

MICRO-COMPUTER MODULES
Specifications

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Eching/Munich, West Germany
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ECB- MICRO-COMPUTER MODULES in Single Eurocard Format

**State-of-the-Art
circuits for maximum Power**

designed and manufactured in Europe.

We are an international organisation with head quarters in West Germany.

We offer systems built to European Standards with German quality.

**Local Support
Local Training
Local Servicing**

The Complete Solution:

Hardware, Software and Systems

ECB + PSI Ψ 80

Which tasks will you give the ECB boards?

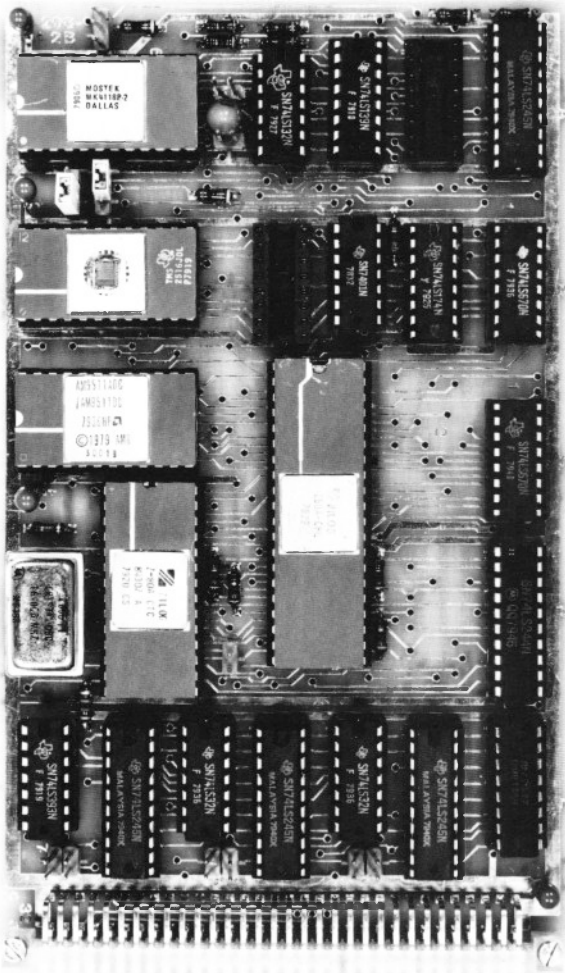
Will you use them for machine-control? In a robot? As an intelligent terminal or subsystem? To automate your laboratory? Will they be used to control complex machinery, or do you need the ideal computer for education? What kind of problems do you have with your application?

We don't know.

But we do know from the experience of years as producer of systems and as a microcomputer distributor what can be done with microcomputers today, which features in a large number of applications are the important ones and how to succeed.

The result of this knowledge is offered to you by the ECB microcomputer board series.

Your experience counts: get to know KONTRON's ECB-Series and its performance.



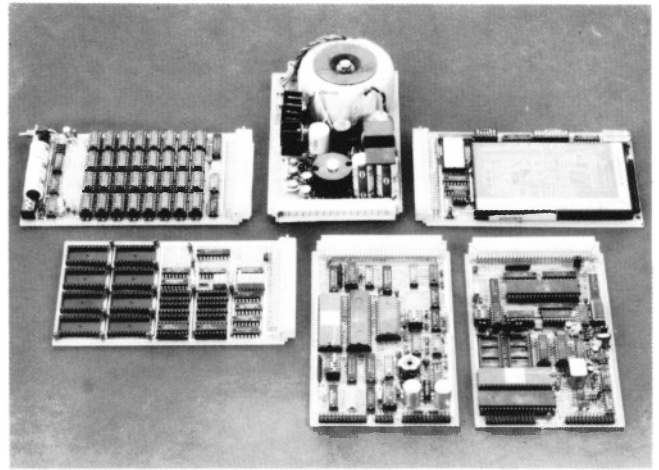
Choose YOUR Partner!

We provide know-how in microcomputers, derived from many years of practice in using this technologies as a systems manufacturer. We offer application support, training, and full documentation.

Our key interest: To get **your** application system running soon!

Compare!

Check the facts that are important. You need power for your application today, and even more performance for your applications tomorrow.



Save Time and Money!

Your application is a highly sophisticated one – dedicate your effort totally to it.

You can do this with the confidence that our experience and work in the production of microcomputer modules and systems, is ready to solve your problem.

Our know-how covers virtually all branches of electronics, starting from the integrated circuit (IC) and extending to turn-key systems for image-analysis, medical equipment and small computer business applications.

Microcomputer Modules from the ECB-Series offer a Total Solution

- CPU boards in several different configurations with different operating speeds of CPU, and different amount of memory, input and output.
- Sub-system modules for dedicated tasks and systems with distributed intelligence.
- Memory modules of varying technologies for program and data storage: nMOS, CMOS and Magnetic Bubbles.
- Input and output modules for serial, parallel and opto-isolated digital inputs and/or outputs.
- Accessories like card cages, power supplies, cables.
- General operating software.

Look for an open-ended manufacturer!

ECB-boards are simply plugged into your 19"-rack.

With sub-processor modules, real time clock, digital- and analog input/output interfaces, IEEE 488-bus-controllers, hardware arithmetic module, bubble-memories and other add-ons, our ECB system is the ideal solution fitting **your** exact application.



Complete Systems for use of ECB-Boards

In addition to the family of the ECB microcomputer modules, there is a complete system, ready to run any of the Z80 A-ECB modules in its built in card-cage.

This system, also developed by KONTRON, is called PSI 80/xx (or PSI 80 D/xx, respectively, in its double density version).

This system includes, in addition to a complete computer with Z80 A-CPU, RAM, ROM, basic-I/O, timers, keyboard, industrial monitor, floppy disk drives and an ECB-interface, and the necessary disk resident operating software called KOS, which is fully CP/M compatible.



Hardware Specifications of the PSI ψ 80 family:

Basic Unit

Housing: approximately $455 \times 355 \times 270$ mm
Weight: 15 kg, flame retardent (UL 94) plastic
Power consumption: 160 VA
Approved by German VDE/FTZ (No. CO898-80)
Temperature range: 10 ... 35 Celsius (operating)
Relative humidity: 20 ... 95% non-condensing

Electronics

Highly integrated computer on special board on Z80 A-CPU base.

Speed:

Clock frequency: 4 MHz
Minimum execution time: 1 microsecond
No wait cycles on memory access and I/O

Monitor

Built-in high quality monitor (16 MHz \pm 3 dB video band width).
Additional TV monitor can be added (PSI 80/M types)
Graphic mode: more than 130.000 pixels (256 lines each with 512 dots).
Alphanumeric mode: 2.000 characters in 8×10 matrix (25 lines of text, 80 characters/line).
Character and screen reverse video under software control.
Brightness control
Colour: P 39 green (P 4 yellow is optional)

Keyboard

Separate keyboard housing
Auto-repeat function
Keyboard to German standard DIN 2137 or American standard
7 Bit ASCII Code
optional Numeric pad
Size: $410 \times 210 \times 60$ mm
Weight: about 1 kg

Floppy Disk

2 drives can be incorporated. Soft sectored organisation, 16 sectors per track, 77 tracks.
Capacity per drive (formatted):
154 kByte: PSI ψ 80/xx
308 kByte: PSI ψ 80 D/xx
616 kByte: PSI ψ 80 Q/xx*
Transfer rate: 125 kbit/s
Track to track access time 35 ms
Average access time 1224 ms

Hard Disk PSI ψ 80/WINS 10 (/WINS 18) (optional)

Capacity per drive 10 (18) Mbyte
Average access time 60 msec
Data transfer rate 50 kByte/sec, parallel
Medium: 8" Winchester
Separate housing
Connection to PSI ψ 80 System via parallel interface

Power supply

Switching mode power supply, in PSI ψ 80/M systems available for extension rack:
+ 5V 3 A
 ± 12 V 0,2 A
 ± 15 V 0,2 A

Hardware Extendability (M-series)

Full buffering of ECB-Bus (Schmitt trigger). ECB bus standard (DIN 41612 connector). Maximum capacity: 6 single Eurocards, 3 double Eurocards or 1 S100 Bus card. A broad range of standard cards is available (Z80 A-ECB series, see separate description).

Peripherals (optional)

See also list of the last page.
Your local representative has a broad range of printers, plotters, and special peripherals available.
Basic drivers are included for serial output/output. Extended drivers on request, also drivers for parallel printers with CENTRONIC type interfaces and for digital plotters.

KONTRON'S Microcomputer Board

Product Overview

Z80* as Basic Intelligence

All ECB boards are based on the Z80 microprocessor from the microcomputer specialist ZILOG.

Special features of the Z80 family of integrated components are:

- Careful design with attention to system aspects:
Coordination of the different specialities of system analysts, software specialists, semiconductors and system engineers. The result is a technically complete family of circuits.
- You need only a minimum amount of auxiliary hardware:
Only one 5 V power supply, 1-phase-TTL clock; interrupt and refresh controllers integrated in the main components.
- Full software and application compatibility with 8080 and 8085 systems.
- Extension of processor capabilities into two directions:
First towards 16 bit computers through the implementation of 16 bit move and arithmetic instructions with additional addressing modes and block transfer as well as extended interrupt capability implemented in the hardware of the LSI chips.
Towards machine control by single bit operations (test bit, set bit, reset bit) and by a new hardware concept, and intelligent parallel input/output components.
input/output components.
- Z80 microcomputer components are available from 4 independent licensed semiconductor producers in USA, Japan and Europe (not counted are the unlicensed producers). This means security for the user!

Meeting your speed requirements

To optimize your cost/performance-requirements, KONTRON's ECB-boards are offered in various execution-time versions.

The maximum clock rate of an ECB board is specified by a letter following the 'Z80'-definition:

Z80 -ECB/xx: Maximum system processor clock rate is 2,5 MHz

Z80 A-ECB/xx: Maximum system processor clock rate is 4 MHz

Z80 B-ECB/xx: Maximum system processor clock rate is 6 MHz

ECB/xx: Item may be used in any system, using a clock rate up to 6 MHz.

Please note, that the use of any board within KONTRON's OEM computer system PSI 80 or PSI 80D requires at least a 4 MHz capability.

ECB-Microcomputer Boards

The most widespread use of microcomputers is that of incorporating 'technical intelligence' into a variety of equipment,

instruments etc. This really means giving the equipment the ability to make programmed decisions, performing sophisticated calculations, and to interface them to operations in convenient ways.

