# DATA SHEET

*( DOC No. HX8257-A01-DS )*

## HX8257-A01

480RGBX272 TFT LCD Single Chip Digital Driver

*Version 01, November 2008*

**Himax Technologies, Inc.**
http://www.himax.com.tw

# 1. General Description

The HX8257-A is a single chip digital driver supporting 480RGBX272 or 480RGBX240 resolution. The single chip includes Source, Gate, TCON, and Power circuits. The driver receives 24-bit digital display data with single clock edge and generates corresponding 64 level gray scale voltage outputs with dithering function to realize 16M colors display. Positive and negative polarity voltages can be alternately output from each channel in line (row) inversion driving method.

The HX8257-A can be applied on dual gate TFT LCD panel. Source line is half with 720 channels and gate line is double with 544 or 480-channel outputs.

# 2. Features

- Support 480RGBx272 or 480RGBx240 graphics display TFT LCD panel
- 64-gray level with 2 bit dithering function to realize 16M colors
- Support 8-bit serial RGB data and 24-bit parallel RGB data input
- Power supply:
  - VDDIO: 1.8V ~ 3.6V
  - VCI: 3.0V ~ 3.6V
- Built in 1.8V LDO for internal logic circuit
- Maximum gate driving output range: 30Vp-p
- Source output range: 0.1 ~ VLCD - 0.1
- Source and gate scan direction control
- 720-channel source outputs and 544-channel gate outputs
- Programmable gamma correction curve
- Support contrast/brightness adjustment
- Support PAL decimation in 480RGBx240 resolution
- Non-Volatile Memory (OTP) for VCOM calibration
- On-chip DC-DC converter for gate driver VGH/VGL and panel AC VCOM signal
- PWM control function to generate power for backlight
- CABC function is embedded
- COG package

# 3. Block Diagram

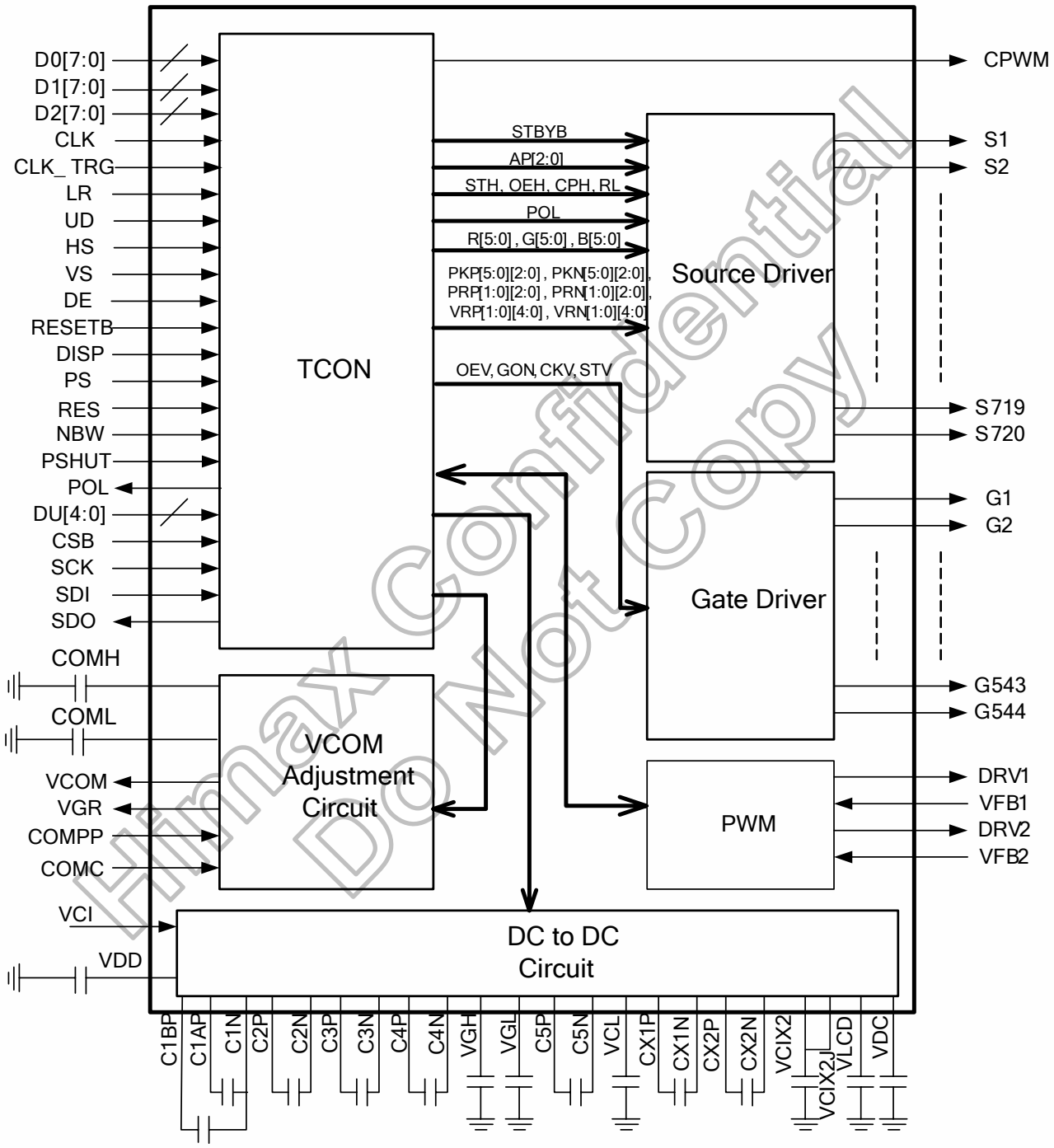
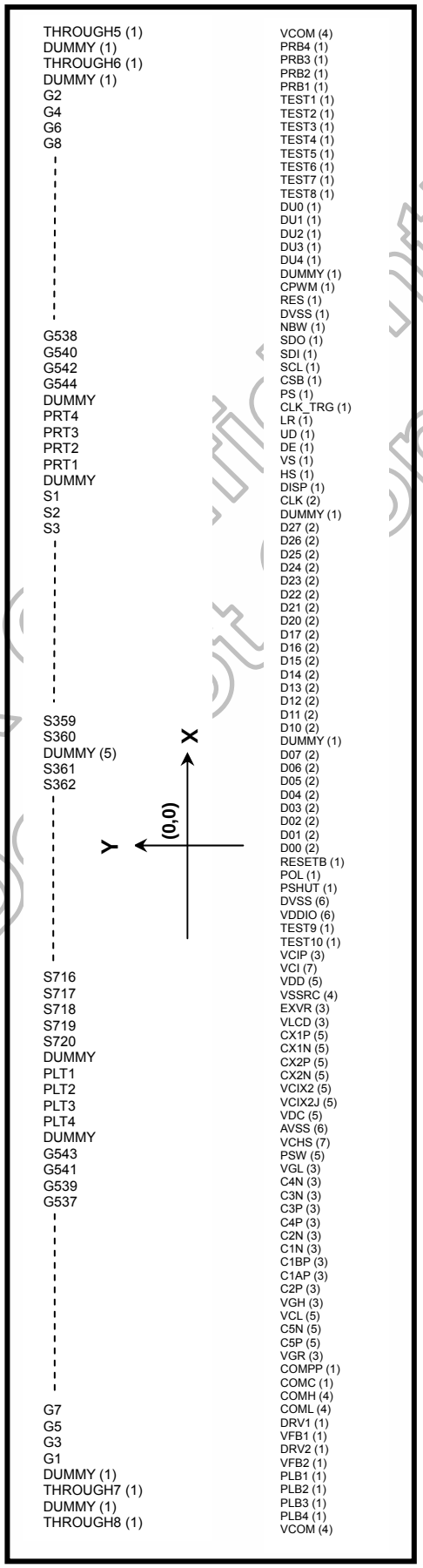
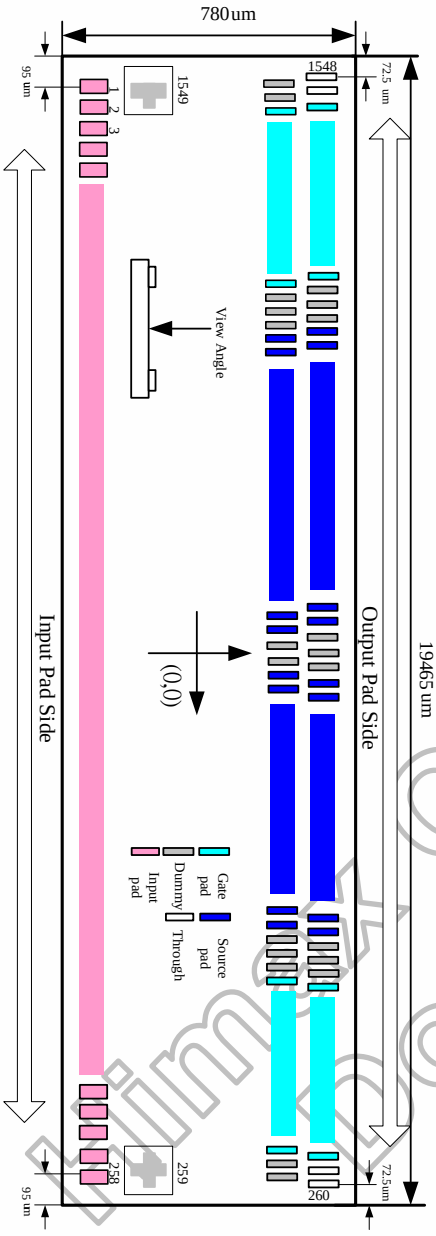
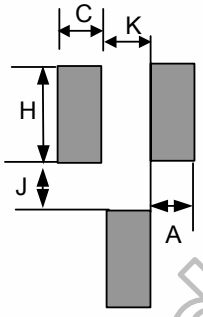



**Figure 3.1 Block Diagram**

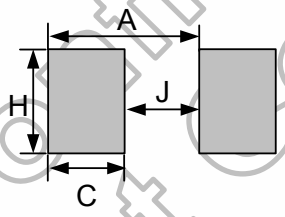
# 4. Pad Assignment(Gold Bump Face Up)





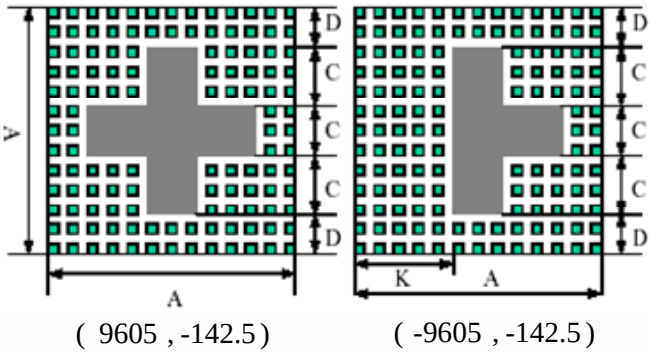




| Output Pad | symbol | Size |
|---|---|---|
| Bump pitch | A | 15um |
| Bump width | C | 15um |
| Bump height | H | 110um |
| Bump gap1 ( Vertical ) | J | 30um |
| Bump gap2( Horizontal) | K | 15um |
| Bump area | C x H | 1650um^2 |




| Input Pad | symbol | Size |
|---|---|---|
| Bump pitch | A | 75um |
| Bump width | C | 50um |
| Bump height | H | 110um |
| Bump gap1 ( Vertical) | J | 25um |
| Bump area | C x H | 5500um2 |

