~~~~~~
MOTOROLA MICROPROCESSOR & MEMORY TECHNOLOGY GROUP
M68000 Hi-Performance Microprocessor Division
M68060 Software Package
Production Release P1.00 -- October 10, 1994

~~~~~~

68060 INTEGER SOFTWARE PACKAGE (Kernel version)

The file isp.sa contains the 68060 Integer Software Package.
This package is essentially an exception handler that can be
integrated into an operating system to handle the "Unimplemented
Integer Instruction" exception vector #61.
This exception is taken when any of the integer instructions
not hardware implemented on the 68060 are encountered. The
isp.sa provides full emulation support for these instructions.

The unimplemented integer instructions are:

- 64-bit divide
- 64-bit multiply
- movep
- cmp2
- chk2
- cas (w/ a misaligned effective address)
- cas2

Release file format:

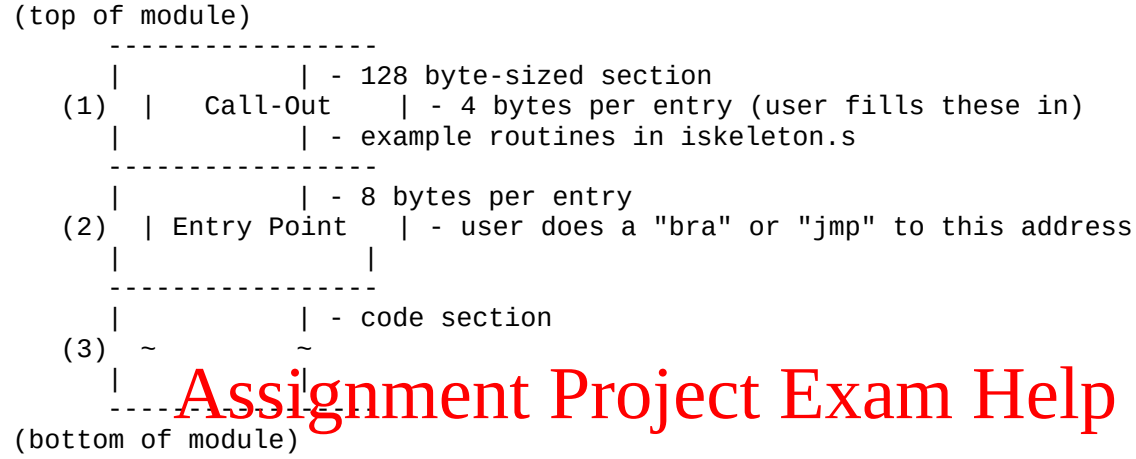
The file isp.sa is essentially a hexadecimal image of the
release package. This is the ONLY format which will be supported.
The hex image was created by assembling the source code and
then converting the resulting binary output image into an
ASCII text file. The hexadecimal numbers are listed
using the Motorola Assembly Syntax assembler directive "dc.l"
(define constant longword). The file can be converted to other

assembly syntaxes by using any word processor with a global
search and replace function.

To assist in assembling and linking this module with other modules,
the installer should add a symbolic label to the top of the file.
This will allow calling routines to access the entry points
of this package.

The source code isp.s has also been included but only for
documentation purposes.

Release file structure:



The first section of this module is the "Call-out" section. This section
is NOT INCLUDED in isp.sa (an example "Call-out" section is provided at
the end of the file iskeleton.s). The purpose of this section is to allow
the ISP routines to reference external functions that must be provided
by the host operating system. This section MUST be exactly 128 bytes in
size. There are 32 fields, each 4 bytes in size. Each field corresponds
to a function required by the ISP (these functions and their location are
listed in "68060ISP call-outs" below). Each field entry should contain
the address of the corresponding function RELATIVE to the starting address
of the "call-out" section. The "Call-out" section must sit adjacent to the
isp.sa image in memory.

