[Chapter 2] Programming Model

```
 < 1> A hardware reset does not result in the same state as a manual reset.
                    * This is because the SCK2/MRESET terminal is pulled up
 < 2> The standby mode is disabled
                    * This is because clock output stops and the system hangs
 < 3> Ownership of the bus is not released.
                    * This is because the /BREQ terminal is locked 'H'

   >> There is no restriction on use of registers.
```

[Chapter 3] Memory Management Unit (MMU)

```
< 1> The external memory space is used as follows.
        Area 0:   BootROM, FlashMemory, Holly-Register, MODEM, AICA, G2_External_area
        Area 1:   TextureMemory
        Area 2: Not used
        Area 3: SystemMemory
        Area 4: Polygon-Converter, YUV-Converter, TextureMemory
        Area 5: G2_External_area
        Area 6: Not used

   >> There are no restrictions on register use.
```

[Chapter 4] Cache

```
 < 1> Areas capable of cache access are as follows.
        SystemMemory ..................... Read/Write                 : 0C000000-0CFFFFFF,0E000000-0EFFFFFF
        BootROM .......................... Read/-                     : 00000000-001FFFFF                 ^Revised
        FlashMemory ...................... Read/-                     : 00200000-0021FFFF                 ^Revised
        TextureMemory[via PVRi/f] ........ Read/Write                 : 04000000-047FFFFF,06000000-067FFFFF
                                                                        05000000-057FFFFF,07000000-077FFFFF
        G2_External_area ................. Depends on specifications  : 01000000-01FFFFFF,03000000-03FFFFFF
                                                                        14000000-17FFFFFF
    - BootROM and FlashMemory are write-inhibited.
    - Whether or not the cache can be used to access G2_External_areadepends on the device specifications.
 < 2> Areas capable of write access using cache are as follows.
        Polygon-Converter[via TA-FIFO] ...    -/Write                 : 10000000-107FFFFF,12000000-127FFFFF
        YUV-Converter[via TA-FIFO] .......    -/Write                : 10800000-10FFFFFF,12800000-12FFFFFF
        TextureMemory[via TA-FIFO] .......    -/Write                 : 11000000-117FFFFF,13000000-137FFFFF
    - When using the cache via the TA-FIFO path, a 32-byte boundary must be set on addresses written.
                    * This is because data is written to TA-FIFO in the order in which it is output.
    - Incorrect operation will result if write-back is not carefully controlled when using the cache via
      TA-FIFO.
      (This is because, if a write-back occurs before 32 bytes of write-back data have been accumulated,
      the data is sent to TA-FIFO. For example, if an interrupt occurs while data is being prepared in
      chunks of 4 bytes, duplication of the current address by the address entry used by the interrupt will
      result in cache replacement, so that the intended data is not sent. When using the cache to write to
      TA^FIFO, interrupts must be inhibited, at least until 32 bytes of data have accumulated.)
 < 3> Areas that can be accessed by store queue are as follows.
        SystemMemory ..................... Read/Write                 : 0C000000-0CFFFFFF,0E000000-0EFFFFFF
        Polygon-Converter[via TA-FIFO] ...    -/Write                 : 10000000-107FFFFF,12000000-127FFFFF
        YUV-Converter[via TA-FIFO] .......    -/Write                 : 10800000-10FFFFFF,12800000-12FFFFFF
        TextureMemory[via TA-FIFO] .......    -/Write                 : 11000000-117FFFFF,13000000-137FFFFF
        TextureMemory[via PVRi/f] ........ Read/Write                 : 04000000-047FFFFF,06000000-067FFFFF
                                                                        05000000-057FFFFF,07000000-077FFFFF
        G2_External_area ................. Depends on specifications  : 01000000-01FFFFFF,03000000-03FFFFFF
                                                                        14000000-17FFFFFF
    - Store queue access is limited to write only.
    - Whether or not store queue access to the G2_External_area is possible varies according to device
      specifications.

   >> There is no restriction on use of registers.
```

