AccessionIndex: TCD-SCSS-T.20141006.001
Accession Date: 6-Oct-2014
Accession By: Dr.Brian Coghlan
Object name: Motorola MEX68KDM Design Module
Vintage: c. 1979
Synopsis: MC68000 evaluation board, including documentation. S/N: 3183.

Description:
The MEX68KDM M68000 Design Module was an evaluation and debug board
introduced by Motorola Microsystems in 1979 to foster the development of 68000-
based microprocessor systems. Related software and documentation was released over
the next year.

The 68000 microprocessor was Motorola's third-generation CPU, following on from
the 6800 and 6809. Its 32-bit internal architecture included 16 x 32-bit registers, eight
for data and seven for address manipulation, and two system stack pointers, as well as
PC and status registers. All data and address registers could be employed as index
registers and all address registers could be employed as user stack pointers. Five basic
addressing modes were provided, but actually fifteen modes when all the variations
were considered. Also, five basic datatypes were supported: bits, 4-bit BCD, 8-bit
bytes, 16-bit words and 32-bit longwords. Two levels of privilege were provided, and
unusually for its time, 192 interrupt trap vectors were provided. Although nominally a
clean RISC-style architecture, the 68000 controlpath had about 1000 states, handling
about 1000 opcode combinations. Externally it provided 16-bits of data and 24-bits of
address (allowing 16MB of memory) on an asynchronous address/data bus, plus seven
vectored priority interrupts. Unlike DEC and Intel architectures, but like those of
IBM, addressing was big-endian.

The design module provided a 68000 CPU, 8kB of BIOS ROM, 32kB DRAM, 2 x
16-bit parallel I/O ports, 2 x RS-232C serial ports, and 3 x programmable timers. The
BIOS (MACSBUG) was an interactive debugger and host utility. It also allowed
download of cross-compiled programs for execution by the design module.

The design module was constructed on an oversized EXORbus PCB, see Fig.20 and
Fig.21 for pinouts. The EXORbus evolved as a proprietary Motorola board format for
PCBs for the MC6800 and MC6809 microprocessors. For the MC68000 it was soon
superceded by the proprietary Motorola Versabus format with Eurocard dimensions
and edge connectors, which then was quickly standardised as the VME board format
but with Eurocard connectors. A preliminary Versabus specification was supplied
with this design module, see Fig.9.

The module was supplied with documentation, which is properly part of the literature
category of this catalog, but is listed here too for convenience.

Accession Index	Object with Identification
TCD-SCSS-T.20141006.001	Motorola MEX68KDM M68000 Design Module. Includes: Motorola MC68000L4 'TGE8019' CPU Motorola MC3480P dynamic memory controller Intel D3242 memory interface 16 x Motorola MC4116AC20 16k x 1-bit DRAMs Motorola MC14411 bit rate frequency generator Motorola MC6821P parallel I/O interfaces Motorola MC6850P serial interface Motorola MC6840P programmable timer P/N: 84EW6791X01 ISS C, 01EW1791X01 ISS L S/N: 3183 BAD 2489 Copyright 1979 by Motorola Inc., Motorola Microsystems.
TCD-SCSS-V.20141006.001.01	M68K BUS (D1) Versabus Preliminary Specification. Nov-1979.
TCD-SCSS-V.20141006.001.02	M68K MBUG (D2) MACSbug Initialisation and I/O Routines. Jan-1980.
TCD-SCSS-V.20141006.001.03	MEX68K DM (D3) MC68000 Design Module User's Guide. Jan-1980.
TCD-SCSS-V.20141006.001.04	Motorola MC68000 brochure, p1-8.

References:

1. Bitsavers EXORbus documents and brochures,
   http://bitsavers.trailing-edge.com/pdf/motorola/6800/exorciser/
   Downloaded 18-May-2015.

