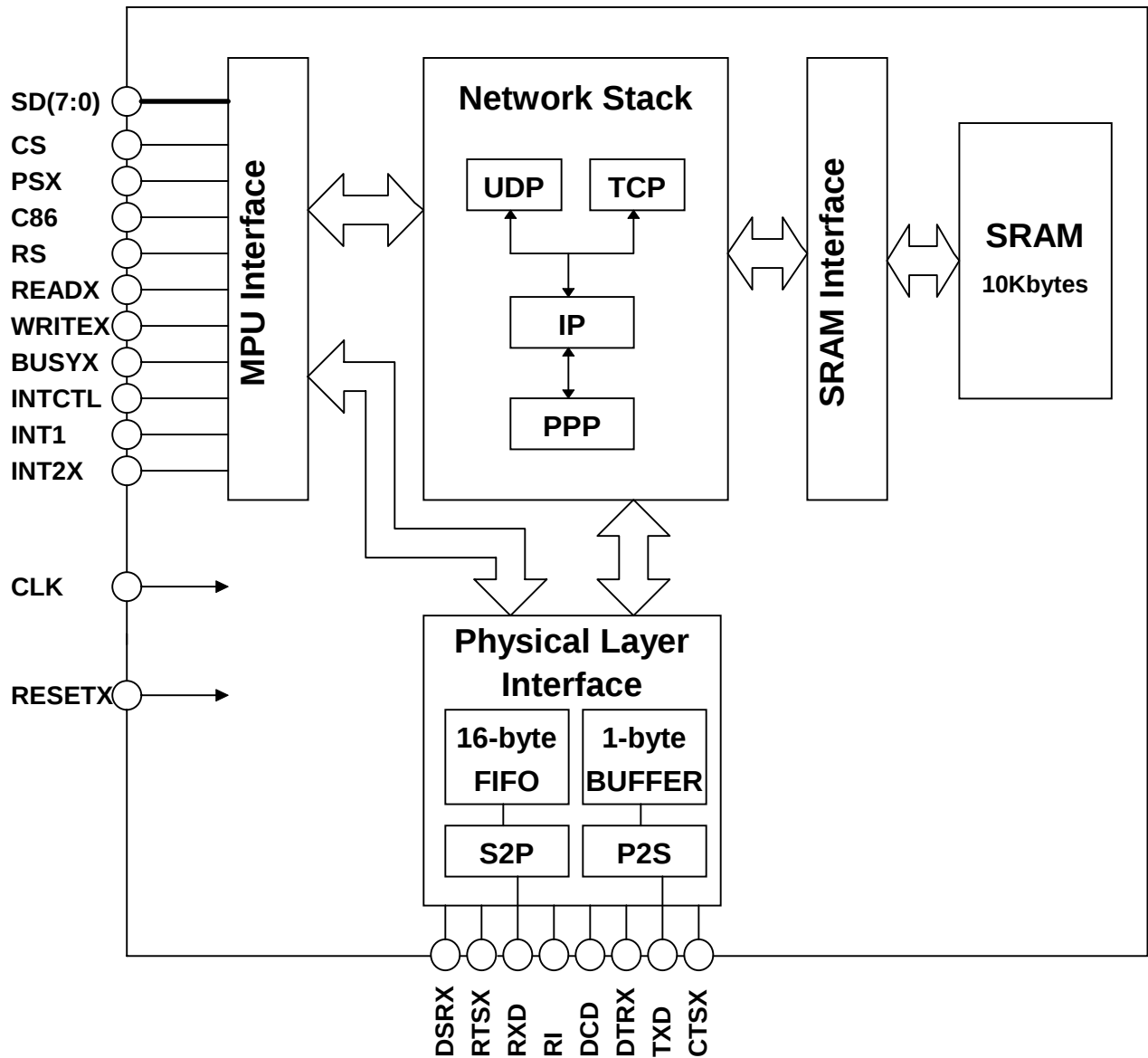


Figure 2-1 **Block Diagram**

The transport and network layers contain:

- Two general sockets that provide connectivity between the application layer and the transport layer.
- TCP/UDP module that allows for reliable (retransmission) and unreliable (no retransmission) datagram deliveries.
- IP module that provides connectionless packet delivery.
- PPP module that provides point-to-point connection link between two hosts.

3. Terminals

3.1. Pin Assignment

Figure 3-1 shows Pin Assignment in Package.

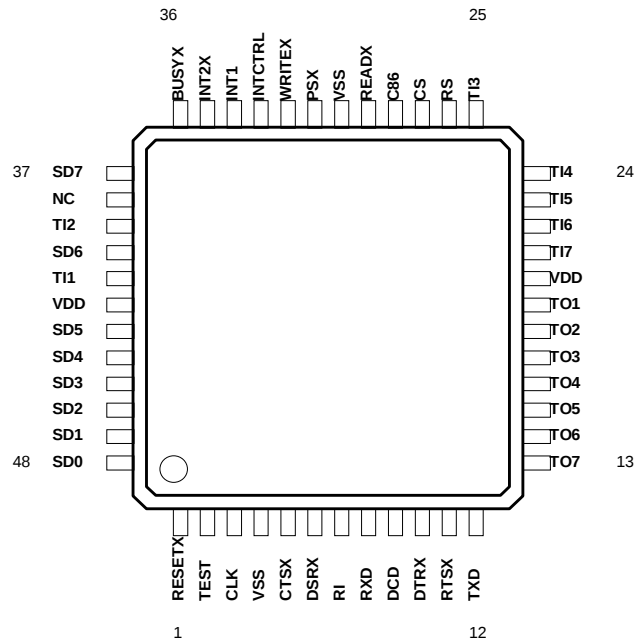


Figure 3-1Pin Assignment

Table 3-1 shows signal names, listed by Pin Number.

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	RESETX	13	TO7	25	TI3	37	SD7
2	TEST	14	TO6	26	RS	38	NC
3	CLK	15	TO5	27	CS	39	TI2
4	VSS	16	TO4	28	C86	40	SD6
5	CTSX	17	TO3	29	READX	41	TI1
6	DSRX	18	TO2	30	VSS	42	VDD
7	RI	19	TO1	31	PSX	43	SD5
8	RXD	20	VDD	32	WRITEX	44	SD4
9	DCD	21	TI7	33	INTCTRL	45	SD3
10	DTRX	22	TI6	34	INT1	46	SD2
11	RTSX	23	TI5	35	INT2X	47	SD1
12	TXD	24	TI4	36	BUSYX	48	SD0

Table 3-1 Pin Assignment

3.2. Package Dimensions

S-7600A is housed in a 48-pin QFP package with 0.5mm pin pitch spacing. The package layout is depicted in Figure 3-2.

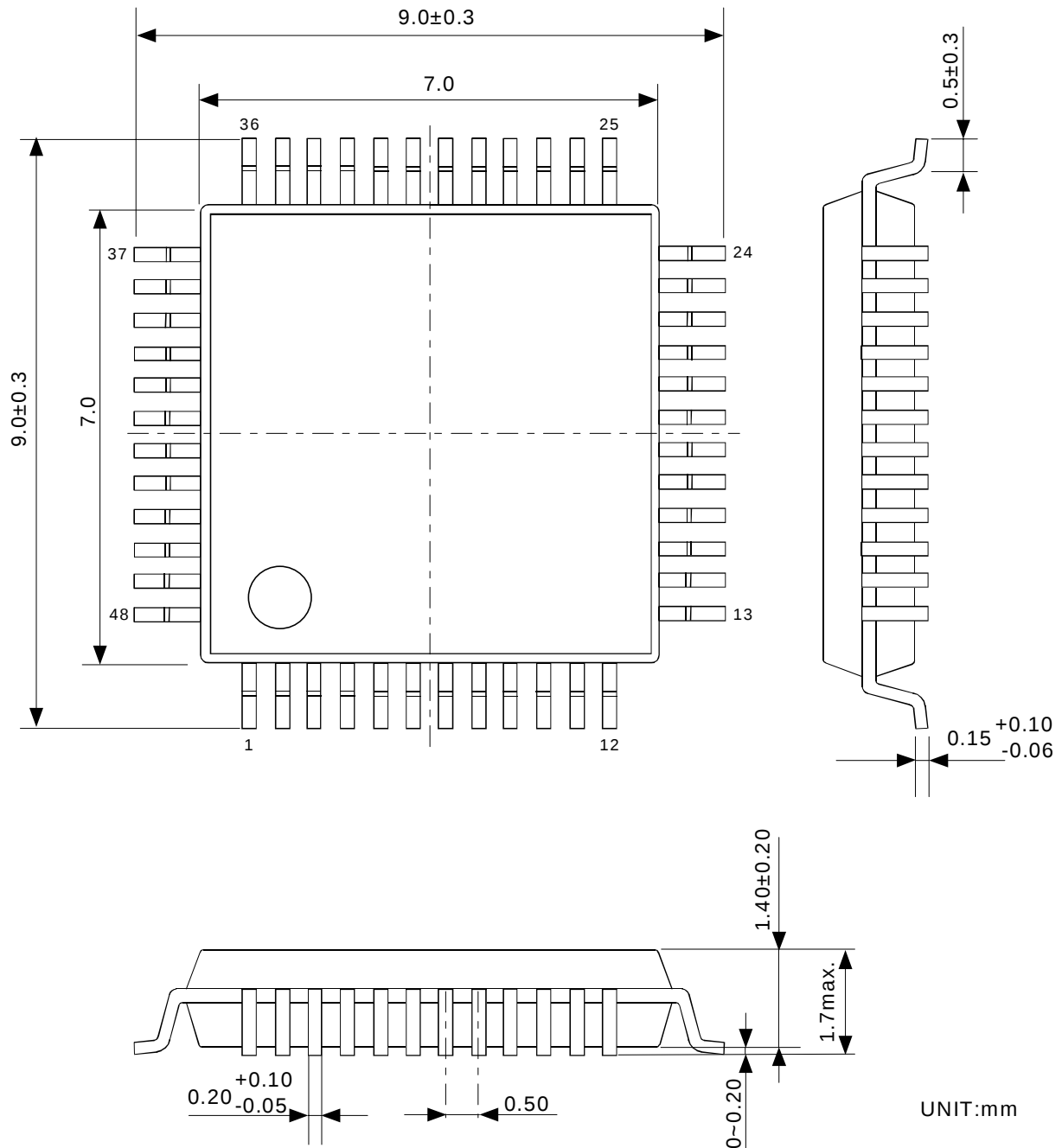


Figure 3-2 Package Dimensions

3.3. Pin Description

The pins and signal descriptions are listed by function in Table 3-2.

Name	I/O	Description	Type
VDD1,VDD2	-	Positive power supply	
VSS1,VSS2	-	GND potential	
RESETX	I	Reset input	A
TEST, TI1 to TI7	I	Test input (pull-down resistor is built in) When normal use, connect to V _{SS} or open	B
TO1 to TO7	O	Test output When normal use, open	D
CLK	I	Clock input	C
CTSX	I	Clear to send input	C
DSRX	I	Data set ready input	C
RI	I	Ring indicator input	C
RXD	I	Serial received data input	C
DCD	I	Data carrier detect input	C
DTRX	O	Data terminal ready output	D
RTSX	O	Request to send output	D
TXD	O	Serial transmit data output	D
RS	I	Register selection input	C
CS	I	Chip selection input	C
C86	I	MPU interface mode selection input 68k mode : 1 x80 mode : 0	C
READX	I	x80 mode : read requirement input 68k mode : enable input	C
PSX	I	parallel/serial interface selection input	C
WRITEX	I	x80 mode : write requirement input 68k/Serial mode : read/write selection input	C
INTCTRL	I	INT1/INT2X drive type(CMOS/OD) selection input	C
INT1	*OT	Interrupt output(active High) from S-7600A chip to MPU	E
INT2X	*OT	Interrupt output(active Low) from S-7600A chip to MPU	E
BUSYX	O	busy indicator output	D
SD7	*B	x80/68k mode : data bus Serial mode : serial data input	F
SD6	*B	x80/68k mode : data bus Serial mode : serial clock input	F
SD5	*B	x80/68k mode : data bus Serial mode : serial data output	F
SD0 to SD4	*B	Data bus	F

*OT : Tri-state output

*B : bi-directional

Table 3-2 Pin Description

3.4. Pin Configuration

Figure 3-3 shows configuration of each pin.

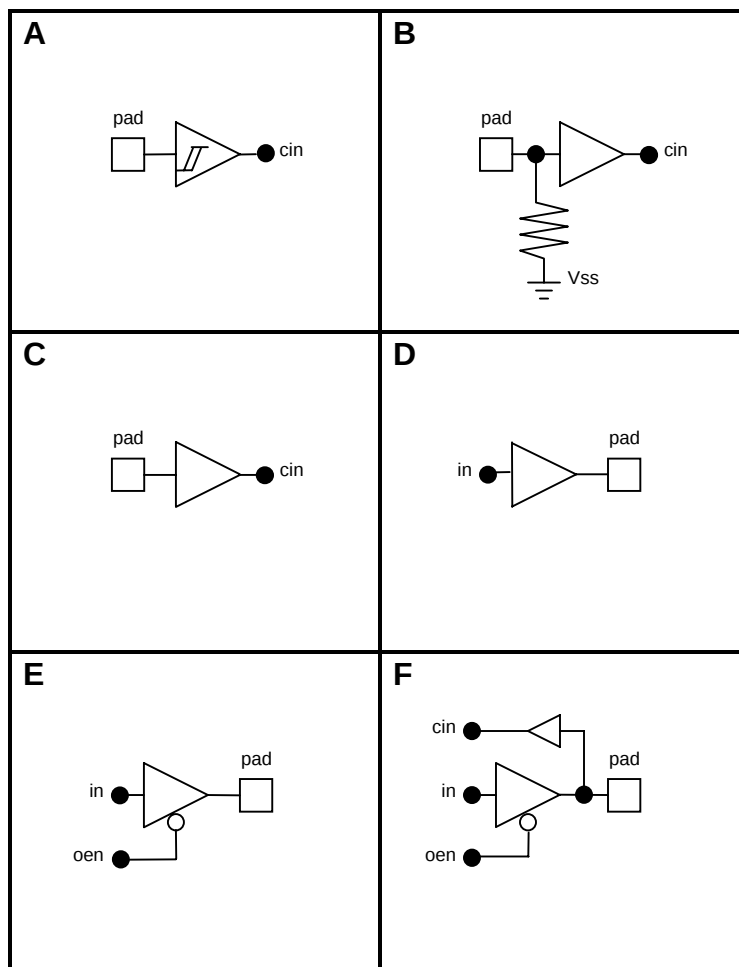


Figure 3-3 Configuration of Each Pin

4. Electrical Characteristics

4.1. Absolute Maximum Ratings

Parameter	Symbol	Conditions	Rating	Unit
Storage temperature	T _{sta}		-40 to +125	°C
Operating temperature	T _{opr}		-40 to +85	°C
Power supply voltage	V _{DD}	Ta=25°C	-0.3 to +4.0	V
Input voltage	V _{IN}	Ta=25°C	V _{SS} -0.3 to V _{DD} +0.3	V
Output voltage	V _{OUT}	Ta=25°C	V _{SS} to V _{DD}	V

Table 4-1 Absolute Maximum Ratings

4.2. Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Operating Frequency range	F _{OPR}	Ta=-40 to +85°C	-	0.256	5	MHz	1
Clock Pulse width	Pw	Ta=-40 to +85°C	80	-	-	nS	
Operating voltage range	V _{DD}	Ta=-40 to +85°C	2.4	-	3.6	V	
Input voltage	V _{IN}	Ta=-40 to +85°C	0	-	V _{DD}	V	

Note1: The clock is given by the CLK pin and needs to be as four times or more fast as the BAUD rate.
(The multiplier is an integer whose tolerance is <±2%)

Table 4-2 Recommended Operating Conditions

4.3. DC Characteristics

Unless otherwise specified: $V_{DD}=3.0V$, $V_{SS}=0V$, $T_a=25^{\circ}C$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Low level input voltage	V_{IL}		$0.2 \times V_{DD}$	-	-	V
High level input voltage	V_{IH}		-	-	$0.8 \times V_{DD}$	V
Low level input leakage current	I_{LL}	$V_{IN}=V_{SS}$	-1.0	-	1.0	μA
High level input leakage current	I_{LH}	All input terminals without pull-down resistor $V_{IN}=V_{DD}$	-1.0	-	1.0	μA
High level input current	I_{IH}	All input terminals with pull-down resistor $V_{IN}=V_{DD}$	18	70	220	μA
Low level output current	I_{OL}	$V_{OL}=0.4V$	5.0	-	-	mA
High level output current	I_{OH}	$V_{OH}=2.6V$	-	-	-3.5	mA
Schmitt Hysteresis voltage	V_{WD}		-	0.46	-	V

Table 4-3 DC Characteristics

4.4. Power Current Consumption

Unless otherwise specified: $V_{DD}=3.0V$, $V_{SS}=0V$, $T_a=25^{\circ}C$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Full-transmitting Operating current consumption	I_{DD1}	$T_a=-40$ to $+85^{\circ}C$ $F_{OPR}=256KHz$	-	0.9	2.2	mA
Non-transmitting Operating current consumption	I_{DD2}	$T_a=-40$ to $+85^{\circ}C$ $F_{OPR}=256KHz$ $RESETX=V_{SS}$	-	150	300	μA
Standby current consumption	I_S	$T_a=-10$ to $+70^{\circ}C$	-	1.0	15.0	μA
		$T_a=-40$ to $+85^{\circ}C$			30.0	

Table 4-4 Power Current Consumption

5. MPU Interface

5.1. Overview

The S-7600A supports two MPU interfaces: parallel and serial. In parallel interface mode, S-7600A can interface with x80 Family MPU or 68k Family MPU.

PSX	CS	RS	READ X	WRITE X	BUSYX	C86	SD7	SD6	SD5	SD4 to SD0
H: parallel x80	CS	RS	READ X	WRITE X	BUSYX	L	D7	D6	D5	D4 to D0
H: parallel 68k	CS	RS	E	R/WX	BUSYX	H	D7	D6	D5	D4 to D0
L: serial	CS	RS	H or L	R/WX	BUSYX	H or L	SI	SCL	SO	Hi-Z

Table 5-1 Interface Selection

5.2. Parallel Interface

Setting **PSX** to “H” select the parallel interface. In parallel interface mode the S-7600A can interface with either x80 Family MPU or 68k Family MPU. The desired MPU mode can be selected by setting the C86 pin to “H” or “L”.

RS	68k Family MPU R/WX	x80 Family MPU		Function
		READX	WRITE X	
1	1	0	1	Read Register
1	0	1	0	Write Register
0	1	0	1	Read Index Register
0	0	1	0	Write Index Register

Table 5-2 Connection Relationship between MPU and Pins

5.2.1. 68k Family MPU Mode

This mode can be selected by pulling the **C86** input pin “H” and the **PSX** input pin “H”. In this mode, the address and data are muxed into a single 8-bit bus. All cycles start by placing an address on the bus and setting the **RS** pin to “L”. In this mode **WRITEX** signal works as read/write(R/WX) signal and **READX** is the enable(E) signal for 68k Family MPU interface. After the address cycle, the MPU generates a read or writes strobe by setting the **READX** and **WRITEX** pins. The S-7600A MPU interface logic assert a **BUSYX** signal low during data write and read phases. The MPU samples the **BUSYX** signal before starting a new cycle. The can initiate a new cycle if the bit is “H”.

5.2.1.1. Write Cycle Timing

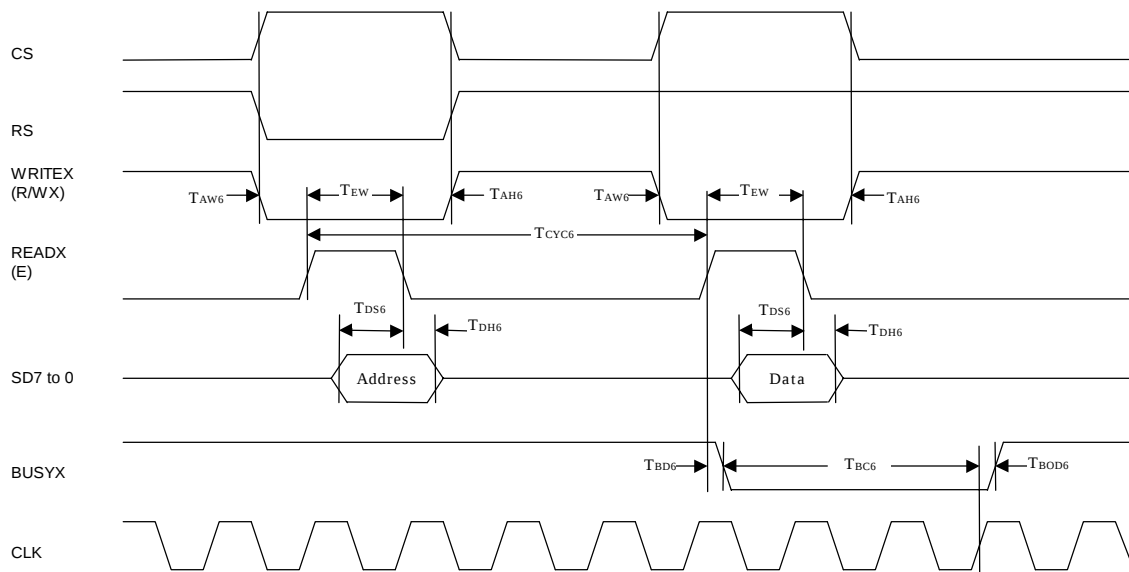


Figure 5-1 68k Family MPU Write Timing

Symbol	Description	Min	Max	Notes
T _{CYC6}	System Cycle Time	100 ns	-	
T _{AH6}	Address Hold Time	20ns	-	
T _{AW6}	Address Setup Time	20ns	-	
T _{DS6}	Data Setup time	20ns	-	
T _{DH6}	Data Hold Time	20 ns	-	
T _{EW}	Enable Pulse Width	40 ns	1.9CLK	
T _{BD6}	BUSYX Delay Time	-	30ns	CL=80pF
T _{BC6}	BUSYX Pulse Width	2CLK	-	
T _{BOD6}	BUSYX Output Disable Time	-	30ns	CL=80pF

NOTES: • CLK is the clock of S-7600A

- Timing is specified of 50% of the signal waveform.
- Rise/fall time(20%,80%) of the input signal is 15nsec or less.

Table 5-3 68k Family MPU Write Cycle Timing

5.2.1.2. Read Cycle Timing

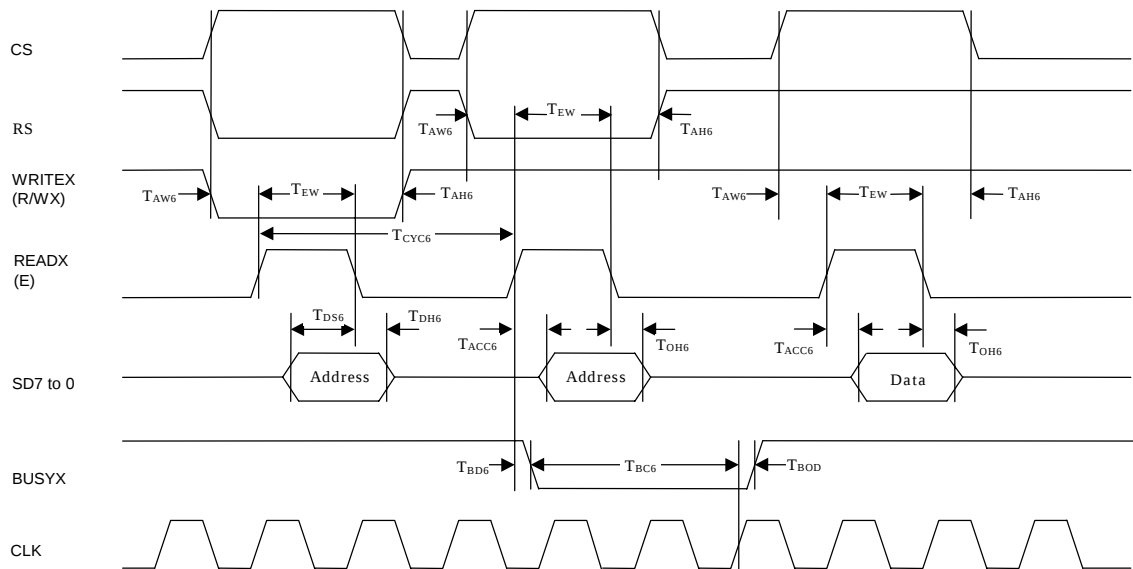


Figure 5-2 68k Family MPU Read Timing

Symbol	Description	Min	Max	Notes
T _{CYC6}	System Cycle Time	100 ns	-	
T _{AH6}	Address Hold Time	20ns	-	
T _{AW6}	Address Setup Time	20ns	-	
T _{DS6}	Data Setup time	20ns	-	
T _{DH6}	Data Hold Time	20 ns	-	
T _{ACC6}	Access time	-	30ns	CL=80pF
T _{OH6}	Output Disable Time	20 ns	-	CL=80pF
T _{EW}	Enable Pulse Width	40 ns	1.9CLK	
T _{BD6}	BUSYX Delay Time	-	30ns	CL=80pF
T _{BC6}	BUSYX Pulse Width	2CLK	-	
T _{BOD6}	BUSYX Output Disable Time	-	30ns	CL=80pF

NOTES: • CLK is the clock of S-7600A

- Timing is specified of 50% of the signal waveform.
- Rise/fall time(20%,80%) of the input signal is 15nsec or less.

