Gemini MultiBoard Microsystem
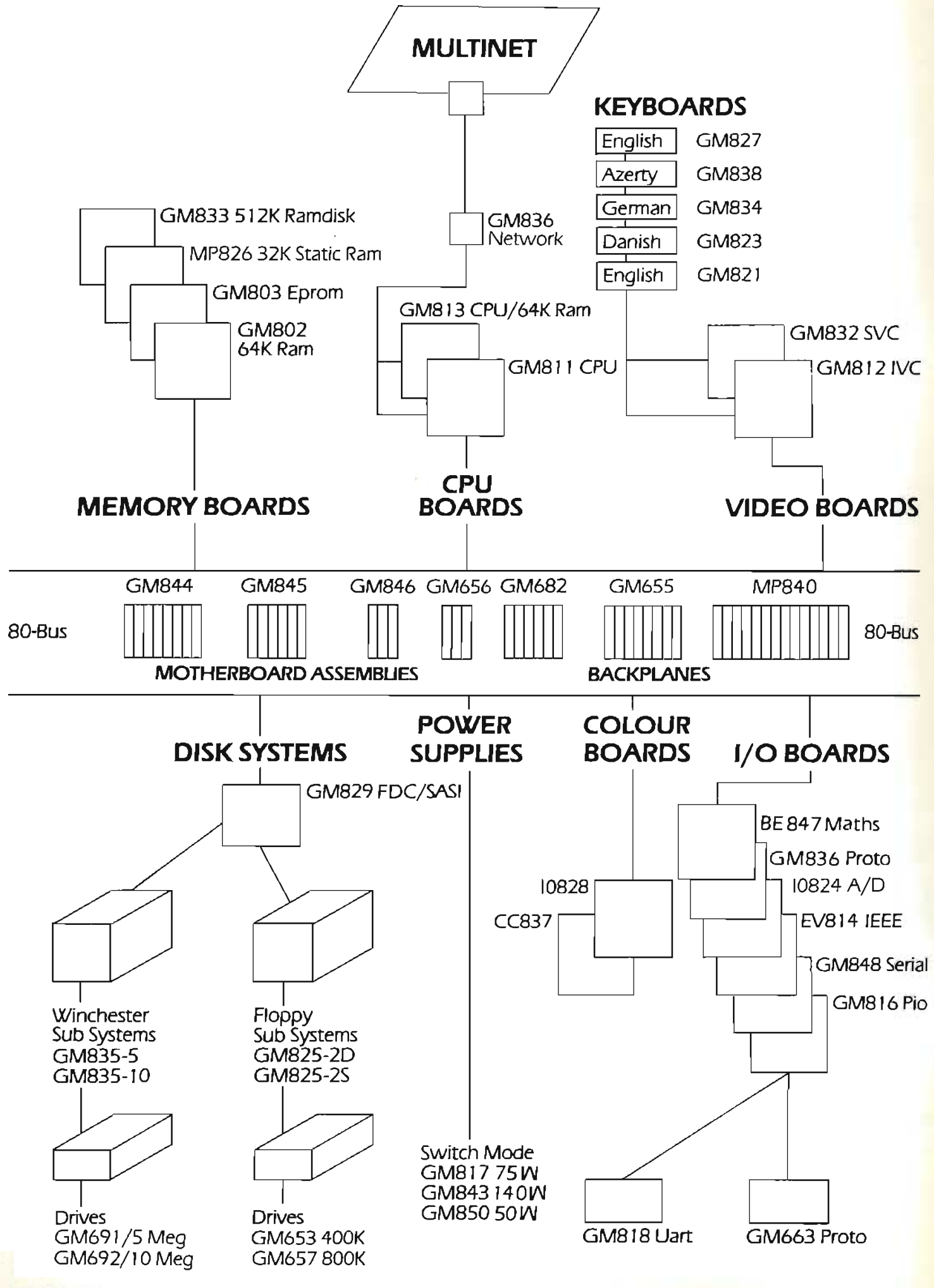
CATALOGUE

No.4

END OF 1983

No.4

THE 80-BUS MICROSYSTEM

MULTINET

KEYBOARDS

English	GM827
Azerty	GM838
German	GM834
Danish	GM823
English	GM821

GM836
Network

GM833 512K Ramdisk

MP826 32K Static Ram

GM803 Eprom

GM802
64K Ram

GM813 CPU/64K Ram

GM811 CPU

GM832 SVC

GM812 IVC

MEMORY BOARDS

CPU BOARDS

VIDEO BOARDS

GM844	GM845	GM846	GM656	GM682	GM655	MP840

80-Bus

80-Bus

MOTHERBOARD ASSEMBLIES

BACKPLANES

DISK SYSTEMS

POWER SUPPLIES

COLOUR BOARDS

I/O BOARDS

GM829 FDC/SASI

Winchester
Sub Systems
GM835-5
GM835-10

Floppy
Sub Systems
GM825-2D
GM825-2S

Drives
GM691/5 Meg
GM692/10 Meg

Drives
GM653 400K
GM657 800K

Switch Mode
GM817 75W
GM843 140W
GM850 50W

I0828

CC837

BE 847 Maths

GM836 Proto

I0824 A/D

EV814 IEEE

GM848 Serial

GM816 Pio

GM818 Uart

GM663 Proto

Introduction

Gemini MultiBoard Microsystem — the expandable solution

The Gemini MultiBoard system was first introduced in 1980. Since then a large range of BUS compatible boards have been produced by both Gemini and a number of other companies.

The philosophy behind MultiBoard allows for a totally flexible approach to the configuration of computer systems, thereby meeting the exact requirements of the user. The majority of competitive systems offer limited features in expansion capability or flexibility. With the MultiBoard system your requirements may be met as little as one board or by a combination of as many of 10 or even more boards

80-BUS Expansion

The first specification for 80-BUS was produced in 1978. The version which is now adopted by Gemini and other companies was established in 1980. Unlike alternative BUS structures the 80-BUS was specifically designed to support systems using the Z80. The Z80 continues to be the most widely used microprocessor.

CP/M and RP/M Operating System

The principal advantage of a Z80A based system is the abundance of software that is available. The majority of packages operate under the CP/M disk operating system. With CP/M, software becomes machine independent providing the user with literally the widest range of software available. In order to provide for users of cassette based systems, Gemini developed the RP/M monitor program. RP/Ms utilisation of CP/M standards means that cassette and disk based programs are identical, allowing the user to easily migrate to a full disk system at a later date without altering any of his existing software.

MultiBoard — defining your system

The first decision to be taken when designing a new computer system around Gemini MultiBoards is that of choosing the CPU board. For control applications the GM811 with its 4 bytewide sockets is the most suitable; for development systems, small business and general purpose designs the GM813 with 64K of dynamic RAM on-board is more appropriate.

If a video output is required that the Gemini GM812 Intelligent Video Controller board or Gemini GM832 Super Video Controller board can provide an 80 x 25 format, pixel graphics and a programmable character generator. The GM832 also provides 256 x 256 bit mapped graphics and also character attributes, including half-tone which can be particularly useful in wordprocessing applications. Colour graphics can be added to the system by using either the I.O. Research, IO828 or Climax Computer CC837 board.

If mass storage is needed then one or even two GM829 FDC SASI boards can be added to the system. Each board can handle up to four floppy disk drives including 8", 5.25" and 3.5" types. A further one or two 5.25" Winchester drives can be incorporated into the system.

Recognising the importance of providing an abundance of I/O facilities, Gemini has paid particular emphasis recently to expanding its range of I/O boards, and further expansion to the range can be anticipated in coming months.

Finally the Gemini MultiNet networking system allows the MultiBoard user to interconnect systems by adding GM836 network interface boards to the CPU boards. Unlike many systems this Network facility can be introduced retrospectively without any conflict.

Distribution Policy

MultiBoard products are available through Gemini's dealer network and also through approved distributors in Western Europe. The name and address of your nearest supplier can be obtained by contacting Gemini direct.

The products listed within this catalogue, which are not manufactured by Gemini are also made available from the Gemini dealer network, both in the UK and Overseas.

Addresses of all third party manufacturers have been supplied and all requests for further technical information should be directed towards these suppliers

GM813 — CPU/64K RAM Board

- 4MHz Z80A CPU
- 64K Dynamic RAM
- RS232 Serial Interface
- Two 8-Bit I/O Ports
- 1200 Baud Cassette Interface
- Extended and Page Addressing Modes

Controlled by a 4MHz Z80A processor and having 64K of on-board dynamic RAM, the Gemini GM813 is particularly suited for use in software development, educational or business applications. There is also an EPROM socket, normally fitted with Gemini's unique RP/M monitor. This 4K block resides at the top of memory, and the GM813's reset jump circuitry always passes program control to this device on power-on or a reset. It may be switched in or out of the memory map under software control, allowing the full 64K of RAM to be utilised.

For certain specialist applications the Z80A's normal addressing range of 64K may prove to be limiting. Consequently on the GM813 there are two methods of extending the amount of memory available. The first is a Page Mode capability that allows the user to select one of four entire pages of memory under software control. The GM802, GM803 and MP826 memory boards all support this facility. The second method involves the use of a 'Memory-Mapper', extending the number of address lines on the bus to 19, giving, with future memory boards, an addressing capability of 512K bytes. Under software control the user may select any 16x4K blocks from this memory to be at any place in the Z80A's 64K map. In conjunction with the Page Mode this gives a total memory capability of 2 Megabytes!
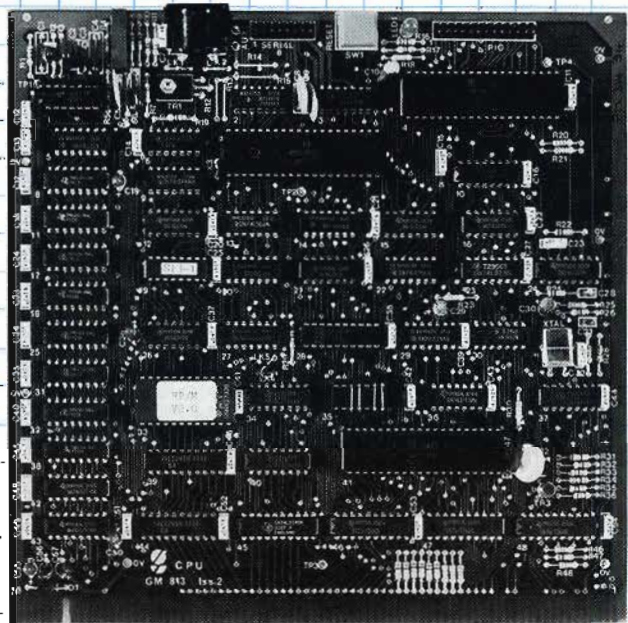
The GM813 also has extensive I/O facilities. There are dual 8-bit parallel interfaces in the form of a Z80A PIO, and a serial interface which includes programmable baud rates, full modem control signals, inputs and outputs at RS232 levels, and a highly reliable 1200 baud Kansas City/CUTS cassette interface.

The GM813 CPU/RAM board is the ideal choice for many applications. Add a video board and you have a powerful cassette based system, then add a disk controller board and drives and you have a 64K CP/M system.

GM811 — CPU Board

- 4MHz Z80A CPU
- Four 'Bytewide' Memory Sockets
- Two 8-Bit Input/Output Ports
- RS232 Serial Interface
- 1200 Baud CUTS Cassette Interface

The Gemini GM811 is ideal for OEM and other specialised applications because of its use of a 4MHz Z80A microprocessor and its incredible memory flexibility. Four 'bytewide' sockets are provided for on-board memory, allowing a wide variety of different memory ICs to be accommodated. These may range from 1Kx8 to 32Kx8 devices including 1Kx8, 2Kx8 and 4Kx8 static RAMs; 2716, 2732, 2764 and 27128 EPROMs, and 2Kx8, 4Kx8, 8Kx8, 16Kx8 and 32Kx8 ROMs. There is no restriction as to what mixture of devices is installed, decoding being done by an exchangeable PROM. Additionally wait states on the board may be permanently enabled or disabled, or set to operate only when memory on the CPU board itself is accessed. This allows different speeds of memory ICs to be used. A further feature of the GM811's memory section is that the entire on-board memory block may be switched in or out of the Z80A's memory map under software control, allowing the full capacity of external RAM boards to be utilised. The GM811 is supplied with Gemini's unique 4K RP/M monitor.