Die Size approximately: 19465 x 780 um^2
Bump Height: 15 um +/- 3um
Bump Hardness: 60 Hv +/- 15 Hv




| Alignment Mark | symbol | Size |
|---|---|---|
| Alignment mark size | A | 105um |
| Clearance gap1 | D | 15um |
| Clearance gap2 | K | 40um |
| Alignment mark width | C | 25um |
| Alignment area | A x A | 11025um^2 |

**Figure 4.1 HX8257-A Die Floor Plan (Bump Face UP)**

# 5. Pad Coordinates

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1 | VCOM | -9637.5 | -270 | 50x110 |
| 2 | VCOM | -9562.5 | -270 | 50x110 |
| 3 | VCOM | -9487.5 | -270 | 50x110 |
| 4 | VCOM | -9412.5 | -270 | 50x110 |
| 5 | PLB4 | -9337.5 | -270 | 50x110 |
| 6 | PLB3 | -9262.5 | -270 | 50x110 |
| 7 | PLB2 | -9187.5 | -270 | 50x110 |
| 8 | PLB1 | -9112.5 | -270 | 50x110 |
| 9 | VFB2 | -9037.5 | -270 | 50x110 |
| 10 | DRV2 | -8962.5 | -270 | 50x110 |
| 11 | VFB1 | -8887.5 | -270 | 50x110 |
| 12 | DRV1 | -8812.5 | -270 | 50x110 |
| 13 | COML | -8737.5 | -270 | 50x110 |
| 14 | COML | -8662.5 | -270 | 50x110 |
| 15 | COML | -8587.5 | -270 | 50x110 |
| 16 | COML | -8512.5 | -270 | 50x110 |
| 17 | COMH | -8437.5 | -270 | 50x110 |
| 18 | COMH | -8362.5 | -270 | 50x110 |
| 19 | COMH | -8287.5 | -270 | 50x110 |
| 20 | COMH | -8212.5 | -270 | 50x110 |
| 21 | COMC | -8137.5 | -270 | 50x110 |
| 22 | COMPP | -8062.5 | -270 | 50x110 |
| 23 | VGR | -7987.5 | -270 | 50x110 |
| 24 | VGR | -7912.5 | -270 | 50x110 |
| 25 | VGR | -7837.5 | -270 | 50x110 |
| 26 | C5P | -7762.5 | -270 | 50x110 |
| 27 | C5P | -7687.5 | -270 | 50x110 |
| 28 | C5P | -7612.5 | -270 | 50x110 |
| 29 | C5P | -7537.5 | -270 | 50x110 |
| 30 | C5P | -7462.5 | -270 | 50x110 |
| 31 | C5N | -7387.5 | -270 | 50x110 |
| 32 | C5N | -7312.5 | -270 | 50x110 |
| 33 | C5N | -7237.5 | -270 | 50x110 |
| 34 | C5N | -7162.5 | -270 | 50x110 |
| 35 | C5N | -7087.5 | -270 | 50x110 |
| 36 | VCL | -7012.5 | -270 | 50x110 |
| 37 | VCL | -6937.5 | -270 | 50x110 |
| 38 | VCL | -6862.5 | -270 | 50x110 |
| 39 | VCL | -6787.5 | -270 | 50x110 |
| 40 | VCL | -6712.5 | -270 | 50x110 |
| 41 | VGH | -6637.5 | -270 | 50x110 |
| 42 | VGH | -6562.5 | -270 | 50x110 |
| 43 | VGH | -6487.5 | -270 | 50x110 |
| 44 | C2P | -6412.5 | -270 | 50x110 |
| 45 | C2P | -6337.5 | -270 | 50x110 |
| 46 | C2P | -6262.5 | -270 | 50x110 |
| 47 | C1AP | -6187.5 | -270 | 50x110 |
| 48 | C1AP | -6112.5 | -270 | 50x110 |
| 49 | C1AP | -6037.5 | -270 | 50x110 |
| 50 | C1BP | -5962.5 | -270 | 50x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 51 | C1BP | -5887.5 | -270 | 50x110 |
| 52 | C1BP | -5812.5 | -270 | 50x110 |
| 53 | C1N | -5737.5 | -270 | 50x110 |
| 54 | C1N | -5662.5 | -270 | 50x110 |
| 55 | C1N | -5587.5 | -270 | 50x110 |
| 56 | C2N | -5512.5 | -270 | 50x110 |
| 57 | C2N | -5437.5 | -270 | 50x110 |
| 58 | C2N | -5362.5 | -270 | 50x110 |
| 59 | C4P | -5287.5 | -270 | 50x110 |
| 60 | C4P | -5212.5 | -270 | 50x110 |
| 61 | C4P | -5137.5 | -270 | 50x110 |
| 62 | C3P | -5062.5 | -270 | 50x110 |
| 63 | C3P | -4987.5 | -270 | 50x110 |
| 64 | C3P | -4912.5 | -270 | 50x110 |
| 65 | C3N | -4837.5 | -270 | 50x110 |
| 66 | C3N | -4762.5 | -270 | 50x110 |
| 67 | C3N | -4687.5 | -270 | 50x110 |
| 68 | C4N | -4612.5 | -270 | 50x110 |
| 69 | C4N | -4537.5 | -270 | 50x110 |
| 70 | C4N | -4462.5 | -270 | 50x110 |
| 71 | VGL | -4387.5 | -270 | 50x110 |
| 72 | VGL | -4312.5 | -270 | 50x110 |
| 73 | VGL | -4237.5 | -270 | 50x110 |
| 74 | PSW | -4162.5 | -270 | 50x110 |
| 75 | PSW | -4087.5 | -270 | 50x110 |
| 76 | PSW | -4012.5 | -270 | 50x110 |
| 77 | PSW | -3937.5 | -270 | 50x110 |
| 78 | PSW | -3862.5 | -270 | 50x110 |
| 79 | VCHS | -3787.5 | -270 | 50x110 |
| 80 | VCHS | -3712.5 | -270 | 50x110 |
| 81 | VCHS | -3637.5 | -270 | 50x110 |
| 82 | VCHS | -3562.5 | -270 | 50x110 |
| 83 | VCHS | -3487.5 | -270 | 50x110 |
| 84 | VCHS | -3412.5 | -270 | 50x110 |
| 85 | VCHS | -3337.5 | -270 | 50x110 |
| 86 | AVSS | -3262.5 | -270 | 50x110 |
| 87 | AVSS | -3187.5 | -270 | 50x110 |
| 88 | AVSS | -3112.5 | -270 | 50x110 |
| 89 | AVSS | -3037.5 | -270 | 50x110 |
| 90 | AVSS | -2962.5 | -270 | 50x110 |
| 91 | AVSS | -2887.5 | -270 | 50x110 |
| 92 | VDC | -2812.5 | -270 | 50x110 |
| 93 | VDC | -2737.5 | -270 | 50x110 |
| 94 | VDC | -2662.5 | -270 | 50x110 |
| 95 | VDC | -2587.5 | -270 | 50x110 |
| 96 | VDC | -2512.5 | -270 | 50x110 |
| 97 | VCIX2J | -2437.5 | -270 | 50x110 |
| 98 | VCIX2J | -2362.5 | -270 | 50x110 |
| 99 | VCIX2J | -2287.5 | -270 | 50x110 |
| 100 | VCIX2J | -2212.5 | -270 | 50x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 101 | VCIX2J | -2137.5 | -270 | 50x110 |
| 102 | VCIX2 | -2062.5 | -270 | 50x110 |
| 103 | VCIX2 | -1987.5 | -270 | 50x110 |
| 104 | VCIX2 | -1912.5 | -270 | 50x110 |
| 105 | VCIX2 | -1837.5 | -270 | 50x110 |
| 106 | VCIX2 | -1762.5 | -270 | 50x110 |
| 107 | CX2N | -1687.5 | -270 | 50x110 |
| 108 | CX2N | -1612.5 | -270 | 50x110 |
| 109 | CX2N | -1537.5 | -270 | 50x110 |
| 110 | CX2N | -1462.5 | -270 | 50x110 |
| 111 | CX2N | -1387.5 | -270 | 50x110 |
| 112 | CX2P | -1312.5 | -270 | 50x110 |
| 113 | CX2P | -1237.5 | -270 | 50x110 |
| 114 | CX2P | -1162.5 | -270 | 50x110 |
| 115 | CX2P | -1087.5 | -270 | 50x110 |
| 116 | CX2P | -1012.5 | -270 | 50x110 |
| 117 | CX1N | -937.5 | -270 | 50x110 |
| 118 | CX1N | -862.5 | -270 | 50x110 |
| 119 | CX1N | -787.5 | -270 | 50x110 |
| 120 | CX1N | -712.5 | -270 | 50x110 |
| 121 | CX1N | -637.5 | -270 | 50x110 |
| 122 | CX1P | -562.5 | -270 | 50x110 |
| 123 | CX1P | -487.5 | -270 | 50x110 |
| 124 | CX1P | -412.5 | -270 | 50x110 |
| 125 | CX1P | -337.5 | -270 | 50x110 |
| 126 | CX1P | -262.5 | -270 | 50x110 |
| 127 | VLCD | -187.5 | -270 | 50x110 |
| 128 | VLCD | -112.5 | -270 | 50x110 |
| 129 | VLCD | -37.5 | -270 | 50x110 |
| 130 | EXVR | 37.5 | -270 | 50x110 |
| 131 | EXVR | 112.5 | -270 | 50x110 |
| 132 | EXVR | 187.5 | -270 | 50x110 |
| 133 | VSSRC | 262.5 | -270 | 50x110 |
| 134 | VSSRC | 337.5 | -270 | 50x110 |
| 135 | VSSRC | 412.5 | -270 | 50x110 |
| 136 | VSSRC | 487.5 | -270 | 50x110 |
| 137 | VDD | 562.5 | -270 | 50x110 |
| 138 | VDD | 637.5 | -270 | 50x110 |
| 139 | VDD | 712.5 | -270 | 50x110 |
| 140 | VDD | 787.5 | -270 | 50x110 |
| 141 | VDD | 862.5 | -270 | 50x110 |
| 142 | VCI | 937.5 | -270 | 50x110 |
| 143 | VCI | 1012.5 | -270 | 50x110 |
| 144 | VCI | 1087.5 | -270 | 50x110 |
| 145 | VCI | 1162.5 | -270 | 50x110 |
| 146 | VCI | 1237.5 | -270 | 50x110 |
| 147 | VCI | 1312.5 | -270 | 50x110 |
| 148 | VCI | 1387.5 | -270 | 50x110 |
| 149 | VCIP | 1462.5 | -270 | 50x110 |
| 150 | VCIP | 1537.5 | -270 | 50x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 151 | VCIP | 1612.5 | -270 | 50x110 |
| 152 | TEST10 | 1687.5 | -270 | 50x110 |
| 153 | TEST9 | 1762.5 | -270 | 50x110 |
| 154 | VDDIO | 1837.5 | -270 | 50x110 |
| 155 | VDDIO | 1912.5 | -270 | 50x110 |
| 156 | VDDIO | 1987.5 | -270 | 50x110 |
| 157 | VDDIO | 2062.5 | -270 | 50x110 |
| 158 | VDDIO | 2137.5 | -270 | 50x110 |
| 159 | VDDIO | 2212.5 | -270 | 50x110 |
| 160 | DVSS | 2287.5 | -270 | 50x110 |
| 161 | DVSS | 2362.5 | -270 | 50x110 |
| 162 | DVSS | 2437.5 | -270 | 50x110 |
| 163 | DVSS | 2512.5 | -270 | 50x110 |
| 164 | DVSS | 2587.5 | -270 | 50x110 |
| 165 | DVSS | 2662.5 | -270 | 50x110 |
| 166 | PSHUT | 2737.5 | -270 | 50x110 |