See the extensive set of documents in the related folder in this catalog.
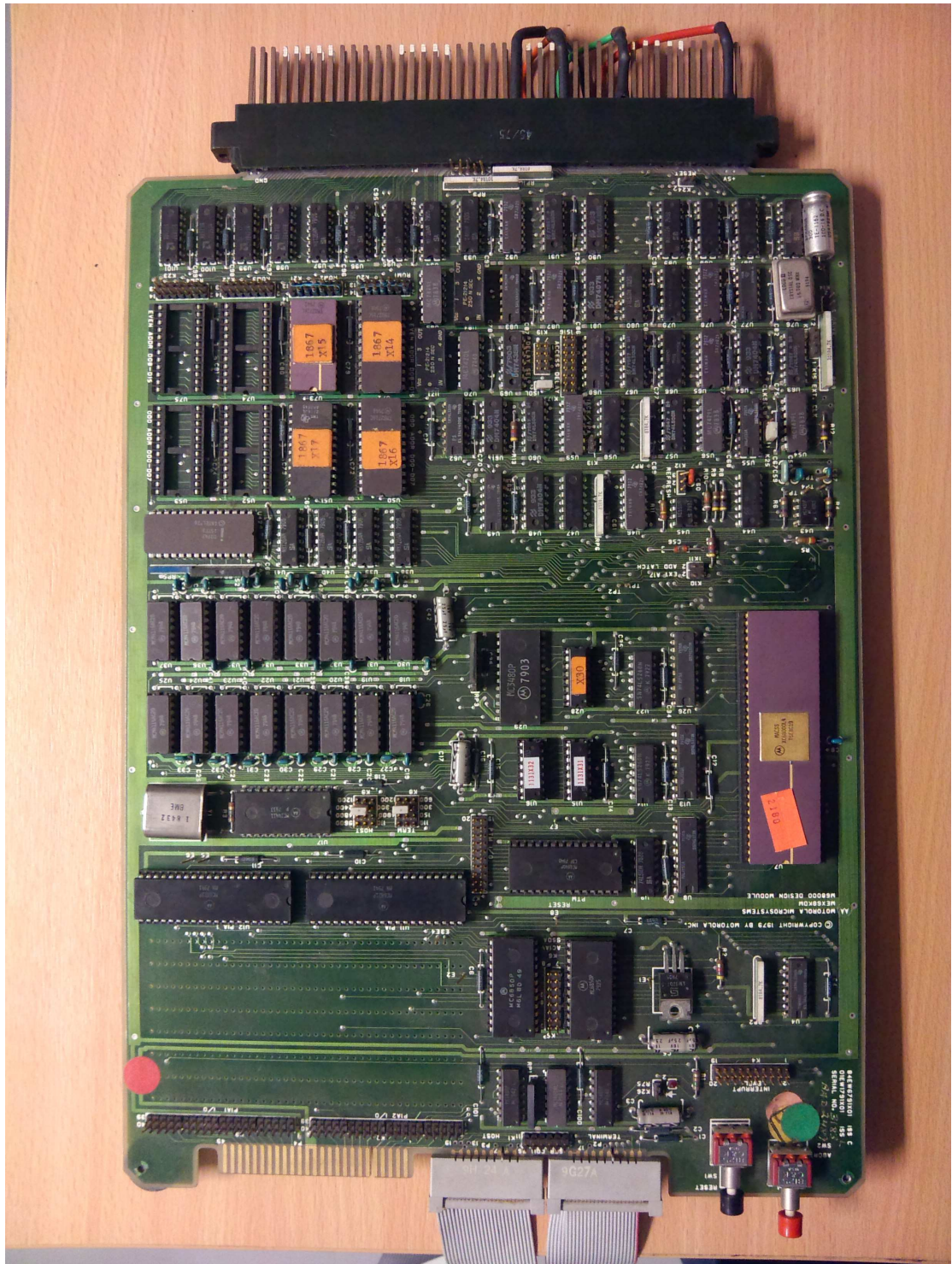
Figure 1: Motorola MEX68KDM top view
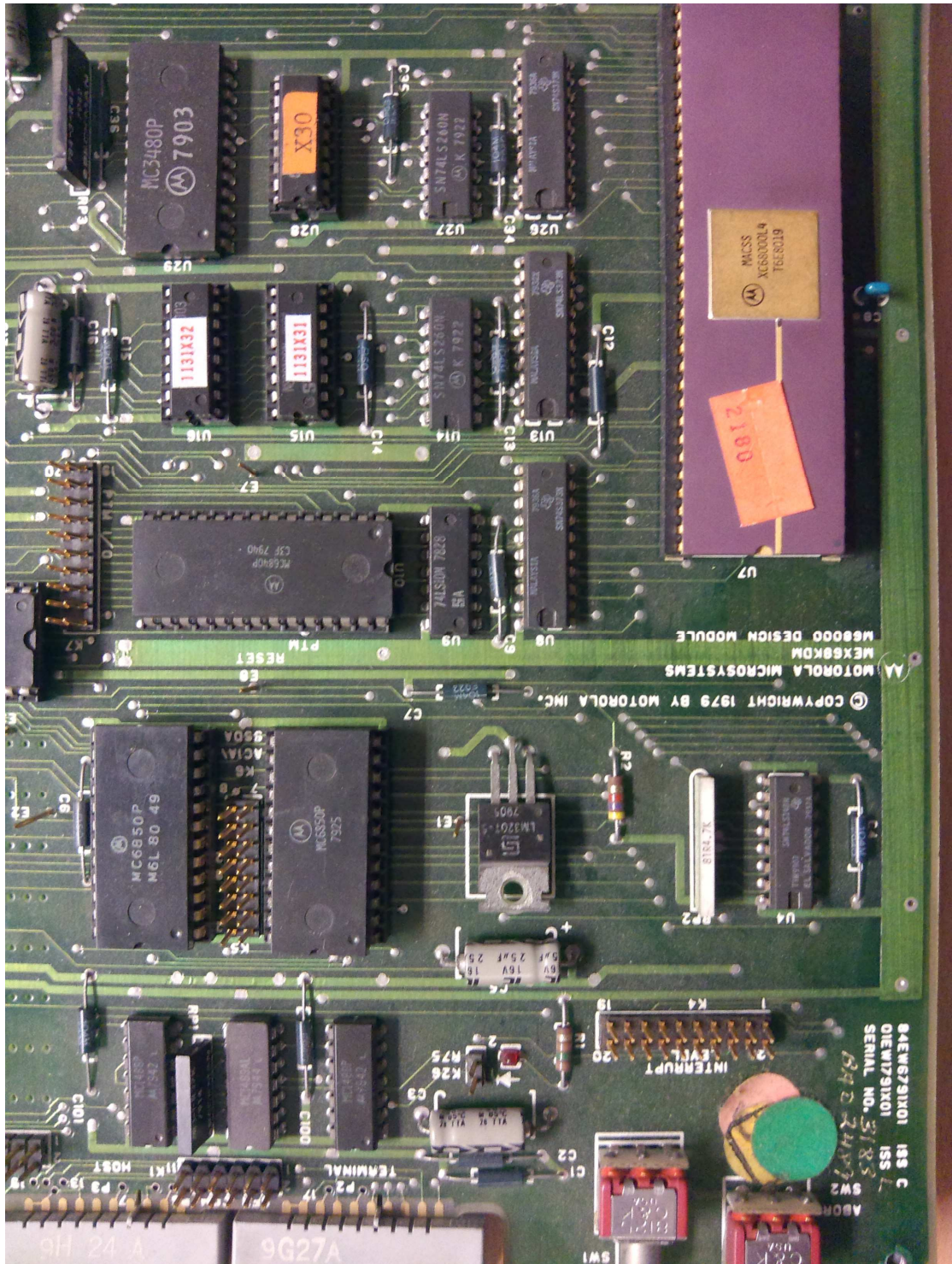