The GM811 also has extensive I/O facilities. Two 8-bit input/output ports are provided by a Z80A PIO in addition to a further 8-bit input port that may be used, for example, for connection to a keyboard! A serial interface includes programmable baud rates, full modem control signals, inputs and outputs at RS232 levels, and a highly reliable 1200 baud Kansas City/CUTS cassette interface.
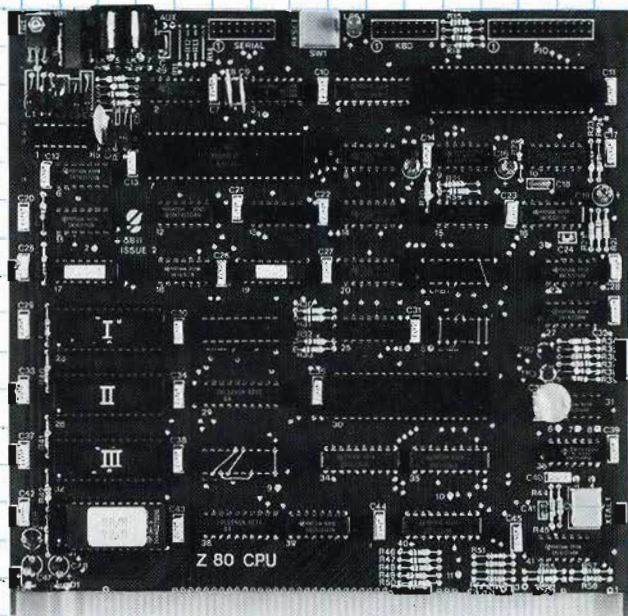
Because of its extensive I/O capability and memory flexibility this board can be used in a wide variety of applications. It may be used by itself as a stand-alone controller, in conjunction with one or more I/O boards in a more advanced control capacity, or in combination with a whole range of 80 — BUS boards as an extensive development system.
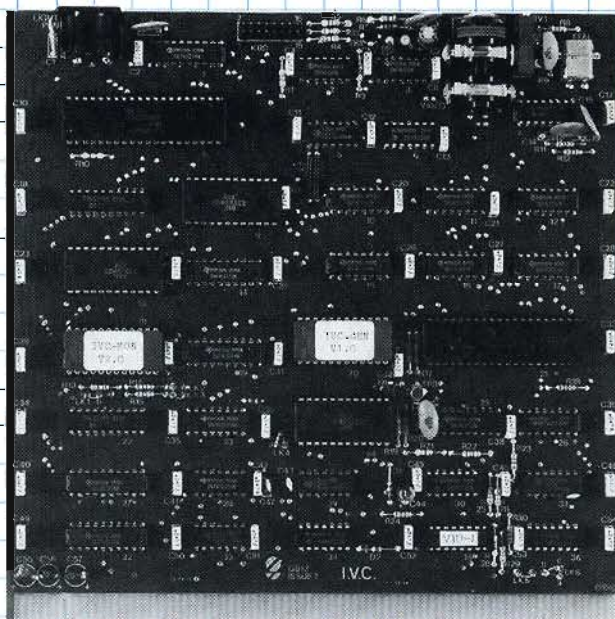
GM812 — IVC Board

- 80 x 25 Display Format
- On-board Z80A Microprocessor
- Buffered Keyboard Input
- Programmable Character Generator
- 160 x 75 Pixel Graphics
- Light Pen Input

The GM812 Intelligent Video Controller (IVC) Board is an 80–BUS compatible video display board. It features its own on-board Z80A processor to allow the video section of the computer to provide a variety of complex video functions without imposing any memory or processing overhead on the main CPU. Communication between the GM812 and the host system is through the bus, via Z80A I/O ports. All reading and writing to the screen is transparent, providing a flicker free display. The standard screen format of the GM812 is 80x25, the preferred format for most applications. The board also has an adjustable dot clock to provide alternative formats.

The standard character set of 128 characters provides all upper and lower case alpha-numerics plus some additional characters. Lower case characters have true descenders. An additional 128 character shapes may be defined under software control. These can be used to provide inverse characters, or pixel graphics characters with a resolution of 160x75. Alternatively the user may define his own characters under software control.

The GM812 includes both light pen and ASCII keyboard input sockets. The light pen input can resolve a single character on the screen. The keyboard input provides a buffer to allow 'type-ahead' without loss of characters.

GM832 — SVC Board

- Upwards Compatible with GM812 IVC
- 256 x 256 Hi-res Graphics
- 6 MHz Z80B Microprocessor
- User-definable Character Attributes
- On-board Buzzer
- Comprehensive On-board Software
- 256 Character Programmable Character Generator
- English, French, German and Danish Character Sets

The GM832 Super Video Controller (SVC) board provides a number of additional powerful and useful facilities to those of the GM812 IVC, whilst maintaining full software compatibility in all normal modes.

The most significant additional facility provided by the GM832 is a high-resolution graphics mode of 256x256. The on-board monitor program contains a number of high-level commands to make these graphics easy to use – including line drawing, circle drawing and polygon fill routines. Text handling is also supported in the graphics mode, providing 25 lines of 32 characters.

In order to provide high-speed graphics handling the GM832 is fitted with a 6 MHz Z80B microprocessor. This also means that all of the other facilities of the SVC run even faster than the IVC.

Additional facilities provided on the GM832 GVC include an on-board buzzer responding to the ASCII BELL code, and user-definable character attributes of blinking, half-tone and inverse.
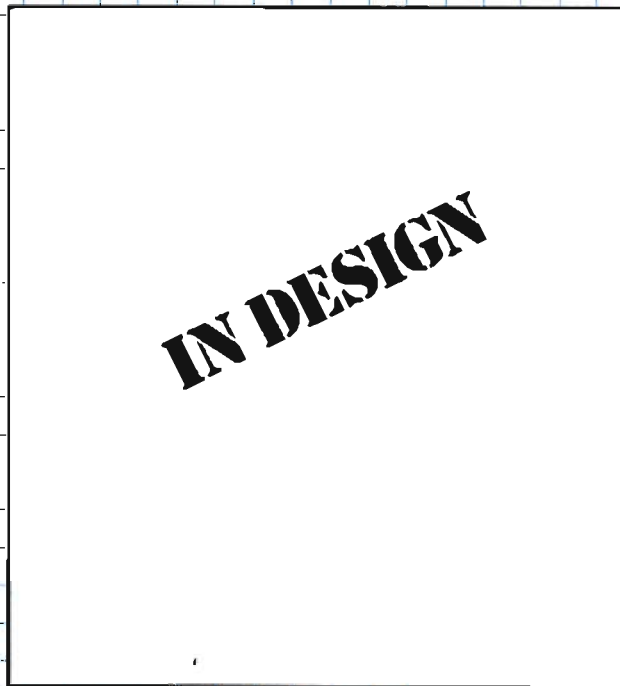
Two standard text modes are provided, 80x25 and 40x25. The character set of 256 characters is fully software definable, and the GM832 has switchable options of English, French, German and Danish alphabets.
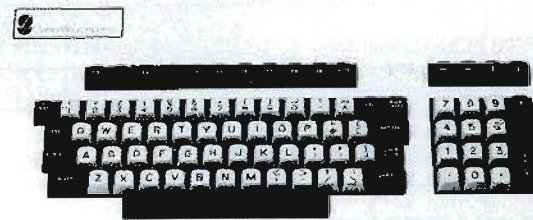
Keyboards

GM827 — 87 Key Keyboard

- ■ User Definable Function Keys
- ■ Numeric Keypad
- ■ Cursor Control Keys

Exclusively designed for Gemini, the GM827 is an 87 key ASCII encoded keyboard, providing 11 function keys, cursor control keys and a numeric pad, in addition to the main 57 key cluster. These 30 additional keys return unique two-byte codes in both their normal and shifted modes, and software on the GM812 or GM832 video boards then translates each of these 60 codes into strings that can be defined by the user, either directly from the keyboard or under program control.

The main key cluster of the GM827 provides 128 ASCII codes and includes TAB, ESCAPE, CONTROL and CAPS LOCK keys.

The output from the keyboard is 7 data bits plus strobe and is auto-repeating when any key is held down.

GM827E Enclosed Keyboard

The GM827 keyboard is available in an attractively designed metal enclosure with a DB15 connector fitted on the back panel. This enclosure is also used for GM838 (ref GM838E) GM834 (ref GM834E) and GM823 (ref GM823E).

The enclosure is available separately ref GM664 as is the internal cable assembly ref GM668.

GM821 — 59 Key Keyboard

- ■ 128 ASCII Code Output
- ■ Cursor Control Keys

The GM821 is a 59 key ASCII encoded keyboard that has been exclusively designed for Gemini. The output of 7 data bits plus strobe provides 128 ASCII codes. The user would normally connect this to the GM812 or GM832 video boards, thus benefiting from their input buffers. The keyboard features cursor control keys, a caps lock function, and auto-repeat action on all keys.

There is also a metal keyboard enclosure available, for the GM821, the GM647. This keyboard is also available fitted into the enclosure complete with internal cable ref. GM821E.

Keyboards

Alternative Keyboards

The GM827 keyboard has been reconfigured to meet the needs of languages other than English. Also we can supply the appropriate character generation EPROMS for the IVC card.

GM838 French Version (Azerty)

| FØ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | EDIT |

| F10 | F11 | F12 | F13 |

Keyboard layout (AZERTY):
- ESC | 1 & | 2 é { | 3 " | 4 ' | 5 (| 6 §] | 7 è } | 8 ! | 9 ç \ | Ø à @ | ° [| — | DEL | BACK SPACE
- TAB | A Z E R T Y U I O P | ^ ¨ | £ $ # | RETURN
- CAPS LOCK | Q S D F G H J K L M | ù % ! | é > | CNTL
- SHIFT | W X C V B N | ? . | ; . | / : | + = | * < | SHIFT

Right block:
- EM MG | EL ↑ | MD | FORM
- EC ← | RAP | IC → | —
- FINI SAV | IL ↓ | LH EH | AIDE
- SVT | RMP CH | L8 E8 | I/R

GM823 Danish/Scandanavian Version

| FØ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | EDIT |

| ← | → | ↑ | ↓ |

Keyboard layout (QWERTY):
- ESC | ! 1 | " 2 | £ 3 | $ 4 | % 5 | & 6 | / 7 | (8 |) 9 | Ø 0 | = | ~ ~ | DEL | BACK SPACE
- TAB | Q W E R T Y U I O P Å | + ; | RETURN
- CONTROL | A S D F G H J K L Æ Ø | * : | CAPS LOCK
- SHIFT | Z X C V B N M | < , | ? . | ? / | \ @ | SHIFT

Numeric keypad:
- 7 8 9 +
- 4 5 6 −
- 1 2 3 ENTER
- , 0 .

GM834 German Version

| FØ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | EDIT |

| ← | → | ↑ | ↓ |

Keyboard layout (QWERTY):
- ESC | ! 1 | " 2 | £ 3 | $ 4 | % 5 | & 6 | / 7 | (8 |) 9 | Ø 0 | = | ß ß | DEL | BACK SPACE
- TAB | Q W E R T Y U I O P Ü | + ; | RETURN
- CONTROL | A S D F G H J K L Ö Ä | * : | CAPS LOCK
- SHIFT | Z X C V B N M | < , | > . | ? / | \ @ | SHIFT

Numeric keypad:
- 7 8 9 +
- 4 5 6 −
- 1 2 3 ENTER
- , 0 .

GM646 — Coiled Keyboard Cable

The GM646 keyboard cable is a DB15 Male to DB15 Female connector for connecting an enclosed Gemini keyboard to one of the Gemini frame enclosures. It is 3 feet long (coiled), extending to over 8 feet.

Memory Boards

GM802 — 64K Dynamic RAM Board

- **64K Dyamic RAM**
- **4MHz Operation**
- **RAM Disable Function**
- **Page Mode Operation**

The Gemini GM802 is a dynamic random access memory board with a capacity of 64K bytes, allowing the total memory capability of the Z80A to be implemented on a single board. The board utilises an active delay line to give full 4MHz operation, with no wait-states required.

The GM802 includes logic for a Page Mode operation which, when used with the appropriate software, allows up to four memory boards to be fitted in a single system.

Additionally this RAM board supports the 80-BUS RAMDIS signal. This allows the user to have ROM or EPROM in the system, the RAMDIS signal ensuring that there is no bus contention with the 64K RAM.
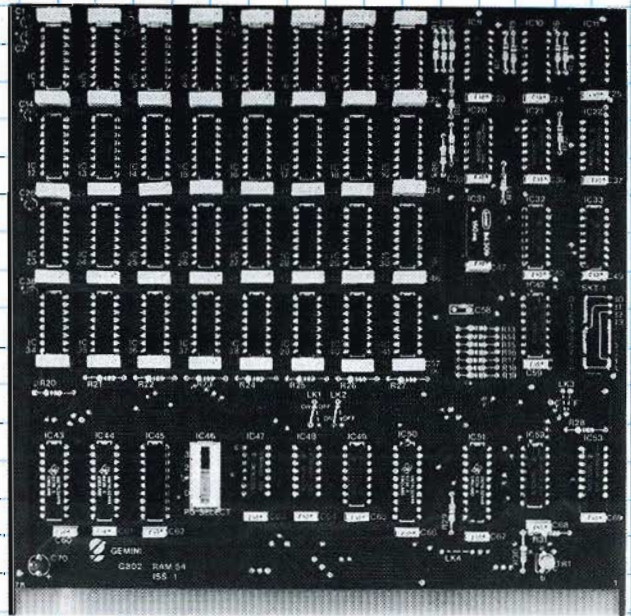
GM803 — EPROM/ROM Board

- **Up to 40K of Firmware**
- **2708 or 2716 Type EPROMs**
- **Page Mode Operation**

The Gemini GM803 EPROM/ROM board is ideal for the user requiring a large amount of firmware in his system. This board caters for up to 40K of EPROM and ROM. There are 16 sockets organised in four banks of four and, as long as each bank contains the same type of EPROM, banks may be mixed between 2708 (1Kx8) and 2716 (2Kx8) devices. Each bank may be decoded to start at any 4K boundary.

The board also has a 24 pin MK36000 series 8K ROM socket, as well as a wait-state generator for use with slower EPROMs. When selected the wait-state facility is only active when the board is being addressed.