| 167 | POL | 2812.5 | -270 | 50x110 |
| 168 | RESETB | 2887.5 | -270 | 50x110 |
| 169 | D00 | 2962.5 | -270 | 50x110 |
| 170 | D00 | 3037.5 | -270 | 50x110 |
| 171 | D01 | 3112.5 | -270 | 50x110 |
| 172 | D01 | 3187.5 | -270 | 50x110 |
| 173 | D02 | 3262.5 | -270 | 50x110 |
| 174 | D02 | 3337.5 | -270 | 50x110 |
| 175 | D03 | 3412.5 | -270 | 50x110 |
| 176 | D03 | 3487.5 | -270 | 50x110 |
| 177 | D04 | 3562.5 | -270 | 50x110 |
| 178 | D04 | 3637.5 | -270 | 50x110 |
| 179 | D05 | 3712.5 | -270 | 50x110 |
| 180 | D05 | 3787.5 | -270 | 50x110 |
| 181 | D06 | 3862.5 | -270 | 50x110 |
| 182 | D06 | 3937.5 | -270 | 50x110 |
| 183 | D07 | 4012.5 | -270 | 50x110 |
| 184 | D07 | 4087.5 | -270 | 50x110 |
| 185 | DUMMY | 4162.5 | -270 | 50x110 |
| 186 | D10 | 4237.5 | -270 | 50x110 |
| 187 | D10 | 4312.5 | -270 | 50x110 |
| 188 | D11 | 4387.5 | -270 | 50x110 |
| 189 | D11 | 4462.5 | -270 | 50x110 |
| 190 | D12 | 4537.5 | -270 | 50x110 |
| 191 | D12 | 4612.5 | -270 | 50x110 |
| 192 | D13 | 4687.5 | -270 | 50x110 |
| 193 | D13 | 4762.5 | -270 | 50x110 |
| 194 | D14 | 4837.5 | -270 | 50x110 |
| 195 | D14 | 4912.5 | -270 | 50x110 |
| 196 | D15 | 4987.5 | -270 | 50x110 |
| 197 | D15 | 5062.5 | -270 | 50x110 |
| 198 | D16 | 5137.5 | -270 | 50x110 |
| 199 | D16 | 5212.5 | -270 | 50x110 |
| 200 | D17 | 5287.5 | -270 | 50x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 201 | D17 | 5362.5 | -270 | 50x110 |
| 202 | D20 | 5437.5 | -270 | 50x110 |
| 203 | D20 | 5512.5 | -270 | 50x110 |
| 204 | D21 | 5587.5 | -270 | 50x110 |
| 205 | D21 | 5662.5 | -270 | 50x110 |
| 206 | D22 | 5737.5 | -270 | 50x110 |
| 207 | D22 | 5812.5 | -270 | 50x110 |
| 208 | D23 | 5887.5 | -270 | 50x110 |
| 209 | D23 | 5962.5 | -270 | 50x110 |
| 210 | D24 | 6037.5 | -270 | 50x110 |
| 211 | D24 | 6112.5 | -270 | 50x110 |
| 212 | D25 | 6187.5 | -270 | 50x110 |
| 213 | D25 | 6262.5 | -270 | 50x110 |
| 214 | D26 | 6337.5 | -270 | 50x110 |
| 215 | D26 | 6412.5 | -270 | 50x110 |
| 216 | D27 | 6487.5 | -270 | 50x110 |
| 217 | D27 | 6562.5 | -270 | 50x110 |
| 218 | DUMMY | 6637.5 | -270 | 50x110 |
| 219 | CLK | 6712.5 | -270 | 50x110 |
| 220 | CLK | 6787.5 | -270 | 50x110 |
| 221 | DISP | 6862.5 | -270 | 50x110 |
| 222 | HS | 6937.5 | -270 | 50x110 |
| 223 | VS | 7012.5 | -270 | 50x110 |
| 224 | DE | 7087.5 | -270 | 50x110 |
| 225 | UD | 7162.5 | -270 | 50x110 |
| 226 | LR | 7237.5 | -270 | 50x110 |
| 227 | CLK_TRG | 7312.5 | -270 | 50x110 |
| 228 | PS | 7387.5 | -270 | 50x110 |
| 229 | CSB | 7462.5 | -270 | 50x110 |
| 230 | SCL | 7537.5 | -270 | 50x110 |
| 231 | SDI | 7612.5 | -270 | 50x110 |
| 232 | SDO | 7687.5 | -270 | 50x110 |
| 233 | NBW | 7762.5 | -270 | 50x110 |
| 234 | DVSS | 7837.5 | -270 | 50x110 |
| 235 | RES | 7912.5 | -270 | 50x110 |
| 236 | CPWM | 7987.5 | -270 | 50x110 |
| 237 | DUMMY | 8062.5 | -270 | 50x110 |
| 238 | DU4 | 8137.5 | -270 | 50x110 |
| 239 | DU3 | 8212.5 | -270 | 50x110 |
| 240 | DU2 | 8287.5 | -270 | 50x110 |
| 241 | DU1 | 8362.5 | -270 | 50x110 |
| 242 | DU0 | 8437.5 | -270 | 50x110 |
| 243 | TEST8 | 8512.5 | -270 | 50x110 |
| 244 | TEST7 | 8587.5 | -270 | 50x110 |
| 245 | TEST6 | 8662.5 | -270 | 50x110 |
| 246 | TEST5 | 8737.5 | -270 | 50x110 |
| 247 | TEST4 | 8812.5 | -270 | 50x110 |
| 248 | TEST3 | 8887.5 | -270 | 50x110 |
| 249 | TEST2 | 8962.5 | -270 | 50x110 |
| 250 | TEST1 | 9037.5 | -270 | 50x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 251 | PRB1 | 9112.5 | -270 | 50x110 |
| 252 | PRB2 | 9187.5 | -270 | 50x110 |
| 253 | PRB3 | 9262.5 | -270 | 50x110 |
| 254 | PRB4 | 9337.5 | -270 | 50x110 |
| 255 | VCOM | 9412.5 | -270 | 50x110 |
| 256 | VCOM | 9487.5 | -270 | 50x110 |
| 257 | VCOM | 9562.5 | -270 | 50x110 |
| 258 | VCOM | 9637.5 | -270 | 50x110 |
| 259 | R_MARK | 9605 | -142.5 | NA |
| 260 | THROUGH5 | 9660 | 270 | 15x110 |
| 261 | DUMMY | 9645 | 130 | 15x110 |
| 262 | THROUGH6 | 9630 | 270 | 15x110 |
| 263 | DUMMY | 9615 | 130 | 15x110 |
| 264 | G2 | 9600 | 270 | 15x110 |
| 265 | G4 | 9585 | 130 | 15x110 |
| 266 | G6 | 9570 | 270 | 15x110 |
| 267 | G8 | 9555 | 130 | 15x110 |
| 268 | G10 | 9540 | 270 | 15x110 |
| 269 | G12 | 9525 | 130 | 15x110 |
| 270 | G14 | 9510 | 270 | 15x110 |
| 271 | G16 | 9495 | 130 | 15x110 |
| 272 | G18 | 9480 | 270 | 15x110 |
| 273 | G20 | 9465 | 130 | 15x110 |
| 274 | G22 | 9450 | 270 | 15x110 |
| 275 | G24 | 9435 | 130 | 15x110 |
| 276 | G26 | 9420 | 270 | 15x110 |
| 277 | G28 | 9405 | 130 | 15x110 |
| 278 | G30 | 9390 | 270 | 15x110 |
| 279 | G32 | 9375 | 130 | 15x110 |
| 280 | G34 | 9360 | 270 | 15x110 |
| 281 | G36 | 9345 | 130 | 15x110 |
| 282 | G38 | 9330 | 270 | 15x110 |
| 283 | G40 | 9315 | 130 | 15x110 |
| 284 | G42 | 9300 | 270 | 15x110 |
| 285 | G44 | 9285 | 130 | 15x110 |
| 286 | G46 | 9270 | 270 | 15x110 |
| 287 | G48 | 9255 | 130 | 15x110 |
| 288 | G50 | 9240 | 270 | 15x110 |
| 289 | G52 | 9225 | 130 | 15x110 |
| 290 | G54 | 9210 | 270 | 15x110 |
| 291 | G56 | 9195 | 130 | 15x110 |
| 292 | G58 | 9180 | 270 | 15x110 |
| 293 | G60 | 9165 | 130 | 15x110 |
| 294 | G62 | 9150 | 270 | 15x110 |
| 295 | G64 | 9135 | 130 | 15x110 |
| 296 | G66 | 9120 | 270 | 15x110 |
| 297 | G68 | 9105 | 130 | 15x110 |
| 298 | G70 | 9090 | 270 | 15x110 |
| 299 | G72 | 9075 | 130 | 15x110 |
| 300 | G74 | 9060 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 301 | G76 | 9045 | 130 | 15x110 |
| 302 | G78 | 9030 | 270 | 15x110 |
| 303 | G80 | 9015 | 130 | 15x110 |
| 304 | G82 | 9000 | 270 | 15x110 |
| 305 | G84 | 8985 | 130 | 15x110 |
| 306 | G86 | 8970 | 270 | 15x110 |
| 307 | G88 | 8955 | 130 | 15x110 |
| 308 | G90 | 8940 | 270 | 15x110 |
| 309 | G92 | 8925 | 130 | 15x110 |
| 310 | G94 | 8910 | 270 | 15x110 |
| 311 | G96 | 8895 | 130 | 15x110 |
| 312 | G98 | 8880 | 270 | 15x110 |
| 313 | G100 | 8865 | 130 | 15x110 |
| 314 | G102 | 8850 | 270 | 15x110 |
| 315 | G104 | 8835 | 130 | 15x110 |
| 316 | G106 | 8820 | 270 | 15x110 |
| 317 | G108 | 8805 | 130 | 15x110 |
| 318 | G110 | 8790 | 270 | 15x110 |
| 319 | G112 | 8775 | 130 | 15x110 |
| 320 | G114 | 8760 | 270 | 15x110 |
| 321 | G116 | 8745 | 130 | 15x110 |
| 322 | G118 | 8730 | 270 | 15x110 |
| 323 | G120 | 8715 | 130 | 15x110 |
| 324 | G122 | 8700 | 270 | 15x110 |
| 325 | G124 | 8685 | 130 | 15x110 |
| 326 | G126 | 8670 | 270 | 15x110 |
| 327 | G128 | 8655 | 130 | 15x110 |
| 328 | G130 | 8640 | 270 | 15x110 |
| 329 | G132 | 8625 | 130 | 15x110 |
| 330 | G134 | 8610 | 270 | 15x110 |
| 331 | G136 | 8595 | 130 | 15x110 |
| 332 | G138 | 8580 | 270 | 15x110 |
| 333 | G140 | 8565 | 130 | 15x110 |
| 334 | G142 | 8550 | 270 | 15x110 |
| 335 | G144 | 8535 | 130 | 15x110 |
| 336 | G146 | 8520 | 270 | 15x110 |
| 337 | G148 | 8505 | 130 | 15x110 |
| 338 | G150 | 8490 | 270 | 15x110 |
| 339 | G152 | 8475 | 130 | 15x110 |
| 340 | G154 | 8460 | 270 | 15x110 |
| 341 | G156 | 8445 | 130 | 15x110 |
| 342 | G158 | 8430 | 270 | 15x110 |
| 343 | G160 | 8415 | 130 | 15x110 |
| 344 | G162 | 8400 | 270 | 15x110 |
| 345 | G164 | 8385 | 130 | 15x110 |
| 346 | G166 | 8370 | 270 | 15x110 |
| 347 | G168 | 8355 | 130 | 15x110 |
| 348 | G170 | 8340 | 270 | 15x110 |
| 349 | G172 | 8325 | 130 | 15x110 |
| 350 | G174 | 8310 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 351 | G176 | 8295 | 130 | 15x110 |