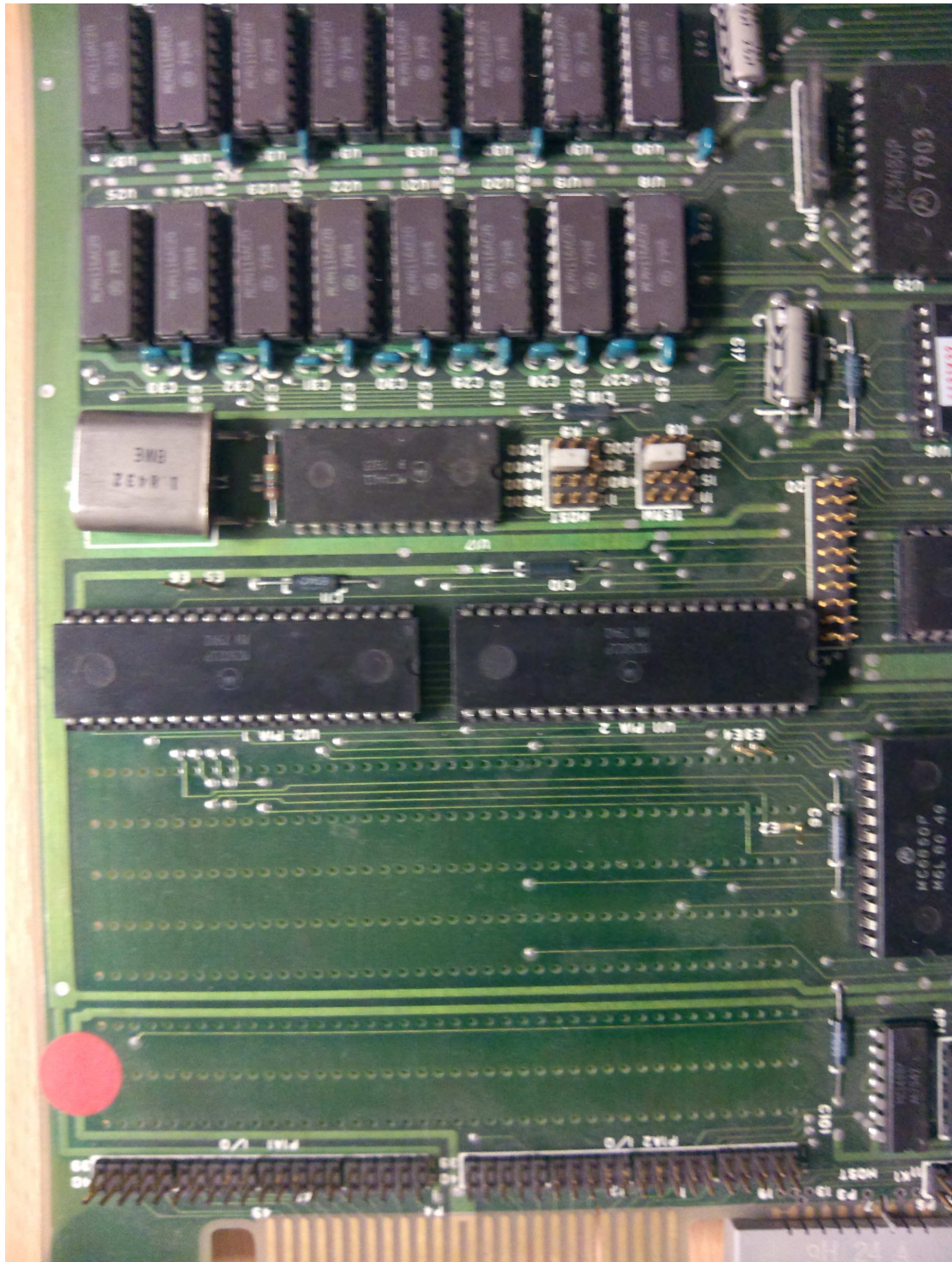*Figure 2: Motorola MEX68KDM top front right view*
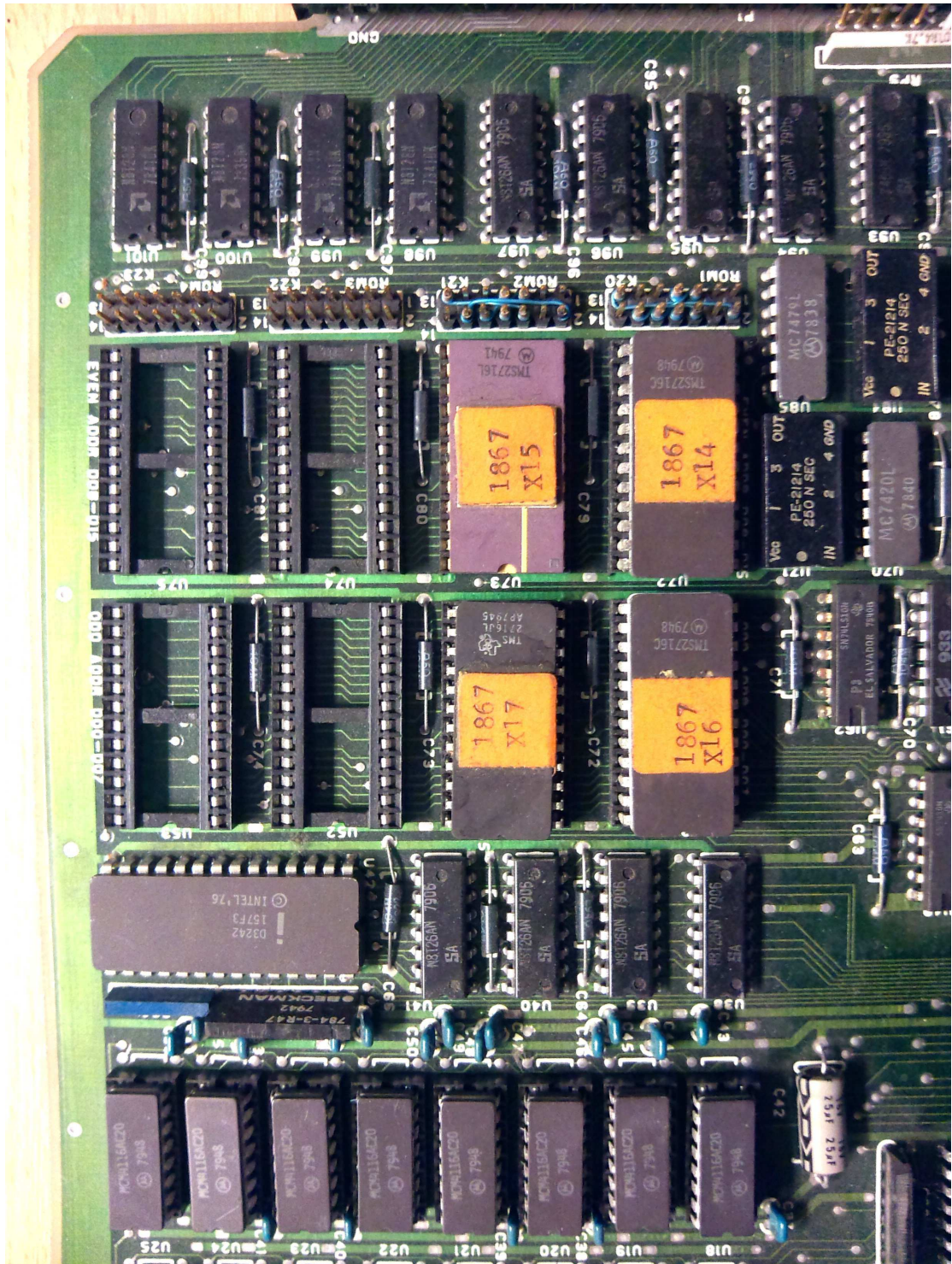
Figure 3: Motorola MEX68KDM top front left view
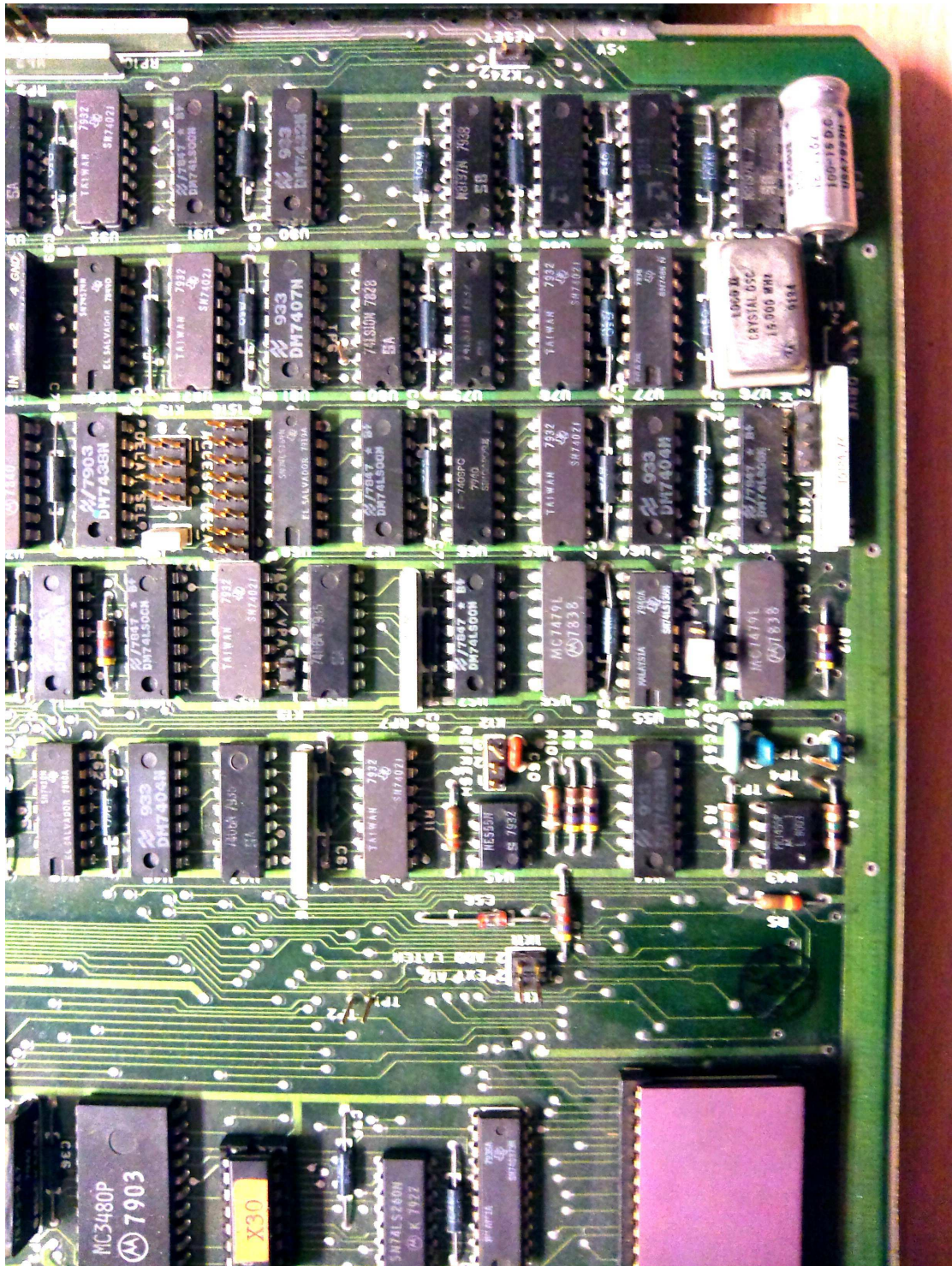
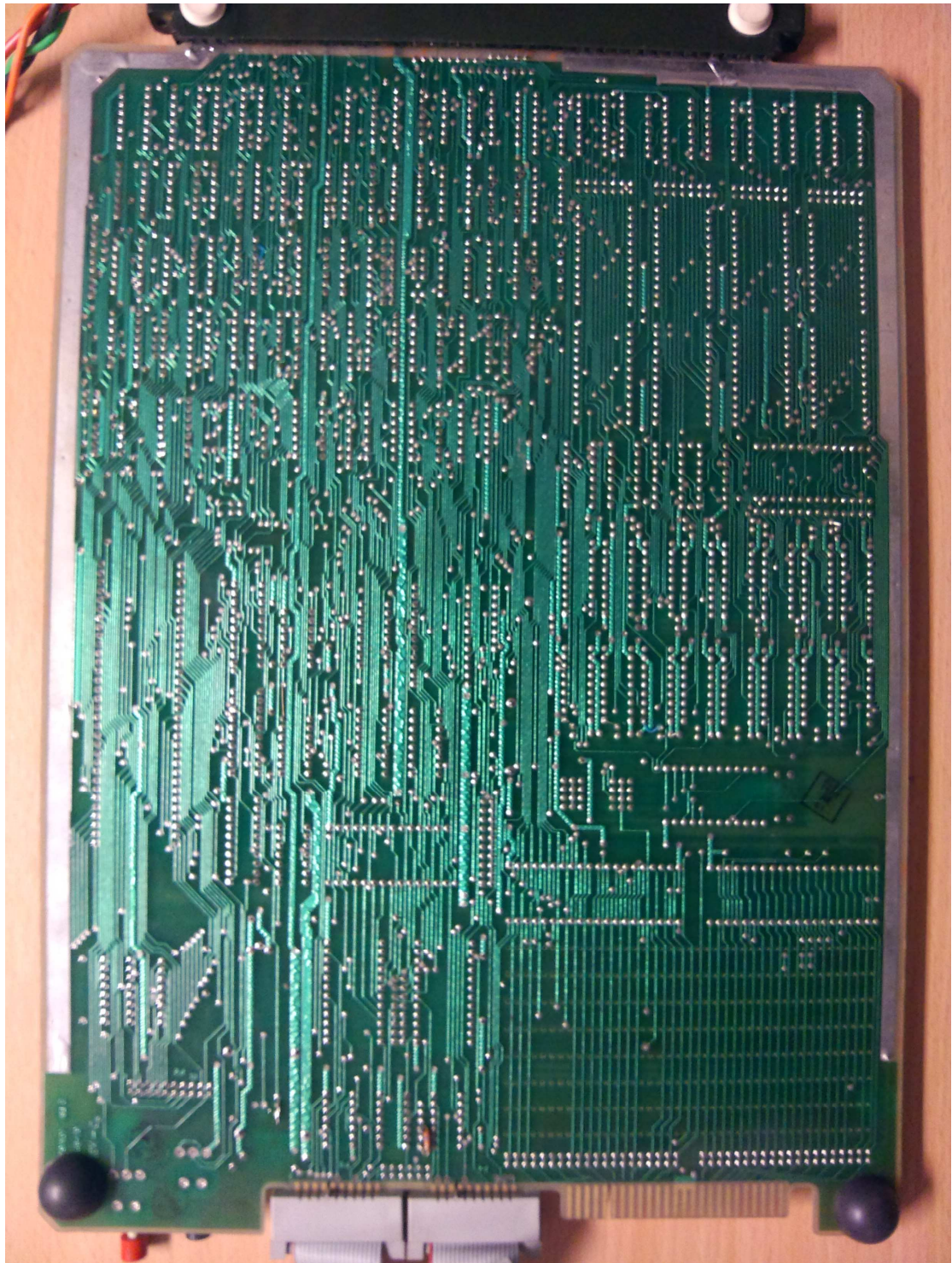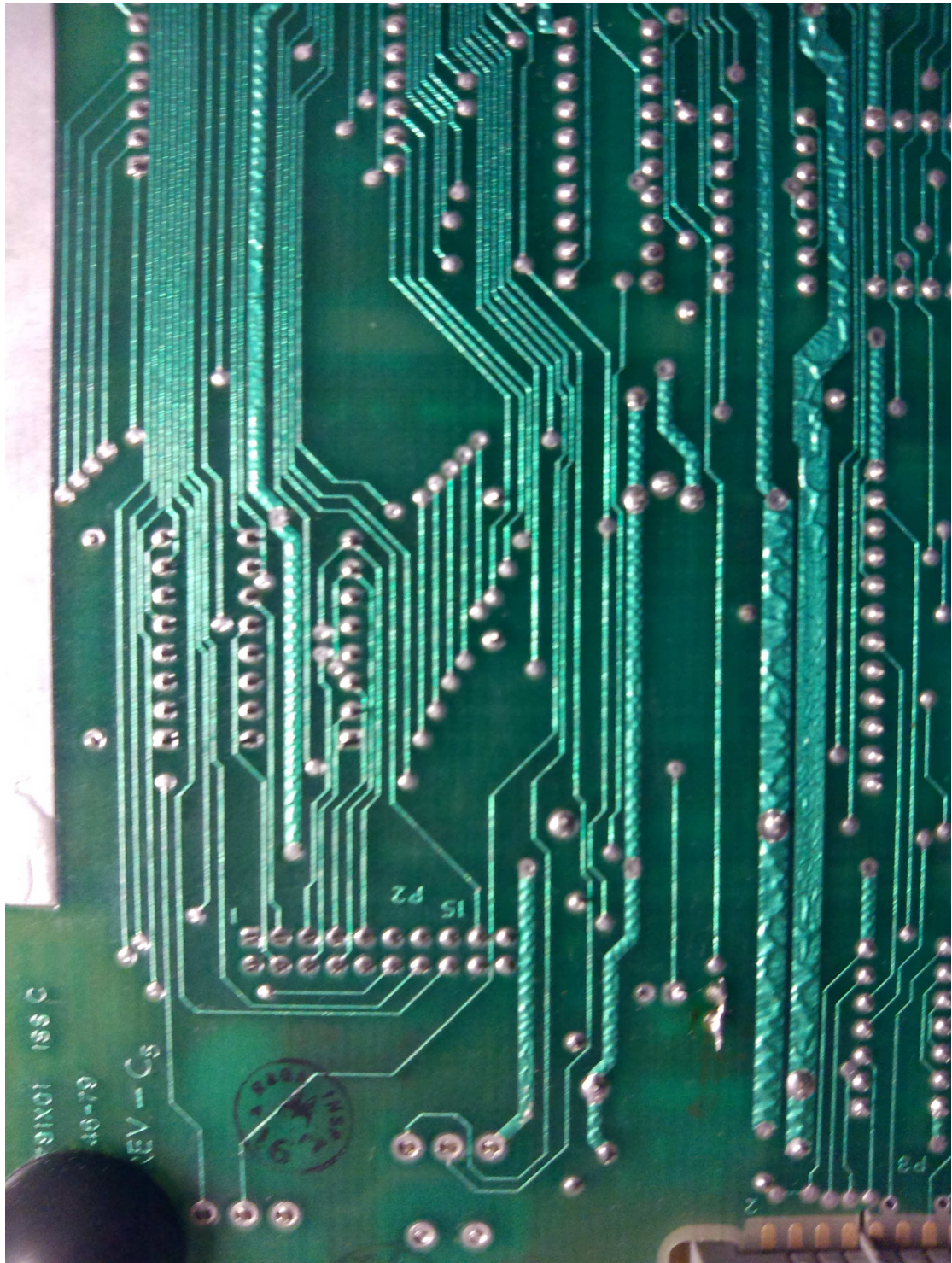*Figure 4: Motorola MEX68KDM top back left view*

