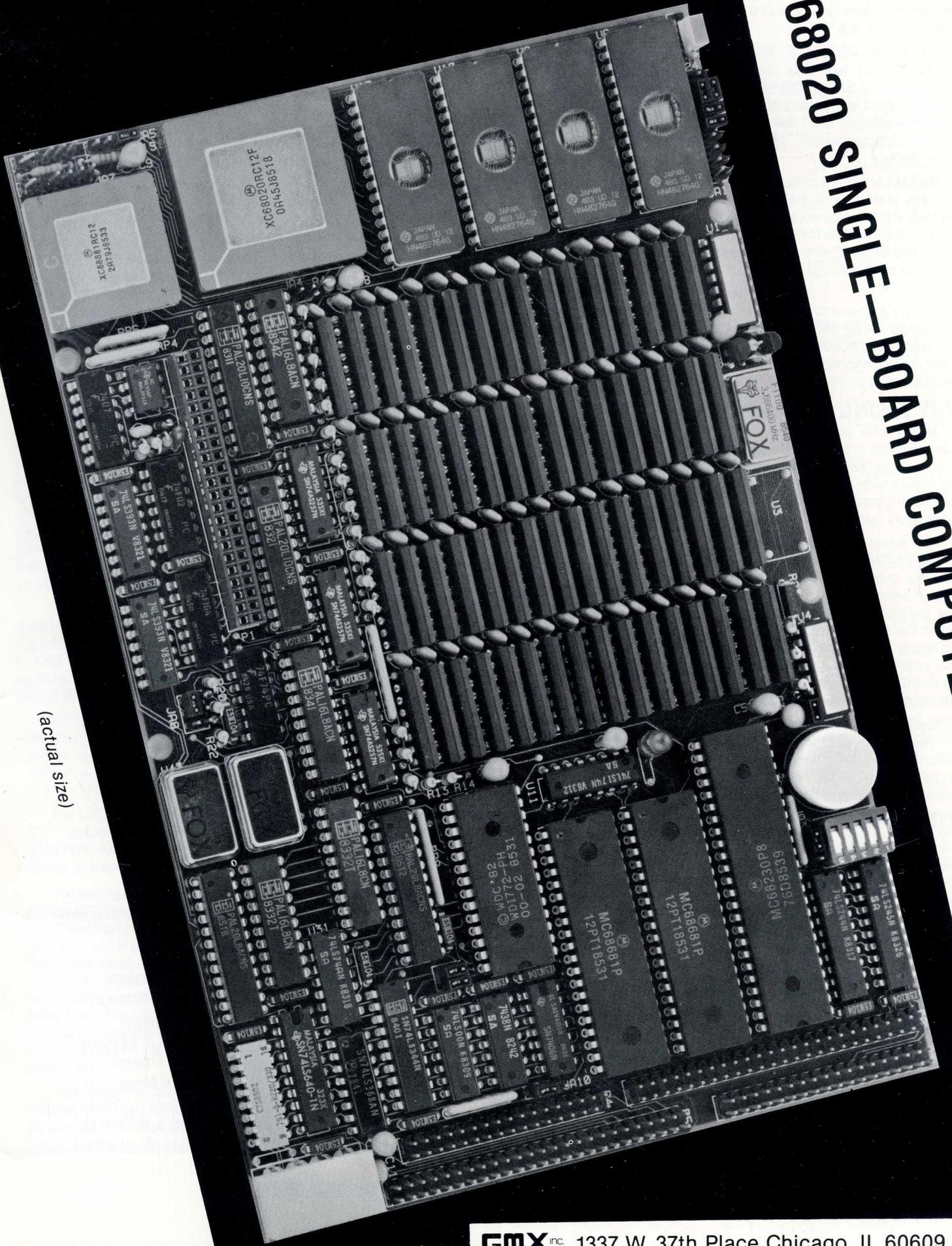


GMX™ MICRO-20

68020 SINGLE-BOARD COMPUTER



(actual size)

GENERAL DESCRIPTION

The GMX Micro-20 SBC provides the basis for a powerful, compact, 32-bit computing system. Using the state-of-the-art Motorola MC68020 microprocessor and an optional MC68881 floating-point coprocessor, it offers mainframe CPU performance on a board measuring only 5.75" × 8.8"!