With modern MOS technology especially using ZILOG's Z80-family this can be achieved at costs which are far below the total cost of equivalent hardwired logic, implemented on boards of relatively small size for optimal efficiency and partitioning. It is often best to consider the final equipment to consist of at least two main elements, or subsystems. One of these is the microcomputer, being the microprocessor with its closely associated devices, memories, peripheral interfaces etc.; the other is the user subsystem, i. e. the specialized part of the equipment, analog signal handling, for example, which is placed under the control of the microcomputer.

There is a very wide and diverse range of opportunities to use microcomputers, and of course these user-systems generally reflect unique characteristics of the equipment being produced. However, in general, all microcomputer systems contain the same elements, although quantities vary, like how much memory, how many I/O interfaces etc. This observation leads to the conclusion that a microcomputer system can be implemented best by combining relatively small functional units to get maximum flexibility. The family of KONTRON's Z80 based microcomputer modules described in this document is the result of a painstaking analysis of many customers' requirements.

The unique benefit of small size, Z80 based computer modules results from the following:

1. The Z80 computing power and memory efficiency compared to other microcomputers is so great, that many applications can be solved with a single, small printed circuit card. Each Z80 microcomputer system uses at least one autonomous single board microcomputer.
2. On the other hand the Z80 is so well suited to the solution of very complex applications that the Z80 microcomputer cards were conceived so that expansion to the full power and expandibility of the Z80 is possible simply by plugging any combination of boards into the rack.

The two longer edges of the ECB boards are used to guide and support the board in a rack. The two shorter sides are used to provide electrical connections to the board. The microprocessor address, data and control signals are all located at one end of the board.

Input and output signals are taken from the cards from the other end via 3M connectors for the following reasons:

- i) input/output signals in many applications are used on the front side instead of the backplane end.
- ii) the user can make his own interface module and use this in a piggy back or sandwich system to connect to his own peripherals.
- iii) if all the signals, including input/output signals were on the bus side of the card, very expensive connectors and a complicated bus wiring would be required, and loss of space would result on the modules.

To save implementation and wiring problems, a complete card cage ECB/R and a backplane are offered.

* Z80 is a registered trade mark of ZILOG Inc.

The System Concept: One Bus for all of them

ECB modules mean flexibility: the Z80 oriented bus connects CPU boards with peripheral and memory extensions.

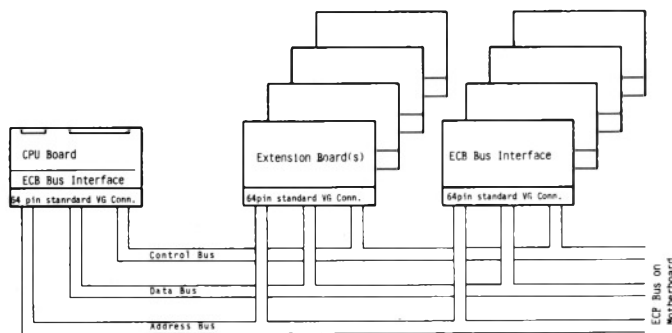
The ECB concept is a high performance, application oriented system bus designed to utilize the full capabilities of Z80, Z80A and Z80B microprocessors, which is used by a large number of microcomputer board producers and has become the Industry Standard for Z80 based boards.

All signals are connected to the 64 pin standard VG connector in such a way that all modules are connected with one another since all of them have the same pin assignment. As a result, standard backplanes may be used.

The connector has a matrix of 64 pins on .1" (2.54 mm) centers, which are set in 2 rows of 32 pins each. A molded plastic housing surrounds the pin array, providing mechanical rigidity and protecting the pins from mechanical damage.

The backplanes use a similar style of mating connector. These connectors are highly reliable in an industrial environment because connection surfaces are completely enclosed and shielded from dirt and dust when the connectors are mated. Another advantage of this connector is its high density which permits the design of compact boards. In addition, the connectors are self-aligning and keyed to prevent improper insertion.

All of the signals on the ECB boards are assigned to one connector so that entire user-systems may be implemented in



ECB-Busorganisation

many cases without any wiring effort, simply plugging the boards into a card-cage.

Nine of the 64 pins are allocated to power distribution, with the remaining 55 dedicated to address, data, timing, priority and control. I/O signals are all contained on separate connectors on the opposite edge of the boards from the bus connector, providing high noise isolation between the bus and the 'real world'. Microcomputer boards designed for this bus structure can use the $\pm 5V$, $+12V$ and $\pm 15V$ available on the backplane. However, many of the ECB boards require only a single $+5V$ supply.

In addition to the power distribution lines, the ECB Bus includes a $+5V$ battery line. Using this line, parts of the system may be fed by a battery in the case of power-fail use, allowing the current machine status to be stored if non-volatile memory has been provided in the system.

Address and Data

The address and data information is provided by separate address and data lines.

The ECB bus has two independent interrupt groups, INT and NMI. Each group has an interrupt request line, while the interrupt enable input and output daisy chain is common for both. A different priority level is assigned to the requesting device by its position within the chain.

In addition to the interrupt groups, the ECB bus has a bus request group consisting of a bus request signal along with a bus acknowledge input and output daisy chain. This group allows several devices to have access to the bus for DMA operations.

Pin-Name	Function	Comment
A0-A 15	Address Lines	address bus (Tri-state)
D0-D 7	Data Lines	data bus (Tri-state, bidirectional)
M 1 MRQ IORQ RD WR REFRESH	Machine Cycle 1 Memory Request IN/OUT Request Read Write Refresh	system control bus, outputs
HLT WAIT INT NMI RESET	Stop Wait Interrupt Non Maskable Int. Reset	CPU-control inputs
IEI IEO	Int. Enable In Int. Enable Out	Daisy Chain-Interrupt-Control
PWRCL PHI 2 PHI n PHI	Power On Reset Clock 2.45 MHz 2 x Clock n x Clock	Output
BUSRQ BUSAK BAI BAO	Bus request Bus Acknowledge Bus Priority Contr. In Bus Priority Contr. Out	Bus control for DMA-based systems
WRITEEN DPR	Write enable for ECB/D (Synchronization for ECB/V)	Special-functions
+ 5 GND + 12 - 5 + 15 - 15 VCMOS	+ 5V Ground + 12V for EPROMs - 5V + 15V) for V 24 and - 15V) AD converters + 5V battery (Power fail Supply)	Power supply

The ECB-bus combines economy and performance. When building small or complex systems the following features are available:

- Interrupt nesting
- Bus priority control
- Refresh control for dynamic memories
- User assignable input/output-addressing
- User addressing assignment of memory blocks
- High noise immunity via Schmitt trigger buffering

CPU Boards

The ECB series offers a number of different CPU boards, which have to be selected according to the speed and configuration requirements of the total system application.

All CPU boards use the Z80(A)-CPU*, one of the most powerful 8 bit microprocessors available today, and allow system implementations to utilise the full CPU capability.

Z80 A-ECB/C8 includes Z80 A-CPU, typically 4 kBytes read-only memory, read/write-memory (RAM) and parallel plus serial I/O. Minimum execution time is 1 μ sec, corresponding to 4 MHz CPU clock frequency.

Z80-ECB/C8 same as Z80 A-ECB/C8, but execution-time of 1.6 μ sec corresponding to 2.5 MHz-CPU clock frequency.

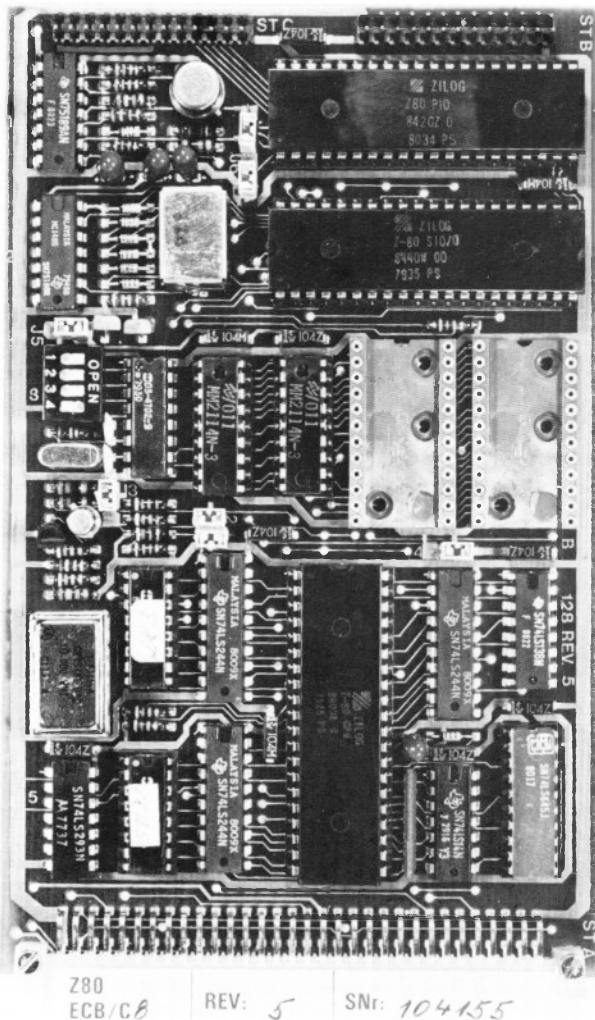
Z80 A-ECB/Z includes a significant amount of read-only-memory (up to 16 kBytes of PROM) and read/write-memory (RAM). I/O has to be added externally. Minimum execution-time is 1 μ sec corresponding to 4 MHz-CPU clock frequency.

All these CPU boards allow system expansion via additional boards (memory extension, I/O extension, subprocessors) of the Z80 A-ECB/xx-type (4 MHz). For the Z80-ECB/C8 the 2.5 MHz-boards of the Z80-ECB/xx-type are sufficient.

In KONTRON's ECB series, memory and I/O addressing are fully implemented and each card fully decodes all addresses.

The well defined, standardized bus is fully buffered and allows the implementation of very large systems. Configuration is straight forward because of a strict 1:1 pin assignment on all ECB boards; thus, standard racks may be used as card-cages.

* trademark of ZILOG, Inc.