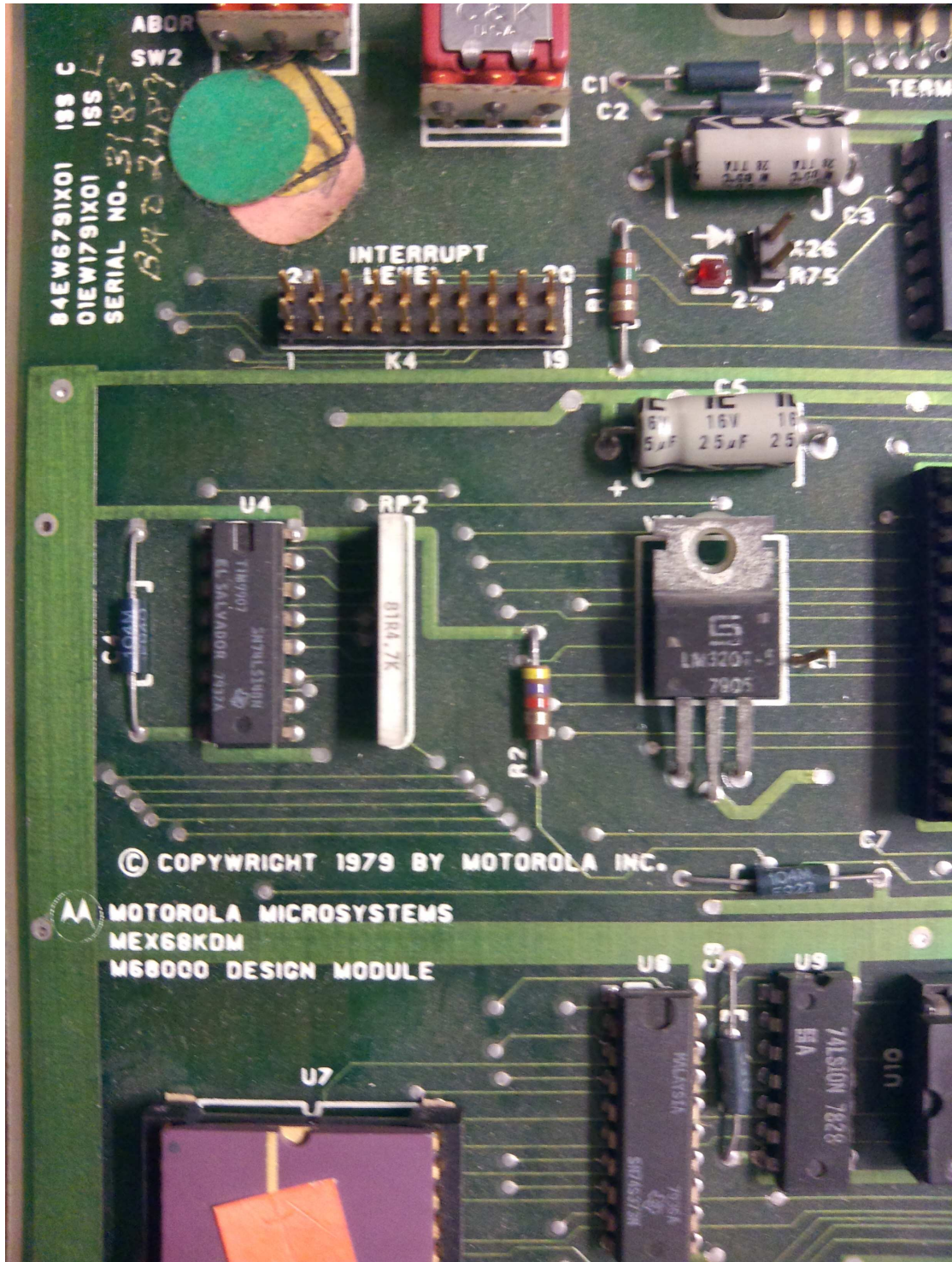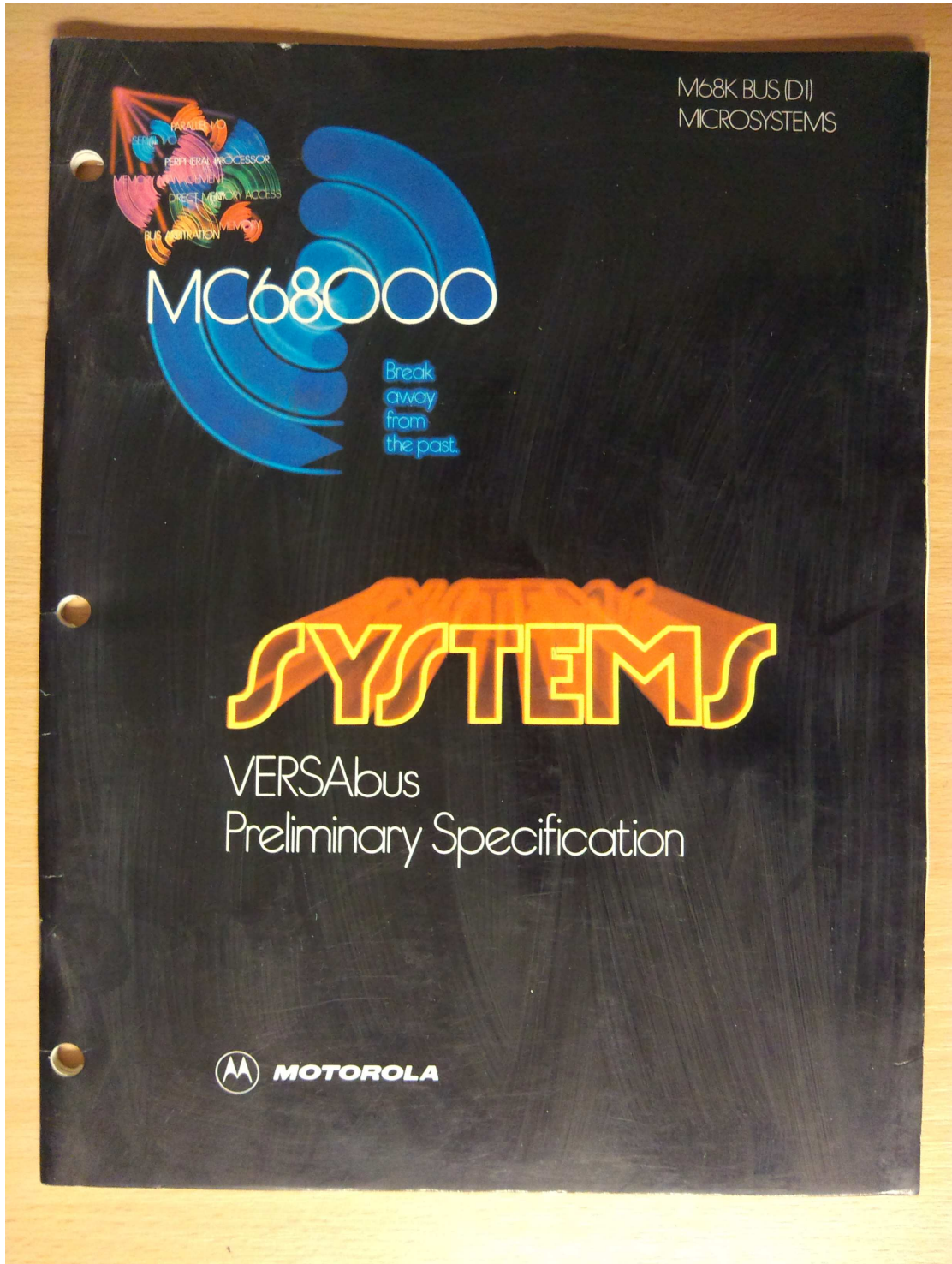*Figure 5: Motorola MEX68KDM top back right view*

Figure 6: Motorola MEX68KDM rear view

Figure 7: Motorola MEX68KDM rear closeup

Figure 8: Motorola MEX68KDM manufacturing label
P/N: 84EW6791X01 ISS C, 01EW1791X01 ISS L
S/N: 3183 BAD 2489
Copyright 1979 by Motorola Inc.
Motorola Microsystems
MEX68KDM
M68000 Design Module

Figure 9: Motorola M68K BUS (D1) Versabus Preliminary Specification
Nov-1979

Figure 10: Motorola MBUG (D2) MACSbug Initialisation and I/O Routines Jan-1980
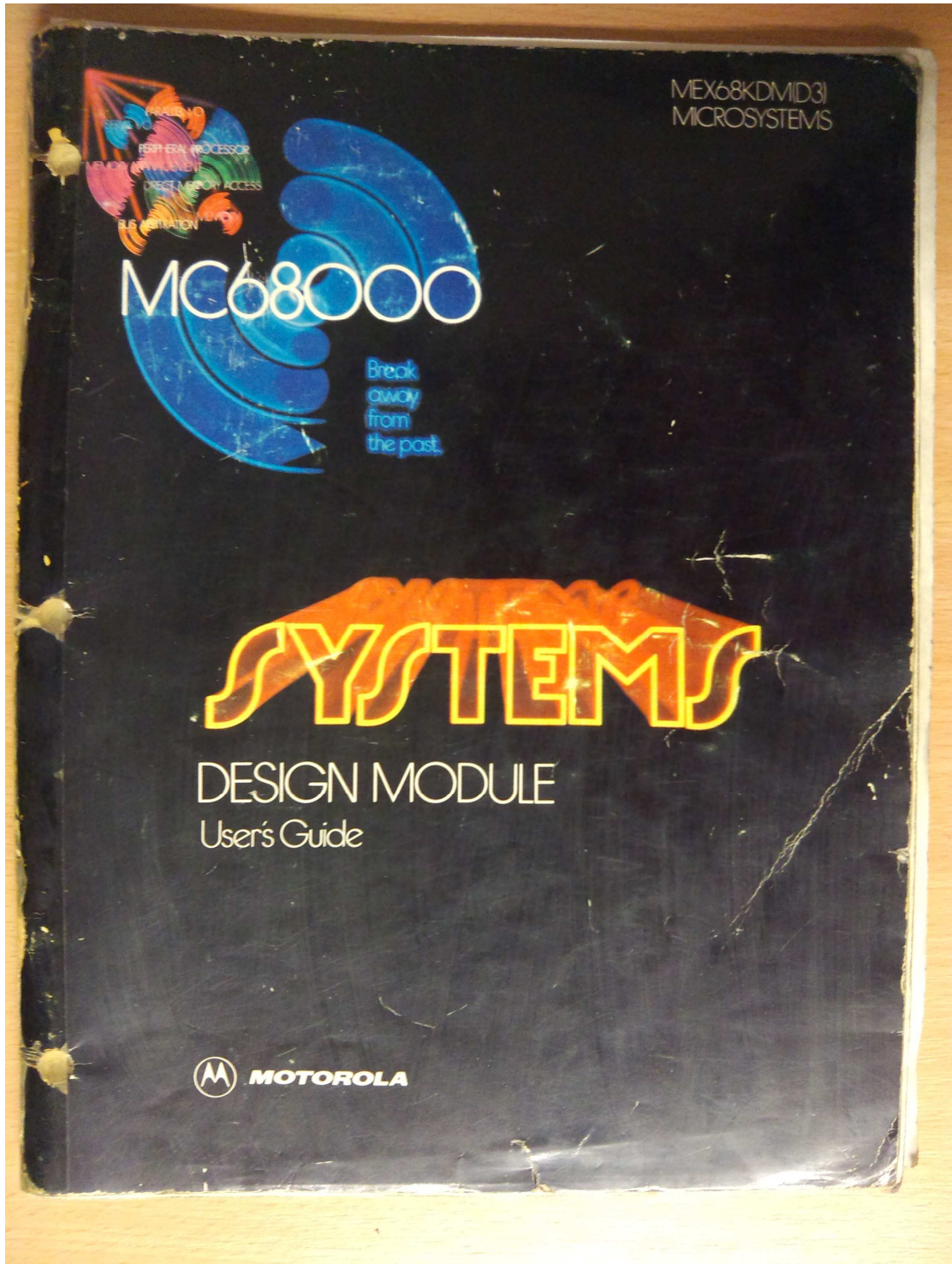
Figure 11: Motorola MEX68K DM (D3) MC68000 Design Module User's Guide Jan-1980
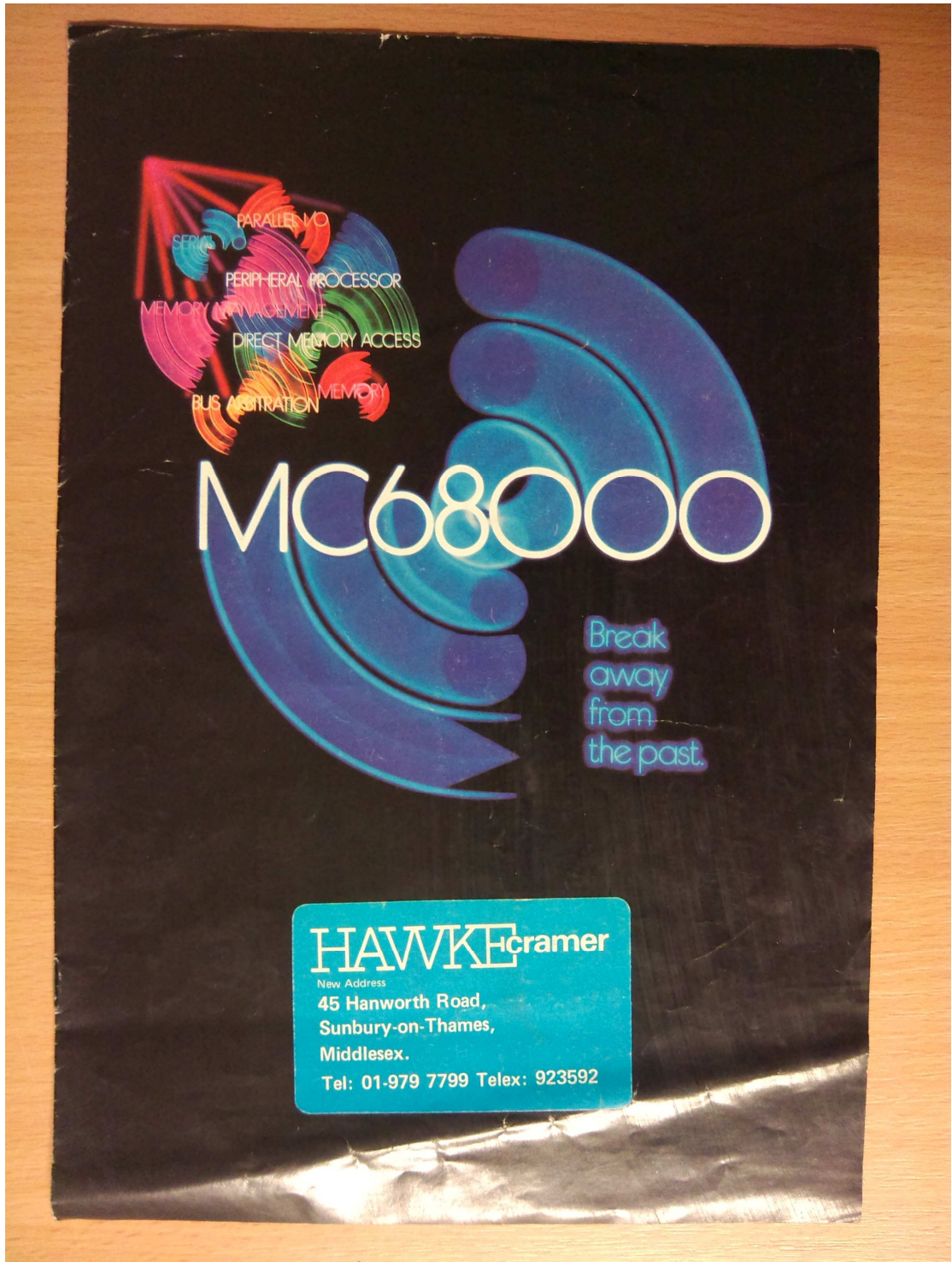
Figure 12: Motorola MC68000 brochure p.1

