Chapter 6. Single Board Computer

The Single Board Computer (SBC) is a 586-class single-board computer designed for use in ruggedized applications, such as the embedded products and complete systems offered by IBM WorldWide Plant Floor Solutions group. The SBC can be combined with the PMC video card for complete system function.

Two models are available, and both models can be ordered with or without a built-in 10 BaseT/100 BaseTx Ethernet feature. The SBCs are identified as:

- 586 (without Ethernet) and 586E (with Ethernet)
- 586U (without Ethernet) and 586EU (with Ethernet)

The SBCs support external processor bus speeds between 50 MHz and 66 MHz and a PCI bus operating at up to 33 MHz. The following figure shows the features of the SBC.

| Table 6-1. SBC Features				
Features	**586**	**586E**	**586U**	**586EU**
Processors: • Pentium® processors up to 200 MHz • Pentium processors with MMX up to 233 MHz • AMD K6-2 processors up to 366 MHz (see Table 6-6 on page 6-17 for restrictions)	X	X	X X X	X X X
Optional 512 KB of pipelined, synchronous-burst cache	X	X	X	X
8 MB to 256 MB of extended data-out (EDO) parity DRAM	X	X	X	X
Connectors for standard I/O devices: • Two integrated PCI IDE controllers (see note) • Two NS16550- and NS16550A-compatible serial ports • Parallel port with extended-capabilities port (ECP) and enhanced-parallel port (EPP) support • Diskette drive controller (1.44 MB and 2.88 MB support) • Keyboard port • Mouse port • Two USB ports • Optional PCI 10 BaseT/100 BaseTx Ethernet	X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X X
Thermal sensing of ambient and processor temperatures			X	X
Watchdog timer			X	X
Real-time clock	X	X	X	X
Optional PMC card	X	X	X	X
Software BIOS (can be upgraded)	X	X	X	X
External PCI expansion connectors (2.1 revision)	X	X	X	X
PCI Industry Computer Manufacturers Group (PICMG) edge connector, which supports external ISA and PCI adapters	X	X	X	X
IEEE P1386 PMC card connector	X	X	X	X
Note: Each IDE controller supports IDE modes 0, 1, 2, and 3, or PIO mode 4, and ATA multi-word DMA modes 0, 1, and 2.				

