PDP-11 MEGATEK 7000 INTERFACE DESCRIPTION AND PROGRAMMING

GENERAL

The 7000 interface for the PDP-11 permits data to be transmitted to and from the 7000 system through three different paths as described below. The various control, status, and data registers are described in detail in Figure 1, attached.

DIRECT MEMORY ACCESS TRANSFER

Starting addresses in the host PDP-11 and the 7000 are set up prior to the transfer, as is a word count (16 bit words). The transfer is started by setting the appropriate bit (s) in the status/control register of the 7000 interface. No further action is required by the host PDP-11. Because 32 bit 7000 words are transferred, the word count register must always contain even numbers prior to the transfer. A programming example may be found at the end of this section.

PROGRAMMED I/O TRANSFER

To set up a PIO transfer, the starting address in 7000 graphics memory is loaded in the 7000 address register (GXSAD). The actual PIO transfer occurs when the second 16 bit word is moved to or from the data word registers. The order is critical. Transferring to 7000 memory must be done most significant data first, then least significant data; transferring from 7000 memory must be done least significant data first, then most significant data. Because PIO transfers occur essentially at UNIBUS rates, no interrupts are generated after the transfer and it is not possible to check the ready bit in GXST during a transfer. A programming example may be found at the end of this section.

PERIPHERAL BUS TRANSFER

Programmed I/O transfers to graphics peripheral devices are made using three registers on the 7000 interface. The peripheral select register is loaded by either the PDP-11 or a graphics peripheral device (joystick, data tablet, etc.). The data in this register is a six bit device code plus an input bit to flag data from graphics device waiting. Details of graphics peripheral bus programming are found in the documentation for the individual peripheral devices.
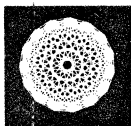
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 1                                              .TITLE PDP-11 INTERFACE PROGRAMMING EXAMPLES
 2                                      ;
 3                                      ;WRITE TO GRAPHICS MEMORY-PIO
 4                                      ;  CALLED FROM FORTRAN:  CALL STGRAP(ISAD,IMSD,ILSD)
 5                                      ;
 6 000000  005725                STGRAP::TST      (R5)+               ;DUMP # ARGUMENTS
 7 000002  013577  000000G               MOV      @(R5)+,@.GXSAD      ;STARTIND ADDRESS (7000)
 8 000006  013577  000000G               MOV      @(R5)+,@.GXMSD      ;MOST SIGNIFICANT DATA
 9 000012  013577  000000G               MOV      @(R5)+,@.GXLSD      ;LEAST SIGNIFICANT DATA
10 000016  000207                        RTS      PC
11                                      ;
12                                      ;WRITE TO GRAPHICS MEMORY-DMA
13                                      ;  CALLED FROM FORTRAN:  CALL DCHWR(ISAD,IDATA,IWCNT)
14                                      ;
15 000020  005725                DCHWR:: TST      (R5)+               ;DUMP # ARGUMENTS
16 000022  013577  000000G               MOV      @(R5)+,@.GXSAD      ;STARTING ADDRESS (7000)
17 000026  012577  000000G               MOV      (R5)+,@.GXPDA       ;STARTING ADDRESS (PDP-11)
18 000032  013577  000000G               MOV      @(R5)+,@.GXWCT      ;2'S COMPLEMENT WORD COUNT
19 000036  005277  000000G               INC      @.GXST              ;START TRANSFER
20 000042  032777  000200  000000G WWAIT: BIT     #200,@.GXST         ;WAIT FOR
21 000050  001774                        BEQ      WWAIT               ;TRANSFER TO COMPLETE
22 000052  000207                        RTS      PC
23                                      ;
24                                      ;READ FROM GRAPHICS MEMORY-PIO
