AccessionIndex: TCD-SCSS-T.20151118.004
Accession Date: 18-Nov-2015
Accession By: Seamus Guiry
Object name: DEC M792E Unibus Boot ROM Board
Vintage: c.1985
Synopsis: Early diode-array ROM for booting the popular PDP-11 series made by DEC. Date-stamped: 18-Sep-1974.

Description:
There are many ways of starting a computer system, but most fall into the form of an initial program loader (*IPL*) or bootstrap (*boot*) loader. *Boot* is short *pulling oneself up by one's bootstraps*, as a small loader might load in a larger loader, and so on, over many such steps. In simpler early computers (e.g. the Interdata Model 70 in this catalog) the boot loader was a sequence of instructions manually inserted into memory, but for more elaborate systems (e.g. the IBM 360/44 in this catalog) this was reduced to a single I/O instruction that was automatically invoked on power-ON, or when a button was pressed, to input a larger boot loader from a storage device like a paper tape reader.

The advent of read-only-memories (ROMs), especially semiconductor ROMs, led to a more uniform and persistent approach that requires only a simple press of a restart (or *reset*) button to reset the system to a known initial state and begin a starting sequence stored in the ROM, leading to a desired end state (which might not necessarily be execution of an operating system, it could be diagnostics, or software update, etc).

In logic a 2^N x 1-bit ROM just exhaustively decodes all possible *minterms* of the N logic inputs. A minterm (a *product*) is simply an AND of the inputs. The output is the logic OR (a *sum*) of the minterms (i.e. it is the *sum* of the products). If there are K output bits it just means there are K ROMs packaged together, one per output bit, yielding a 2^N x K-bit ROM. The AND and OR gates can be produced in many ways, and the ROMs can be used for many purposes in logic, but also for program storage, where the inputs are the program address and the outputs are the program data.

Before the introduction of semiconductor ROMs, there were a number of technologies for implementing ROMs. For example, Bell Lab's *plated wire memory*, a grid of wires coated with iron-nickel *permalloy*, was used in NASA's *Viking* Mars landers, *Voyager* probes, *Space Shuttle*, and *Hubble* telescope. Another technology, *core rope memory*, a read-only form of core memory (see elsewhere in this collection), was used in NASA's early Mars probes and their *Apollo* guidance computer, and also in the HP9100A calculator in this collection. More usually ROMs were implemented with diode-logic gates, laid out with a 2-d array of diodes (a *diode matrix*).

The DEC M792E was an optional diode matrix read-only memory for the PDP-11 that stored a bootstrap loader of up to 32 words (64 bytes) on a matrix of 32 x 16 semiconductor diodes on a Unibus board. With all 512 diodes in place, the memory data was all at logic 1. The data was programmed by cutting off each diode that was to be logic 0. DEC also sold pre-programmed versions (the BM792-Yx series) for many standard input devices by omitting diodes as needed.

It is not known what boot loader was manually programmed into the M792E in this collection (the removal of diodes is clearly visible). The PDP-11 family became DEC's signature products, highly popular 16-bit minicomputers, beginning with the PDP 11/15 and 11/20 in 1970 and ending with the PDP 11/93 and 11/94 in 1990, when they sold the product family to Mentec in Ireland (founded by a TCD engineering graduate, Mike Pierce). The M792E in this collection is a Unibus board date-stamped 18-Sep-1974, so it was from an early model.

Thanks to Seamus Guiry, a technician in the 1980s in the Dept.Computer Science at Trinity College Dublin (e.g. see the BBC Micro in this collection), then moved to the Waterford General Hospital, who donated the M792E in this collection.