586 and 586E SBC Component Layout
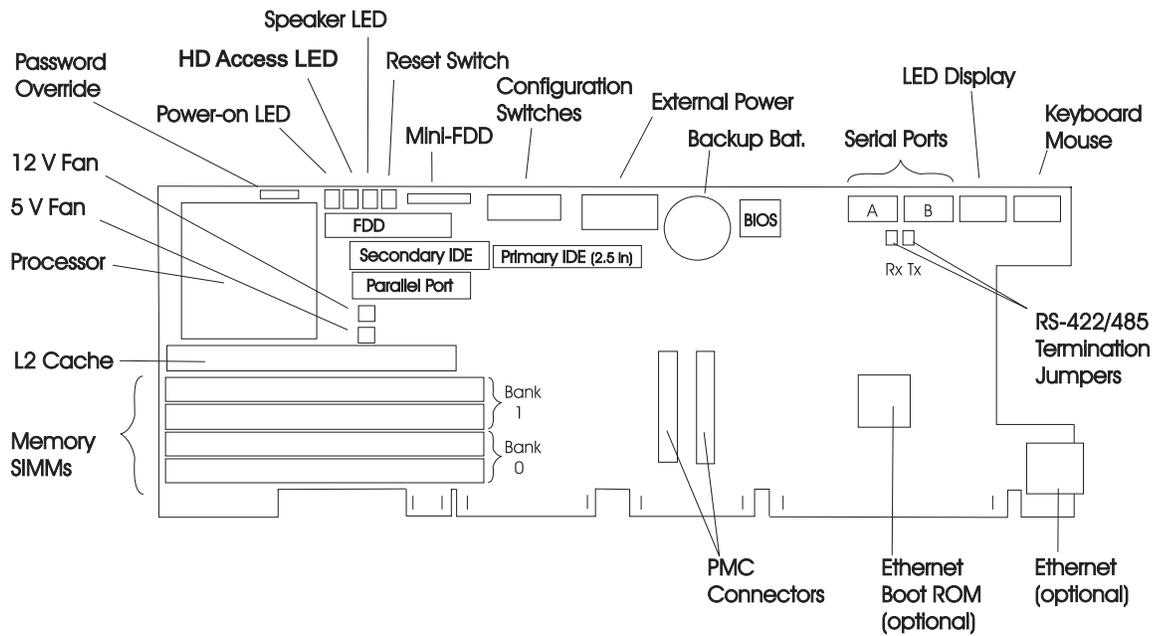
Figure   6-1. 586 and 586E SBC Component Layout
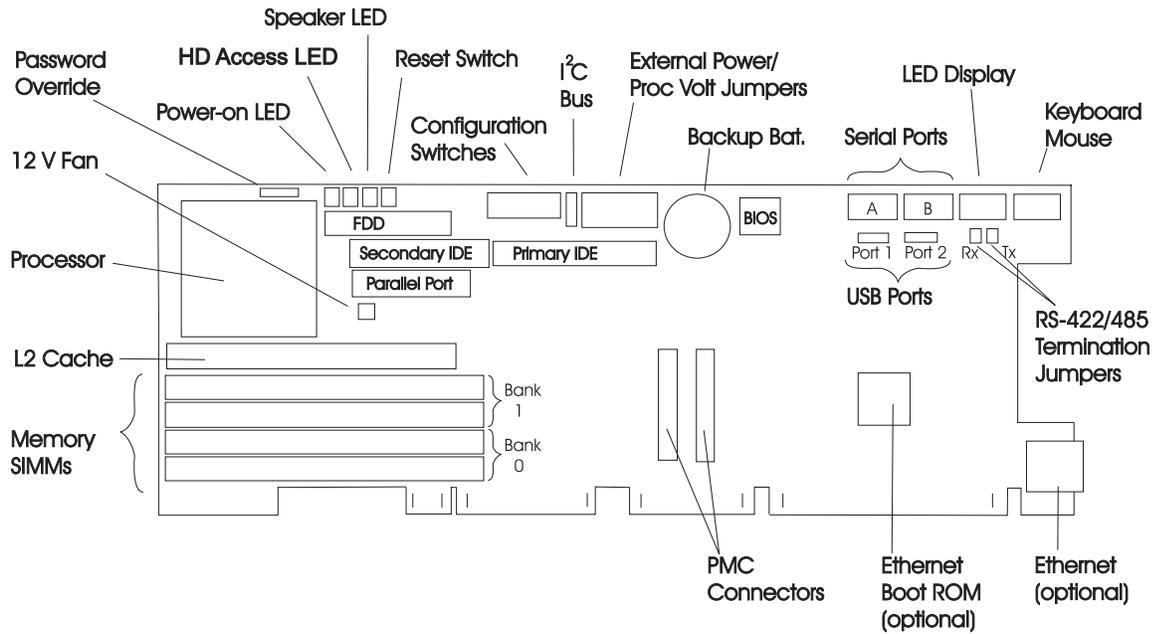
586U and 586EU SBC Component Layout

Figure 6-2. 586U and 586EU SBC Component Layout

Memory Subsystem

SIMMs

The SBC has four 72-pin SIMM sockets organized into two banks of memory. These sockets can accept gold-tabbed, 60-ns, EDO parity SIMMs. These SIMMs can be 4 MB, 8 MB, 16 MB, 32 MB, or 64 MB. Each bank of memory must contain a pair of SIMMs identical in size, speed, and technology. The SIMMs do not have to be the same from one bank to another; the SBC will optimize for the maximum performance of each bank.

Cache

The SBC has a single socket for the level-2 (L2) cache. This socket can be populated with a 512 KB cache module. L2 cache is not required for proper operation on the SBC. If L2 cache is not installed, the SBC operates using the internal cache on the microprocessor. L2 cache gives increased performance in almost all applications. The amount of performance increase depends on the application.

Indicators

Hex Displays

There are two hex displays viewable from the top of the SBC. These displays give codes indicating the progress of the POST for the SBC. When the SBC has completed POST successfully, the displays will show a 00, and the operating system will start loading. If an error is detected during POST, the error code will be displayed in the hex displays, as follows:

1. The start code of **EE**
2. The first two digits of the error code
3. The second two digits of the error code
4. The end code of **EE**

For example, if a 162 configuration error occurred at power-on, you would see **EE 01 62 EE** in the hex displays. This will repeat until you press a key.

Note: The 162 error will not display when the SBC is set to auto-configure mode. In auto-configure mode, the SBC automatically reconfigures itself and reboots.

Power-On LED

This 2-pin connector on the SBC provides input to the system power-on indicator. It turns on the LED whenever 5 volts is applied to the SBC.