25                                      ;  CALLED FROM FORTRAN:  CALL RDGRAP(ISAD,IMSD,ILSD)
26                                      ;
27 000054  005725                RDGRAP::TST      (R5)+               ;DUMP # ARGUMENTS
28 000056  013577  000000G               MOV      @(R5)+,@.GXSAD      ;STARTING ADDRESS (7000)
29 000062  017775  000000G 000002        MOV      @.GXLSD,@2(R5)      ;LEAST SIGNIFICANT DATA
30 000070  017735  000000G               MOV      @.GXMSD,@(R5)+      ;MOST SIGNIFICANT DATA
31 000074  000207                        RTS      PC
32                                      ;
33                                      ;READ FROM GRAPHICS MEMORY-DMA
34                                      ;  CALLED FROM FORTRAN:  CALL DCHRD(ISAD,IDATA,IWCNT)
35                                      ;
36 000076  005725                DCHRD:: TST      (R5)+               ;DUMP # ARGUMENTS
37 000100  013577  000000G               MOV      @(R5)+,@.GXSAD      ;STARTING ADDRESS (7000)
38 000104  012577  000000G               MOV      (R5)+,@.GXPDA       ;STARTING ADDRESS (PDP-11)
39 000110  013567  000000G               MOV      @(R5)+,.GXWCT       ;2'S COMPLEMENT WORD COUNT
40 000114  052777  000002  000000G       BIS      #2,@.GXST           ;START READ
41 000122  032777  002100  000000G RWAIT: BIT     #2100,@.GXST        ;WAIT FOR
42 000130  001774                        BEQ      RWAIT               ;TRANSFER TO COMPLETE
43 000132  000207                        RTS      PC
44          000001                        .END
```

FIGURE 1 – PDP11-7000 INTERFACE

766000 **GXST**

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

STATUS CONTROL FOR GRAPHICS BUS (GXST)

ERROR
IF SET, AN ERROR WAS DETECTED THIS BIT SET IF ANY OF BITS 12 13 14 SET

BUS TIMEOUT ERROR
IF SET, NON EXISTENT GRAPHICS MEMORY WAS REFERENCED

INTERFACE ERROR
IF SET ERROR CONDITION WAS CAUSED BY INTERFACE

ERROR
0 FOR DMA ERROR, 1 FOR PIO ERROR

READY

INTERRUPT ENABLE
SET TO ALLOW INTERRUPTS

MEMORY EXTENSION BITS FOR DMA TRANSFER

7000 RESET
SET TO FORCE 7000 BUS INIT

START READ
START TO INITIATE DMA TRANSFER

START WRITE
SET TO INITIATE DMA TRANSFER

766002

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

MOST SIGNIFICANT DATA TO BE TRANSFERRED TO FROM 7000 MEMORY IN PIO TRANSFER (GXMSD)

766004

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

LEAST SIGNIFICANT DATA TO BE TRANS FERRED TO FROM 7000 MEMORY IN PIO TRANSFER (GXLSD)

766006

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

UNIBUS ADDRESS WHERE NEXT DMA TRANSFER TO START THE CONTENTS OF THIS REGISTER ARE INCREMENTED DURING EACH TRANSFER (GXPDA)

766010

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

TWO'S COMPLEMENT WORD COUNT (UNI BUS WORDS) FOR DMA TRANSFER THE CONTENTS OF THIS REGISTER ARE INCRE MENTED DURING EACH TRANSFER (GXWCT)

766012

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

7000 STARTING ADDRESS (GXSAD)

766014 **GPST**

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

STATUS/CONTROL FOR GRAPHICS PERIPHERAL BUS (GPST)

BUSY
SET WHEN START BIT SET, CLEARED WHEN DONE BIT SET

DONE
SET WHEN PERIPHERAL DEVICE RESPONDS TO PREVIOUS CLEAR OR PULSE

INTERRUPT ENABLE
SET TO ALLOW INTERRUPT WHENEVER "DONE" FLAG IS SET

PULSE *poll?*
SET TO CAUSE PULSE OF A GRAPHICS PERIPHERAL DEVICE

CLEAR *= ackn. int.*
SET TO CAUSE CLEAR OF A GRAPHICS PERIPHERAL DEVICE

START
SET TO SET BUSY AND CLEAR DONE

766016

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

PERIPHERAL DATA DATA TRANSFERRED TO/FROM GRAPHICS PERIPHERAL (GPD)

766020 **GPCS**

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

GRAPHICS PERIPHERAL CONTROL SELECT (GPCS)

PERIPHERAL STATUS

INPUT (READ ONLY BIT)
SET BY GRAPHICS PERIPHERAL TO FLAG DATA WAITING FOR INPUT

PERIPHERAL UNIT NUMBER
(00 THRU 77 OCTAL)

= device code

→ GPD bit 14=1 : data from joystick
13=1 : " " tablet
12=1 : " " keyboard