| 352 | G178 | 8280 | 270 | 15x110 |
| 353 | G180 | 8265 | 130 | 15x110 |
| 354 | G182 | 8250 | 270 | 15x110 |
| 355 | G184 | 8235 | 130 | 15x110 |
| 356 | G186 | 8220 | 270 | 15x110 |
| 357 | G188 | 8205 | 130 | 15x110 |
| 358 | G190 | 8190 | 270 | 15x110 |
| 359 | G192 | 8175 | 130 | 15x110 |
| 360 | G194 | 8160 | 270 | 15x110 |
| 361 | G196 | 8145 | 130 | 15x110 |
| 362 | G198 | 8130 | 270 | 15x110 |
| 363 | G200 | 8115 | 130 | 15x110 |
| 364 | G202 | 8100 | 270 | 15x110 |
| 365 | G204 | 8085 | 130 | 15x110 |
| 366 | G206 | 8070 | 270 | 15x110 |
| 367 | G208 | 8055 | 130 | 15x110 |
| 368 | G210 | 8040 | 270 | 15x110 |
| 369 | G212 | 8025 | 130 | 15x110 |
| 370 | G214 | 8010 | 270 | 15x110 |
| 371 | G216 | 7995 | 130 | 15x110 |
| 372 | G218 | 7980 | 270 | 15x110 |
| 373 | G220 | 7965 | 130 | 15x110 |
| 374 | G222 | 7950 | 270 | 15x110 |
| 375 | G224 | 7935 | 130 | 15x110 |
| 376 | G226 | 7920 | 270 | 15x110 |
| 377 | G228 | 7905 | 130 | 15x110 |
| 378 | G230 | 7890 | 270 | 15x110 |
| 379 | G232 | 7875 | 130 | 15x110 |
| 380 | G234 | 7860 | 270 | 15x110 |
| 381 | G236 | 7845 | 130 | 15x110 |
| 382 | G238 | 7830 | 270 | 15x110 |
| 383 | G240 | 7815 | 130 | 15x110 |
| 384 | G242 | 7800 | 270 | 15x110 |
| 385 | G244 | 7785 | 130 | 15x110 |
| 386 | G246 | 7770 | 270 | 15x110 |
| 387 | G248 | 7755 | 130 | 15x110 |
| 388 | G250 | 7740 | 270 | 15x110 |
| 389 | G252 | 7725 | 130 | 15x110 |
| 390 | G254 | 7710 | 270 | 15x110 |
| 391 | G256 | 7695 | 130 | 15x110 |
| 392 | G258 | 7680 | 270 | 15x110 |
| 393 | G260 | 7665 | 130 | 15x110 |
| 394 | G262 | 7650 | 270 | 15x110 |
| 395 | G264 | 7635 | 130 | 15x110 |
| 396 | G266 | 7620 | 270 | 15x110 |
| 397 | G268 | 7605 | 130 | 15x110 |
| 398 | G270 | 7590 | 270 | 15x110 |
| 399 | G272 | 7575 | 130 | 15x110 |
| 400 | G274 | 7560 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 401 | G276 | 7545 | 130 | 15x110 |
| 402 | G278 | 7530 | 270 | 15x110 |
| 403 | G280 | 7515 | 130 | 15x110 |
| 404 | G282 | 7500 | 270 | 15x110 |
| 405 | G284 | 7485 | 130 | 15x110 |
| 406 | G286 | 7470 | 270 | 15x110 |
| 407 | G288 | 7455 | 130 | 15x110 |
| 408 | G290 | 7440 | 270 | 15x110 |
| 409 | G292 | 7425 | 130 | 15x110 |
| 410 | G294 | 7410 | 270 | 15x110 |
| 411 | G296 | 7395 | 130 | 15x110 |
| 412 | G298 | 7380 | 270 | 15x110 |
| 413 | G300 | 7365 | 130 | 15x110 |
| 414 | G302 | 7350 | 270 | 15x110 |
| 415 | G304 | 7335 | 130 | 15x110 |
| 416 | G306 | 7320 | 270 | 15x110 |
| 417 | G308 | 7305 | 130 | 15x110 |
| 418 | G310 | 7290 | 270 | 15x110 |
| 419 | G312 | 7275 | 130 | 15x110 |
| 420 | G314 | 7260 | 270 | 15x110 |
| 421 | G316 | 7245 | 130 | 15x110 |
| 422 | G318 | 7230 | 270 | 15x110 |
| 423 | G320 | 7215 | 130 | 15x110 |
| 424 | G322 | 7200 | 270 | 15x110 |
| 425 | G324 | 7185 | 130 | 15x110 |
| 426 | G326 | 7170 | 270 | 15x110 |
| 427 | G328 | 7155 | 130 | 15x110 |
| 428 | G330 | 7140 | 270 | 15x110 |
| 429 | G332 | 7125 | 130 | 15x110 |
| 430 | G334 | 7110 | 270 | 15x110 |
| 431 | G336 | 7095 | 130 | 15x110 |
| 432 | G338 | 7080 | 270 | 15x110 |
| 433 | G340 | 7065 | 130 | 15x110 |
| 434 | G342 | 7050 | 270 | 15x110 |
| 435 | G344 | 7035 | 130 | 15x110 |
| 436 | G346 | 7020 | 270 | 15x110 |
| 437 | G348 | 7005 | 130 | 15x110 |
| 438 | G350 | 6990 | 270 | 15x110 |
| 439 | G352 | 6975 | 130 | 15x110 |
| 440 | G354 | 6960 | 270 | 15x110 |
| 441 | G356 | 6945 | 130 | 15x110 |
| 442 | G358 | 6930 | 270 | 15x110 |
| 443 | G360 | 6915 | 130 | 15x110 |
| 444 | G362 | 6900 | 270 | 15x110 |
| 445 | G364 | 6885 | 130 | 15x110 |
| 446 | G366 | 6870 | 270 | 15x110 |
| 447 | G368 | 6855 | 130 | 15x110 |
| 448 | G370 | 6840 | 270 | 15x110 |
| 449 | G372 | 6825 | 130 | 15x110 |
| 450 | G374 | 6810 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 451 | G376 | 6795 | 130 | 15x110 |
| 452 | G378 | 6780 | 270 | 15x110 |
| 453 | G380 | 6765 | 130 | 15x110 |
| 454 | G382 | 6750 | 270 | 15x110 |
| 455 | G384 | 6735 | 130 | 15x110 |
| 456 | G386 | 6720 | 270 | 15x110 |
| 457 | G388 | 6705 | 130 | 15x110 |
| 458 | G390 | 6690 | 270 | 15x110 |
| 459 | G392 | 6675 | 130 | 15x110 |
| 460 | G394 | 6660 | 270 | 15x110 |
| 461 | G396 | 6645 | 130 | 15x110 |
| 462 | G398 | 6630 | 270 | 15x110 |
| 463 | G400 | 6615 | 130 | 15x110 |
| 464 | G402 | 6600 | 270 | 15x110 |
| 465 | G404 | 6585 | 130 | 15x110 |
| 466 | G406 | 6570 | 270 | 15x110 |
| 467 | G408 | 6555 | 130 | 15x110 |
| 468 | G410 | 6540 | 270 | 15x110 |
| 469 | G412 | 6525 | 130 | 15x110 |
| 470 | G414 | 6510 | 270 | 15x110 |
| 471 | G416 | 6495 | 130 | 15x110 |
| 472 | G418 | 6480 | 270 | 15x110 |
| 473 | G420 | 6465 | 130 | 15x110 |
| 474 | G422 | 6450 | 270 | 15x110 |
| 475 | G424 | 6435 | 130 | 15x110 |
| 476 | G426 | 6420 | 270 | 15x110 |
| 477 | G428 | 6405 | 130 | 15x110 |
| 478 | G430 | 6390 | 270 | 15x110 |
| 479 | G432 | 6375 | 130 | 15x110 |
| 480 | G434 | 6360 | 270 | 15x110 |
| 481 | G436 | 6345 | 130 | 15x110 |
| 482 | G438 | 6330 | 270 | 15x110 |
| 483 | G440 | 6315 | 130 | 15x110 |
| 484 | G442 | 6300 | 270 | 15x110 |
| 485 | G444 | 6285 | 130 | 15x110 |
| 486 | G446 | 6270 | 270 | 15x110 |
| 487 | G448 | 6255 | 130 | 15x110 |
| 488 | G450 | 6240 | 270 | 15x110 |
| 489 | G452 | 6225 | 130 | 15x110 |
| 490 | G454 | 6210 | 270 | 15x110 |
| 491 | G456 | 6195 | 130 | 15x110 |
| 492 | G458 | 6180 | 270 | 15x110 |
| 493 | G460 | 6165 | 130 | 15x110 |
| 494 | G462 | 6150 | 270 | 15x110 |
| 495 | G464 | 6135 | 130 | 15x110 |
| 496 | G466 | 6120 | 270 | 15x110 |
| 497 | G468 | 6105 | 130 | 15x110 |
| 498 | G470 | 6090 | 270 | 15x110 |
| 499 | G472 | 6075 | 130 | 15x110 |
| 500 | G474 | 6060 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 501 | G476 | 6045 | 130 | 15x110 |
| 502 | G478 | 6030 | 270 | 15x110 |
| 503 | G480 | 6015 | 130 | 15x110 |
| 504 | G482 | 6000 | 270 | 15x110 |
| 505 | G484 | 5985 | 130 | 15x110 |
| 506 | G486 | 5970 | 270 | 15x110 |
| 507 | G488 | 5955 | 130 | 15x110 |
| 508 | G490 | 5940 | 270 | 15x110 |
| 509 | G492 | 5925 | 130 | 15x110 |
| 510 | G494 | 5910 | 270 | 15x110 |
| 511 | G496 | 5895 | 130 | 15x110 |
| 512 | G498 | 5880 | 270 | 15x110 |
| 513 | G500 | 5865 | 130 | 15x110 |
| 514 | G502 | 5850 | 270 | 15x110 |
| 515 | G504 | 5835 | 130 | 15x110 |
| 516 | G506 | 5820 | 270 | 15x110 |
| 517 | G508 | 5805 | 130 | 15x110 |
| 518 | G510 | 5790 | 270 | 15x110 |
| 519 | G512 | 5775 | 130 | 15x110 |
| 520 | G514 | 5760 | 270 | 15x110 |
| 521 | G516 | 5745 | 130 | 15x110 |
| 522 | G518 | 5730 | 270 | 15x110 |
| 523 | G520 | 5715 | 130 | 15x110 |
| 524 | G522 | 5700 | 270 | 15x110 |
| 525 | G524 | 5685 | 130 | 15x110 |
| 526 | G526 | 5670 | 270 | 15x110 |
| 527 | G528 | 5655 | 130 | 15x110 |
| 528 | G530 | 5640 | 270 | 15x110 |
| 529 | G532 | 5625 | 130 | 15x110 |
| 530 | G534 | 5610 | 270 | 15x110 |
| 531 | G536 | 5595 | 130 | 15x110 |
| 532 | G538 | 5580 | 270 | 15x110 |
| 533 | G540 | 5565 | 130 | 15x110 |
| 534 | G542 | 5550 | 270 | 15x110 |
| 535 | G544 | 5535 | 130 | 15x110 |
| 536 | DUMMY | 5520 | 270 | 15x110 |
| 537 | PRT4 | 5505 | 130 | 15x110 |
| 538 | PRT3 | 5490 | 270 | 15x110 |
| 539 | PRT2 | 5475 | 130 | 15x110 |
| 540 | PRT1 | 5460 | 270 | 15x110 |
| 541 | DUMMY | 5445 | 130 | 15x110 |
| 542 | S1 | 5430 | 270 | 15x110 |
| 543 | S2 | 5415 | 130 | 15x110 |
