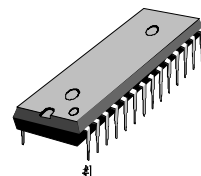


## VIDEO AMP MERGED OSD PROCESSOR

The S1D2514X01 is a very high frequency video amplifier & wide range OSD processor 1 chip system with I<sup>2</sup>C Bus control used in monitors. It contains 3 matched R/G/B video amplifiers with OSD processor and provides flexible interfacing to I<sup>2</sup>C Bus controlled adjustment systems.

32-DIP-600A



## FUNCTIONS

- R/G/B video amplifier
- OSD processor
- I<sup>2</sup>C bus control
- Cut-off brightness control
- R/G/B sub contrast/cut-off control
- Half tone

## ORDERING INFORMATION

| Device          | Package     | Operating Temperature |
|-----------------|-------------|-----------------------|
| S1D2514X01-D0B0 | 32-DIP-600A | -20 °C – +75 °C       |

## FEATURES

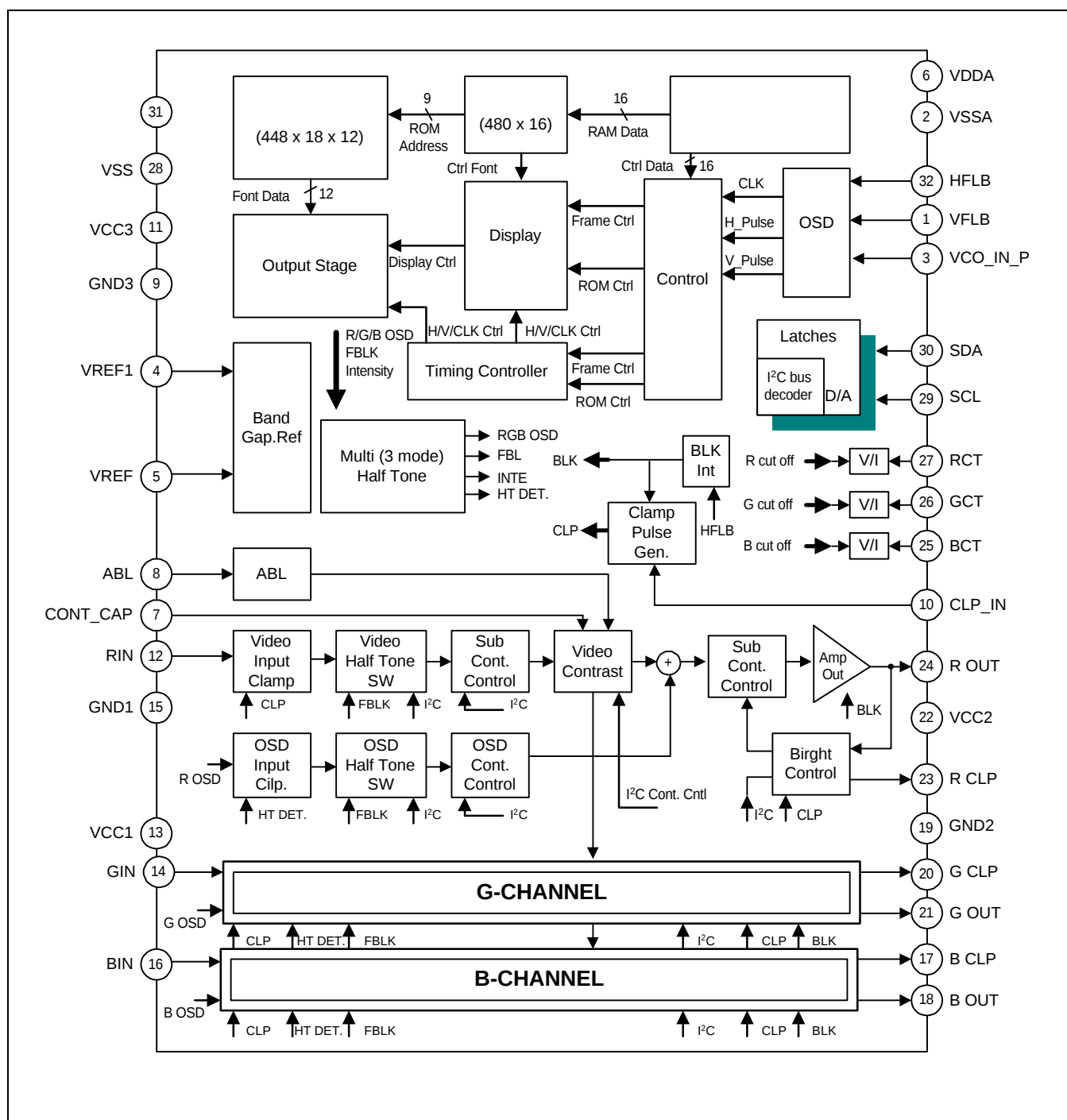
### VIDEO AMP PART

- 3-channel R/G/B video amplifier, 150MHz @f-3dB
- I<sup>2</sup>C bus control items
  - Contrast control: -38dB
  - Sub contrast control for each channel: -12dB
  - Brightness control
  - OSD contrast control: -38dB
  - Cut-off brightness control (AC coupling)
  - Cut-off control for each channel (AC coupling)
  - Switch registers for SBLK and video half tone and CLP/BLK polarity selection and INT/EXT CLP selection
- Built in ABL (automatic beam limitation)
- Built in video input clamp, BRT clamp
- Built in video half tone (3mode) function on OSD pictures
- Capable of 8.0Vp-p output swing
- Improvement of rise & fall time (2.2ns)
- Cut-off brightness control
- Built in blank gate with spot killer
- Clamp pulse generator
- OSD intensity
- BLK, CLP polarity selection
- Clamp gate with anti OSD sagging

### OSD PART

- Built in 1K-byte SRAM
- 256 ROM fonts (each font consists of 12 × 18 dots.)
- Full screen memory architecture
- Wide range PLL available (15kHz — 90kHz, Reference 800 X 600)
- Programmable vertical height of character
- Programmable vertical and horizontal positioning
- Character color selection up to 16 different colors (in a units of character)
- Programmable background color (up to 16 colors)
- Character blinking and shadowing
- Character scrolling
- 72MHz pixel frequency from on-chip PLL (Reference 800 ± 600)
- Full white pattern generation function

## BLOCK DIAGRAM



**Figure 1. Functional Block Diagram**

## PIN CONFIGURATION

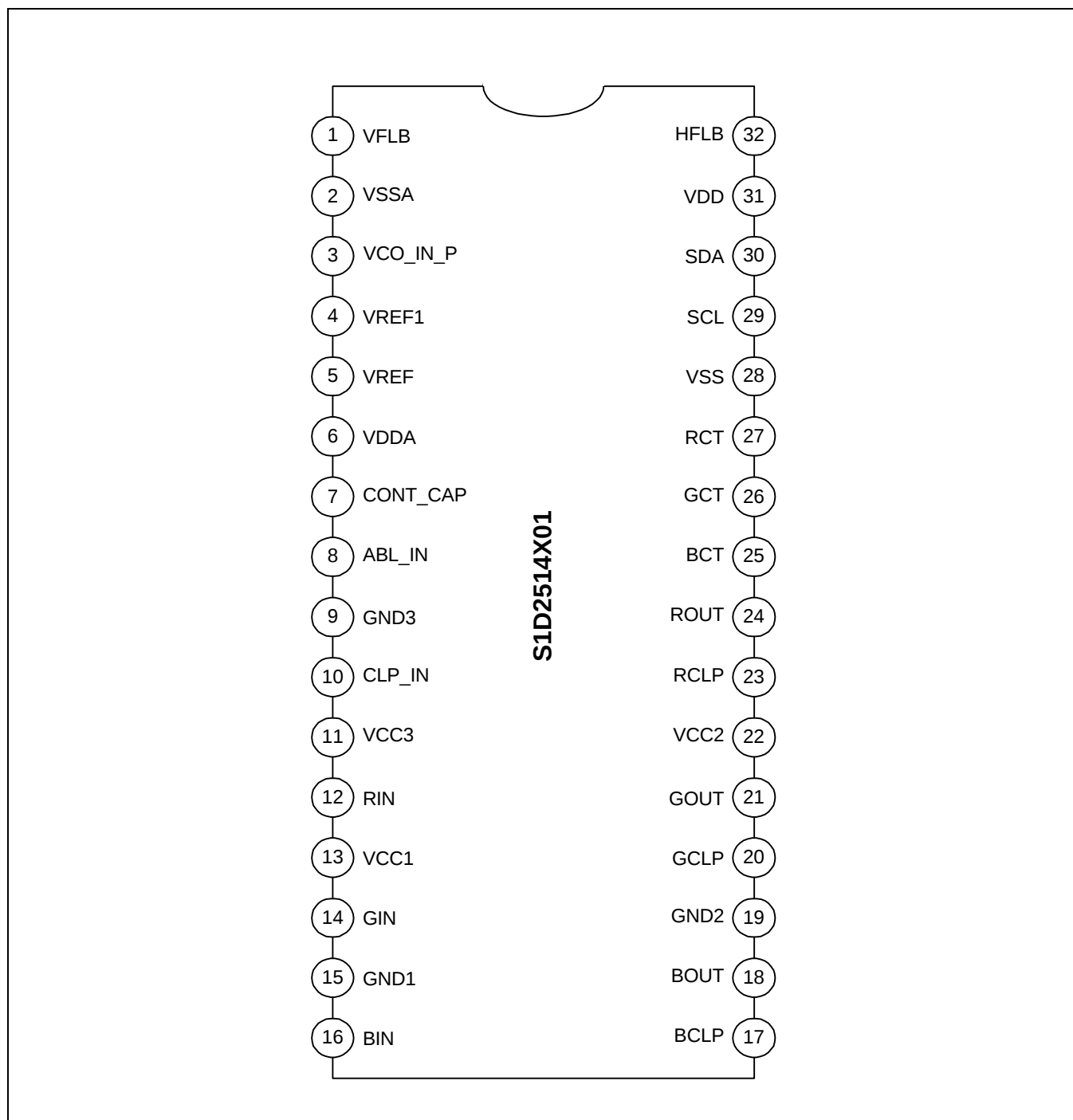


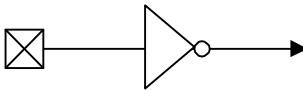
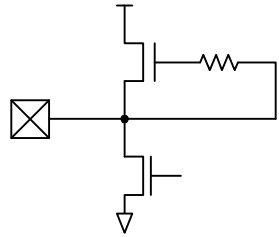
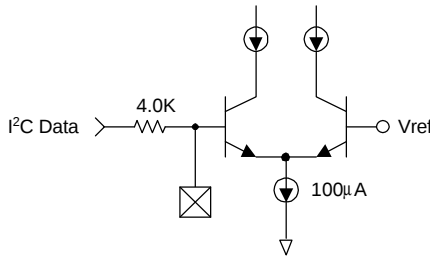
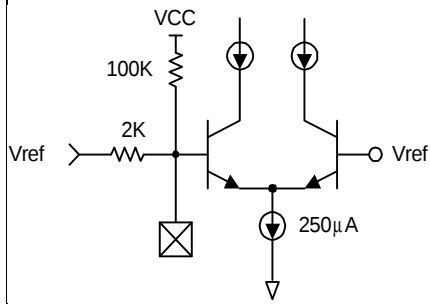
Figure 2. Pin Configuration

**Table 1. Pin Configuration**

| Pin No. | Symbol   | I/O | Configuration                                                                                   |
|---------|----------|-----|-------------------------------------------------------------------------------------------------|
| 1       | VFLB     | I   | Vertical flyback signal                                                                         |
| 2       | VSSA     | -   | Ground (PLL part)                                                                               |
| 3       | VCO_IN_P | I   | This voltage is generated at the external loop filter and goes into the input stage of the VCO. |
| 4       | VREF1    | O   | Charge pump output                                                                              |
| 5       | VREF     | O   | PLL regulator filter                                                                            |
| 6       | VDDA     | -   | +5V supply voltage for PLL part                                                                 |
| 7       | CONT_CAP | -   | Contrast control for AMP part                                                                   |
| 8       | ABL      | -   | Auto beam limit.                                                                                |
| 9       | GND3     | -   | Ground for video AMP part(for AMP control)                                                      |
| 10      | CLP_IN   | -   | Video clamp pulse input                                                                         |
| 11      | VCC3     | -   | +12V supply voltage for video AMP part(for AMP control)                                         |
| 12      | RIN      | I   | Video signal input (red)                                                                        |
| 13      | VCC1     | -   | +12V supply voltage for video AMP(for main video signal process)                                |
| 14      | GIN      | I   | Video signal input (green)                                                                      |
| 15      | GND1     | -   | Ground for video AMP part(for main video signal process)                                        |
| 16      | BIN      | I   | Video signal input (blue)                                                                       |
| 17      | BCLP     | -   | B output clamp cap                                                                              |
| 18      | BOUT     | O   | Video signal output (blue)                                                                      |
| 19      | GND2     | -   | Ground for video AMP part(for video output drive)                                               |
| 20      | GCLP     | -   | G output clamp cap                                                                              |
| 21      | GOUT     | O   | Video signal output (green)                                                                     |
| 22      | VCC2     | -   | +12V supply voltage for video AMP part(for video output drive)                                  |
| 23      | RCLP     | -   | R output clamp cap                                                                              |
| 24      | ROUT     | O   | Video signal output (red)                                                                       |
| 25      | BCT      | -   | B cut-off output                                                                                |
| 26      | GCT      | -   | G cut-off output                                                                                |
| 27      | RCT      | -   | R cut-off output                                                                                |
| 28      | VSS      | -   | Ground for digital part                                                                         |
| 29      | SCL      | I   | Serial clock (I <sup>2</sup> C)                                                                 |
| 30      | SDA      | I/O | Serial data (I <sup>2</sup> C)                                                                  |
| 31      | VDD      | -   | +5V supply voltage for digital part                                                             |
| 32      | HFLB     | I   | Horizontal flyback signal                                                                       |

## PIN DESCRIPTION

Table 2. Pin Description

| Pin No | Pin Name                   | Schematic                                                                            | Description                         |
|--------|----------------------------|--------------------------------------------------------------------------------------|-------------------------------------|
| 1      | VFLB                       |    | FLB signal is in TTL level          |
| 32     | HFLB                       |                                                                                      | Multi polarity input                |
| 3      | VCO_IN_P                   |     | PLL loop filter output              |
| 4      | VPEF1                      |                                                                                      | BandGap ref. output                 |
| 5      | VREF                       |                                                                                      |                                     |
| 7      | Contrast cap<br>(CONT_CAP) |  | Contrast cap range<br>(0.1uF — 5uF) |
| 8      | ABL_IN                     |  | ABL input DC range<br>(1 — 4.5V)    |

**Table 2. Pin Description (Continued)**

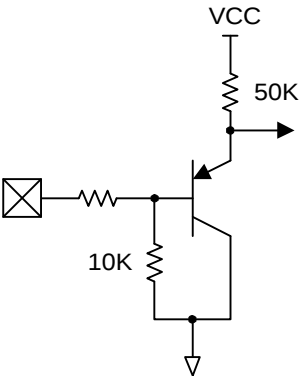
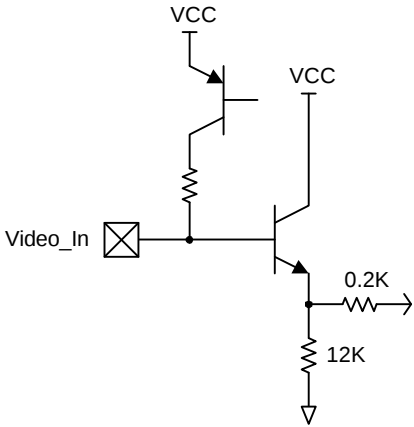
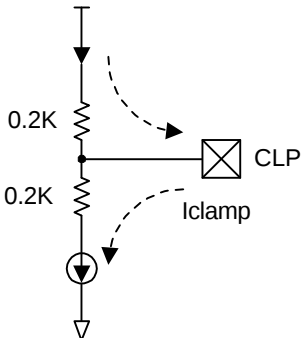
| Pin No | Pin Name                | Schematic                                                                           | Description                                                                                                 |
|--------|-------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 10     | CLP_IN                  |    | Multi polarity input<br><br>Clamp gate pulse TTL level input                                                |
| 12     | Red video input (RIN)   |  | Max input video signal is 0.7 Vpp                                                                           |
| 14     | Green video input (GIN) |                                                                                     |                                                                                                             |
| 16     | Blue video input (BIN)  |                                                                                     |                                                                                                             |
| 17     | Blue (B clamp cap)      |  | Brightness controlling actives by charging and discharging of the external cap. (0.1µF) (During clamp gate) |
| 20     | Green (G clamp cap)     |                                                                                     |                                                                                                             |
| 23     | Red (R clamp)           |                                                                                     |                                                                                                             |

Table 2. Pin Description (Continued)

| Pin No         | Pin Name                                                                               | Schematic | Description                                     |
|----------------|----------------------------------------------------------------------------------------|-----------|-------------------------------------------------|
| 18<br>21<br>24 | Blue video output (BOUT)<br>Green video output (GOUT)<br>Red video output (ROUT)       |           | Video signal output                             |
| 27<br>26<br>25 | Red cut-off control (RCT)<br>Green cut-off control (GCT)<br>Blue cut-off control (BCT) |           | Cut-off control output                          |
| 29             | SCL                                                                                    |           | Serial clock input port of I <sup>2</sup> C bus |
| 30             | SDA                                                                                    |           | Serial data input port of I <sup>2</sup> C bus  |

**ABSOLUTE MAXIMUM RATINGS** (see 1)

(Ta = 25 °C)

**Table 3. Absolute Maximum Ratings**

| No | Item                          | Symbol            | Value |      |      | Unit      |
|----|-------------------------------|-------------------|-------|------|------|-----------|
|    |                               |                   | Min   | Typ  | Max  |           |
| 1  | Maximum supply voltage        | V <sub>CC</sub>   | -     | -    | 13.2 | V         |
|    |                               | V <sub>DD</sub>   | -     | -    | 6.5  |           |
| 2  | Operating temperature (see 2) | T <sub>opr</sub>  | -20   | -    | 75   | °C        |
| 3  | Storage temperature           | T <sub>stg</sub>  | -65   |      | 150  | °C        |
| 4  | Operating supply voltage      | V <sub>CCop</sub> | 11.4  | 12.0 | 12.6 | V (see 3) |
|    |                               | V <sub>DDop</sub> | 4.75  | 5.00 | 5.25 |           |
| 5  | Power dissipation             | P <sub>D</sub>    | -     | -    |      | W         |

