P800M Programmer's Guide 2
Volume IV: Disc Real Time Monitor

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Preface

This is volume IV of a four-volume set dealing with the Disc Operating System (non-real time and real time) for the P800M series. It describes the Disc Real Time Monitor.

The other volumes of this set, to be used in conjunction with this one, contain the following:
- Volume I: Disc Operating Monitor
- Volume II: Instruction Set
- Volume III: Software Processors

- Volume VI: Extended Disc File Management

Other books pertaining to the P800M series are:
P852M System Handbook
P856M/P857M System Handbook
P800M Operator's Guide
P800M Interface and Installation Manual
P800M Software Reference Data

Great care has been taken to ensure that the information contained in this manual is accurate and complete. However, should any errors or omissions be discovered, or should any user wish to make a suggestion for improving this manual, he is invited to send his comments, written on the sheet provided at the end of the book, to:

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at the address on the opposite page.

PART 1 MONITOR USE

The Disc Real Time Monitor (DRTM) is a disc-oriented system which is intended to supervise the execution of user application programs in a real time environment. It is assumed that these programs have been developed and pretested under the DOM.
The system is based on a structure of priorities, incorporating hardware interrupt levels and software priority levels, where up to 48 hardware interrupt signals and 15 software user levels can be handled. This system is enhanced by the socalled scheduled label feature.
The monitor is of modular structure to allow the user to easily adapt it to his particular application.

The P800M Disc Real Time Monitor has been designed to supervise the execution of pretested programs in a real time environment, on the basis of a priority system consisting of up to 48 hardware interrupt levels and 14 software priority levels. The DRTM is compatible with the Disc Operating Monitor (DOM), i.e. programs can first be developed and partly tested under the DOM, then used under the DRTM.

There is no memory protection, so all programs run in system mode. It is assumed that they have all been debugged and pretested. There is hardly any distinction between system and user programs; not all system programs are confined to any particular level, nor are user-written programs. It is therefore better to speak of <u>standard system programs</u> and <u>application programs</u>. In Part 2 of this manual some guidelines are given as to the interrupt levels to which some standard system programs can best be connected.

The priority system incorporates hardware interrupt lines and software priority levels:

- 0 to 47 are the levels for the hardware interrupt lines
- 48 is the level for interruptable monitor service routines
- 49 - 62 are software priority levels for system and application programs
- 63 is the idle task level.

The highest priority level is 0, so hardware interrupts will always overrule software level programs.

The interrupt routines which service the internal and external hardware interrupts are connected to levels 0 to 47.

Some of the interrupt routines are standard; the user can easily include interrupt routines written by himself, however. Incoming interrupts are handled by hardware and receive control on the basis of the

priority level to which they have been assigned. The dispatcher, a monitor module at level 48 which divides central processor time between competing priorities, also allots processor time to the user programs. The highest level active program always gets control until it is interrupted. Registers are saved by hardware in a system stack (addressed by register A15) and by software in the same stack or in a save area, which the system reserves in front of the program or in a special save area.
There are several types of programs, each related to a particular memory area: memory resident, read only, swappable and background programs.

Read only programs are loaded upon activation, one at a time; when a higher priority read only program is activated, the current one is erased. For this reason these programs must be read only.

Background programs are programs connected to the lowest priority level. Several of them may be in memory at the same time, allowing multiprogramming between them.

Swappable programs are executed on a time slice basis, according to priority. One such program at a time is loaded into a special partition and its execution started. If, at the end of a time slice a program of the same or higher priority has become active, the first program (in fact the whole swap partition) is swapped out, back onto disc, and the new one is loaded into memory. Otherwise the first program continues. Programs must be declared swappable before activation.

All these programs, in particular the read only ones, can make use of the dynamic allocation area to obtain temporary memory space dynamically. Not only programs, but also re-entrant subroutines will utilize this area. The dynamic allocation area is located behind the monitor area in memory. Programs obtain and release memory space in this area by issuing certain monitor requests.