The board includes 2 Megabytes of high-speed DRAM (512K × 32-bits), four serial ports, an 8-bit parallel port, a floppy disk controller, a SASI (SCSI subset) peripheral interface, and a time-of-day clock with battery backup. A 16-bit I/O expansion connector allows the use of off-the-shelf or custom interfaces to extend the board's I/O capabilities. The board supports up to 256K bytes of EPROM (64K × 32-bits).

The GMX Micro-20 is ideally suited to a wide variety of applications, and provides a cost-effective alternative to other MC68020 evaluation and development systems. As an educational tool, it is an excellent introduction to the power and versatility of the MC68020. It can be used as a software development station, a general purpose scientific or small business computer, or a real-time controller in process control systems, to name just a few possibilities.

The only additional devices needed to form a working system are a power supply and an ASCII serial terminal. This basic configuration is easily expanded to include floppy disks, hard disks, additional terminals or other serial devices (up to 20 total), and a parallel printer. Custom I/O devices may also be added, using the I/O expansion connector.

WHY A SINGLE-BOARD COMPUTER?

Advances in semiconductor and packaging technologies now make it possible to build an extremely powerful computer on a single, compact circuit board. By combining the MC68020 a 32-bit processor with high-density memory packaging, programmable logic devices, and a floating-point coprocessor, the GMX Micro-20 achieves performance levels that rival those of minicomputer and mainframe CPUs.

Until recently, computers as powerful as the GMX Micro-20 required a bus-oriented architecture, with multiple circuit boards and a backplane to interconnect them. While this type of architecture has some advantages, it results in a computer that is usually physically large and very costly. In contrast, the GMX Micro-20 incorporates most of the necessary components on single circuit board. This not only results in a reduction in size, it also provides greater reliability, lower power consumption, and lower cost. Eliminating the backplane also eliminates signal delays and noise problems that often limit bus-oriented systems to much less than their full potential.

Many single board computers have little or no potential for expansion. However, the GMX Micro-20 provides I/O expansion capability, without the need for a backplane. An add-on board can simply be plugged directly into the board's I/O expansion connector. Several boards may be added in this way by using stacking connectors.

THE 68020 32-BIT PROCESSOR

The Motorola MC68020 is perhaps the most powerful microprocessor currently available. To attain this high level of performance, Motorola enhanced the existing 68000 family architecture in three major areas: higher processing speed, an expanded instruction set, and a coprocessor interface.

To increase the processing speed of the MC68020, it was designed to run at higher clock rates than its predecessors, and the number of clock cycles required to perform certain functions was reduced. The 68020 uses a full 32-bit data bus which transfers twice as much data per bus cycle as a 16-bit bus, and requires only three clock periods to complete a bus cycle. A 256-byte on-chip instruction cache holds recently used instruction sequences that can be accessed in only two clock periods per 32 bits. The 68020 also supports instruction overlap, allowing portions of several instructions to execute simultaneously. Under certain circumstances, instruction overlap results in a net instruction execution time of zero clock cycles. Other enhancements include the addition of special multiply logic and a barrel shifter.

The instruction set of the 68020 is a superset of the 68000/68010 instruction set, and retains almost total object code compatibility at the user level. Instructions that did not previously support 32-bit operations have been extended to 32-bits, while the divide instructions have been expanded to support both 32 and 64-bit operands. Branch instructions, which only supported a 16-bit maximum displacement, now support a full 32-bit displacement as well. In addition to the enhancement of existing instructions, many new instructions have been added to the 68020. These new instructions include: pack and unpack instructions for BCD data, support for program "modules", "compare and swap" instructions for shared pointer and queue management, a "trap on condition code" instruction, and bit field instructions to manipulate from 1 to 32 contiguous bits anywhere in the address space. The 68020 also includes a memory indirect addressing mode, and scaled indexing has been added to several existing addressing modes.

The 68020 coprocessor interface allows direct extension of the processor architecture through the addition of devices such as the MC68881 floating-point coprocessor. Coprocessor instructions become part of the 68020 instruction set and are coded in-line like any other instruction. While the coprocessor uses the 68020 for functions such as effective address calculation and memory transfers, both processors can also operate concurrently.