**THERMAL & ESD PARAMETER**

**Table 4. Thermal & ESD Parameter**

| No | Item                                  | Symbol          | Value |     |     | Unit |
|----|---------------------------------------|-----------------|-------|-----|-----|------|
|    |                                       |                 | Min   | Typ | Max |      |
| 1  | Thermal resistance (junction-ambient) | θ <sub>ja</sub> | -     | 48  | -   | °C/W |
| 2  | Junction temperature                  | T <sub>j</sub>  | -     | 150 | -   | °C   |
| 3  | Human body model (C = 100p, R = 1.5k) | HBM             | 2     | -   | -   | KV   |
| 4  | Machine model (C = 200p, R = 0)       | MM              | 300   | -   | -   | V    |
| 5  | Charge device model                   | CDM             | 800   | -   | -   | V    |

## ELECTRICAL CHARACTERISTICS

### DC ELECTRICAL CHARACTERISTICS

(Tamb = 25 °C, V<sub>CC</sub> = 12V, V<sub>DD</sub> = V<sub>DDA</sub> = 5V, ABL input voltage = 5V, HFLB input signal = S3, load resistors = 470Ω, except OSD part current 35mA, unless otherwise stated)

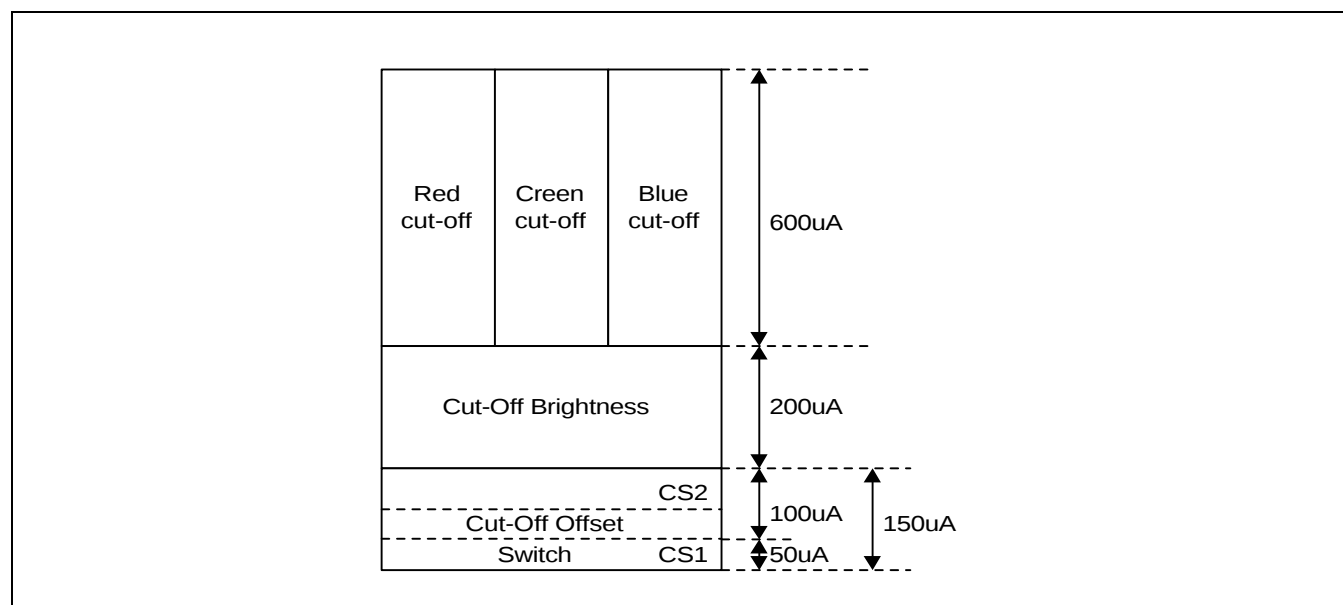
**Table 5. DC Electrical Characteristics**

| Parameter                                    | Symbol                  | Conditions                                     | Value |      |      | Unit |
|----------------------------------------------|-------------------------|------------------------------------------------|-------|------|------|------|
|                                              |                         |                                                | Min   | Typ  | Max  |      |
| Supply current                               | I <sub>CC</sub> (see 4) |                                                | 100   | 125  | 130  | mA   |
| Minimum supply current                       | I <sub>CC</sub> min     | V <sub>CC</sub> = 11.4V                        | 95    | 110  | 120  | mA   |
| Maximum supply current                       | I <sub>CC</sub> max     | V <sub>CC</sub> = 12.6V                        | 105   | 130  | 140  | mA   |
| ABS supply current                           | I <sub>CC</sub> abs     | V <sub>CC</sub> = 13.2V                        | -     | -    | 175  | mA   |
| Video input bias voltage                     | V bias                  |                                                | 1.8   | 2.1  | 2.4  | V    |
| Video black level voltage (POR)              | V blackpor              |                                                | 1.20  | 1.50 | 1.80 | V    |
| Black level voltage channel difference (POR) | Δ V blackpor<br>(see 5) |                                                | Δ 10  | -    | -    | %    |
| Video black level voltage (FFH)              | V blackff               | 04 = FFH (see 13)                              | 2.2   | 2.7  | 3.2  | V    |
| Black level voltage channel difference (FFH) | Δ V blackff             |                                                | Δ 10  | -    | -    | %    |
| Video black level voltage (00H)              | V black00               | 04 = 00H                                       | -     | 0.2  | 0.5  | V    |
| Black level voltage channel difference (00H) | Δ V black00             |                                                | Δ 10  | -    | -    | %    |
| Spot killer voltage                          | Vspot                   | V <sub>CC</sub> = Var.                         | 9.20  | 10.4 | 11.2 | V    |
| Cut-off current (FFH)                        | ICTff                   | Pin25, 26, 27 = 12V<br>09 — 0B: FFH<br>0C: 00H | 500   | 625  | 750  | μA   |
| Cut-off current (00H)                        | ICT00                   | Pin25, 26, 27 = 12V<br>09 — 0C: 00H            | -     | 2.0  | 5.0  | μA   |
| Cut-off brightness current (FFH)             | ICTBRTff                | Pin25, 26, 27 = 12V<br>09 — 0B: 00H<br>0C: FFH | 100   | 180  | 260  | μA   |
| Cut-off brightness current (80H)             | ICTBRT80                | Pin25, 26, 27 = 12V<br>09 — 0B: 00H<br>0C: 80H | 50    | 90   | 130  | μA   |
| Cut-off offset current 1                     | ICS1                    | Pin25, 26, 27 = 12V<br>09 — 0C: 00H<br>0E: 11H | 25    | 50   | 75   | μA   |

**Table 5. DC Electrical Characteristics (Continued)**

| Parameter                | Symbol | Conditions                                     | Value |     |     | Unit |
|--------------------------|--------|------------------------------------------------|-------|-----|-----|------|
|                          |        |                                                | Min   | Typ | Max |      |
| Cut-off offset current 2 | ICS2   | Pin25, 26, 27 = 12V<br>09 — 0C: 00H<br>0E: 12H | 50    | 100 | 130 | μA   |
| Soft BLK output voltage  | Vsblk  | 0D: 80H<br>0E: 14H                             | -     | 0.2 | 0.5 | V    |
| Clamp cap voltage (POR)  | Vcap   |                                                | 6.0   | 7.0 | 8.0 | V    |

Total external cut-off current range



**AC ELECTRICAL CHARACTERISTICS**

(Tamb = 25 °C, V<sub>CC</sub> = 12V, V<sub>DD</sub> = V<sub>DDA</sub> = 5V, ABL input voltage = 5V, HFLB input signal = S3, load resistors = 470Ω, Vin = 0.7Vpp manually adjust video output pins 18, 21 and 24 to 4V DC for the AC test (see 11) unless otherwise stated (see 12))

**Table 6. AC Electrical Characteristics**

| Parameter                                     | Symbol                      | Conditions                                      | Value |      |      | Unit            |
|-----------------------------------------------|-----------------------------|-------------------------------------------------|-------|------|------|-----------------|
|                                               |                             |                                                 | Min   | Typ  | Max  |                 |
| Contrast max. output voltage                  | Vc <sub>ff</sub>            | 03, 05, 06, 07 = FFH                            | 5.0   | 5.7  | 6.4  | V <sub>pp</sub> |
| Contrast max. output channel difference       | Δ Vc <sub>ff</sub>          | 04, 08 — 0C = 80H<br>RGB input = S1             | Δ 10  | -    | -    | %               |
| Contrast center output voltage                | Vc <sub>80</sub>            | 03, 04, 08 — 0C = 80H                           | 2.5   | 2.85 | 3.2  | V <sub>pp</sub> |
| Contrast center output channel difference     | Δ Vc <sub>80</sub>          | 05, 06, 07 = FFH<br>RGB input = S1              | Δ 10  | -    | -    | %               |
| Contrast max. - Center attenuation            | C                           | C = 20log (Vc <sub>80</sub> /Vc <sub>ff</sub> ) | -8    | -6   | -4   | dB              |
| Sub contrast center output voltage            | Vd <sub>80</sub>            | 03 = FFH                                        | 2.3   | 2.6  | 2.9  | V <sub>pp</sub> |
| Sub contrast center output channel difference | Δ Vd <sub>80</sub>          | 04 — 0C = 80H<br>RGB input = S1                 | Δ 10  | -    | -    | %               |
| Sub contrast min. output voltage              | Vd <sub>00</sub>            | 03 = FFH, 05 — 07: 00H                          | 1.3   | 1.6  | 1.9  | V <sub>pp</sub> |
| Sub contrast min. output channel difference   | Δ Vd <sub>00</sub>          | 04, 08 — 0C = 80H<br>RGB input = S1             | Δ 10  | -    | -    | %               |
| Sub contrast max. - min. attenuation          | D                           | D = 20log (Vd <sub>00</sub> /Vc <sub>ff</sub> ) | -14   | -12  | -10  | dB              |
| ABL control range                             | ABL                         | (see 15)                                        | -12   | -10  | -8   | dB              |
| R/G/B video rising time (see 7)               | tr (video)                  | 03, 05 — 07: FFH                                | -     | 2.2  | 2.8  | ns              |
| R/G/B video falling time (see 7)              | tf (video)                  | 04, 08 — 0C: 80H<br>RGB input = S2              | -     | 2.2  | 2.8  | ns              |
| R/G/B blank output rising time (see 7)        | tr (blank)                  | POR                                             | -     | 6.0  | 12.0 | ns              |
| R/G/B blank output falling time (see 7)       | tf (blank)                  | HFLB: S4                                        | -     | 8.0  | 15.0 | ns              |
| R/G/B video band width (see 7, 8)             | f (-3dB)                    | (see 16)                                        | 150   | -    | -    | MHz             |
| Video AMP 50MHz cross talk                    | CT_50M<br>(see 7, 9)        | (see 17)                                        | -     | -25  | -20  | dB              |
| Video AMP 130MHz cross talk                   | CT_130M<br>(see 7, 9)       | (see 18)                                        | -     | -15  | -10  | dB              |
| Absolute gain match                           | Av <sub>match</sub> (see 6) |                                                 | -1    | -    | 1    | dB              |
| Gain change between amplifier                 | Av <sub>track</sub> (see 7) |                                                 | -1    | -    | 1    | dB              |

**OSD ELECTRICAL CHARACTERISTICS**

(Tamb = 25 °C, V<sub>CC</sub> = 12V, V<sub>DD</sub> = V<sub>DDA</sub> = 5V, HFLB input voltage = S3, load resistors = 470Ω, V-AMP test registers FBLK, OSD input conditions unless otherwise stated)

**Table 7. OSD Electrical Characteristics**

| Parameter                                     | Symbol    | Conditions                                                                                                                              | Value |      |      | Unit |
|-----------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                                               |           |                                                                                                                                         | Min   | Typ  | Max  |      |
| OSD contrast max. output voltage              | Vocff     | 08 = FFH                                                                                                                                | 5.4   | 6.4  | 7.4  | Vpp  |
| OSD contrast max. output channel difference   | Δ Vocff   | OSD RGB output conditions                                                                                                               | Δ 10  | -    | -    | %    |
| OSD contrast center output voltage            | Voc80     | 08 = 80H                                                                                                                                | 2.7   | 3.2  | 3.7  | Vpp  |
| OSD contrast center output channel difference | Δ Voc80   | OSD RGB output conditions                                                                                                               | Δ 10  | -    | -    | %    |
| R/G/B OSD rising time                         | tr (OSD)  | 08: FFH                                                                                                                                 | -     | 4.0  | 5.0  | ns   |
| R/G/B OSD falling time                        | tf (OSD)  |                                                                                                                                         | -     | 4.0  | 5.0  | ns   |
| HT video level                                | HTvideo   | ABL = 6V                                                                                                                                | -6.0  | -4.5 | -3.0 | dB   |
| HT video output channel difference            | Δ HTvideo | RGB input = S1<br>03, 05 — 08: FFH<br>0D: 01H<br>OSD black conditions input<br>HTvideo = 20log(V <sub>htvideo</sub> /V <sub>cff</sub> ) | Δ 15  | -    | -    | %    |
| HT OSD level                                  | HTosd     | ABL = 6V                                                                                                                                | -7.0  | -5.5 | -4.0 | dB   |
| HT OSD output channel difference              | Δ HTosd   | 05 — 08: FFH<br>0D: 0FH<br>OSD white condition input<br>HTosd = 20log (V <sub>htosd</sub> /V <sub>ocff</sub> )                          | Δ 15  | -    | -    | %    |

## OPERATION TIMINGS

Table 8. Operation Timings

| Parameter                                                    | Symbol            | Min | Typ | Max | Unit |
|--------------------------------------------------------------|-------------------|-----|-----|-----|------|
| <b>Input Signal HFLB, VFLB</b>                               |                   |     |     |     |      |
| Horizontal flyback signal frequency                          | $f_{\text{HFLB}}$ | -   | -   | 120 | kHz  |
| Vertical flyback signal frequency                            | $f_{\text{VFLB}}$ | -   | -   | 200 | Hz   |
| <b>I<sup>2</sup>C Interface SDA, SCL (Refer to Figure 3)</b> |                   |     |     |     |      |
| SCL clock frequency                                          | $f_{\text{SCL}}$  | -   | -   | 300 | kHz  |
| Hold time for start condition                                | $t_{\text{hs}}$   | 500 | -   | -   | ns   |
| Set up time for stop condition                               | $t_{\text{sus}}$  | 500 | -   | -   | ns   |
| Low duration of clock                                        | $t_{\text{low}}$  | 400 | -   | -   | ns   |
| High duration of clock                                       | $t_{\text{high}}$ | 400 | -   | -   | ns   |
| Hold time for data                                           | $t_{\text{hd}}$   | 0   | -   | -   | ns   |
| Set up time for data                                         | $t_{\text{sud}}$  | 500 | -   | -   | ns   |
| Time between 2 access                                        | $t_{\text{ss}}$   | 500 | -   | -   | ns   |
| Fall time of SDA                                             | $t_{\text{fSDA}}$ | -   | -   | 20  | ns   |
| Rise time of both SCL and SDA                                | $t_{\text{rSDA}}$ | -   | -   | -   | ns   |

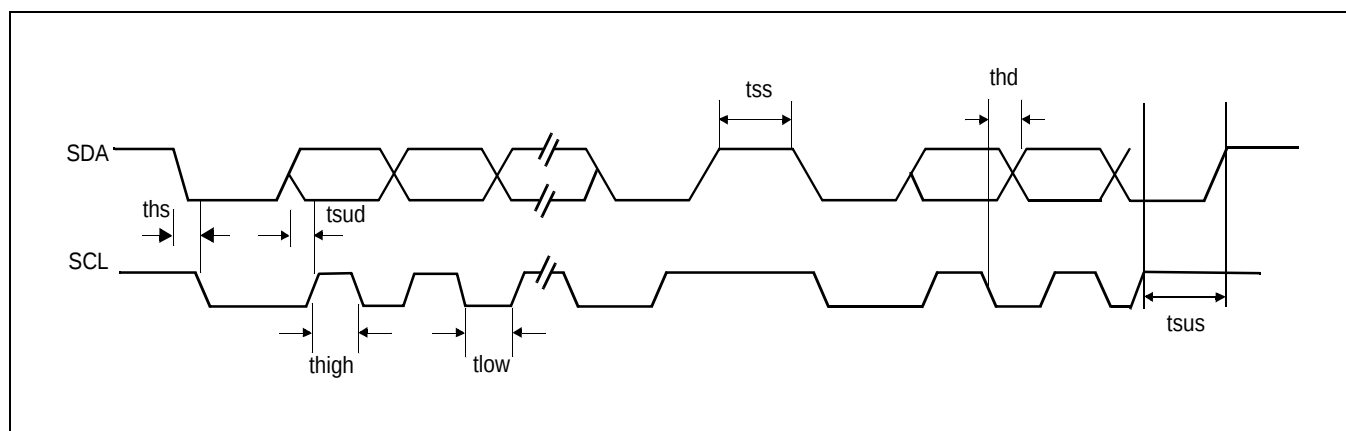


Figure 3. I<sup>2</sup>C Bus Timing Diagram

**OSD PART DC ELECTRICAL CHARACTERISTICS**

(Ta = 25 °C, V<sub>DDA</sub> = V<sub>DD</sub> = 5V)

