```spin
{{
        File:       gpu.spin
        Author:     Connor Spangler
        Description:
                    This file contains the PASM code defining a JCAP GPU
}}

CON
    ' Clock settings
    _clkmode = xtal1 + pll16x         ' Standard clock mode w/ 16x PLL
    _xinfreq = 6_500_000              ' 6.5 MHz clock for x16 = 104 MHz

    ' Pin settings
    VS_PIN = 26
    RX_PIN = 0

OBJ
    system          : "system"       ' Import system settings
    gfx_rx          : "rx"           ' Import graphics reception system
    vga_render      : "vga_render"   ' Import VGA render system
    vga_display     : "vga_display"  ' Import VGA display system

VAR
    ' Video system pointers
    long  gfx_buffer_base_            ' Register pointing to graphics resources buffer
    long  gfx_buffer_size_            ' Size of the graphics buffer
    long  data_ready_base_            ' Register pointing to data status indicator
    long  cur_scanline_base_          ' Register pointing to current scanline being requested by the VGA Display system
    long  scanline_buff_base_         ' Register pointing to scanline buffer
    long  horizontal_position_        ' Register pointing to base of tile color palettes
    long  tcolor_palette_base_        ' Register pointing to base of tile color palettes
    long  scolor_palette_base_        ' Register pointing to base of sprite color palettes
    long  sprite_att_base_            ' Register pointing to base of sprite attribute table
    long  tile_map_base_              ' Register pointing to base of tile maps
    long  tile_palette_base_          ' Register pointing to base of tile palettes
    long  sprite_palette_base_        ' Register pointing to base of sprite palettes

PUB main | rx1, rx2
    ' Initialize graphics system pointers
    gfx_buffer_base_   := @gfx_buff                                              ' Point graphics buffer base to graphics buffe
    gfx_buffer_size_   := system#GFX_BUFFER_SIZE                                 ' Set the size of the graphics resources buffe
    cur_scanline_base_ := @cur_scanline                                         ' Point current scanline base to current scanl
    data_ready_base_   := @data_ready                                           ' Point data ready base to data ready indicato
    scanline_buff_base_ := @scanline_buff                                       ' Point video buffer base to video buffer
    horizontal_position_ := gfx_buffer_base_                                    ' Point tile color palette base to base of til
    tcolor_palette_base_ := horizontal_position_+system#NUM_PARALLAX_REGS*4     ' Point tile color palette base to base of til
    scolor_palette_base_ := tcolor_palette_base_+system#NUM_TILE_COLOR_PALETTES*4*4  ' Point sprite color palette base to base of s
    sprite_att_base_   := scolor_palette_base_+system#NUM_SPRITE_COLOR_PALETTES*4*4  ' Point sprite attribute table base to base of
    tile_map_base_     := sprite_att_base_+system#SAT_SIZE*4                    ' Point tile map base to base of tile maps
    tile_palette_base_ := @tile_palettes                                       ' Point tile palette base to base of tile pale
    sprite_palette_base_ := @sprite_palettes                                   ' Point sprite palette base to base of sprite

    ' Start subsystems
    rx1 := constant(NEGX|0)
    rx2 := constant(system#GFX_BUFFER_SIZE << 16) | @gfx_buff
    gfx_rx.start(@rx1, VS_PIN, RX_PIN)                     ' Start video data RX driver
    repeat while rx1
    vga_display.start(@data_ready_base_)          ' Start display driver
    vga_render.start(@data_ready_base_)           ' Start renderers

DAT

            ' Graphics engine resources
data_ready      long      0                       ' Graphics data ready indicator
cur_scanline    long      0                       ' Current scanline being rendered
scanline_buff   long      0[system#VID_BUFFER_SIZE]      ' Video buffer
gfx_buff        long      0[system#GFX_BUFFER_SIZE]       ' Graphics resources buffer

tile_palettes
            ' Empty tile
tile_blank      long      $0_0_0_0_0_0_0_0        ' Tile 0
                long      $0_0_0_0_0_0_0_0
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                long        $0_0_0_0_0_0_0_0