The GM803 supports the Page Mode scheme, which enables up to four memory boards to be fitted to a single system. The RP/M Page command allows memory contents to be transfered from one page to another with a single instruction.
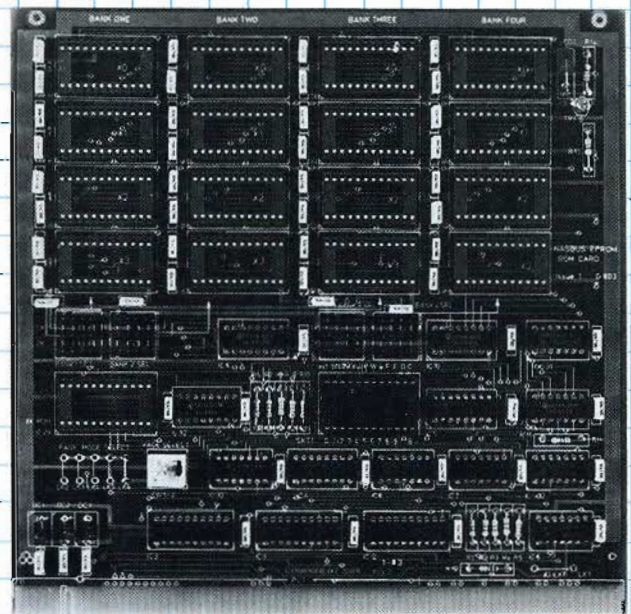
Memory Boards

GM833 — 512K RAM-Disk

- **512K Bytes Dynamic RAM**
- **High-speed 'silicon disk'**
- **Simple Software Interface**
- **Can Use Multiple Boards — Up to 8 MBytes**

The GM833 'RAM-DISK' board is not a conventional RAM board, but has been designed to use three 80-BUS I/O ports, which may be regarded as 'track', 'sector' and 'data'. This allows the board to be very simply interfaced to CP/M to appear as an extremely high speed disk drive — over 30 times faster than a conventional floppy disk in certain applications. Alternatively the user may simply drive the board directly from an applications program for, for example, high-speed data capture.

The GM833 'RAM-DISK' is supplied with 512K bytes capacity and an on-board DIL switch allows multiple boards to be fitted to a single system, up to 8M bytes, the maximum logical drive size permitted by CP/M 2.2
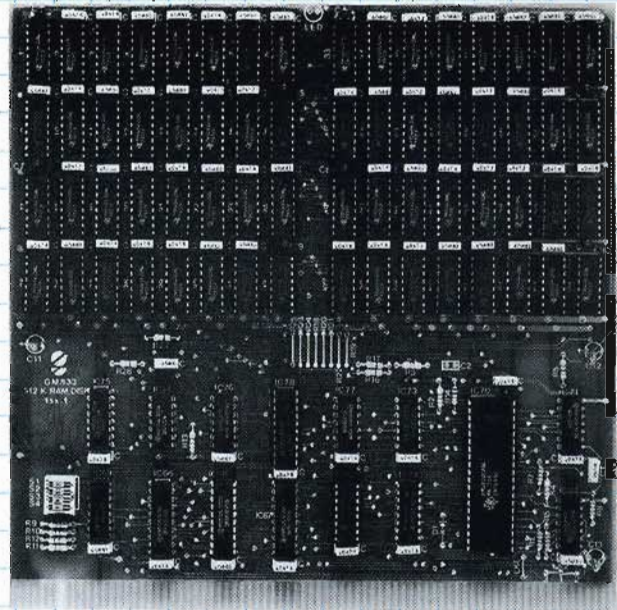
MP826 — 32K Static RAM Board

- **32K Static RAM**
- **Battery back-up**
- **Page Mode Operation**

The Microcode MP826 is a 32K CMOS static RAM board fitted with an automatically recharged battery back-up. This provides over 1000 hours of memory retention during power-down periods. The use of high speed RAMs allow full 4MHz operation, with no wait-states being required.

The flexible address decoding of the MP826, combined with logic for Page Mode operation, allows a wide range of possible memory configurations.

The ability to switch off the microcomputer system without loss of memory contents is extremely convenient, especially in systems involved in medium to high speed data-acquisition.

for further details contact:
Microcode Process Control Systems
41a Moor Lane
Clitheroe, Lancashire
Tel: 0200 27890
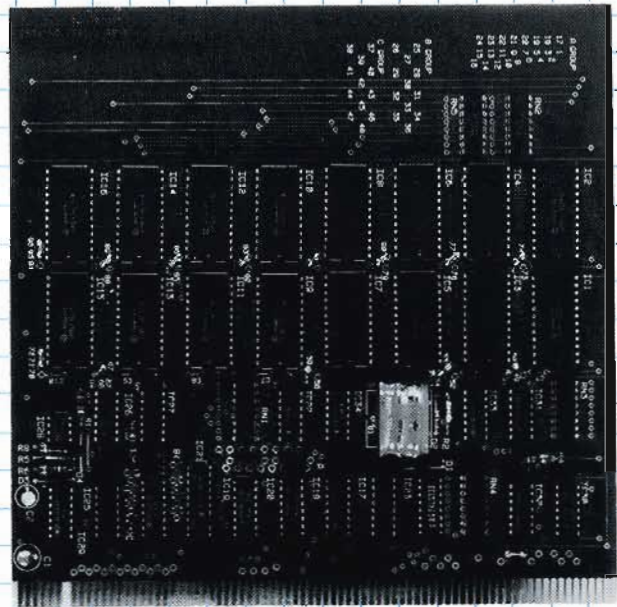
Disk Systems

Gemini Disk Systems — A Brief History

At Gemini we have always maintained a policy of constant development and improvement of our product range. Our first disk system, the GM805, was produced as an add-on to the Nascom computer range. The GM805 was a single density system using Pertec FD250 drives and providing 160K storage per drive, (Gemini SDDS format). This system proved extremely popular and from it we developed the again highly successful GM809/GM815 double density system, providing 350K per drive, (Gemini DDDS format).

However, the future of 48TPI (tracks per inch) drives such as the FD250 is limited as all manufacturers change over to the new high capacity 96 TPI drives. These are the drives of the future, and these are the drives used in Gemini systems.

GM829 — FDC/SASI Board

- **Single/Double Density Operation**
- **Single/Doubled Sided Drive Support**
- **Up to 4 mixed 3.5" 5.25" and 8" Drives**
- **Industry Standard SASI Hard Disk Interface**

The Gemini GM829 combined FDC (floppy disk controller) and SASI (Shugart Associates Systems Interface) board has been designed to allow both floppy disk drives and Winchester hard disk drives to be easily added to a MultiBoard system.

Up to four floppy disk drives may be controlled. These may be single or double sided, 48 or 96 TPI drives, in single or double density formats. The drives may also be 3.5", 5.25" or 8" types, or a combination of these. Switching between single and double density, and 5.25" and 3.5"/8" drives, are under software control.

High performance and reliability are provided by variable write precompensation and phase locked loop data recovery circuitry. The board uses the Western Digital 1397 chip set and occupies 8 Z80 I/O ports. These ports may be set to one of two positions, allowing two GM829 boards to be used in a single system.

The industry standard 50 way 'SASI' interface allows Winchester hard disk sub-systems, such as the Gemini GM835, to be simply plugged straight in.

This board is a development of the extremely popular GM809 FDC board and maintains the same elegant and reliable engineering design which has been proven on the GM809. Full 5.25" software compatibility is maintained, with the added advantage of also being able to control 3.5", 5.25", 8" and hard disk drives simultaneously from the one 80-BUS board.
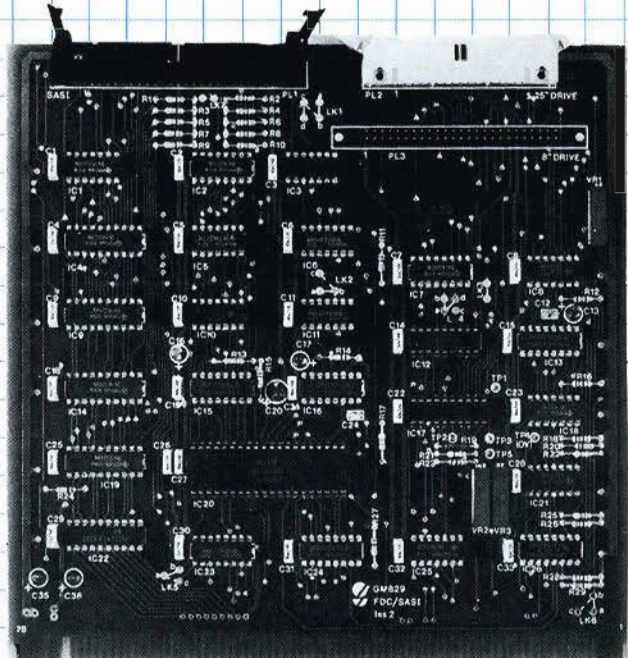
GM695 — Winchester Disk Controller

- **Industry Standard SASI Interface**
- **Automatic Error Detection and Correction**
- **Automatic Retries**
- **Extensive Diagnostics**

The GM695 Winchester Fixed Disk Controller Board provides a compact, field-proven microprocessor-based controller to operate one or two 5.25" Winchester hard-disk drives. The GM695 is produced by Xebec, the industry's largest independent disk controller manufacturer.

Connecting directly to the GM829 FDC/SASI Board, the GM695 incorporates automatic error detection and correction, automatic seek and position verification, and automatic retry on drive errors.
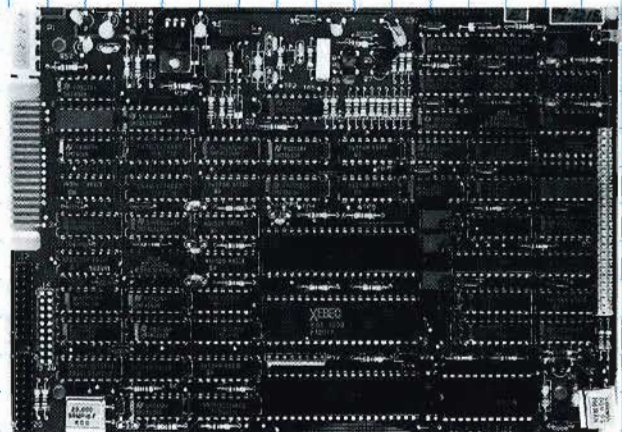
Disk Systems
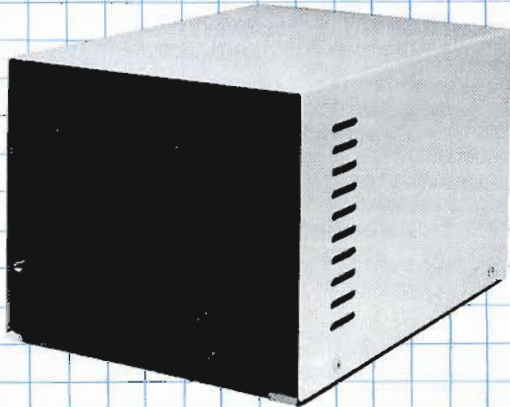
GM825 — Disk Drive Unit

- **Integral Power Supply**
- **High Capacity Drives**
- **Stylish Enclosure**

The Gemini GM825 floppy disk housing is supplied with either one or two 5.25" single or double sided, double density, 96TPI high capacity Micropolis 1115 disk drives. These provide 400K or 800K bytes of formatted storage per drive. (Gemini QDSS and QDDS formats).

The GM825 housing contains its own integral power supply for the drives and comes complete with the cable assembly for connecting to the GM829 disk controller board.

GM825-1S Single 400K disk drive unit
GM825-2S Twin 400K disk drive unit
GM825-1D Single 800K disk drive unit
GM825-2D Twin 800K disk drive unit
GM653 — Additional 400K disk drive
GM657 — Additional 800K disk drive

GM835 — Winchester Drive Sub-System

- **5.4 or 10.8 Megabyte Formatted Capacity**
- **Industry Standard SASI Interface**
- **Integral Controller and Power Supply**

The Gemini GM835 has been designed to plug directly into the GM829 FDC/SASI board to provide the MultiBoard user with the hard-disk advantages of high performance, high speed, high reliability and high storage.

The enclosure, styled to match the Gemini Galaxy and GM825 floppy disk housings, contains the Winchester drive, the GM695 Winchester controller board, and a switch mode power supply. The drives used are the British made Rodime RO201 and RO202 models, providing 5.4 and 10.8 MB capacities respectively. Average seek time is 90ms and the data transfer rate is 5 MBits per second. The intelligent controller provides a 512 byte sector buffer and automatic error detection and correction.

GM835-5 — 5.4 M Byte Winchester Sub-System
GM835-10 — 10.8 M Byte Winchester Sub-System
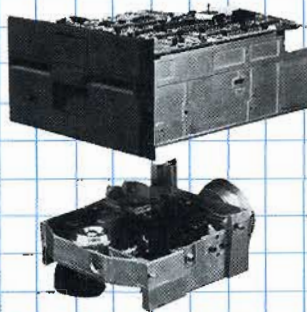
GM653 and GM657 Floppy Disk Drives

- **400KB and 800KB formatted capacities**
- **Microprocessor Controlled**
- **Silent Operation**
- **Second Generation Reliability**

The GM653/GM657 are second generation floppy disk drives manufactured by Micropolis and containing many advanced features. These include twin chassis construction, steel leadscrew with jewel follower for head positioning, accurate disk centering mechanism and microprocessor control. The GM653 and GM657 are both double density, 96TPI drives with 6mS track-to-track access times. The GM653 is single sided and the GM657 is double sided, providing formatted capacities of 400K and 800K byte capacities respectively.
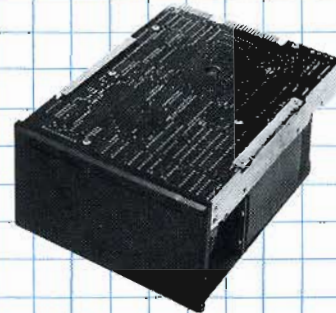
GM691 and GM692 Winchester Disk Drives

- **5.4 MB and 10.8 MB formatted capacities**
- **Industry Standard Interface**
- **Microprocessor Controlled**
- **British Made**

The GM691 and GM692 are Winchester disk drives manufactured by Rodime. These high-performance drives incorporate many advanced features including thermal compensation, two chamber construction, and special airflow giving these drives high reliability.