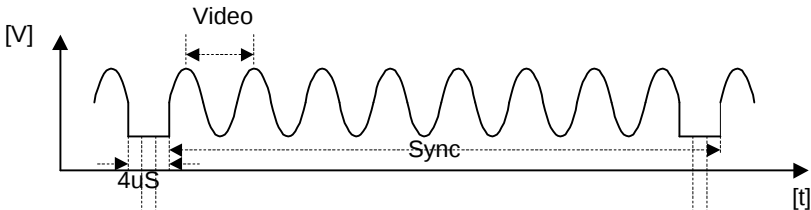
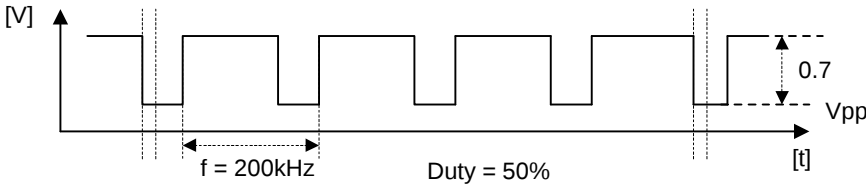
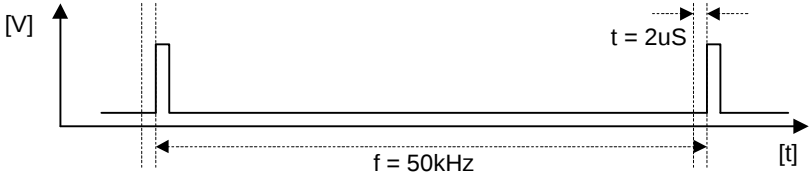
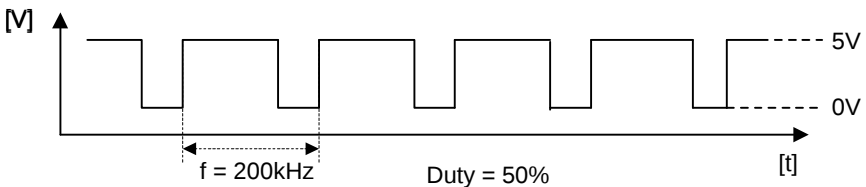
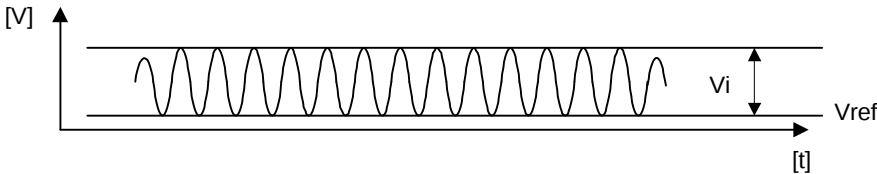
| Parameter                | Symbol          |                    | Typ  | Max             |   |
|--------------------------|-----------------|--------------------|------|-----------------|---|
| Supply voltage           | V               | 4.75               | 5.00 |                 | V |
| Supply current           | I <sub>DD</sub> |                    | -    | 25              |   |
| Input voltage            | V               | 0.8V <sub>DD</sub> |      | -               | V |
|                          | I <sub>L</sub>  | -                  |      | V <sub>SS</sub> | V |
| Output voltage<br>(±1mA) | V <sub>OH</sub> | 0.8V               | -    | -               |   |
|                          | V <sub>OL</sub> |                    | -    | V + 0.4         | V |
|                          | I <sub>IL</sub> |                    | -    | 10              | A |
| VCO input voltage        | V <sub>CO</sub> |                    | 2.5  |                 |   |

## NOTES:

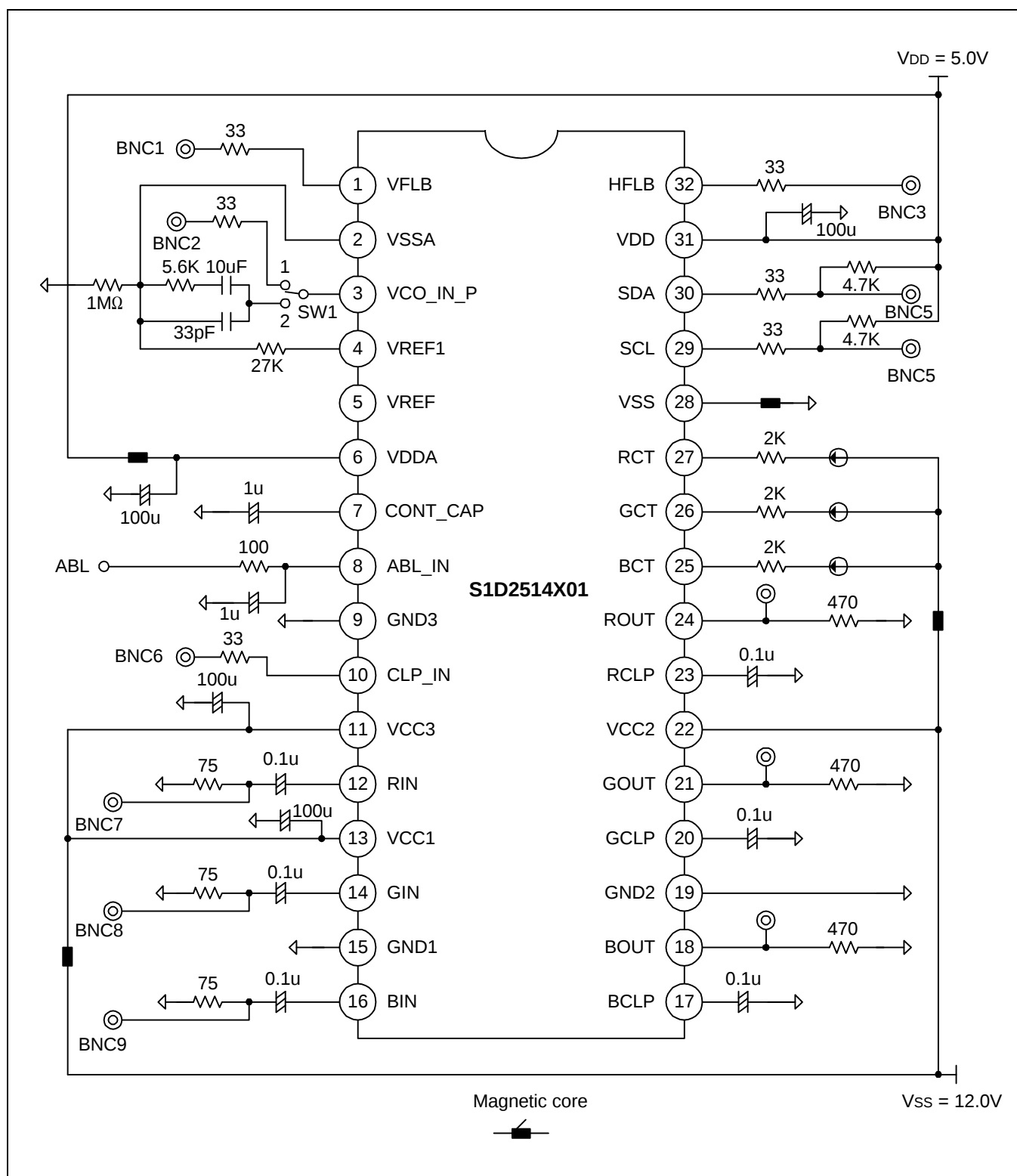
1. Absolute maximum rating indicates the limit beyond which damage to the device may occur.
2. Operating ratings indicate conditions for which the device is functional but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the electrical characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
3. VCC supply pins 11, 13, and 22 must be externally wired together to prevent internal damage during VCC power on/off cycles.
4. The supply current specified is the quiescent current for VCC1/VCC2 and VCC3 with  $R_L = \infty$ . The supply current for VCC2 (pin 22) also depends on the output load.
5. Output voltage is dependent on load resistor. Test circuit uses  $R_L = 470\Omega$
6. Measure gain difference between any two amplifiers  $V_{in} = 700\text{mV}_{pp}$ .
7. When measuring video amplifier bandwidth or pulse rise and fall times, a double sided full ground plane printed circuit board without socket is recommended. Video amplifier 50MHz cross talk test also requires this printed circuit board. The reason for a double sided full ground plane PCB is that large measurement variations occur in single sided PCBs.
8. Adjust input frequency from 10MHz (AV max reference level) to the -3dB frequency (f -3dB).
9. Measure output levels of the other two undriven amplifiers relative to the driven amplifier to determine channel separation. Terminate the undriven amplifier inputs to simulate generator loading. Repeat test at  $f_{in} = 50\text{MHz}$  for cross talk 50MHz.
10. A minimum pulse width of 200 ns is guaranteed for a horizontal line of 15kHz. This limit is guaranteed by design. if a lower line rate is used a longer clamp pulse may be required.
11. During the AC test the 4V DC level is the center voltage of the AC output signal. For example. If the output is 4Vpp the signal will swing between 2V DC and 6V DC.
12. These parameters are not tested on each product which is controlled by an internal qualification procedure.
13. The conditions blocks 03, 04, 05... etc. signify sub address'0F03, 0F04, 0F05... etc.
14. Sub address 0F03, 0F05 — 0F07: FFH  
0F04, 0F08 — 0F0C: 80H  
RGB input = S1,  
When the ABL input voltage is 0V, the R/G/Bs output voltage is  $V_R/V_G/V_B$  and uses the formula  $ABLR = 20\log(V_R/V_{cfrR})$
15. OSD TST mode = High, CLP operation off,  
RGB input = S5 (frequency sweep),  
RGB input clamp cap = 2.1V DC,  
RGB clamp cap (pin 23/20/17) = Vcap voltage (7.0V),  
S5s frequency 1MHz → 130MHz sweep, -3dB point =  $20\log(V_{130\text{MHz}}/V_{1\text{MHz}})$   
03, 05 — 07: FFH  
04, 08 — 0C: 80H  
0F: 80H
16. OSD TST mode = High, CLP operation off,  
RGB input clamp cap = 2.1V DC,  
RGB clamp cap (pin 23/20/17) = Vcap voltage (7.0V),  
03, 05 — 07: FFH  
04, 08 — 0C: 80H  
0F: 80H  
R input = S5 (50MHz)  
 $CT_{50M} = 20\log(V_{outG}/V_{outR})$  or  $20\log(V_{outB}/V_{outR})$
17. OSD TST mode = High, CLP operation off,  
RGB input clamp cap = 2.1V DC,  
RGB clamp cap (pin 23/20/17) = Vcap voltage (7.0V),  
03, 05 — 07: FFH  
04, 08 — 0C: 80H  
0F: 80H  
R input = S5 (130MHz)  
 $CT_{150M} = 20\log(V_{outG}/V_{outR})$  or  $20\log(V_{outB}/V_{outR})$

## TEST SIGNAL FORMAT

**Table 10. Test Signal Format**

| Signal Name | Input Signal Format                                                                  | Signal Description                                                                                                                                             |
|-------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1          |    | <p>Video gain measurement</p> <p>Video = 1MHz/0.7Vpp<br/>           Sync = 50kHz</p>                                                                           |
| S2          |    | <p>Video Tr/Tf measurement</p> <p>f = 200kHz<br/>           V = 0.7Vpp<br/>           Duty = 50%</p>                                                           |
| S3          |  | <p>HFLB (posi &amp; nega.) input</p> <p>f = 50kHz<br/>           t = 2μs<br/>           V = 0V/5V</p>                                                          |
| S4          |  | <p>OSD level measurement</p> <p>Blank Tr/Tf measurement</p> <p>f = 50kHz<br/>           V = 0V/5V</p>                                                          |
| S5          |  | <p>Crosstalk test</p> <p>Bandwidth measurement</p> <p>1MHz/10MHz/50MHz/<br/>           130MHz</p> <p>Vref = input clamp voltage<br/>           Vi = 0.7Vpp</p> |

- S1, S2 signals low level must be synchronized with the S3 signals sync. term.
- The input signal level uses the IC pin as reference.

**TEST CIRCUIT**

**Figure 4. Test Circuit**

## FUNCTIONAL DESCRIPTIONS

### DATA TRANSMISSION

The interface between S1D2514X01 and MCU follows the I<sup>2</sup>C protocol. After the starting pulse, the transmission takes place in the following order: Slave address with R/W bit, 2-byte register address, 2-byte data, and stop condition. an acknowledge signal is received for each byte, excluding only the start/stop condition. The 2-byte register address is composed of an 8-bit row address, and an 8-bit column address. The order of transmission for a 2-byte register address is 'Row address → Column address'. The 2 bytes of data is because S1D2514X01 has a 16-bit base register configuration. S1D2514X01's slave address is BAh. It is BBh in read mode, and BAh in write mode.

- Address Bit Pattern for Display Registers Data**

(a) row address bit pattern

R3 - R0: Valid data for row address

| A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8 |
|-----|-----|-----|-----|-----|-----|----|----|
| X   | X   | X   | X   | R3  | R2  | R1 | R0 |

(b) Column address bit pattern

C4 - C0: Valid data for column address

| A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |
|----|----|----|----|----|----|----|----|
| X  | X  | X  | C4 | C3 | C2 | C1 | C0 |

X: Don't care bit

- Data Transmission Format**

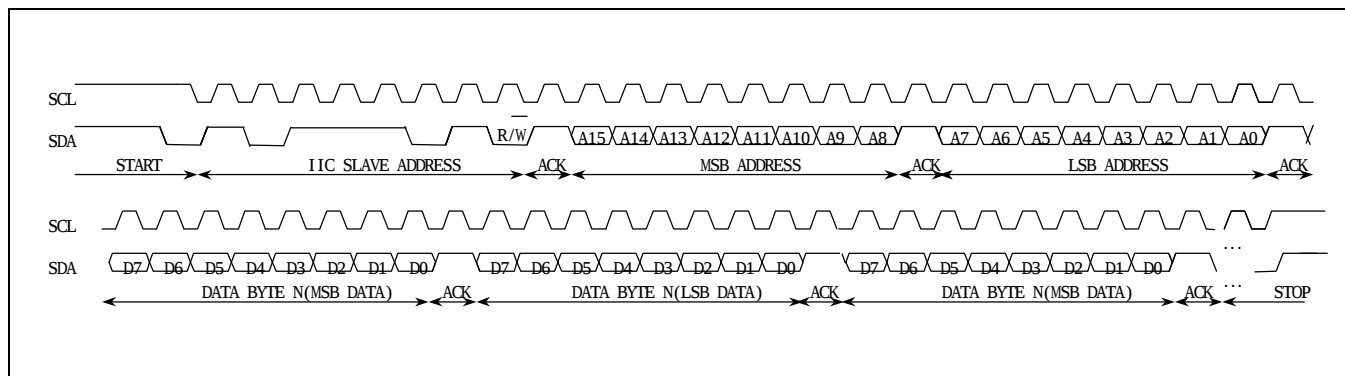
Start → Slave address → ACK → Row address → ACK → Column address → ACK  
 Data byte N → ACK → Data byte N+1 → ACK → Stop

**Figure 5. Data Transmission Format at Writing Operation**

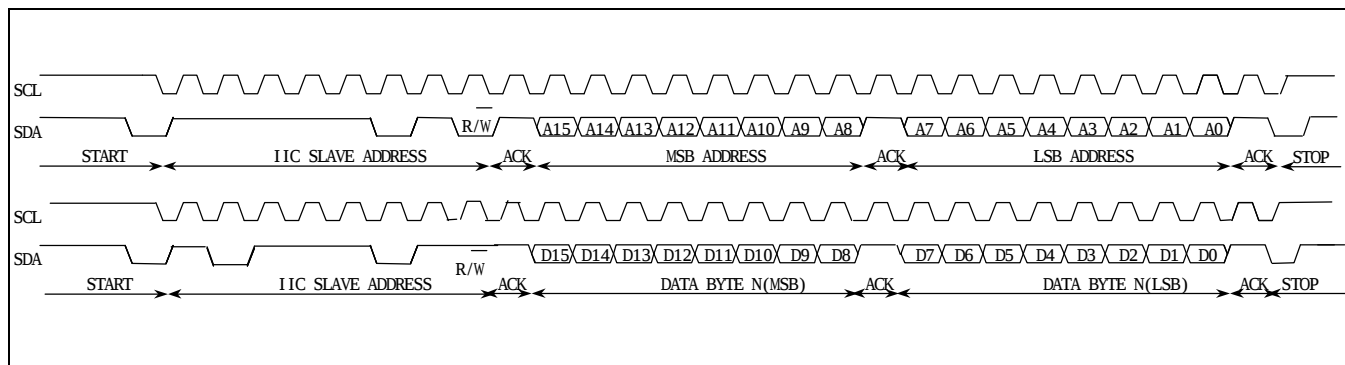
Start → Slave address → ACK → Row address → ACK → Column address → ACK → Stop  
 Start → Slave address → ACK → Data byte N → ACK → Data byte N+1 → ACK → Stop

**Figure 6. Data Transmission Format at Reading Operation**

• **SDA / SCL Signal At Communication**

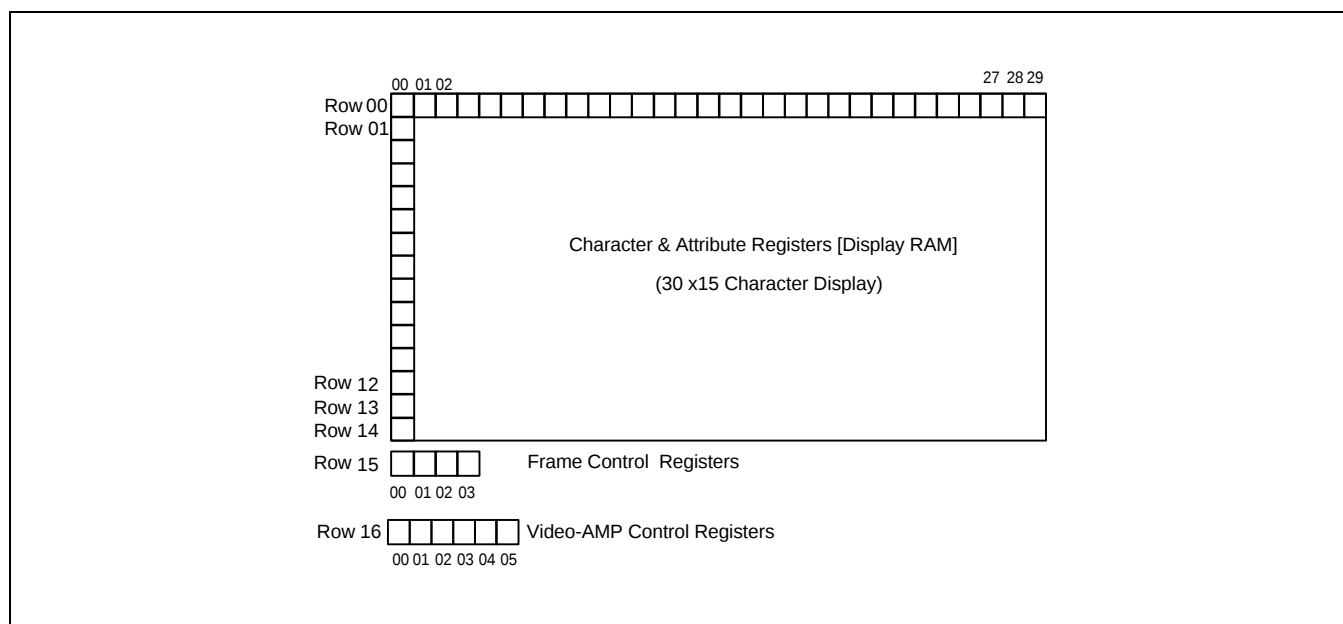


**Figure 7. SDA line and SCL line (Write Operation)**



**Figure 8. SDA line and SCL line (Read Operation)**

## MEMORY MAP



**Figure 9. Memory Map of Display Registers**

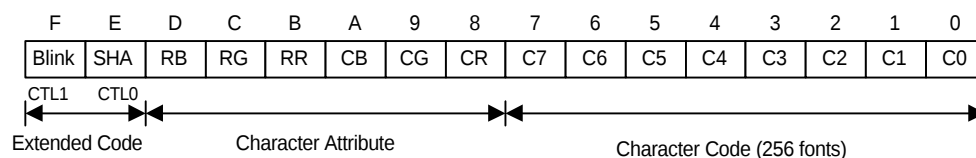
The display RAM's address of the row and column number are assigned in order. The display RAM is composed of 3 register groups (character & attribute register, frame control register and V-AMP control register).