| 544 | S3 | 5400 | 270 | 15x110 |
| 545 | S4 | 5385 | 130 | 15x110 |
| 546 | S5 | 5370 | 270 | 15x110 |
| 547 | S6 | 5355 | 130 | 15x110 |
| 548 | S7 | 5340 | 270 | 15x110 |
| 549 | S8 | 5325 | 130 | 15x110 |
| 550 | S9 | 5310 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 551 | S10 | 5295 | 130 | 15x110 |
| 552 | S11 | 5280 | 270 | 15x110 |
| 553 | S12 | 5265 | 130 | 15x110 |
| 554 | S13 | 5250 | 270 | 15x110 |
| 555 | S14 | 5235 | 130 | 15x110 |
| 556 | S15 | 5220 | 270 | 15x110 |
| 557 | S16 | 5205 | 130 | 15x110 |
| 558 | S17 | 5190 | 270 | 15x110 |
| 559 | S18 | 5175 | 130 | 15x110 |
| 560 | S19 | 5160 | 270 | 15x110 |
| 561 | S20 | 5145 | 130 | 15x110 |
| 562 | S21 | 5130 | 270 | 15x110 |
| 563 | S22 | 5115 | 130 | 15x110 |
| 564 | S23 | 5100 | 270 | 15x110 |
| 565 | S24 | 5085 | 130 | 15x110 |
| 566 | S25 | 5070 | 270 | 15x110 |
| 567 | S26 | 5055 | 130 | 15x110 |
| 568 | S27 | 5040 | 270 | 15x110 |
| 569 | S28 | 5025 | 130 | 15x110 |
| 570 | S29 | 5010 | 270 | 15x110 |
| 571 | S30 | 4995 | 130 | 15x110 |
| 572 | S31 | 4980 | 270 | 15x110 |
| 573 | S32 | 4965 | 130 | 15x110 |
| 574 | S33 | 4950 | 270 | 15x110 |
| 575 | S34 | 4935 | 130 | 15x110 |
| 576 | S35 | 4920 | 270 | 15x110 |
| 577 | S36 | 4905 | 130 | 15x110 |
| 578 | S37 | 4890 | 270 | 15x110 |
| 579 | S38 | 4875 | 130 | 15x110 |
| 580 | S39 | 4860 | 270 | 15x110 |
| 581 | S40 | 4845 | 130 | 15x110 |
| 582 | S41 | 4830 | 270 | 15x110 |
| 583 | S42 | 4815 | 130 | 15x110 |
| 584 | S43 | 4800 | 270 | 15x110 |
| 585 | S44 | 4785 | 130 | 15x110 |
| 586 | S45 | 4770 | 270 | 15x110 |
| 587 | S46 | 4755 | 130 | 15x110 |
| 588 | S47 | 4740 | 270 | 15x110 |
| 589 | S48 | 4725 | 130 | 15x110 |
| 590 | S49 | 4710 | 270 | 15x110 |
| 591 | S50 | 4695 | 130 | 15x110 |
| 592 | S51 | 4680 | 270 | 15x110 |
| 593 | S52 | 4665 | 130 | 15x110 |
| 594 | S53 | 4650 | 270 | 15x110 |
| 595 | S54 | 4635 | 130 | 15x110 |
| 596 | S55 | 4620 | 270 | 15x110 |
| 597 | S56 | 4605 | 130 | 15x110 |
| 598 | S57 | 4590 | 270 | 15x110 |
| 599 | S58 | 4575 | 130 | 15x110 |
| 600 | S59 | 4560 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 601 | S60 | 4545 | 130 | 15x110 |
| 602 | S61 | 4530 | 270 | 15x110 |
| 603 | S62 | 4515 | 130 | 15x110 |
| 604 | S63 | 4500 | 270 | 15x110 |
| 605 | S64 | 4485 | 130 | 15x110 |
| 606 | S65 | 4470 | 270 | 15x110 |
| 607 | S66 | 4455 | 130 | 15x110 |
| 608 | S67 | 4440 | 270 | 15x110 |
| 609 | S68 | 4425 | 130 | 15x110 |
| 610 | S69 | 4410 | 270 | 15x110 |
| 611 | S70 | 4395 | 130 | 15x110 |
| 612 | S71 | 4380 | 270 | 15x110 |
| 613 | S72 | 4365 | 130 | 15x110 |
| 614 | S73 | 4350 | 270 | 15x110 |
| 615 | S74 | 4335 | 130 | 15x110 |
| 616 | S75 | 4320 | 270 | 15x110 |
| 617 | S76 | 4305 | 130 | 15x110 |
| 618 | S77 | 4290 | 270 | 15x110 |
| 619 | S78 | 4275 | 130 | 15x110 |
| 620 | S79 | 4260 | 270 | 15x110 |
| 621 | S80 | 4245 | 130 | 15x110 |
| 622 | S81 | 4230 | 270 | 15x110 |
| 623 | S82 | 4215 | 130 | 15x110 |
| 624 | S83 | 4200 | 270 | 15x110 |
| 625 | S84 | 4185 | 130 | 15x110 |
| 626 | S85 | 4170 | 270 | 15x110 |
| 627 | S86 | 4155 | 130 | 15x110 |
| 628 | S87 | 4140 | 270 | 15x110 |
| 629 | S88 | 4125 | 130 | 15x110 |
| 630 | S89 | 4110 | 270 | 15x110 |
| 631 | S90 | 4095 | 130 | 15x110 |
| 632 | S91 | 4080 | 270 | 15x110 |
| 633 | S92 | 4065 | 130 | 15x110 |
| 634 | S93 | 4050 | 270 | 15x110 |
| 635 | S94 | 4035 | 130 | 15x110 |
| 636 | S95 | 4020 | 270 | 15x110 |
| 637 | S96 | 4005 | 130 | 15x110 |
| 638 | S97 | 3990 | 270 | 15x110 |
| 639 | S98 | 3975 | 130 | 15x110 |
| 640 | S99 | 3960 | 270 | 15x110 |
| 641 | S100 | 3945 | 130 | 15x110 |
| 642 | S101 | 3930 | 270 | 15x110 |
| 643 | S102 | 3915 | 130 | 15x110 |
| 644 | S103 | 3900 | 270 | 15x110 |
| 645 | S104 | 3885 | 130 | 15x110 |
| 646 | S105 | 3870 | 270 | 15x110 |
| 647 | S106 | 3855 | 130 | 15x110 |
| 648 | S107 | 3840 | 270 | 15x110 |
| 649 | S108 | 3825 | 130 | 15x110 |
| 650 | S109 | 3810 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 651 | S110 | 3795 | 130 | 15x110 |
| 652 | S111 | 3780 | 270 | 15x110 |
| 653 | S112 | 3765 | 130 | 15x110 |
| 654 | S113 | 3750 | 270 | 15x110 |
| 655 | S114 | 3735 | 130 | 15x110 |
| 656 | S115 | 3720 | 270 | 15x110 |
| 657 | S116 | 3705 | 130 | 15x110 |
| 658 | S117 | 3690 | 270 | 15x110 |
| 659 | S118 | 3675 | 130 | 15x110 |
| 660 | S119 | 3660 | 270 | 15x110 |
| 661 | S120 | 3645 | 130 | 15x110 |
| 662 | S121 | 3630 | 270 | 15x110 |
| 663 | S122 | 3615 | 130 | 15x110 |
| 664 | S123 | 3600 | 270 | 15x110 |
| 665 | S124 | 3585 | 130 | 15x110 |
| 666 | S125 | 3570 | 270 | 15x110 |
| 667 | S126 | 3555 | 130 | 15x110 |
| 668 | S127 | 3540 | 270 | 15x110 |
| 669 | S128 | 3525 | 130 | 15x110 |
| 670 | S129 | 3510 | 270 | 15x110 |
| 671 | S130 | 3495 | 130 | 15x110 |
| 672 | S131 | 3480 | 270 | 15x110 |
| 673 | S132 | 3465 | 130 | 15x110 |
| 674 | S133 | 3450 | 270 | 15x110 |
| 675 | S134 | 3435 | 130 | 15x110 |
| 676 | S135 | 3420 | 270 | 15x110 |
| 677 | S136 | 3405 | 130 | 15x110 |
| 678 | S137 | 3390 | 270 | 15x110 |
| 679 | S138 | 3375 | 130 | 15x110 |
| 680 | S139 | 3360 | 270 | 15x110 |
| 681 | S140 | 3345 | 130 | 15x110 |
| 682 | S141 | 3330 | 270 | 15x110 |
| 683 | S142 | 3315 | 130 | 15x110 |
| 684 | S143 | 3300 | 270 | 15x110 |
| 685 | S144 | 3285 | 130 | 15x110 |
| 686 | S145 | 3270 | 270 | 15x110 |
| 687 | S146 | 3255 | 130 | 15x110 |
| 688 | S147 | 3240 | 270 | 15x110 |
| 689 | S148 | 3225 | 130 | 15x110 |
| 690 | S149 | 3210 | 270 | 15x110 |
| 691 | S150 | 3195 | 130 | 15x110 |
| 692 | S151 | 3180 | 270 | 15x110 |
| 693 | S152 | 3165 | 130 | 15x110 |
| 694 | S153 | 3150 | 270 | 15x110 |
| 695 | S154 | 3135 | 130 | 15x110 |
| 696 | S155 | 3120 | 270 | 15x110 |
| 697 | S156 | 3105 | 130 | 15x110 |
| 698 | S157 | 3090 | 270 | 15x110 |
| 699 | S158 | 3075 | 130 | 15x110 |
| 700 | S159 | 3060 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 701 | S160 | 3045 | 130 | 15x110 |
| 702 | S161 | 3030 | 270 | 15x110 |
| 703 | S162 | 3015 | 130 | 15x110 |
| 704 | S163 | 3000 | 270 | 15x110 |
| 705 | S164 | 2985 | 130 | 15x110 |
| 706 | S165 | 2970 | 270 | 15x110 |
| 707 | S166 | 2955 | 130 | 15x110 |
| 708 | S167 | 2940 | 270 | 15x110 |
| 709 | S168 | 2925 | 130 | 15x110 |
| 710 | S169 | 2910 | 270 | 15x110 |
| 711 | S170 | 2895 | 130 | 15x110 |
| 712 | S171 | 2880 | 270 | 15x110 |
| 713 | S172 | 2865 | 130 | 15x110 |
| 714 | S173 | 2850 | 270 | 15x110 |
| 715 | S174 | 2835 | 130 | 15x110 |
| 716 | S175 | 2820 | 270 | 15x110 |
| 717 | S176 | 2805 | 130 | 15x110 |
| 718 | S177 | 2790 | 270 | 15x110 |
| 719 | S178 | 2775 | 130 | 15x110 |
| 720 | S179 | 2760 | 270 | 15x110 |
| 721 | S180 | 2745 | 130 | 15x110 |
| 722 | S181 | 2730 | 270 | 15x110 |
| 723 | S182 | 2715 | 130 | 15x110 |
| 724 | S183 | 2700 | 270 | 15x110 |
| 725 | S184 | 2685 | 130 | 15x110 |
| 726 | S185 | 2670 | 270 | 15x110 |
| 727 | S186 | 2655 | 130 | 15x110 |
| 728 | S187 | 2640 | 270 | 15x110 |
| 729 | S188 | 2625 | 130 | 15x110 |
| 730 | S189 | 2610 | 270 | 15x110 |
| 731 | S190 | 2595 | 130 | 15x110 |
| 732 | S191 | 2580 | 270 | 15x110 |
| 733 | S192 | 2565 | 130 | 15x110 |
| 734 | S193 | 2550 | 270 | 15x110 |
| 735 | S194 | 2535 | 130 | 15x110 |
| 736 | S195 | 2520 | 270 | 15x110 |
| 737 | S196 | 2505 | 130 | 15x110 |
| 738 | S197 | 2490 | 270 | 15x110 |
| 739 | S198 | 2475 | 130 | 15x110 |
| 740 | S199 | 2460 | 270 | 15x110 |
| 741 | S200 | 2445 | 130 | 15x110 |
| 742 | S201 | 2430 | 270 | 15x110 |
| 743 | S202 | 2415 | 130 | 15x110 |
| 744 | S203 | 2400 | 270 | 15x110 |
| 745 | S204 | 2385 | 130 | 15x110 |
| 746 | S205 | 2370 | 270 | 15x110 |
| 747 | S206 | 2355 | 130 | 15x110 |
| 748 | S207 | 2340 | 270 | 15x110 |
| 749 | S208 | 2325 | 130 | 15x110 |
| 750 | S209 | 2310 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 751 | S210 | 2295 | 130 | 15x110 |
| 752 | S211 | 2280 | 270 | 15x110 |
| 753 | S212 | 2265 | 130 | 15x110 |
| 754 | S213 | 2250 | 270 | 15x110 |
| 755 | S214 | 2235 | 130 | 15x110 |
| 756 | S215 | 2220 | 270 | 15x110 |
| 757 | S216 | 2205 | 130 | 15x110 |
| 758 | S217 | 2190 | 270 | 15x110 |
| 759 | S218 | 2175 | 130 | 15x110 |
| 760 | S219 | 2160 | 270 | 15x110 |
| 761 | S220 | 2145 | 130 | 15x110 |
| 762 | S221 | 2130 | 270 | 15x110 |
| 763 | S222 | 2115 | 130 | 15x110 |
| 764 | S223 | 2100 | 270 | 15x110 |
| 765 | S224 | 2085 | 130 | 15x110 |
| 766 | S225 | 2070 | 270 | 15x110 |
| 767 | S226 | 2055 | 130 | 15x110 |
| 768 | S227 | 2040 | 270 | 15x110 |
| 769 | S228 | 2025 | 130 | 15x110 |
| 770 | S229 | 2010 | 270 | 15x110 |
| 771 | S230 | 1995 | 130 | 15x110 |
| 772 | S231 | 1980 | 270 | 15x110 |
| 773 | S232 | 1965 | 130 | 15x110 |
| 774 | S233 | 1950 | 270 | 15x110 |
| 775 | S234 | 1935 | 130 | 15x110 |
| 776 | S235 | 1920 | 270 | 15x110 |
| 777 | S236 | 1905 | 130 | 15x110 |
| 778 | S237 | 1890 | 270 | 15x110 |
| 779 | S238 | 1875 | 130 | 15x110 |
| 780 | S239 | 1860 | 270 | 15x110 |
| 781 | S240 | 1845 | 130 | 15x110 |
| 782 | S241 | 1830 | 270 | 15x110 |
| 783 | S242 | 1815 | 130 | 15x110 |
| 784 | S243 | 1800 | 270 | 15x110 |
| 785 | S244 | 1785 | 130 | 15x110 |
| 786 | S245 | 1770 | 270 | 15x110 |
| 787 | S246 | 1755 | 130 | 15x110 |
| 788 | S247 | 1740 | 270 | 15x110 |
| 789 | S248 | 1725 | 130 | 15x110 |
| 790 | S249 | 1710 | 270 | 15x110 |
| 791 | S250 | 1695 | 130 | 15x110 |
| 792 | S251 | 1680 | 270 | 15x110 |
| 793 | S252 | 1665 | 130 | 15x110 |
| 794 | S253 | 1650 | 270 | 15x110 |
| 795 | S254 | 1635 | 130 | 15x110 |
| 796 | S255 | 1620 | 270 | 15x110 |
| 797 | S256 | 1605 | 130 | 15x110 |
| 798 | S257 | 1590 | 270 | 15x110 |
| 799 | S258 | 1575 | 130 | 15x110 |
| 800 | S259 | 1560 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 801 | S260 | 1545 | 130 | 15x110 |
| 802 | S261 | 1530 | 270 | 15x110 |
| 803 | S262 | 1515 | 130 | 15x110 |
| 804 | S263 | 1500 | 270 | 15x110 |
| 805 | S264 | 1485 | 130 | 15x110 |
| 806 | S265 | 1470 | 270 | 15x110 |
| 807 | S266 | 1455 | 130 | 15x110 |
| 808 | S267 | 1440 | 270 | 15x110 |
| 809 | S268 | 1425 | 130 | 15x110 |
| 810 | S269 | 1410 | 270 | 15x110 |
| 811 | S270 | 1395 | 130 | 15x110 |
| 812 | S271 | 1380 | 270 | 15x110 |
| 813 | S272 | 1365 | 130 | 15x110 |
| 814 | S273 | 1350 | 270 | 15x110 |
| 815 | S274 | 1335 | 130 | 15x110 |
| 816 | S275 | 1320 | 270 | 15x110 |
| 817 | S276 | 1305 | 130 | 15x110 |
| 818 | S277 | 1290 | 270 | 15x110 |
| 819 | S278 | 1275 | 130 | 15x110 |
| 820 | S279 | 1260 | 270 | 15x110 |
| 821 | S280 | 1245 | 130 | 15x110 |
| 822 | S281 | 1230 | 270 | 15x110 |
| 823 | S282 | 1215 | 130 | 15x110 |
| 824 | S283 | 1200 | 270 | 15x110 |
| 825 | S284 | 1185 | 130 | 15x110 |
| 826 | S285 | 1170 | 270 | 15x110 |
| 827 | S286 | 1155 | 130 | 15x110 |
| 828 | S287 | 1140 | 270 | 15x110 |
| 829 | S288 | 1125 | 130 | 15x110 |
| 830 | S289 | 1110 | 270 | 15x110 |
| 831 | S290 | 1095 | 130 | 15x110 |
| 832 | S291 | 1080 | 270 | 15x110 |
| 833 | S292 | 1065 | 130 | 15x110 |
| 834 | S293 | 1050 | 270 | 15x110 |
| 835 | S294 | 1035 | 130 | 15x110 |
| 836 | S295 | 1020 | 270 | 15x110 |
| 837 | S296 | 1005 | 130 | 15x110 |
| 838 | S297 | 990 | 270 | 15x110 |
| 839 | S298 | 975 | 130 | 15x110 |
| 840 | S299 | 960 | 270 | 15x110 |
| 841 | S300 | 945 | 130 | 15x110 |
| 842 | S301 | 930 | 270 | 15x110 |
| 843 | S302 | 915 | 130 | 15x110 |
| 844 | S303 | 900 | 270 | 15x110 |
| 845 | S304 | 885 | 130 | 15x110 |
| 846 | S305 | 870 | 270 | 15x110 |
| 847 | S306 | 855 | 130 | 15x110 |
| 848 | S307 | 840 | 270 | 15x110 |
| 849 | S308 | 825 | 130 | 15x110 |
| 850 | S309 | 810 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 851 | S310 | 795 | 130 | 15x110 |
| 852 | S311 | 780 | 270 | 15x110 |
| 853 | S312 | 765 | 130 | 15x110 |
| 854 | S313 | 750 | 270 | 15x110 |
| 855 | S314 | 735 | 130 | 15x110 |
| 856 | S315 | 720 | 270 | 15x110 |
| 857 | S316 | 705 | 130 | 15x110 |
| 858 | S317 | 690 | 270 | 15x110 |
| 859 | S318 | 675 | 130 | 15x110 |
| 860 | S319 | 660 | 270 | 15x110 |
| 861 | S320 | 645 | 130 | 15x110 |
| 862 | S321 | 630 | 270 | 15x110 |
| 863 | S322 | 615 | 130 | 15x110 |
| 864 | S323 | 600 | 270 | 15x110 |
| 865 | S324 | 585 | 130 | 15x110 |
| 866 | S325 | 570 | 270 | 15x110 |
| 867 | S326 | 555 | 130 | 15x110 |
| 868 | S327 | 540 | 270 | 15x110 |
| 869 | S328 | 525 | 130 | 15x110 |
| 870 | S329 | 510 | 270 | 15x110 |
| 871 | S330 | 495 | 130 | 15x110 |
| 872 | S331 | 480 | 270 | 15x110 |
| 873 | S332 | 465 | 130 | 15x110 |
| 874 | S333 | 450 | 270 | 15x110 |
| 875 | S334 | 435 | 130 | 15x110 |
| 876 | S335 | 420 | 270 | 15x110 |
| 877 | S336 | 405 | 130 | 15x110 |
| 878 | S337 | 390 | 270 | 15x110 |
| 879 | S338 | 375 | 130 | 15x110 |
| 880 | S339 | 360 | 270 | 15x110 |
| 881 | S340 | 345 | 130 | 15x110 |
| 882 | S341 | 330 | 270 | 15x110 |
| 883 | S342 | 315 | 130 | 15x110 |
| 884 | S343 | 300 | 270 | 15x110 |
| 885 | S344 | 285 | 130 | 15x110 |
| 886 | S345 | 270 | 270 | 15x110 |
| 887 | S346 | 255 | 130 | 15x110 |
| 888 | S347 | 240 | 270 | 15x110 |
| 889 | S348 | 225 | 130 | 15x110 |
| 890 | S349 | 210 | 270 | 15x110 |
| 891 | S350 | 195 | 130 | 15x110 |
| 892 | S351 | 180 | 270 | 15x110 |
| 893 | S352 | 165 | 130 | 15x110 |
| 894 | S353 | 150 | 270 | 15x110 |
| 895 | S354 | 135 | 130 | 15x110 |
| 896 | S355 | 120 | 270 | 15x110 |
| 897 | S356 | 105 | 130 | 15x110 |
| 898 | S357 | 90 | 270 | 15x110 |
| 899 | S358 | 75 | 130 | 15x110 |
| 900 | S359 | 60 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 901 | S360 | 45 | 130 | 15x110 |
| 902 | DUMMY | 30 | 270 | 15x110 |
| 903 | DUMMY | 15 | 130 | 15x110 |
| 904 | DUMMY | 0 | 270 | 15x110 |
| 905 | DUMMY | -15 | 130 | 15x110 |
| 906 | DUMMY | -30 | 270 | 15x110 |
| 907 | S361 | -45 | 130 | 15x110 |
| 908 | S362 | -60 | 270 | 15x110 |
| 909 | S363 | -75 | 130 | 15x110 |
| 910 | S364 | -90 | 270 | 15x110 |
| 911 | S365 | -105 | 130 | 15x110 |
| 912 | S366 | -120 | 270 | 15x110 |
| 913 | S367 | -135 | 130 | 15x110 |
| 914 | S368 | -150 | 270 | 15x110 |
| 915 | S369 | -165 | 130 | 15x110 |
| 916 | S370 | -180 | 270 | 15x110 |
| 917 | S371 | -195 | 130 | 15x110 |
| 918 | S372 | -210 | 270 | 15x110 |
| 919 | S373 | -225 | 130 | 15x110 |
| 920 | S374 | -240 | 270 | 15x110 |
| 921 | S375 | -255 | 130 | 15x110 |
| 922 | S376 | -270 | 270 | 15x110 |
| 923 | S377 | -285 | 130 | 15x110 |
| 924 | S378 | -300 | 270 | 15x110 |
| 925 | S379 | -315 | 130 | 15x110 |
| 926 | S380 | -330 | 270 | 15x110 |
| 927 | S381 | -345 | 130 | 15x110 |
| 928 | S382 | -360 | 270 | 15x110 |
| 929 | S383 | -375 | 130 | 15x110 |