The GM691 and GM692 feature microprocessor control which includes ten self-diagnostic tests. An automatic transit lock allows simple transportation. The GM691 is a single platter drive, and the GM692 is twin platter, providing 5.4 MB and 10.8 MB capacities respectively.

Multi Board Systems

In the early part of 1982 Gemini began producing the first general purpose systems based around the MultiBoard range of cards — the Galaxy series of computers.

The philosophy adopted was one of exploiting the full potential of a multiple-board approach as opposed to the single board computer (SBC) systems which have become prevalent in recent times. Many of our competitors have adopted the SBC method because of cost savings in manufacture, but we believe that this deprives the potential user of the ability to expand easily. We recognise the fact that a majority of customers may not initially be aware of their exact requirements, therefore, it is obviously more desirable to provide a system which anticipates expansion and change rather than tie the user to the many limitations of the SBC system.

Each Galaxy system utilises the GM813 CPU/RAM board and the GM812 Intelligent Video Controller. Also provided is the GM827, 87 key keyboard and a 12" monitor with either green or amber phospher. All systems with the exception of the Galaxy 4 workstations also include the GM829 FDC/SASI board.

The range of Galaxy systems has expanded very rapidly and now includes:-

Galaxy 2 the standard twin floppy, Z80 based system. Each drive can have either 400K or 800K byte capacity.

Galaxy 3 includes either a 5 or a 10 megabyte winchester with an 800K floppy for back-up and data transfer.

Galaxy MFB really does show how versatile our system is. This unit allows the transfer of data from one soft sectored disk based system to another and is particularly useful for software houses.

Galaxy 4 encompasses the range of systems included in the MultiNet networking system. Currently available are either 5 or 10 megabyte file servers. The standard workstation (up to 31 can be included on a standard system) has a spare slot for an additional MultiBoard card. Also Galaxy 2 and Galaxy 3 can be incorporated retrospectively into the system.

All Galaxies have unused spare slots for expansion. Many customers use these for additional I/O, colour graphics or more memory.

All Galaxy systems incorporate a number of special features which are not found on most CP/M systems; an on-screen edit-mode allows the operator to make alterations to an incorrectly entered command line; a screen-dump command will print-out the contents of the current video display; extensive disk error checking allows full recovery when, for example, a disk drive door has been accidently left open; and additional memory boards (GM802 or GM833) may be used as a high speed 'disk-drive', drive 'M'.

Galaxy 2
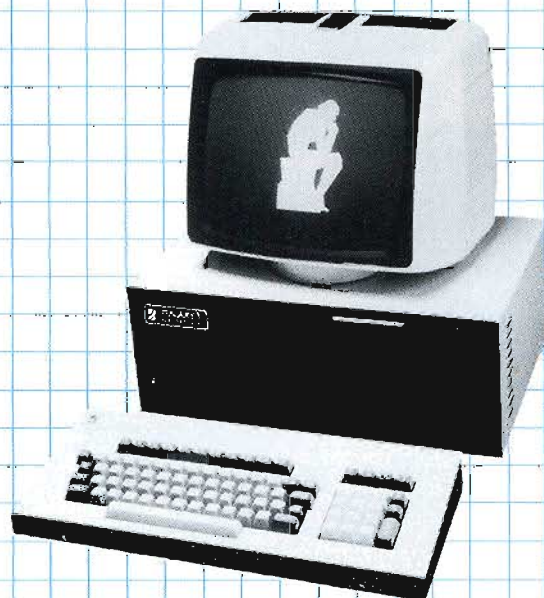
Galaxy 3

Galaxy MFB

The Galaxy M-F-B (Multi-Format-BIOS) system is ideal for applications where users need to read and/or write disks of many different formats. The hardware consists of a Galaxy computer fitted with a 5 Mbyte Winchester hard disk, two double sided 5.25" floppy disk drives, and a separate single sided 8" disk drive. The software supplied allows the M-F-B system to be set-up to handle most 48 or 96TPI, single or double sided, single or double density soft-sectored 5.25" formats, and most single-sided 8" formats. The format library supplied already includes the formats below, and more are being regularly added.

IBM3740	Research Machines	Televideo
Superbrain	Osborne	Toshiba
Rair	Gemini	SD Systems
Transtec	Digico	Cromenco
Nascom	NCR	Kaypro

The set-up software is simple to operate, being menu-driven and a disk analysis program is included to assist users wishing to add further formats to the library.

The M-F-B system is ideal for organisations using a number of different CP/M machines and for software companies wishing to make their products available on a wide range of different formats.

Galaxy MFB

Galaxy ST

The Galaxy ST twin disk CP/M computer is ideal for users already possessing a terminal. Supplied without screen or keyboard, the Galaxy ST only requires the addition of an RS232 terminal to its serial port in order to provide a fully functional system. The built-in Centronics interface allows the simple addition of a printer. If it is required to drive a serial printer this can be done by the addition of either a GM848 Serial I/O board or a GM816 I/O board with GM818 Serial daughter board into one of the Galaxy ST's 4 spare slots.

The Galaxy ST is available in two versions. One model is supplied with two 800K byte floppy disk drives, and the other with a 10.8 Mbyte Winchester drive and 800 Kbyte floppy disk drive for backup.
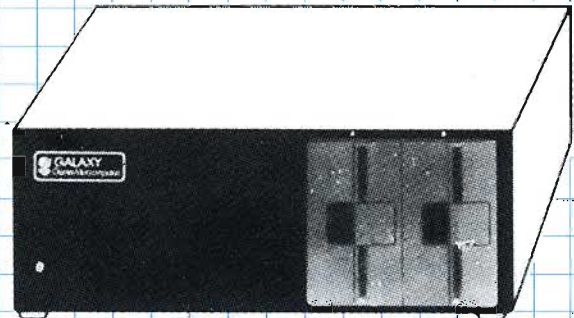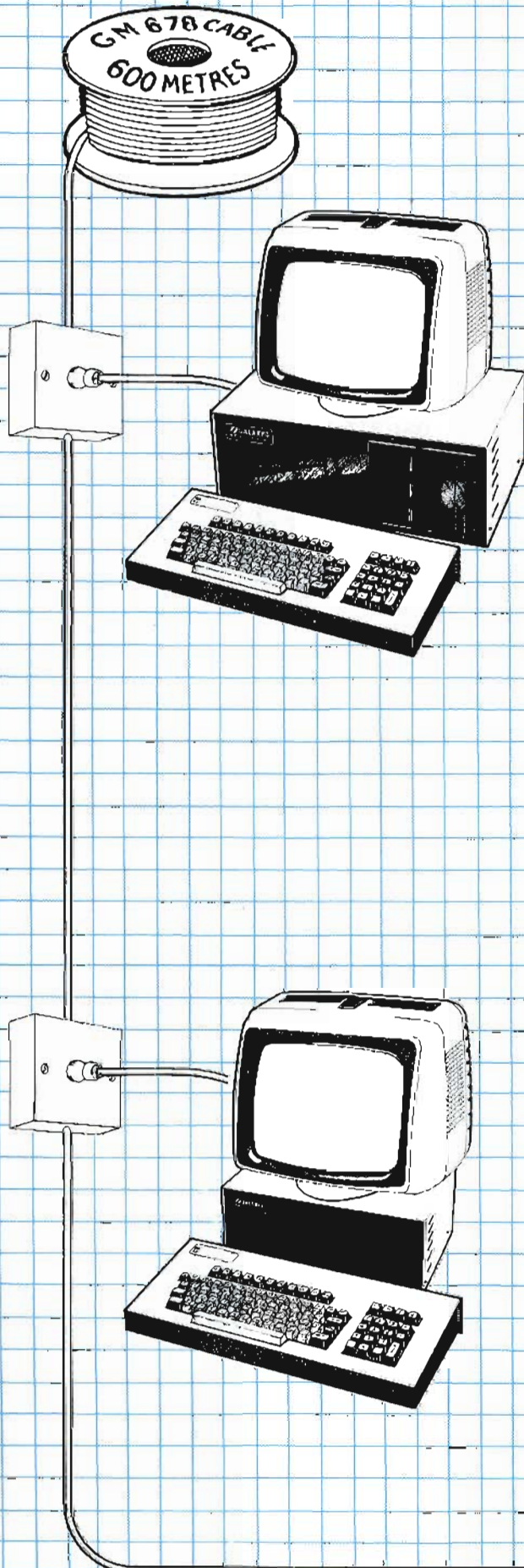
MultiNet Philosophy

The underlying philosophy of MultiNet is to enable as many people as possible to have access to their own microcomputer with mass storage and printer facilities for the lowest possible cost. This is achieved by providing a central 'server' fitted with a Winchester hard disk unit and printer interfaces, in conjunction with a method of interconnecting up to thirty-one workstations to the file-server.

MultiNet Hardware

MultiNet is the hardware and software associated with this interconnection of multiple machines. The file-server and each station are fitted with the Gemini GM836 network interface board. This board contains all of the circuitry necessary to allow connection to the network, and a 5 way DIL switch allows a unique address for each machine on the network to be selected.

Data is transmitted serially at 250 kilobaud along a single twisted pair cable, using a variant of RS422 differential transmission. The maximum length of the cable is in the region of 600m (2000 feet) and up to 32 machines may be connected to the cable at any set of points along its length.

MultiNet Software

There are three main software components in a MultiNet system, and these respectively fulfill the requirements of the server, standard workstations, and workstations with local disk storage (Superstations).

All data is transmitted through the network in variable size packets, each packet ending with a CRC (checksum) to detect any errors during transmission. On the receipt of a packet the receiving station checks that the packet has been received correctly, and if an error has occurred, signals this to the sender. The sender will then retransmit the packet.

GM910/912 File-servers

The Galaxy 4 file-server is available with either a 5 or 10 Mbyte Winchester hard disk and an 800K floppy disk drive. The software supplied handles all network disk requests from the various workstations and who controls shared printing facilities.

The printer may have either RS232 Serial or Centronics parallel interfaces. In the latter case a GM816 Multi I/O Board must be added to the file-server.

GM909 — Workstation

The standard Galaxy 4 workstation is a compact unit complete with keyboard and separate video monitor. The system utilises the Gemini GM813 and GM812 boards, thus providing the user with twin Z80A processors, 64K of RAM, an 80 x 25 video display, and all of the other facilities offered by these boards. An expansion slot is provided, allowing another 80-BUS board to be added to provide further facilities, such as colour graphics.

The operating software, which is automatically down-loaded from the file-server when the workstation is switched on and the user logged in, provides a virtual CP/M 2.2 system. Each user has his own set of files which no other user can access. In addition there are many applications where it may be necessary to share files between users on a read only basis and this facility is provided by allocating disk areas where files are common between users.

In addition the workstation user may send files to be printed by the server, making use of the printer attached to the server, or may use a 'local' printer.

Up to 32 Systems
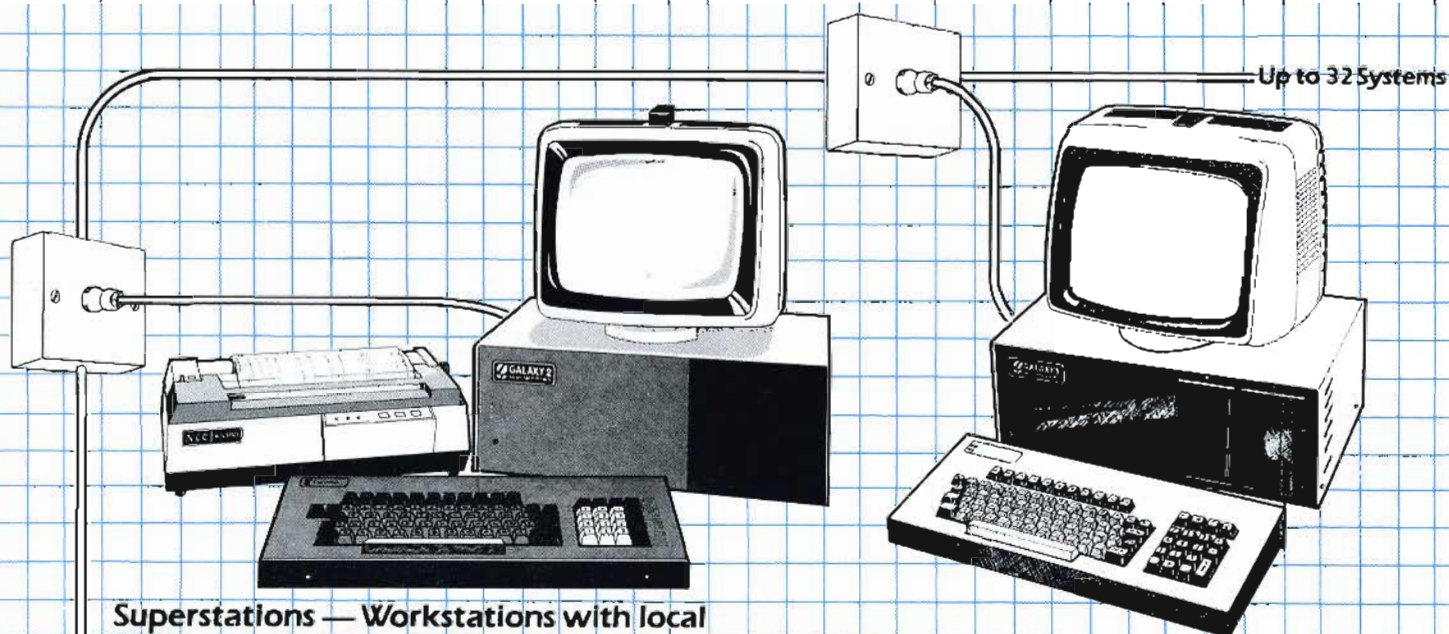
Superstations — Workstations with local disks

A Gemini system already fitted with floppy disks or Winchester drives, such as Galaxy 2 or 3, can also be fitted with the GM836 Network Interface Board and connected to the network. In this instance a CP/M file is provided which, when executed under the workstations own copy of CP/M, obtains the user's number, and logs him onto the network.