The display area in the monitor screen is 30 column  $\times$  15 row, so the related character & attribute registers are also 30 column  $\times$  15 row. Each register has a character address and characteristics corresponding to the display location on the screen, and one register is composed of 16 bits. The lower 8 bits select the font from the 256 ROM fonts, and the upper 8 bits give font characteristics to the selected font.

The frame control registers are in the 16th row. It controls OSD's display location, character height and scroll in units of frame.

The V-AMP control registers are also located in the 17th row.

### Character & Attribute Register: Row00 ~ 14, Column00 ~ 29



| F | E | D | C | B | A | 9 | 8     | 7     | 6    | 5     | 4    | 3     | 2    | 1     | 0  |
|---|---|---|---|---|---|---|-------|-------|------|-------|------|-------|------|-------|----|
| - | - | - | - | - | - | - | FullW | EX-EN | BGEN | ScrEN | ScrT | BliEN | BliT | Erase | EN |

|     |     |     |     |     |     |      |      |      |      |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|------|------|------|------|-----|-----|-----|-----|-----|-----|
| F   | E   | D   | C   | B   | A   | 9    | 8    | 7    | 6    | 5   | 4   | 3   | 2   | 1   | 0   |
| CP1 | CP0 | Fpl | HF2 | HF1 | HF0 | dot1 | dot0 | HPOL | VPOL | CH5 | CH4 | CH3 | CH2 | CH1 | CH0 |

PLL Control: CP1, CP0, Fpl, HF2, HF1, HF0, dot1, dot0  
 Polarity: HPOL, VPOL  
 Character Height Control: CH5, CH4, CH3, CH2, CH1, CH0

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| F   | E   | D   | C   | B   | A   | 9   | 8   | 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| HP7 | HP6 | HP5 | HP4 | HP3 | HP2 | HP1 | HP0 | VP7 | VP6 | VP5 | VP4 | VP3 | VP2 | VP1 | VP0 |

Horizontal Start Position      Vertical Start Position

Diagram illustrating the structure of the 16-bit input sequence (F, E, D, C, B, A, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0) and its mapping to four 4-bit control fields (CTL11, CTL10, CTL01, CTL00).

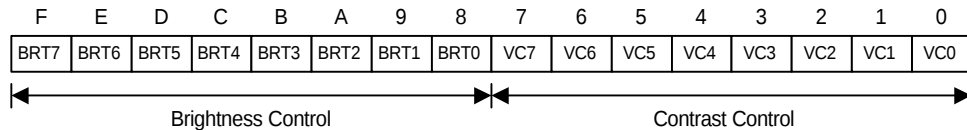
| F     | E   | D    | C    | B     | A   | 9    | 8    | 7     | 6   | 5    | 4    | 3     | 2   | 1    | 0    |
|-------|-----|------|------|-------|-----|------|------|-------|-----|------|------|-------|-----|------|------|
| Blink | SHA | RINT | CINT | Blink | SHA | RINT | CINT | Blink | SHA | RINT | CINT | Blink | SHA | RINT | CINT |

The sequence is mapped to four 4-bit control fields (CTL11, CTL10, CTL01, CTL00) as follows:

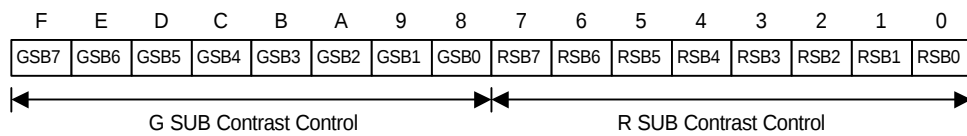
- CTL11: F, E, D, C
- CTL10: B, A, 9, 8
- CTL01: 7, 6, 5, 4
- CTL00: 3, 2, 1, 0

**Video AMP Control Register: Row 16, Column 00 - 05**

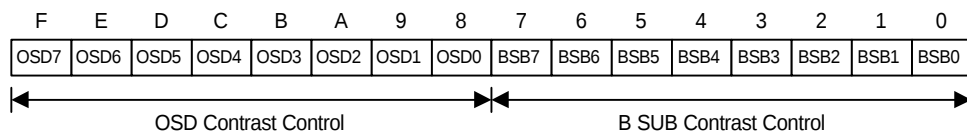
Column 00



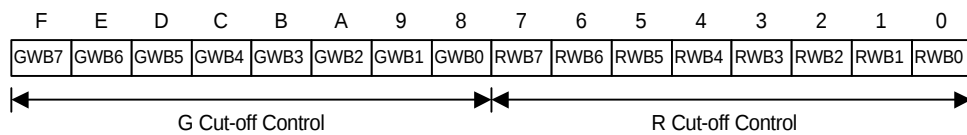
Column 01



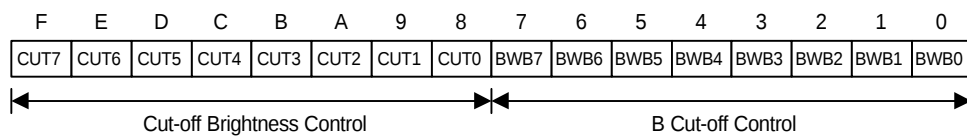
Column 02



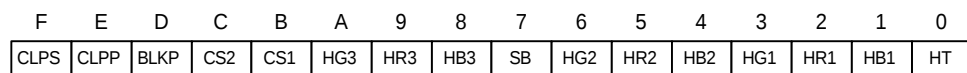
Column 03



Column 04



Column 05



' - ' ; Dont care bit

**Figure 10. Register Description**

**Table 11. Register Description**

| Registers                                                           | Bits                      | Description                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Character & Attribute Registers<br>(Row 00 ~ 14,<br>Column 00 ~ 29) | C7 — C0<br>(Bit 7 — 0)    | Character code address<br>This is the address of 256 ROM fonts.                                                                                                                                                                                                                                                            |
|                                                                     | CB, CG, CR<br>(Bit A — 8) | Character color<br>The character color is chosen from 16 colors using these 3 bits and the frame control register 3\$ CINT bit.                                                                                                                                                                                            |
|                                                                     | RB, RG, RR<br>(Bit D — B) | Raster color is determined by these bits.<br>The raster color is chosen from out of 16 colors using these 3 bits and the frame control register 3\$ RINT bit.                                                                                                                                                              |
|                                                                     | SHA / CTL0<br>(Bit E)     | Character shadowing / CTL0(Extended Code)<br>If you set the frame control register 0\$ EX-EN bit to '0', this bit carries out character shadowing feature.( If SHA bit is '1', the character shadowing is shown)<br>If you set the frame control register 0\$ EX-EN bit to '1', this bit is used for extended code.        |
|                                                                     | Blink / CTL1<br>(Bit F)   | Character blinking / CTL1(Extended Code)<br>If you set the frame control register 0\$ EX-EN bit to '0', this bit carries out character blinking feature.( If Blink bit is '1', the character blinking feature is shown)<br>If you set the frame control register 0\$ EX-EN bit to '1', this bit is used for extended code. |

If you set the Frame Control Register 0\$ 'EX-EN' bit as '1', the Character & Attribute Registers 'SHA' and 'Blink' bits are used to call the Extended Code.

In other words, the combination of SHA and Blink bits can call four kind Extended Code 'CTL00', 'CTL01', 'CTL10' and 'CTL11', the CINT, RINT, SHA and Blink features can be carried out in a unit of character fonts.

**Table 11. Register Description (Continued)**

| Registers                                              | Bits             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame Control<br>Registers - 0<br>(Row15,<br>Column00) | EN<br>(Bit 0)    | OSD enable<br>OSD is enabled when this bit is '1'. In other words, if this bit isn't '1' OSD is not output in spite of writing control data. We recommend that you enable the OSD after setting the control registers (such as the character & attribute register) because of video and OSD output timing.                                                                                                                                                                                                                                                                                                                                                            |
|                                                        | Erase<br>(Bit 1) | RAM erasing<br>If this bit is '1', the RAM data (character & attribute registers) is erased. The time spent in carrying out this operation is called erasing time, which can be calculated as follows.<br><br><div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> Erasing time = RAM clock × 480 (RAM cell no.)<br/> RAM clock = 12 dot clock<br/> Dot clock = 1/(dot frequency)<br/> Dot frequency = Horizontal frequency × resolution (mode) </div> Therefore, the maximum erasing time value is:<br><br><div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> (Erasing Time)<sub>MAX</sub> = (12 × 480) / (15k × 320) = 1.2ms </div> |
|                                                        | BliT<br>(Bit 2)  | Blink time control<br>If this bit is '1', blink time is 0.5sec, and if not, 1sec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                        | BliEN<br>(Bit 3) | Blinking enable<br>Blinking effect is controlled by this bit.<br>If this bit is '1', blinking effect is enabled.<br>If this bit is '0', a full OSD screen blinking effect is disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                        | ScrT<br>(Bit 4)  | Scroll time control<br>If this bit is '1', scroll time is 0.5sec, and if not, 1sec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                        | ScrEN<br>(Bit 5) | Scroll enable<br>Scrolling effect is controlled by this bit. If this bit is '1', scrolling effect is enabled. You must remember that scrolling can be turned on/off only when OSD is enabled/disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                        | BGEN<br>(Bit 6)  | Back ground enable<br>If the BGEN bit is '1' and the raster color is black, the raster is transparent. That is, the video back ground is shown. If not, the OSD raster covers the video's back ground. Refer to other color effect.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                        | EX-EN<br>(Bit 7) | Extended code enable<br>If the EX-EN bit is '1', the Character & Attribute registers' Blink, SHA bits carry out Extended Code features instead of Blink and SHA features.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                        | FullW<br>(Bit 8) | Full white pattern enable<br>If the FullW bit is '1', the full white pattern is displayed in the screen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

Table 11. Register Description

| Registers                                       | Bits                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|--|---|---|--|---|---|--|---|---|--|---|---|--|
| Frame Control<br>Registers - 1<br><br>Column01) | CH5 — CH0                                                                                                                                                                                                                | Character height control<br>While the purpose of VZ[1:0] (vertical character height) is to control the<br><br>to output OSD of a uniform size even if the resolution changes. If you adjust<br>the value in the range of CH = 18 ~ CH = 63, each line's repeating number<br><br>line is repeated. For more information on repeating number selection, refer<br>to character height. |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
|                                                 | (Bit 6)                                                                                                                                                                                                                  | Polarity of vertical fly back signal<br><br>words, this bit is set to '1' if active high, and '0' if active low.                                                                                                                                                                                                                                                                    |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
|                                                 | HPOL                                                                                                                                                                                                                     | Polarity of horizontal fly back signal<br>If this bit is '1', HFLB's polarity is positive, and if '0', it is negative. In other                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
|                                                 | dot1, dot0<br>(Bit 9, 8)                                                                                                                                                                                                 | <table><tr><th>Dot1</th><th>Dot0</th><th></th></tr><tr><td>0</td><td>0</td><td></td></tr><tr><td>0</td><td>1</td><td></td></tr><tr><td>1</td><td>0</td><td></td></tr><tr><td>1</td><td>1</td><td></td></tr></table><br>As shown above, the number of dots per horizontal line is decided by a<br>combination of these two bits.                                                     | Dot1 | Dot0 |  | 0 | 0 |  | 0 | 1 |  | 1 | 0 |  | 1 | 1 |  |
|                                                 | Dot1                                                                                                                                                                                                                     | Dot0                                                                                                                                                                                                                                                                                                                                                                                |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
| 0                                               | 0                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
| 0                                               | 1                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
| 1                                               | 0                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
| 1                                               | 1                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
| (Bit C — A)                                     | Horizontal frequency<br><br>This is related to the selection of DOT[1:0], so you can't numerically<br>express the frequency range with only the HF[2:0] selection. For more                                              |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |
| FPLL<br>(Bit D)                                 | If this bit is '1', the OSD_PLL block's VCO operates at full range (4.8MHz -<br>96MHz). If it is '0', it operates within the region decided by the HF bit [C:A]<br><br>the high region, you may set the FPLL bit to '1'. |                                                                                                                                                                                                                                                                                                                                                                                     |      |      |  |   |   |  |   |   |  |   |   |  |   |   |  |

**Table 11. Register Description (Continued)**

| Registers                                              | Bits                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |                     |   |   |         |   |   |         |   |   |         |   |   |         |
|--------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|---------------------|---|---|---------|---|---|---------|---|---|---------|---|---|---------|
| Frame Control<br>Registers - 1<br>(Row15,<br>Column01) | CP1, CP0<br>(Bit F, E) | <p>Charge pump output current control<br/>This is the PLL block's internal phase detector output status, converted into current. Refer to PLL control.</p> <table border="1"> <thead> <tr> <th>CP1</th><th>CP0</th><th>Charge Pump Current</th></tr> </thead> <tbody> <tr> <td>0</td><td>0</td><td>0.50 mA</td></tr> <tr> <td>0</td><td>1</td><td>0.75 mA</td></tr> <tr> <td>1</td><td>0</td><td>1.00 mA</td></tr> <tr> <td>1</td><td>1</td><td>1.25 mA</td></tr> </tbody> </table> <p>The output is decided by the combination of these two bits.</p> | CP1 | CP0 | Charge Pump Current | 0 | 0 | 0.50 mA | 0 | 1 | 0.75 mA | 1 | 0 | 1.00 mA | 1 | 1 | 1.25 mA |
| CP1                                                    | CP0                    | Charge Pump Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |                     |   |   |         |   |   |         |   |   |         |   |   |         |
| 0                                                      | 0                      | 0.50 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |                     |   |   |         |   |   |         |   |   |         |   |   |         |
| 0                                                      | 1                      | 0.75 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |                     |   |   |         |   |   |         |   |   |         |   |   |         |
| 1                                                      | 0                      | 1.00 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |                     |   |   |         |   |   |         |   |   |         |   |   |         |
| 1                                                      | 1                      | 1.25 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |                     |   |   |         |   |   |         |   |   |         |   |   |         |

The purpose of bits 'HPOL', and 'VPOL' is to provide flexibility when using the S1D2514X01 IC. No matter which polarity you choose for the input signal, the IC will handle them identically, so you can select active high or active low according to your convenience.

**Tabel 4. Register Description (Continued)**

| Registers                                          | Bits                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame Control Registers - 2<br>(Row 15, Column 02) | VP7 — VP0<br>(Bit 7 — 0) | Vertical start position control ( = VP[7:0] × 4)<br>Signifies top margin height from the V-Sync reference edge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                    | HP7 — HP0<br>(Bit F — 8) | Horizontal start position control ( = HP[7:0] × 6)<br>Signifies delay of the horizontal display from the H-Sync reference edge to the character's 1st pixel location.                                                                                                                                                                                                                                                                                                                                                                                                               |
| Frame Control Registers - 3<br>(Row 15, Column 03) | CTL 00<br>(Bit 3 — 0)    | Extended code<br>In case the EX-EN bit is '1' and the Character & Attribute register's E and F bits are '0', these bits have meanings.<br>If you set the CINT(character color intensity) bit '1', the character color intensity feature is carried out.<br>If you set the RINT(raster color intensity) bit '1', the raster color intensity feature is carried out.<br>If you set the SHA(character shadowing) bit '1', the character shadowing feature is carried out.<br>If you set the Blink(character blinking) bit '1', the character blinking feature is carried out.          |
|                                                    | CTL 01<br>(Bit 7 — 4)    | Extended code<br>In case the EX-EN bit is '1' and the Character & Attribute register's E bit is '1' and F bit is '0', these bits have meanings.<br>If you set the CINT(character color intensity) bit '1', the character color intensity feature is carried out.<br>If you set the RINT(raster color intensity) bit '1', the raster color intensity feature is carried out.<br>If you set the SHA(character shadowing) bit '1', the character shadowing feature is carried out.<br>If you set the Blink(character blinking) bit '1', the character blinking feature is carried out. |
|                                                    | CTL 10<br>(Bit B — 8)    | Extended code<br>In case the EX-EN bit is '1' and the Character & Attribute register's E bit is '0' and F bit is '1', these bits have meanings.<br>If you set the CINT(character color intensity) bit '1', the character color intensity feature is carried out.<br>If you set the RINT(raster color intensity) bit '1', the raster color intensity feature is carried out.<br>If you set the SHA(character shadowing) bit '1', the character shadowing feature is carried out.<br>If you set the Blink(character blinking) bit '1', the character blinking feature is carried out. |

**Tabel 4. Register Description (Continued)**

| <b>Registers</b>                                         | <b>Bits</b>           | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame Control<br>Registers - 3<br>(Row 15,<br>Column 03) | CTL 11<br>(Bit F — C) | <p>Extended code</p> <p>In case the EX-EN bit is '1' and the Character &amp; Attribute registers E and F bits are '1', these bits have meanings.</p> <p>If you set the CINT(character color intensity) bit '1', the character color intensity feature is carried out.</p> <p>If you set the RINT(raster color intensity) bit '1', the raster color intensity feature is carried out.</p> <p>If you set the SHA(character shadowing) bit '1', the character shadowing feature is carried out.</p> <p>If you set the Blink(character blinking) bit '1', the character blinking feature is carried out.</p> |