| 930 | S384 | -390 | 270 | 15x110 |
| 931 | S385 | -405 | 130 | 15x110 |
| 932 | S386 | -420 | 270 | 15x110 |
| 933 | S387 | -435 | 130 | 15x110 |
| 934 | S388 | -450 | 270 | 15x110 |
| 935 | S389 | -465 | 130 | 15x110 |
| 936 | S390 | -480 | 270 | 15x110 |
| 937 | S391 | -495 | 130 | 15x110 |
| 938 | S392 | -510 | 270 | 15x110 |
| 939 | S393 | -525 | 130 | 15x110 |
| 940 | S394 | -540 | 270 | 15x110 |
| 941 | S395 | -555 | 130 | 15x110 |
| 942 | S396 | -570 | 270 | 15x110 |
| 943 | S397 | -585 | 130 | 15x110 |
| 944 | S398 | -600 | 270 | 15x110 |
| 945 | S399 | -615 | 130 | 15x110 |
| 946 | S400 | -630 | 270 | 15x110 |
| 947 | S401 | -645 | 130 | 15x110 |
| 948 | S402 | -660 | 270 | 15x110 |
| 949 | S403 | -675 | 130 | 15x110 |
| 950 | S404 | -690 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 951 | S405 | -705 | 130 | 15x110 |
| 952 | S406 | -720 | 270 | 15x110 |
| 953 | S407 | -735 | 130 | 15x110 |
| 954 | S408 | -750 | 270 | 15x110 |
| 955 | S409 | -765 | 130 | 15x110 |
| 956 | S410 | -780 | 270 | 15x110 |
| 957 | S411 | -795 | 130 | 15x110 |
| 958 | S412 | -810 | 270 | 15x110 |
| 959 | S413 | -825 | 130 | 15x110 |
| 960 | S414 | -840 | 270 | 15x110 |
| 961 | S415 | -855 | 130 | 15x110 |
| 962 | S416 | -870 | 270 | 15x110 |
| 963 | S417 | -885 | 130 | 15x110 |
| 964 | S418 | -900 | 270 | 15x110 |
| 965 | S419 | -915 | 130 | 15x110 |
| 966 | S420 | -930 | 270 | 15x110 |
| 967 | S421 | -945 | 130 | 15x110 |
| 968 | S422 | -960 | 270 | 15x110 |
| 969 | S423 | -975 | 130 | 15x110 |
| 970 | S424 | -990 | 270 | 15x110 |
| 971 | S425 | -1005 | 130 | 15x110 |
| 972 | S426 | -1020 | 270 | 15x110 |
| 973 | S427 | -1035 | 130 | 15x110 |
| 974 | S428 | -1050 | 270 | 15x110 |
| 975 | S429 | -1065 | 130 | 15x110 |
| 976 | S430 | -1080 | 270 | 15x110 |
| 977 | S431 | -1095 | 130 | 15x110 |
| 978 | S432 | -1110 | 270 | 15x110 |
| 979 | S433 | -1125 | 130 | 15x110 |
| 980 | S434 | -1140 | 270 | 15x110 |
| 981 | S435 | -1155 | 130 | 15x110 |
| 982 | S436 | -1170 | 270 | 15x110 |
| 983 | S437 | -1185 | 130 | 15x110 |
| 984 | S438 | -1200 | 270 | 15x110 |
| 985 | S439 | -1215 | 130 | 15x110 |
| 986 | S440 | -1230 | 270 | 15x110 |
| 987 | S441 | -1245 | 130 | 15x110 |
| 988 | S442 | -1260 | 270 | 15x110 |
| 989 | S443 | -1275 | 130 | 15x110 |
| 990 | S444 | -1290 | 270 | 15x110 |
| 991 | S445 | -1305 | 130 | 15x110 |
| 992 | S446 | -1320 | 270 | 15x110 |
| 993 | S447 | -1335 | 130 | 15x110 |
| 994 | S448 | -1350 | 270 | 15x110 |
| 995 | S449 | -1365 | 130 | 15x110 |
| 996 | S450 | -1380 | 270 | 15x110 |
| 997 | S451 | -1395 | 130 | 15x110 |
| 998 | S452 | -1410 | 270 | 15x110 |
| 999 | S453 | -1425 | 130 | 15x110 |
| 1000 | S454 | -1440 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1001 | S455 | -1455 | 130 | 15x110 |
| 1002 | S456 | -1470 | 270 | 15x110 |
| 1003 | S457 | -1485 | 130 | 15x110 |
| 1004 | S458 | -1500 | 270 | 15x110 |
| 1005 | S459 | -1515 | 130 | 15x110 |
| 1006 | S460 | -1530 | 270 | 15x110 |
| 1007 | S461 | -1545 | 130 | 15x110 |
| 1008 | S462 | -1560 | 270 | 15x110 |
| 1009 | S463 | -1575 | 130 | 15x110 |
| 1010 | S464 | -1590 | 270 | 15x110 |
| 1011 | S465 | -1605 | 130 | 15x110 |
| 1012 | S466 | -1620 | 270 | 15x110 |
| 1013 | S467 | -1635 | 130 | 15x110 |
| 1014 | S468 | -1650 | 270 | 15x110 |
| 1015 | S469 | -1665 | 130 | 15x110 |
| 1016 | S470 | -1680 | 270 | 15x110 |
| 1017 | S471 | -1695 | 130 | 15x110 |
| 1018 | S472 | -1710 | 270 | 15x110 |
| 1019 | S473 | -1725 | 130 | 15x110 |
| 1020 | S474 | -1740 | 270 | 15x110 |
| 1021 | S475 | -1755 | 130 | 15x110 |
| 1022 | S476 | -1770 | 270 | 15x110 |
| 1023 | S477 | -1785 | 130 | 15x110 |
| 1024 | S478 | -1800 | 270 | 15x110 |
| 1025 | S479 | -1815 | 130 | 15x110 |
| 1026 | S480 | -1830 | 270 | 15x110 |
| 1027 | S481 | -1845 | 130 | 15x110 |
| 1028 | S482 | -1860 | 270 | 15x110 |
| 1029 | S483 | -1875 | 130 | 15x110 |
| 1030 | S484 | -1890 | 270 | 15x110 |
| 1031 | S485 | -1905 | 130 | 15x110 |
| 1032 | S486 | -1920 | 270 | 15x110 |
| 1033 | S487 | -1935 | 130 | 15x110 |
| 1034 | S488 | -1950 | 270 | 15x110 |
| 1035 | S489 | -1965 | 130 | 15x110 |
| 1036 | S490 | -1980 | 270 | 15x110 |
| 1037 | S491 | -1995 | 130 | 15x110 |
| 1038 | S492 | -2010 | 270 | 15x110 |
| 1039 | S493 | -2025 | 130 | 15x110 |
| 1040 | S494 | -2040 | 270 | 15x110 |
| 1041 | S495 | -2055 | 130 | 15x110 |
| 1042 | S496 | -2070 | 270 | 15x110 |
| 1043 | S497 | -2085 | 130 | 15x110 |
| 1044 | S498 | -2100 | 270 | 15x110 |
| 1045 | S499 | -2115 | 130 | 15x110 |
| 1046 | S500 | -2130 | 270 | 15x110 |
| 1047 | S501 | -2145 | 130 | 15x110 |
| 1048 | S502 | -2160 | 270 | 15x110 |
| 1049 | S503 | -2175 | 130 | 15x110 |
| 1050 | S504 | -2190 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1051 | S505 | -2205 | 130 | 15x110 |
| 1052 | S506 | -2220 | 270 | 15x110 |
| 1053 | S507 | -2235 | 130 | 15x110 |
| 1054 | S508 | -2250 | 270 | 15x110 |
| 1055 | S509 | -2265 | 130 | 15x110 |
| 1056 | S510 | -2280 | 270 | 15x110 |
| 1057 | S511 | -2295 | 130 | 15x110 |
| 1058 | S512 | -2310 | 270 | 15x110 |
| 1059 | S513 | -2325 | 130 | 15x110 |
| 1060 | S514 | -2340 | 270 | 15x110 |
| 1061 | S515 | -2355 | 130 | 15x110 |
| 1062 | S516 | -2370 | 270 | 15x110 |
| 1063 | S517 | -2385 | 130 | 15x110 |
| 1064 | S518 | -2400 | 270 | 15x110 |
| 1065 | S519 | -2415 | 130 | 15x110 |
| 1066 | S520 | -2430 | 270 | 15x110 |
| 1067 | S521 | -2445 | 130 | 15x110 |
| 1068 | S522 | -2460 | 270 | 15x110 |
| 1069 | S523 | -2475 | 130 | 15x110 |
| 1070 | S524 | -2490 | 270 | 15x110 |
| 1071 | S525 | -2505 | 130 | 15x110 |
| 1072 | S526 | -2520 | 270 | 15x110 |
| 1073 | S527 | -2535 | 130 | 15x110 |
| 1074 | S528 | -2550 | 270 | 15x110 |
| 1075 | S529 | -2565 | 130 | 15x110 |
| 1076 | S530 | -2580 | 270 | 15x110 |
| 1077 | S531 | -2595 | 130 | 15x110 |
| 1078 | S532 | -2610 | 270 | 15x110 |
| 1079 | S533 | -2625 | 130 | 15x110 |
| 1080 | S534 | -2640 | 270 | 15x110 |
| 1081 | S535 | -2655 | 130 | 15x110 |
| 1082 | S536 | -2670 | 270 | 15x110 |
| 1083 | S537 | -2685 | 130 | 15x110 |
| 1084 | S538 | -2700 | 270 | 15x110 |
| 1085 | S539 | -2715 | 130 | 15x110 |
| 1086 | S540 | -2730 | 270 | 15x110 |
| 1087 | S541 | -2745 | 130 | 15x110 |
| 1088 | S542 | -2760 | 270 | 15x110 |
| 1089 | S543 | -2775 | 130 | 15x110 |
| 1090 | S544 | -2790 | 270 | 15x110 |
| 1091 | S545 | -2805 | 130 | 15x110 |
| 1092 | S546 | -2820 | 270 | 15x110 |
| 1093 | S547 | -2835 | 130 | 15x110 |
| 1094 | S548 | -2850 | 270 | 15x110 |
| 1095 | S549 | -2865 | 130 | 15x110 |
| 1096 | S550 | -2880 | 270 | 15x110 |
| 1097 | S551 | -2895 | 130 | 15x110 |
| 1098 | S552 | -2910 | 270 | 15x110 |
| 1099 | S553 | -2925 | 130 | 15x110 |
| 1100 | S554 | -2940 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1101 | S555 | -2955 | 130 | 15x110 |
| 1102 | S556 | -2970 | 270 | 15x110 |
| 1103 | S557 | -2985 | 130 | 15x110 |
| 1104 | S558 | -3000 | 270 | 15x110 |
| 1105 | S559 | -3015 | 130 | 15x110 |
| 1106 | S560 | -3030 | 270 | 15x110 |
| 1107 | S561 | -3045 | 130 | 15x110 |
| 1108 | S562 | -3060 | 270 | 15x110 |
| 1109 | S563 | -3075 | 130 | 15x110 |
| 1110 | S564 | -3090 | 270 | 15x110 |
| 1111 | S565 | -3105 | 130 | 15x110 |
| 1112 | S566 | -3120 | 270 | 15x110 |
| 1113 | S567 | -3135 | 130 | 15x110 |