The connector is a 2-pin header attached through a cable to the system power-on LED (green).

Pin	Description
1	–
2	+

HDD Access LED

This connector will drive a hard-disk-drive-accessed LED. It will light the LED whenever there is activity to either of the IDE ports.

The connector is a 2-pin header that connects through a cable to the HD-access LED (yellow).

Pin	Description
1	+
2	–

Speaker LED

This 2-pin connector on the SBC is used to drive a speaker or an LED. A standard PC-class speaker can be connected to this connector and it will give the normal system audio outputs.

The speaker light connector is a 2-pin header attached through a cable to the system speaker LED.

Pin	Description
1	Data out
2	Vcc

I/O Connectors

Diskette Drive Connectors

The SBC provides for attaching a single diskette drive through one of two connectors. Only one connector can be used at a time.

34-Pin

This connector is a standard diskette interface. The port supports two diskette drives through the addition of a 34-pin ribbon cable.

This connector is a 2-by-17 header.

Pin	Description	Pin	Description
1	Ground	2	Density Sel
3	Key	4	N/C
5	Ground	6	DRate 0
7	Ground	8	-Index
9	Ground	10	-Motor 0
11	Ground	12	-FDSel 1
13	Ground	14	-FDSel 0
15	Ground	16	-Motor 1
17	Ground	18	Dir
19	Ground	20	-Step
21	Ground	22	-WData
23	Ground	24	-WGate
25	Ground	26	-Track 0
27	Ground	28	-WrProt
29	Ground	30	-RData
31	Ground	32	HD Select
33	DRata 1	34	DskChange

Mini 26-pin

This mini-header supports a single, laptop-style diskette drive through the addition of a 26-pin flat circuit cable. This mini-header is present only on the 586 or 586E SBCs.

The connector is a miniature 1-by-26 header.

Pin	Description	Pin	Description
1	+5 V	2	Index
3	+5 V	4	Drive Select
5	+5 V	6	Disk Change
7	NC	8	Ready
9	HD Out	10	Motor On
11	DRate 1	12	Direction Select
13	NC	14	Step
15	Ground	16	Write Data
17	Ground	18	Write Gate
19	Ground	20	Track 00
21	Ground	22	Write Protect
23	Ground	24	Read Data
25	Ground	26	Side Out Select

IDE Connectors

The SBC has two IDE connectors: one to the primary controller and the other to the secondary controller. Each controller supports two drives and can operate in PIO modes 0 through 4 and DMA modes 0 through 2. These interfaces support transfer rates of up to 16.7 MB per second, depending on the hard drive installed. The mode for each drive (PIO or DMA) is selected through the Configuration/Setup Utility program.

The type of connector depends on the model of the SBC. On the 586 and 586E SBCs, the connector for the primary controller is a miniature 50-pin connector, and the connector for the secondary controller is a 40-pin connector. On the 586U and 586EU SBCs, both connectors are 40-pin connectors.

40-pin

This connector is a standard 2-by-20 header that provides a signal path to the IDE controller. Each interface supports two standard, 3.5-inch drives through a 40-pin, flat-ribbon cable.

Pin	Description	Pin	Description
1	-Reset	2	Ground
3	Data 7	4	Data 8
5	Data 6	6	Data 9
7	Data 5	8	Data 10
9	Data 4	10	Data 11
11	Data 3	12	Data 12
13	Data 2	14	Data 13
15	Data 1	16	Data 14
17	Data 0	18	Data 15
19	Ground	20	Key
21	DRQy	22	Ground
23	-IOW	24	Ground
25	-IOR	26	Ground
27	IOChRdy	28	NC
29	-DACKy	30	Ground
31	-IRQ 14	32	-IO CS 16
33	HA1	34	Ground
35	HA 0	36	HA 2
37	-CS 0(1F0h)	38	-CS 1 (3F0h)
39	-IDEACT	40	Ground

Mini 50-pin

This connector is a miniature 2-by-25 header that provides a signal path to the primary IDE controller. It supports two laptop-style, 2.5-inch drives through a 50-pin, flat-ribbon cable.