When logged on the software determines whether any CP/M system call is to be handled locally or via the network. All facilities of the network can thus be accessed by this type of user, with the advantage of also having local floppy or hard disk drives. Local printers can also be supported.
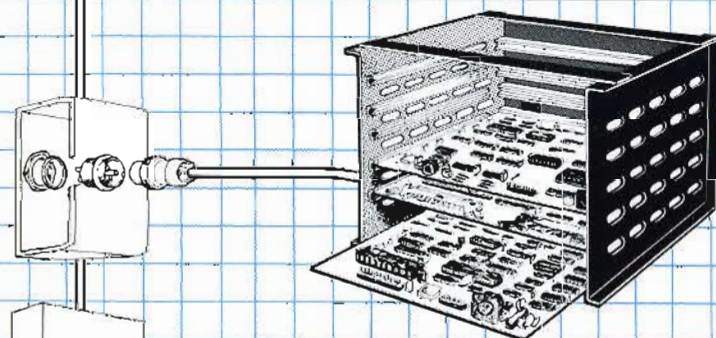
GM685 6 Card Frame Based System

MultiBoard systems can be built up using one of the standard Gemini card frames. Typically the GM813 CPU/RAM or GM811 CPU board is located in the lowest position. The GM836 MultiNet board is fixed to the side of the card frame and then connected by ribbon cable to the PIO connector on the CPU board. Thereafter, the user may configure a system as required. This open frame approach can also utilise the GM686 3 card frame.
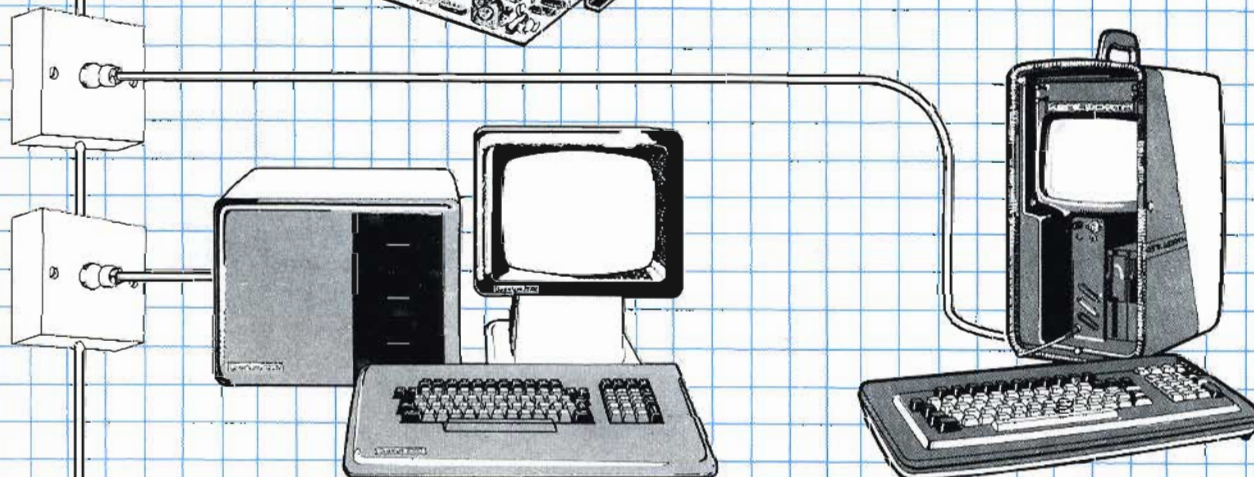
Quantum Computer Systems

The Q2000 system built by Quantum is based on Gemini's MultiBoard system and can be networked using the GM836 network card. MultiNet will support both Gemini and Quantum systems on the same network.

Quantum Computer Systems Ltd
55 Wade Lane
Merrion Centre
Leeds LS2 8NG
Tel: 0532 458877

Kenilworth Computers

MultiBoard versions of this British built portable computer are available and using the GM836 network card they can be linked to Gemini or Quantum systems.

Kenilworth Computers Ltd
16 The Square
Kenilworth
Warwickshire
Tel: 0926 512127

Colour Boards

I0828 — Colour Graphics Processor Board

- **640 x 288 Bit Mapped Display**
- **On-board 16-Bit Microprocessor**
- **Comprehensive On-board Software**

The IO Research I0828 ('PLUTO') is an intelligent high-resolution colour graphics display board. It combines 192K bytes of dual-ported RAM with a fast 16-bit microprocessor which, in conjunction with a comprehensive on-board software package, provides a highly functional graphics system. Commands are issued to 'PLUTO' as a sequence of bytes over two Z80A I/O ports.

The I0828 provides a resolution of 640hx288 in eight colours. The user may define his own characters and symbols.

The I0828's on-board software provides a number of high-level functions, including fast vector draw and rectangle fill, both using REPLACE, XOR, AND and OR functions, and also copy and complex polygon colour fill commands.

for further details contact: I O Research Ltd
117-121 High Street
Barnet, Herts EN5 5UZ
Tel: 01 441 5700
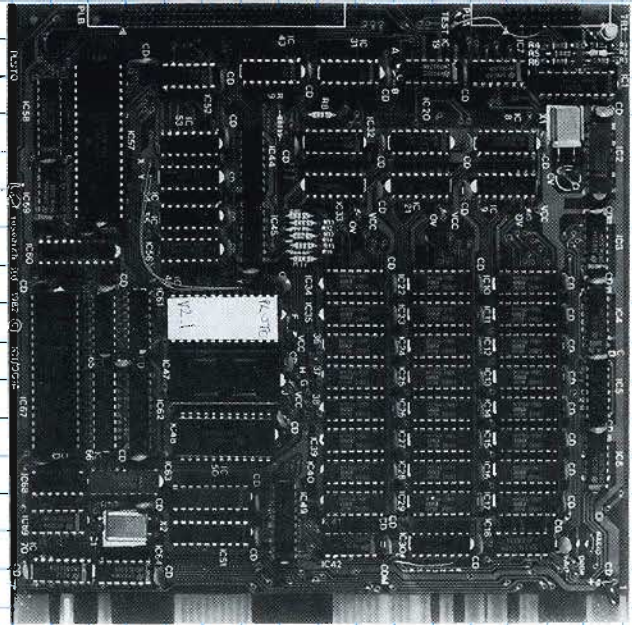
CC837 — Colour Graphics Display Interface

- **256 x 256 16 Colour Pixel Display**
- **Ultra-fast Vector and Character Generation**
- **96 ASCII Character Set**
- **Audio and Light Pen Inputs**

The Climax Computers CC837 is a high performance graphics display interface board. Various graphics primitives such as vector and character generation are provided by a Thomson EF9365 Graphic Display Processor. The plotting rate is typically 1 million pixels per second, giving animation capability. Various vector and character types can be selected and characters may be scaled to give 256 different sizes.

The CC837A has a high quality PAL UHF output with an intercarrier sound facility as well as a composite 75 ohm B/W output. The CC837B has additional 75 ohm RGB outputs for connection to a video monitor.

The CC837 provides a resolution of 256 x 256 pixels in 16 colours using 32K bytes of on-board memory. The board occupies 17 Z80 I/O ports, commands being single byte control codes.

A comprehensive set of assembly language subroutines given in the operating manual enables the user to develop his own graphics programs quickly and efficiently.

for further details contact: Climax Computers Ltd
17a Broad Street
South Molton, Devon EX36 4JE
Tel: 076 95 2314
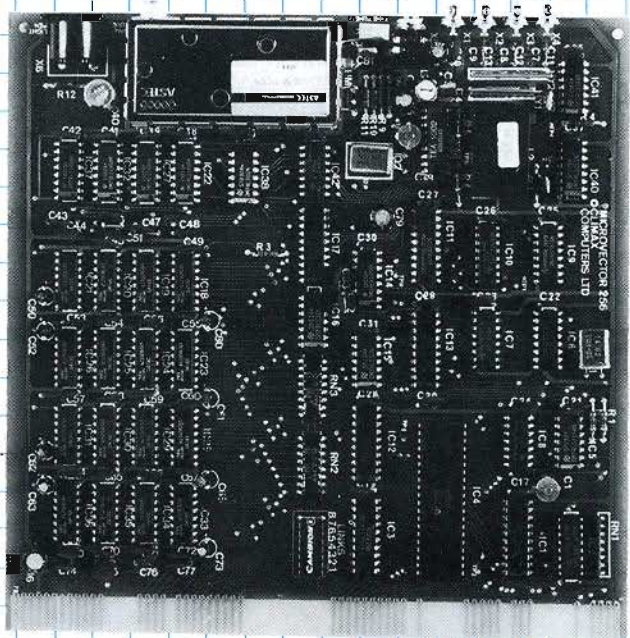
GM836 — Network Interface Board

■ 250 KBaud transmission
■ Up to 32 Stations
■ Simple Interface to MultiBoard Systems

The Gemini GM836 is a small add-on board which plugs into the 26-way connector of the PIO of a GM811 or GM813 CPU board by means of a ribbon cable. The board contains all of the necessary interfacing circuitry to allow the connection of a machine to a network. Data is transmitted serially using a differential transmission method at 250 KBaud along a twisted pair cable. Using this system up to 32 machines can be connected to the network and the length of cable can be up to 600m (2000 feet) end to end.

Data is transmitted through the network in variable sized packets, each packet having a CRC to detect errors during transmission, retries being automatically performed if a packet is delivered incorrectly.

There are two software options when ordering GM836 boards. GM836UPG is supplied with software to allow a MultiBoard or Galaxy system with Winchester drive to be converted into a file-server, or a floppy or Winchester based system to be converted into a Superstation (see MultiNet Networking System).
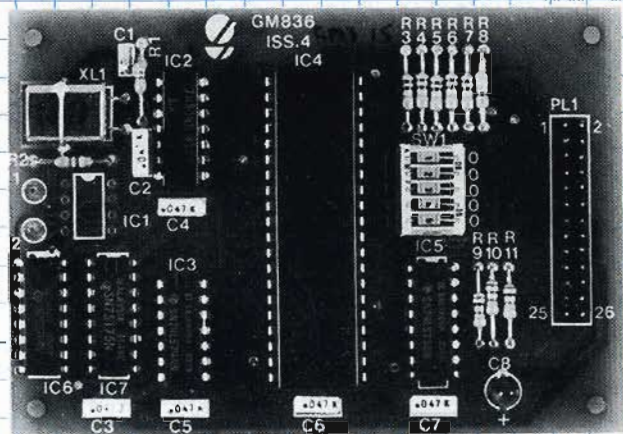
GM836OEM is supplied with basic transport software for sending and receiving blocks of data to and from other 836 boards connected together in, for example, a control application.

GM836 may also be purchased by itself.

Accessories for Network Systems

GM678 — MultiNet Cable

This specially selected screened twisted pair cable should be used on all MultiNet installations.

GM679 — Wall Mounting Box

This unit allows wiring to be terminated in a convenient form for Workstations and Fileservers. A 3 pin MultiNet socket is mounted in the box.

GM680 — 3 Pin Plug

This standard MultiNet 3 pin plug connects into either the GM679 mounting box or into the rear connector on the Galaxy 4 Fileserver or Workstation.

GM697 — 3 Pin Socket

Usually supplied either in the GM679 Box (above) or in the Galaxy, this may be purchased separately if required.
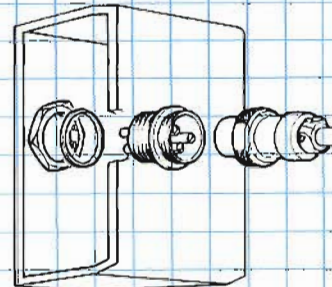
GM679 — Wall Mounting Box

I0824 — A/D Board

■ 8 Input Channels
■ 8 Bit Resolution
■ Sample and Hold

The I0824 is an Analogue to Digital convertor board from IO Research. It provides 8 channels, each having a resolution of 8 bits. Inputs to the board are via jack sockets, the standard analogue input range being 0-5 volts. All input channels have over-voltage protection. Signal conversion time is approximately 30 micro-seconds, including a sample-and-hold phase.