Accession Index	Object with Identification
TCD-SCSS-T.20151118.004.01	DEC M792E Unibus Boot ROM Board. Date-stamped 18-Sep-1974

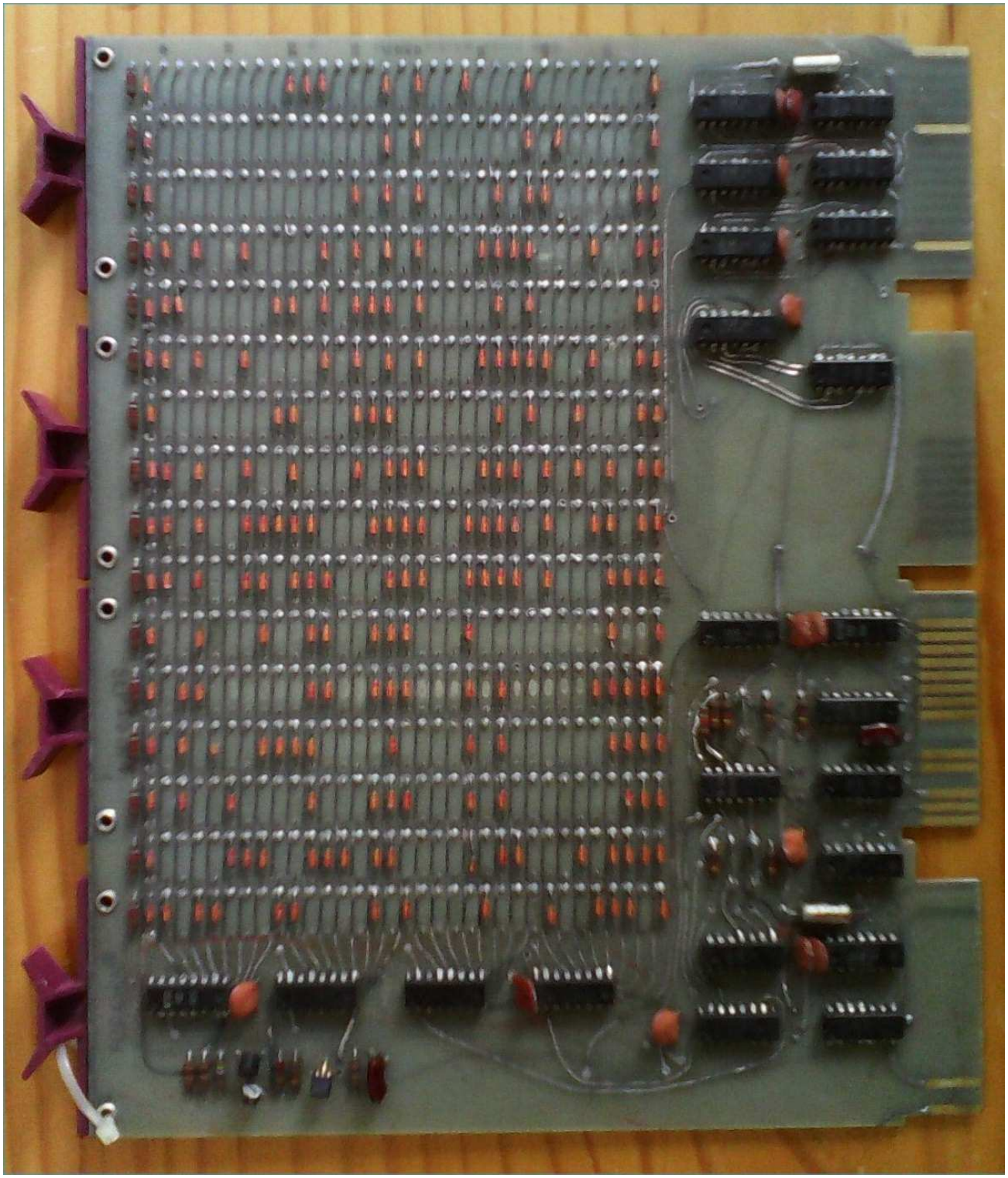

