ADVANCED REAL TIME MULTI TASKING OPERATING SYSTEM
FOR EMBEDDED CONTROL APPLICATIONS

CAMBRIDGE
MICROPROCESSOR
SYSTEMS LIMITED

MINOS *Operating* SYSTEM

Multi Tasking
Real Time
Royalty Free

```
C > mdir

 Address  |   Size   |  Module Name  |   Type     | Memory
==========================================================
 f44e80   |     682  | dr68681       | Driver     |   Ram
 0058aa   |      34  | sysinit       | System     |  Flash
 005900   |      50  | ticker        | System     |  Flash
 005972   |     1ce  | drdsk         | Driver     |  Flash
 005b62   |      2a  | D1            | Dit        |  Flash
 006252   |      22  | S0            | Dit        |  Flash
 006296   |    277c  | Maths         | Subrtn     |  Flash
 008a34   |     722  | dr8530        | Driver     |  Flash
 009178   |      24  | TERM          | Dit        |  Flash
 0091be   |      22  | S2            | Dit        |  Flash
 009202   |    27e2  | shell         | Absolute   |  Flash
 00ba06   |    4b9a  | load          | Absolute   |  Flash
 0105c2   |    22b0  | procs         | Absolute   |  Flash
 012894   |    27d8  | mdir          | Absolute   |  Flash
 01508e   |    207c  | echo          | Absolute   |  Flash
 01712c   |    1f06  | code          | Absolute   |  Flash
 019054   |    2ed2  | unload        | Absolute   |  Flash
 01bf48   |    21ec  | lock          | Absolute   |  Flash
 01e156   |    21f2  | unlock        | Absolute   |  Flash
 02036a   |    3502  | setime        | Absolute   |  Flash
 02388e   |    36d2  | erasef        | Absolute   |  Flash
 026f82   |    2222  | turnkey       | Absolute   |  Flash
 0291c6   |    25a4  | save          | Absolute   |  Flash
 085d84   |     2a4  | rts307        | Driver     |   Rom
 08604a   |      26  | OB0485        | Dit        |   Rom
 0867d6   |      22  | S1            | Dit        |   Rom
 095cf4   |    2104  | signal        | Absolute   |   Rom
 097e1a   |     e4e  | nodog         | Absolute   |   Rom
 098c8a   |    12b4  | demo          | Absolute   |   Rom
```

The picture shows the output of the mdir utility listing details of all data stored in memory and the memory type.

FEATURES

- 68000 Operating System
- Multi Tasking
- Interprocess Communication
- Real Time
- Interrupts
- Device Drivers
- Device Initialisation Tables
- Memory Management
- Battery Backup Support
- I/O Paths
- Uniform Device Interface
- Many drivers supplied as standard
- Position independent code
- Supported in United Kingdom

DESCRIPTION

Minos is an advanced operating system developed by CMS in the United Kingdom for use on 68000 based controllers. It is highly optimised for embedded control applications with the emphasis being on ease of use rather than advanced filing systems and other such features that are rarely if ever used in the embedded environment. The operating system is modular in construction allowing it to adapt for a particular application. Extra features can be added by including a new system module or driver. Likewise features that are not required can be left out.

The operating system is fully multi tasking allowing both programs or processes to be run concurrently. This is ideally suited to monitoring and control applications where a number of tasks must be performed at once. The multi tasking system uses a round robin scheduler with a 10ms time slice given to each running process in turn. Although round robin schedulers can be considered a little restrictive, the Minos scheduler allows tasks to be changed mid way through a time slot and the process queue to be reordered, creating a more event driven structure. A process can give up its time slot entirely if not required. Signals can be passed between processes at any time or when the process finishes.

The operating system makes a copy of the interrupt vector table in the static RAM on the controller card allowing interrupt service routines to be added at run time. When an interrupt is received by the processor it stops the current task and services the interrupt. Interrupts can be generated from most I/O devices including serial ports, digital ports or analogue inputs.

Most peripherals are added to the system simply by including a driver and a device initialisation table. The device driver is a piece of machine code, which contains all the device dependant software. The driver is highly structured and contains five basic routines that must be provided for each device even if they do not perform any function. The first routine is an initialisation routine. This is called when a device is opened for the first time. The second is a read routine, called to read data from the device. The third is a write routine, called to write data to the device. The fourth are special functions. These are device specific functions that do not fit easily into one of the other routines. The final function is the de-initialisation function, which is called when the device is closed down. The initialisation table is a module that contains in-

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formation about a particular I/O device. The initialisation table will contain data on things like the address of the device, baud rate, interrupt vector, driver etc. Many initialisation tables can use one driver. This standard I/O structure means that all devices can be accessed using the same functions.

One of the key features in any operating system in the memory manager. This is responsible for allocating and deallocating memory as it is required by the applications program. Most devices use buffered I/O so the memory manager must also handle these as well. As well as the read only and read write memory on the controller the Minos memory manager must also handle battery backed memory and non-battery backed memory. Programs are usually loaded into battery backed memory whereas buffers are usually created in non-battery backed memory. The memory manager allocates memory in 32 byte blocks, and links each block together. If a claim is made for less than the minimum block size the claim is rounded up.

Minos is available in two versions, one for the Starter Pack and one for the Development Pack version.

The Starter Pack contains a single copy of Minos and is a single license version. This allows the operating system to be used on a single controller card only. Future controllers will require the subsequent purchase of Minos if the operating system is to be used.

The Development Pack is supplied as standard with a royalty FREE unlimited copy license version of the operating system. This allows all identical products, or range of products, to use the operating system in the target environment with out the need to purchase licenses, making the system extremely cost effective.

FUNCTIONS

The Minos operating system has a number of functions as described below

_Malloc	Allocate a block of memory
_Dalloc	Return a block of memory
_Fix_Mod	Add a module to the system
_Link	Find an existing module
_Unlink	Remove a Module
_Fork	Create a process from a subroutine
_Chain	Create a process from a module
_Exit	Terminate a process
_Sleep	Make a process idle for a time
_Wait	Make a process permanently idle
_Signal	Send a signal to a process
_ReadSys	Read Supervisor Only Registers
_Irq	Fit routine into IRQ polling table
_Open	Create a path to a device or file
_Read	Read a block of binary data
_ReadLn	Read a line of characters
_Write	Write a block of binary data
_WriteSys	Write to a Supervisor Only Register
_Function	Perform special device functions
_Close	Close down an I/O path
_WrTick	Write elapsed time counter
_RdTick	Read elapsed time counter
_UsrRam	Return start of safe RAM area
_Escape	Turn the Escape key on or off
_Ready	Return number of characters ready
_Dog	Change state of watchdog trigger
_Create	Create a file by name
_Delete	Delete a file by name
_SetPos	Set file pointer position
_GetPos	Read file pointer position
_Setup	Get address of configuration table
_Reinit	Force a device to reinitialise
_ModDir	Get start of system module list
_Procs	Get pointer to process table
_UnFix	Remove a module from the list
_Fsize	Return the length of a file
_BackUp	Battery back this memory
_UnBack	Remove this backed up memory
_Trim	Trim down this memory
_Debug	Exit to 68000 debug monitor
_Vectors	Start of 68000 vector table
_Di	Disable interrupt and process swaps
_Ei	Enable interrupts
_ResTyp	Read last reset type
_MkData	Creates a data module
_Death	Send signal as process dies
_Echo	Change echo device for line input
_Getime	Read from the real time clock
_Setime	Write to the real time clock
_DeInit	Call a drivers deinit routine

```
C > procs
 PID |  Module Name |  Status  |  Signal | Sleep  | Death
=============================================================
   0 | shell        | Waiting  |  none   |      0 | none
   1 | mdir         | Running  |  none   |      0 | none
   2 | procs        | Running  |  none   |      0 |    0
```

The picture shows the output of the procs utility. This shows the status of all running processes

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