Table 5-4 68k Family MPU Read Cycle Timing

5.2.2. x80 Family MPU Mode

This mode is selected by pulling the **C86** input pin “L” and the **PSX** input pin “H”. In this mode, the address and data are muxed onto a single 8-bit bus. All cycles start with the address placed on the bus. This address is then latched internally on the rising edge of **WRITEX**. The **RS** pin “L” indicates that the **WRITEX** strobe is for the address phase. In the next phase, data is either written or read by generating **WRITEX** or **READX** strobe. The MPU interface logic will assert the **BUSYX** signal after **READX** or **WRITEX** strobes are de-asserted. The **BUSYX** signal is de-asserted after the S-7600A complete a read or writes operation. The MPU samples the **BUSYX** signal before starting a new cycle. The MPU can initiate a new cycle after the **BUSYX** signal gets de-asserted.

5.2.2.1. Write Cycle Timing

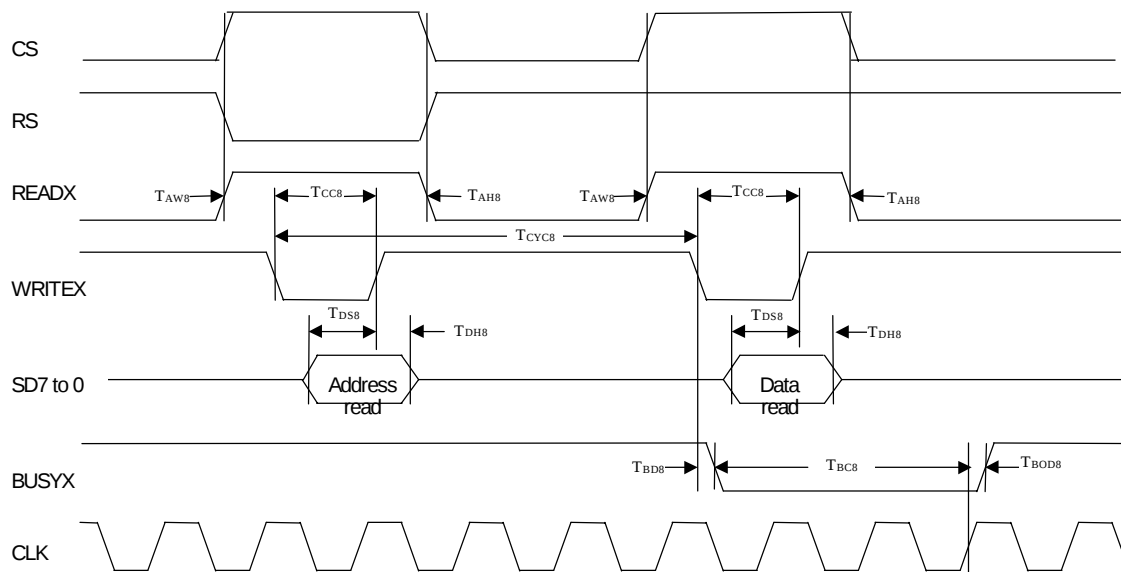


Figure 5-3 x80 Family MPU Write Cycle Timing

Symbol	Description	Min	Max	Notes
T_{CYC8}	System Cycle Time	100 ns	-	
T_{AH8}	Address Hold Time	20ns	-	
T_{AW8}	Address Setup Time	20ns	-	
T_{DS8}	Data Setup time	20ns	-	
T_{DH8}	Data Hold Time	20 ns	-	
T_{CC8}	Control Pulse Width	40 ns	1.9CLK	
T_{BD8}	BUSYX Delay Time	-	30ns	CL=80pF
T_{BC8}	BUSYX Pulse Width	2CLK	-	
T_{BOD8}	BUSYX Output Disable Time	-	30ns	CL=80pF

NOTES: • CLK is the clock of S-7600A

- Timing is specified of 50% of the signal waveform.
- Rise/fall time(20%,80%) of the input signal is 15nsec or less.

Table 5-5 x80 Family MPU Write Cycle Timing

5.2.2.2. Read Cycle Timing

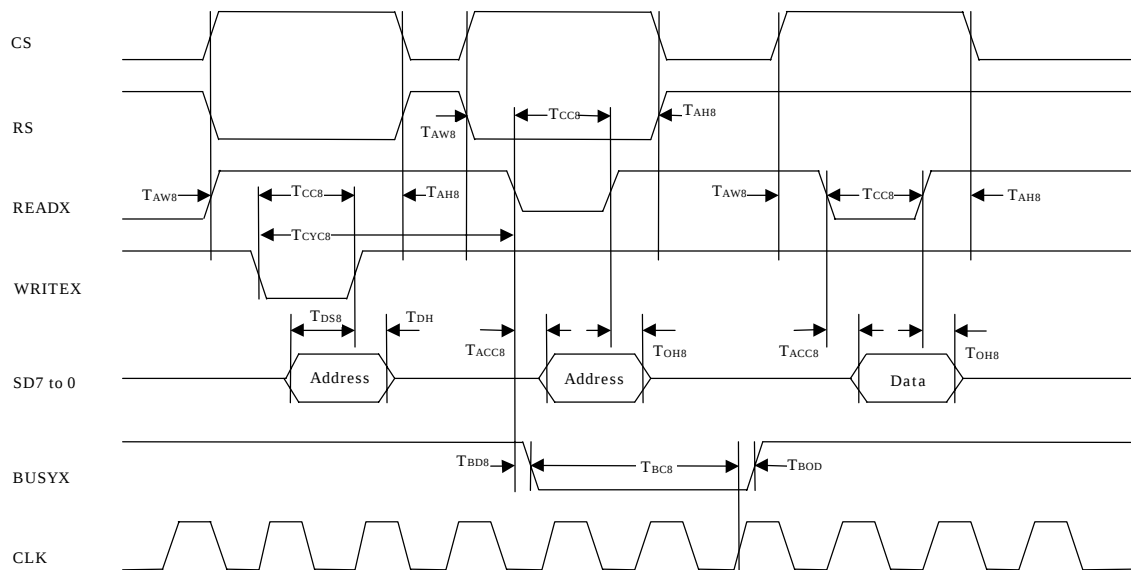


Figure 5-4 x80 Family MPU Read Cycle Timing

Symbol	Description	Min	Max	Notes
T_{CYC8}	System Cycle Time	100 ns	-	
T_{AH8}	Address Hold Time	20ns	-	
T_{AW8}	Address Setup Time	20ns	-	
T_{DS8}	Data Setup time	20ns	-	
T_{DH8}	Data Hold Time	20 ns	-	
T_{ACC8}	Access time	-	30ns	CL=80pF
T_{OH8}	Output Disable Time	20 ns	-	CL=80pF
T_{CC8}	Control Pulse Width	40 ns	1.9CLK	
T_{BD8}	BUSYX Delay Time	-	30ns	CL=80pF
T_{BC8}	BUSYX Pulse Width	2CLK	-	
T_{BOD8}	BUSYX Output Disable Time	-	30ns	CL=80pF

NOTES: • CLK is the clock of S-7600A

- Timing is specified of 50% of the signal waveform.
- Rise/fall time(20%,80%) of the input signal is 15nsec or less.

Table 5-6 x80 Family MPU Read Cycle Timing

5.3. Serial Interface

This mode is selected by pulling the **PSX** input pin “L”. In this mode Bit 6 of the Data Bus is used as the serial clock and bit 5 and 7 are used as Data Input and Data Output. Bit 0 to 4 are high impedance. By pulling **WRITEX** signal to “H” or “L”, the MPU performs a read or write operation.

5.3.1. Write Cycle Timing

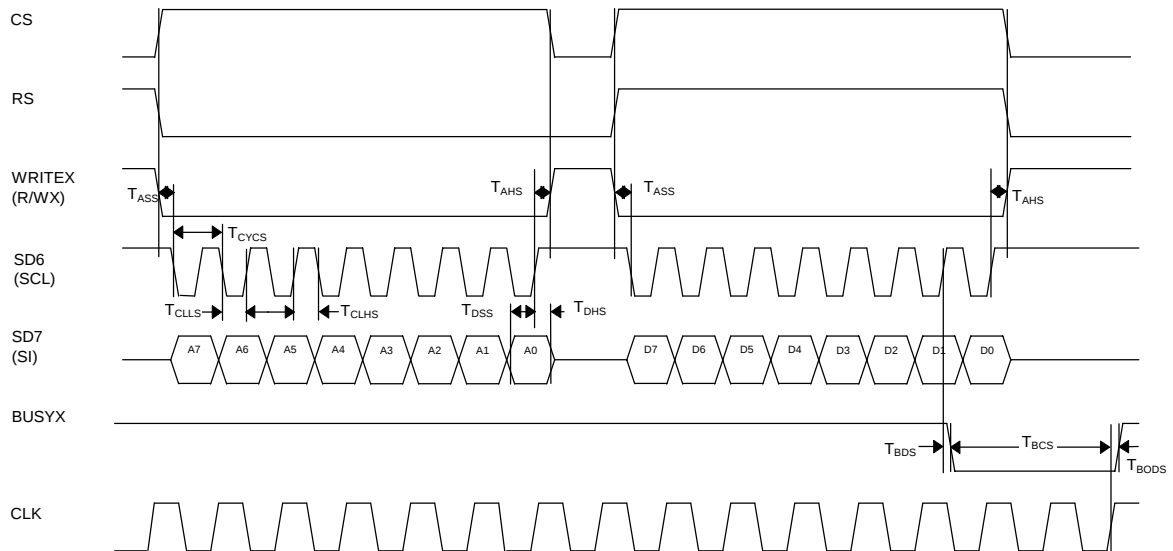


Figure 5-5 Serial Interface Write Timing

Symbol	Description	Min	Max	Notes
T _{CYCS}	System Cycle Time	100 ns	1.9CLK	
T _{CLLS}	Clock L Time	40ns	-	
T _{CLHS}	Clock H Time	40 ns	-	
T _{ASS}	Address Setup Time	20ns	-	
T _{AHS}	Address Hold Time	20ns	-	
T _{DSS}	Data Setup time	20ns	-	
T _{DHS}	Data Hold Time	20 ns	-	
T _{BDS}	BUSYX Delay Time	-	30ns	CL=80pF
T _{BCS}	BUSYX Pulse Width	2CLK	-	
T _{BODS}	BUSYX Output Disable Time	-	30ns	CL=80pF

NOTES: • CLK is the clock of S-7600A
 • Timing is specified of 50% of the signal waveform.
 • Rise/fall time(20%,80%) of the input signal is 15nsec or less.

Table 5-7 Serial Interface Write Cycle Timing

5.3.2. Read Cycle Timing

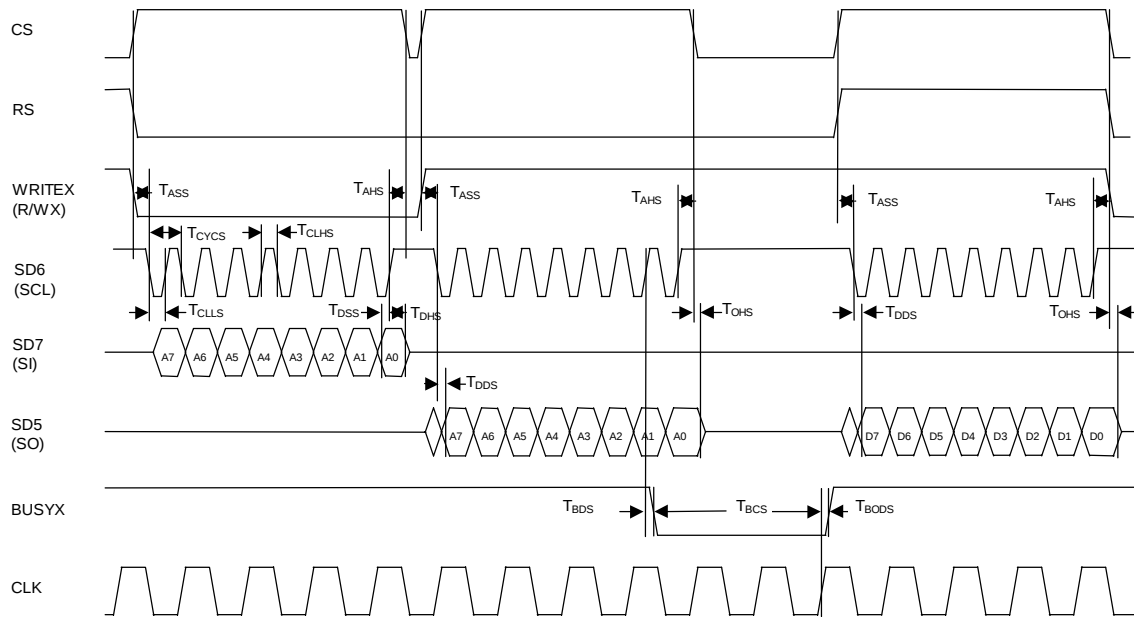


Figure 5-6 Serial Interface Read Timing

Symbol	Description	Min	Max	Notes
T_{CYCS}	System Cycle Time	100 ns	1.9CLK	
T_{CLLS}	Clock L Time	40ns	-	
T_{CLHS}	Clock H Time	40 ns	-	
T_{ASS}	Address Setup Time	20ns	-	
T_{AHS}	Address Hold Time	20ns	-	
T_{DSS}	Data Setup time	20ns	-	
T_{DHS}	Data Hold Time	20 ns	-	
T_{DDS}	Data delay Time	-	30ns	CL=80pF
T_{OHS}	Output Disable Time	-	20ns	CL=80pF
T_{BDS}	BUSYX Delay Time	-	30ns	CL=80pF
T_{BCS}	BUSYX Pulse Width	2CLK	-	
T_{BODS}	BUSYX Output Disable Time	-	30ns	CL=80pF

NOTES: • CLK is the clock of S-7600A
 • Timing is specified of 50% of the signal waveform.
 • Rise/fall time(20%,80%) of the input signal is 15nsec or less.

Table 5-8 Serial Interface Read Cycle Timing

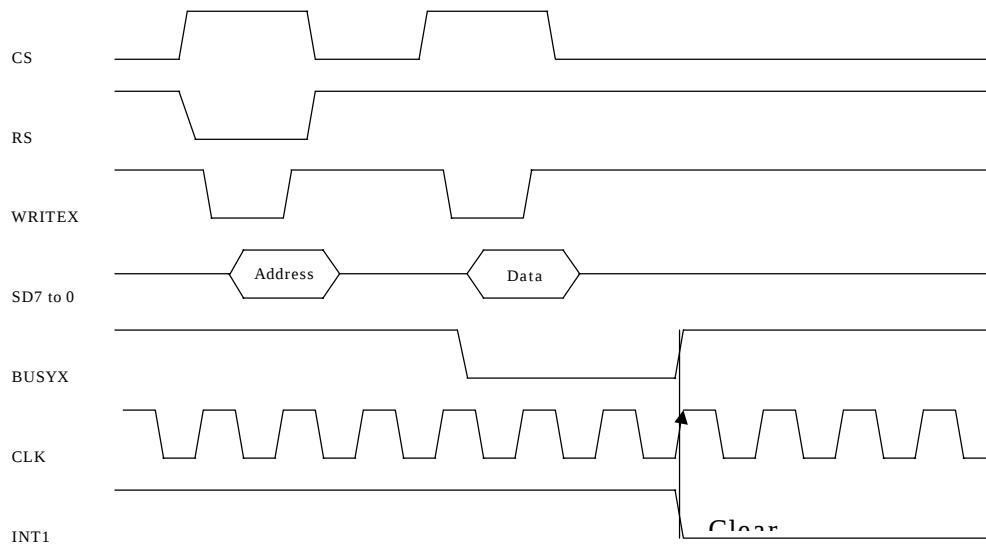
5.4. Interrupt

The interrupt signal outputs an active level while the interrupt flag is set in the interrupt register in the S-7600A's interrupt register. The interrupt signal returns to an inactive level if the flag clears. Show the interrupt timing in the Figure 5-7.

The **INT1** and **INT2X** can be Open Drain or CMOS output depending on the setting of **INTCTL**. The **INT1** and **INT2X** outputs are CMOS if **INTCTL** is "H" otherwise outputs are Open Drain. Table 5-9 defines the interrupt selection.

Interrupt flag	INTCTL	INT1	INT2X
Set	H	H	L
Set	L	H	L
Reset	H	L	H
Reset	L	Hi-Z	Hi-Z

Table 5-9 Interrupt Selection Table



(x80 Family MPU mode, INTCTL=high)

Figure 5-7 INT1 Interrupt Timing

6. Memory Requirements

6.1. Overview

S-7600A contains two general sockets along with the TCP/UDP/IP and PPP protocols. Their total memory requirement is 10K bytes. This memory is included on the S-7600A chip.

6.2. Memory Interface Architecture

The Network Stack feeds all of its memory requests into a single Memory Arbiter inside of the Network Stack core. The arbiter then feeds out one memory request to the SRAM interface. This interface serves to translate the network stack's timing into signal timing required by the SRAM. This architecture is shown in Figure 6-1.

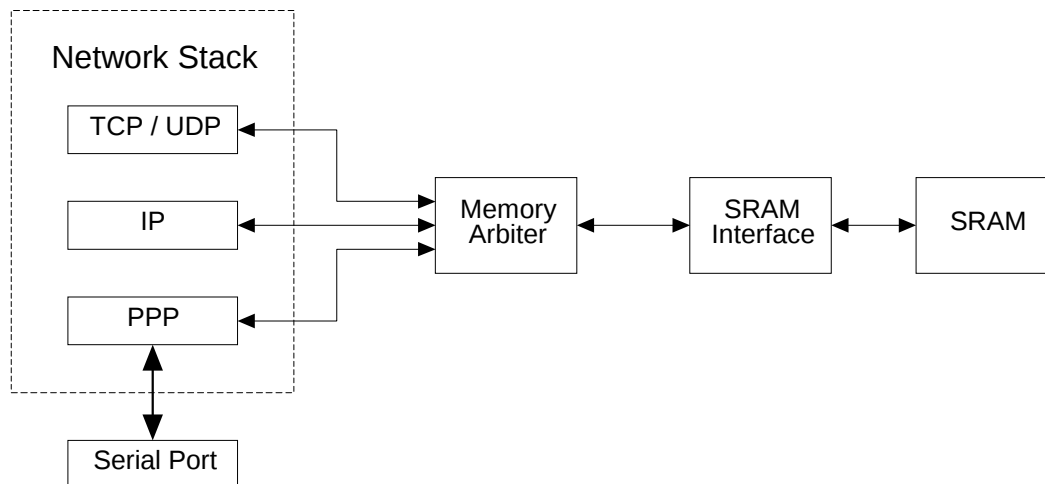


Figure 6-1

Memory Interface Architecture

6.3. Memory Map

The memory map has been configured to make the SRAM supporting the S-7600A compact. S-7600A has two 5 K byte memory banks (denoted as “0” and “1”). Their mapping addresses are given in Table 6-1 and Table 6-2.

The actual capacity of the incoming buffer is 2047 bytes.

The actual capacity of the outgoing buffer is 1023 bytes for TCP mode and 1015 bytes for UDP mode.

Table 6-1 S-7600A Memory Map (Bank 0)

Address	Size	Contents
0x0000 - 0x07FF	2 K	Socket 0 Receive Buffer
0x0800 - 0x0BFF	1 K	Socket 0 Send Buffer
0x0C00 - 0x0FFF	1 K	TCP Data Base
0x1000 - 0x13FF	1 K	IP Buffer

Table 6-2 S-7600A Memory Map (Bank 1)

Address	Size	Contents
0x0000 - 0x07FF	2 K	Socket 1 Receive Buffer
0x0800 - 0x0BFF	1 K	Socket 1 Send Buffer
0x0C00 - 0x0FFF	1 K	PPP Buffer
0x1000 - 0x13FF	1 K	PAP Buffer

7. S-7600A Register Definitions

7.1. Overview

This section covers the S-7600A's API registers. The register are divided into three types: global, direct and indexed.

Global registers occupy the address space from 0x00 to 0x1D and 0x60 to 0x6F. Direct and indexed registers occupy the configuration space from 0x20 to 0x3F. Indexed register require the socket index to be set prior to accessing the registers.

7.2. iAPI Register Map

Table 7-1 and Table 7-2 shows the complete iAPI register map for the S-7600A chip. All registers not listed are reserved, and should not be accessed.

Table 7-1 iAPI Register Map

Add	Register	Bit Definitions							
0x00	Revision	Major Revision Number				Minor Revision Number			
0x01	General_Control	-	-	-	-	-	-	-	SW_RST
0x02	General_Socket_Location	0	0	0	0	0	0	S1	S0
0x04	Master_Interrupt	-	-	-	-	-	PT_INT	LINK_INT	SOCK_INT
0x08	Serial_Port_Config	S_DAV	DCD	DSR/HWFC	CTS	RI	DTR	RTS	SCTL
0x09	Serial_Port_Int	PT_INT	-	-	-	-	-	-	-
0x0A	Serial_Port_Int_Mask	PINT_EN	DSINT_EN	-	-	-	-	-	-
0x0B	Serial_Port_Data	Serial Data Register							
0x0C - 0x0D	BAUD_Rate_Div	BAUD Rate Divider Registers							
0x10 - 0x13	Our_IP_Address	Our IP Address							
0x1C	Clock_Div_Low	Low Byte for 1 kHz clock divider							
0x1D	Clock_Div_High	High Byte for 1 kHz clock divider							
0x20	Index	Socket index							
0x21	TOS*	Type of Service Field							
0x22	Socket_Config_Status_Low*	TO	Buff_Empty	Buff_Full	Data_Avail/RST	-	Protocol_Type		
0x23	Socket_Status_Mid*	URG	RST	Term	ConU	TCP State			
0x24	Socekt_Activate	-	-	-	-	-	-	S1	S0
0x26	Socket_Interrupt	-	-	-	-	-	-	I1	I0
0x28	Socket_Data_Avail	-	-	-	-	-	-	DAV1	DAV0

NOTE: 1)Reserved bits are signified by a dash (-). All reserved bits should be written as "0".
2)Indexed registers are signified by an asterisk (*).

Table 7-2 iAPI Register Map (Continued)

Add	Register	Bit Definitions							
0x2A	Socket_Interrupt_Mask_Low*	TO_En	Buff_Emp_En	Buff_Full	Data_Avail_En	-	-	-	-
0x2B	Socket_Interrupt_Mask_High*	URG_En	RST_En	Term_En	ConU_En	-	-	-	-
0x2C	Socket_Interrupt_Low*	TO	Buff_Empty	Buff_Full	Data_Avail	-	-	-	-
0x2D	Socket_Interrupt_High*	URG	RST	Term	ConU	-	-	-	-
0x2E	Socket_Data*	Socket 8-bit data							
0x30	TCP_Data_Send (WO)*	Any write causes data to be sent							
0x30 - 0x31	Buffer_Out (RO)*	Buffer Out Length							
0x32 - 0x33	Buffer_In (RO)*	Buffer In Length							
0x34 - 0x35	Urgent_Data_Pointer*	Urgent Data Offset Pointer							
0x36 - 0x37	Their_Port*	Target Port Address							
0x38 - 0x39	Our_Port*	Our Port Address							
0x3A	Socket_Status_High*	-	-	-	-	-	-	-	Snd_bsy
0x3C - 0x3F	Their_IP_Address*	Target IP Address							
0x60	PPP_Control_Status	PPP_Int	Con_Val	Use_PAP	To_Dis	PPP_Int_En	Kick	PPP_En	PPP_Up / SRset
0x61	PPP_Interrupt_Code	Interrupt Code							
0x62	PPP_Max_Retry	-				PPP Maximum retry			
0x64	PPP_String	Pap user name and password							

NOTE: 1)Reserved bits are signified by a dash (-). All reserved bits should be written as "0".
2)Indexed registers are signified by an asterisk (*).

7.3. Register Definitions

7.3.1. Revision Register (0x00)

(Read-Only, Default 0x21)

This direct read-only register reports back the design revision. See the design revision form in Table 7-3 and Table 7-4.

Table 7-3 Revision Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	Major Revision Number				Minor Revision Number			
Default	0x2				0x1			

Table 7-4 Revision Register Description

Bit	Bit Name	Access	Description
7:4	Major Revision Number	R	This nibble indicates the major revision number for the S-7600A core.
3:0	Minor Revision Number	R	This nibble indicates the minor revision number for the S-7600A core.

7.3.2. General Control Register (0x01)

(Read/Write, Default 0x00)

This direct register contains the master software reset. See the register format in Table 7-5 and Table 7-6. See the wave format in figure 9.-2.

Table 7-5 General Control Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	-	-	-	-	-	-	-	SW_RST
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-6 General Control Register Description

Bit	Bit Name	Access	Description
0	SW_RST	R/W	Software Reset. This active high reset returns the S-7600A core to power-on reset settings. It is self-clearing and does not need to be written to "0" for proper operations. 0 = Normal operation 1 = Soft reset

7.3.3. Generic Socket Location Register (0x02)

(Read-Only)

This register is used to report back the location of general sockets to the software layer. Only bits [1:0] will be set because the S-7600A chip is equipped with two general sockets.

Table 7-7 Generic Socket Location Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	S7	S6	S5	S4	S3	S2	S1	S0
Value	0	0	0	0	0	0	1	1

Table 7-8 Generic Socket Location Register Description

Bit	Bit Name	Access	Description
7	S7	R	Not available
6	S6	R	Not available
5	S5	R	Not available
4	S4	R	Not available
3	S3	R	Not available
2	S2	R	Not available
1	S1	R	General socket 1 available
0	S0	R	General socket 0 available

7.3.4. Master Interrupt (0x04)

(Read-Only, Default 0x00)

This direct register indicates the source of the S-7600A interrupt.

Table 7-9 Master Interrupt Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	-	-	-	-	-	PT_INT	LINK_INT	SOCK_INT
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All Reserved bits should be written as "0".

Table 7-10 Master Interrupt Register Descriptions (Continued)

Bit	Bit Name	Access	Description
2	PT_INT	R	Physical Transport Interrupt The physical transport triggers this interrupt. An application should check the <i>Serial Port Int</i> register to determine the actual cause of the interrupt.
1	LINK_INT	R	Link Layer Interrupt The link layer triggers this interrupt. An application should check the <i>PPP Interrupt Code</i> register to determine the actual cause of the interrupt.
0	SOCK_INT	R	Socket Interrupt One of the sockets that need servicing causes this interrupt. An application should check the <i>Socket Interrupt</i> register to determine the actual socket number.

7.3.5. Serial Port Configuration / Status Register (0x08)

(Read/Write, Default 0X0XX110B)

This register configures the serial port as shown in Table 7-11 and Table 7-12.

Table 7-11 Conf Status Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	S_DAV	DCD	DSR/ HWFC	CTS	RI	DTR	RTS	SCTL
Default	0	-	0	-	-	1	1	0

Table 7-12

Conf Status Register Description

Bit	Bit Name	Access	Description
7	S_DAV	R/W	Serial Port Data Available When read, bit indicates that Serial Port data is available. This bit should be written 0.
6	DCD	R/W	Carrier Detect This bit reflects the current state of the DCD bit on the serial port. It is independent of the SCTL bit setting. This bit should be written 0.
5	DSR / HWFC	R/W	Data Send Ready / Hardware Flow Control When read, this bit reflects the current state of the DSR bit on the serial port. When this bit written: 0 = Hardware Flow control is deactivated 1 = Hardware Flow control activated Refer to Chapter 8 for more information about Hardware Flow Control.
4	CTS	R	Clear To Send This read-only bit reflects the current state of the CTS bit on the serial port. It is independent of the SCTL bit setting.
3	RI	R	Ring Indicator This read-only bit reflects the current state of the RI bit on the serial port. It is independent of the SCTL bit setting.
2	DTR	R/W	Data Terminal Ready Reading this bit follows the current state of the DTR bit on the serial port. The MPU can control the DTR by writing to this bit.
1	RTS	R/W	Request To Send Reading this bit follows the current state of the RTS bit on the serial port. The MPU can control the RTS by writing to this bit.
0	SCTL	R/W	Serial Port Control This bit determines who controls the serial port. When this bit is low (default), the MPU controls the port. When the SCTL bit is high, the network stack controls the serial serial port. 0 = MPU controls serial port 1 = Hardware controls serial port

7.3.6. Serial Port Interrupt Register (0x09)

(Read-Only, Default 0X000000B)

This register indicates the state of the serial port interrupt.

Table 7-13 Serial Port Interrupt Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	PT_INT	-	-	-	-	-	-	-
Default	0	-	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All Reserved bits should be written as "0".

Table 7-14 Serial Port Interrupt Register Description

Bit	Bit Name	Access	Description
7	PT_INT	R	Port Transport Interrupt This bit indicates when the serial port interrupt is active. This condition depends on the states of the PINT_EN and DSINT_EN bits in the Serial Port Interrupt Mask Register. When PINT_EN is 1, an interrupt will occur whenever data is available in the serial port input FIFO ("S_DAV" in the Serial Port Configuration/Status Register is 1). When DSINT_EN is 1, an interrupt will be active whenever the CPU can write to the Serial Port Data Register to transmit a byte of data. If both PINT_EN and DSINT_EN are enabled, the interrupt will be active if either condition is met.

7.3.7. Serial Port Interrupt Mask Register (0x0A)

(Read/Write, Default 0x00)

This register enables the serial port interrupts. The default for this register is 0x00 (interrupts disabled).

Table 7-15 Serial Port Interrupt Mask Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	PINT_EN	DSINT_EN	-	-	-	-	-	-
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All Reserved bits should be written as "0".

Table 7-16 Serial Port Interrupt Mask Register Description

Bit	Bit Name	Access	Description
7	PINT_EN	R/W	Port Interrupt Enable This is the enable for the port interrupt.
6	DSINT_EN	R/W	Data sent interrupt Enable. This is enable for the data sent interrupt.

7.3.8. Serial Port Data Register (0x0B)

(Read/Write)

This register sends data to and reads data from the serial port UART. The data is valid when the **S_DAV** bit in the *Serial Port Config* register is set. Data can be written to this register when the **PT_INT** bit in the *Serial Port Interrupt* register is set. See the register description in Table 7.-14.

*Note: This register should only be used when the **SCTL** bit in the Serial Port config register is low.*

7.3.9. BAUD Rate Divider Registers (0x0C-0x0D)

(Read/Write, Default 0x0000)

These registers set the BAUD rate for the serial port. Calculate the value by using the following formula:

$$\text{Program Value} = [(\text{clk Frequency}) / (\text{BAUD Rate})] - 1$$

Where clk is the clock for the S-7600A core

Example: The clock rate of the S-7600A is 256 KHz and a BAUD rate of 64 Kbps is desired, the programmed value should be:

$$(256 \text{ KHz} / 64 \text{ k}) - 1 = 4 - 1 = 3$$

Note: The lowest value that should be programmed into these registers is 0x0003.

7.3.10. Our IP Address Registers (0x10-0x13)

(Read/Write, Default 0x00000000)

These registers store our IP address or the IP address of the local device. The 0x10 register stores the least significant byte and the 0x13 register stores the most significant byte. If the system controller dose not write an IP address, it will be negotiated for during PPP negotiations (floating IP address). When a PPP connection is established (indicated by bit 0, register 60) these registers can be read to query the IP address obtained.

Table 7-17 Our IP Address Register Bit Definitions (0x10)

Bit	7	6	5	4	3	2	1	0
Def.	Least significant byte of the local IP address							
Default	0x00							

Table 7-18 Our IP Address Register Bit Definitions (0x11)

Bit	7	6	5	4	3	2	1	0
Def.	3rd byte of the local IP address							
Default	0x00							

Table 7-19 Our IP Address Register Bit Definitions (0x12)

Bit	7	6	5	4	3	2	1	0
Def.	2nd byte of the local IP address							
Default	0x00							

Table 7-20 Our IP Address Register Bit Definitions (0x13)

Bit	7	6	5	4	3	2	1	0
Def.	Most significant byte of the local IP address							
Default	0x00							

7.3.11. Clock Divider Registers (0x1C-0x1D)

(Read/Write, Default 0x03E7)

These registers program the 1kHz clock generator. This clock is used internally for various S-7600A timing functions. The following equation determines the value programmed into these registers:

$$(\text{clk Freq}/1 \text{ kHz}) - 1 = \text{Divide Count}$$

Where clk Freq is S-7600A clock frequency. Therefore, for a 1 MHz clock, the divide count equals $1\text{M} / 1\text{kHz} - 1 = 999 = 0x03\text{e}7$.

7.3.12. Index Register (0x20)

(Read/Write, Default 0x00)

This register must be programmed prior to accessing indexed socket registers. Valid programmed values are 0x00 and 0x01. If the selected socket number has not changed since the last access, this register not need to be reprogrammed.

Table 7-21 Index Register Bit Definition

Bit	7	6	5	4	3	2	1	0
Def.	Socket Index [7:0]							
Default	0x00							

Table 7-22 Index Register Description

Bit	Bit Name	Access	Description
7:0	Socket_Index	R/W	0x00 : General Socket 0 Selected 0x01: General Socket 1 Selected All other values are reserved

7.3.13. Type of Service Register (TOS) (0x21)

(Read/Write, Default 0x00)

This register configures the TOS field in the IP header for outgoing datagrams. It is an optional setting that defaults to 0x00.

7.3.14. Socket Config Status Low Register (0x22)

(Read/Write, Default 0x40)

This register configures the socket.

Table 7-23 Socket Config Status Low Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	TO	Buff_ Empty	Buff_Full	Data_ Avail / RST	-	Protocol_Type		
Default	0	1	0	0	0	0		

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-24 Socket Config Status Low Register Description

Bit	Bit Name	Access	Description
7	TO	R	TCP Timeout This bit indicates that a TCP timeout condition occurred while attempting to establish a TCP connection or while waiting for a TCP packet after the connection was established. 0 = Normal Operating Condition 1 = Timeout Occurred
6	Buff_Empty	R	This bit indicates whether or not a socket's outgoing data buffer is empty. The bit sets on an empty condition. It then clears and remains clear as long as there is any data in the socket's outgoing data buffer. 0 = Buffer Not Empty 1 = Buffer Empty
5	Buff_Full	R	This bit indicates whether the outgoing buffer is full (1023 bytes or more). It also triggers an interrupt when the outgoing data buffer is full, and the Buff_Full_En bit in the <i>Socket Interrupt Mask Low</i> register (0x2A) is set. The Data Register should not be written to when this bit is a "1". 0 = Buffer Space Available 1 = No Buffer Space Available
4	Data_Avail / RST	R/W	Writing this bit resets all socket parameters to default settings. It is self-clearing and does not need to be written to low for proper operations. Before resetting, ensure that Snd_Bsy bit of <i>Socket Status High</i> register (0x3A) is 0. When read, this bit indicates that the socket has data available.
2:0	Protocol_Type	R/W	These bits are used to set the protocol of the socket. All decodes not shown are reserved. 010 = TCP Client Mode 101 = UDP Mode 110 = TCP Server mode

7.3.15. Socket Status Mid Register (0x23)

(Read-Only, Default 0x00)

This read-only register reports other socket status conditions.

Table 7-25 Socket Status Mid Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	URG	RST	Term	ConU	TCP State			
Default	0	0	0	0	0x0			

Table 7-26 Socket Status Mid Register Description

Bit	Bit Name	Access	Description
7	URG	R	This bit indicates the arrival of urgent data. Writing a “1” to the URG bit in the <i>Socket Interrupt</i> register (bit 7) clears this bit. 0 = No urgent data present 1 = Urgent data present
6	RST	R	This bit indicates when the socket receives the RST signal from the TCP peer. 0 = No RST received 1 = RST received
5	Term	R	This bit indicates when the socket terminates from the source and triggers an interrupt if the Term_En bit is set in the <i>Socket Interrupt Mask High</i> register (0x2B). The interrupt mask setting does not effect the reporting of this status bit. 0 = Normal Operating Condition 1 = Socket terminated from source This bit becomes “1” when the S-7600A receives a TCP segment with the FIN flag on. This means that the remote peer has requested to close the TCP connection.
4	ConU	R	This bit indicates when the socket establishes a connection to a host machine. The bit clears when the connection terminates (by either end). 0 = No Connection Established 1 = Connection Established
3:0	TCP State	R	These bits indicate the current TCP state. 0 = CLOSED 1 = SYN_SENT 2 = ESTABLISHED 3 = CLOSE_WAIT 4 = LAST_ACK 5 = FIN_WAIT1 6 = FIN_WAIT2 7 = CLOSING 8 = TIME_WAIT 9 = LISTEN a = SYN_RECVD

7.3.16. Socket Activate Register (0x24)

(Read/Write, Default 0x00)

This register is used to activate the sockets and also show the current status of each socket. Setting a bit to “1” activates the corresponding socket. This register defaults to 0x00 upon resets.

Table 7-27 Socket Activate Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	-	-	-	-	-	-	S1	S0
Default	0	0	0	0	0	0	0	0

Table 7-28 Socket Activate Register Description

Bit	Bit Name	Access	Description
1	S1	R/W	This bit is used to activate general socket 1. 0 = General socket 1 inactive 1 = General socket 1 active
0	S0	R/W	This bit is used to activate general socket 0. 0 = General socket 0 inactive 1 = General socket 0 active

7.3.17. Socket Interrupt Register (0x26)

(Read-Only, Default 0x00)

This register indicates which socket has interrupts pending. When identification of an interrupting socket occurs, the actual source of the interrupt is determined by examining the specific socket's interrupt register.

Table 7-29 Socket Interrupt Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	-	-	-	-	-	-	I1	I0
Default	0	0	0	0	0	0	0	0

Table 7-30 Socket Interrupt Register Description

Bit	Bit Name	Access	Description
1	I1	R	This bit is used to indicate that socket 1 has an interrupt pending. 0 = General socket 1 interrupt inactive 1 = General socket 1 interrupt active
0	I0	R	This bit is used to indicate that socket 0 has an interrupt pending. 0 = General socket 0 interrupt inactive 1 = General socket 0 interrupt active

7.3.18. Socket Data Available Register (0x28)

(Read-Only, Default 0x00)

This read-only register indicates which socket has data pending in the input buffer. A “1” in a bit position indicates that the socket has data available. The bit remains set as long as there is data available.

Table 7-31 Socket Data Avail Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	-	-	-	-	-	-	DAV1	DAV0
Default	0	0	0	0	0	0	0	0

Table 7-32 Socket Data Avail Register Description

Bit	Bit Name	Access	Description
1	DAV1	R	This bit is used to indicate that socket 1 has data available. 0 = General socket 1 has no data available 1 = General socket 1 has data available
0	DAV0	R	This bit is used to indicate that socket 0 has data available. 0 = General socket 0 has no data available 1 = General socket 0 has data available

7.3.19. Socket Interrupt Mask Low Register (0x2A)

(Read/Write, Default 0x00)

This register reports certain interrupt conditions. Setting a bit enables the corresponding interrupt.

Table 7-33 Socket Interrupt Mask Low Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	TO_En	Buff_Emp_En	Buff_Full_En	Data_Avail_En	-	-	-	-
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-34 Socket Interrupt Mask Low Register Description

Bit	Bit Name	Access	Description
7	TO_En	R/W	Writing a "1" enables the Timeout interrupt.
6	Buff_Empty_En	R/W	Writing a "1" enables the Buffer Empty interrupt.
5	Buff_Full_En	R/W	Writing a "1" enables the Buffer Full interrupt.
4	Data_Avail_En	R/W	Writing a "1" enables the Data Available interrupt.

7.3.20. Socket Interrupt Mask High Register (0x2B)

(Read/Write, Default 0x00)

This register enables certain types of interrupt conditions. Setting bits enables their corresponding interrupts.

Table 7-35 Socket Interrupt Mask High Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	URG_En	RST_En	Term_En	ConU_En	-	-	-	-
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-36 Socket Interrupt Mask High Register Description

Bit	Bit Name	Access	Description
7	URG_En	R/W	Writing a "1" to enable the Urgent Data interrupt.
6	RST_En	R/W	Writing a "1" to enable the Connection Reset interrupt.
5	Term_En	R/W	Writing a "1" to enable the Socket Termination interrupt.
4	ConU_En	R/W	Writing a "1" to enable the Connection Up interrupt.

7.3.21. Socket Interrupt Low Register (0x2C)

(Read/Write, Default 0x00)

This register reports certain interrupt conditions. When an interrupt condition occurs and its enable bit is set, the hardware sets the corresponding bit. Writing a "1" to the bit clears it. Disabling the corresponding enable bit prevents the interrupt from showing.

Table 7-37 Socket Interrupt Low Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	TO	Buff_Empty	Buff_Full	Data_Avail	-	-	-	-
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-38 Socket Interrupt Low Register Description

Bit	Bit Name	Access	Description
7	TO	R/W	This interrupt is generated when a timeout condition occurred while trying to establish a connection. Writing a "1" to this bit clears the interrupt.
6	Buff_Empty	R/W	This interrupt is generated when outgoing buffer is empty. Writing a "1" to this bit clears the interrupt.
5	Buff_Full	R/W	This interrupt is generated when the outgoing buffer is full (1023 bytes). Writing a "1" to this bit clears the interrupt. Do not use this bit in UDP.
4	Data_Avail	R/W	This interrupt is generated when data is available from the incoming buffer. Writing a "1" to this bit clears the interrupt.

7.3.22. Socket Interrupt High Register (0x2D)

(Read/Write, Default 0x00)

This register reports certain interrupt conditions. When an interrupt condition occurs and its enable bit is set, the hardware sets the corresponding bit. Writing a "1" to the bit clears it. Disabling the corresponding enable bit prevents the interrupt from showing.

Table 7-39 Socket Interrupt High Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	URG	RST	Term	ConU	-	-	-	-
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-40 Socket Interrupt High Register Description

Bit	Bit Name	Access	Description
7	URG	R/W	This interrupt is generated when urgent data arrives. The system interface should read the <i>Urgent Data Pointer</i> register to see the location of the data. Writing a “1” to this bit clears the interrupt.
6	RST	R/W	This interrupt is generated when a TCP peer sends the socket RST flag indicating that the current TCP session is not valid. Writing a “1” to this bit clears this interrupt. When this condition occurs, the hardware no longer operates and re-initializing the socket is recommended.
5	Term	R/W	This interrupt is generated when the socket connection is terminated and a TCP FIN flag is received. Writing a “1” to this bit clears the interrupt.
4	ConU	R/W	This interrupt is generated when a connection is established. Writing a “1” to this bit clears the interrupt.

7.3.23. Socket Data Register (0x2E)

(Memory Mapped Read/Write, Default 0x00)

This register is used by a system controller to read incoming data packets and write outgoing data. Data transmissions start for TCP connections only after a write occurs at 0x30.

7.3.24. TCP Data Send and Buffer Out Length Registers (0x30-0x31)

(Read/Write, Default 0x03FF)

When read, these registers report the amount of space available in the outgoing buffer. Register 0x30 stores the least significant byte; 0x31 stores the most significant byte. Writing any data to 0x30 causes data transmissions to start on TCP connections.

7.3.25. Buffer In Length Registers (0x32-0x33)

(Read-Only, Default 0x0000)

These read-only registers report the amount of data available in the received data buffer. 0x32 stores the least significant byte; 0x33 stores the most significant byte.

7.3.26. Urgent Data Pointer Registers (0x34-0x35)

(Read-Only, Default 0x0000)

These read-only registers report the offset to the start of urgent data (as marked through the TCP header) relative to the incoming data buffer. Register 0x34 stores the least significant byte; 0x35 stores the most significant byte.

7.3.27. Their Port Registers (0x36-0x37)

(Read/Write, Default 0x0000)

These registers specify the destination port for an outgoing data packets. For TCP client or UDP mode, this value must be set prior to activating the socket. For TCP server mode, these registers are automatically setup on a connection with the peer's port number. Register 0x36 stores the least significant byte and 0x37 stores the most significant byte.

Table 7-41 Their Port Register Bit Definitions (0x36)

Bit	7	6	5	4	3	2	1	0
Def.	Least significant byte of the target port number							
Default	0x00							

Table 7-42 Their Port Register Bit Definitions (0x37)

Bit	7	6	5	4	3	2	1	0
Def.	Most significant byte of the target port number							
Default	0x00							

7.3.28. Our Port Registers (0x38-0x39)

(Read/Write, Default 0x0000)

These registers are used it indicate the source port for an outgoing data packet. When setting a TCP client or sending data using UDP, these registers should be set to the proper value. Normally in client applications, the software increments the value of this register. The TCP and UDP server application should set these registers to be the value used by the server applications. Register 0x38 stores the least significant byte; 0x39 stores the most significant byte.

Table 7-43 Our Port Register Bit Definitions (0x38)

Bit	7	6	5	4	3	2	1	0
Def.	Least significant byte of the local port number							
Default	0x00							

Table 7-44 Our Port Register Bit Definitions (0x39)

Bit	7	6	5	4	3	2	1	0
Def.	Most significant byte of the local port number							
Default	0x00							

7.3.29. Socket Status High Register (0x3A)

(Read-Only, Default 0x00)

This register reports the busy status of the socket.

Table 7-45 Socket Status High Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	-	-	-	-	-	-	-	Snd_Bsy
Default	0	0	0	0	0	0	0	0

NOTE: Reserved bits are signified by a dash (-). All reserved bits should be written as "0".

Table 7-46 Socket Status High Register Description

Bit	Bit Name	Access	Description
0	Snd_Bsy	R	This bit indicates that the current socket is busy sending TCP segments. Before the socket is reset, this bit should be 0. 0 = Socket not busy 1 = Socket busy

7.3.30. Their IP Address Registers (0x3C-0x3F)

(Read/Write, Default 0x00000000)

These registers indicate the destination IP address for the socket. For TCP client or UDP mode, this value must be set prior to activating the socket. For TCP server mode, these register are automatically setup on a connection with the peer's IP address The registers can be written in any order.

Table 7-47 Their IP Address Register Bit Definitions (0x3C)

Bit	7	6	5	4	3	2	1	0
Def.	Least significant byte of Destination IP address							
Default	0x00							

Table 7-48 Their IP Address Register Bit Definitions (0x3D)

Bit	7	6	5	4	3	2	1	0
Def.	3rd byte of Destination IP address							
Default	0x00							

Table 7-49 Their IP Address Register Bit Definitions (0x3E)

Bit	7	6	5	4	3	2	1	0
Def.	2nd byte of Destination IP address							
Default	0x00							

Table 7-50 Their IP Address Register Bit Definitions (0x3F)

Bit	7	6	5	4	3	2	1	0
Def.	Most significant byte of Destination IP address							
Default	0x00							

7.3.31. PPP Control and Status Register (0x60)

(Read/Write, Default 0x00)

This register control the PPP layer and reports its status.

Table 7-51 PPP Control and Status Register Bit Definitions (0x60)

Bit	7	6	5	4	3	2	1	0
Def.	PPP_Int	Con_Val	Use_PAP	TO_Dis	PPP_Int_En	Kick	PPP_En	PPP_Up /SRst
Default	0	0	0	0	0	0	0	0

Table 7-52 PPP Control Status Register Description

Bit	Bit Name	Access	Description
7	PPP_Int	R/W	PPP Interrupt This bit indicates that the PPP triggered an interrupt condition. Read the PPP interrupt code register to determine the cause. Writing a "1" to this bit position clears the interrupt.
6	Con_Val	R/W	Connection Valid This bit indicates to the network stack that the underlying connection is up and valid. 0 = Connection down 1 = Connection up
5	Use_PAP	R/W	This bit enables PAP authentication within the PPP protocol. If enabled, a PAP request is issued after PAP authentication is negotiated. The PAP string enters through register 0x64. 0 = PAP disabled (default) 1 = PAP enabled
4	TO_Dis	R/W	Timeouts Disabled This bit disables the PPP block from timeouts for diagnostic purposes. It should remain enable for normal operations. 0 = Timeouts enabled (default) 1 = Timeouts disabled
3	PPP_Int_En	R/W	PPP Interrupt Enable This bit enables the PPP interrupt. 0 = PPP Interrupt disabled (default) 1 = PPP Interrupt enabled
2	Kick	W	PPP Kick Start When written to a 1, this bit will start the PPP if it falls into a timeout condition. It clears once the kick operation performs. This bit is self-clearing.
1	PPP_En	R/W	PPP Enable This bit enables the PPP layer. The bit must be set before any transmissions occur. 0 = PPP disabled (default) 1 = PPP enabled

Bit	Bit Name	Access	Description
0	PPP_UP/SRst	R/W	When read, this bit indicates when the PPP layer establishes a connection. 0 = PPP Connection down 1 = PPP Connection established When written, this bit will reset the PPP engine. It is self-clearing and goes not need to be written low for normal operations. 0 = PPP Normal operation 1 = PPP Reset

7.3.32. PPP Interrupt Code (0x61)

(Read-Only, Default 0x00)

This register indicates the interrupt condition that causes the PPP interrupt to trigger.

Table 7-53 PPP Interrupt Code Register Bit Definitions

Bit	7	6	5	4	3	2	1	0
Def.	PPP Interrupt Code							
Default	0							

Table 7-54 PPP Interrupt Error Codes

Error Code	Definition
0x00	Reserved
0x01	PPP Failed initial LCP negotiations
0x02	PPP Failed NCP negotiations
0x05	PAP Failed negotiations

7.3.33. PPP Max Retry, (0x62)

(Read/Write, Default 0x0A)

This register configures the maximum retry number. This number is used to determine the maximum number of configuration requests that are sent during the PPP negotiation stage.

Table 7-55 PPP Max Retry Register

Bit	7	6	5	4	3	2	1	0
Def.	-				PPP Maximum Retry			
Default	0x0				0xA			

NOTE: Reserved bits are signified by a dash (-).

7.3.34. PAP String (0x64)

(Write-Only)

This write-only register enters the string for the PAP configuration request packet. Enter the string according to the format shown Table 7-56.

Table 7-56 PAP String Format

Byte	String
[0]	Length of username
[1]	First byte of username
[2]	Second byte of username
[n]	Last byte of username (where n is the length of the username string)
[n+1]	Length of password
[n+2]	First byte of password
[n+m+1]	Last byte of password (where m is the length of the password string)

As an example, if the username string is "joe" and the password is "public", enter the bytes as shown in Table 7-57.

Table 7-57 PAP String Example

byte:0	0x03	Length of username string
byte:1	0x6a	Character "j"
byte:2	0x6f	Character "o"
byte:3	0x65	Character "e"
byte:4	0x06	Length of password string
byte:5	0x70	Character "p"
byte:6	0x75	Character "u"
byte:7	0x62	Character "b"
byte:8	0x6C	Character "l"
byte:9	0x69	Character "i"
byte:a	0x63	Character "c"

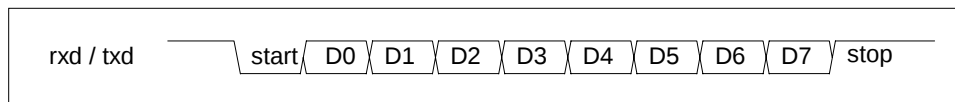
If PAP is used, the **Use_PAP** bit must be set in the *PPP Control and Status* register (0x60) prior to entering the PAP string.

8. Data Communications

8.1. Overview

The S-7600A chip contains a on-board serial port for physical transports. The data format of the serial port is fixed at 1 start bit (logic "0"), 8 data bits, 1 stop bit (logic "1") and no parity bits. The data bits are sent out, least significant bit first. This data format is shown in Figure 8-1. Also included with the serial port is a 16- byte Receive FIFO and 1-byte Send Buffer.

Figure 8-1 Serial Data Format



8.2. Serial Port Register Map

The following registers are used to communicate with the serial port.

Table 8-1 Serial Port Register Map

Add	Register	Bit Definitions							
0x08	Serial_Port_Config	S_DAV	DCD	DSR/ HWFC	CTS	RI	DTR	RTS	SCTL
0x09	Serial_Port_Int	PT_INT	-	-	-	-	-	-	-
0x0A	Serial_Port_Int_ Mask	PINT_E N	DSINT_ EN	-	-	-	-	-	-
0x0B	Serial_Port_Data	Serial Port Data Register							
0x0C - 0x0D	BAUD_Rate_Div	BAUD Rate Divider Registers							

8.2.1. Hardware Flow Control (RTS/CTS Handshaking)

The Hardware Flow Control is turned off by default. In this mode, data is transmitted independent of the state of the **CTS_X** signal. While the MPU is in control of the serial port, it can monitor the state of all the serial port control signals and control when data gets sent or received, either through polling the status bits or interrupts. It can also control the **RTS_X** signal by asserting the **RTS** bit in the *Serial Port Config* register. When the S-7600A controls the serial port, data will be sent out as soon as it is available from the PPP layer. When receiving data, the software in the MPU control mode should read the data out of the 16-byte FIFO fast enough to prevent buffer overflow.

Hardware Flow Control can be turned on by writing a "1" to bit 5 (**DSR/HWFC**) of the *Serial Port Config* Register (0x08). With the hardware flow control turned on, full RTS/CTS handshaking is supported. When the serial port detects that **CTS** is de-asserted, it will stop sending data until **CTS** is reasserted. Any byte output at the time **CTS** is de-asserted will complete, but no further bytes will be sent until **CTS** is asserted.

In the other direction, the S-7600A will de-assert **RTS** if the serial port's 16-byte FIFO is half full. This indicates to the machine on the other end of the serial line to stop transmitting data. The **RTS** bit will reassert when the MPU or the S-7600A has read data out of the Receive FIFO and room becomes empty. If the machine communicating with the S-7600A over the serial port does not support RTS/CTS handshaking, the Receive FIFO may overflow and data loss will occur.

8.2.2. Serial Port Control

The control of the serial port is turned over to the MPU by default and after any reset condition. In this mode, any data written to the *Serial Port Data* register will be sent out and all data received will be made available to the MPU via this same register. Prior to using the data register, the MPU should set the *BAUD Rate Div* register to the proper setting. An interrupt can be triggered when data is available from the serial port by asserting the **PINT_EN** bit. When this bit is asserted, an interrupt will trigger any time that there is data available to be read from the port. If there is more than one byte in the Receive FIFO, the interrupt will remain active until all bytes are read. An interrupt can also trigger indicating that the outgoing data byte has been sent, by asserting the **DSINT_EN** bit. This interrupt will trigger whenever there is no more data to be sent.

The MPU turns over control to the S-7600A by asserting the **SCTL** bit in the *Serial Port Config* register. When the S-7600A controls the port, the MPU should not access the *Serial Port Data* register. The S-7600A chip will automatically send PPP packets to the serial port and read incoming bytes from the serial port. The serial port interrupts are not valid when the S-7600A controls the port.

8.3. TCP/UDP Data Communications

8.3.1. TCP Data Communications

TCP data communications can be performed if the SCTL-bit of the Serial Port Config register (0x08) is set to "1."

For data transmission, data is written to the Socket Data register (0x2E). The S-7600A stores data in its outgoing buffer via the Socket Data Register. The address of the outgoing buffer is specified by the Buffer Out Length register (0x30-0x31). The value of the Buffer Out Length register is 0x03ff when the outgoing buffer is empty. The value of the Buffer Out Length register decrements each time a byte of data is written to the Socket Data register (0x2E). After the data is written, if any data is written to the TCP Data Send register (0x30), the data in the outgoing buffer is processed by TCP protocols and transmitted. The value of the Buffer Out Length register increases by the value of the number of bytes of transmitted data and returns to 0x03ff when all data has been sent. In TCP data transmission, the outgoing buffer has a capacity of 1023 bytes. Datagrams longer than 1023 bytes are split by the MPU and transmitted in chunks. When the outgoing buffer becomes full (i.e., comes to contain 1023 bytes of data), the value of the Buffer Out Length register becomes 0x0000. This can be confirmed by checking the Buff_Full bit in the Socket Config Status Low register (0x22). It can also be confirmed by examining the Buff_Full bit in the Socket Interrupt Low register (0x2C) following an interrupt. No more than 1023 bytes of data are permitted in the Socket Data register. If data is written to the TCP Data Send register under these conditions, the data in the outgoing buffer is transmitted. The MPU repeats the procedure of sending residual data after verifying that the Buffer Out Length register has been reset to 0x03ff. Transmission of all data in the outgoing buffer can be confirmed by checking the Buff_Empty bit in the Socket Config Status Low register (0x22), as well as the Buff_Empty bit in the Socket Interrupt Low register (0x2C) following an interrupt.

When the S-7600A receives TCP data, it applies TCP protocol processing and stores data in the incoming buffer. The address of the incoming buffer is specified by the Buffer In Length register (0x32-0x33). The value of the Buffer In Length register is 0x0000 when the incoming buffer is empty. Otherwise, it increments by a value equal to the number of bytes of the stored data. Data reception is detected by checking the Data_Avail bit in the Socket Config Status Low register (0x22), Socket Data Available register (0x28), and the Data_Avail bit in the Socket Interrupt Low register (0x2C) following an interrupt. Read the Socket Data register (0x2E) while monitoring the Data_Avail bit in the Socket Config Status Low register. This reads in the received data from the incoming buffer. Each time a byte of data is read out from the Socket Data register, the value of the Buffer In Length register decrements. When all data is read out, its value returns to 0x0000. The incoming buffer can hold up to 2047 bytes of data for TCP data reception. The S-7600A and its peer apply TCP protocols to prevent overflowing incoming buffers during data reception.

8.3.2. UDP Data Communications

UDP data communications are performed if the SCTL-bit of the Serial Port Config register (0x08) is set to "1."

For data transmission, data is written to the Socket Data register (0x2E). The S-7600A stores data in its outgoing buffer via the Socket Data register. The address of the outgoing buffer is specified by the Buffer Out Length register (0x30-0x31). The value of the Buffer Out Length register is 0x03ff when the outgoing buffer is empty. The value of the Buffer Out Length register decrements each time a byte of data is written to the Socket Data register (0x2E). After the data is written, if any data is written to the TCP Data Send register (0x30), the data stored in the outgoing buffer is processed by UDP protocols and transmitted. Since the value of the Buffer Out Length register increases by the value of the number of bytes of transmitted data, it is reset to 0x03ff when all data has been sent. For UDP data transmission, the outgoing buffer can hold up to 1015 bytes of data. Datagrams longer than 1015 bytes are split by the MPU and transmitted in chunks. When the outgoing buffer accumulates 1015 bytes of data, the value of the Buffer Out Length register becomes 0x0008. No more than 1015 bytes of data are permitted in the Socket Data register. Since this condition is not indicated by the Buff_Full bit in the Socket Config Status Low register (0x22) or by the Buff_Full bit in the Socket Interrupt Low register (0x2C), the Buffer Out Length register must be monitored, or supervised in the application layer. If data is written to the TCP Data Send register under these conditions, the data in the outgoing buffer is transmitted. The MPU repeats the procedure of sending residual data after checking that the Buffer Out Length register has been restored to 0x03ff. The transmission of all data in the outgoing buffer can be confirmed by checking the Buff_Empty bit in the Socket Config Status Low register (0x22) and the Buff_Empty bit in the Socket Interrupt Low register (0x2C) following an interrupt.

When the S-7600A receives UDP data, it applies UDP protocol processing and stores the processed data in the incoming buffer after adding 12 bytes of header information. Data reception can be determined by checking whether the value of the Buffer In Length register equals 0x0000 or a different value. The Data_Avail bit in the Socket Config Status Low register (0x22), the Socket Data Available register (0x28), and the Data_Avail bit following an interrupt in the Socket Interrupt Low register (0x2C) can all indicate data reception. Read the Socket Data register (0x2E) while monitoring the Data_Avail bit in the Socket Config Status Low register. This fetches the 12 byte header from the incoming buffer, followed by the data. Table 8-2 shows the header structure.

Table 8-12 Header Structure

Byte position from head	Implication of each byte	Remarks
0	The most significant byte of their IP address	
1	The second significant byte of their IP address	
2	The third significant byte of their IP address	
3	The least significant byte of their IP address	
4	The most significant byte of their port number	
5	The least significant byte of their port number	
6	The most significant byte of our port number	
7	The least significant byte of our port number	
8	The most significant byte of UDP datagram size	8 bytes of UDP header are not included here
9	The least significant byte of UDP datagram size	
10	The most significant byte of UDP checksum	
11	The least significant byte of UDP checksum	

Each time a byte of data is read out from the Socket Data register, the value of the Buffer In Length register decrements. When all data is read out, the register value returns to 0x0000. In UDP data reception, the incoming buffer has a maximum capacity of 2047 bytes, including the 12-byte header. The application layer is responsible for using the header information and the buffer control to prevent any overflow in the two incoming buffers.

9. Reset Functions

9.1. Overview

The S-7600A has two reset functions which are hardware reset and software reset.

9.1.1. Hardware Reset Function

The S-7600A operates to be synchronous to the **CLK** signal(clock input). When the **RESETX** pin set to low level in two clock period minimum, the S-7600A accept hardware reset input and starts initializing internal circuit at positive edge timing of forth clock. After the **RESETX** pin return to high level, the S-7600A maintains initialized state and turns normal state at positive edge timing of forth clock.

See the Figure 9-1.

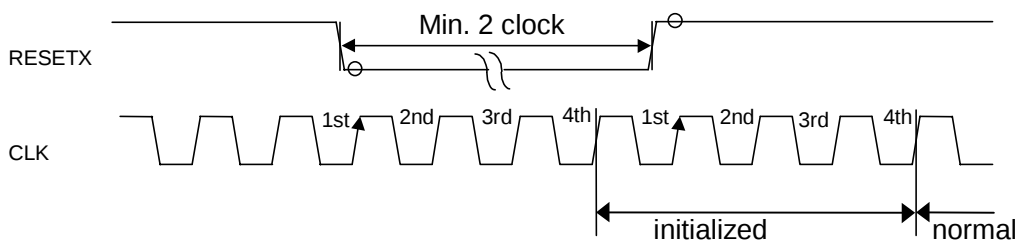


Figure 9-1 **Hardware Reset Timing**

9.1.2. Software Reset Function

The S-7600A is able to initialize the internal circuit by the *General Control Register*(0x01). Show the reset timing in case of x80 Family MPU mode. See the Figure 9-2.