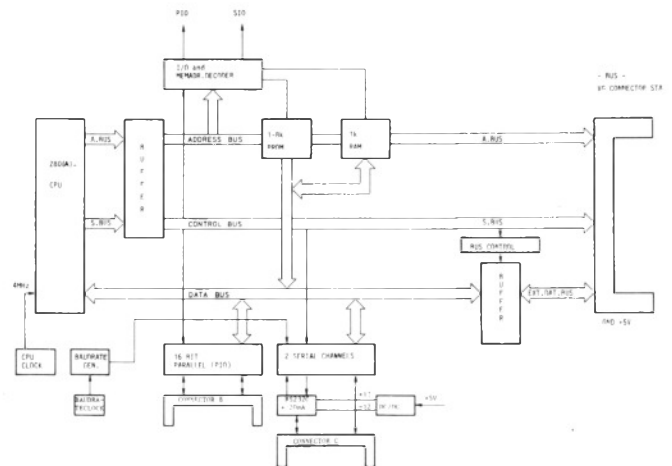


Single Board Computers ECB/C8

KONTRON's single board ECB/C8 microcomputers may be used as small stand alone computer systems with CPU, RAM, PROM and serial and parallel I/O or as central units of large sophisticated multi-board computer systems. They are available in a 4 MHz clock version (Z80 A-ECB/C8), and in a 2.5 MHz version (Z80-ECB/C8).

The ECB/C8 contains the following functional units:

- Z80 A-CPU (on Z80 A-ECB/C8 or Z80-CPU (on Z80-ECB/C8)
- 4 MHz clock (on Z80 A-ECB/C8), derived from a 16 MHz crystal
- Decoder for full memory and I/O expansion
- Schmitt Trigger Buffering of all bus signals
- DMA bus signals
- Sockets for 1... 8 kByte of read-only memory, prewired for i2716, i2732, HM 7641, HM 7681.
- 1 kByte of static RAM (NMOS or CMOS)
- two 8 bit parallel I/O interfaces (1 x PIO)
- two full duplex serial I/O interfaces (1 x SIO)
- separate crystal for baud rate generation (Z80 A-ECB/C8 only)
- full RS232C and 20 mA interface
- 14 switch-selectable baud rates
- DC/DC converter for serial interface (+12V)
- 64 pin standard edge connector
- I/O connections via two 26 pin 3M WWP connectors
- ECB bus pinning

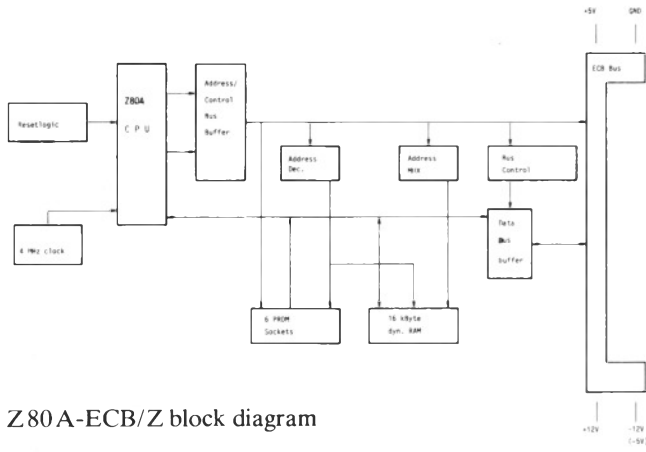


Z80 A-ECB/C8 block diagram

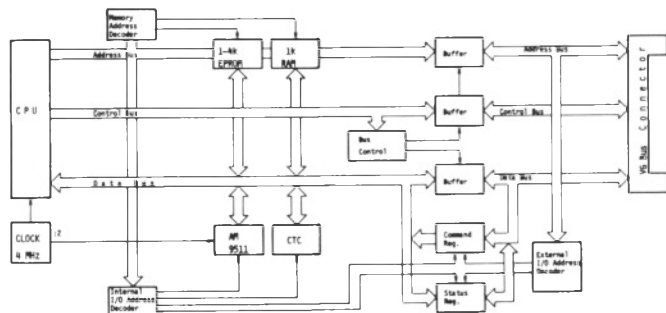
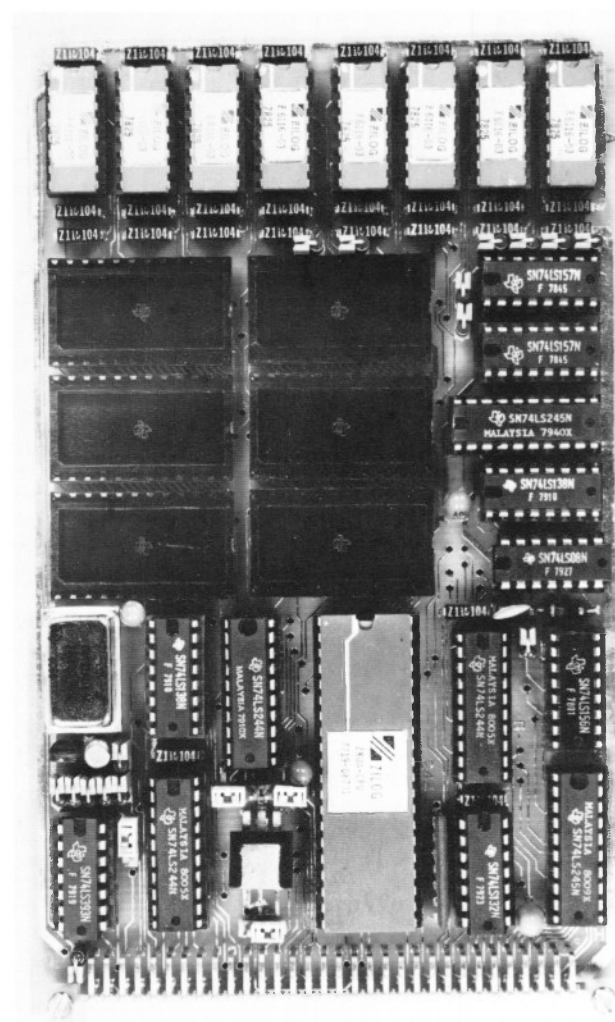
Central Processor Unit Board Z80 A-ECB/Z

This CPU board meets the requirements of larger, RAM intensive microcomputer systems. It features:

- Z80 A-CPU
- 4 MHz-CPU-clock, derived from a 16 MHz crystal clock generator
- Memory decoder
- Schmitt trigger buffers for all bus signals
- DMA bus signals
- On-board reset logic
- 16 kBytes of dynamic read/write-memory (RAM)
- 6 sockets for EPROM's i2716/i2732 (max. 16 kBytes)
- Power requirements +5V ($\pm 5\%$), +12V ($\pm 5\%$) and -5V or -12V ($\pm 5\%$)
- 64 pin standard edge connector
- ECB bus pin out



Z80A-ECB/Z block diagram



Z80A-ECB/A block diagram

Arithmetic Processor Board Z80A-ECB/A

The subprocessor computer board ECB/A combines the computing power of the hardware-arithmetic IC am9511 with the strength of a Z80A-CPU microprocessor.

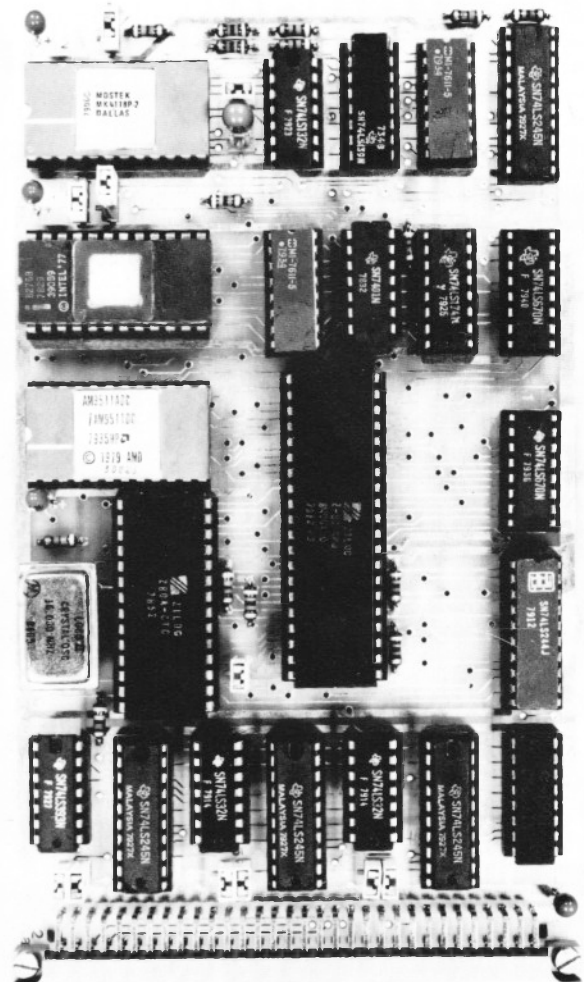
Thus, the ECB/A is an autonomous subsystem, able to compute formulas and other mathematic functions independently of a general purpose master computer. The standard software which comes with the ECB/A may be enhanced by the user implementing additional user specific programs. For this purpose the ECB/A provides a socket which allows the use of a 2716 PROM or a compatible RAM IC MK 4118. In this case, formulas may be brought into the arithmetic subsystem from a master computer system by down-loading.

The hardware arithmetic module ECB/A is mechanically and electrically fully compatible with the ECB series.

In addition, this module may be used in all computer systems of the PSI 80 series, which contain an in-built ECB rack.

The module provides the following features:

- arithmetic processor am9511
- Z80A-CPU, which controls the am9511 and provides independent solution of complex arithmetic problems within the ECB/A
- 4 MHz clock
- power-on reset
- bus buffering using bidirectional address, control, and data-bus buffers
- 2 kBytes EPROM (2716)
- 1 kByte static RAM (MK4118), exchangeable with 2758 or 2716 EPROM's
- Z80A-CTC for interrupt control
- 64 pin standard edge connector
- ECB bus pinning
- supporting software delivered with the board



Memory Extension Boards

Dynamic RAM Extension Family ECB/D

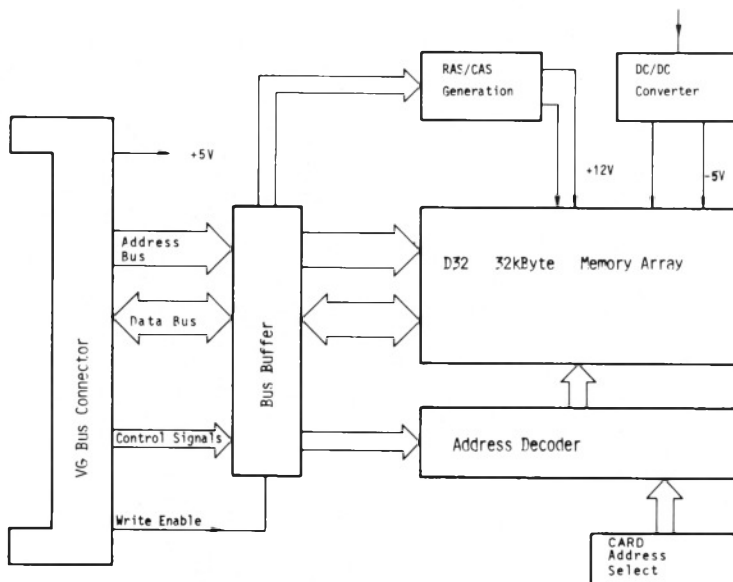
The ECB/D-boards are a family of high speed, high density, low cost memory modules for RAM intensive ECB systems. It provides a range of different operation speeds and memory capacities.

The family includes the following modules for both, the Z80 A-ECB/xxx and the Z80-ECB/xxx-serie:

	operation speed	memory capacity
Z80 A-ECB/D32	4 MHz	32k × 8 bits
Z80 A-ECB/D16	4 MHz	16k × 8 bits
Z80-ECB/D32	2.5 MHz	32k × 8 bits
Z80-ECB/D16	2.5 MHz	16k × 8 bits
Z80-ECB/D8	2.5 MHz	8k × 8 bits

As a special feature, all these boards require only a +5V power supply. This is achieved by on-board DC/DC converters. To achieve maximum noise immunity and reliability, all bus signals are buffered by Schmitt trigger-circuits. The addresses A12...A15 are latched at memory request time. The dynamic RAM's are refreshed automatically when the card is used in conjunction with a Z80 processor board.

The boards are equipped with 64 pin standard edge connectors to the ECB bus pin out.



ECB/D32 block diagram

PROM/RAM-Expansion Board ECB/E

The ECB/E boards support PROM based ECB systems using EPROM's such as i2708/2704, i2758 or high speed bipolar fusible link PROM's like the HM 7608, 7641 or equivalent. The boards are available in 4 MHz versions (Z80 A-ECB/E) and 2.5 MHz-versions (Z80-ECB/E).

These modules contain the following functional elements:

- sockets for 1 . . . 8 kbytes of ROM, PROM or EPROM
- 1 kByte of static RAM
- Decoder
- a switch for address mapping
- 64 pin standard edge connector
- ECB bus pin-out

PROM/RAM – Expansion Board Z80-ECB/E16

The ECB/E16 is suitable for EPROM/PROM/ROM intensive systems with a medium amount of static RAM. They provide sockets for up to 16 kBytes of EPROM, fusible link PROM or mask-programmed ROM's (e.g. i2716, i2758, HM 7681), and 1 kByte of static RAM, expandable to 4 kBytes.

Features of the ECB/E16:

- sockets for up to 16 kBytes of EPROM, PROM or ROM
- 1 kByte of static RAM and sockets for additional 3 kBytes
- RAM and ROM area switch selectable separately
- 64 pin standard edge connector
- ECB bus pin-out

PROM/RAM – Expansion Board Z80 A-ECB/E64

The ECB/E64 is designed to allow the implementation of PROM oriented microcomputer systems with maximum density at minimum cost.

It's features make it especially effective in larger systems with non-volatile memory as in machine control, traffic control or other complex industrial applications. It permits one to change the entire PROM resident program of a total system by changing just one small, handy ECB board. The board is totally universal; it allows the use of state of the art EPROMs and ROMs with a capacity up to 64K bits. It operator in large Z80 A-ECB systems at clock frequencies up to 4 MHz, using relatively slow EPROMs.

The most important specifications of this board are:

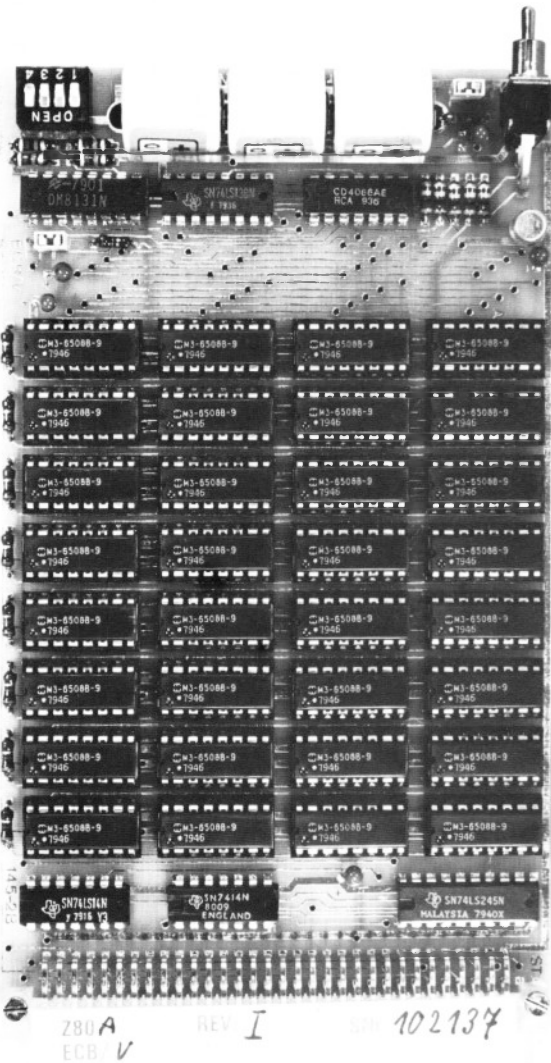
- 8 sockets for read only memory for 8 K bytes up to 64 K bytes according to the type of the used. ROM, PROM or EPROM
- 1 K byte static nMOS-RAM (on-board expandable to up to 4 K byte)
- CMOS-RAM for power fail-safe systems: Z80 A-ECB/E 64 V* is available as an option.
- optimized bus interface which allows the use of the module in Z80 A-ECB systems with up to 4 MHz system clock using low cost relatively slow EPROMs.
- bus fully buffered by Schmitt trigger circuits for maximum reliability and noise protection
- 64 pin bus connector according to DIN 41612 (VG 95324) to the ECB bus definition

*Note: Can be ordered in quantities of 50 upwards only. For price and availability please contact factory.

To allow a wide variety of 'read-only' memory chips to be used on the ECB/E64, a carefully designed, small wiring area has been implemented on the board.

This area also offers the choice of using the read-only memory chips in a fast or slow access mode to control power consumption.

As a fully tested factory configuration a small piggy back jumper board comes with the ECB/E64 which is plugged onto the wired socket. This configuration supports the use of i2716 EPROMs in the fast access mode and, after changing a few jumpers, also the slow, power saving access mode using the same chip. For other piggy back strapping option boards, please contact the factory. An overview of the most commonly used EPROMs is shown in figure 1. In this figure and in the following text the suffix 'F' (= fast) after the PROM name stands for the fast access operation and the suffix 'S' (= slow) for the slow, power saving operation.



4K Byte CMOS RAM Board ECB/V

The Single Eurocard size board ECB/V is a fully static, universal CMOS Memory Board with 4 kBytes of high density RAM. It is available in a 4 MHz version for Z80 A ECB systems (Z80A-ECB/V) and in a 2.5 MHz version for Z80 ECB systems (Z80-ECB/V).

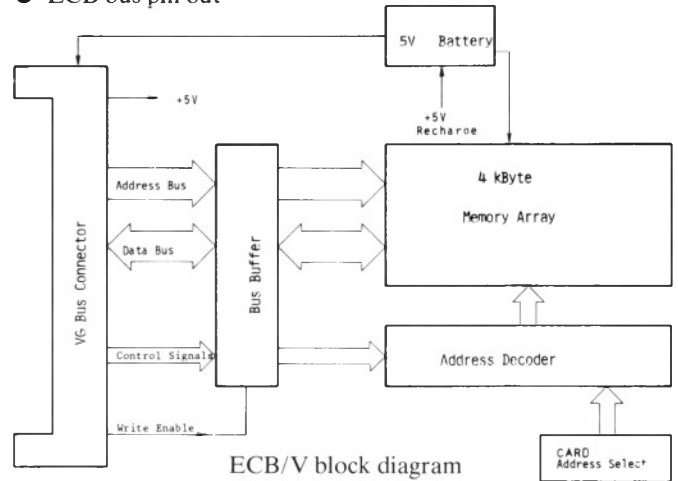
Because of its extremely low standby power consumption it is ideally suited to the following applications:

- large low standby power memories. A 64 kByte RAM, for instance, may be implemented by means of 16 ECB/V-boards with a standby current of only 20 mA.
- non-volatile memory. Programs and data are protected against power-failure by a battery that is recharged during normal operation. A write protect switch allows the use of the board as a true "quasi-EPROM". Therefore, the ECB/V

can be regarded as a relatively low cost, high speed and small size alternative to core memories.

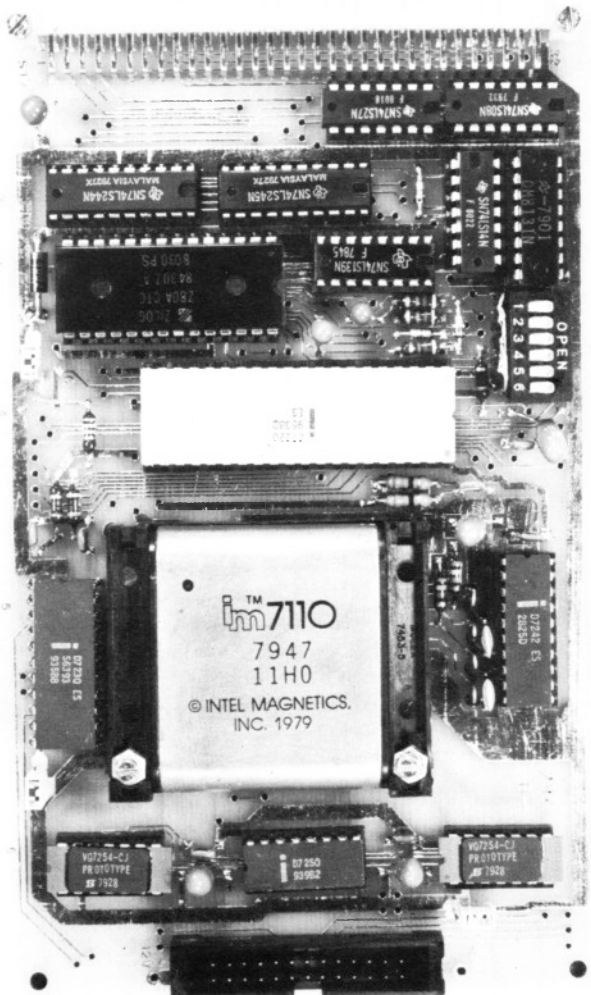
It provides the following features:

- on-board decoders and address switches
- on-board buffers
- on-board rechargeable battery
- 64 pin-standard edge connector
- ECB bus pin out



Bubble-Memory-Board ECB/BM

- 128 k Bytes of non-volatile magnetic bubble memory
- transfer rate 100 μ sec/byte
- record oriented organisation
- any record length possible
- on-board buffer for 40 characters
- expandable by additional bubble chips via piggy back board
- 64 pin standard edge connector
- ECB bus pin out



Input/Output Modules

KONTRON's ECB-Input/Output boards provide the full power of the Z80 interrupt architecture which is similar to the structure of large process control computers.