THE MC68881 FLOATING POINT COPROCESSOR

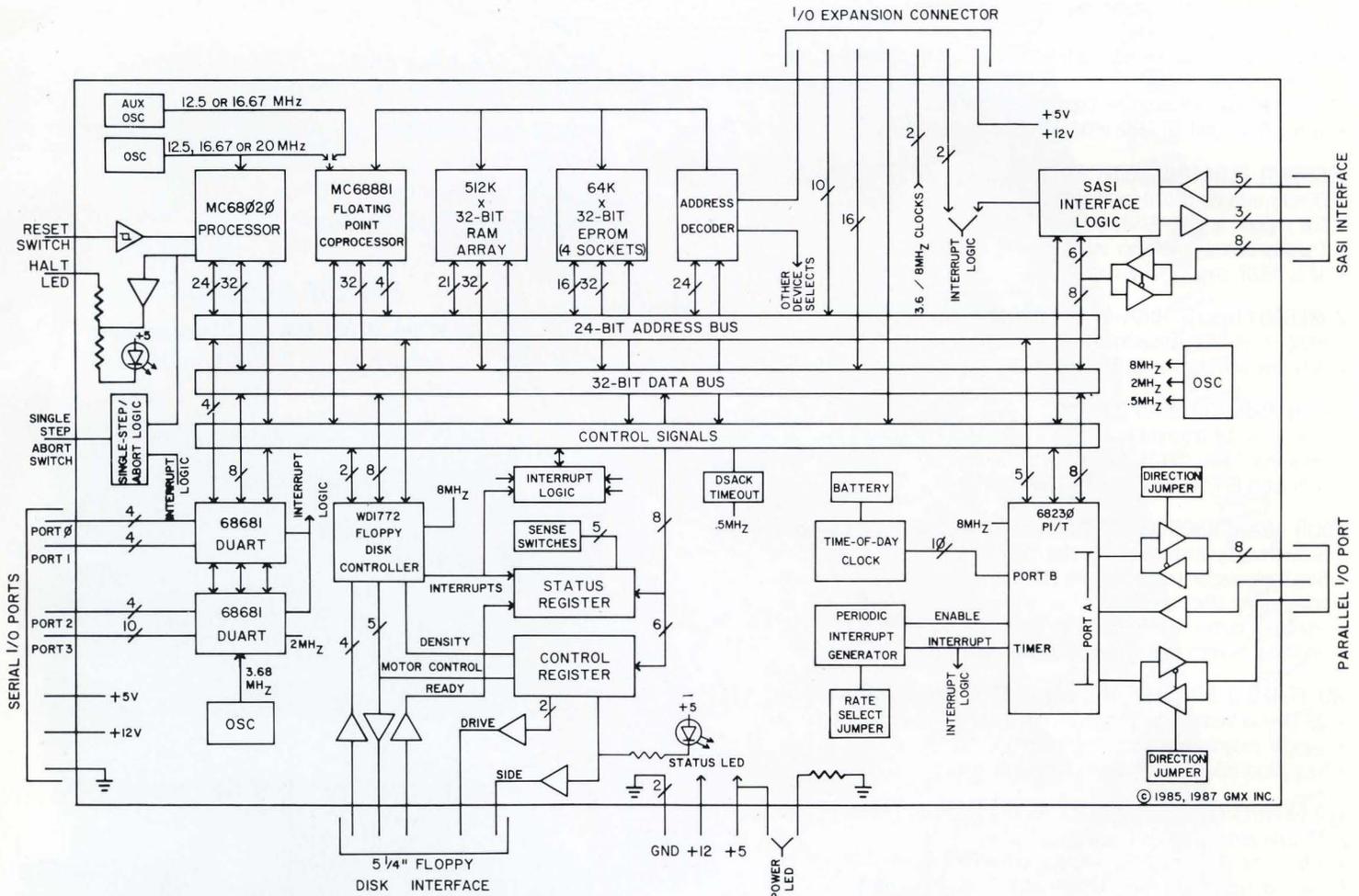
The MC68881 FPC extends the architecture of the 68020 to include eight 80-bit floating point data registers (a 64-bit mantissa plus a sign bit, and a 15-bit signed exponent), arithmetic functions conforming to IEEE floating-point standards (P754, Draft 10.0), and a full set of trigonometric and transcendental functions. The FPC also adds three special purpose registers, instructions to move and compare floating-point numbers and special branch and trap instructions. It supports seven data types: byte, word, and long integers; single, double, and extended precision real numbers; and packed BCD string real numbers. In assembly language programs, coprocessor instructions and registers are treated as though they were part of the 68020 instruction and register sets.

The MC68881 features a 67-bit arithmetic unit for fast calculations with an intermediate precision greater than the extended precision format, a 67-bit barrel shifter, and 22 common constants in ROM. It supports virtual machine/memory operations, concurrent instruction execution with the main processor, and has efficient mechanisms for procedure calls, context switches, and interrupt handling.

MC68881 FUNCTIONS

Add	Sine
Subtract	Arc sine
Multiply	Hyperbolic sine
Divide	Cosine
No operation	Arc cosine
Square root	Hyperbolic Cosine
Return mantissa	Simultaneous sine/cosine
Test operand	Tangent
Return exponent	Arc tangent
Compare	Hyperbolic tangent
Take integer part	Hyperbolic arc tangent
Negate	e to the X power
Modulo	e to the (X - 1) power
Remainder	10 to the X power
Scale exponent	2 to the X power
Log Base 10	Log base e
Log base 2	Log base e of (X + 1)

BLOCK DIAGRAM



INTERFACING

The GMX Micro-20 is easily incorporated into new or existing product designs. It measures only 8.8" x 5.75", and can be mounted directly on a standard 5 1/4" disk drive. The board requires regulated +5 and +12 Volt D.C. supplies, and uses the same power connector as a 5 1/4" disk drive.

The I/O connectors are dual-row header with .025" sq. pins on .100" centers that mate with standard ribbon cable connectors. The floppy disk, SASI, and parallel port connectors use industry standard pinouts to simplify interconnections.

The serial I/O connector provides direct access to the TTL level signals from the two on-board MC68681 DUARTs. A small adapter board is included with the GMX Micro-20 which provides RS-232 level translation and a separate connector for each of the four serial ports. The adapter board is available in two versions, one with 9-pin and one with 25-pin D-subminiature connectors. It is powered by the main board, with on-board provisions for generating the negative voltage required by the RS-232 standard. Since level translation is performed on a separate board, the GMX Micro-20 is easily adapted to other interface standards (RS-422, RS-485, current-loop, etc.) by replacing the adapter board.

Two single-row headers provide connection points for remotely mounted RESET and SINGLE-STEP/ABORT switches, and for POWER-ON and HALT indicator LEDs. Contact debounce for the switches and current limiting for the LEDs are provided on-board.

FIRMWARE

The board includes the GMX version of Motorola's 020Bug™, a powerful evaluation, debugging, and hardware diagnostic tool. 020Bug is PROM-based, and uses a command-driven user interface with tree-structured command directories. DIP-switch options allow the user to choose one of several operating modes.

020Bug has extensive facilities for executing and debugging user programs. These include commands to upload and download programs in Motorola S-record format, display and modify memory, single-step and trace program execution, set breakpoints, and assemble/disassemble memory-resident 68020 code. 020Bug also provides many basic I/O functions as system calls that are available to user programs.

A self-test on power-up feature and a suite of test programs provide comprehensive hardware diagnostics. The power-up self-test verifies basic system integrity whenever the system is powered-up or reset. If a problem is detected, an on-board LED flashes a "fault code" that indicates the nature of the problem, and gives the user diagnostic information even if the console I/O channel isn't working. Hardware diagnostic commands provide the ability to test most of the board's hardware functions individually or as a group. Included are tests for the RAM, the serial and parallel I/O devices, the floppy disk controller, the SASI interface, the processor's on-chip cache, and the optional floating-point coprocessor.

If one of the optional disk operating systems is purchased, a bootstrap loader for that operating system is included in PROMs along with the 020Bug.

FEATURES

MC68020 32-BIT PROCESSOR

- 32-bit wide non-multiplexed data and address buses
- On-chip instruction cache
- Object-code compatible with earlier M68000 family members (68000/68008/68010)
- Enhanced instruction set — Coprocessor interface
- 12.5, 16.67 and 20 MHz versions

MC68881 FLOATING-POINT COPROCESSOR (OPTIONAL)

- Directly extends 68020 instruction set
- Full support of IEEE P754, draft 10.0
- Transcendentals and other standard math functions
- 12.5, 16.67 and 20 MHz versions

2 MEGABYTES OF HIGH-SPEED DRAM

- 512K × 32-bit organization
- Only one wait-state at 12.5, 16.67 or 20 MHz

UP TO 256K BYTES OF EPROM

- 64K × 32-bit organization
- Uses four 2764, 27128, 27256, or 27512 EPROMs
- Selectable EPROM access times (wait-states)

FOUR ASYNCHRONOUS SERIAL I/O PORTS (2 × MC68681)

- Software programmable baud rates to 38.4K baud
- Standard adapter board provides RS-232 level signals or use custom adapters for other standards
- Input and output flow-control lines for all four ports
- Additional modem control lines available for one port

BUFFERED 8-BIT PARALLEL I/O PORT (1/2 MC68230)

- 36-pin Centronics-type parallel printer pinout
- Jumper programmable for input or output
- Two handshake lines: 1 input, 1 input or output

I/O EXPANSION CONNECTOR FOR ADDITIONAL I/O DEVICES

- 1K byte address space (expandable to 4K)
- 8 or 16-bit data paths — Clock and control signals
- Two interrupt inputs — +5 and +12VDC supplies

TIME-OF-DAY CLOCK/CALENDAR WITH BATTERY BACKUP

FLOPPY DISK CONTROLLER FOR UP TO TWO 5 1/4" DRIVES

- Single or double sided — Single or double density
- 48 or 96 track per inch (40/80 Track)
- 2, 3, 6, and 12 millisecond stepping rates
- Industry standard 34-pin connector pinout

SASI INTELLIGENT PERIPHERAL INTERFACE

- SASI/SCSI Compatible (SCSI subset)
- Supports hard disk controllers, tape controllers, etc.
- Handles up to eight controllers
- Compatible with most SASI/SCSI controllers
- Industry standard 50-pin connector pinout

PROGRAMMABLE PERIODIC INTERRUPT GENERATOR

- Interrupt rates from microseconds to seconds
- Accurate (5 ppm) timebase

5-BIT SENSE SWITCH, READABLE BY THE PROCESSOR

PROVISIONS FOR A REMOTE RESET SWITCH

PROVISIONS FOR A REMOTE SINGLE-STEP/ABORT SWITCH

- Single-step mode runs processor to the end of the next bus cycle, Abort mode generates a level 7 (non-maskable) interrupt (mode is jumper selectable)

PROVISIONS FOR REMOTE POWER-ON AND HALT INDICATORS

- LED compatible, with built-in current limiting

SPECIFICATIONS

GMX Micro-20

SIZE:

8.8 × 5.75 × 0.68 inches
(Can be mounted on 5 1/4" disk drives)

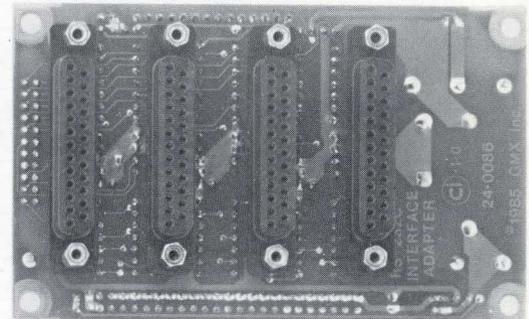
POWER REQUIREMENTS:

+5VDC @ 4.5A max.
+12VDC @ .15A max.
(Includes RS-232 adapter board)

RS-232 Adapters

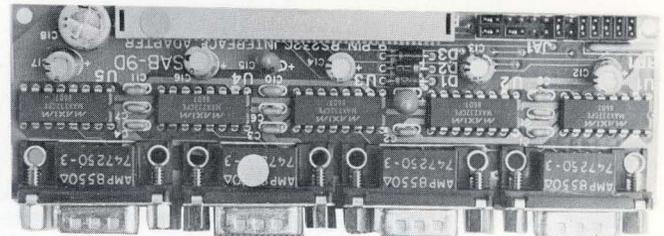
SAB-25 With DB-25 Connectors

Size: 4.4 × 2.7 × 1.2 inches



SAB-9D With DB-9 Connectors

Size: 5.3 × 1.8 × 0.6 inches



SOFTWARE

INCLUDED:

GMX version of Motorola's 020Bug Debugger and GMX hardware diagnostics in EPROM.

OPTIONAL:

For information on disk operating systems and other software see the price list and the software literature.

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