Motorola's MC68000 sets new MPU system performance standards for the '80s. Now.

Motorola announces a new microprocessor so advanced in concept it offers the designer virtually unlimited freedom of system design. Advanced technologies provide it with a speed/power product four times that of standard NMOS. Break away from the past and step into the new era of microprocessors.

Everything you need for system design is available now—a Design Module for evaluating the MC68000, development hardware and software, full documentation and training. In addition, the MC68000 interfaces directly and easily with existing M6800 Family peripherals, MPUs, and MCUs.

The MC68000 is, by design, perfect for an easy-to-handle, block-structured, high-level language like PASCAL. It simplifies modern programming techniques like modular programming.

Big software saving.

Because painstaking effort was taken to develop a regular, consistent, new architecture for the MC68000—registers, addressing modes, even data types—programming time and program storage space are significantly reduced. Your net result is great reduction in both cost and risk of software development.

Writing programs, whether with PASCAL or with assembly language, is simpler with this consistent MC68000 structure. No separate, special instructions are necessary for operation on byte, word and long-word integers. You remember just one mnemonic for each type of operation and specify the data size, source addressing mode and destination addressing mode.

Most sophisticated architecture.

The MC68000 is the first advanced 16-bit microprocessor with a 32-bit internal architecture, and the first with 16-megabyte direct memory addressing, without segmentation. Its 32-bit registers include eight for data, seven for address and two system stack pointers, supporting larger word sizes and holding great promise for future systems.

All data and address registers may be used as index registers and all address registers may be used as stack pointers to reduce programming bottlenecks.

The five basic addressing modes actually add up to 15 modes when all variations are considered. These addressing modes combine with the MC68000 instructions to provide over 1,000 usable op code combinations.

Powerful instructions are instrumental, but other factors like pipelining and the 32-bit internal registers also play vital roles in achieving the MC68000's system throughput of up to two million instructions and data transfers per second.

Extensive, detailed study of many actual programs—assembly language, high-level language, compiler generated—led to the powerful yet simple and easy-to-use instruction set.

Five basic data types are supported: bits, BCD digits, bytes, words and long words. The multiply and divide instructions are the fastest available in a general-purpose microprocessor. LINK and UNLINK reduces subroutine calling overhead.

The Move Multiple Registers instruction easily saves any or all of the registers' contents. Many instructions operate memory-to-memory. All of the arithmetic and multiple shift and rotate instructions can use 8-, 16- or 32-bit operands.

Traps and vectored interrupts.

Among the many user-oriented advantages of the MC68000 is the extensive use of traps and vectored interrupts. Seven prioritized interrupts are provided, and 192 interrupt address vectors are available. Traps are available to catch improper operations and for use as software interrupts.

Emphasis on system integrity and security is a vital aspect of the MC68000. The Test And Set instructions provide lockout features for handling resource allocation with software. Privileged instructions, supervisory or user operation, and traps generated on unauthorized activity all contribute to system security.

Ask for complete information today.

Call your Motorola sales office or distributor, or use the reply coupon on the back page, for all the details on how to break away from the past and build your

Innovative systems through...

Figure 14: Motorola MC68000 brochure p.3

Complete M68000 design support available now.

Concurrent with introduction of the MC68000, the design tools to help you break away from the past are now available.

A major commitment to development of timely and effective M68000 hardware and software has been part of the program from the beginning. The results, part innovation and part evolution, give you a choice among Motorola's EXORciser®, the IBM 370 and the PDP*-11 for system hardware and software development.

M68000 Design Module for EXORciser.

Just as the MC68000 can spark a new systems generation, so the M68000 Design Module leads the familiar EXORciser® family into high-performance support products.

The Design Module permits chip evaluation using either an EXORciser® system or in a stand-alone mode in conjunction with cross computer software. For system emulation, the module includes 32K bytes of RAM, two 16-bit parallel I/O ports, three 16-bit programmable timers, two serial RS-232 ports and 8K bytes of debug ROM.

MACSBUG, the innovative debug tool.

The M68000 Design Module includes MACSBUG™, one of the most powerful 16-bit microprocessor debug tools anywhere. This innovative monitor offers an extensive assortment of new debug modes: symbol referencing and printing, offset addressing, calls to user utility routines, host computer communications, effective address window to memory data, and trace display selection.

Download—option for software development.

The capability to download to the Design Module allows software designers to use their own in-house computer as well as an EXORciser® for MC68000 software development.

It's a simple yet effective method for accepting host-computer-generated programs for direct debug execution by the M68000 Design Module.

PASCAL—here now for the MC68000.

Another way for you to break away from the past is with PASCAL, and its machine independent software compatibility. This high-level language, destined for systems of the '80s, is here now for the MC68000.

PASCAL for the MC68000 gives you the benefits of structured programming techniques, modularity, simplified debug, maintainability, self-documentation and easy modification of this user-oriented language.

*Trademark of Digital Equipment Corporation.

You'll get lower implementation cost, portability to protect your software investment and shorter system design cycles.

PASCAL cross compilers are available now for your EXORciser®, IBM 370 or PDP*-11.

EXORciser design support protects investment.