The I0824 has full interrupt control, user configurable I/O addresses, an on-board prototyping area, and comes complete with a comprehensive manual.

for further details contact:
I O Research Ltd
117-121 High Street
Barnet, Herts EN5 5VZ
Tel: 01-959 0106
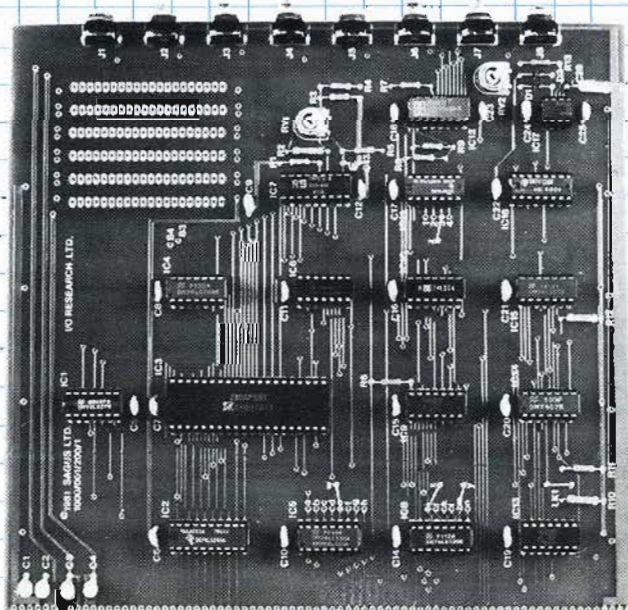
EV814 — IEEE488 Controller

■ **Cost Effective Controller**
■ **Comprehensive Software Supplied**

This board from EV Computing has been designed to fully implement all IEEE488 interface functions. It is capable of controlling any equipment fitted with a standard IEEE488 or GPIB interface.

Under the supplied software the interface responds both to standard IEEE488 message mnemonics, and a set of comprehensive macro commands. These may be typed on the keyboard or passed from the users BASIC or machine code program via a simple user routine.

The circuit board incorporates a standard IEEE488 bus connector and, together with the board's other features, this should enable the user to get his bus controller system up and running immediately.

With the increasing popularity of the IEEE488 interface bus, this board gives the user a very versatile method of controlling equipment on the bus at minimal cost.

for further details contact: EV Computing
700 Burnage Lane
Manchester M19 1NA
Tel: 061 431 4866
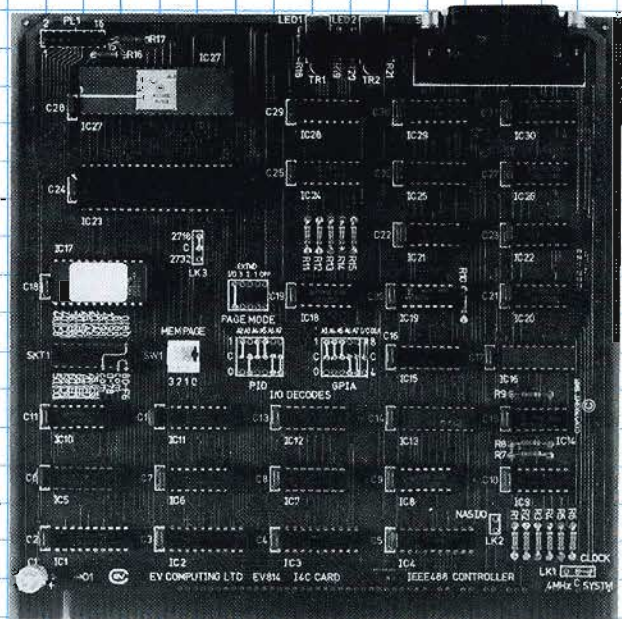
GM816 — Multi-I/O Board

■ **6 I/O Ports**
■ **4 Counter/Timer Channels**
■ **Real Time Clock**
■ **Further Expansion Capability**

The Gemini GM816 Multi-I/O board provides a comprehensive means of interfacing with the outside world. Three Z80A PIOs provide 6 bi-directional 8-bit data ports with handshaking signals, a Z80A CTC provides 4 counter/timer channels, and an MM58174 provides a Real Time Clock. An on-board auto-recharging battery keeps the clock functioning during power-down periods, and the clock chip itself provides information from tenths of seconds to tens of months.

The GM816 has an internally decoded I/O bus, and provision has been made for a daughter board to connect into and mount onto the PCB to expand its I/O capability. Daughter boards may, for example, provide A-D or D-A conversion, opto-coupling, or additional PIOs, UARTs etc.
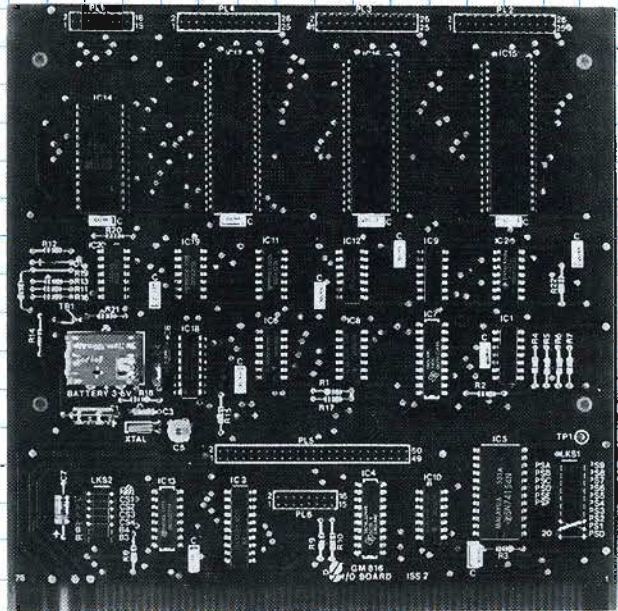
drawing of GM818 being attached to GM816
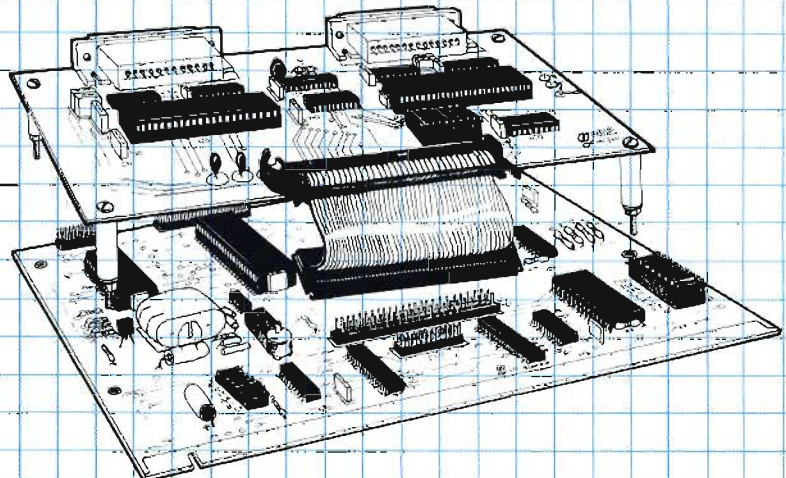
GM848 — Serial I/O Board

- **4 Serial I/O Channels**
- **Programmable Baud Rates**
- **Synchronous/Asynchronous Operation**
- **Two 8-bit I/O ports (Z80 PIO)**

The GM848 Serial I/O Board utilises two Z80A SIO chips to provide four Synchronous/Asynchronous serial channels. Baud rates are independently software selectable for all four channels and for the transmit and receive side of each channel. Baud rates are switchable between 75 and 9600 baud or, for synchronous communication, from the external clocks. All inputs and outputs are provided at RS232 levels and full modem control signals are available.

The GM848 is also fitted with a Z80A PIO to provide two 8-bit bi-directional data ports with handshake signals.

The GM848 occupies 16 consecutive 80-BUS I/O ports, the base address of which is switchable.

IN DESIGN

GM818 — Serial I/O Board

- **2 Serial I/O Channels**
- **Fully Programmable**
- **RS232 I/O Levels**
- **Full Modem Controls**

The GM818 Serial I/O Board is one of the daughter boards available for the GM816 Multi-I/O Board. Fitted with two 8250 type UARTS it provides two serial I/O channels with individually programmable baud rates, stop bits, parity etc. Full modem control signals are provided and all inputs and outputs are at RS232 levels. Four uncommitteed output lines are also provided.

The GM818 board is supplied with interconnection cable and mounting pillars for fitting on the GM816 board and it utilises the buffering and decoding logic of this board. Because of this approach the GM818 allows extensive asynchronous serial communication facilities to be added to a MultiBoard system for minimal cost.
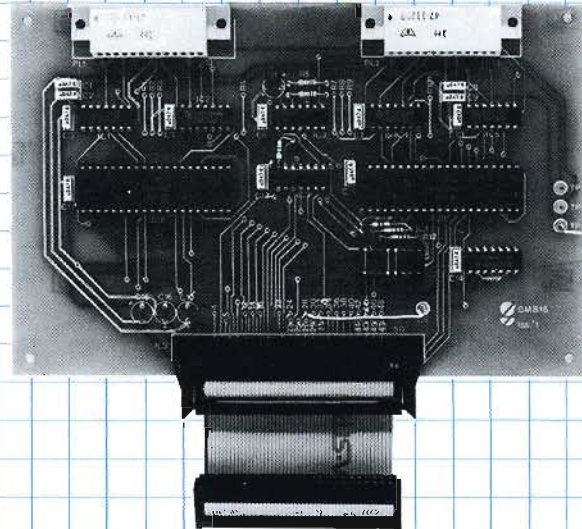
GM663 — Prototyping Daughter Board

The GM663 Prototyping Daughter Board mounts onto the GM816 Multi-I/O Board and interconnection is provided via the 50 way ribbon cable assembly supplied. The prototyping board takes advantage of the necessary buffered bus and decode signals provided by the GM816 thus allowing easy prototyping of additional I/O devices.
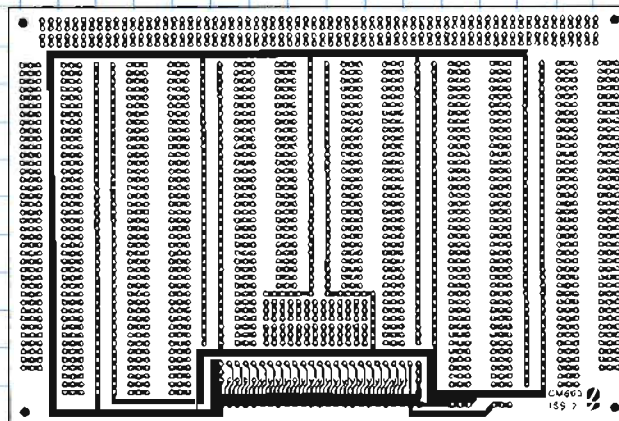
Miscellaneous Boards

GM822K — Real Time Clock Kit

- **Real Time Clock**
- **Calendar**
- **Battery Back-up**

The Gemini GM822K is a small board that connects to a Z80A PIO. It uses the MM58174 real time clock chip that provides the time from tenths of seconds to tens of months. An auto-recharging on-board battery provides back-up when the computer system is switched off.

GM822K is supplied as a kit.
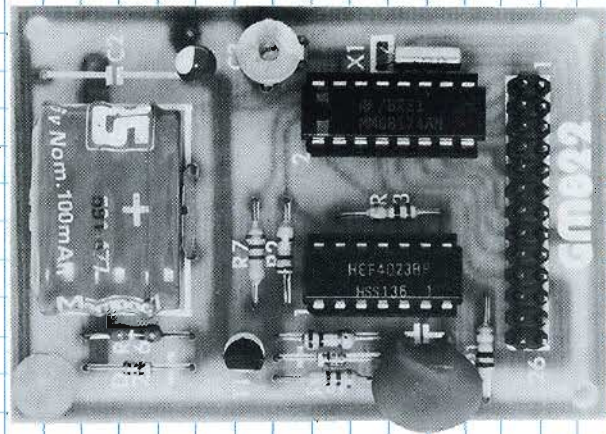
BE847 — Arithmetic Board

- **High Speed Arithmetic Processor**
- **Simple Software Interface**
- **Pascal Compiler Included**

The BE847 Arithmetic Board from Belectra utilises the AMD 9511 IC and performs high speed arithmetic and trigonometric calculations in hardware, 10 to 100 times faster than the equivalent Z80 software routines. It operates simultaneously with the system CPU, further increasing throughput.

The BE847 is supplied with the Hisoft HP5 Pascal compiler. HP5 has been specially modified to use the BE847 for all maths functions and features 32 bit integers.

The BE847 is also very easily used by assembly language programs.
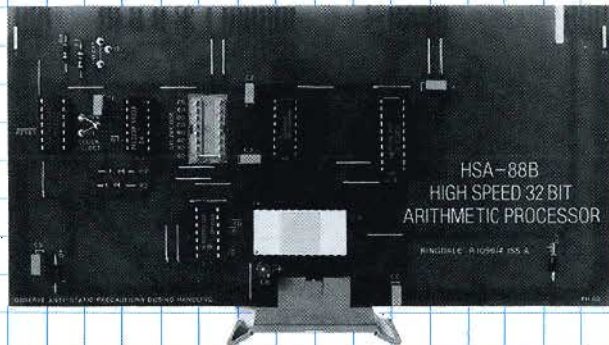
for further details contact: Belectra Limited
11 Decoy Road
Worthing, Sussex BN14 8ND
Tel: 0903 213131

Operating Systems

For disk system users Gemini have implemented the CP/M 2.2 disk operating system (DOS). CP/M is the accepted industry standard DOS and consequently there is already a vast software base upon which Gemini users can draw. For cassette based systems Gemini have adopted the RP/M monitor which has been written in such a way as to be upward compatible to CP/M. This compatibility means that Gemini are able to offer a number of packages written specifically for MultiBoard that may be run on either disk or cassette based systems without modification to the code.