Figure 1: DEC M792E front view

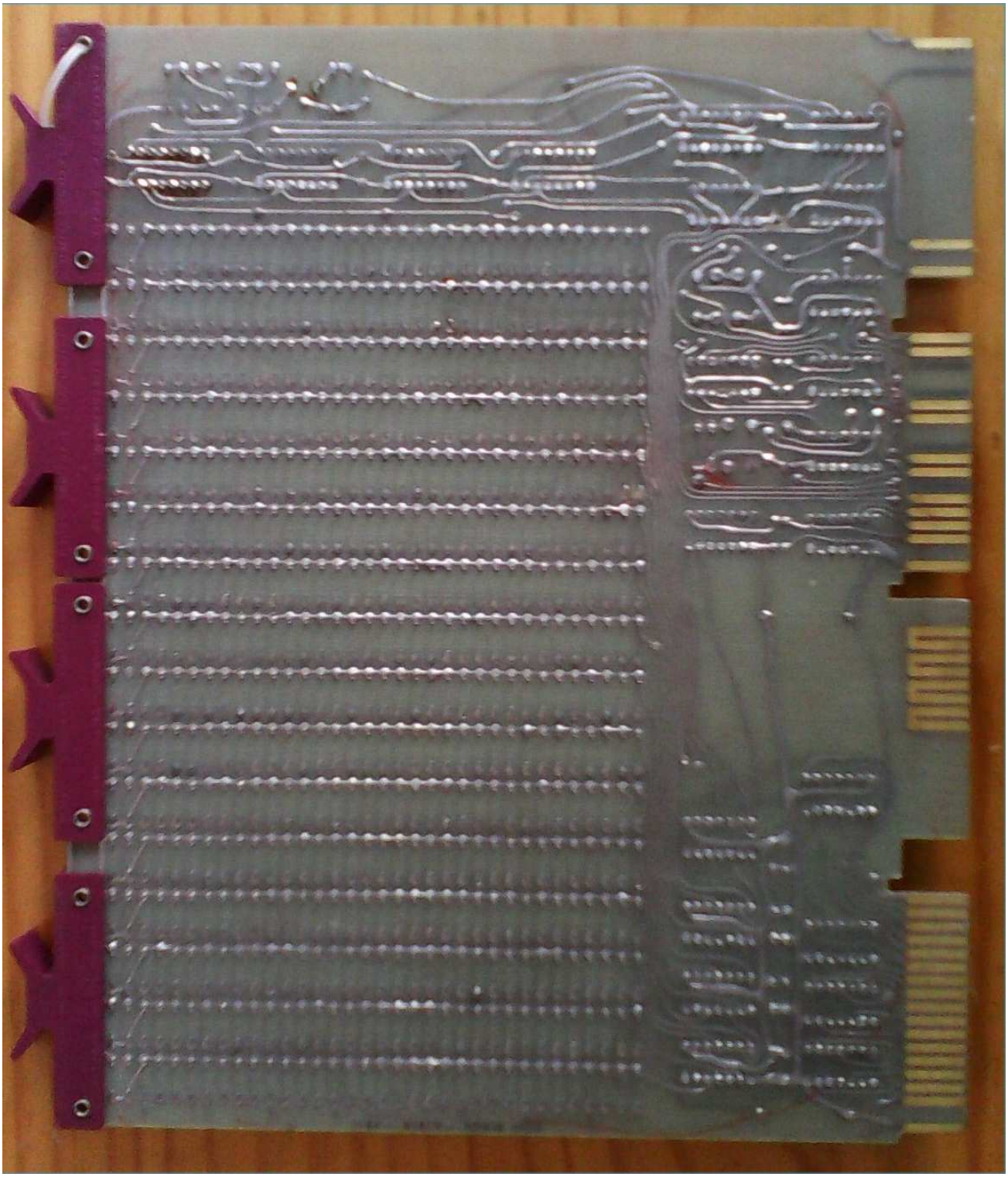

Figure 2: DEC M792E rear view

Figure 3: DEC M792E manufacturing label
"ROM DIODE MATRIX 792E"