**Tabel 4. Register Description (Continued)**

| <b>Registers</b>                                         | <b>Bits</b>               | <b>Description</b>                                                                                                                                                                                                          |
|----------------------------------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V-AMP Control<br>Registers - 0<br>(Row 16,<br>Column 00) | VC7 — VC0<br>(Bit7 — 0)   | The contrast adjustment is made by controlling simultaneously the gain of three internal variable gain amplifiers.<br>The contrast adjustment allows to cover a typical range of 38dB.                                      |
|                                                          | BRT7 — BRT0<br>(BitF — 8) | The brightness adjustment controls to add the same black level (pedestal) to the 3-channel R/G/B signals after contrast amplifier.                                                                                          |
| V-AMP Control<br>Registers - 1<br>(Row 16,<br>Column 01) | RSB7 — RSB0<br>(Bit7 — 0) | R channel SUB contrast control.<br>The SUB contrast adjustment is used to adjust the white balance, and the gain of each channel is controlled.<br>The SUB contrast adjustment allows you to cover a typical range of 12dB. |
|                                                          | GSB7 — GSB0<br>(BitF — 8) | G channel SUB contrast control.<br>The SUB contrast adjustment is used to adjust the white balance, and the gain of each channel is controlled.<br>The SUB contrast adjustment allows you to cover a typical range of 12dB. |
| V-AMP Control<br>Registers - 2<br>(Row 16,<br>Column 02) | BSB7 — BSB0<br>(Bit7 — 0) | B channel SUB contrast control.<br>The SUB contrast adjustment is used to adjust the white balance, and the gain of each channel is controlled.<br>The SUB contrast adjustment allows you to cover a typical range of 12dB. |
|                                                          | OSD7 — OSD0<br>(BitF — 8) | The OSD contrast adjustment is made by controlling simultaneously the gain of three internal variable gain amplifiers.<br>The OSD contrast adjustment allows to cover a typical range of 38dB.                              |
| V-AMP Control<br>Registers - 3<br>(Row 16,<br>Column 03) | RWB7 — RWB0<br>(Bit7 — 0) | R channel cut-off control.<br>The cut-off adjustment is used to adjust the raster white balance.                                                                                                                            |
|                                                          | GWB7 — GWB0<br>(BitF — 8) | G channel cut-off control.<br>The cut-off adjustment is used to adjust the raster white balance.                                                                                                                            |
| V-AMP Control<br>Registers - 4<br>(Row 16,<br>Column 04) | BWB7 — BWB0<br>(Bit7 — 0) | B channel cut-off control.<br>The cut-off adjustment B used to adjust the raster white balance.                                                                                                                             |
|                                                          | CUT7 — CUT0<br>(BitF — 8) | The cut-off brightness adjustment is made by simultaneously controlling the external cut-off current.                                                                                                                       |

**Tabel 4. Register Description (Continued)**

| Registers                                          | Bits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |     |         |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|---------|-------|----------------|----------------|----------------|----------------|-----|---|---|---|---|---|---|-------|-------|---|---|---|---|---|---|------|------|---|---|---|---|---|---|-----|-----|---|---|---|---|---|---|---------|---------|---|---|---|---|---|---|-------|-------|---|---|---|---|---|---|------|------|---|---|---|---|---|---|--------|--------|---|---|---|---|---|---|-------|-------|--|
| V-AMP Control Registers - 5<br>(Row 16, Column 05) | HT<br>(Bit 0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Video & OSD half tone enable.<br>If you set this bit to '1', the half tone function is on.<br>Then you can see the video signal & OSD raster.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |     |         |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
|                                                    | HG1 — HB1<br>(Bit3 — 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | HG1 — HB1 bits select OSD raster color 1 to be half tone.<br>To carry out half tone function, set the HT bit to '1'. <table><tr><th rowspan="2">HG1</th><th rowspan="2">HR1</th><th rowspan="2">HB1</th><th colspan="3">OSD</th><th rowspan="2">Raster Color 1</th><th rowspan="2">POR</th></tr><tr><th>G</th><th>R</th><th>B</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>Black</td><td>O</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>Blue</td><td></td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>Red</td><td></td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>Magenta</td><td></td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>Green</td><td></td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>Cyan</td><td></td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>Yellow</td><td></td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>White</td><td></td></tr></table> | HG1 | HR1 | HB1 | OSD     |       |                | Raster Color 1 | POR            | G              | R   | B | 0 | 0 | 0 | 0 | 0 | 0     | Black | O | 0 | 0 | 1 | 0 | 0 | 1    | Blue |   | 0 | 1 | 0 | 0 | 1 | 0   | Red |   | 0 | 1 | 1 | 0 | 1 | 1       | Magenta |   | 1 | 0 | 0 | 1 | 0 | 0     | Green |   | 1 | 0 | 1 | 1 | 0 | 1    | Cyan |   | 1 | 1 | 0 | 1 | 1 | 0      | Yellow |   | 1 | 1 | 1 | 1 | 1 | 1     | White |  |
|                                                    | HG1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | HR1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |     | HB1     | OSD   |                |                |                | Raster Color 1 | POR |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | G   | R   | B   |         |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
|                                                    | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 0   | 0   | 0       | Black | O              |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 0   | 1   | Blue    |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 1   | 0   | Red     |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 1   | 1   | Magenta |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 0   | 0   | Green   |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 0   | 1   | Cyan    |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 1   | 0   | Yellow  |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 1   | 1   | White   |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| HG2 — HB2<br>(Bit6 — 4)                            | HG2 ~ HB2 bits select OSD raster color 2 to be half tone.<br>To carry out half tone function, set the HT bit to '1'. <table><tr><th rowspan="2">HG2</th><th rowspan="2">HR2</th><th rowspan="2">HB2</th><th colspan="3">OSD</th><th rowspan="2">Raster Color 2</th><th rowspan="2">POR</th></tr><tr><th>G</th><th>R</th><th>B</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>Black</td><td>O</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>Blue</td><td></td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>Red</td><td></td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>Magenta</td><td></td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>Green</td><td></td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>Cyan</td><td></td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>Yellow</td><td></td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>White</td><td></td></tr></table> | HG2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | HR2 | HB2 | OSD |         |       | Raster Color 2 | POR            | G              | R              | B   | 0 | 0 | 0 | 0 | 0 | 0 | Black | O     | 0 | 0 | 1 | 0 | 0 | 1 | Blue |      | 0 | 1 | 0 | 0 | 1 | 0 | Red |     | 0 | 1 | 1 | 0 | 1 | 1 | Magenta |         | 1 | 0 | 0 | 1 | 0 | 0 | Green |       | 1 | 0 | 1 | 1 | 0 | 1 | Cyan |      | 1 | 1 | 0 | 1 | 1 | 0 | Yellow |        | 1 | 1 | 1 | 1 | 1 | 1 | White |       |  |
| HG2                                                | HR2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     | HB2 | OSD     |       |                |                | Raster Color 2 | POR            |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R   | B   |     |         |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 0   | 0   | Black   | O     |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 0   | 1   | Blue    |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 1   | 0   | Red     |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 0                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0   | 1   | 1   | Magenta |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 0   | 0   | Green   |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 0   | 1   | Cyan    |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 1   | 0   | Yellow  |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| 1                                                  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1   | 1   | 1   | White   |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |
| SB<br>(Bit 7)                                      | Soft blanking enable<br>If you set this bit '1', the R/G/B outputs go to GND.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |     |     |         |       |                |                |                |                |     |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |     |     |   |   |   |   |   |   |         |         |   |   |   |   |   |   |       |       |   |   |   |   |   |   |      |      |   |   |   |   |   |   |        |        |   |   |   |   |   |   |       |       |  |

**Tabel 4. Register Description (Continued)**

|                           | Bits                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|---------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|--------|-----|---------|-------------------|--|-------------------|---|----|---|---|---|-----|---|--|-------|------|---|--|---|---|--|---|------|--|--|---|---|--|---|---|--|--|---|---|--|---|---|--|---------|--|---|--|---|---|--|---|-------|--|---|---|--|---|---|--|------|--|---|--|---|---|--|---|--------|--|--|---|---|--|---|---|--|--|
| Registers - 5<br>(Row 16, | HG3 — HB3<br>(BitA — 8) | To carry out half tone function, set the HT bit to '1'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | <table><tr><th rowspan="2"></th><th rowspan="2">HR3</th><th rowspan="2">HB3</th><th colspan="3"></th><th rowspan="2">Raster<br/>Color 3</th><th rowspan="2"></th></tr><tr><th>G</th><th>R</th><th></th></tr><tr><td>1</td><td>0</td><td></td><td>0</td><td>0</td><td></td><td>Black</td><td></td></tr><tr><td>1</td><td></td><td>1</td><td>0</td><td></td><td>1</td><td>Blue</td><td></td></tr><tr><td></td><td>1</td><td>0</td><td></td><td>1</td><td>0</td><td></td><td></td></tr><tr><td>1</td><td>1</td><td></td><td>0</td><td>1</td><td></td><td>Magenta</td><td></td></tr><tr><td>0</td><td></td><td>0</td><td>1</td><td></td><td>0</td><td>Green</td><td></td></tr><tr><td>0</td><td>0</td><td></td><td>1</td><td>0</td><td></td><td>Cyan</td><td></td></tr><tr><td>0</td><td></td><td>0</td><td>1</td><td></td><td>0</td><td>Yellow</td><td></td></tr><tr><td></td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td></td><td></td></tr></table> |     | HR3  | HB3 |        |     |         | Raster<br>Color 3 |  | G                 | R |    | 1 | 0 |   | 0   | 0 |  | Black |      | 1 |  | 1 | 0 |  | 1 | Blue |  |  | 1 | 0 |  | 1 | 0 |  |  | 1 | 1 |  | 0 | 1 |  | Magenta |  | 0 |  | 0 | 1 |  | 0 | Green |  | 0 | 0 |  | 1 | 0 |  | Cyan |  | 0 |  | 0 | 1 |  | 0 | Yellow |  |  | 1 | 1 |  | 1 | 1 |  |  |
|                           |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |      |     | HR3    | HB3 |         |                   |  | Raster<br>Color 3 |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | G   | R    |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0   |      | 0   | 0      |     | Black   |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     | 1    | 0   |        | 1   | Blue    |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1   | 0    |     | 1      | 0   |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   |      | 0   | 1      |     | Magenta |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     | 0    | 1   |        | 0   | Green   |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0   |      | 1   | 0      |     | Cyan    |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
| 0                         |                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   |      | 0   | Yellow |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | 1                       | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     | 1    | 1   |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | CS2 — CS1               | Cut-off offset current control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | <table><tr><th>CS2</th><th>CS1</th><th></th><th>POR</th></tr><tr><td>0</td><td></td><td>100μ</td><td></td></tr><tr><td>0</td><td>1</td><td>μA</td><td></td></tr><tr><td></td><td>0</td><td>0 A</td><td>O</td></tr><tr><td></td><td>1</td><td>50 A</td><td></td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CS2 | CS1  |     | POR    | 0   |         | 100μ              |  | 0                 | 1 | μA |   |   | 0 | 0 A | O |  | 1     | 50 A |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | CS2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CS1 |      | POR |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     | 100μ |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           |                         | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1   | μA   |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | 0                       | 0 A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | O   |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | 1                       | 50 A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | BLKP                    | Polarity of horizontal fly back signal<br>If this bit is '0', HFLBs polarity is negative, and if '1', it is positive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | (Bit E)                 | Polarity of clamp pulse signal<br><br>This bit has meaning only if the CLPS bit is set to '1'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |
|                           | CLPS                    | Clamp pulse generation enable<br>If this bit is '0', clamp signal is made using the HFLB signal, so there is<br><br>and if '1' you must supply external clamp signal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |      |     |        |     |         |                   |  |                   |   |    |   |   |   |     |   |  |       |      |   |  |   |   |  |   |      |  |  |   |   |  |   |   |  |  |   |   |  |   |   |  |         |  |   |  |   |   |  |   |       |  |   |   |  |   |   |  |      |  |   |  |   |   |  |   |        |  |  |   |   |  |   |   |  |  |

**VIDEO AMP PART ADDRESS MAP**

**Register sub address**

**Table 12. Video AMP Part Address Map**

| SUB Address [Hex] | Function                   |      |      |     |     |     |     |     |                          |     |     |     |     |     |     |    | POR Value [Hex] |
|-------------------|----------------------------|------|------|-----|-----|-----|-----|-----|--------------------------|-----|-----|-----|-----|-----|-----|----|-----------------|
|                   | F                          | E    | D    | C   | B   | A   | 9   | 8   | 7                        | 6   | 5   | 4   | 3   | 2   | 1   | 0  |                 |
| 1000              | Brightness control         |      |      |     |     |     |     |     | Contrast control         |     |     |     |     |     |     |    | 8080            |
| 1001              | SUB contrast control (G)   |      |      |     |     |     |     |     | SUB contrast control (R) |     |     |     |     |     |     |    | 8080            |
| 1002              | OSD contrast control       |      |      |     |     |     |     |     | SUB contrast control (B) |     |     |     |     |     |     |    | 8080            |
| 1003              | Cut-off control (G)        |      |      |     |     |     |     |     | Cut-off control (R)      |     |     |     |     |     |     |    | 8080            |
| 1004              | Cut-off brightness control |      |      |     |     |     |     |     | Cut-off control (B)      |     |     |     |     |     |     |    | 8080            |
| 1005              | CLPS                       | CLPP | BLKP | CS2 | CS1 | HG3 | HR3 | HB3 | SB                       | HG2 | HR2 | HB2 | HG1 | HR1 | HB1 | HT | 1800            |

**Contrast Register (SUB ADRS: 00H) (Vin = 0.7Vpp, bright: 80H, subcont: FFH)**

| Hex           | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Contrast (Vpp) | Gain (dB) | int. Value (Hex) |
|---------------|----|----|----|----|----|----|----|----|----------------|-----------|------------------|
| 00            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0              | -         |                  |
| 80            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2.85           | -         | O                |
| FF            | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 5.2            | -         |                  |
| Increment/bit |    |    |    |    |    |    |    |    | 0.0223         |           |                  |

**Brightness Register (3-ch) (SUB ADRS: 00H) (cont: 80H, subcont: 80H)**

| Hex           | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Brightness (Vpp) | Int. Value (Hex) |
|---------------|----|----|----|----|----|----|----|----|------------------|------------------|
| 00            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0.2              |                  |
| 80            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1.5              | O                |
| FF            | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 2.7              |                  |
| Increment/bit |    |    |    |    |    |    |    |    | 0.01055          |                  |

**SUB Contrast Register (R/G/B-ch) (SUB ADRS: 01/02H)**

(Vin = 0.7Vpp, bright: 40H, cont: FFH)

| Hex           | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | SUB Contrast (Vpp) | Gain (dB) | Int. Value (Hex) |
|---------------|----|----|----|----|----|----|----|----|--------------------|-----------|------------------|
| 00            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |                    | -         |                  |
| 80            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |                    | -         | O                |
| FF            | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |                    | -         |                  |
| Increment/bit |    |    |    |    |    |    |    |    |                    |           |                  |

**OSD Contrast Register (SUB ADRS: 02H)** (VOSD = TTL, bright: 80H, subcont: 80H)

| Hex           | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | OSD Contrast (Vpp) | Gain (dB) | Int. Value (Hex) |
|---------------|----|----|----|----|----|----|----|----|--------------------|-----------|------------------|
| 00            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                  | -         |                  |
| 80            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 3.2                | -         | 0                |
| FF            | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 6.4                | -         |                  |
| Increment/bit |    |    |    |    |    |    |    |    | 0.025              |           |                  |

**Cut-Off Brightness Register (3-ch) (SUB ADRS: 04H)**

| Hex           | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Cut-Off Brightness (μA) | Int. Value (Hex) |
|---------------|----|----|----|----|----|----|----|----|-------------------------|------------------|
| 00            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                       |                  |
| 80            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 100                     | 0                |
| FF            | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 200                     |                  |
| Increment/bit |    |    |    |    |    |    |    |    | 0.781                   |                  |

**Cut-Off Register (R/G/B-ch) (SUB ADRS: 03/04H)**

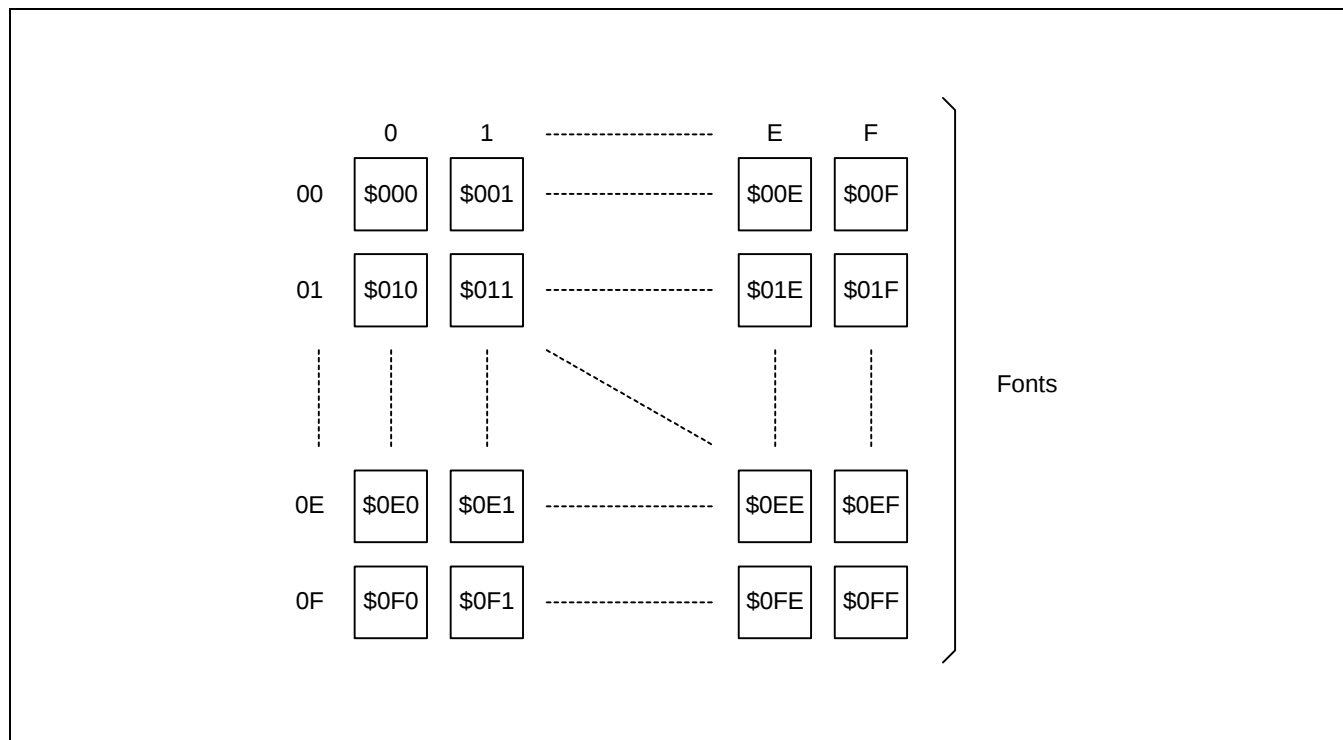
(cont = 80H, subcont: 80H)

| Hex           | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Cut-Off EXT (μA) | Int. Value (Hex) |
|---------------|----|----|----|----|----|----|----|----|------------------|------------------|
| 00            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                |                  |
| 80            | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 300              | 0                |
| FF            | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 600              |                  |
| Increment/bit |    |    |    |    |    |    |    |    | 2.344            |                  |

**ADDRESSING**

- **ROM Fonts**

S1D2514X01 provides 256 Rom fonts for displaying OSD Icons, which allows the use of multi-language OSD Icons. Font \$000 is reserved for blank data.