RP/M

RP/M is the resident operating system on the GM811 CPU and GM813 CPU/RAM boards. The concept behind RP/M is that software should be compatible between Gemini computers regardless of whether or not disks are used. Therefore, from the point of view of the programs being executed, RP/M has been written to appear as much like CP/M as possible. However the code used is quite different and the commands are simple and do not resemble those provided by CP/M.

RP/M provides a useful series of commands for processing tape files, examining and manipulating ports and memory and executing programs. RP/M can also 'boot' a disk, so that it is still needed if a disk system is added. Commands are fully checked

for errors and a wide range of error messages produced. Special features of RP/M, when used in conjunction with the GM812 IVC or GM832 SVC include on-screen editing, both of commands and within user programs, and the ability to 'dump' the contents of the screen to a printer.

CP/M

For disk system users Gemini have produced various CP/M 2.2 packages. Each of these contain a master CP/M 2.2 disk and extensive documentation. As well as the standard CP/M programs (PIP, STAT, SUBMIT, SYSGEN etc.) the disk contains five Gemini supplied utility programs:-

FORMAT — formats and verifies blank disks
BACKUP — provides a fast means of copying disks for back-up purposes
CONFIG — allows easy setting of BIOS options (see below)
READCAS) allow tape and disk files to be transferred
WRITCAS) between media, the tapes being in RP/M format.

In a CP/M system the BIOS is the software interface between the CP/M operating system and the specific hardware in use. In these CP/M packages the BIOSs are extremely comprehensive. Extensive error checking, reporting and retry facilities are included. The printer routines incorporated allow for serial, serial with handshake or parallel printers to be connected, and a very powerful on-screen editing facility is provided.

Backplanes, Card Extenders, Prototyping Boards

MP840 — Terminated Backplane

- 14 Slot Backplane
- Signal Termination
- Extension Ground Shielding

The Microcode MP840 is a 14 slot 80-BUS backplane which has been specially designed to overcome problems often associated with running long microcomputer backplanes. All active bus signals are terminated into a potential balanced RC filter and are interlaced with ground shield tracks, plus one side of the backplane provides a complete ground plane.

The backplane features interrupt and bus request daisy chaining and can be used in different lengths by a simple 'score and break' operation.
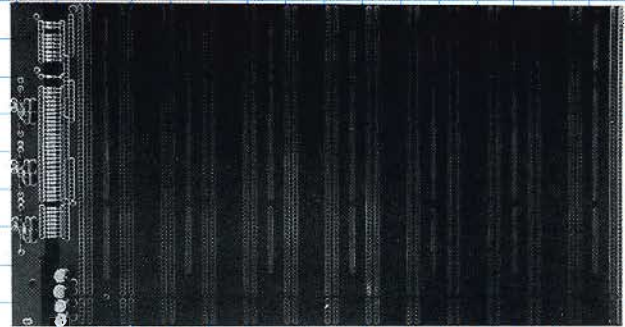
for further details contact:
Microcode Process Control Systems   41a Moor Lane
Clitheroe, Lancashire   Tel: 0200 27890

GM841 — Extender Board

- Test Point on Each Line
- All 80-BUS Signals Identified

The GM841 Extender Board allows 80-BUS boards to be brought outside of a frame for testing and debugging purposes. Test points are provided on every bus line and each line is identified by both number and 80-BUS name.

GM839 — Prototyping Board

- Fibreglass PCB
- 80-BUS Signal Identification
- High Density IC Capability

The Gemini GM839 high quality 80-BUS prototyping board provides the MultiBoard user with a convenient means of adding specialised 'one-off' boards to his system. This single-sided fibreglass PCB provides extensive power supply tracking and the layout has been optimised to allow a high IC packing density. Additionally one edge of the PCB has been designed to accommodate multi-way insulation displacement type connectors.

The component side of the GM839 is silk-screened to show the positioning of the power rails and component pads, and all 80-BUS signals are identified. On the track side of the board the 80-BUS lines are identified by number. An 80-BUS specification booklet is included.
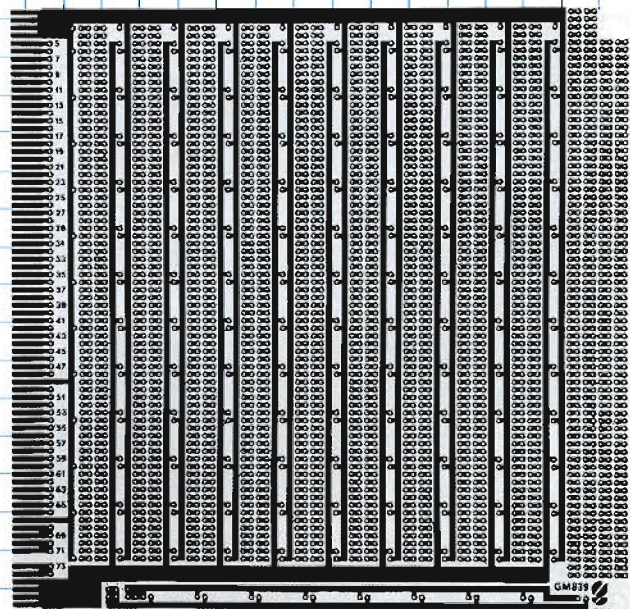
Backplanes and Mother Boards

GM655, GM682 and GM656 Motherboards

3, 6 and 8 slot versions

Full Daisy-chaining

Extensive Ground Plane

The Gemini motherboards cater for a wide range of system requirements. Available in 3 different sizes they all incorporate full 80-BUS daisy-chaining and an extensive ground plane to keep electrical noise to an absolute minimum.
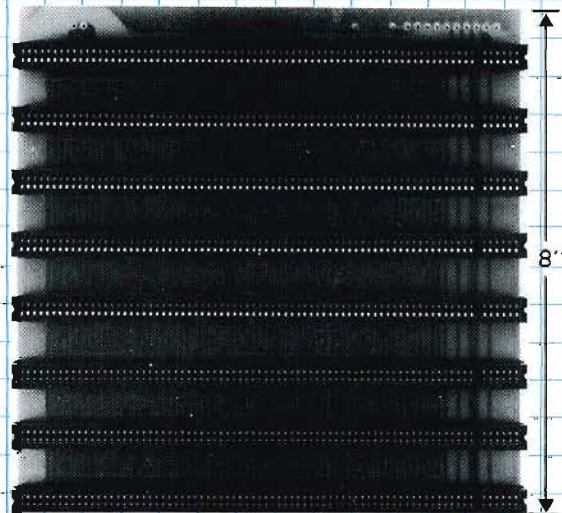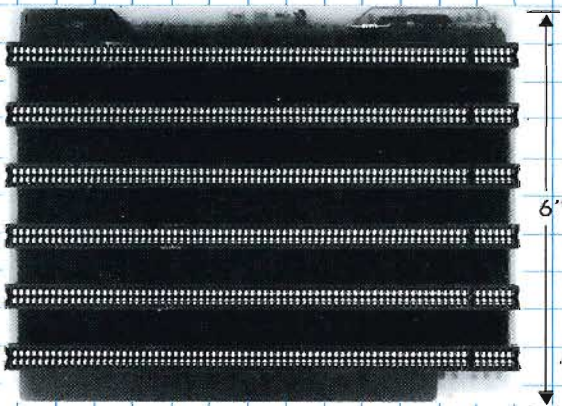

GM656-3 slot motherboard
GM682-6 slot motherboard
GM655-8 slot motherboard
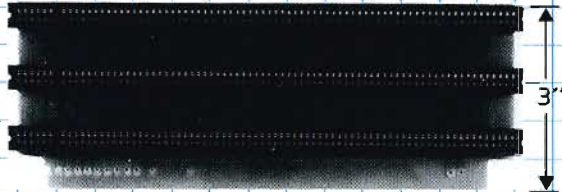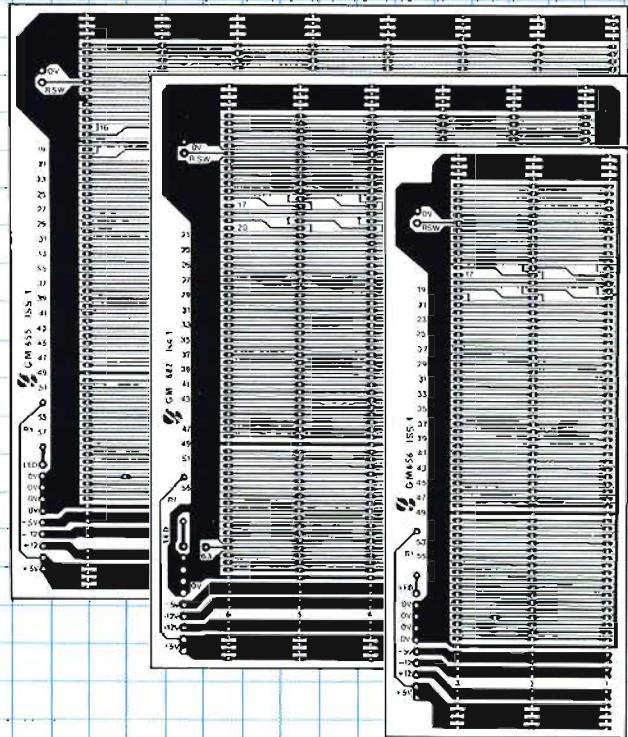
GM846, GM845 and GM844 Motherboard Assemblies

The range of motherboards shown above are available completely assembled with edge connectors.

GM846-3 slot motherboard assembly
GM845-6 slot motherboard assembly
GM844-8 slot motherboard assembly

GM817/GM843/GM850 Power Supplies

- ■ Switch Mode Designs
- ■ Protected Outputs
- ■ Compact Shielded Units

The Gemini switch-mode power supplies are of compact design and low magnetic radiation, to conform to International Safety and RFI Regulations. This range of supplies is ideal for most system sizes. Each supply has dual input voltages and regulated outputs of:

	−12	−5	+5	+12	Volts
GM817 (75 Watt)	1	1	6	2.5	
GM843 (140 Watt)	0.5	0.5	12	6	Amps
GM850 (50 Watt)	1	1	5	1	
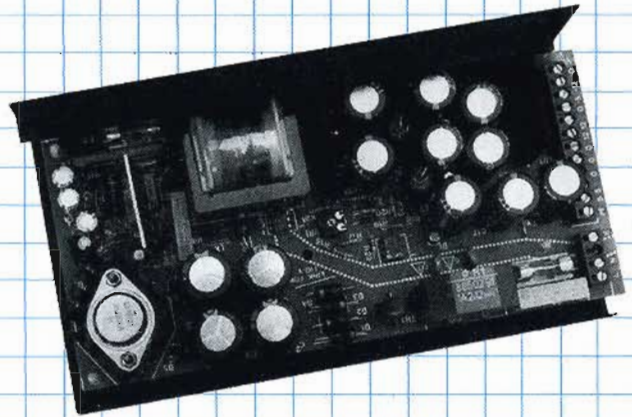
GM817 — 75 Watt
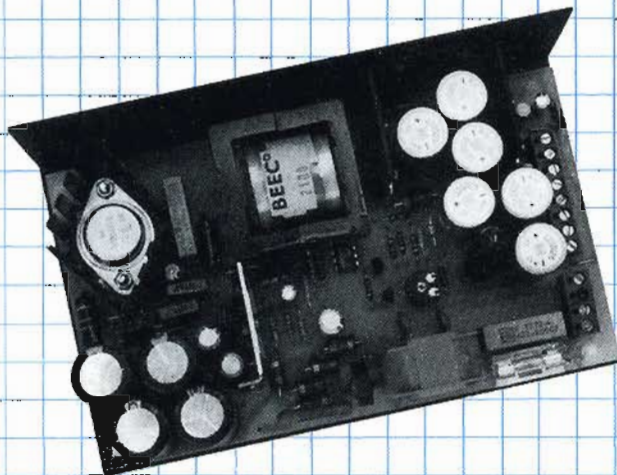
GM850 — 50 Watt

GM843 — 140 Watt

The power supplies are shown here with their shields removed.

GM685 and GM686 Frames

- 6 or 3 80-BUS slots
- Wiring Loom Supplied

The Gemini GM685 and GM686 frames comprise of metal chassis fitted with six or three card motherboards respectively, 80-BUS edge connectors and complete with a wiring loom. The loom can be connected directly to one of the Gemini switch-mode power supplies, and in the case of the GM685 connectors are also included for connecting two floppy disk drives.