[Chapter 5] Exception Processing

```
 < 1> A hardware reset is the same as a power-on reset.
      A hardware reset does not result in a manual reset.
                    * This is because the SCK2/MRESET terminal is pulled up
 < 2> Power-on or manual resets cannot be initiated by watchdog timer.
                    * Although the CPU is initialized, other chips are not, meaning that erroneous operation
                      may result.
 < 3> The system may not recover normally in the event of a manual reset, a Hitachi-UDI reset, a command TLB
     multi-bit exception, or a data TLB multi-bit exception.
                    * Although the CPU is initialized, other chips are not, meaning that erroneous operation
                      may result.
    - Since manipulating the Holly SFRES (SoftwarerReset) register results in a system reset, use this
      method for recovery.
                    * This method results in the same operation as a PowerON reset, so all chips are reset.
    - Alternatively, initiate a PowerON reset.
 < 4> Non-maskable interrupts are for use only during debugging, and must not be generated by the product.
                    * Because the NMI terminal is pulled up.
    - If a NMI occurs during DMA, the DMA sequence between SH4 and Holly is disrupted and no futher DMA        ^Added
      is possible. (However, data can still be read and written normally.) Normal DMA operation can only be
      restored by PowerOn reset.
 < 5> Only terminals /IRL1 and /IRL2 are used for external interrupts.
                    * Terminals /IRL0 and /IRL3 are pulled up.
```

```
       Terminals /IRL3-/IRL0=1001 : Level 6 external interrupt
       Terminals /IRL3-/IRL0=1011 : Level 4 external interrupt
       Terminals /IRL3-/IRL0=1101 : Level 2 external interrupt
       Level 1, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, and 15 external interrupts are not generated.
 < 6> The following interrupts are not generated.
       TMU2/TICPI2 : Input capture interrupt                    * The TCLK terminal is pulled up
       RTC/ATI       : Alarm interrupt                           * RTC is not used in products
     RTC/PRI     : Periodic interrupt                          * RTC is not used in products
     RTC/CUI     : Digit roll-up interrupt                     * RTC is not used in products
     SCI/ERI     : Receive error interrupt                     * SCI is not used
     SCI/RXI     : Receive data full interrupt                 * SCI is not used
     SCI/TXI     : Send data empty interrupt                   * SCI is not used
     SCI/TEI     : Send completed interrupt                    * SCI is not used
     REF/RCMI    : Compare match interrupt                     * Inhibited because refresh used
     DMAC/DMTE0  : DMAC-ch0 transfer completed interrupt       * Inhibited
     GPI0/GPI0I  : I/O port interrupt   * Use of I/O port interrupts is inhibited
 < 7> The Hitachi-UDI interrupt is only for debugging.

   >> There is no restriction on use of registers.


[Chapter 6]  Floating Point Unit ____________________________________________________________________

 < 1> No restrictions on use.


[Chapter 7]  Command Set ____________________________________________________________________________

 < 1> No restrictions on use.


[Chapter 9]  Low Power Mode _________________________________________________________________________

 < 1> The sleep mode can be used.
 < 2> The deep sleep mode is inhibited.
                    * Because self-refresh operation is inhibited.
 < 3> The standby mode is inhibited.
                    * Because clock output stops and the system hangs.
 < 4> The module standby function can be used.
    - The enable bit must be set to OFF for each module before stopping supply of the clock to the modules.
 < 5> Clock supply is stopped because the SCI is not used.
      (In the event that SCI has been used, it must be stopped before stopping supply of the clock.)
 < 6> Clock supply is stopped because the RTC is not used in products.
      (Before setting the standby control register and stopping the clock supply, RTC control register 2
      must be set and the RTC stopped.)

   >> Standby Control Register(STBCR)  FFC00004 = 03                      %%% Setting must be changed %%%

                                     [0000:0011] initial   = 0000:0000
                                      |||| ||||
                                      |||| |||`- MSTP0     :    1 = Stop clock supply to SCI
                                      |||| ||`-- MSTP1     :    1 = Stop clock supply to RTC
                                      |||| |`--- MSTP2     :    0 = Activates TMU
                                      |||| `---- MSTP3     :    0 = Activates SCIF
                                      |||`------ MSTP4     :    0 = Activates DMAC
                                      ||`------- PPU       :    0 = Pulls up terminals related to peripheral
                                      ||                           modules (MD0/SCK,MD1/TXD2,MD2/RXD2,MD7/TXD,
                                      ||                           MD8/RTS2,SCK2/MRESET,RXD,CTS2,DREQ0/DBREQ,
                                      ||                           DACK0/TDACK,DRAK0/BAVL,DREQ1/TR,DACK1/ID0,
                                      ||                           DRAK1/ID1,TCLK)
                                      |`-------- PHZ       :    0 = Terminals related to peripheral modules
                                      |                           are in the normal state while in the
                                      |                           standby mode(MD0/SCK,MD1/TXD2,MD7/TXD,
                                      |                           MD8/RTS2,CTS2, DACK0/TDACK,
                                      |                           DRAK0/BAVL,DACK1/ID0, DRAK1/ID1)
                                      `--------- STBY      :    0 = Shift to sleep mode upon SLEEP command

   >> Standby Control Register 2(STBCR2)  FFC00010 = 00                %%% Setting must not be changed %%%

                                     [0---:----] initial   = 0000:0000
                                      |
                                      `--------- DSLP      :    0 = Shift to sleep mode upon SLEEP command

[Chapter 10]     Clock Generation Circuit ___________________________________________________________

 < 1> Clock input is through EXTAL, rather than by crystal oscillator.   * Terminal MD8=0
 < 2> The clock is used in operational mode 5.                           * Terminal MD2=1,Terminal MD1=0,
                                                                           Terminal MD0=1
       1/2 cycle                     :    Off
       PLL1                          :     On
       PLL2                          :     On
       EXTAL clock input             :  33MHz                          * 13.5000MHz×400÷27÷2÷3
       CPU clock (IΦ)               : 200MHz (EXTAL×6  )
       Bus clock (BΦ)               : 100MHz (EXTAL×3  )
       Peripheral module clock (PΦ) :  50MHz (EXTAL×3/2)
 < 3> CKI0 is the clock output.
 < 4> Use of the watchdog timer mode that applies a reset to the CPU is inhibited.
                    * Erroneous operation can result, because while the CPU is initialized, other chips are
                      not.

   >> Frequency control register(FRQCR)  FFC00000 = 0E0A                %%% Settings cannot be changed %%%
```

```
                        [----:1110:0000:1010] initial   = 0000:1110:0000:1010 (When above MD is set)
                              |||| |||| ||||
                              |||| |||| |`++- PFC2-0    :  010 = Peripheral clock(×1/4)
                              |||| ||`+-+---- BFC2-0    :  001 = Bus clock       (×1/2)
                              |||`-++-------- IFC2-0    :  000 = CPU clock       (×1)
                              ||`------------ PLL2EN    :    1 = PLL2 used
                              |`------------- PLL1EN    :    1 = PLL1 used
                              `-------------- CKOEN     :    1 = CKIO clock output

>> Watchdog timer counter (WTCNT)  FFC00008                                %%% No restrictions on use %%%

                        [----:----:****:****] initial   = 0000:0000
                        (0101 1010)

>> Watchdog timer control/status register (WTCSR)  FFC0000C = A500       %%% No restrictions on use %%%
                                                                              <<bits 6 and 5 are fixed>>
                        [----:----:*00*:****] initial   = 0000:0000
                        (1010 0101)|||| ||||
                                   |||| |`++- CKS2-0    : Arbitrary   WTCNT clock selection
                                   |||| |                      (clock from divider 2 is 200 MHz)
                                   |||| `---- IOVF      : Arbitrary   Overflow flag
                                   ||||                         (used in the interval timer mode)
                                   |||`------ WOVF      : Arbitrary   Overflow flag
                                   |||                          (not set in the interval timer mode)
                                   ||`------- RSTS      :    0 = Power-on reset
                                   ||                           (Ignored in the interval timer mode)
                                   |`-------- WT/IT     :    0 = Use in the interval timer mode.
                                   `--------- TME       : Arbitrary  (Timer enable)
```

[Chapter 11] Realtime Clock (RTC)

```
 < 1> The RTC is stopped because it is  not used in products.
 < 2> The TCLK terminal is used as input.
 < 3> RTC control register 2 (RCR2) must be set before setting the standby control register (STBCR).


   >> 64 Hz counter(R64CNT)  FFC80000                                          %%% Access inhibited %%%
   >> Second counter (RSECCNT)     FFC80004                                       %%% Access inhibited %%%
   >> Minute counter (RMINCNT)     FFC80008                                       %%% Access inhibited %%%
   >> Hour counter (RHRCNT)  FFC8000C                                        %%% Access inhibited %%%
   >> Weekday counter (RWKCNT)     FFC80010                                       %%% Access inhibited %%%
   >> Day counter (RDAYCNT)  FFC80014                                        %%% Access inhibited %%%
   >> Month counter (RMONCNT) FFC80018                                       %%% Access inhibited %%%
   >> Year counter (RYRCNT)  FFC8001C                                        %%% Access inhibited %%%
   >> Second alarm register (RSECAR)     FFC80020                                %%% Access inhibited %%%
   >> Minute alarm register (RMINAR)     FFC80024                                %%% Access inhibited %%%
   >> Hour alarm register (RHRAR)  FFC80028                                %%% Access inhibited %%%
   >> Weekday alarm register (RWKAR)     FFC8002C                                %%% Access inhibited %%%
   >> Day alarm register (RDAYAR)  FFC80030                                %%% Access inhibited %%%
   >> Month alarm register (RMONAR) FFC80034                               %%% Access inhibited %%%

   >> RTC control register 1 (RCR1) FFC80038 = 00                    %%% Settings cannot be changed %%%

                                   [*--0:0--*] initial   = XXX0:0XXX
                                    |  | |  |
                                    |  | |  `- AF        : Arbitrary  (alarm flag)
                                    |  | `---- AIE       :    0 = Alarm interrupts not generated
                                    |  `------ CIE       :    0 = Round-up interrupts not generated
                                    `--------- CF        : Arbitrary  (Rounding flag)

   >> RTC control register 2 (RCR2)  FFC8003C = 02                        %%% Settings must be changed %%%

                                   [*000:0010] initial   = X000:1001
                                    |||| ||||
                                    |||| |||`- START     :    0 = Counter stopped
                                    |||| ||`-- RESET     :    1 = Divider circuit reset
                                    |||| |`--- ADJ       :    0 = Normal clock operation
                                    |||| `---- RTCEN     :    0 = RTC crystal oscillator stopped
                                    |`++------ PES2-0    :  000 = Periodic interrupts not generated
                                    `--------- PEF       : Arbitrary  (periodic interrupt flag)
```