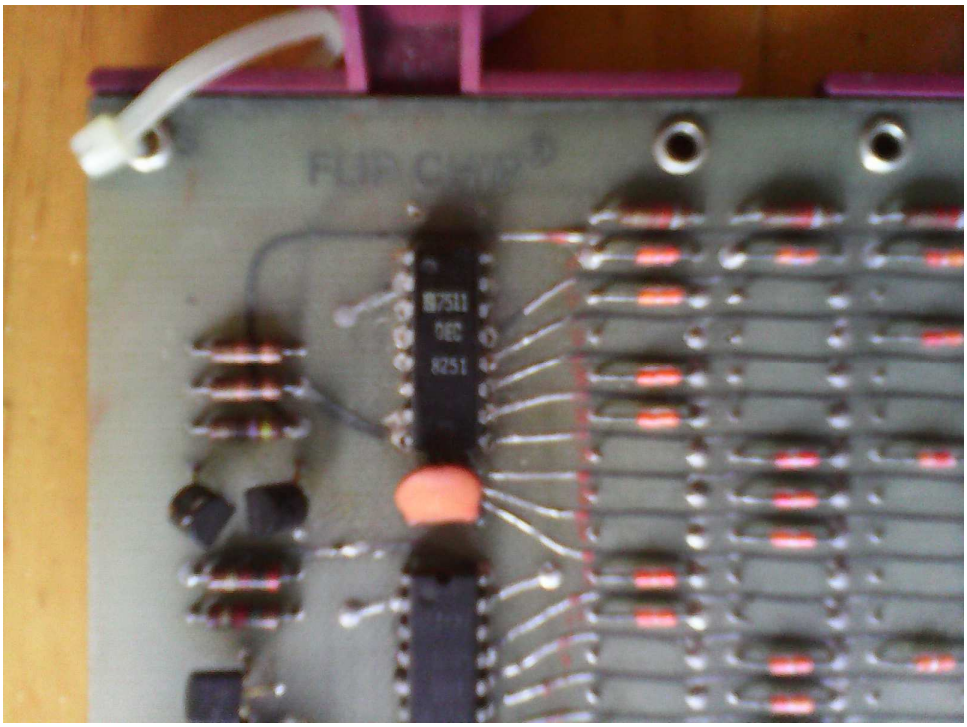

Figure 4: DEC M792E product series label
"FLIP CHIP"

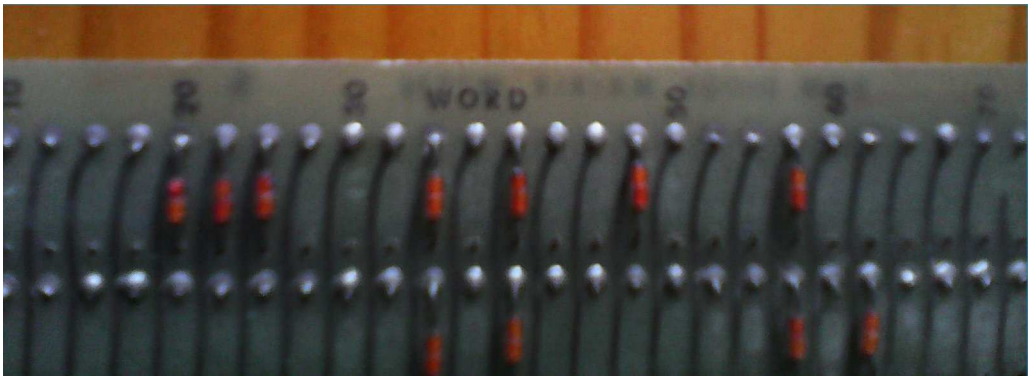

Figure 5: DEC M792E addressing label
Shown: Octal WORD 10-70 (hexadecimal WORD 08-38)