The assignment of interrupt requests to the appropriate interrupt handling routines is performed by indirect addressing using a RAM resident vector table, which points to the starting address of the interrupt service routine.

An address value stored in the I register of the Z80-CPU determines the high order address of this table; the intelligent peripheral components of the Z80 series automatically add an offset value which is stored in the peripheral chip itself to this address at interrupt acknowledge time. This procedure gives maximum flexibility in the I/O structure and fast interrupt response time.

Each interrupt service request is terminated by an automatic jump back to the next instruction of the interrupted program ("RETI" = Return on Interrupt); the intelligent Z80 peripheral component is informed of the fact that its service routine has been terminated in order to adjust its priority status.

This status is determined by two separate pins on each peripheral component, the Interrupt Enable In (IEI) and the Interrupt Enable Out (IEO) pin, which are cascaded from one peripheral chip to the next one. Servicing of this interrupt priority chain is performed automatically as well as nesting according to the instantaneous priority status.

Digital I/O-Boards

Input/Output Expansion Board ECB/I

The board is designed for applications which require more digital I/O lines than implemented on the CPU board.

It provides, in addition, the opportunity to adapt the entire system to the specific application by an on board wire wrap area with nine 16 pin DIP sockets (drivers, buffers, level shifters, opto couplers, reed relays, line drivers, latches . . .).

The board is available in a 4 MHz-version for Z80 A-ECB-systems (Z80 A-ECB/I) and a 2.5 MHz-version for Z80-ECB-systems (Z80-ECB/I).

The module includes the following functional units:

- 4 parallel interfaces (2 x PIO)
- 4 counter/timer channels (1 x CTC)
- 9 unwired sockets for standard interface chips
- 64 pin standard edge connector
- 3 x 3 M-WWP-connectors for I/O
- ECB bus pin out

Opto-Coupled Digital I/O Board Series ECB/O

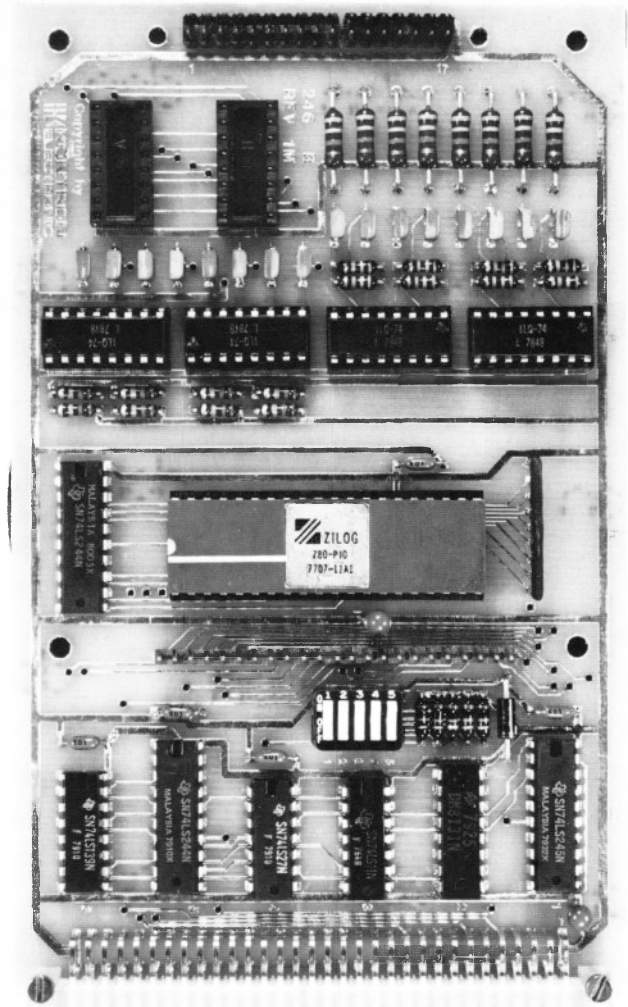
The ECB/O board family has been designed to add opto-coupled I/O interfaces to KONTRON's ECB microcomputer board system. They all provide electrical isolation between input and output of the system and are connected to the system bus by parallel interfaces. Electrical isolation is done using ILO 74 opto-isolators. These components include 4 opto-couplers in one 16 pin dual in line package. In addition, the layout of the boards has been done in a such way that a separation several millimeters large between all in/output lines and system lines exists to provide an unusually high level of isolation.

The opto-coupler board family includes the following three boards:

ECB/O	8 inputs, 8 outputs
ECB/OA	16 outputs
ECB/OE	16 inputs

In addition 2 piggy back boards for expansion purpose are available:

ECB/OAA	16 outputs
ECB/OEE	16 inputs

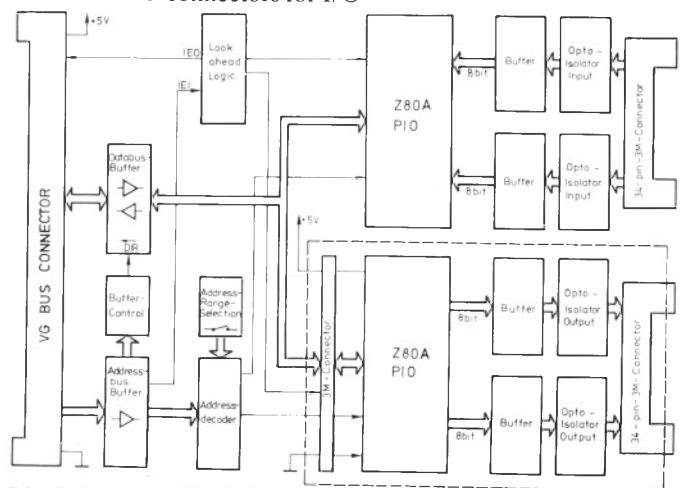


All basic boards include the following functional units:

- 1 parallel I/O interface (1 x Z80 A-PIO)
- Bus fully buffered by Schmitt trigger buffers for maximum noise immunity and reliability
- Opto-coupled inputs and/or outputs for I/O address decoding
- 64 pin bus connector to DIN 41 612 (VG 95324)
- 3M-WWP connectors for I/O inputs/outputs

Piggy back board may be plugged into the respective connectors on the basic boards to extend the capability of the basic board as follows:

- 1 parallel I/O interface (1 off Z80 A-PIO)
- Opto-coupled input and output
- 3M-WWP connectors for I/O



Block diagram of ECB/OE with option ECB/OAA

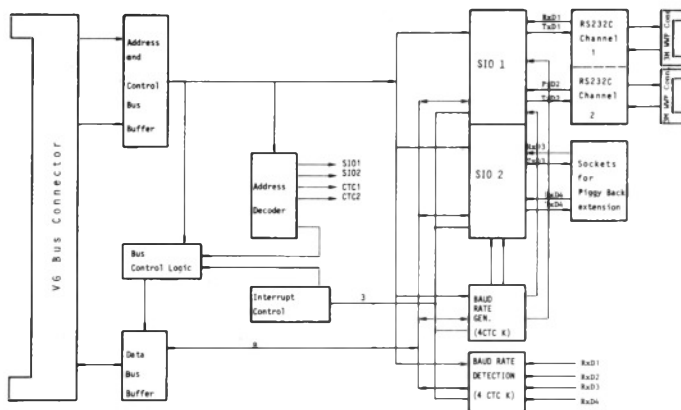
Counter-Timer Modules for Real Time Operation ECB/T and ECB/TC

The ECB/T and ECB/TC boards are designed to facilitate more complex microcomputer systems with a vast variety of counter and timer functions. The following functions are ideally catered for by these cards:

- interval timer
- stop watch
- watchdog timer
- frequency synthesizer
- high accuracy baud rate generator
- event counter
- pulse generator
- 24 hour clock (ECB/TC only)

The boards contain the following functional modules:

- 3 Z80 A-CTC chips: 12 counter/timer circuits (8 bits + 8 bit prescaler with interrupt capability)
- 1 am 9513: 5 counter/timer (16 bit) with time of day mode
- The am9513 timer circuit may be used as a software controlled 24 hour clock. For details and program examples please see the appropriate user manual (Advanced Micro Device am9513 user manual).
- 7 unwired sockets for additional interface circuitry
- full bus buffering Schmitt trigger circuits to provide the highest possible reliability
- 64 pin DIN 41612 bus connector (pin-out according to ECB standard)
- I/O 3M WWP connector



ECB/X block diagram

Serial I/O and Data Communication Modules of the ECB/X-family

The ECB/X series is a family of I/O extension boards for KONTRON's Z80A-ECB and Z80-ECB series and accessories. It was designed for use in data communications equipment and in control systems with a larger number of powerful, asynchronous and synchronous serial input/output interfaces. All ECB/X boards are equipped with two Z80A-SIO circuits to allow not only asynchronous and synchronous serial data transmission but also many internationally standardized synchronous protocols like SDLC, HDLC, Bysinc (BSC) and Monosync, which are supported in hardware by the SIO component.

The baud rate of all channels may be programmed by the user program via 4 CTC-channels (2 CTC-components with 4 channels each are implemented on the board). The remaining 4 CTC-channels are available for baud rate recognition and user specific applications. They are configured such that any time interval from 1 microsecond up to 60 seconds may be triggered by software.

The total concept of the ECB/X family is a modular one. The basic boards include the hardware described plus 2 standardized interfaces; the remaining 2 serial channels are connected without buffering to on-board 3M connectors. Expansion of the on-board buffering can be done using an additional piggy back board which is available for different standard interfaces.

Thus, choosing the appropriate basic board plus the desired expansion, always allows the implementation of the ideal interface mix at minimum cost without any unnecessary overhead.

Furthermore, the basic board is offered in two versions:

- a 'built in' version to be used in more complex systems where the channels have to be connected between the rear of the system and the board via cables. In this version the 2 buffered standard interfaces are brought out to 3M connectors.
- a 'direct connection' version where 25-pin CANNON connectors with the standard pin out of the interface to be used are mounted directly on the board together with an appropriate 4 channel front panel. This module should be used where the board may be integrated into the equipment in a such way, that external plugs can be connected directly to the connectors on the ECB/X.