[Chapter 12] Timer Unit (TMU)

```
 < 1> External clock and input capture function are not used             * TCLK terminal input is pulled up
 < 2> Internal RTC output clock cannot be used                           * RTC is not used in products
 < 3> The peripheral module clock (P?) is 50 MHz

   >> Timer output control register (TOCR)  FFD80000 = 00               %%% Settings cannot be changed %%%

                                   [----:---0] initial   = 0000:0000
                                             |
                                             `- TCOE      :    0 = TCLK terminal input

   >> Timer start register (TSTR)  FFD80004                                  %%% No restrictions on use %%%

                                   [----:-***] initial   = 0000:0000
                                          |||
                                          ||`- STR0      : Arbitrary  (timer counter 0 control)
```

```
                                        |`-- STR1      : Arbitrary  (timer counter 1 control)
                                        `--- STR2      : Arbitrary  (timer counter 2 control)

>> Timer constant register 0 (TCOR0)  FFD80008                            %%% No restrictions on use %%%

>> Timer counter 0 (TCNT0)  FFD8000C                                      %%% No restrictions on use %%%

>> Timer control register 0 (TCR0)  FFD80010                              %%% No restrictions on use %%%
                                                                              <<bits 4 and 3 are fixed>>
                      [----:---*:--*0:0***] initial   = 0000:0000:0000:0000
                               |   || ||||
                               |   || |`++- TPSC2-0   : Arbitrary  (timer prescalar 000-100)
                               |   |`-+---- CKEG1-0   :   00 = Rising edge
                               |   `------- UNIE      : Arbitrary  (Underflow interrupt control)
                               `----------- UNF       : Arbitrary  (Underflow flag)

>> Timer constant register 1 (TCOR1)  FFD80014                            %%% No restrictions on use %%%

>> Timer counter 1 (TCNT1)  FFD80018                                      %%% No restrictions on use %%%

>> Timer control register 1 (TCR1)  FFD8001C                              %%% No restrictions on use %%%
                                                                              <<bits 4 and 3 are fixed>>
                      [----:---*:--*0:0***] initial   = 0000:0000:0000:0000
                               |   || ||||
                               |   || |`++- TPSC2-0   : Arbitrary  (timer prescalar 000-100)
                               |   |`-+---- CKEG1-0   :   00 = Rising edge
                               |   `------- UNIE      : Arbitrary  (Underflow interrupt control)
                               `----------- UNF       : Arbitrary  (Underflow flag)

>> Timer constant register 2 (TCOR2)  FFD80020                            %%% No restrictions on use %%%

>> Timer counter 2 (TCNT2)  FFD80024                                      %%% No restrictions on use %%%

>> Timer control register 2(TCR2)  FFD80028                               %%% No restrictions on use %%%
                                                                         <<bits 7, 6, 4 and 3 are fixed>>
                      [----:--**:00*0:0***] initial   = 0000:0000:0000:0000
                              || |||| ||||
                              || |||| |`++- TPSC2-0   : Arbitrary  (timer prescalar 000-100)
                              || |||`-+---- CKEG1-0   :   00 = Rising edge
                              || ||`------- UNIE      : Arbitrary  (Underflow interrupt control)
                              || `+-------- ICPE1-0   :   00 = Input capture function disabled
                              |`----------- UNF       : Arbitrary  (Underflow flag)
                              `------------ ICPF      : Arbitrary  (Input capture innterrupt flag)

>> Input capture register (TCPR2)  FFD8002C                                  %%% Access inhibited %%%


[Chapter 13] Bus State Controller (BSC) ____________________________________________________________________
      (Synchronous DRAM indicated as SDRAM)

 < 1> External requests are not generated.                              * The /BREQ terminal is fixed to 'H'.
 < 2> Used as little-endian                                             * MD5=1
 < 3> Used in the master mode                                           * MD7=1
 < 4> Area 0 bux size is 64 bits                                        * MD4=0,MD3=0
 < 5> Area 0 is used by the MPX bus                                     * MD6=0
 < 6> The external memory space is used as follows.
        Area 0 | 64bit : MPX   : 3wait + external wait  | BootROM, FlashMemory, Holly-Register, MODEM,
                                                        | AICA, G2_External_area
        Area 1 | 64bit : MPX   : 3wait + external wait  | TextureMemory
        Area 2 | 64bit : MPX   : 3wait + external wait  | Reserved
        Area 3 | 64bit : SDRAM : wait ignored           | SystemMemory
        Area 4 | 64bit : MPX   : 0wait + external wait  | Polygon-Converter, YUV-Converter, TextureMemory
        Area 5 | 64bit : MPX   : 3wait + external wait  | G2_External_area
        Area 6 | 64bit : MPX   : 3wait + external wait  | Reserved
 < 7> SDRAM is used in the following mode
        Burst length = 4
        Wrap type    = Sequential
        CAS latency  = 3
 < 8> SDRAM is used in the RAS down mode
 < 9> Use of the SDRAM self-refresh mode is inhibited
 <10> The SDRAM refresh interval is 15040 nsec (10nsec*16*94)
 <11> The following SDRAMs are used
                     |    SET4-8M     |    SET4-32M    |         Mass produced-16M           |
                     |                |    SET5-32M    |                  SET5-16M           |
        -------------+----------------+----------------+-------------------------------------+
        SDRAM        |        SAMSUNG |        SAMSUNG |          SAMSUNG |               NEC |
                     | KM416S1020B-10 | KM416S4030A-10 | KM432S2030BT-GLT | uPD4564323G5-A10S |
         Capacity    |         16Mbit |         64Mbit |           64Mbit |            64Mbit |
         Bus width   |       16bitbus |       16bitbus |          32bitbus |          32bitbus |
         Banks       |          2BANK |          4BANK |            4BANK |             4BANK |
         Number used |              4 |              4 |                2 |                 2 |
        -------------+----------------+----------------+-------------------------------------+
        WR-PRE(TRWL) |           1clk |           1clk |             1clk |            10nsec |
        PRE-RAS(TPC) |         26nsec |         24nsec |           20nsec |            20nsec |
        RAS-CAS(RCD) |         26nsec |         24nsec |           20nsec |            30nsec |
        RAS-PRE      |         50nsec |         50nsec |           50nsec |            60nsec |
        RAS-RAS      |         80nsec |         80nsec |           70nsec |            80nsec |
        REF-RAS(TRAS)|         80nsec |         80nsec |           70nsec |            60nsec |
        -------------+----------------+----------------+-------------------------------------+
        AMX          | 000            | 010            | 100              | 100               |
        -------------+----------------+----------------+-------------------------------------+
```

```
>> Bus control register 1 (BCR1)  FF800000 = A3020008            %%% Change of settings is required %%%

  [101-:--11:--00:001-:0000:0000:0000:10-0] initial   = 1010:0000:0000:0000:0000:0000:0000:0000
   |||    ||   || |||  |||| |||| |||| || |
   |||    ||   || |||  |||| |||| |||| || `- A56PCM    :    0 = Area 56 normal memory
   |||    ||   || |||  |||| |||| |||`-++--- DRAMTP2-0 :  010 = Area 2 normal memory,Area 3SDRAM
   |||    ||   || |||  |||| |||| `++------- A6BST2-0  :  000 = Area 6 normal memory (ignored with MPX)