**Figure 11. Composition of the ROM Fonts**

## COLORING

If you have an Intensity feature, the number of possible colors you can express becomes doubled. In other words, the number of colors you can represent with three colors blue, green, and red is 8 ( $= 2^3$ ), but with the intensity feature, it is 16 ( $= 2^4$ ).

- Character Color**

Character color is assigned for each font, and the 4 components for expressing a color are listed below.

|           |                                                                                                                                                                                        |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blue      | Character & attribute register's CB bit[A]                                                                                                                                             |
| Green     | Character & attribute register's CG bit[9]                                                                                                                                             |
| Red       | Character & attribute register's CR bit[8]                                                                                                                                             |
| Intensity | If the EX-EN bit is '1' and the Frame Control Register 3 CTL's CINT bit called by Character & Attribute registers' Blink, SHA bits is '1', the character intensity feature is enabled. |

- Raster Color**

|           |                                                                                                                                                                                     |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blue      | Character & Attribute register's RB bit[D]                                                                                                                                          |
| Green     | Character & Attribute register's RG bit[C]                                                                                                                                          |
| Red       | Character & Attribute register's RR bit[B]                                                                                                                                          |
| Intensity | If the EX-EN bit is '1' and the Frame Control Register 3 CTL's RINT bit called by Character & Attribute registers' Blink, SHA bits is '1', the RASTER intensity feature is enabled. |

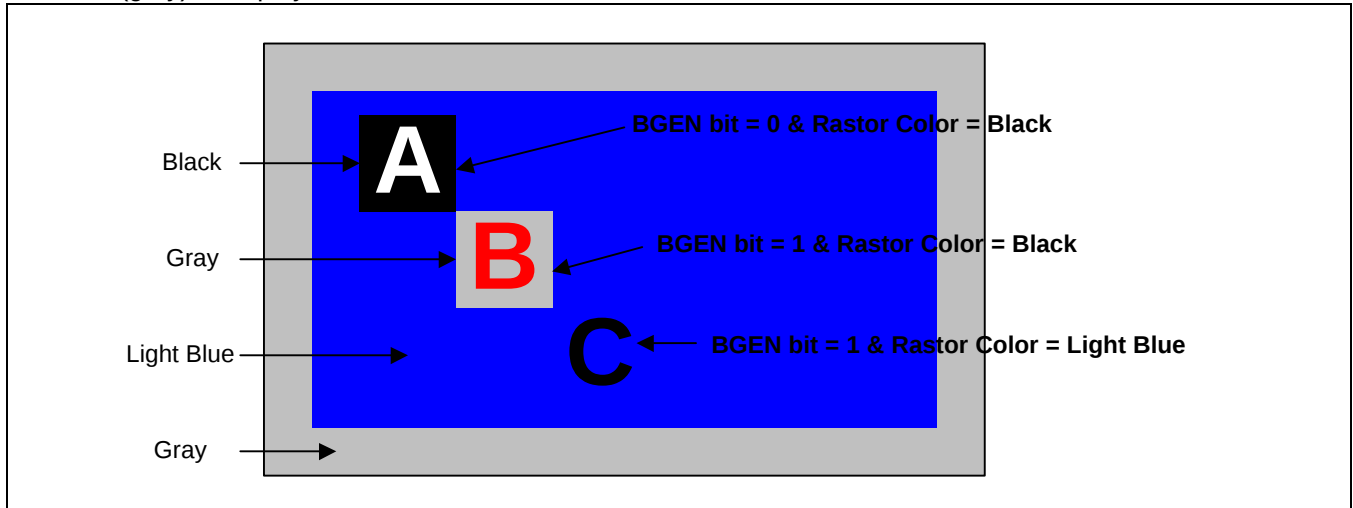
According to the 'EX-EN', 'RINT' and 'CINT' bits setting, raster and character color intensity can be assigned in units of character.

### Notes for When Making S1D2514X01 Fonts

Address 000h is appointed as blank data. RAM's initial values are all 0, and all bits are written as 0 when you erase the RAM, so blank data means the initial value. In other words, blank data means 'do nothing'. You don't need to write any data for the space font, except for 000h. It just needs to be an undotted area.

- **Other Color Effect**

The Frame Control Register 0 'BGEN' bit's function is shown in the Figure below. If you set the 'BGEN' bit as '0' after selecting A's raster color as black, the raster color black will be displayed. But if you set the 'BGEN' bit as '1', after selecting B's raster color as black, the raster color black becomes invisible, so the video back ground color (gray) is displayed as if it is the raster color.



**Figure 12. Color Effect by BGEN Bit**

## HEIGHT/POSITIONING

### • Character Height

The purpose of CH[5:0] (Character Height) is to output a uniformly sized OSD even if the resolution changes. To express a Character Height of CH = 18 ~ CH = 63 after receiving CH[5:0]'s input from the frame control register-1, decide on each line's repeating number (Standard Height CH = 18) and repeat the lines.

The following Figure shows two examples of a height-controlled character. height control is carried out by repeating some of the lines.

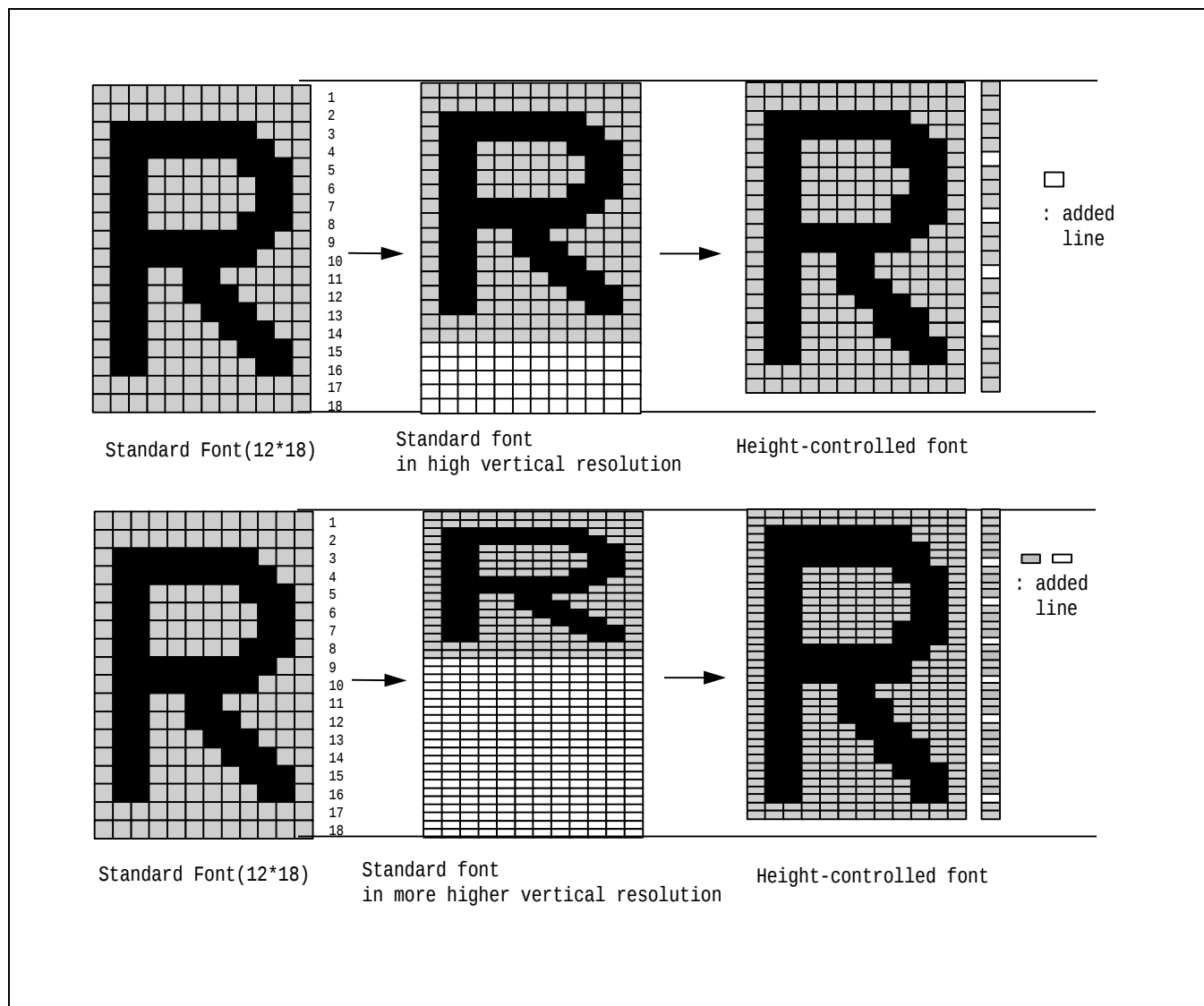


Figure 13. Character Height

Repeating line-number can be found by the following formula.

[# of the repeating lines =  $2 + N \times M$ ],  
 where  $N = 1, 2, 3, \dots$  and  $M = \text{round}\{14, (CH[5:0]-18)\}$ .

1. If  $CH[5:0]$  is greater than 32 and less than or equal to 46 ( $32 < CH[5:0] \leq 46$ ), all lines are repeated once or twice. The lines that are repeated twice are chosen by the following formula.

[# of the repeating lines =  $2 + N \times M$ ],  
 where  $N = 1, 2, 3, \dots$  and  $M = \text{round}\{14 \leq (CH[5:0]-32)\}$ .

2. If  $CH[5:0]$  is greater than 46 and less than or equal to 60 ( $46 < CH[5:0] \leq 60$ ), all lines are repeated two or three times. The lines that are repeated three times are chosen by the following formula.

[# of the repeating lines =  $2 + N \times M$ ],  
 where  $N = 1, 2, 3, \dots$  and  $M = \text{round}\{14 \leq (CH[5:0]-46)\}$ .

3. If  $CH[5:0]$  is greater than 60 and less than or equal to 64 ( $60 < CH[5:0] \leq 64$ ), all Lines are repeated three or four times. The lines that are repeated four times are chosen by the following formula.

[# of the repeating lines =  $2 + N \times M$ ],  
 where  $N = 1, 2, 3, \dots$  and  $M = \text{round}\{14 \leq (CH[5:0]-60)\}$ .

CH's reference value is 18, and even if you input 0, it operates in the same way as when  $CH = 18$ . The repeating line-number is limited to 16. If the M value is less than or equal to 1, all lines of the standard font are repeated more than once.

**Table 13. Repeating Line as Controlling by CH bits**

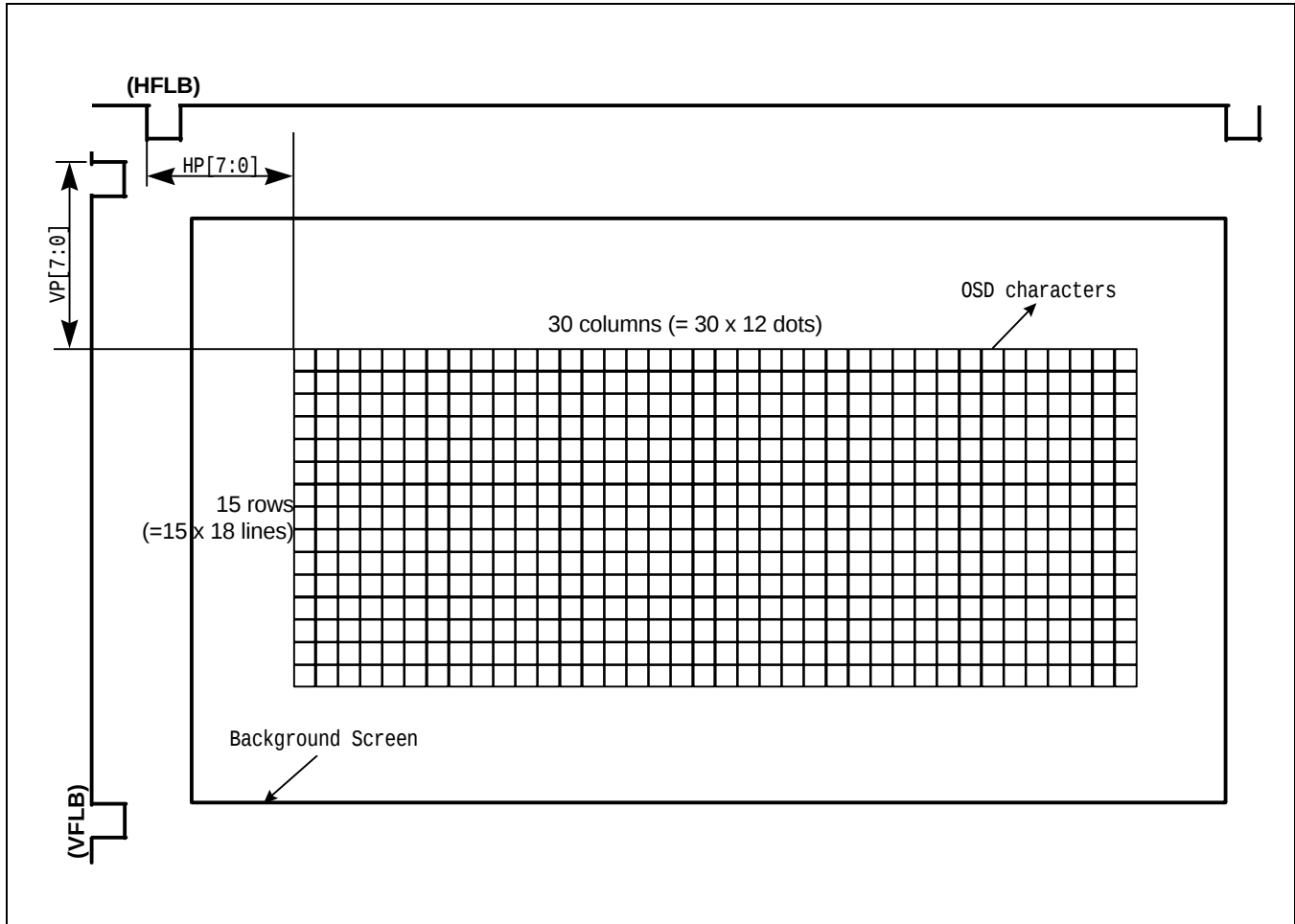
| Character Height    | Repeating Line                                     |
|---------------------|----------------------------------------------------|
| CH = 18             | -                                                  |
| CH = 19             | 9                                                  |
| CH = 20, 21         | 6, 13                                              |
| CH = 22             | 5, 11, 17                                          |
| CH = 23             | 4, 9, 14, 19                                       |
| CH = 24             | 3, 7, 11, 15, 19, 21                               |
| CH = 25, 26, 27     | 3, 7, 11, 13, 15, 19, 22                           |
| CH = 28             | 3, 6, 9, 12, 14, 18, 20, 23, 25                    |
| CH = 29             | 3, 6, 9, 11, 13, 15, 18, 21, 23, 25, 26            |
| CH = 30             | 3, 6, 8, 10, 12, 14, 16, 18, 20, 22, 25, 27        |
| CH = 31             | 2, 5, 7, 9, 11, 13, 15, 17, 21, 23, 25, 27, 28     |
| CH = 32, 33, 34, 35 | 2, 5, 7, 9, 11, 13, 15, 18, 21, 23, 25, 27, 28, 29 |
| CH = 36             | -                                                  |
| CH = 37             | 18                                                 |

Table 13. Repeating Line as Controlling by CH bits

| Character Height    | Repeating Line (Continued)                           |
|---------------------|------------------------------------------------------|
| CH = 38, 39         | 12, 25                                               |
| CH = 40             | 10, 20, 30                                           |
| CH = 41             | 8, 16, 24, 32                                        |
| CH = 42             | 6, 12, 18, 24, 30, 36                                |
| CH = 43, 44, 45     | 6, 12, 18, 24, 30, 36, 41                            |
| CH = 46             | 4, 8, 12, 17, 21, 25, 29, 33, 37, 41                 |
| CH = 47             | 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44             |
| CH = 48             | 4, 8, 12, 16, 20, 23, 26, 29, 33, 37, 41, 45         |
| CH = 49             | 4, 8, 12, 16, 19, 22, 25, 28, 31, 35, 39, 43, 47     |
| CH = 50, 51, 52, 53 | 4, 8, 12, 15, 18, 21, 24, 27, 30, 33, 36, 40, 44, 48 |
| CH = 54             | -                                                    |
| CH = 55             | 27                                                   |
| CH = 56, 57         | 18, 36                                               |
| CH = 58             | 14, 28, 42                                           |
| CH = 59             | 12, 23, 34, 45                                       |
| CH = 60             | 9, 18, 26, 34, 43, 52                                |
| CH = 61, 62, 63     | 8, 16, 23, 30, 37, 44, 51                            |

- **Positioning**

The frame control register-2's HP Bit [F:8] signifies delay of the horizontal display from the H-Sync reference edge to the character's 1st pixel location, and is controlled by multiplying HP [F:8]'s range value by 6. Also, VP bit[7:0] signifies the top margin height from the V-Sync reference edge, and is controlled by multiplying 4 to the VP [7:0]'s range value. Refer to the Figure shown below.