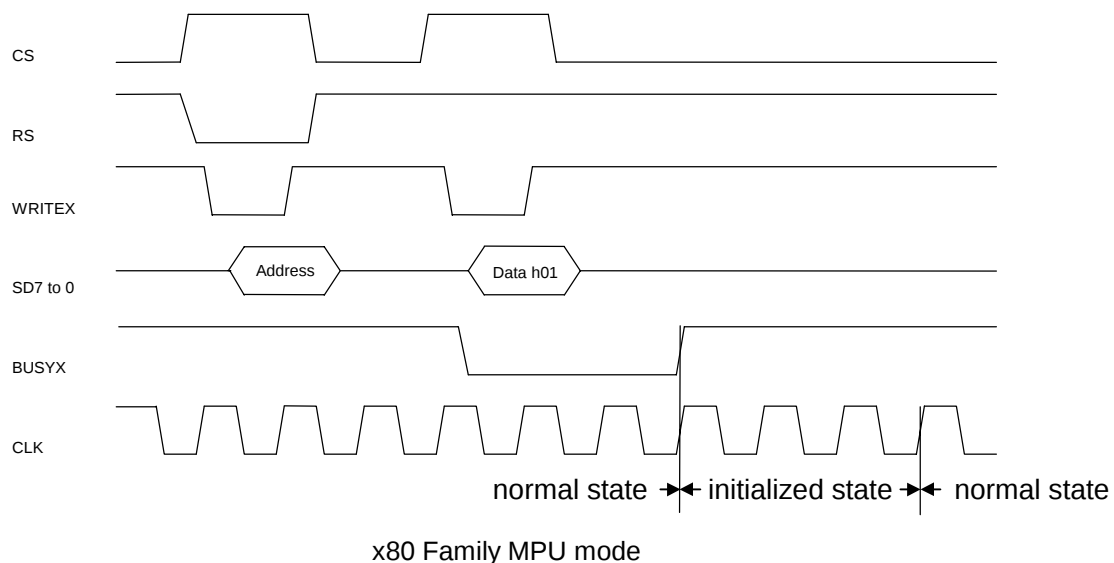


Figure 9-2 **Software Reset Timing**

10. Application Examples

10.1.1. In Case of x80 Family MPU with LCD Controller

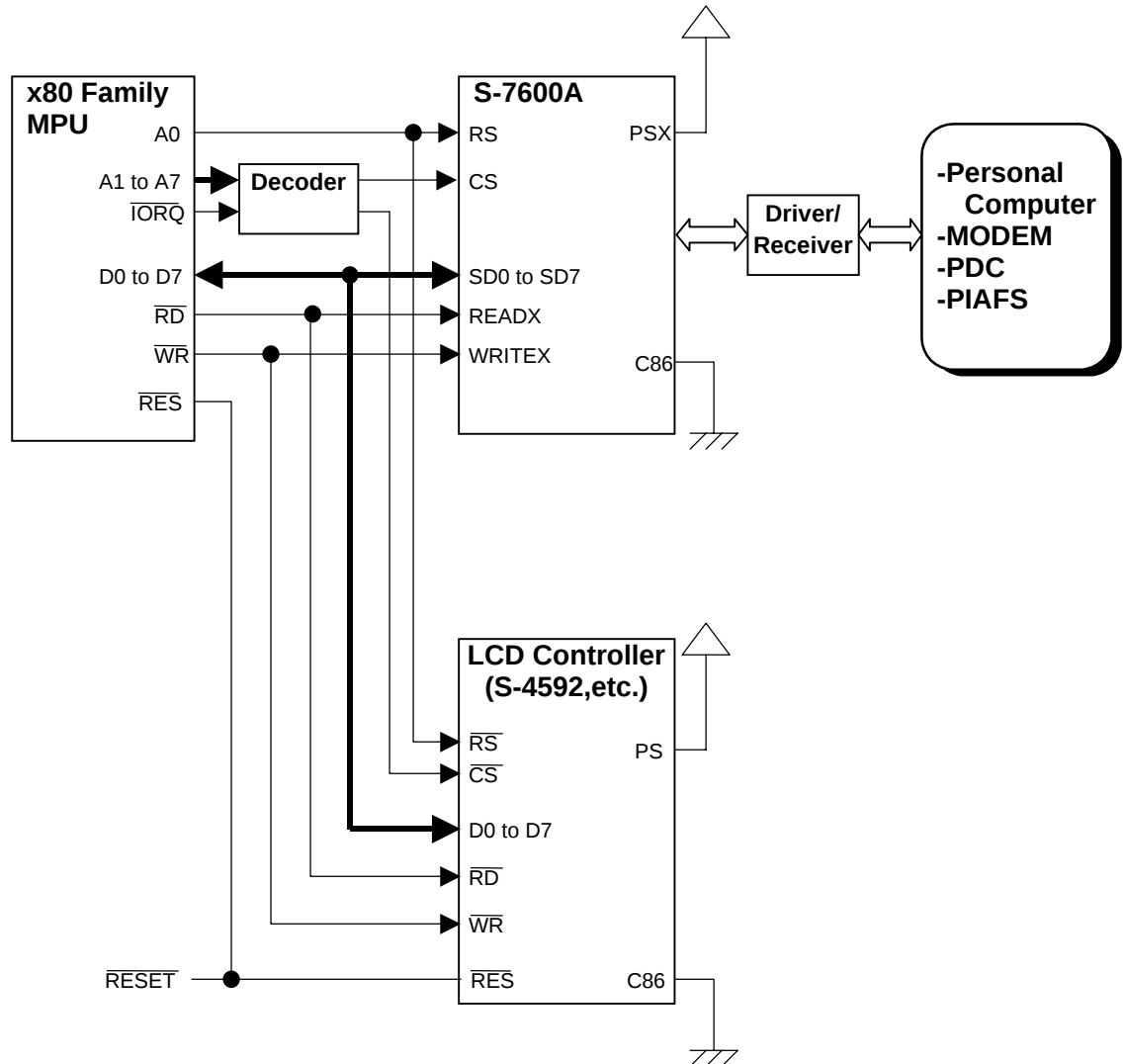


Figure 10-1 Example for x80 Family MPU

10.1.2. In Case of 68k Family MPU with LCD Controller

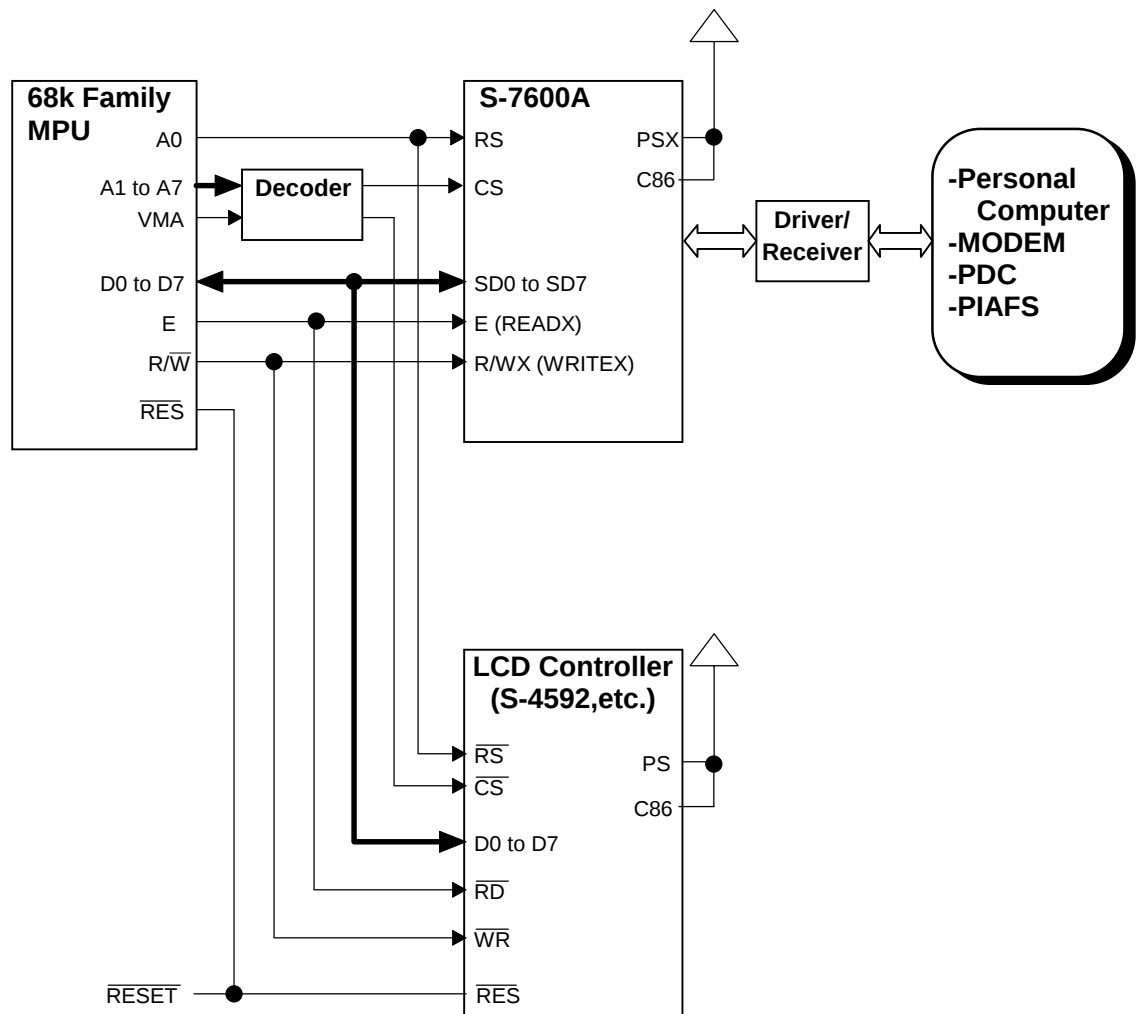


Figure 10-2 Example for 68k Family MPU

10.1.3. In Case of Serial Interface with LCD Controller

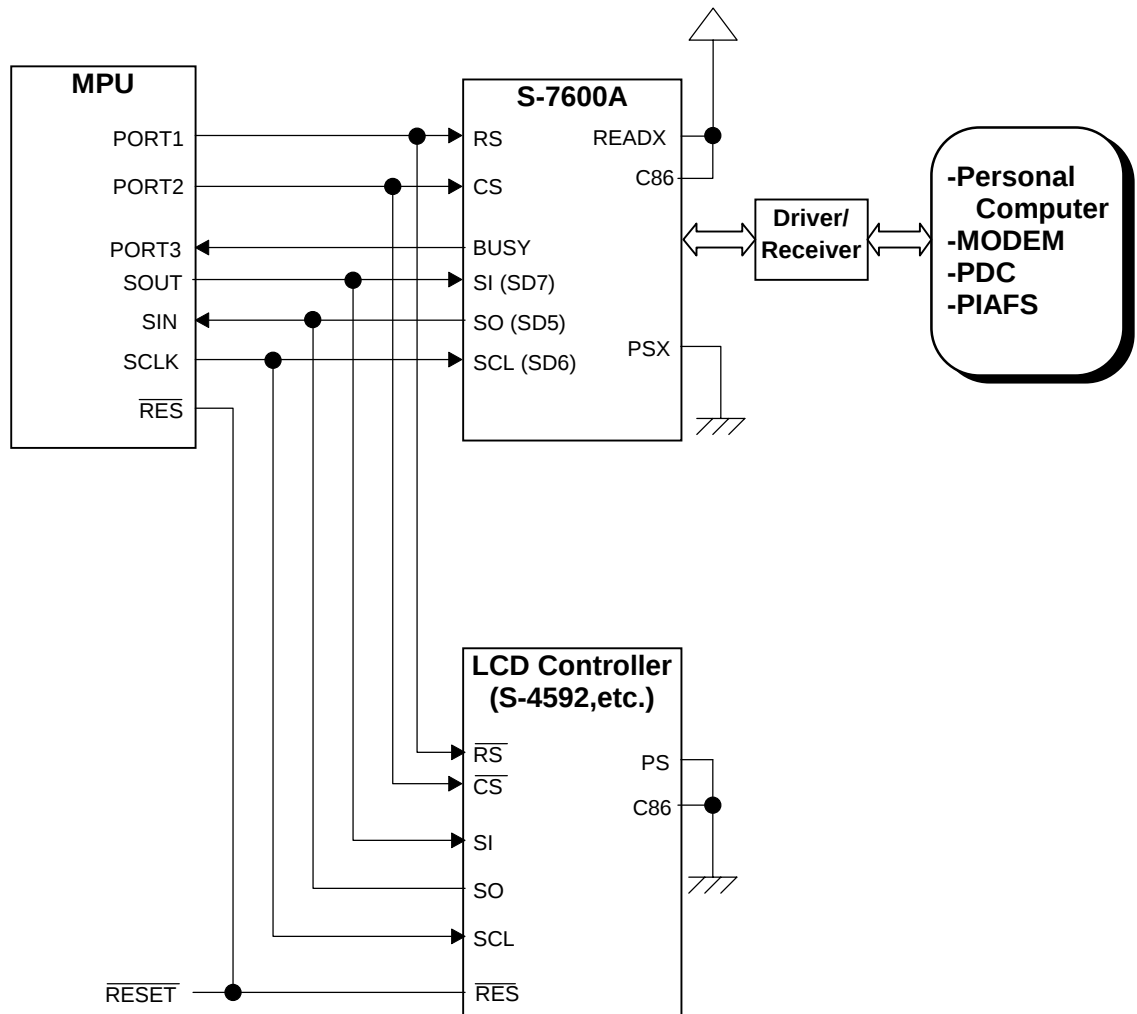


Figure 10-3 Example for Serial Interface



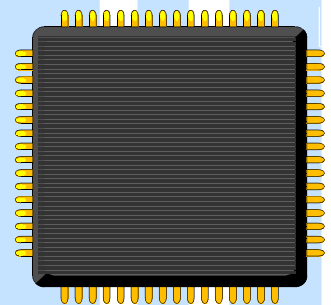
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The S7600A TCP/IP Network Stack LSI is based upon iReady's Internet Tuner® technology.
The URL for iReady's Web site is,
<http://www.iready.com>

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