   |||    ||   || |||  |||| |`++----------- A5BST2-0  :  000 = Area 5 normal memory (ignored with MPX)
   |||    ||   || |||  ||`+-+------------- A0BST2-0  :  000 = Area 0 normal memory (ignored with MPX)
   |||    ||   || |||  |`------------------ HIZCNT    :    0 = Hi-z during standby with bus released
   |||    ||   || |||  |                                     (RAS,RAS2,WEn,RD,RD2)
   |||    ||   || |||  `------------------- HIZMEM    :    0 = Hi-z during standby
   |||    ||   || |||                                     (A[25:0],BS,CSn,RD/WR,CE2A,CE2B,RD/WR2)
   |||    ||   || ||`---------------------- MEMMPX    :    1 = Area 1-6 is MPX
   |||    ||   || |`----------------------- PSHR      :    0 = Master mode
   |||    ||   || `------------------------ BREQEN    :    0 = External request invalid
   |||    ||   |`-------------------------- A4MBC     :    0 = Area 4 normal mode (MPX priority)
   |||    ||   `--------------------------- A1MBC     :    0 = Area 1 normal mode (MPX priority)
   |||    |`------------------------------- OPUP      :    1 = Control terminal not pulled up
   |||    |                                                 (A[25:0],BS,CSn,RD,WEn,RD/WR,RAS,RAS2,CE2A,
   |||    |                                                  CE2B,RD2,RD/WR2)
   |||    `------------------------------- IPUP      :    1 = Control terminal not pulled up
   |||                                                      (NMI,IRL3-0,BREQ,MD6,RDY)
   ||`------------------------------------ A0MPX     :    1 = Area 0 is MPX
   |`------------------------------------- MASTER    :    0 = Master
   `-------------------------------------- ENDIAN    :    1 = Little-endian

>> Bus control register 2 (BCR2)  FF800004 = 0001                %%% Change of settings is required %%%

                         [0000:0000:0000:00-1] initial   = 0011:1111:1111:1100
                          |||| |||| |||| || |
                          |||| |||| |||| || `- PORTEN    :    1 = Port hold
                          |||| |||| |||| `+--- A1SZ1-0   :   00 = Area 1 is 64 bits
                          |||| |||| ||`+------ A2SZ1-0   :   00 = Area 2 is 64 bits
                          |||| |||| `+-------- A3SZ1-0   :   00 = Area 3 is 64 bits
                          |||| ||`+----------- A4SZ1-0   :   00 = Area 4 is 64 bits
                          |||| `+------------- A5SZ1-0   :   00 = Area 5 is 64 bits
                          ||`+---------------- A6SZ1-0   :   00 = Area 6 is 64 bits
                          `+------------------ A0SZ1-0   :   00 = Area 0 is 64 bits

>> Wait control register 1 (WCR1)  FF800008 = 01110111            %%% Change of settings is required %%%

  [-000:-001:-001:-001:-000:-001:-001:-001] initial   = 0111:0111:0111:0111:0111:0111:0111:0111
    |||  |||  |||  |||  |||  |||  |||  |||
    |||  |||  |||  |||  |||  |||  |||  `++- A0IW2-0   :  001 = Area 0 idle cycles=1
    |||  |||  |||  |||  |||  |||  `++------ A1IW2-0   :  001 = Area 1 idle cycles=1
    |||  |||  |||  |||  |||  `++----------- A2IW2-0   :  001 = Area 2 idle cycles=1
    |||  |||  |||  |||  `++---------------- A3IW2-0   :  000 = SDRAM used in RAS down mode
    |||  |||  |||  `++--------------------- A4IW2-0   :  001 = Area 4 idle cycles=1
    |||  |||  `++-------------------------- A5IW2-0   :  001 = Area 5 idle cycles=1
    |||  `++------------------------------- A6IW2-0   :  001 = Area 6 idle cycles=1
    `++------------------------------------ DMAIW2-0  :  000 = SDRAM used in RAS down mode
                                          * Since SDRAM is used in the RAS down mode, DMAIW2-0 and
                                            A3IW2-0 are 000.

>> Wait control register 2 (WCR2)  FF80000C = 618066D8            %%% Change of settings is required %%%

  [0110:0001:1000:000-:011-:0110:1101:1000] initial   = 1111:1111:1111:1110:1110:1111:1111:1111
   |||| |||| |||| |||  |||  |||| |||| ||||
   |||| |||| |||| |||  |||  |||| |||| |`++- A0B2-0    :  000 = Area 0 burst pitch=0
   |||| |||| |||| |||  |||  |||| ||`+-+---- A0W2-0    :  011 = 3 waits for 1st Area 0 data,
   |||| |||| |||| |||  |||  |||| ||                            0 waits for subsequent data
   |||| |||| |||| |||  |||  |||`-++-------- A1W2-0    :  011 = 3 waits for 1st Area 1 data,
   |||| |||| |||| |||  |||  |||                                 0 waits for subsequent data
   |||| |||| |||| |||  |||  `++------------ A2W2-0    :  011 = 3 waits for 1st Area 2 data,
   |||| |||| |||| |||  |||                                      0 waits for subsequent data
   |||| |||| |||| |||  `++---------------- A3W2-0    :  011 = SDRAM CAS latency =3
   |||| |||| |||| `++--------------------- A4W2-0    :  000 = 1 wait for 1st Area 4 read data,
   |||| |||| ||||                                               0 waits for subsequent data
   |||| |||| |`++------------------------- A5B2-0    :  000 = Area 5 burst pitch=0
   |||| ||`+-+----------------------------- A5W2-0    :  011 = 3 waits for 1st Area 5 data,
   |||| ||                                                      0 waits for subsequent data
   |||`-++--------------------------------- A6B2-0    :  000 = Area 6 burst pitch=0
   `++------------------------------------- A6W2-0    :  011 = 3 waits for 1st Area 6 data,
                                                               0 waits for subsequent data

>> Wait control register 3 (WCR3)  FF800010 = 07777777        %%% Change of settings is not required %%%
                                                                   * Because only MPX and SDRAM are used
  [----:-111:-111:-111:-111:-111:-111:-111] initial   = 0000:0111:0111:0111:0111:0111:0111:0111
         |||  |||  |||  |||  |||  |||  |||
         |||  |||  |||  |||  |||  |||  |`+- A0H1-0    :   11 = Area 0 data hold=3
         |||  |||  |||  |||  |||  |||  `--- A0S0      :    1 = Area 0 write strobe setup=1
         |||  |||  |||  |||  |||  |`+------ A1H1-0    :   11 = Area 1 data hold=3
         |||  |||  |||  |||  |||  `-------- A1S0      :    1 = Area 1 write strobe setup=1
         |||  |||  |||  |||  |`+----------- A2H1-0    :   11 = Area 2 data hold=3
         |||  |||  |||  |||  `------------- A2S0      :    1 = Area 2 write strobe setup=1
         |||  |||  |||  |`+---------------- A3H1-0    :   11 = Area 3 data hold=3
         |||  |||  |||  `------------------ A3S0      :    1 = Area 3 write strobe setup=1
         |||  |||  |`+---------------------- A4H1-0    :   11 = Area 4 data hold=3
         |||  |||  `----------------------- A4S0      :    1 = Area 4 write strobe setup=1
         |||  |`+-------------------------- A5H1-0    :   11 = Area 5 data hold=3
```

```
        |||  `---------------------------- A5S0      :    1 = Area 5 write strobe setup=1
        |`+------------------------------- A6H1-0    :   11 = Area 6 data hold=3
        `--------------------------------- A6S0      :    1 = Area 6 write strobe setup=1

>> Individual memory control register (MCR)  FF800014 = C0121204  (SET4-8M)
                                                                   %%% Change of settings is required %%%
                                        FF800014 = C0121214  (SET4-32M,SET5-32M)
                                        FF800014 = C00A0E24  (SET5-16M,mass produced-16M)

  [1*00:0---:0-01:0-10:0001:0010:0000:0100] initial   = 0000:0000:0000:0000:0000:0000:0000:0000
   |||| |    | || | || |||| |||| |||| ||||
   |||| |    | || | || |||| |||| |||| |||`- EDOMODE   :    0 = SDRAM, so 0
   |||| |    | || | || |||| |||| |||| ||`-- RMODE     :    0 = Perform CAS before RAS refres
   |||| |    | || | || |||| |||| |||| ||                     Self-refresh is inhibited.
   |||| |    | || | || |||| |||| |||| |`--- RFSH      :    1 = Perform refresh
   |||| |    | || | || |||| |||| ||`+-+---- AMX2-0    :  000 = 16M,16bus,2BANK,4(SET4-8M)
   |||| |    | || | || |||| |||| ||                       010 = 64M,16bus,4BANK,4(SET4-32M,SET5-32M)