The second section, the "Entry-point" section, is used by external routines
to access the functions within the ISP. Since the isp.sa hex file contains
no symbol names, this section contains function entry points that are fixed
with respect to the top of the package. The currently defined entry-points
are listed in section "68060 ISP entry points" below. A calling routine
would simply execute a "bra" or "jmp" that jumped to the selected function
entry-point.

For example, if the 68060 hardware took a "Unimplemented Integer Instruction"
exception (vector #61), the operating system should execute something
similar to:

```
      bra   _060ISP_TOP+128+0
```

(_060ISP_TOP is the starting address of the "Call-out" section; the "Call-out"
section is 128 bytes long; and the Unimplemented Integer ISP handler entry
point is located 0 bytes from the top of the "Entry-point" section.)

The third section is the code section. After entering through an "Entry-point",
the entry code jumps to the appropriate emulation code within the code section.

68060ISP call-outs: (details in iskeleton.s)

```
--------------------
0x000:      _060_real_chk
0x004:      _060_real_divbyzero
0x008:      _060_real_trace
0x00c:      _060_real_access
0x010:      _060_isp_done

0x014:      _060_real_cas
0x018:      _060_real_cas2
0x01c:      _060_real_lock_page
0x020:      _060_real_unlock_page

0x024:      (Motorola reserved)
0x028:      (Motorola reserved)
0x02c:      (Motorola reserved)
0x030:      (Motorola reserved)
0x034:      (Motorola reserved)
0x038:      (Motorola reserved)
0x03c:      (Motorola reserved)

0x040:      _060_imem_read
0x044:      _060_dmem_read
0x048:      _060_dmem_write
0x04c:      _060_imem_read_word
0x050:      _060_imem_read_long
0x054:      _060_dmem_read_byte
0x058:      _060_dmem_read_word
0x05c:      _060_dmem_read_long
0x060:      _060_dmem_write_byte
0x064:      _060_dmem_write_word
0x068:      _060_dmem_write_long

0x06c:      (Motorola reserved)
0x070:      (Motorola reserved)
0x074:      (Motorola reserved)
0x078:      (Motorola reserved)
0x07c:      (Motorola reserved)

68060ISP entry points:
----------------------
0x000:      _060_isp_unimp

0x008:      _060_isp_cas
0x010:      _060_isp_cas2
0x018:      _060_isp_cas_finish
0x020:      _060_isp_cas2_finish
0x028:      _060_isp_cas_inrange
0x030:      _060_isp_cas_terminate
0x038:      _060_isp_cas_restart

Integrating cas/cas2:
---------------------
The instructions "cas2" and "cas" (when used with a misaligned effective
address) take the Unimplemented Integer Instruction exception. When the
060ISP is installed properly, these instructions will enter through the
_060_isp_unimp() entry point of the ISP.

After the 060ISP decodes the instruction type and fetches the appropriate
data registers, and BEFORE the actual emulated transfers occur, the
package calls either the "Call-out" _060_real_cas() or _060_real_cas2().
If the emulation code provided by the 060ISP is sufficient for the
host system (see isp.s source code), then these "Call-out"s should be
made, by the system integrator, to point directly back into the package
through the "Entry-point"s _060_isp_cas() or _060_isp_cas2().
```

One other necessary action by the integrator is to supply the routines _060_real_lock_page() and _060_real_unlock_page(). These functions are defined further in iskeleton.s and the 68060 Software Package Specification.

If the "core" emulation routines of either "cas" or "cas2" perform some actions which are too system-specific, then the system integrator must supply new emulation code. This new emulation code should reside within the functions _060_real_cas() or _060_real_cas2(). When this new emulation code has completed, then it should re-enter the 060ISP package through the "Entry-point" _060_isp_cas_finish() or _060_isp_cas2_finish().
To see what the register state is upon entering _060_real_cas() or _060_real_cas2() and what it should be upon return to the package through _060_isp_cas_finish() or _060_isp_cas2_finish(), please refer to the source code in isp.s.

Miscellaneous:

_060_isp_unimp:

- documented in 2.2 in spec.
- Basic flow: