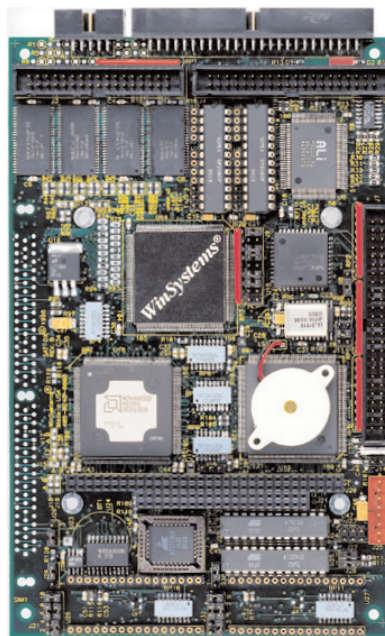# WinSystems®

EMBEDDED COMPUTERS

FEATURES

- 486DX CPU with 100 MHz clock
- PC-AT compatible
- Up to 64 Mbytes of installable system DRAM with either EDO or Fast Page SIMM supported
- Optional surface mount DRAM available
- Two solid state disk sockets supports onboard bootable DIP Flash, SRAM or (EP)ROM
- Up to 288 MB Flash Disk with flash file system
- Industry standard BIOS with POST
- 2 serial ports with FIFOs; COM1 and COM2 with RS-232, optional RS-422/485 for both channels
- Bidirectional LPT port that supports EPP/ECP
- 24 general purpose parallel I/O lines (82C55A)
- Onboard PCI IDE hard disk interface
- Onboard floppy disk controller
- Two interrupt controllers and 7 DMA channels
- Three 16-bit counter/timers
- AT keyboard controller
- 16-bit PC/104 expansion connector
- Low power and low cost
- Watchdog timer and power fail reset
- Real-time clock with battery backup
- Status and hard disk activity LEDs
- Speaker port and onboard piezo transducer
- Upgrade for SAT-SX and SAT-SLC
- Small size: 4.5 x 7.1 inches (114mm x 180mm)
- +5 volt only operation

WinSystems' SAT-DX is a small, low cost 486DX Single board AT computer intended for embedded applications. It is designed for applications where PC-AT power, performance and compatibility plus PC/104 expansion are needed in space and budget-limited industrial applications.

*SHADING INDICATES SOCKET ONLY
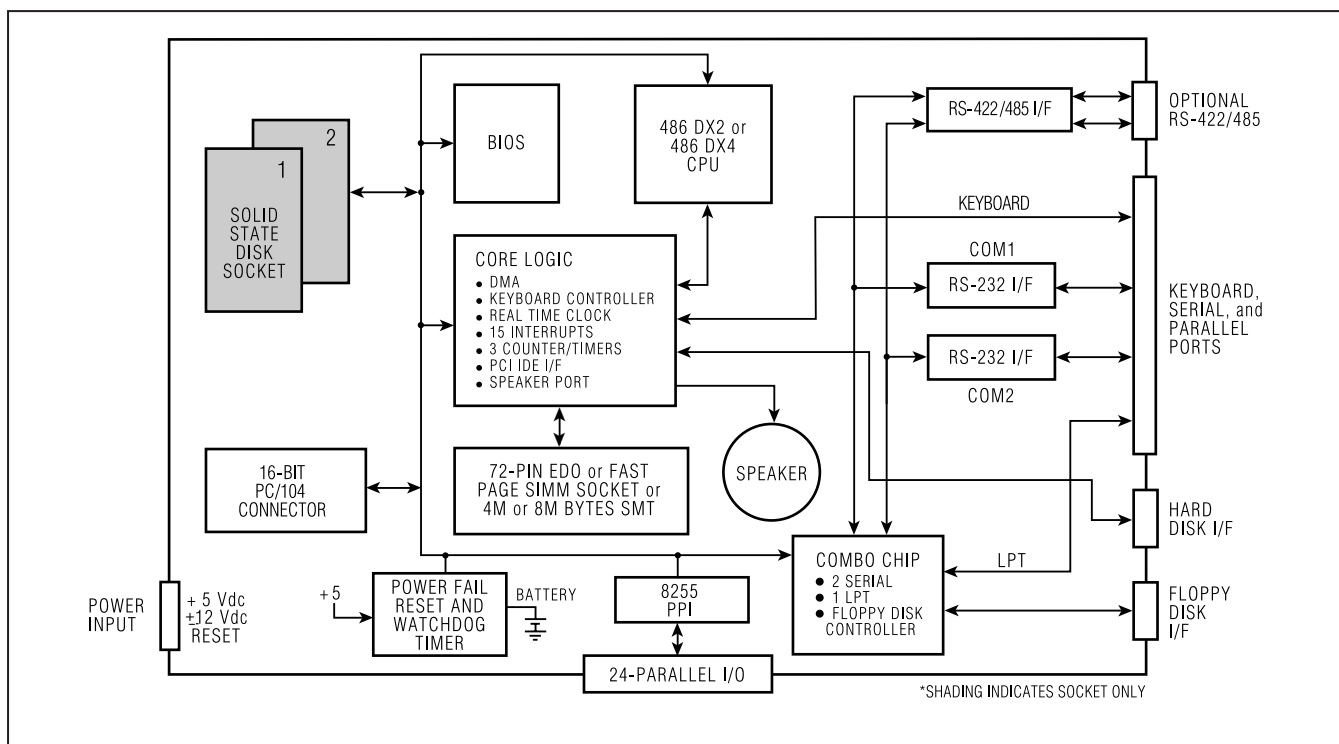
OVERVIEW

The SAT-DX is a highly integrated 486DX-based single board computer. Its feature-rich onboard I/O controllers makes the SAT-DX ideal for embedded control industrial applications. Plus its PC software compatibility assures easy program development and checkout.

Even though the board is PC-AT compatible, it will operate without disks, keyboard or a monitor. The SAT-DX board is well suited for applications such as automated industrial equipment, SCADA, medical instrumentation, transportation, manufacturing, communications, test and measurement and on the factory floor.

Users also have a migration path from the SAT-386SX, SAT-SX, SAT-SLC, and SAT-486SLC boards since the mounting holes, COM1, COM2, PC/104, LPT and power connectors have the same pin-out and location.

FUNCTIONAL CAPABILITY

Processor - The SAT-DX is available with a surface mounted 100 MHz DX4 CPU. The chipset provides the core logic that makes the board PC/AT software compatible. It includes the DRAM controller, bus interface and integrated peripheral controllers (8237 DMAs, 82C54 timer, 82C59 PICs, RTC, keyboard controller, and CMOS memory) plus an internal PCI bus for high-speed operation.

Memory - Up to 64Mbytes of Dynamic RAM can be populated on the board with a 72-pin SIMM. The BIOS can detect and automatically support either Fast Page or EDO memories. The board is typically shipped with no memory installed which permits the user to install and upgrade the memory in the field. A right angle connector is located underneath the board to secure the customer installed SIMM and to prevent interference to the PC/104 module stack. The SAT-DX will support either the x32 or x36 SIMMs.

As an alternative, surface mount DRAMs are available in 4, 8, 16, 32, or 64 Mbyte configurations. These parts are soldered onto the board to improve reliability for applications subject to shock and vibration.

The SAT-DX is shipped from the factory with an industry standard BIOS installed in a 128KB EPROM. At reset, the BIOS is shadowed into the DRAM so that it will execute faster.

Direct Memory Access (DMA) - Seven DMA channels are supported with Channel 2 dedicated to the floppy disk controller. The LPT is jumper selectable for Channels 1 or 3 for ECP operation. The DMA channels are wired to the PC/104 connector.

3.5" and 5.25" Floppy Disk Support - Up to two floppy disk drives from 360KB through 1.44MB formats are supported by the board. The output buffers are capable of sinking 48mA and are accessed via a standard 34-pin connector.

16-Bit IDE Hard Disk Interface - The SAT-DX incorporates a PCI IDE local bus interface for high-performance data transfers for up to 2 devices. A 40-pin header connector handles all command, data, and status I/O lines to an industry standard IDE interface.

Solid State Disks (SSD) - A user can substitute on-board semiconductor devices for applications where the environment is too harsh for mechanical hard disks or floppy disk drives while offering significant speed advantages.

Two 32-pin sockets support SRAM, EPROM, PEROM or one DiskOnChip®. Device sizes are 512K x 8 for the SRAM, EPROM, and PEROM. Also, a 1M x 8 EPROM can be used in each socket.