   |||| |    | || | || |||| |||| ||                       100 = 64M,32bus,4BANK,2
   |||| |    | || | || |||| |||| ||                             (SET5-16M,mass produced-16M)
   |||| |    | || | || |||| |||| |`-------- AMXEXT    :    0 = Bank address normal
   |||| |    | || | || |||| |||`-+--------- SZ1-0     :   00 = SDRAM=64bit
   |||| |    | || | || |||| ||`------------ BE        :    1 = DRAM burst (1 because of RAS down)
   |||| |    | || | || |||`-++------------- TRAS2-0   :  100 = REF-RAS=8+TRC=8 (SET4-8M,SET4-32M,SET5-32M)
   |||| |    | || | || |||                               011 = REF-RAS=7+TRC=7
   |||| |    | || | || |||                                     (SET5-16M,mass produced-16M)
   |||| |    | || | || `++----------------- TRWL2-0   :  000 = Write precharge=1
   |||| |    | || | `+---------------------- RCD1-0    :   10 = RAS-CAS=3
   |||| |    | `+-+------------------------ TPC2-0    :  010 = PRE-RAS=3 (SET4-8M,SET4-32M,SET5-32M)
   |||| |    |                                           001 = PRE-RAS=2 (SET5-16M,Mass produced-16M)
   |||| |    `----------------------------- TCAS      :    0 = CAS negate=1
   ||`+-+---------------------------------- TRC2-0    :  000 = RAS precharge after refresh=0
   |`------------------------------------- MRSET     :    *   When 0, all banks are precharged for SDMR
   |                                                          writes
   |                                                          When 1, SDMR writes are according to the
   |                                                          mode register settings
   `--------------------------------------- RASD      :    1 = RAS down mode

                                  * Self-refresh is inhibited because of time is required for CAS before
                                    RAS refresh with certain combinations TRAS and TRC when self refresh
                                    is enabled

>> PCMCIA control register (PCR)  FF800018 = 0000            %%% Change of settings is not required %%%
                                                                          * Because PCMCIA is not used
                        [0000:0000:0000:0000] initial   = 0000:0000:0000:0000
                         |||| |||| |||| ||||
                         |||| |||| |||| |`++- A6TEH2-0  :  000 = Area 6PCMCIAOE/WE negate address delay=0
                         |||| |||| ||`+-+---- A5TEH2-0  :  000 = Area 5PCMCIAOE/WE negate address delay=0
                         |||| |||`-++-------- A6TED2-0  :  000 = Area 6PCMCIA address-OE/WE assert delay=0
                         |||| `++------------ A5TED2-0  :  000 = Area 5PCMCIA address-OE/WE assert delay=0
                         ||`+---------------- A6PCW1-0  :   00 = Area 6PCMCIA wait=0
                         `+----------------- A5PCW1-0  :   00 = Area 5PCMCIA wait=0

>> SDRAM mode register (SDMR)  FF940190 = FF                                %%% Setting required %%%
                                                 * Simultaneous MCR, MRSET control is required when setting.
    Address=FF940000+[0000:0001:1001:0000]
                                || |||| |
                                || ||`+-+---- BL        :  010 = Burst length=4
                                || |`-------- WT        :    0 = Wrap type   =Sequential
                                `+-+--------- LTMODE    :  011 = CAS latency =3

>> Refresh timer control/status register (RTCSR)  FF80001C = A510 %%% Change of settings is required %%%

                        [----:----:*001:0***] initial   = 0000:0000:0000:0000
                        (1010 0101)|||| ||||
                                   |||| |||`- LMTS      : any (overflow limit select)
                                   |||| ||`-- OVIE      : any (overflow interrupt control)
                                   |||| |`--- OVF       : any (overflow flag)
                                   ||`+-+---- CKS2-0    :  010 = clock =CKIO/16=160nsec
                                   |`-------- CMIE      :    0 = compare match interrupts inhibited
                                   `--------- CMF       : any (compare match flag)

>> Refresh timer counter (RTCNT)  FF800020 = A500            %%% Change of settings is not required %%%
                                 * Setting not required, but may be set for uniformity of start-up routine
                        [----:----:0000:0000] initial   = 0000:0000:0000:0000
                        (1010 0101)

>> Refresh time constant (RTCOR)  FF800024 = A55E                %%% Change of settings is required %%%

                        [----:----:0101:1110] initial   = 0000:0000:0000:0000
                        (1010 0101)|||| ||||
                                   `+++-++++-           :   5E = 94(10nsec*16*94=15040nsec)

>> Refresh count register (RFCR)  FF800028                                %%% No restrictions on use %%%

                        [----:---*:****:****] initial   = 0000:0000:0000:0000
                        (1010 010)
```

```
< 1> The DMAC is used in the DDT mode.
< 2> Channel 0 is used by hardware, so software access is inhibited.
  -  Use of the DMA termination interrupt is inhibited.
  -  The hardware uses channel 0 in the single address burst mode with a transfer data length of 32 bytes
     for burst mode, external requests, and rising edge detection.
< 3> Channel 2 performs DMA operation in combination with ch2-DMA of Holly. Both the CPU DMAC channel 2
     register and the Holly ch2-DMA register must be controlled by software at the same time.
  -  Transfer is restricted to block transfer with a data length of 32 bytes.
  -  The only possible address mode is the single address mode.
  -  Transfer initiation is possible only through external requests (from external address sopace to external device)
     Low level detection is used for sampling.
  -  Bus operation is restricted to the burst mode.
  -  DMA termination interrupts can be generated either by CPU DMAC or by Holly ch2-DMA.
     Select one or the other. (Enabling both will simply result in generation of two interrupts.)
< 4> Channel 1 and channel 3 can be used as follows.
       ***********************************************************************
       ***** Note: When using channel 1 or channel 3 DMA, refer to other   *****
       *****       documentation regarding "write failures to the          *****
       *****       peripheral module control register during DMA           *****
       *****       transfers".                                             *****
       ***********************************************************************
  -  Possible transfer data lengths (8bit, 16bit, 32bit, 64bit, 32byte) depend on the area specification of
     the source and destination.
     Specification of a 64 bit transfer data length is possible only when byth the source and destination
     are SystemMemory.
  -  The only address mode that can be used is the dual address mode.
  -  Either SCIF interrupts or auto requests can be used to request transfer initiation.    ---*1
  -  Either the cycle steal mode or the burst mode can be used as be bus mode.              ---*1
  -  The DMA termination interrupt can be used.

  >> DMA source address register 0 (SAR0)  FFA00000                              %%% Access inhibited %%%

  >> DMA destination address register 0 (DAR0)  FFA00004                         %%% Access inhibited %%%

  >> DMA transfer count register 0 (DMATCR0)  FFA00008                           %%% Access inhibited %%%

  >> DMA channel control register 0 (CHCR0)  FFA0000C                            %%% Access inhibited %%%

  >> DMA source address register 1 (SAR1)  FFA00010                          %%% No restrictions on use %%%

  >> DMA destination address register 1 (DAR1)  FFA00014                     %%% No restrictions on use %%%

  >> DMA transfer count register 1 (DMATCR1)  FFA00018                       %%% No restrictions on use %%%

  >> DMA channel control register 1 (CHCR1)  FFA0001C = 00005440            %%% No restrictions on use %%%