6¾"
170 mm

8¼"
210 mm

9⅛"
231 mm

4¾"
110 mm

8¼"
210 mm

9⅛"
231 mm
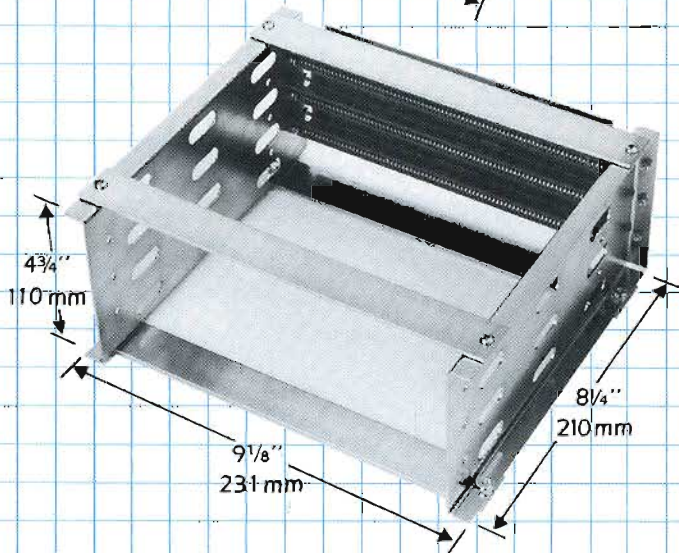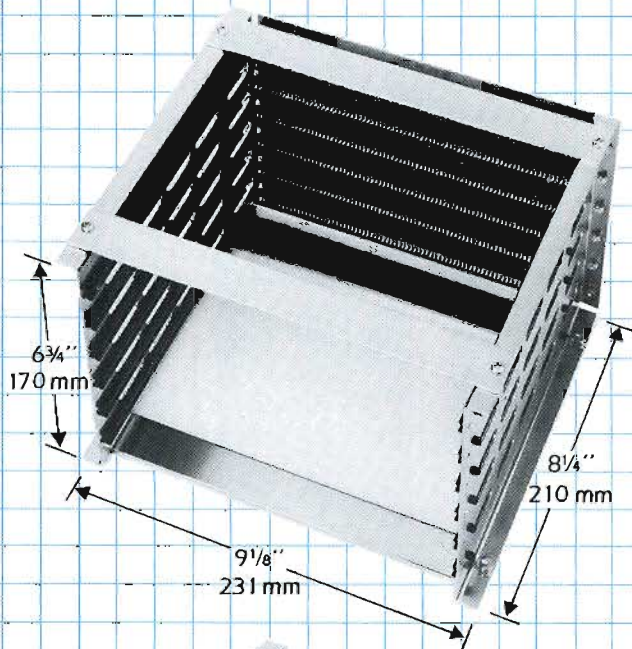
GM610 — 19" Frame

- Standard 19" Unit
- Ideal for Development Systems

The Gemini GM610 frame is ideal for the user wanting a system consisting of a large number of boards and requiring easy access to them. The frame can support any of the Gemini motherboards, or the Gemini GM810 combined 5APSU and 8 slot motherboard.

8"
230 mm

8"
230 mm

19"
482 mm
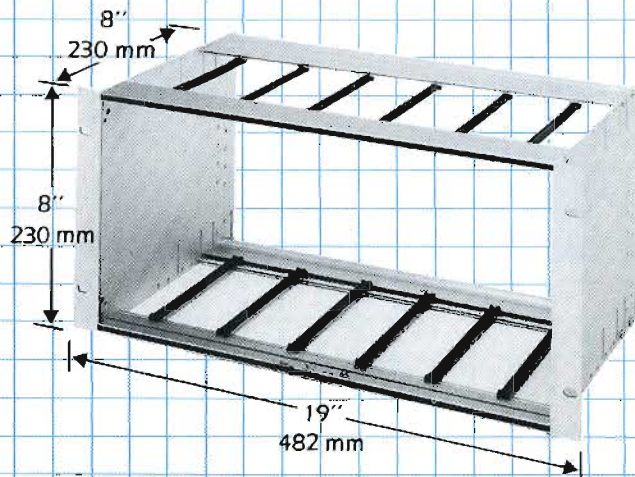
GM687 and GM688 Enclosures

- 3 Board and 6 Board Enclosures
- Pre-stamped Holes For I/O Connectors

The GM687/GM688 Enclosures are designed to accept the GM686 3 board and GM685 6 board frames respectively, along with either the GM850 or GM817 PSU in the GM687, or the GM817 or GM843 PSU in the GM688.

Both enclosures have pre-stamped holes for I/O connectors, including ones for video, keyboard, printer, mains etc.


GM688

DO NOT OBSTRUCT

RESET

KEYBOARD

VIDEO

SERIAL I/O RS 232

LIGHT PEN

OFF

ON

220/240

KEEP FILTER CLEAN AT ALL TIMES

PARALLEL PRINTER

CASSETTE

|————— 383 MM x 302 MM x 172 MM D —————|

GALAXY 4
Multinet Work Station

GM687

FUSE

OFF

ON

220/240

KEYBOARD

SERIAL I/O RS 232

PARALLEL I/O

NETWORK

MADE IN ENGLAND

RESET

VIDEO

LIGHT PEN

CASSETTE I/O

|————— 345 MM x 183 MM x 155 MM D —————|
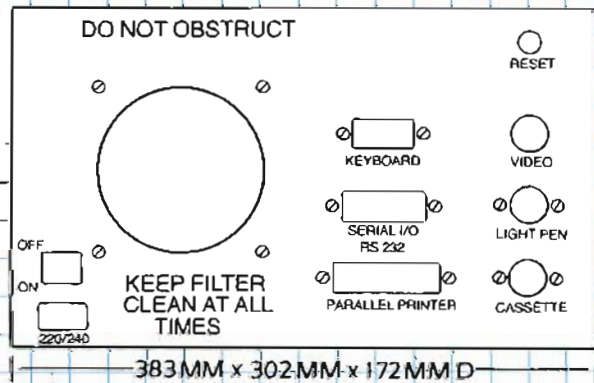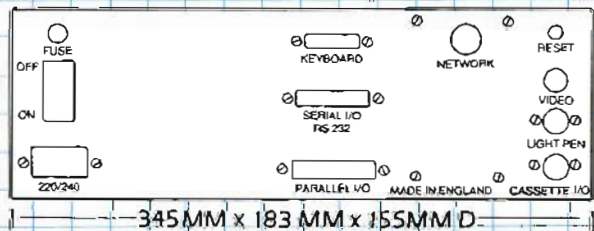
Accessories

GM621 16 Way I.D. Plug
GM622 26 Way I.D. Plug
GM623 34 Way I.D. Plug
GM624 50 Way I.D. Plug

GM625 16 Way I.D. Socket
GM626 26 Way I.D. Socket
GM627 34 Way I.D. Socket
GM628 50 Way I.D. Socket

GM629 26 Way Right Angle I.D. Plug
GM630 34 Way Right Angle I.D. Plug
GM631 50 Way Right Angle I.D. Plug

GM634 80-BUS Edge Connector
GM635 Edge Connector Clips
GM642 DB15 I.D. Socket
GM643 DB15 I.D. Plug
GM645 Centronics Plug
GM644 Centronics Socket
GM645 Centronics Plug
GM648 34 Way Disk Drive Cable Assembly (for GM825)
GM649 34 Way Disk Drive Cable Assembly (for Galaxy)
GM650 34 Way Disk Drive Cable Assembly (for Quantum)
GM665 Parallel Printer Cable Assembly
GM669 Internal Parallel Printer Cable Assembly
GM683 Internal RS232 Cable Assembly
GM660 Video Cable Assembly PL259 — Phono.
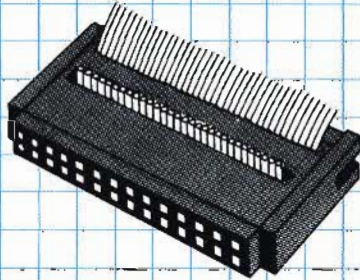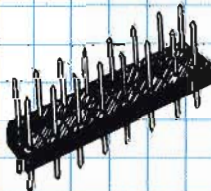
GM626 26 Way I.D. Socket
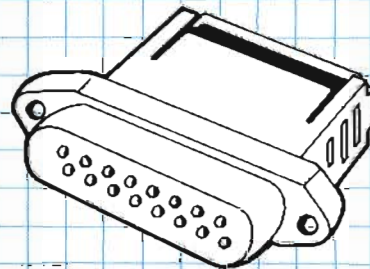
GM642 DB15 I.D. Socket
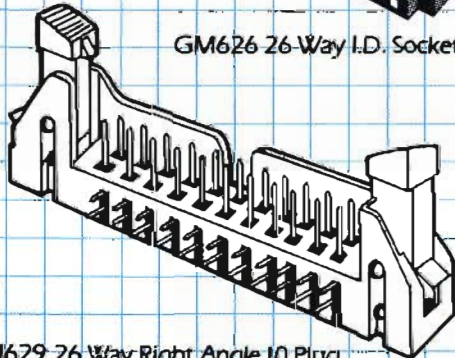
GM629 26 Way Right Angle ID Plug
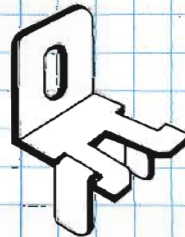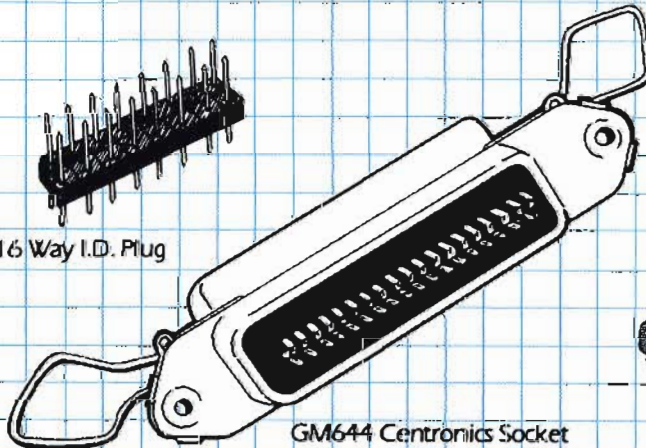
GM635 Edge Connector Clip
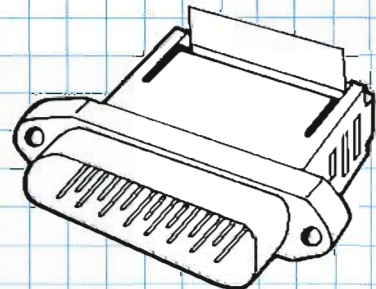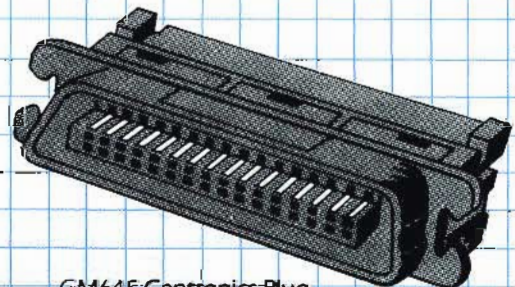
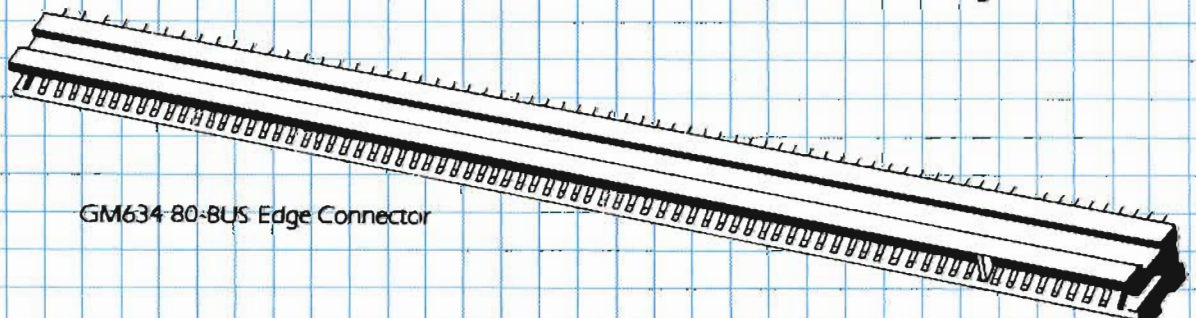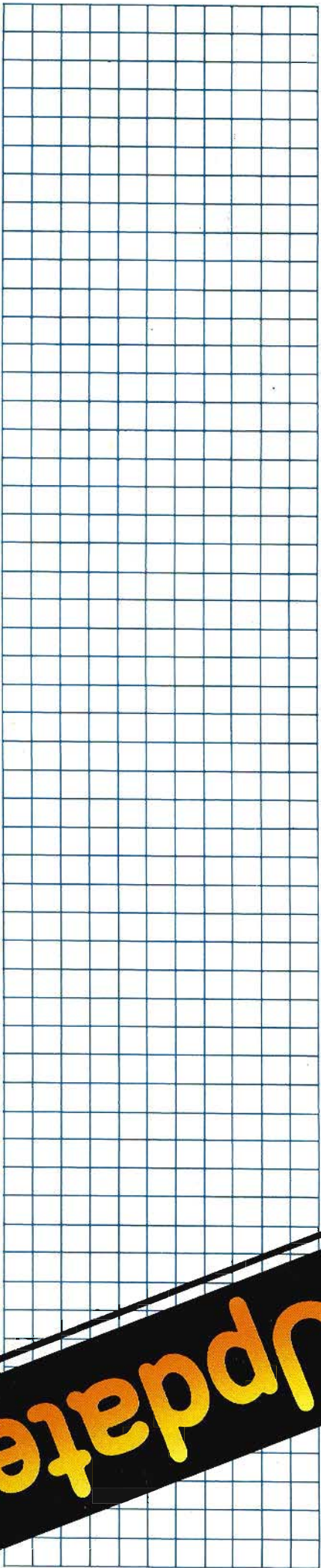GM643 DB15 I.D. Plug

GM621 16 Way I.D. Plug

GM644 Centronics Socket

GM645 Centronics Plug

GM634 80-BUS Edge Connector

Update