Pin	Description	Pin	Description
A	Test Only	B	Test Only
C	Master/Slave	D	Master/Slave
E	Not Used	F	Not Used
1	-Reset	2	Ground
3	Data 7	4	Data 8
5	Data 6	6	Data 9
7	Data 5	8	Data 10
9	Data 4	10	Data 11
11	Data 3	12	Data 12
13	Data 2	14	Data 13
15	Data 2	16	Data 14
17	Data 0	18	Data 15
19	Ground	20	Key
21	DRQx	22	Ground
23	-IOW	24	Ground
25	-IOR	26	Ground
27	IOCHRDY	28	NC
29	-DACKx	30	Ground
31	-IRQ14	32	-IOCS16
33	HA1	34	NC
35	HA0	36	HA2
37	-CS0(1F0h)	38	-CS1(3F0h)
39	-IDEACT	40	Ground
41	+5 Volts	42	+5 V Motor
43	Ground	44	AT Interface

Keyboard/Mouse

The SBC has an 8-position header that provides both the keyboard and mouse inputs. Any IBM-compatible mouse or keyboard will work with these ports.

The keyboard/mouse connector is a 2-by-4 header. It can be attached through a cable to a connector on the PMC video card or attached through two 4-pin cables to two 6-pin, miniature-DIN connectors fastened to the chassis.

Pin	Description	Pin	Description
1	Keyboard Data	2	Ground
3	5 Volts	4	Keyboard Clock
5	Mouse Data	6	Ground
7	5 Volts	8	Mouse Clock

Parallel Port

The SBC has a 26-pin connector that provides a full-function, bi-directional parallel port. This port supports the Extended Capability Port (ECP) and the Enhanced Parallel Port (EPP) modes. The Configuration/Setup Utility program configures these modes in the BIOS. This connector is designed to be interfaced to the standard system parallel port connector through a cable.

This connector is a 2-by-13 header attached through a 26-pin ribbon cable to a 25-pin, D-shell connector fastened to the chassis.

Pin	Description		Pin	Description	
	ECP	EPP		ECP	EPP
1	-Strobe	-Write	2	-Auto FD	-Dstrobe
3	Data 0	Data 0	4	-Error	-Error
5	Data 1	Data 1	6	-Init	-Init
7	Data 2	Data 2	8	-Select In	-AStrobe
9	Data 3	Data 3	10	Ground	Ground
11	Data 4	Data 4	12	Ground	Ground
13	Data 5	Data 5	14	Ground	Ground
15	Data 6	Data 6	16	Ground	Ground
17	Data 7	Data 7	18	Ground	Ground
19	-ACK	-ACK	20	Ground	Ground
21	Busy	-Wait	22	Ground	Ground
23	PE	PE	24	Ground	Ground
25	Select	Select	26	Reserved	Reserved

Serial Port

The SBC has two serial ports on two 10-pin headers. These ports are designed to be interfaced to the system unit through cables. The Configuration/Setup Utility program controls the software setup for these ports.

Serial Port A

Serial Port A normally is configured to be COM1 and is a standard NS16550-compatible serial port.

The connector is a 2-by-5 header attached through a 10-pin cable to a male 9-pin D-sub connector fastened to the chassis.

| Table 6-2. COM Port 1 (RS-232 only)			
Pin	**Description**	**Pin**	**Description**
1	Carrier Detect	2	Data Set Ready
3	Receive Data	4	Request to Send
5	Transmit Data	6	Clear to Send
7	Data Terminal Ready	8	Ring Indicator
9	Ground	10	Key

Serial Port B

Serial Port B normally is configured to be COM2 and is a standard NS16550-compatible serial port. Serial Port B can have one of two physical interfaces: RS-232 or RS-422/485. Configuration switch 4 controls the physical interface.

The connector is a 2-by-5 header attached through a 10-pin cable to a male 9-pin D-sub connector fastened to the chassis.

Table 6-3. COM Port 2 (RS-232, RS-422/485)					
	Description			**Description**	
Pin	**RS-232**	**RS-422/485**	**Pin**	**RS-232**	**RS-422/485**
1	Carrier Detect	TD–	2	Data Set Ready	NC
3	Receive Data	RD–	4	Request to Send	NC
5	Transmit Data	TD+	6	Clear to Send	NC
7	Data Terminal Ready	RD+	8	Ring Indicator	NC
9	Ground	Ground	10	Key	Key

USB Port

The 586U and 586EU SBCs have two USB ports on two 5-pin headers. The Configuration/Setup Utility program controls the setup for these ports.

Each connector is a 1-by-5 header attached through a cable to a standard USB-port connector that is fastened to the chassis.