                long        $0_0_0_0_0_0_0_0
                long        $0_0_0_0_0_0_0_0
                long        $0_0_0_0_0_0_0_0
                long        $0_0_0_0_0_0_0_0
                long        $0_0_0_0_0_0_0_0

                ' Upper left corner of box
tile_box_tl     long        $1_1_1_1_1_1_1_1        ' Tile 1
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2

                ' Upper right corner of box
tile_box_tr     long        $1_1_1_1_1_1_1_1        ' Tile 2
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1

                ' Bottom right corner of box
tile_box_br     long        $2_2_2_2_2_2_2_1        ' Tile 3
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $2_2_2_2_2_2_2_1
                long        $1_1_1_1_1_1_1_1

                ' Bottom left corner of box
tile_box_bl     long        $1_2_2_2_2_2_2_2        ' Tile 4
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1

sprite_palettes
                ' Ship sprite
sprite_ship     long        $0_0_0_0_1_0_0_0        ' Sprite 0
                long        $0_0_0_1_1_1_0_0
                long        $0_0_0_0_1_0_0_0
                long        $0_0_0_0_1_0_0_0
                long        $0_0_0_1_1_1_0_0
                long        $0_0_1_2_2_2_1_0
                long        $0_4_1_3_3_3_1_6
                long        $0_4_1_0_3_0_1_6

                ' Rock sprite
sprite_rock     long        $0_0_0_0_0_0_0_0        ' Sprite 1
                long        $4_4_0_0_0_0_0_0
                long        $1_1_1_0_0_0_0_0
                long        $0_3_2_1_0_0_1_0
                long        $3_3_2_1_1_1_1_1
                long        $0_3_2_1_0_0_1_0
                long        $1_1_1_0_0_0_0_0
                long        $6_6_0_0_0_0_0_0

                ' Mario top left sprite
mario_tl        long        $0_0_0_0_0_1_1_1        ' Sprite 2
```

```
                long        $0_0_0_0_1_1_1_1
                long        $0_0_0_0_2_2_2_3
                long        $0_0_0_2_3_2_3_3
                long        $0_0_0_2_3_2_2_3
                long        $0_0_0_2_2_3_3_3
                long        $0_0_0_0_0_3_3_3
                long        $0_0_0_0_2_2_1_2

                ' Mario top right sprite
mario_tr        long        $1_1_0_0_0_0_0_0        ' Sprite 3
                long        $1_1_1_1_1_0_0_0
                long        $3_2_3_0_0_0_0_0
                long        $3_2_3_3_3_0_0_0
                long        $3_3_2_3_3_3_0_0
                long        $3_2_2_2_2_0_0_0
                long        $3_3_3_3_0_0_0_0
                long        $2_2_0_0_0_0_0_0

                ' Mario bottom left sprite
mario_bl        long        $0_0_0_2_2_2_1_2        ' Sprite 4
                long        $0_0_2_2_2_2_1_1
                long        $0_0_3_3_2_1_3_1
                long        $0_0_3_3_3_1_1_1
                long        $0_0_3_3_1_1_1_1
                long        $0_0_0_0_1_1_1_0
                long        $0_0_0_2_2_2_0_0
                long        $0_0_2_2_2_2_0_0

                ' Mario bottom right sprite
mario_br        long        $2_1_2_2_2_0_0_0        ' Sprite 5
                long        $1_1_2_2_2_2_0_0
                long        $1_3_1_2_3_3_0_0
                long        $1_1_1_3_3_3_0_0
                long        $1_1_1_1_3_3_0_0
                long        $0_1_1_1_0_0_0_0
                long        $0_0_2_2_2_0_0_0
                long        $0_0_2_2_2_2_0_0

                ' Test sprite
tester1         long        $1_1_1_1_1_1_1_1        ' Sprite 6
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2

                ' Test sprite
tester2         long        $1_1_1_1_1_1_1_1        ' Sprite 7
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2

                ' Test sprite
tester3         long        $1_1_1_1_1_1_1_1        ' Sprite 8
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2
                long        $1_1_1_1_1_1_1_1
                long        $2_2_2_2_2_2_2_2

                ' Test sprite
tester4         long        $1_1_1_1_1_1_1_1        ' Sprite 9
```

```
long        $2_2_2_2_2_2_2_2
long        $1_1_1_1_1_1_1_1
long        $2_2_2_2_2_2_2_2
long        $1_1_1_1_1_1_1_1
long        $2_2_2_2_2_2_2_2
long        $1_1_1_1_1_1_1_1
long        $2_2_2_2_2_2_2_2
```