Flash Disk - A 32-pin DiskOnChip® Flash disk is supported but not populated. It is a 32-pin device that offers 8 to 288Mbyte capacity and includes TrueFFS®, an embedded flash file system. The file system provides hard disk read/write compatibility, automatic bad block management, and wear leveling.

ROMDISK - A diskette imaging program called MKDISK is provided to simplify the creation of a bootable ROMDISK made from a floppy diskette. Since the bootable ROMDISK is an exact image of a bootable floppy diskette, all testing and debugging can be accomplished by using a floppy drive. Once the application is ready for ROM, it is a simple matter to use the MKDISK utility to create the EPROMs necessary for a bootable ROMDISK equivalent of the functioning floppy.

RAMDISK - A RAMDISK is available as a bootable device using the BIOS extension or as a non-bootable disk by using an installable device driver. By using the standard MS-DOS Format program, a bootable RAMDISK can be created in a floppy disk size of up to 1MB. Either a 512KB SRAM or Atmel PEROM (Flash) device is supported.

WinSystems provides an installable device driver called USSD.SYS for use with MS-DOS and ROM-DOS operating systems. It supports disk sizes up to 1MB onboard and up to 16MB off board when using the PCM-SSD PC/104 modules. The driver supports both PEROMs (Atmel +5V Flash) and battery backed SRAMs in the socket.

Serial Communications - Two independent, double-buffered, full-duplex, serial asynchronous channels are

supported. Each transmit and receive channel has a 16-byte FIFO. This device is a dual 16550 compatible UART that offers software compatibility with PC-type driver programs. They are mapped at COM1 and COM2 (3F8-3FF and 2F8-2FF hex) respectively. Independent control of transmit, receive, line status and data set interrupts are on both channels. Each channel is set up to provide internal diagnostics such as loopback and echo mode on the data stream. The unit contains two independent on-chip software programmable baud rate generators selectable from 50 through 115.2 K bits per second. Modem handshake control signals are supported for both channels.

Both serial channels are configured as Data Terminal Equipment (DTE) and wired to a 50-pin connector at the edge of the board. WinSystems offers the optional CBL-247-1 which adapts each serial channel to 9-pin male "D" connectors with PC-AT compatibility.

CBL-247-1 COM1 & COM2 RS-232 Pin-Out

Pin	Flow	Signal
1	IN	Data Carrier Detect (DCD)
2	IN	Receive Data (RxD)
3	OUT	Transmit Data (TxD)
4	OUT	Data Terminal Ready (DTR)
5	—	Signal Ground (GND)
6	IN	Data Set Ready (DSR)
7	OUT	Request To Send (RTS)
8	IN	Clear To Send (CTS)
9	IN	Ring Indicator (RI)

RS-232 interface levels are supported on both channels. The RS-232 drivers have an on-chip charge pump to generate the plus and minus voltages so that the SAT-DX only requires +5 volts to operate.

Either RS-422 or RS-485 electrical levels can be supported on both COM1 and COM2 by removing the RS-232 transceivers and installing the optional CK-75176 chip kit per channel. The RS-422/485 signals are wired to a separate connector from the RS-232 signals with the following pin designation.

RS-422/485 Pin Out

Pin	Description	Pin	Description
1	COM1 TX+	2	COM1 TX-
3	COM1 RX+	4	COM1 RX-
5	GND	6	Vcc
7	COM2 TX+	8	COM2 TX-
9	COM2 RX+	10	COM2 RX-

The SAT-DX is designed to properly disable the transmitter upon reset to prevent potential lock-up problems caused by a transmitter stuck in the ON mode. The SAT-DX permits user installable termination resistors for impedance matching and biasing on the RS-422/485 lines.

Keyboard Controller - An 80C42 equivalent keyboard controller supports a PC/AT-type keyboard. It is accessed via the CBL-247-1 Multi-I/O adapter cable.

CBL-247-1 Keyboard Female Connector Pin-Out

Pin	Signal
1	Keyboard Clock
2	Keyboard Data
3	N/C
4	Ground
5	+5 volts

Line Printer Port - The SAT-DX has a bidirectional parallel printer port mapped at LPT1 (278-27F hex). It is both Enhanced Parallel Port (EPP) and Extended Capabilities Port (ECP) compatible. The controller chip is designed to provide enhanced ESD and Latch-Up protection of up to 4KV/300mA.