                                                                              <<bits31:24,19:16 are fixed>>
    [0000:0000:----:0000:****:****:****:-***] initial   = 0000:0000:0000:0000:0000:0000:0000:0000
     |||| ||||      |||| |||| |||| ||||  |||
     |||| ||||      |||| |||| |||| ||||  ||`- DE        : any (DMAC enable)
     |||| ||||      |||| |||| |||| ||||  |`-- TE        : any (transfer end)
     |||| ||||      |||| |||| |||| ||||  `--- IE        : any (interrupt enable)
     |||| ||||      |||| |||| |||| |`++------ TS2-0     : any (transfer size)
     |||| ||||      |||| |||| |||| |                      64-bit specification is only possible for
     |||| ||||      |||| |||| |||| |                      SystemMemory
     |||| ||||      |||| |||| |||| `--------- TM        : any transmit mode)
     |||| ||||      |||| |||| ||||                                0 = Cycle steal mode                ---*1
     |||| ||||      |||| |||| ||||                                1 = Burst mode
     |||| ||||      |||| |||| `+++----------- RS3-0     : any (resource select)
     |||| ||||      |||| ||||                                      0100,0101,0110,1010,1011
     |||| ||||      |||| ||||                                      are only possible values            ---*1
     |||| ||||      |||| ||`+---------------- SM1-0     : any (source address mode)
     |||| ||||      |||| `+------------------ DM1-0     : any (destination address mode)
     |||| ||||      |||`--------------------- AL        :    0 = DDT mode (DACK high active)
     |||| ||||      ||`----------------------- AM        :    0 = DACK output upon read
     |||| ||||      |`------------------------ RL        :    0 = DDT mode (DRAK high active)
     |||| ||||      `------------------------- DS        :    0 = DREQ low level detection
     |||| |||`------------------------------- DTC       :    0 = No PCMCIA (PCMCIAdestination wait)
     |||| `++--------------------------------- DSA2-0    :  000 = No PCMCIA (PCMCIA destination space
     ||||                                                        attribute
     |||`------------------------------------- STC       :    0 = No PCMCIA (PCMCIA source wait)
     `++--------------------------------------- SSA2-0    :  000 = No PCMCIA (PCMCIA source space attribute)

  >> DMA source address register 2 (SAR2)  FFA00020    %%% Only SystemMemory addresses can be specified %%%
                                        * Addresses must be specified as 32 byte boundaries (bit4-0 must be 0)

  >> DMA destination addresss register 2 (DAR2)  FFA00024                         %%% Access inhibited %%%

  >> DMA transfer count register 2 (DMATCR2)  FFA00028                       %%% No restrictions on use %%%
                          * The transfer count specified must be the same as that specified on the Holly side.
                            With the CPU DMAC, the transfer count is specified in units of 32 bytes, but with
                            Holly it is specified in bytes.

  >> DMA channel control register 2 (CHCR2)  FFA0002C = 000012C0            %%% No restrictions on use %%%
                                                                         <<bit31:24,19,17,15:14,11:4 are fixed>>
    [0000:0000:----:0-0-:00**:0010:1100:-***] initial   = 0000:0000:0000:0000:0000:0000:0000:0000
     |||| ||||      | |  |||| |||| ||||  |||
     |||| ||||      | |  |||| |||| ||||  ||`- DE        : any (DMAC enab le)
     |||| ||||      | |  |||| |||| ||||  |`-- TE        : any (transfer end)
     |||| ||||      | |  |||| |||| ||||  `--- IE        : any (interrupt enable)
     |||| ||||      | |  |||| |||| |`++------ TS2-0     :  100 = 32 byte block transfer
     |||| ||||      | |  |||| |||| `--------- TM        :    1 = burst mode
```

```
   |||| ||||      | |  |||| `+++----------- RS3-0     : 0010 = external request
   |||| ||||      | |  ||||                                  (external address space -> external device)
   |||| ||||      | |  ||`+---------------- SM1-0     : any (source address mode)
   |||| ||||      | |  `+------------------ DM1-0     :   00 = DDT mode (destination address fixed)
   |||| ||||      | `----------------------- AM        :    0 = DACK output when read
   |||| ||||      `------------------------- DS        :    0 = DREQ low level detection
   |||| |||`------------------------------- DTC       :    0 = No PCMCIA (PCMCIA destination wait)
   |||| `++--------------------------------- DSA2-0    :  000 = No PCMCIA
   ||||                                                         (PCMCIA destination space attribute)
   |||`------------------------------------- STC       :    0 = No PCMCIA (PCMCIA source wait)
   `++------------------------------------- SSA2-0    :  000 = No PCMCIA (PCMCIA source space attribute)

>> DMA source address register 3 (SAR3)  FFA00030                        %%% No restrictions on use %%%

>> DMA destination address register 3 (DAR3)  FFA00034                   %%% No restrictions on use %%%

>> DMA transfer count register 3 (DMATCR3)  FFA00038                     %%% No restrictions on use %%%

>> DMA channel control register 3 (CHCR3)  FFA0003C = 00005440           %%% No restrictions on use %%%
                                                                            <<bit31:24,19,17are fixed>>
  [0000:0000:----:0-0-:****:****:****:-***] initial   = 0000:0000:0000:0000:0000:0000:0000:0000
   |||| ||||      | |  |||| |||| ||||  |||
   |||| ||||      | |  |||| |||| ||||  ||`- DE        : any (DMAC enable)
   |||| ||||      | |  |||| |||| ||||  |`-- TE        : any (transfer end)
   |||| ||||      | |  |||| |||| ||||  `--- IE        : any (interrupt enable)
   |||| ||||      | |  |||| |||| |`++------ TS2-0     : any (transfer size)
   |||| ||||      | |  |||| |||| |                      64-bit specification is possible only with
   |||| ||||      | |  |||| |||| |                      SystemMemory.
   |||| ||||      | |  |||| |||| `--------- TM        : any (transmit mode)
   |||| ||||      | |  |||| ||||                                0 = cycle steal mode                ---*1
   |||| ||||      | |  |||| ||||                                1 = burst mode
   |||| ||||      | |  |||| `+++----------- RS3-0     : any (resource select)
   |||| ||||      | |  ||||                                0100,0101,0110,1010,1011
   |||| ||||      | |  ||||                                are only possible values                ---*1
   |||| ||||      | |  ||`+---------------- SM1-0     : any (source address mode)
   |||| ||||      | |  `+------------------ DM1-0     : any (destination address mode)
   |||| ||||      | `----------------------- AM        :    0 = DACK output when read
   |||| ||||      `------------------------- DS        :    0 = DREQ low level detection
   |||| |||`------------------------------- DTC       :    0 = No PCMCIA (PCMCIA destination wait)
   |||| `++--------------------------------- DSA2-0    :  000 = No PCMCIA (PCMCIA destination space attribute)
   |||`------------------------------------- STC       :    0 = No PCMCIA (PCMCIA source wait)
   `++------------------------------------- SSA2-0    :  000 = No PCMCIA (PCMCIA source space attribute)

>> DMA operation register (DMAOR)  FFA00040 = 00008201           %%% Change of settings is required %%%
                                                                                <<bit2:1 can be any>>
  [----:----:----:----:1---:--10:----:-**1] initial   = 0000:0000:0000:0000:0000:0000:0000:0000
                        |      ||       |||
                        |      ||       ||`- DME       :    DMAC enable
                        |      ||       |`-- NMIF      : any (NMI flag)
                        |      ||       `--- AE        : any (address error flag)
                        |      `+---------- PR1-0     :   10 = ch2 priority  (11 = round robin     …*2)
                        `------------------ DDT       :    1 = DDT mode
```