User written programs and certain standard system programs have to be kept on disc and declared as memory resident or read only programs. Disc access can be done via a Data Management package in sequential or in random access mode. For physical I/O operations, drivers are used.
Under DRTM the EDFM package can be used for accessing extended disc files. This is described in Programmer's Guide 2, Volume VI: EDFM

Files are stored on discs or DADs (Direct Allocation Devices). A DAD is logically considered as a whole disc, although physically it may be only part of a disc. For each user there is one library, pointed to by the user identification in the disc or DAD catalogue. All his permanent files are stored in this library, which is located on one disc or DAD only, i.e. the one containing the directory for that user. This implies that one user cannot have his files stored on several discs or DADs unless of course, he makes use of several user identifications. However, a user can have access to the system library and other libraries by specifying the user identification of the user of those libraries, but he can only read the data in those files and not write in them.
The files contained in a library may be of several types: source program files, object modules, load files (programs ready for execution) and files not belonging to any of these types, e.g. files created by user programs.

All I/O operations are initialized by monitor requests. Monitor requests can perform various functions. They consist of an LKM instruction followed by a DATA directive with a number as operand, to define the function. Necessary parameters must first be loaded into certain registers.

For I/O operations, several functions can be performed, such as binary, ASCII and object I/O, with conversion and control facilities, random read and write operations, etc.
Peripheral devices or disc files are referenced through file codes, logical numbers of 2 hexadecimal digits.

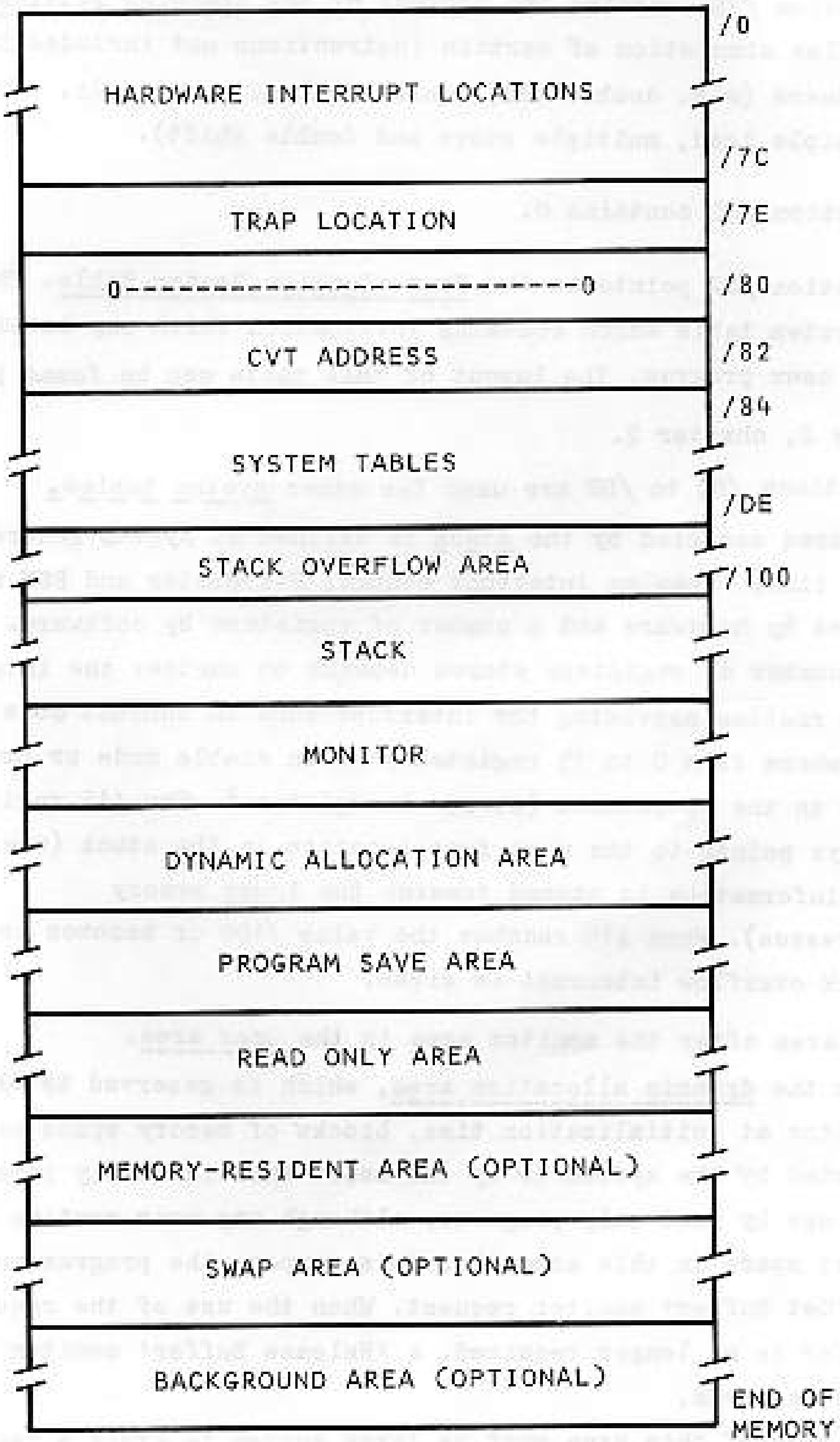
Monitor requests are also used to ask the monitor to perform the following functions:

- program activation
- waiting for the occurrence of an event
- program exit
- obtaining and releasing buffer space in the dynamic allocation area
- connecting programs to a priority level and disconnecting them
- switching from one program to another one at the same level to allow time slicing, i.e. allotting processor time to several programs on one level by turns, on the basis of timer interrupts
- getting the time and date
- informing the monitor of the occurrence of an event
- directing the monitor to wait with activation of a program until a certain, specified time
- reserving a peripheral device for exclusive use by one particular program; detaching that device from the program
- assigning and deleting file codes
- providing for the creating and use of unsollicited operator messages designed by the user himself.

A special feature, enhancing the multiprogramming aspect of the system, is the scheduled label, which is used in conjunction with monitor requests.

A scheduled label is a subroutine which is started when the monitor request function has been completed, although it is specified at the same time as the monitor request, i.e. the main program can continue while the requested function is performed. For example, combined with an I/O request, the main program continues while the requested I/O function is performed and the branch to the scheduled label routine is not made until that operation has been terminated. This can be very useful, for example to analyze the results of a monitor request.

The memory layout is as follows:



- Location /0 to /7C are hardware interrupt locations. They are hard-wired to internal and external interrupt lines. Each location contains the address of the interrupt routine required to service the interrupt connected to that location. The interrupt connected to location /0 has the highest priority (level 0).

- Location /7E contains the address of the trapping routine which handles simulation of certain instructions not included in the hardware (e.g. double add, double subtract, multiply, divide multiple load, multiple store and double shift).

- Location /80 contains 0.

- Location /82 points to the Communication Vector Table. This is a system table which contains information which may be of use to the user program. The layout of this table can be found in Part 2, chapter 2.

- Locations /84 to /DE are used for other system tables.

- The area occupied by the stack is defined at system generation time. When an interrupt occurs, P-register and PSW are stored by hardware and a number of registers by software. The number of registers stored depends on whether the interrupt routine servicing the interrupt runs in inhibit mode (anywhere from 0 to 15 registers) or in enable mode or branches to the dispatcher (always 8 registers). The A15 register always points to the next free location in the stack (where all information is stored towards the lower memory addresses). When A15 reaches the value /100 or becomes lower a stack overflow interrupt is given.

- The area after the monitor area is the user area.
From the dynamic allocation area, which is reserved by the monitor at initialization time, blocks of memory space can be requested by the system or by the user. This is mainly intended for use by read only programs, although any user routine may request space in this area. For this purpose the program must give a 'Get Buffer' monitor request. When the use of the requested buffer is no longer required, a 'Release Buffer' monitor request must be given.
The size of this area must be large enough to avoid a dead-lock in the system. Programs requesting space in this area might be