Alternatively, it can be used as two additional general purpose I/O ports if a printer is not required. The first port is configured as 8 input or output only lines. The other port is configured as 5 input and 3 output lines.

Parallel I/O - An 82C55A Programmable Peripheral Interface (PPI) device supports 24 I/O pins which may be individually programmed in two groups of 12 in three major modes of operation. The signal levels are TTL compatible. Each I/O line has a 10K ohm pull-up resistor to keep the input from floating.

Parallel I/O Connector

Pin	Description	Pin	Description
1	PC7	27	PB2
3	PC6	29	PB1
5	PC5	31	PB0
7	PC4	33	PA7
9	PC3	35	PA6
11	PC2	37	PA5
13	PC1	39	PA4
15	PC0	41	PA3
17	PB7	43	PA2
19	PB6	45	PA1
21	PB5	47	PA0
23	PB4	49	+5V
25	PB3	Even	Gnd

The 82C55A has its I/O lines connected to a 50-pin connector. The 24 data lines are alternated with 24 ground lines for reduced noise and crosstalk. Also +5 volts and ground are included in the cable. The pinout is compatible with the industry standard 4 to 24 position I/O module mounting racks (Opto-22, etc.) for use with high-level AC and DC opto-isolated solid state relays.

A 50-pin conductor ribbon cable such as WinSystems' CBL-115-4 links the SAT-DX directly to a 4, 8, 16 or 24 module rack.

Interrupts - Two 82C59A compatible interrupt controllers accept inputs from the onboard peripherals (including the 82C55A) and the PC/104 Bus for a total of twelve selectable interrupt sources.

Status LEDs - A green status LED monitors system activity. Under a user's program control, it can indicate error conditions or blink different patterns to provide a visual indication of program status. A red activity LED on the IDE interface blinks during data transfer.

Timers - Three 82C54 compatible 16-bit timers are supported. Channel 0 is wired to interrupt Channel 0, Channel 1 generates the DRAM refresh using DMA Channel 0, and Channel 2 is used by the speaker port.

Real Time Clock/Calendar - A MC146818A compatible clock supports a number of features including periodic and alarm interrupt capabilities. In addition to the time and date keeping functions, the system configuration is kept in CMOS RAM contained within the clock section. The remaining 114 bytes of RAM holds all of the DOS setup information regarding hard and floppy disk types, video types, shadowing, wait states, etc.

Watchdog Timer - A software/hardware enabled, retriggerable watchdog timer is provided. This timer must be updated at least once every 1.5 seconds otherwise a failure is assumed and the board will be reset. This circuit is important for use in remote and unattended applications.

Reset - A precision voltage comparator monitors the +5 volt status. Upon detection of an out-of-tolerance condition, the board is reset. This action is critically important in order to detect brown-out or power fail conditions. The reset circuit also ensures that the power is nominal before executing a power-on reset. This circuit also inhibits the processor's memory write line, preventing invalid data from being written to battery-backed static RAMs or EEPROMs during power fluctuations.

Battery Back-up - A 200 mAH battery supplies the SAT-DX board with standby power for either or both SRAM memory sockets, the real time clock and CMOS set-up RAM.

A power supervisory circuit contains the voltage sensing circuit and an internal power switch to route the battery or stand-by voltage to the RAM selected for backup. The battery automatically switches ON when the Vcc of the system drops below the battery voltage and back OFF again when Vcc returns to normal.

Speaker - Both the speaker port interface and onboard piezo transducer are available for sound generation. A beep code will be generated that corresponds to the

BIOS error codes (if required) during the power up or reset sequence.

Expansion Options - The SAT-DX provides a common computer core to which engineers can add off-the-shelf or user-designed PC/104 modules to match their exact configuration. The board can support 3 different modes: Standalone, PC/104 Bus and passive ISA Bus expansion.

Standalone Operation - The board can be used as a simple, complete, standalone embedded controller mounted on a flat surface using a set of standoffs. A separate power connector is located on the board to provide power. The board is only 4.5 x 7.1 inches which is ideal for use as a low power AT computer for embedded or portable industrial applications.

PC/104 Bus - The board has a 16-bit, non-stackthrough, PC/104 interface and connector. The SAT-DX serves as a host CPU and allows multiple PC/104 modules to plug in "piggy back" as a mezzanine expansion bus.
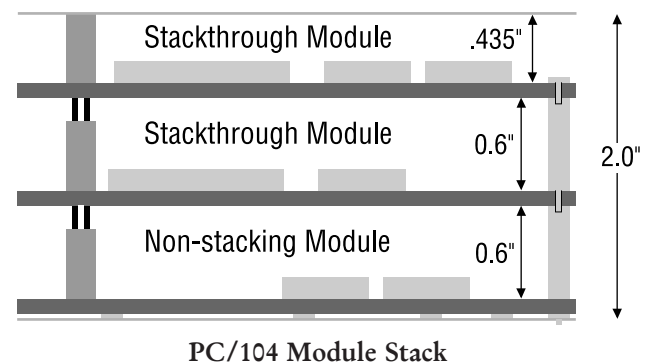

PC/104 Module Stack

PC/104 modules are based on the functional and electrical specifications of the IEEE-P996.1(ISA) draft specification. The modules are self stacking and do not require a card cage or backplane. They are very compact measuring only 3.6 x 3.8 inches and are offered by WinSystems and a number of third party companies. These modules support video, LANs, analog, digital and other special purpose I/O functions at a low cost.

ISA Bus - The PC/104 connector can be cabled to an ISA Bus passive backplane using WinSystems' PCM-ISA. The adapter contains the PC/104 Bus interface module, a 2-slot 16-bit ISA Bus back-plane and connecting cables. This product is easy-to-use and allows products from the two bus architectures to be linked together. This direct Bus-to-Bus link operates at full system speed and does not require software modification or Wait States to communicate.

Board Mounting Considerations - The SAT-DX board measures 4.5 x 7.1 inches (114mm x 180mm). It is designed to fit in small areas where embedded

computing power is a requirement. The SAT-DX with the SIMM socket installed requires a minimum 0.5" (13mm) standoff for proper mounting. The board mounting holes are identical for the SAT-V40, SAT-V41, SAT-386SX, SAT-SX and SAT-SLC to allow a migration path to higher performance.
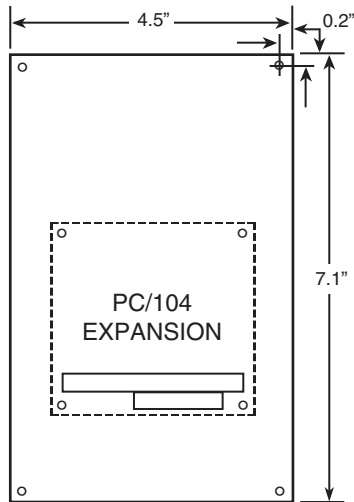
Outline/dimensions of the board

I/O Connector - WinSystems offers an optional Multi-I/O cable adapter for the COM1, COM2, LPT1 and keyboard. These four ports are combined into one 50-pin header at the edge of the board. The CBL-247-1 is a 1 foot adapter cable that offers a more convenient termination. COM1 and COM2 are 9-pin male "D" connectors with strain relief. LPT1 is a 25-pin "D" female socket with strain relief. The keyboard is a standard 5-pin DIN connector.

Drawing of Cable CBL-247-1

Power - Power is brought into the board through an 8-pin connector. The +12 volts is wired directly to the PC/104 connector and is not used by the SAT-DX.

Input Power Connector

Pin	Description	Pin	Description
1	Ext. Reset	2	Ground
3	Ground	4	Ground
5	+5 volts	6	+5 volts
7	+12 volts	8	-12 volts

SOFTWARE SUPPORT

The SAT-DX is designed to support both full PC-AT DOS compatible and embedded systems applications. An industry standard BIOS provides configuration flexibility, performance and AT compatibility. It supports both 3.5 inch and 5.25 inch floppy disk drives, AT-compatible keyboards, and other standard BIOS features. The BIOS also provides set up, power-on self test and boot diagnostics in ROM.

DOS - Since the SAT-DX is software compatible with the PC-AT, it will run the latest versions of DOS, Windows, and OS/2. It will support other operating systems such as QNX and real-time executives that require a "PC-AT" hardware environment.