[Notes]
*1. The workaround described separately for "Write failures to peripheral module control register during DMA transfer" cannot be applied in all situation.
*2. In some cases, it may be necessary to specify round robin priority when using the workaround for "Write failures to peripheral module control register during DMA transfer". However, ordinarily ch2 priority should be specified.

[Chapter 15] Serial communication interface (SCI)

< 1> Use of the SCI is inhibited. * The SCI is not used.

[Chapter 16] Serial communication interface with built-in FIFO (SCIF)

< 1> No restrictions on use.
< 2> The peripheral module clock (PΦ) is 50MHz
< 3> With the device itself, the terminals are handled as follows.

```
       SCK2=H                                                    * The SCK2 terminal is pulled up.
       RxD2=H                                                    * The RxD2 terminal is pulled up.
       CTS2=H                                                    * The CTS2 terminal is pulled up.
       RTS2=L                                                    * The RTS2 terminal is pulled down.
```

>> There are no restrictions on register use.

[Chapter 17] Smart card interface

< 1> Use of smart card interface is inhibited. * The smart card interface is not used.

[Chapter 18] I/O Port

< 1> General-purpose I/O ports are used as follows.

```
       PORT0,PORT1,PORT5-PORT7,PORT10-PORT19 : Reserved
       PORT2-PORT4                           : TV mode settings (output)
       PORT8,PORT9                           : AV connector cable ID (input)
```