All boards of the ECB/X family contain the following functional units:

- switch programmable I/O address decoder
- Interrupt priority control (Daisy Chain) and 'Look ahead' logic
- 8 counter/timer channels (2 Z80 A-CTC circuits) for baud rate generation (4), baud rate detection of user specific applications (other 4 channels)
- 4 serial I/O channels (2 Z80 A-SIO circuits)
- 2 standardized interfaces for terminal or modern operation (channels 1 and 2)
- on-board connectors for 'piggy back module' for expansion of the basic module by additional interfaces (channel 3 and 4)
- ECB bus interface including Schmitt-trigger buffers for all bus signals

Ordering Information:

Cable Connector Versions:

ECB/X232 basic serial I/O module with two Z80 A-SIO, two Z80 A-CTC components and two RS 232 C interfaces. They may be expanded by using ECB/X expansion modules.

ECB/X20* basic serial I/O module with two Z80 A-SIO, two Z80 A-CTC components and two 20 mA interfaces. They may be expanded by using ECB/X expansion modules.

ECB/X449*: basic serial I/O module with two Z80A-SIO and two Z80A-CTC components and two RS 449 (RS 422 A, RS 423 A) interfaces. They may be expanded by using ECB/X expansion modules.

ECB/XE232: expands any of the ECB/X boards by 2 additional RS 232 C interfaces.

ECB/XE20: expands any of the ECB/X boards by 2 additional 20 mA interfaces.

ECB/XE449: expands any of the ECB/X boards by 2 additional RS 449 (RS 422 A, RS 423 A).

Directly Connection Versions

ECXB/XC232: basic serial I/O module with two Z80 A-SIO and two Z80 A-CTC components and two RS 232 C interfaces. They may be expanded by using ECB/X expansion modules.

ECB/XC449*: basic serial I/O module with two Z80 A-SIO and two Z80 A-CTC components and two RS 449 (RS 422 A, RS 423 A) interfaces. They may be expanded by using ECB/X expansion modules.

ECB/XCE232*: expands any of the ECB/X boards by 2 additional RS 232 C interfaces.

ECB/XCE20*: expands any of the ECB/X boards by 2 additional 20 mA interfaces.

ECB/XCE449*: expands any of the ECB/X boards by 2 additional RS 449 (RS 422 A, RS 423 A).

* These boards and add-ons are available in minimum quantities of 50 boards each. Please contact factory.

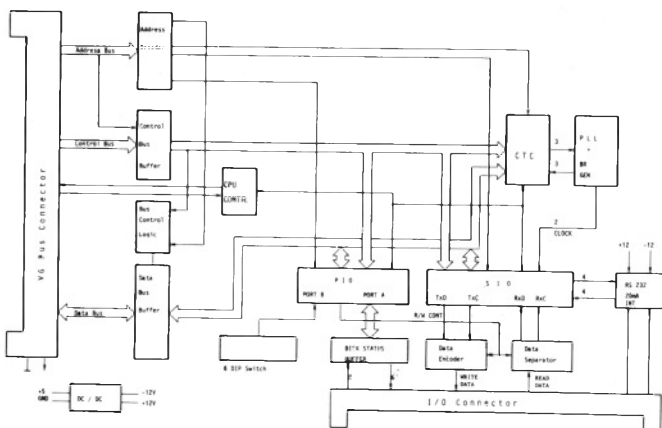
Floppy Disk Controller ECB/F

The ECB/F is a general purpose I/O module for serial and parallel I/O, which can be used very efficiently as a controller for hard sectored Floppy Disk drives. The boards are available in a 4 MHz version (Z80 A-ECB/F) and 2.5 MHz-version (Z80-ECB/F).

The board contains the following functional units:

- CPU interface
- Schmitt trigger buffering of all bus signals.
- address decoder for CTC, PIO and SIO
- Look Ahead for interrupt priority control (Daisy Chain)
- SIO synchronous channel (Floppy Disk Interface) for up to 8 drives
- Fully programmable PLL frequency synthesizer for generating the transfer rate (2 CTC-channels)
- programmable, entirely digital data separator with 16 time constants
- Disk status signals generated by PIO
- Schmitt trigger buffering of all inputs and outputs
- SIO asynchronous channel
- fully programmable baud rate control generation from 50 up to 38k Baud (1 CTC-channel)
- RS 232 C and 20 mA current loop interfaces
- DC/DC converter for +12 V
- 6 modem control signals for RS 232 C
- 6 DIP switches for programming of system variables (via PIO)
- jumper selectable adaptation of the synchronous channel to other peripherals
- 3M WWP-I/O connectors for connection to the peripheral units
- only one +5V power supply required
- 64 pin standard edge connector
- ECB bus pin out

The board is supported by the optional ECB/MON operating software.



ECB/F block diagram

IEEE 488 Controller Board Z80 A-ECB/B

This board provides IEEE 488 capability to the 1978 ANSI standard. It includes a powerful Z80 based software package. It is compatible with 4 MHz Z80 A-ECB- and 2.5 MHz Z80-ECB systems. It may be used to upgrade KONTRON's PSI Ψ 80 microcomputer system to an IEEE 488 control unit with the full range of data assembly, bus control, logging and display of complex IEEE 488 systems, or to implement IEEE 488-capable stand alone systems based on the ECB system.

Talker, listener and control functions are implemented.

The controlling element is the i8291 large scale integrated circuit. It is assisted by a Z80 A-PIO parallel I/O-port. Timing is controlled by a Z80 A-CTC.

Full compatibility to IEEE 488 hardware requirements is achieved by IEEE bus driver circuits MC 3448 A.

Addressing from a microcomputer system is defined by DIL-switches. The board supports DMA operation.

These hardware and firmware features make this board extremely valuable in any microcomputer system, especially when matched with KONTRON's PSI Ψ 80 desktop computer system.

Color Display Control Board Z80 A-ECB/CV

The new Single Eurocard module ECB/CV is based on KONTRON's standard computer board ECB series, it allows alphanumeric and semigraphic color output (6 colours + black/white) in VIDEOTEXT (or PRESTEL, or BILD-SCHIRMTEXT) with 24 lines of 40 characters.

The module allows the implementation of a VIDEOTEXT terminal on the ECB bus as well as a straight forward connection to general purpose ECB based microcomputer systems to the VIDEOTEXT network. Access to international data communication services like PRESTEL (UK) or SORD (USA), are also possible. The system must provide, in addition to this module, one bidirectional serial interface.

The same module may be used, of course, as a stand alone color display interface in general purpose microcomputer control systems. The optional piggy-back board Z80 A-ECB/CVG expands the ECB/CV described above to high resolution graphic output (256 \times 512 pixels); its single color graphic output (green) may be overlapped by alphanumeric color information. This permits remote loading of graphics and picture composition.

Z80 A-ECB/CV

Single Eurocard for color display interface.

- Z80 A CPU
- 2 kBytes (2716) or 4 kBytes (62732) of EPROM
- 1 kByte of (CPU) RAM (static)
- 1 kByte of video RAM (static) including transparent access
- MC 6845 CRT controller
- SAA 5051 VIDEOTEXT character generator (TROM)
- ECB interface
- colour display (RGB) interface
- VIDEOTEXT format: 24 lines of 40 characters
- expandible to display high resolution graphics (256 \times 512 pixels) simultaneously with alphanumeric colour information, using extension ECB/CVG
- powerful graphic software executable by the on-board CPU; so the system CPU is not loaded by image processing

Graphic Expansion for Colour Display Board Z80 A-ECB/CVG

- extension for ECB/CV (piggy back)
- 16 kBytes of dynamic video RAM for high resolution graphics (256 \times 512 pixels)
- transparent video RAM access

Analog I/O Boards

Analog Input/Output Board Z80 A-ECB/AE16

The ECB/AE module provides for the conversion of analog data for a Z80 based computer as well as the transfer of digital data in an analog form to the "analog world". It is suited for use in all Z80 A-ECB and Z80-ECB systems. It contains 16 single ended (or 8 double ended) inputs, an A/D converter and one D/A converter. All analog channels work with 12-bit precision. A DIP switch with 10 switches allows simple selection of measurement range, operation mode etc.

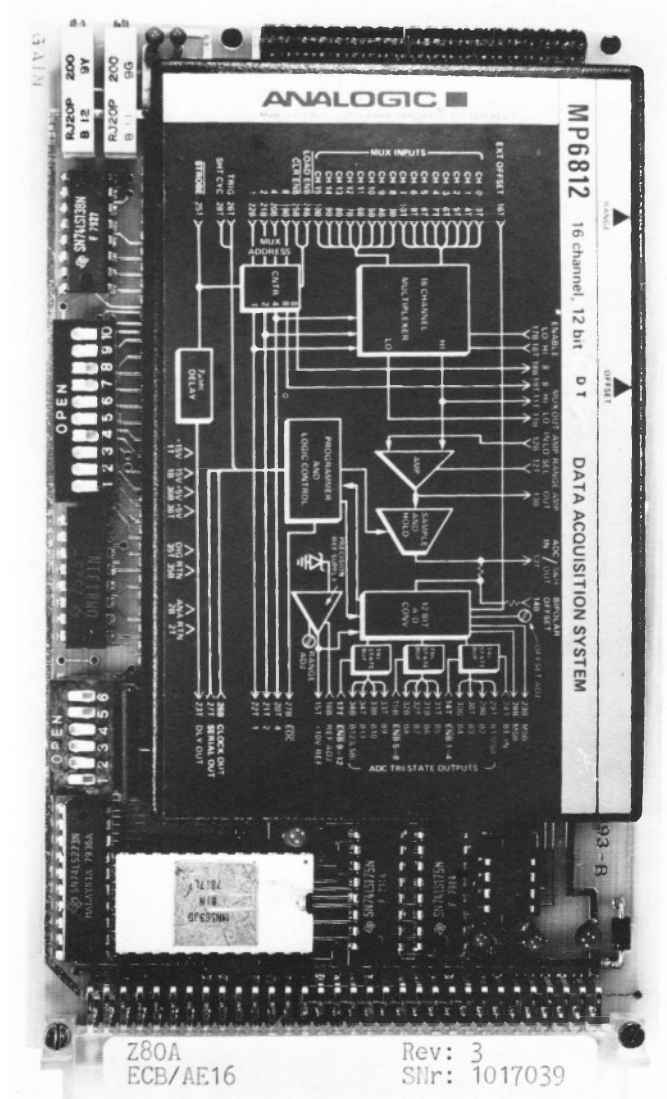
The module has the following functional units:

- one 12-bit A/D converter with 16 channels (MP 6812)
- one 12-bit D/A converter (MN 563)
- address decoder for selection of ADC and DAC
- board address range switch selectable
- I/O channels connected to a 40-pin 3 M connector
- ECB bus pin out

Analog Output Board Z80 A-ECB/AA 4

The D/A conversion module a single ECB/AA 4 is designed for analog output intensive systems with 5V power supply from the Z80 A-ECB-Family (4 MHz-system clock) and the Z80-ECB-Family (2.5 MHz-system-clock). The board includes the following functional units:

- 4 D/A converter channels with 12-bit precision
- buffering and address-decoding
- switch selectable addresses
- switch selectable operator mode (isolated I/O and memory mapped I/O)
- DC/DC converter for +15V
- analog outputs connected to 10 pin 3M-connectors
- 64 pin standard edge connector
- ECB bus pin out



Memory and Digital I/O Extension Boards

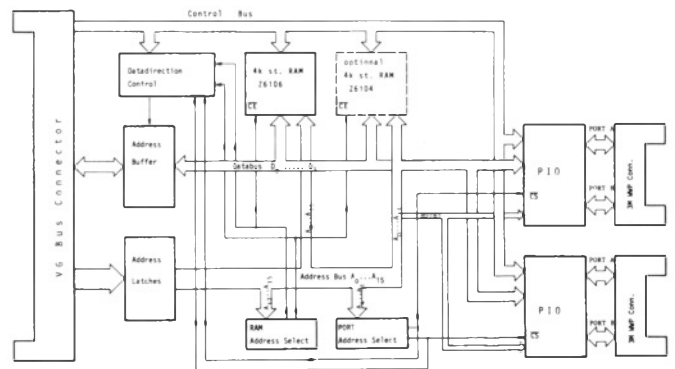
Memory and I/O Extension ECB/S

The ECB/S supports RAM and I/O-intensive ECB based systems, providing a medium size static RAM area and fully programmable parallel I/O.

The boards are available in a 4 MHz-version (Z80 A-ECB/S), compatible with the Z80 A-ECB-series and the Z80 ECB series, and in a 2.5 MHz version to be used in Z80 ECB systems. The standard version is equipped with 4 kBytes of static RAM, sockets for additional 4 kBytes and four 8 bit parallel I/O interfaces with 2 handshake lines (2 PIO).

Here is an overview of the features of the ECB/S:

- 4 kBytes of static RAM, expandable to 8 kBytes
- 8 kByte version (fully assembled and tested) available in quantities of 50 up
- memory address switch-selectable in 8 kB steps
- 4 parallel I/O-interfaces with 8 I/O-lines each plus 2 handshake lines (2 PIO)
- switch selectable port addresses
- all addresses latched
- all bus signals present only 1 TTL/LS load
- data bus lines Schmitt trigger buffered
- 26 pin 3M WWP-I/O connectors
- 64 pin standard edge connector
- ECB bus pin out.



ECB/S block diagram

ECB-Accessories

Card Cage Z80 A-ECB/R

The ECB/R is a 19" standard card edge to ease the implementation of Computer Systems with ECB and custom designed modules for operational frequencies up to 4 MHz.

It comes fully mounted and ready to use. It comprises the rack itself and a quad layer printed mother-board, which allows a maximum of 19 boards to be used. One of these slots is reserved for power supplies (31 pins).

On the mother-board, wiring is provided to implement a highly sophisticated system reset logic.

In quantities of 50 up the ECB/R may be delivered with this reset synchronization logic implemented and fully tested, including supporting software.

ECB/RB Backplane

ECB/RB is the backplane used in the ECB/R-card cage (for description, see chapter ECB/R).

ECB/K25

ECB/K24

25 (34) pin flat cable with Cannon connector; compatible with the 3M-WWP-connector of the ECB/I, ECB/O etc.

Wire Wrap Board ECB/W

This board allows a quick, cost effective realization of custom designed circuitry. 40, 28, 20, 18, 16, 14 and 8 pin DIP packages can be plugged into the universal slots and connected to each other by wire wrapping.

Bus Extender ECB/Y

This board provides extension of the standard ECB bus for test purposes. All 64 pins are connected to its external board plug, and are shielded by a grounded copper area.

ECB Power Supplies ECB/N

The boards of this series are switching mode power supplies fully compatible with the Z80 A-ECB and the Z80-ECB microcomputer board series.

They are available in different voltage configurations and fit into the 31-pin slot of the ECB/R card-cage.

Technical data:

- input voltage: 220 V AC \pm 10% 50/60 Hz
- output voltage: +5 V DC \pm 5% variable
+15 V DC \pm 5% fixed (version N2 only)
+12 V DC \pm 5% fixed (version N4 only)
+5 V DC \pm 5% fixed (version N4 only)
- power fail signal for ECB/R
- all power supplies short circuit proof
- regulation input \pm 1%
output \pm 4% (open circuit/full load)
- isolation (prim/sec) 1 kV-AC
- temperature coefficient: 0,01%/°
- switching frequency of 100 kHz (load-dependent)
- efficiency > 65%
- operating temperature 0...+50°C
- storage temperature -10...+80°C
- humidity < -90%, non-condensing >
- dimensions 160 x 100 x 40 mm
- weight 0,6 kg

The boards are available in the following versions:

ECB/N1	+ 5V	3,5 A
ECB/N2	+ 5V	3,5 A
	+ 15V	0,25 A
	- 15V	0,25 A
ECB/N4	+ 5V	3,5 A
	+ 12V	0,3 A
	- 5V	0,7 A
ECB/N5	+ 5V	3,0 A
	+ 12V	0,3 A
	- 12V	0,3 A

Basic Software for the ECB-Series

The ECB support-software is available either in PROM resident or in diskette resident versions. For shipment, a software license signed by an authorized person is required.

Monitors are basic operating program packages, which may be used for test and control purposes in microcomputer application systems. Together with the microcomputer boards they allow a fast implementation of the entire application as well as a resident test tool; they also handle cold start at power-on and provide a terminal interface. The following functions are implemented:

- GOTO function
- Single Step Operation
- Display Registers
- Display Port
- Change Memory or Port contents
- Fill Memory areas
- Shift Memory areas
- Breakpoints

Monitor Programm ECB/MON

ECB/MON is a 2 kByte-monitor/test/operating program; it may be used on Z80 A-ECB/C8, Z80-ECB/C8 or Z80 A-ECB/Z.

I/O addresses and memory assignment are flexible.

Floppy Disk Operating Software ECB/EXT

The program package ECB/EXT is a 2 kByte extension for the ECB/MON program. It allows the control of 8 inch or 5 1/4 inch FD drives via the ECB/F boards.

Video Monitor Program ECB/18-TV

The 1 kByte monitor/test/operating program ECB/18-TV supports configurations including ECB/C8, ECB/VD, keyboard and monitor.

Standard Arithmetic-Package Z80-SAP

This package contains 8/16 bit-fixed-point arithmetic, conversion routines HEX/ASCII, BINARY/BCD, and trigonometric functions etc. Source code on ZDS 1-diskette.

Floating Point Arithmetic Z80-FPA

includes addition, subtraction, multiplication, division, square-root and conversion routines.

Format: 3 Bytes mantissa, 1 Byte exponent. Source code on ZDS1-diskette.

Floating Point Extension Package Z80-EAP

extends the Z80-FPA-package by trigonometric, logarithmic and statistic functions. Source code on ZDS1-diskette.

Multitask Real Time-Monitor Z80-MTX

This software package allows generation of a full multitasking operating system. It provides the following functions:

- process management
- resource management
- standard I/O drivers

Ordering Information

LITERATURE

Product	Title	Order No.
ECB	Product Specification	SE 157
ECB	ECB Users Manual	
	Hardware and Software	ME 157
Z80-CPU	Technical Manual	ME 121
Z80-PIO	Technical Manual	ME 123
Z80-CTC	Technical Manual	ME 124
Z80-SIO	Technical Manual	ME 128

SINGLE EUROCARD MICROCOMPUTER BOARDS

(160 × 100 mm)

Product	Function	Order-No.
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CPU BOARDS

ECB/C8	Single Board Computer based on Z80(A)-CPU, crystal clock, one kbyte of static RAM, sockets for a maximum of 8 kbytes of ROM or EPROM, two parallel 8 bit input/output interfaces (1 Z80/PIO), two full duplex serial input/output/interfaces (1 Z80/SIO), SDLC/HDLC/Bisync-capable) including voltage converter for RS232C Interface, complete decoding of RAM and input/output addresses, all bus signals buffered by Schmitt trigger bus buffers.	Z80 A-ECB/C8 Z80-ECB/C8
ECB/Z	Single Board Computer with Z80A-CPU, crystal clock, all bus signals buffered by Schmitt triggers, address decoder for full memory extension, six sockets for 2716/2732 EPROMs for a maximum of 16 kbytes of PROM, 16 kbytes of on-board dynamic RAM.	Z80 A-ECB/Z
ECB/A	Hardware arithmetic processor, includes hardware supported floating point and fixed point arithmetic (1 Z80A-CPU, 3 write/read-only memory and am9511 hardware arithmetic chip), also includes software on diskette (please specify whether PSI80 diskette resident software or Zilog ZDS resident software is desired). This board should be used in time critical applications and those where arithmetic operations are used extensively.	Z80 A-ECB/A-P Z80 A-ECB/A-Z

MEMORY BOARDS

ECB/D32	Dynamic RAM extension card with 32 kbytes of memory, parity checker and parity bit option. Single + 5 V power supply required.	Z80 A-ECB/D32 Z80-ECB/D32
ECB/D16	Same as ECB/D32, but with 16 kbytes of dynamic RAM.	Z80 A-ECB/D16 Z80-ECB/D16
ECB/D8	Same as ECB/D32, but with 8 kbytes of dynamic RAM.	Z80-ECB/D8
ECB/E	Memory extension including 1 kbyte of static RAM and sockets for a maximum of 8 kbytes of PROM (i2708/HM 7641/HM 7681).	Z80 A-ECB/E Z80-ECB/E
ECB/E16	Memory extension including 1 kbyte of static RAM (extendable to up to 4 kbytes) and sockets for a maximum of 16 kbytes of read only memory (i2758, i2716).	Z80-ECB/E16
ECB/E64	Memory extension including 4 kbytes of static RAM and sockets for a maximum of 64 kbytes of read only memory (most types of 8/16/32-kbit PROM's and EPROM's may be used).	Z80 A-ECB/E64
ECB/V	4 kbyte static RAM CMOS board, nonvolatile memory with on-board battery and memory protection switch.	Z80 A-ECB/V Z80-ECB/V
ECB/BM	Bubble memory extension, with bubble memory controller and 1 megabit of bubble memory, provides a total capacity of 128 kbytes of nonvolatile read/write bubble memory.	Z80 A-ECB/BM