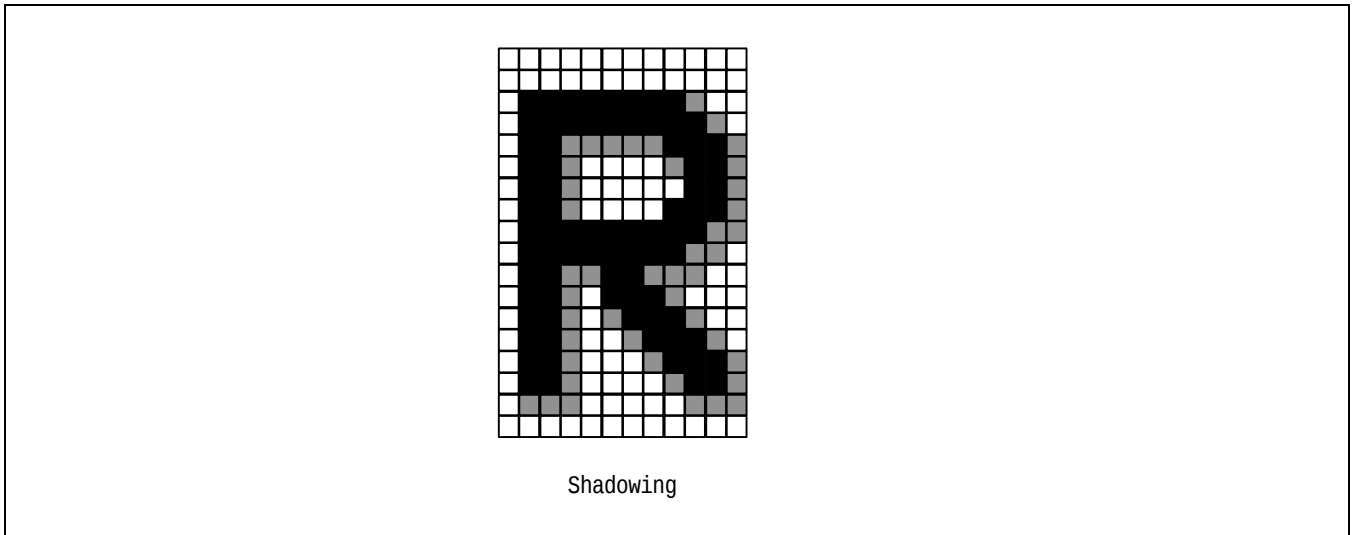


**Figure 14. Frame Composition with the OSD Characters**

**VISUAL EFFECTS**

- **Shadowing**

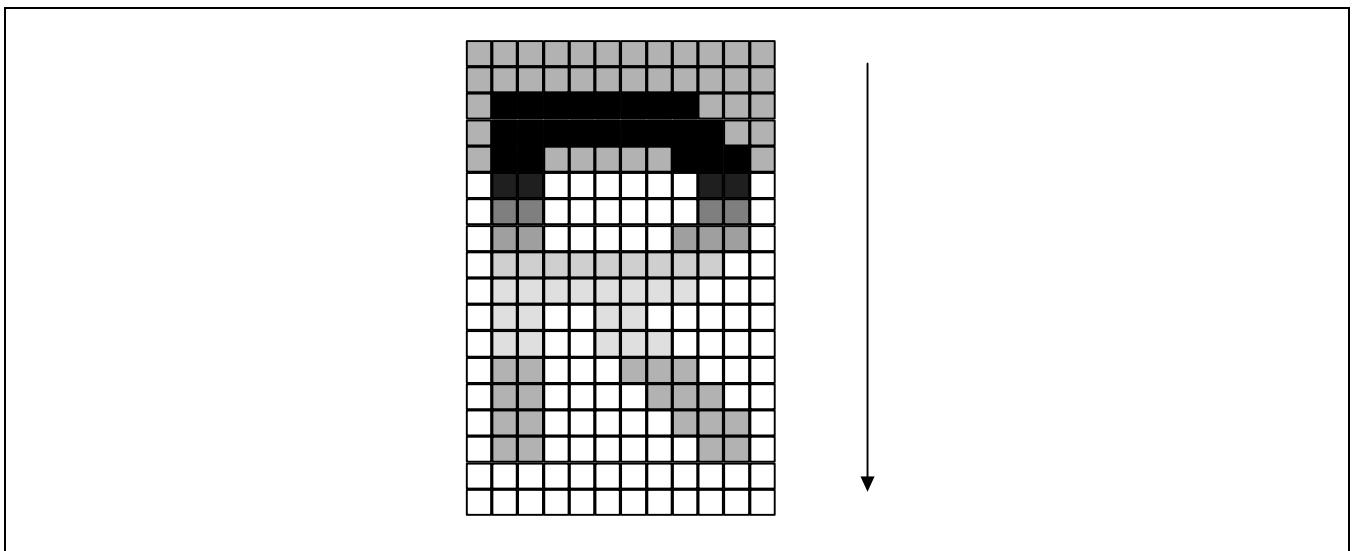
The character shadow can only be black. Character shadow is making 1 pixel to the right and below the character.



**Figure 15. Character Shadowing**

- **Scrolling**

Scrolling is slowly displaying or erasing a character from the top line to the bottom. This effect makes it look as if 1 character line is scrolling up or down.



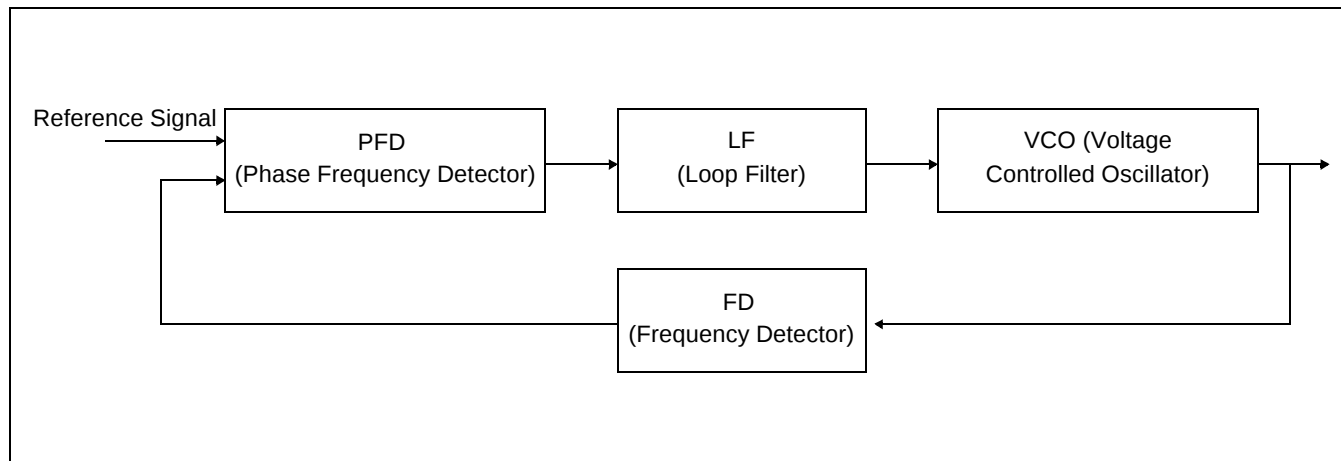
**Figure 16. Scrolling**

## PLL CONTROL

### • Introduction

PLL (Phase Lock Loop) is feedback controlled circuit that maintains a constant phase difference between a reference signal and an oscillator output signal.

Generally, PLL is composed as follow Figure.



**Figure 17. Block Diagram of General PLL**

#### - PFD (Phase Frequency Detector)

PFD compares the phase of the VCO output frequency, with the phase of a reference signal frequency output pulse is generated in proportion to that phase difference.

#### - LF (Loop Filter)

LF smooths the output pulse of the phase detector and the resulting DC component is the VCO input.

#### - VCO (Voltage Controlled Oscillator)

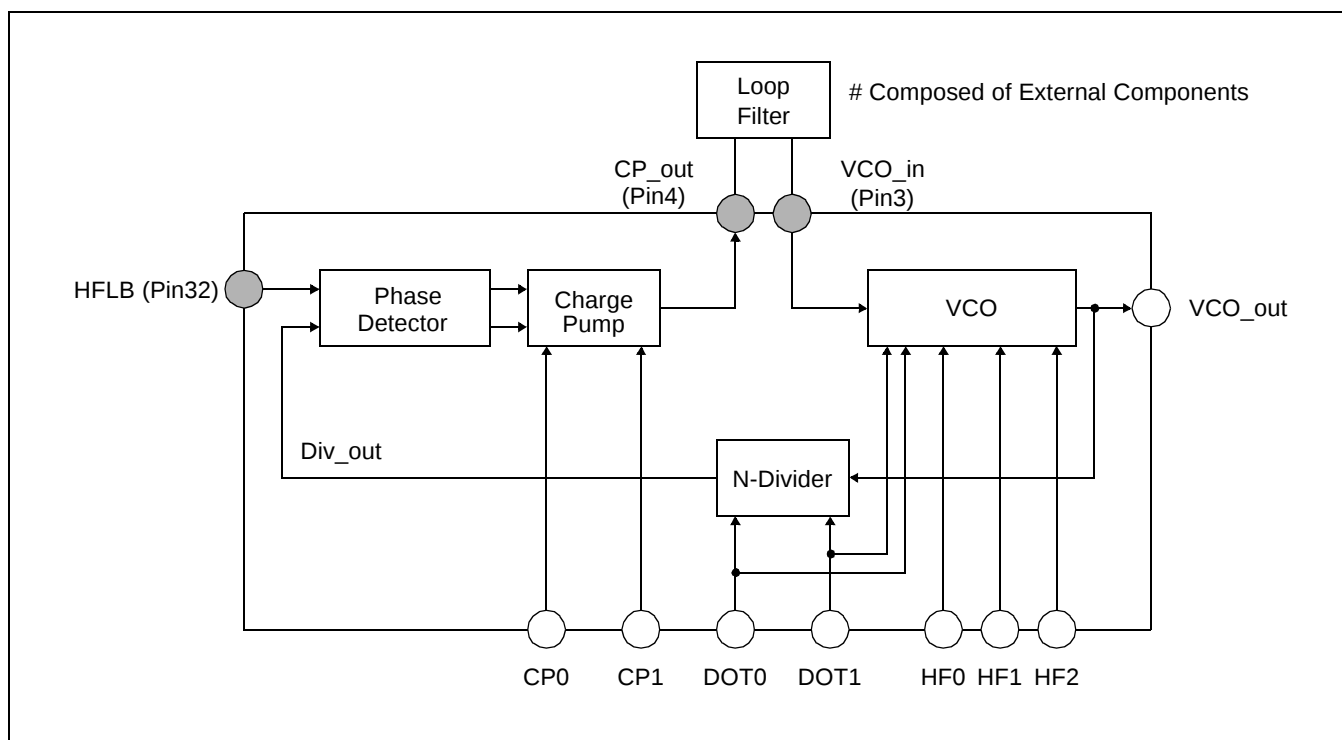
VCO is controlled by loop filter output. The output of the VCO is fed back to the phase frequency detector input for comparison which in turn controls the VCO oscillating frequency to minimize the phase difference.

#### - FD (Frequency Divider)

FD divides too much different frequency that is oscillated from the VCO to compare it with reference signal frequency.

- PLL of the S1D2514X01**

PLL is composed of the phase detector, charge pump, VCO, and N-divider as 4 sub-blocks.



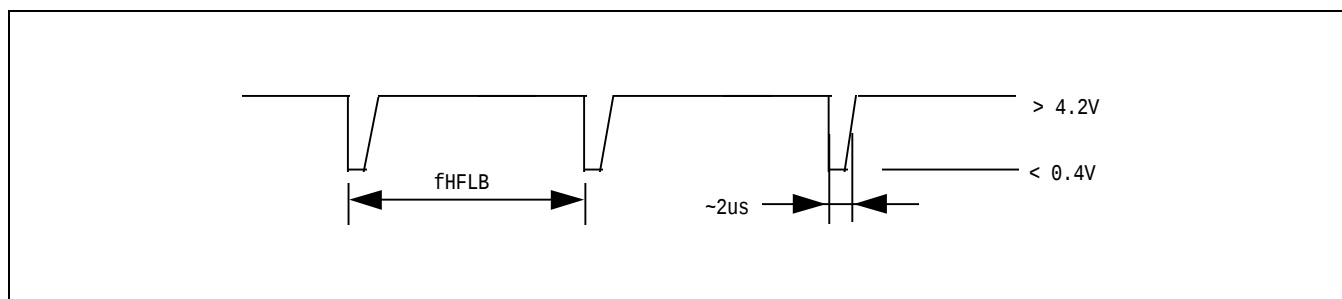
**Figure 18. Block Diagram of the PLL Built in S1D2514X01**

The following is the description of the input/output signals.

- HFLB (Input)**

Horizontal flyback signal is reference signal of the PLL built in S1D2514X01.

The HFLB signal's frequency range is 15 ~ 90kHz, so the PLL block must be a wide range PLL that can cover HFLB's entire frequency range.

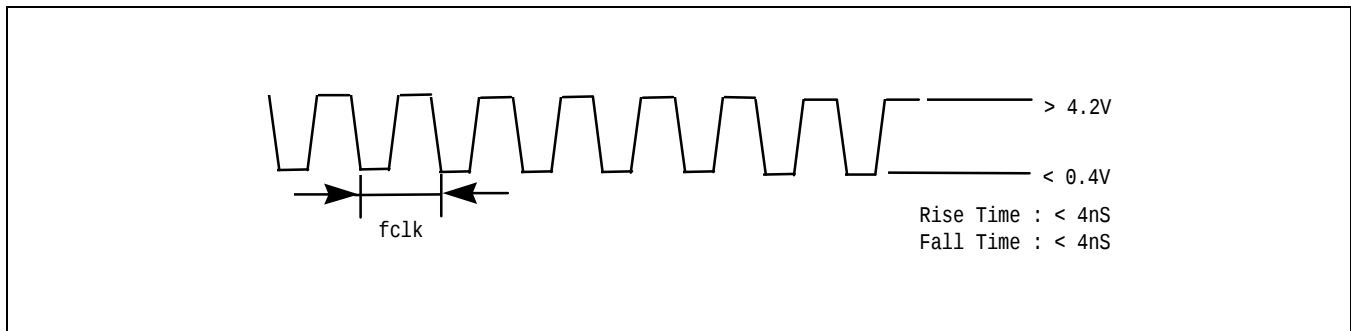


- VCO (Input)**

Error signal that passes through an external loop filter is input into VCO.

Operation voltage range is 1-4V. You can raise immunity towards external noise by lowering VCO sensitivity. You can do this by making it have the maximum operation voltage range possible in the 5V power voltage.

- DOT0, 1 (Input)  
Mode control signal that controls the number of dots per line in the frame control register. There are 4 modes: 320, 480, 640, and 800 dots/line.  
According to your choice of mode, the OSD\_PLL block's N-Divider is controlled by one of  $\div 320$ ,  $\div 480$ ,  $\div 640$ , or  $\div 800$  Divider.
- HF0, 1, 2 (Input)  
The horizontal Sync frequency information is received from the micro controller through the frame control registers-1's bit C-A.
- CP0, 1 (Input)  
Charge Pump's output sourcing (or sinking) current control pin.  
This control data is received through frame control registers-1's bits E-D.
- VCO\_OUT (Output)  
VCO output that becomes a system clock. It is the OSD R, G, B output signal's dot frequency, and the standard signal for OSD's various timings.  
Also, it is input into the N-Divider and makes a PLL loop



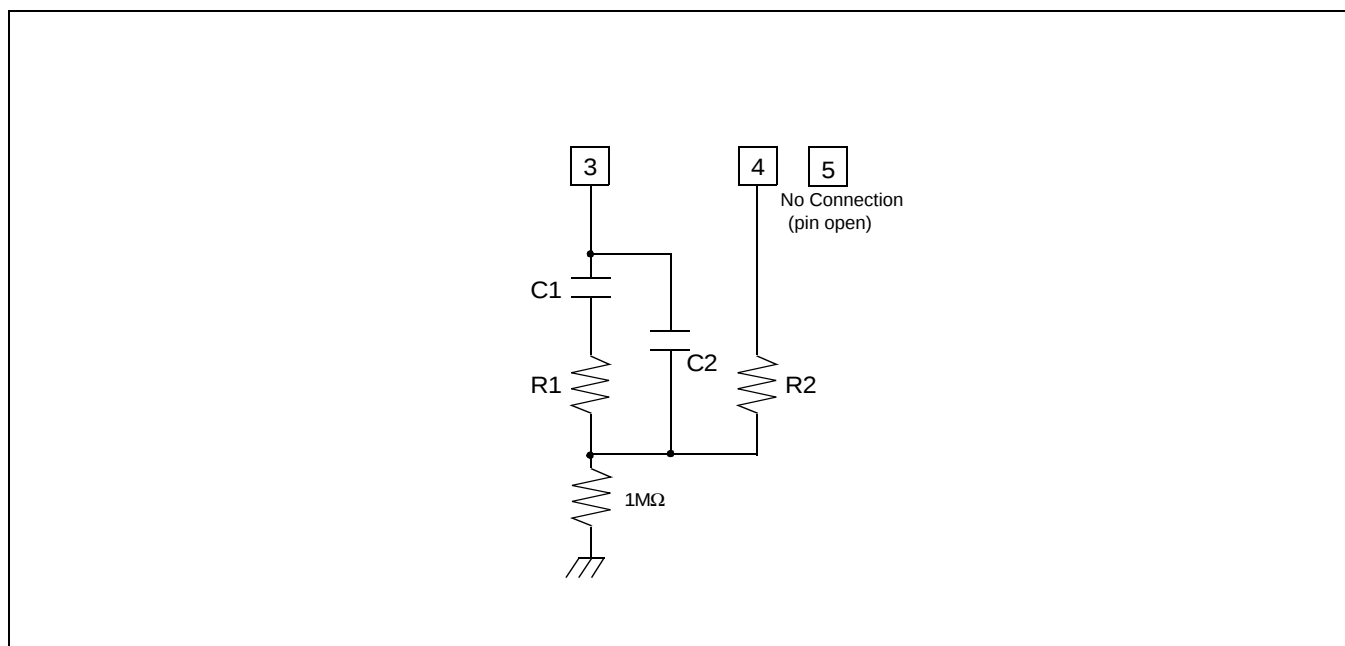
- CP\_OUT (Output)  
Charge Pump circuit's output. input into external loop filter. It becomes one of 3 states according to the standard signal input into the phase detector (HFLB) and the divider output (Div\_Out).
  - HFLB Div\_Out is lead: Current sink
  - HFLB Lag: Current source
  - HFLB In-Phase: High impedance

### TUNNING FACTORS OF THE S1D2514X01 PLL

- **PLL External Circuit**

You may follow the recommendations for PCB art work and input/output signal characteristic improvement in recommendation.

The external circuit that has the most influence on S1D2514X01 PLL block operation is pin 3 (VCO\_IN) and pin 4 (CP\_OUT)'s surrounding circuit. Refer to OSD PLL block.



**Figure 19. PLL External Circuit**

Because the PLL circuit is basically a feedback circuit, there are many components that influence the characteristics. C1, C2, R1, and R2 do not have a localized effect.