- Port control register A is configured after configuring port data register A.

```
   - GPIO interrupts are not used.
< 2> The SCI I/O port is not used.
< 3> The SCIF I/O port can be used.

  >> Port control register A (PCTRA)  FF80002C = 000A03F0          %%% Change of settings is required %%%

    [0000:0000:0000:1010:0000:0011:1111:0000] initial   = 0000:0000:0000:0000:0000:0000:0000:0000
     |||| |||| |||| |||| |||| |||| |||| ||||
     |||| |||| |||| |||| |||| |||| |||| |||`- PB0IO     :    0 = Port 0 input
     |||| |||| |||| |||| |||| |||| |||| ||`-- PB0PUP    :    0 = Port 0 pulled up
     |||| |||| |||| |||| |||| |||| |||| |`--- PB1IO     :    0 = Port 1 input
     |||| |||| |||| |||| |||| |||| |||| `---- PB1PUP    :    0 = Port 1 pulled up
     |||| |||| |||| |||| |||| |||| |||`------ PB2IO     :    1 = Port 2 output
     |||| |||| |||| |||| |||| |||| ||`------- PB2PUP    :    1 = Port 2 not pulled up
     |||| |||| |||| |||| |||| |||| |`-------- PB3IO     :    1 = Port 3 output
     |||| |||| |||| |||| |||| |||| `--------- PB3PUP    :    1 = Port 3 not pulled up
     |||| |||| |||| |||| |||| |||`----------- PB4IO     :    1 = Port 4 output
     |||| |||| |||| |||| |||| ||`------------ PB4PUP    :    1 = Port 4 not pulled up
     |||| |||| |||| |||| |||| |`------------- PB5IO     :    0 = Port 5 input
     |||| |||| |||| |||| |||| `-------------- PB5PUP    :    0 = Port 5 pulled up
     |||| |||| |||| |||| |||`---------------- PB6IO     :    0 = Port 6 input
     |||| |||| |||| |||| ||`----------------- PB6PUP    :    0 = Port 6 pulled up
     |||| |||| |||| |||| |`------------------ PB7IO     :    0 = Port 7 input
     |||| |||| |||| |||| `------------------- PB7PUP    :    0 = Port 7 pulled up
     |||| |||| |||| |||`--------------------- PB8IO     :    0 = Port 8 input
     |||| |||| |||| ||`---------------------- PB8PUP    :    1 = Port 8 not pulled up
     |||| |||| |||| |`----------------------- PB9IO     :    0 = Port 9 input
     |||| |||| |||| `------------------------ PB9PUP    :    1 = Port 9 not pulled up
     |||| |||| |||`------------------------- PB10IO    :    0 = Port 10 input
     |||| |||| ||`-------------------------- PB10PUP   :    0 = Port 10 pulled up
     |||| |||| |`--------------------------- PB11IO    :    0 = Port 11 input
     |||| |||| `---------------------------- PB11PUP   :    0 = Port 11 pulled up
     |||| |||`------------------------------ PB12IO    :    0 = Port 12 input
     |||| ||`------------------------------- PB12PUP   :    0 = Port 12 pulled up
     |||| |`-------------------------------- PB13IO    :    0 = Port 13 input
     |||| `--------------------------------- PB13PUP   :    0 = Port 13 pulled up
     |||`----------------------------------- PB14IO    :    0 = Port 14 input
     ||`------------------------------------ PB14PUP   :    0 = Port 14 pulled up
     |`------------------------------------- PB15IO    :    0 = Port 15 input
     `-------------------------------------- PB15PUP   :    0 = Port 15 pulled up

  >> Port data register A (PDTRA)  FF800030 = F***                 %%% Change of settings is required %%%

                         [1111:11**:111*:**11] initial   = XXXX:XXXX:XXXX:XXXX
                          |||| |||| |||| ||||
                          |||| |||| |||| |||`- PB0DT     :    1 = Port 0 data
                          |||| |||| |||| ||`-- PB1DT     :    1 = Port 1 data
                          |||| |||| |||| |`--- PB2DT     : any  = Port 2 data
                          |||| |||| |||| `---- PB3DT     : any  = Port 3 data
                          |||| |||| |||`------ PB4DT     : any  = Port 4 data
                          |||| |||| ||`------- PB5DT     :    1 = Port 5 data
                          |||| |||| |`-------- PB6DT     :    1 = Port 6 data
                          |||| |||| `--------- PB7DT     :    1 = Port 7 data
                          |||| |||`----------- PB8DT     : any  = Port 8 data
                          |||| ||`------------ PB9DT     : any  = Port 9 data
                          |||| |`------------- PB10DT    :    1 = Port 10 data
                          |||| `-------------- PB11DT    :    1 = Port 11 data
                          |||`---------------- PB12DT    :    1 = Port 12 data
                          ||`----------------- PB13DT    :    1 = Port 13 data
                          |`------------------ PB14DT    :    1 = Port 14 data
                          `------------------- PB15DT    :    1 = Port 15 data

  >> Port control register B (PCTRB)  FF800040                                    %%% Access inhibited %%%

  >> Port data register B (PDTRB)  FF800044                                       %%% Access inhibited %%%

  >> GPIO interrupt control register (GPIOIC)  FF800048                           %%% Access inhibited %%%

  >> Serial port register (SCSPTR1)  FFE0001C                                     %%% Access inhibited %%%

  >> Serial port register (SCSPTR2)  FFE80020                                %%% No restrictions on use %%%

                         [----:----:****:--**] initial   = 0000:0000:0X0X:000X
                                   ||||   ||
                                   ||||   |`- SPB2DT    : any = RxD2 input,TxD2 output data
                                   ||||   `-- SPB2IO    : any = TxD2 output conditions
                                   |||`------ CTSDT     : any = CTS2 I/O data
                                   ||`------- CTSIO     : any = CTS2 I/O
                                   |`-------- RTSDT     : any = RTS2 I/O data
                                   `--------- RTSIO     : any = RTS2 I/O


[Chapter 19] Interrupt Controller (INTC) ____________________________________________________________

 < 1> Non-maskable interrupts are for debugger use only, and are not generated in products.
                                                                  * Because NMI terminal is pulled up.
    - If a NMI occurs during DMA, the DMA sequence between SH4 and Holly is disrupted and no futher DMA        ^Added
      is possible. (However, data can still be read and written normally.) Normal DMA operation can only be
      restored by PowerOn reset.
 < 2> NMI is detected at the rising edge.
 < 3> Only terminals /IRL1 and /IRL2 are used for external interrupts.
                                                                  * Terminals /IRL0 and /IRL3 are pulled up.
```

```
      Terminals /IRL3-/IRL0=1001 : Level 6 external interrupt
      Terminals /IRL3-/IRL0=1011 : Level 4 external interrupt
      Terminals /IRL3-/IRL0=1101 : Level 2 external interrupt
      Level 1, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15 external interrupts are not generated.
< 4> IRL interrupts are level encoded interrupts.
< 5> The following interrupts are not generated.
      TMU2/TICPI2 : Input capture interrupt                 * The TCLK terminal is pulled up.
      RTC/ATI     : Alarm interrupt                         * The RTC is not used in products.
      RTC/PRI     : Periodic interrupt                      * The RTC is not used in products.
      RTC/CUI     : Roll left interrupt                     * The RTC is not used in products.
      SCI/ERI     : Receive error interrupt                 * The SCI is not used.
      SCI/RXI     : Receive data full interrupt             * The SCI is not used.
      SCI/TXI     : Send data empty interrupt               * The SCI is not used.
      SCI/TEI     : Send end interrupt                      * The SCI is not used.
      REF/RCMI    : Compare match interrupt                 * Inhibited because refresh used.
      DMAC/DMTE0  : DMAC-ch0 transfer end interrupt         * DMAC-ch0 transfer end interrupts inhibited.
      GPIO/GPIOI  : I/O port interrupt                      * I/O port interrupts inhibited.
< 6> Hitachi-UDI interrupts are for debugger use only.

  >> Interrupt control register (ICR)  FFD00000 = 8000         %%% Change of settings is not required %%%

                        [10--:--00:0---:----] initial   = 1000:0000:0000:0000
                         ||     || |
                         ||     || `--------- IRLM      :    0 = IRL interrupts are  level encoded
                         ||     |`----------- NMIE      :    0 = NMI is detected at rising edge
                         ||     `------------ NMIB      :    0 = NMI requests are held when SR. BL are 1
                         |`------------------ MAI       :    0 = Interrupts are still enabled when NMI is L
                         `------------------- NMIL      : any (NMI input level)

  >> Interrupt priority level configuration register A (IPRA)  FFD00004      %%% No restrictions on use %%%
                                                                                   <<bit3:fixed to 0>>
                        [****:****:****:0000] initial   = 0000:0000:0000:0000
                         |||| |||| |||| ||||
                         |||| |||| |||| `+++- (RTC)     : 0000 = RTC interrupt request mask
                         |||| |||| `+++------ (TMU2)    : any  (TMU2 interrupt request)
                         |||| `+++----------- (TMU1)    : any  (TMU1 interrupt request)
                         `+++---------------- (TMU0)    : any  (TMU0 interrupt request)

  >> nterrupt priority level configuration register B (IPRB)  FFD00008       %%% No restrictions on use %%%
                                                                                   <<bit7:fixed to 0>>
                        [****:****:0000:----] initial   = 0000:0000:0000:0000
                         |||| |||| ||||
                         |||| |||| `+++------ (SCI)     : 0000 = SCI interrupt request mask
                         |||| `+++----------- (REF)     : any (REF interrupt request)
                         `+++---------------- (WDT)     : any (WDT interrupt request)

  >> Interrupt priority level configuration register C (IPRC)  FFD0000C       %%% No restrictions on use %%%
                                                                                  <<bit15:12,3:fixed to 0>>
                        [0000:****:****:0000] initial   = 0000:0000:0000:0000
                         |||| |||| |||| ||||
                         |||| |||| |||| `+++- (H-UDI)   : 0000 = Hitachi-UDI interrupt request mask
                         |||| |||| `+++------ (SCIF)    : any (SCIF interrupt request)
                         |||| `+++----------- (DMAC)    : any (DMAC interrupt request)
                         `+++---------------- (GPIO)    : 0000 = GPIO interrupt request mask


[Chapter 20] User Break Controller_____________________________________________________________________

 < 1> User break controller is for debugger only, and thus cannot be used.


[Chapter 21] Hitachi User Debugging Interface (Hitachi-UDI)____________________________________________

 < 1> Hitachi user debugging interface is for debugger only, and thus cannot be used.
```