DIGITAL I/O-BOARDS

ECB/I	Input/output-extension providing 40 parallel input/output lines (2×Z80(A)/PIO) handshaking lines, 4 counter-timer channels (1×Z80(A)/CTC), wire-wrap area with 9 free 16 pin sockets for customer designed interfaces.	Z80 A-ECB/I Z80-ECB/I
ECB/O	Input/output board for opto-isolated input/output, with 8 output and 8 input lines, may be extended by piggy-back boards.	Z80 A-ECB/O
ECB/OE	Same as ECB/O, but including 16 opto-isolated input lines; may be extended by piggy-back boards.	Z80 A-ECB/OE
ECB/OA	Same as ECB/O, but with 16 opto-isolated output channels.	Z80 A-ECB/OA
ECB/OEE	Piggy-back extension for ECB/O, ECB/OE or ECB/OA, contains 16 opto-isolated input channels.	Z80 A-ECB/OEE
ECB/OAA	Piggy-back extension for ECB/O, ECB/OE or ECB/OA, contains 16 opto-isolated output channels.	Z80 A-ECB/OAA
ECB/T	Counter/timer-module, containing 3 Z80A-CTC's and 1 am9513 counter/timer circuit, giving a total of twelve bit counter/timers with 8 bit prescalers and three 16 bit programmable counter/timers, 4 sockets for user specific interfaces are available.	Z80 A-ECB/T
ECB/TC	Same as ECB/T, but includes in addition a battery buffered hardware calendar.	Z80 A-ECB/TC
ECB/X232	Serial input/output extension, includes 2 serial channels with RS232C serial interfaces, asynchronous or synchronous operation, supports HDLC, SDLC, Bisync and other hardware protocols, uses 2 Z80 A-SIO's, may be extended by piggy-back boards.	Z80 A-ECB/X
ECB/X449	Same as ECB/X, but with 2 RS449 interfaces.	Z80 A-ECB/X449
ECB/XE232	Piggy-back extension for ECB/X board with 2 additional RS 323 interfaces.	Z80 A-ECB/XE232
ECB/XE20	Piggy-back extension for ECB/X boards including 220 mA interfaces.	Z80 A-ECB/XE20
ECB/XE449	Piggy-back extension for ECB/X boards including 2 RS449 interfaces	Z80 A-ECB/XE449
ECB/XCxx	Serial input/output boards, as in ECB/X series but with 25 pin CANNON connectors mounted directly on the ECB board.	Z80 A-ECB/XCxx
ECB/F	Parallel and serial input/output module, may be used as floppy disk controller for a maximum of (one Z80(A)SIO, one Z80(A)PIO, one Z80(A) CTC. 8 hard sectored single density floppy disk drives.	Z80 A-ECB/F Z80-ECB/F
ECB/B	IEC/IEEE488 bus interface/controller for ECB-based computer systems or PSI80 systems (ECB/B-P) with software for ECB systems on ZDS-1 diskette (ECB/B-Z).	Z80 A-ECB/B-P Z80 A-ECB/B-Z
ECB/CV	Colour Display Video Interface VIDEOTEXT/BILDSCHIRMTEXT/PRESTEL compatible.	Z80 A-ECB/CV
ECB/CVG	Graphics Expansion for color display board Z80 A-ECB/CVG.	Z80 A-ECB/CVG

ANALOG I/O BOARDS

ECB/AE16	Analog input/output board, with 16 analog inputs and 1 analog output, all channels have 12 bit resolution and 30 ms conversion time, $\pm 15V$ power supply.	ECB/AE16
ECB/AA4	4 analog outputs, on-board voltage converter, 12 bit resolution.	ECB/AA4

MEMORY AND I/O EXTENSION BOARDS

ECB/S	Memory and I/O extension with 4 kbytes of static RAM (extendable to up to 8 kbytes), 32 parallel input/output lines and 8 handshake lines ($2 \times Z80(A)$)-(PIO).	Z80A-ECB/S Z80-ECB/S
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Accessories for ECB-Systems

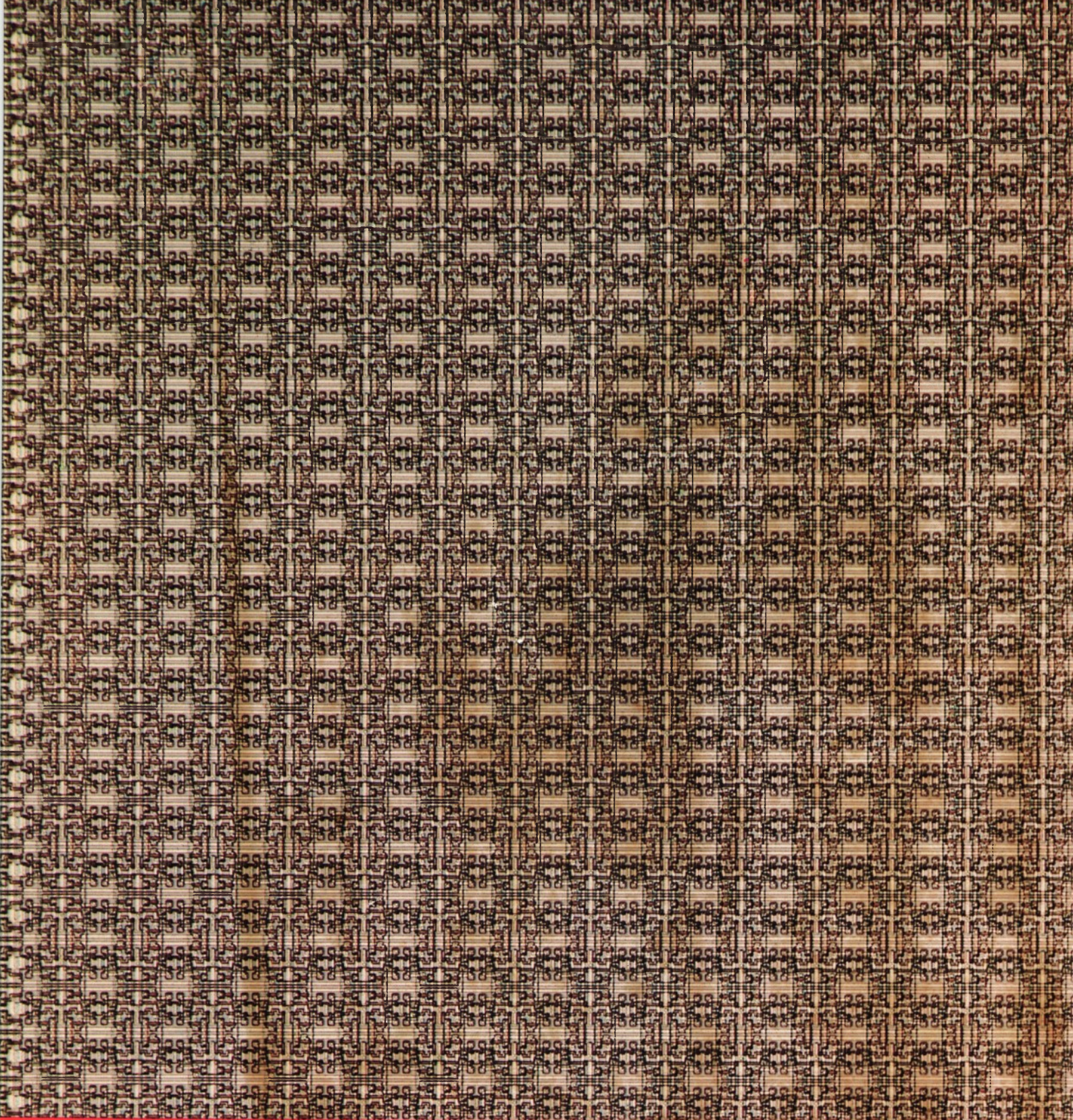
ECB/R	19 inch standard rack for clock frequencies up to at least 4 MHz, 18 slots and additional slot for power supply, ready-wired for reset synchronization (circuitry not provided on the standard board), high quality solution with 4 layer back plane.	ECB/R
ECB/RB	Back plane board used in the ECB/R without mechanical parts.	ECB/RB
ECB/W	Wire-wrap board compatible with ECB series.	ECB/W
ECB/Y	Bus extender board.	ECB/Y
ECB/K25	Flat cable for 25 pin CANNON connector, cable length about 250 mm, suitable for all ECB boards except ECB/AA4 and ECB/AE16.	ECB/K25
ECB/K34	Flat cable and connector 34 pin, cable length about 250 mm, for use on ECB/AA4 and ECB/AE16 boards.	ECB/K34

ECB Power Supplies

ECB/N1	Switching mode power supply for use in ECB/R, provides 3.5 A at + 5V.	ECB/N1
ECB/N2	Switching mode power supply for ECB/R, provides 3.5 A at + 5V, .25 A at - 15 V and .25 A at - 15V.	ECB/N2
ECB/N4	Power supply for ECB/R, provides 3.5 A at + 5V, .3 A at + 12V and .7 A at - 5V.	ECB/N4
ECB/N5	Power supply for ECB/R, provides 3.0 A at + 5V, .3 A at + 12V and .3 A at - 12V.	ECB/N5

Operating Software for Microcomputer Boards

ECB/MON	2 kbyte monitor/operating/test program for ECB/C8, PROM resident (ECB/MON-P) including listing or on ZDS-1 diskette (ECB/MON-Z).	ECB/MON-P ECB/MON-Z
ECB/EXT	Operating software for extension of ECB/MON by 2 additional kbytes, for control of floppy disk systems using ECB/F and ECB/C8, PROM-resident (ECB/EXT-P) including listing or on ZDS-1-diskette (ECB/EXT-Z).	ECB/EXT-P ECB/EXT-Z
ECB/18	1 kbyte monitor/operating/test-program for ECB/C8, PROM-resident including listing.	ECB/18
ECB/18-TV	1 kbyte monitor/operating/test-program for ECB/C8 and ECB/VID via ASCII-keyboard and video monitor, PROM-resident including listing.	ECB/18-TV
Z80-SAP	Standard arithmetic programs, fixed point arithmetic and conversion routines, source-code on ZDS-1 diskette.	Z80-SAP
Z80-FPA	Floating point software: add, subtract, multiply, divide and square root, BCD/Binary and Binary/BCD Conversion. Source code on ZDS-1 diskette.	Z80-FPA
Z80-EAP	Floating point extended arithmetic package, for extension of Z80-FPA, includes trigonometric high level arithmetic and statistic functions, source code on ZDS-1 diskette.	Z80-EAP
Z80-MTX	Multitask Real Time-Monitor	Z80-MTX



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