Pin	Description
1	+5 V
2	D–
3	D+
4	Ground
5	Shield Ground

Ethernet

The SBC has an optional 10 BaseT/100 BaseTx Ethernet port. This port is available to the user through a standard RJ45 connector on the rear of the card. The Ethernet port requires 100-ohm, category-5, shielded twisted-pair cabling.

The connector is a single RJ45 connector.

Pin	Description	Pin	Description
1	TD+	2	TD–
3	RD+	4	NC
5	NC	6	RD–
7	NC	8	NC

Ethernet Boot ROM

When the optional boot ROM is installed, the SBC will boot over a network. In this mode, the SBC will boot with no other media installed. The remote boot function requires that the network operating system support this function. Refer to your operating system documentation and the documentation supplied with the boot ROM feature for more information.

Miscellaneous Connectors

12 V dc Fan Power Connector

This connector provides 12 volts to power a fan-cooled heat sink.

The connector is a 2-pin header.

586, 586E		586U, 586EU	
Pin	**Description**	**Pin**	**Description**
1	+12 V	1	Ground
2	Ground	2	+12 V

5 V dc Fan Power Connector

On the 586 and 586E SBCs, this connector provides 5 volts to power a fan-cooled heat sink. The connector is not present on the 586U or 586EU SBC.

The connector is a 2-pin header.

Pin	**Description**
1	+5 V
2	Ground

Reset Switch

This connector is used with a system reset switch. When the two pins are shorted together, the SBC performs a hardware reset.

The connector is a 2-pin header attached through a cable to the backplane. When used in stand-alone mode, this connector can be attached to a system reset switch.

Pin	**Description**
1	-Reset
2	Ground

External Power Connector/Jumper Block

This 16-pin connector can be used to provide additional power to the SBC. The pin assignments depend on the SBC. On the 586U and 586EU SBCs, this connector also contains jumpers for selecting the processor-core voltage (see Figure 6-3 on page 6-15).

Attention

Do not install these jumpers on the 586 or 586E SBCs. Damage to the SBC will result.

The 586 and 586E SBCs do not support selectable core voltages, and the external power connector for these SBCs is used for power only.

Additional power is not required if the SBC is plugged into a backplane that supports the PICMG standard.

Table 6-4. External Power Connector—586 and 586E			
Pin	**Description**	**Pin**	**Description**
1	Ground	2	+5 V
3	Ground	4	+5 V
5	Ground	6	+5 V
7	Ground	8	+5 V
9	+5 V	10	+5 V
11	+12 V	12	+12 V
13	Ground	14	Ground
15	–12 V	16	–12 V

Table 6-5. External Power Connector—586U and 586EU			
Pin	**Description**	**Pin**	**Description**
1	Used for jumper	2	Used for jumper
3	Used for jumper	4	Used for jumper
5	Used for jumper	6	Used for jumper
7	Used for jumper	8	Used for jumper
9	+5 V	10	Ground
11	+5 V	12	Ground
13	+5 V	14	Ground
15	+12 V	16	–12 V

PMC Connector

The SBC supports the IEEE P1386 PMC standard connections; it uses the PMC connection for video support. The PMC video card attaches to the PMC connector and provides SVGA video output.

BIOS Flash ROM

The BIOS for the SBC is contained in Flash ROM. This lets the BIOS be updated through software. BIOS updates can be downloaded from the Web site (see "Downloading System Support Programs and BIOS Updates" on page 8-2 for more information).

Memory-Retention Battery

This battery is used to maintain the information stored in the CMOS (complimentary metal oxide semiconductor) memory. It also is used to power the time-of-day clock when the system unit is

powered off. If a password is lost or forgotten, you must remove the battery for 10 minutes, and then replace it. This removes all the contents of the CMOS memory, and the password. You will have to run the Configuration/Setup Utility program after you replace the battery.

Jumpers and Switches

RS-422/485 Transmit Termination Jumper

This jumper provides a 100-ohm resistor between the two transmit data lines (+ and –). The line-to-line resistor is connected when the jumper is installed.

RS-422/485 Receive Termination Jumper

This jumper provides a 100-ohm resistor between the two receive data lines (+ and –). The line-to-line resistor is connected when the jumper is installed.

Processor Voltage Selection Jumpers

These jumpers are supported on the 586U and 586EU SBCs only. They select the input voltages supplied to the microprocessor. The following shows the pin location and jumper settings for each microprocessor type.