ROM-DOS - ROM-DOS is a DOS 7.x compatible ROM-based operating system for embedded applications. This operating system enables a user to place the DOS application in a diskless embedded system and have it start running immediately after power is applied. ROM-DOS reduces the ROM, RAM and hardware requirements. It does not require keyboard, video or rotational media to function which is ideal for embedded control applications.

Software Developers Kit - WinSystems offers the SDK2-SAT-248 software developers kit to supply the necessary hardware, software and cables to begin program development with the SAT-DX board. It consists of Microsoft DOS 6.x, CBL-247-1 Multi-I/O cable, a 2GB or larger hard disk plus controller cable, a 1.44MB high density 3.5 inch floppy disk plus controller cable and triple output power supply housed in an enclosure.

SDK-SAT-248 Software Developers Kit

The power supply is a 50 Watt universal switcher that will accept input voltages from 85 VAC to 264 VAC. Output voltages are +5 volts at 5A, +12 volts at 2A, and

-12 volts at 0.5A. The power supply, floppy disk and hard disk are mounted in a black anodized enclosure. The packaging permits easy access to the board, PC/104 modules, and peripherals during program development.

ROM-DOS Developers Kit (RDK) - WinSystems also offers several different Flash-based developers kits for those applications that do not need rotational media during development. When you order a SAT-DX along with the RDK of your choice, WinSystems will jumper the CPU, program and install the Flash part to your SAT-DX. The RDK includes a PS-50W-1, PCM-POST, Flash memory, ROM-DOS, cables and utility software.

SPECIFICATIONS

Electrical
SAT-DX4-100 CPU Clock: 100 MHz
PC/104 Interface: 16-bit, non-stackthrough
Serial Interface: 2 Serial channels with RS-232 levels
             RS-422/485 optional using the CK-75176 kit
LPT Interface: Bidirectional LPT with ECP/EPP
Parallel Interface: 24 I/O lines, TTL compatible
IDE interface: Supports 2 drives
Floppy Disk Interface: BIOS supports one or two
           360K/720K/1.2M/1.44M drives
Vcc= +5V +5% at 1100 mA typ: SAT-DX4-100-8M

System Memory
Addressing: 64 Megabytes
Capacity: 72-pin EDO or Fast Page SIMM supplied and installed by user. Or 4, 8, 16, 32, or 64 Mbytes of factory-installed surface mount DRAM

Solid State Disk
Capacity: Two, 32-pin memory sockets support up to 1MB SRAM or Atmel Flash, 2MB of EPROM or a single DiskOnChip® from 8 to 288MB.

Mechanical
Dimensions: 4.5" x 7.1" (114mm x 180mm)
Jumpers: 0.025" square posts
Weight: 7oz. (198gm.)

Connectors
Serial, Parallel, Keyboard:	50-pin 0.100" grid
Parallel I/O:	26-pin 0.100" grid
Floppy Disk Interface:	34-pin 0.100" grid
IDE Interface:	40-pin 0.100" grid
PC/104 Bus:	64-pin 0.100" socket
	40-pin 0.100" socket
Power:	8-pin in-line Molex

Environmental
SAT-DX4-100 Operating Temperature: -40º to +70ºC

ORDERING INFORMATION

SAT-DX4-100-0M	100 MHz, 486DX SBC with 72-pin SIMM socket (no memory installed)
SAT-DX4-100-4M	4MB, 100 MHz, 486DX SBC
SAT-DX4-100-8M	8MB, 100 MHz, 486DX SBC
SAT-DX4-100-16M	16MB, 100 MHz, 486DX SBC
SAT-DX4-100-32M	32MB, 100 MHz, 486DX SBC
SAT-DX4-100-64M	64MB, 100 MHz, 486DX SBC
SIMM72-xxM	72-pin SIMM, where xx = 4, 8, 16, 32, or 64 Mbytes
RDK-SAT-248-xxF	ROM-DOS Developers Kit
SDK-SAT-104	Software Developers Kit
FLASH-MD2000-Dxx	DiskOnChip®, where xx = 8 to 288 Mbytes memory storage
PCM-ISA	PC/104 to ISA bus adapter
CBL-115-4	4 foot, Opto rack interface cable
CBL-174-1	Power cable for the board
CBL-247-1	1 foot, Multi-I/O adapter cable
CK-75176-2	RS-422/485 chip kit for 1 channel

WinSystems, Inc.