As you can see, they are connected to the PLL control bits and influence the characteristics through their complicated relationships. The main functions of the time constant and their reference values are as follows.

**Table 14. Main Function of Time Constant in PLL External Circuit**

| Time Canstant | Recommended Value | Main Function                                                   |
|---------------|-------------------|-----------------------------------------------------------------|
| C1            | 10uF              | Influences the damping ratio and controls the PLL response time |
| R1            | 5.6KΩ(7.5KΩ)      | Same as C1                                                      |
| R2            | 27KΩ (or 33KΩ)    | Charge pump current adjustment                                  |
| C2            | 33pF              | Removes ripple caused by R-C circuit                            |

- **PLL Control Bit**

After configuring an external circuit using the recommended values, carry out programming using the recommended values for frequency range and control bits given in the Table below.

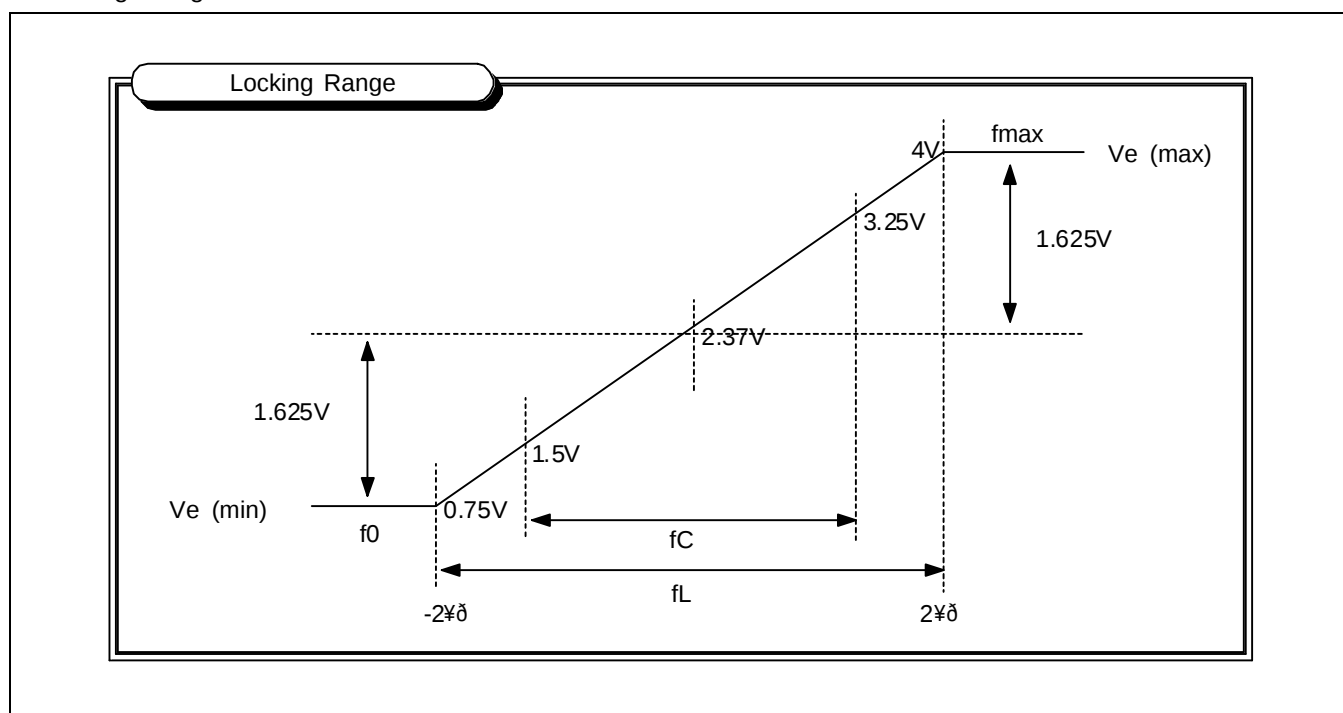
**Table 15. Recommend Values of PLL Control Bit**

| Register Set | PLL Control Bit |     |      |     |     |     |      |      |     |
|--------------|-----------------|-----|------|-----|-----|-----|------|------|-----|
| Freq. Range  | CP1             | CP0 | FPLL | HF2 | HF1 | HF0 | DOT1 | DOT0 | Hex |
| Below 40kHz  | 0               | 0   | 0    | 0   | 1   | 0   | 1    | 1    | 0B  |
| 40 - 50kHz   | 1               | 0   | 0    | 1   | 0   | 0   | 1    | 1    | 93  |
| 50 - 70kHz   | 1               | 1   | 0    | 1   | 0   | 1   | 1    | 1    | A7  |
| Above 70kHz  | 1               | 1   | 0    | 1   | 1   | 1   | 1    | 1    | AF  |

(Ref:  $800 \times 600$ , C1: 10uF, R1: 5.6K, R2: 27K, C2: 33pF)

- **Locking Range**

As you can see the figure below, it is 2.35V that measured voltage at pin-3 to optimize OSD quality. The proper voltage range is 1.5 — 3.25V.



**Figure 20. Locking Range**

- HF Bits Selection**

HF bits is not selecting from out of 8 ( $2^3$ ) steps uniformly, but selecting the step shown in figure below. In example, at 800 mode, there are 5 steps that the frequency range is controlled by HF bits.

**Table 16. HF Bits Selection**

| DIV | DOT1 | DOT0 | HF2 | HF1 | HF0 |
|-----|------|------|-----|-----|-----|
| 320 | 0    | 0    |     |     |     |
|     |      |      |     |     |     |
| 480 | 0    | 1    |     |     |     |
|     |      |      |     |     |     |
|     |      |      |     |     |     |
| 640 | 1    | 0    |     |     |     |
|     |      |      |     |     |     |
|     |      |      |     |     |     |
|     |      |      |     |     |     |
| 800 | 1    | 1    |     |     |     |
|     |      |      |     |     |     |
|     |      |      |     |     |     |
|     |      |      |     |     |     |
|     |      |      |     |     |     |

After fixing time constants of the external circuit and PLL control bits except HF bits, if HF bits are stepped up, the voltage measured at pin-3 drops. On the contrary, if HF bits are stepped down, the voltage rises.

The voltage measured at pin-3 don't change by changing CP bits.

- External Register at pin-4**

The external register at pin-4 is the factor that changes greatly at PLL tuning. The initial value of this external register value is decided as follows.

At first, the external register is replaced variable-register (about 50K $\Omega$  range).

and then, set the lowest PLL control bits at the lowest frequency allowed by set.  
and then, change variable-register to be 2.35V that optimum voltage is locking.  
and then, measure register value at this time.

also, set the highest PLL control bits at the highest frequency allowed by set.

and then, change variable-register to be 2.35V that optimum voltage is locking.  
and then, measure register value at this time.

You may decide the average of these two registers' value to initial value.

The table below shows that other factors change as changing external register's value.

| Fixing Factor                                                      | Variable Factor | Change | Voltage | Current | Lock Range |
|--------------------------------------------------------------------|-----------------|--------|---------|---------|------------|
| Time constants of the external circuit and PLL control bits except | Rext            | ↑      | ↑       | ↓       | ↓ (shift)  |
|                                                                    |                 | ↓      | ↓       | ↑       | ↑ (shift)  |

## RECOMMENDATION

### 5V Power Routing

S1D2514X01's OSD part power is composed of analog VDD and digital VDD. To eliminate clock noise influence in the digital block, you need to separate the analog VDDA and digital VDD.

(BD102 use: Refer to Application Circuit )

### 12V Power Routing

Because S1D2514X01 is a wideband AMP of above 150MHz, 12V power significantly affects the video characteristics. The effects from the inductance and capacitance are different for each board, and , therefore, some tuning is required to obtain the optimum performance. The output power, VCC2, must be separated from VCC1 and VCC3 using a coil, which is parallel-connected to the damping resistor. The appropriate coil value is between 20uH - 200uH. Parallel-connected a variable resistor to the coil and control its resistance to obtain the optimum video waveform.

(Moreover, BD103 can tune using a coil and variable resistor to obtain the optimum video waveform.  
L103, R124, BD103: Refer to application circuit)

### VCC1, VCC3 12V Power

Use a 104 capacitor and large capacitor greater than 470uH for the power filter capacitor.

### 12V Output Stage Power VCC2

Do not use the power filter capacitor.

### 5V Digital Power VDD

Don't use a coil or magnetic core to the VDD input. Make the power filter capacitor, an electric capacitor of greater than 50uF, single and connect it to VSS, the digital GND.

### Output Stage GND2

Care must be taken during routing because it ,as an AMP output stage GND, is an important factor of video oscillation. R/G/B clamp cap and R/G/B load resistor must be placed as close as possible to the GND2 pin. GND2 must be arranged so that it has the minimum GND loop, which at one point must be connected to the main GND.

### Digital GND VSS

When this is to be connected directly to the GND2, it can cause the OSD clock noise, so the loop connection should be routed as far away as possible. If the OSD clock noise affects the screen, separate VSS GND from all GND and connect it to the main board using a bead. Again, the bead connection point should be placed as far away as possible to the GND2.

### Analog Block

The PLL built in to S1D2514X01 is sensitive to noise due to the wide range PLL characteristics. Therefore, you need to isolate the analog block in the following manner. First make a separate land for the analog block (pin2 - pin6)'s ground, and connect it to the main ground through a 1M $\Omega$  resistor. The analog GND of both sides of a double faced PCB must be separated from the main ground. (Separate pin 2's 5V analog GND, which is the GND for OSD PLL, from the main and digital GNDs and connect it to the main GND using about 1M $\Omega$  resistor. GND for pins 2 - 6 is the No. 2 VSSA GND.)

### **I<sup>2</sup>C Control Line (SCL, SDA Line)**

I<sup>2</sup>C communication noise (noise generated in the OSD display pattern when data is transmitted in the I<sup>2</sup>C line) may be generated because of an I<sup>2</sup>C control line that passes near the analog block. The I<sup>2</sup>C control lines near S1D2514X01 must be separated from the analog block as much as possible.

Furthermore, the I<sup>2</sup>C bus interference can be prevented by inserting a series resistor in the line.

### **Horizontal Flyback Signal**

Display jittering can be generated if the horizontal signal (HFLB) input to S1D2514X01 is not a clean signal.

We recommend a short path and shielded cable for obtaining a clean signal.

Generally, the input horizontal signal (HFLB) is generated by using a high voltage horizontal flyback signal. The effect from the high voltage flyback signal can be reduced by separating the R115 and R117 GND, which determines the flyback signal slice level, from the transistor GND, which generates the actual S1D2514X01 input horizontal signal. Furthermore, the flyback signal sharpness must be maintained by minimizing the values of R115, R116 and R117 resistors, which set the horizontal signal slice level. values.

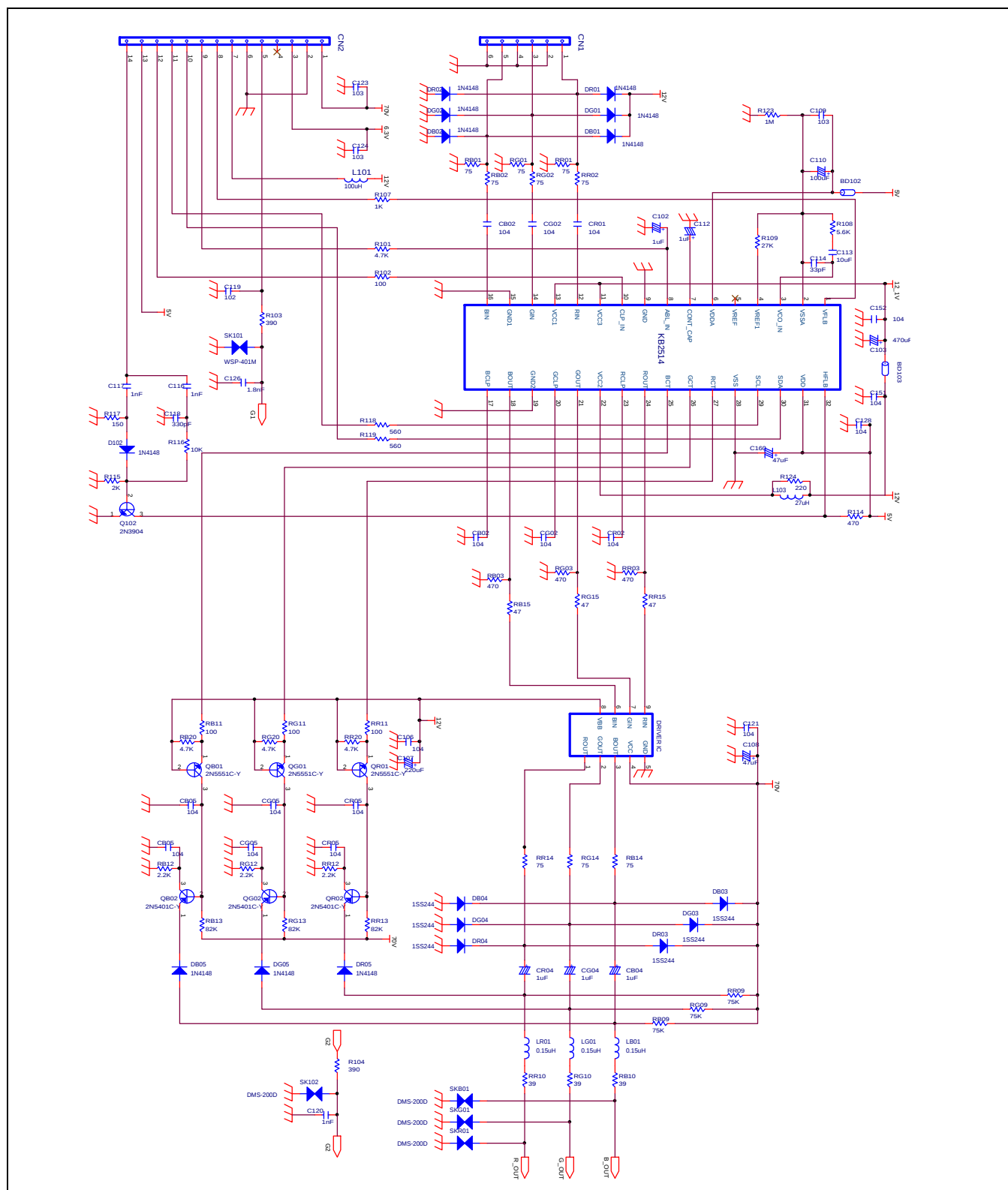
(R115, R116, R117: Refer to application circuit )

### **HFLB Input Signal Generator**

You can correct the circuit by reducing the resistors that sets the slice level of the horizontal signal in the HFLB-generating circuit.

**Figure 21. Application Board Circuit**

## TYPICAL APPLICATION CIRCUIT



**Figure 22. Typical Application Circuit**

## ROM FONTS

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 000 | 001 | 002 | 003 | 004 | 005 | 006 | 007 | 008 | 009 | 00A | 00B | 00C | 00D | 00E | 00F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 010 | 011 | 012 | 013 | 014 | 015 | 016 | 017 | 018 | 019 | 01A | 01B | 01C | 01D | 01E | 01F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 020 | 021 | 022 | 023 | 024 | 025 | 026 | 027 | 028 | 029 | 02A | 02B | 02C | 02D | 02E | 02F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 030 | 031 | 032 | 033 | 034 | 035 | 036 | 037 | 038 | 039 | 03A | 03B | 03C | 03D | 03E | 03F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 040 | 041 | 042 | 043 | 044 | 045 | 046 | 047 | 048 | 049 | 04A | 04B | 04C | 04D | 04E | 04F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 050 | 051 | 052 | 053 | 054 | 055 | 056 | 057 | 058 | 059 | 05A | 05B | 05C | 05D | 05E | 05F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 060 | 061 | 062 | 063 | 064 | 065 | 066 | 067 | 068 | 069 | 06A | 06B | 06C | 06D | 06E | 06F |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 070 | 071 | 072 | 073 | 074 | 075 | 076 | 077 | 078 | 079 | 07A | 07B | 07C | 07D | 07E | 07F |

Figure 23. ROM Fonts

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ä   | Ë   | İ   | Ö   | Ü   | Â   | Ê   | Î   | Ô   | Û   | Á   | É   | Í   | Ó   | Ú   | Ç   |
| 080 | 081 | 082 | 083 | 084 | 085 | 086 | 087 | 088 | 089 | 08A | 08B | 08C | 08D | 08E | 08F |
| ä   | ë   | ï   | ö   | ü   | â   | ê   | î   | ô   | û   | á   | é   | í   | ó   | ú   | ç   |
| 090 | 091 | 092 | 093 | 094 | 095 | 096 | 097 | 098 | 099 | 09A | 09B | 09C | 09D | 09E | 09F |
| À   | È   | Ì   | Ò   | Ù   | Ã   | Õ   | Ñ   | Å   | Š   | Ž   | Ÿ   | ƒ   |     |     |     |
| 0A0 | 0A1 | 0A2 | 0A3 | 0A4 | 0A5 | 0A6 | 0A7 | 0A8 | 0A9 | 0AA | 0AB | 0AC | 0AD | 0AE | 0AF |
| à   | è   | ì   | ò   | ù   | ã   | õ   | ñ   | å   | š   | ž   | ÿ   | œ   |     |     |     |
| 0B0 | 0B1 | 0B2 | 0B3 | 0B4 | 0B5 | 0B6 | 0B7 | 0B8 | 0B9 | 0BA | 0BB | 0BC | 0BD | 0BE | 0BF |
| ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   |
| 0C0 | 0C1 | 0C2 | 0C3 | 0C4 | 0C5 | 0C6 | 0C7 | 0C8 | 0C9 | 0CA | 0CB | 0CC | 0CD | 0CE | 0CF |
| ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   |
| 0D0 | 0D1 | 0D2 | 0D3 | 0D4 | 0D5 | 0D6 | 0D7 | 0D8 | 0D9 | 0DA | 0DB | 0DC | 0DD | 0DE | 0DF |
| ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   |
| 0E0 | 0E1 | 0E2 | 0E3 | 0E4 | 0E5 | 0E6 | 0E7 | 0E8 | 0E9 | 0EA | 0EB | 0EC | 0ED | 0EE | 0EF |
| ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   | ⌂   |
| 0F0 | 0F1 | 0F2 | 0F3 | 0F4 | 0F5 | 0F6 | 0F7 | 0F8 | 0F9 | 0FA | 0FB | 0FC | 0FD | 0FE | 0FF |