Attention

Do not install jumpers in the external power connector on the 586 or 586E SBC. Damage to the SBC will result.
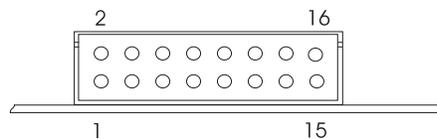
Microprocessor	Jumper Settings
Classic Pentium	
Pentium with MMX	
AMD K6-2	

Figure   6-3. Processor Voltage Selection Jumpers

Configuration Switch

The function of each switch on the configuration switch block is shown in the following table.

Switch	Description
1	CPU speed 0
2	CPU speed 1
3	CPU speed 2
4	Enable RS-232
5	Auto boot
6	CPU/PCI clock speed 0
7	CPU/PCI clock speed 1
8	Disable video
9	Reserved

Processor/Bus Speed Selection Switches

Switches 1 through 3, 6, and 7 are used to configure the SBC to the speed of the microprocessor. Switches 1 through 3 set the internal clock multiplier for the microprocessor. Switches 6 and 7 set the external bus speed.

The following table shows the switch settings by microprocessor. Settings are the same for MMX and non-MMX microprocessors.

Table 6-6. Processor/Bus Speed Selection Switches									
Switch Number								**SBC Notes**	
1	**2**	**3**	**6**	**7**	**Multiplier**	**Bus Frequency**	**Processor Frequency**	**586 586E**	**586U 586UE**
Intel Pentium Processors									
Off	Off	Off	Off	On	1.5x	50 MHz	75 MHz	1	1, 5
Off	Off	Off	On	Off	1.5x	60 MHz	90 MHz	1	1, 5
On	Off	Off	Off	On	2.0x	50 MHz	100 MHz	1	2, 5
Off	Off	Off	On	On	1.5x	66 MHz	100 MHz	1	1, 5
On	Off	Off	On	Off	2.0x	60 MHz	120 MHz	1	2, 5
On	Off	Off	On	On	2.0x	66 MHz	133 MHz	1	2, 5
On	On	Off	On	Off	2.5x	60 MHz	150 MHz	1	2, 5
On	On	Off	On	On	2.5x	66 MHz	166 MHz	1	2, 5
Off	On	Off	On	On	3.0x	66 MHz	200 MHz	1	2, 5
Off	Off	Off	On	On	3.5x	66 MHz	233 MHz	n.s.	3, 5
AMD K6-2 Processors									
On	Off	Off	On	On	2.0x	66 MHz	133 MHz	n.s.	4, 5
On	On	Off	On	On	2.5x	66 MHz	166 MHz	n.s.	4, 5
Off	On	Off	On	On	3.0x	66 MHz	200 MHz	n.s.	4, 5
Off	Off	Off	On	On	3.5x	66 MHz	233 MHz	n.s.	4, 5
On	Off	On	On	On	4.0x	66 MHz	266 MHz	n.s.	4, 5
On	On	On	On	On	4.5x	66 MHz	300 MHz	n.s.	4, 5
Off	On	On	On	On	5.0x	66 MHz	333 MHz	n.s.	4, 5
Off	Off	On	On	On	5.5x	66 MHz	366 MHz	n.s.	4, 5

n.s.—Not supported.

Installing the Pentium processor with MMX or the AMD K6-2 processor on a 586 or 586E SBC will damage the microprocessor when the system is turned on.

Notes:

1. Classic Pentium processor only.

2. Classic Pentium processor or Pentium processor with MMX.

3. Pentium processor with MMX only.

4. The AMD K6-2 processors are supported in special applications only. Contact your IBM representative or your place of purchase.

5. Refer to Figure 6-3 on page 6-15 for the processor voltage setting.

Enable RS-232 Switch

Switch 4 controls the electrical interface of serial port B. If the switch is ON, the port has a standard RS-232 interface. If the switch is OFF, the port has a standard RS-422/485 interface. The serial connector pin-outs for the 7588 Industrial Computer are shown in Appendix C, "Jumpers, Switches, and Pin Assignments."

Auto Boot

Switch 5 lets the SBC auto-configure at power-on. In the auto-configure mode, BIOS detects configuration errors at power-on and alters the CMOS settings to match the hardware. This feature is useful in situations where an operator or keyboard and display are not available to clear the configuration error.

Use this feature carefully because it can mask hardware problems. Hardware errors could cause the computer to change configuration and possibly lead to inconsistent operation of the hardware and applications running on the computer.

Disable Video

Switch 8 lets you disable video through a switch on the SBC. When this switch is in the On position, the SBC disables all video, including the PMC video card and any video cards.