The EXORciser®/EXORterm™ system continues to be the most comprehensive microcomputer design tool, with User System Emulation (USE), and extensive software library and I/O design modules and peripherals. The system supports all M6800 Family MPUs and MCUs—plus the M3870, M2900, M10800—and now the M68000.

A technical library of more than 100 manuals supports the EXORciser®.

An extensive series of comprehensive, easy-to-follow data sheets and manuals is available now to provide assistance in designing with the MC68000.

More for the future.

Because of the uniqueness of M68000 architecture and performance, we are creating an all-new development system optimized for the 16/32-bit microprocessor.

High performance software, hardware and an advanced bus structure are key features.

EFCIS to second-source 68000 in Europe

Continuing its wide-ranging technical agreement with Motorola, EFCIS (a joint venture of Thomson-CSF and the French Atomic Energy Agency) have moved into the new phase of HMOS high-level process technology to second-source the MC68000 family. EFCIS already produces the 8-bit 6800 microprocessor devices and its associated memory parts.

This new agreement with EFCIS, coupled with those of Hitachi and North American Rockwell, confirms our determination to provide customers with the best possible network of second source suppliers in all world markets. These programmes will be supported by Motorola worldwide production facilities, including our European MOS Centre at East Kilbride, Scotland.

Motorola offers you total support for the development of

Innovative systems through silicon.

Figure 15: Motorola MC68000 brochure p.4

Figure 16: Motorola MC68000 brochure p.5

Motorola offers the total range of microcomponents for your advanced systems.

Motorola's original M6800 Family pioneered the concept of the fully-compatible, matched set microprocessor plus I/O, peripheral controller and memory family, complete with support hardware, software and training.

The MC68000 springs from a rich tradition in both microcomponents and MOS technology and is designed to develop in the same total family way as the M6800 Family.

Pace-setting products like the MCM6664 64K dynamic RAM, the MC6809 super 8-bit microprocessor, and the definitive MC6801 and M6805 Family one-chip MCUs have firmly established Motorola's capability.

MC6801—the most advanced single-chip MCU

Power, speed and unique multimode design flexibility put the MC6801 8-bit single-chip MCU in a class by itself. It represents an unprecedented state-of-the-art advance in design convenience.

It's general purpose in application, high in performance and packs maximum function on the chip. On-chip functions with the CPU include 2K bytes of ROM, 128 bytes of RAM, 31 parallel I/O lines, a serial communications I/O port, a clock and a 16-bit timer.

In addition to its single-chip, expanded multiplexed and expanded non-multiplexed modes, other modes are used for testing and special operations. Each is built in and user selectable.

MC68701—the user-programmable MCU.

It's a variation on the MC6801, with user programmability built in via replacement of on-chip ROM with 2K bytes of EPROM.

The MC68701 is ideal for prototyping because the control program is easily changed during development. It's also very appropriate for low-volume systems for which factory programming isn't practical, for initial field test units of a user's system and for systems requiring field programming.

MC6805—the answer for low-cost controllers.

The HMOS MC6805P2 is the first in a family of cost-effective HMOS and CMOS single-chip 8-bit microcomputers providing you with a level of performance never before available in this price class.

The M6805 Family brings relief for designers who require better performance with low cost for simple industrial and high-end consumer control applications.

MC6809—most powerful general-purpose 8-bit MPU.

The 8-bit MC6809 is the most powerful microprocessor of its generation and provides a bridge to the 16-bit world by including many 16-bit features in its internal architecture. The '6809 is designed to take full advantage of block-structured, high-level languages like PASCAL. And, like the MC68000, it helps immeasurably to increase software efficiency and significantly lower software development costs.

64K RAM leads memory line.

For high-performance, memory-intensive microprocessors such as the MC6809 and MC68000, Motorola has developed the single +5 V MCM6664 64K dynamic RAM, our leadership memory. It is upward compatible from the 16K RAM and provides top performance and improved reliability at low cost. Refresh control is available on pin 1.

Your choice of software.

Motorola software for both the M6800 and M68000 families offers a choice of Motorola development system or non-resident computer. In some instances, the software is available in high-level languages as well as assembly language.

The first PASCAL resident software was written for the MC6809. Now, MC68000 software uses this easy-to-handle, block-structured, high-level language.

Motorola software is also on a variety of USA and international timeshare services.

Introduction of the MC68000 and its M68000 design support continues Motorola's coverage of the total range of microcomponents for your

Innovative systems
through silicon.

Figure 17: Motorola MC68000 brochure p.6

64K RAM

MC6800 MC6805

MC68000

VLSI

MC6801 MC6809

MC68701

Figure 18: Motorola MC68000 brochure p.7

From the CMOS MC14500B single-bit processor and MC141000 4-bit single-chip microcomputer, to the M2900 and M10800 bipolar bit-slice families, to the 8-bit MC3870 and famous M6800 Family, Motorola has it all for you.

And now we offer the greatest opportunity ever in 16-bit design, with the M68000. As it always has, with Motorola, this means components, support, documentation and training. Everything. All here, now. An unparalleled offering. Ask for it today and break away from the past.

EUROPEAN MOTOROLA SEMICONDUCTOR SALES OFFICES

FRANCHISED MOTOROLA SEMICONDUCTOR DISTRIBUTORS

Cut this coupon and send to your nearest Motorola Sales Office or Distributor.

☐ Please send me your literature on the MC68000 and its design support.

Name _____ Title _____

Company _____

Address _____

EUROPEAN SEMICONDUCTOR FACTORIES

Ⓜ **MOTOROLA** *Semiconductors*

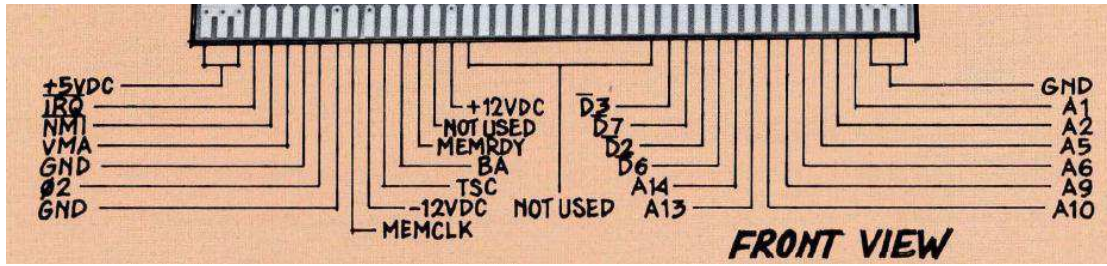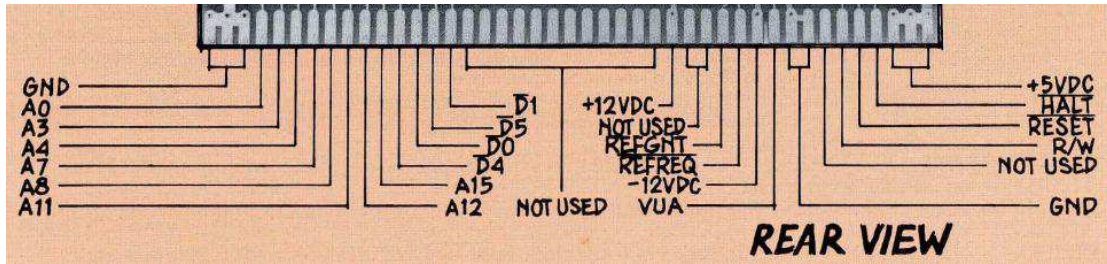*Figure 19: Motorola MC68000 brochure p.8*

Figure 20: Motorola EXORbus front pinout

Figure 21: Motorola EXORbus front pinout