| 1114 | S568 | -3150 | 270 | 15x110 |
| 1115 | S569 | -3165 | 130 | 15x110 |
| 1116 | S570 | -3180 | 270 | 15x110 |
| 1117 | S571 | -3195 | 130 | 15x110 |
| 1118 | S572 | -3210 | 270 | 15x110 |
| 1119 | S573 | -3225 | 130 | 15x110 |
| 1120 | S574 | -3240 | 270 | 15x110 |
| 1121 | S575 | -3255 | 130 | 15x110 |
| 1122 | S576 | -3270 | 270 | 15x110 |
| 1123 | S577 | -3285 | 130 | 15x110 |
| 1124 | S578 | -3300 | 270 | 15x110 |
| 1125 | S579 | -3315 | 130 | 15x110 |
| 1126 | S580 | -3330 | 270 | 15x110 |
| 1127 | S581 | -3345 | 130 | 15x110 |
| 1128 | S582 | -3360 | 270 | 15x110 |
| 1129 | S583 | -3375 | 130 | 15x110 |
| 1130 | S584 | -3390 | 270 | 15x110 |
| 1131 | S585 | -3405 | 130 | 15x110 |
| 1132 | S586 | -3420 | 270 | 15x110 |
| 1133 | S587 | -3435 | 130 | 15x110 |
| 1134 | S588 | -3450 | 270 | 15x110 |
| 1135 | S589 | -3465 | 130 | 15x110 |
| 1136 | S590 | -3480 | 270 | 15x110 |
| 1137 | S591 | -3495 | 130 | 15x110 |
| 1138 | S592 | -3510 | 270 | 15x110 |
| 1139 | S593 | -3525 | 130 | 15x110 |
| 1140 | S594 | -3540 | 270 | 15x110 |
| 1141 | S595 | -3555 | 130 | 15x110 |
| 1142 | S596 | -3570 | 270 | 15x110 |
| 1143 | S597 | -3585 | 130 | 15x110 |
| 1144 | S598 | -3600 | 270 | 15x110 |
| 1145 | S599 | -3615 | 130 | 15x110 |
| 1146 | S600 | -3630 | 270 | 15x110 |
| 1147 | S601 | -3645 | 130 | 15x110 |
| 1148 | S602 | -3660 | 270 | 15x110 |
| 1149 | S603 | -3675 | 130 | 15x110 |
| 1150 | S604 | -3690 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1151 | S605 | -3705 | 130 | 15x110 |
| 1152 | S606 | -3720 | 270 | 15x110 |
| 1153 | S607 | -3735 | 130 | 15x110 |
| 1154 | S608 | -3750 | 270 | 15x110 |
| 1155 | S609 | -3765 | 130 | 15x110 |
| 1156 | S610 | -3780 | 270 | 15x110 |
| 1157 | S611 | -3795 | 130 | 15x110 |
| 1158 | S612 | -3810 | 270 | 15x110 |
| 1159 | S613 | -3825 | 130 | 15x110 |
| 1160 | S614 | -3840 | 270 | 15x110 |
| 1161 | S615 | -3855 | 130 | 15x110 |
| 1162 | S616 | -3870 | 270 | 15x110 |
| 1163 | S617 | -3885 | 130 | 15x110 |
| 1164 | S618 | -3900 | 270 | 15x110 |
| 1165 | S619 | -3915 | 130 | 15x110 |
| 1166 | S620 | -3930 | 270 | 15x110 |
| 1167 | S621 | -3945 | 130 | 15x110 |
| 1168 | S622 | -3960 | 270 | 15x110 |
| 1169 | S623 | -3975 | 130 | 15x110 |
| 1170 | S624 | -3990 | 270 | 15x110 |
| 1171 | S625 | -4005 | 130 | 15x110 |
| 1172 | S626 | -4020 | 270 | 15x110 |
| 1173 | S627 | -4035 | 130 | 15x110 |
| 1174 | S628 | -4050 | 270 | 15x110 |
| 1175 | S629 | -4065 | 130 | 15x110 |
| 1176 | S630 | -4080 | 270 | 15x110 |
| 1177 | S631 | -4095 | 130 | 15x110 |
| 1178 | S632 | -4110 | 270 | 15x110 |
| 1179 | S633 | -4125 | 130 | 15x110 |
| 1180 | S634 | -4140 | 270 | 15x110 |
| 1181 | S635 | -4155 | 130 | 15x110 |
| 1182 | S636 | -4170 | 270 | 15x110 |
| 1183 | S637 | -4185 | 130 | 15x110 |
| 1184 | S638 | -4200 | 270 | 15x110 |
| 1185 | S639 | -4215 | 130 | 15x110 |
| 1186 | S640 | -4230 | 270 | 15x110 |
| 1187 | S641 | -4245 | 130 | 15x110 |
| 1188 | S642 | -4260 | 270 | 15x110 |
| 1189 | S643 | -4275 | 130 | 15x110 |
| 1190 | S644 | -4290 | 270 | 15x110 |
| 1191 | S645 | -4305 | 130 | 15x110 |
| 1192 | S646 | -4320 | 270 | 15x110 |
| 1193 | S647 | -4335 | 130 | 15x110 |
| 1194 | S648 | -4350 | 270 | 15x110 |
| 1195 | S649 | -4365 | 130 | 15x110 |
| 1196 | S650 | -4380 | 270 | 15x110 |
| 1197 | S651 | -4395 | 130 | 15x110 |
| 1198 | S652 | -4410 | 270 | 15x110 |
| 1199 | S653 | -4425 | 130 | 15x110 |
| 1200 | S654 | -4440 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1201 | S655 | -4455 | 130 | 15x110 |
| 1202 | S656 | -4470 | 270 | 15x110 |
| 1203 | S657 | -4485 | 130 | 15x110 |
| 1204 | S658 | -4500 | 270 | 15x110 |
| 1205 | S659 | -4515 | 130 | 15x110 |
| 1206 | S660 | -4530 | 270 | 15x110 |
| 1207 | S661 | -4545 | 130 | 15x110 |
| 1208 | S662 | -4560 | 270 | 15x110 |
| 1209 | S663 | -4575 | 130 | 15x110 |
| 1210 | S664 | -4590 | 270 | 15x110 |
| 1211 | S665 | -4605 | 130 | 15x110 |
| 1212 | S666 | -4620 | 270 | 15x110 |
| 1213 | S667 | -4635 | 130 | 15x110 |
| 1214 | S668 | -4650 | 270 | 15x110 |
| 1215 | S669 | -4665 | 130 | 15x110 |
| 1216 | S670 | -4680 | 270 | 15x110 |
| 1217 | S671 | -4695 | 130 | 15x110 |
| 1218 | S672 | -4710 | 270 | 15x110 |
| 1219 | S673 | -4725 | 130 | 15x110 |
| 1220 | S674 | -4740 | 270 | 15x110 |
| 1221 | S675 | -4755 | 130 | 15x110 |
| 1222 | S676 | -4770 | 270 | 15x110 |
| 1223 | S677 | -4785 | 130 | 15x110 |
| 1224 | S678 | -4800 | 270 | 15x110 |
| 1225 | S679 | -4815 | 130 | 15x110 |
| 1226 | S680 | -4830 | 270 | 15x110 |
| 1227 | S681 | -4845 | 130 | 15x110 |
| 1228 | S682 | -4860 | 270 | 15x110 |
| 1229 | S683 | -4875 | 130 | 15x110 |
| 1230 | S684 | -4890 | 270 | 15x110 |
| 1231 | S685 | -4905 | 130 | 15x110 |
| 1232 | S686 | -4920 | 270 | 15x110 |
| 1233 | S687 | -4935 | 130 | 15x110 |
| 1234 | S688 | -4950 | 270 | 15x110 |
| 1235 | S689 | -4965 | 130 | 15x110 |
| 1236 | S690 | -4980 | 270 | 15x110 |
| 1237 | S691 | -4995 | 130 | 15x110 |
| 1238 | S692 | -5010 | 270 | 15x110 |
| 1239 | S693 | -5025 | 130 | 15x110 |
| 1240 | S694 | -5040 | 270 | 15x110 |
| 1241 | S695 | -5055 | 130 | 15x110 |
| 1242 | S696 | -5070 | 270 | 15x110 |
| 1243 | S697 | -5085 | 130 | 15x110 |
| 1244 | S698 | -5100 | 270 | 15x110 |
| 1245 | S699 | -5115 | 130 | 15x110 |
| 1246 | S700 | -5130 | 270 | 15x110 |
| 1247 | S701 | -5145 | 130 | 15x110 |
| 1248 | S702 | -5160 | 270 | 15x110 |
| 1249 | S703 | -5175 | 130 | 15x110 |
| 1250 | S704 | -5190 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1251 | S705 | -5205 | 130 | 15x110 |
| 1252 | S706 | -5220 | 270 | 15x110 |
| 1253 | S707 | -5235 | 130 | 15x110 |
| 1254 | S708 | -5250 | 270 | 15x110 |
| 1255 | S709 | -5265 | 130 | 15x110 |
| 1256 | S710 | -5280 | 270 | 15x110 |
| 1257 | S711 | -5295 | 130 | 15x110 |
| 1258 | S712 | -5310 | 270 | 15x110 |
| 1259 | S713 | -5325 | 130 | 15x110 |
| 1260 | S714 | -5340 | 270 | 15x110 |
| 1261 | S715 | -5355 | 130 | 15x110 |
| 1262 | S716 | -5370 | 270 | 15x110 |
| 1263 | S717 | -5385 | 130 | 15x110 |
| 1264 | S718 | -5400 | 270 | 15x110 |
| 1265 | S719 | -5415 | 130 | 15x110 |
| 1266 | S720 | -5430 | 270 | 15x110 |
| 1267 | DUMMY | -5445 | 130 | 15x110 |
| 1268 | PLT1 | -5460 | 270 | 15x110 |
| 1269 | PLT2 | -5475 | 130 | 15x110 |
| 1270 | PLT3 | -5490 | 270 | 15x110 |
| 1271 | PLT4 | -5505 | 130 | 15x110 |
| 1272 | DUMMY | -5520 | 270 | 15x110 |
| 1273 | G543 | -5535 | 130 | 15x110 |
| 1274 | G541 | -5550 | 270 | 15x110 |
| 1275 | G539 | -5565 | 130 | 15x110 |
| 1276 | G537 | -5580 | 270 | 15x110 |
| 1277 | G535 | -5595 | 130 | 15x110 |
| 1278 | G533 | -5610 | 270 | 15x110 |
| 1279 | G531 | -5625 | 130 | 15x110 |
| 1280 | G529 | -5640 | 270 | 15x110 |
| 1281 | G527 | -5655 | 130 | 15x110 |
| 1282 | G525 | -5670 | 270 | 15x110 |
| 1283 | G523 | -5685 | 130 | 15x110 |
| 1284 | G521 | -5700 | 270 | 15x110 |
| 1285 | G519 | -5715 | 130 | 15x110 |
| 1286 | G517 | -5730 | 270 | 15x110 |
| 1287 | G515 | -5745 | 130 | 15x110 |
| 1288 | G513 | -5760 | 270 | 15x110 |
| 1289 | G511 | -5775 | 130 | 15x110 |
| 1290 | G509 | -5790 | 270 | 15x110 |
| 1291 | G507 | -5805 | 130 | 15x110 |
| 1292 | G505 | -5820 | 270 | 15x110 |
| 1293 | G503 | -5835 | 130 | 15x110 |
| 1294 | G501 | -5850 | 270 | 15x110 |
| 1295 | G499 | -5865 | 130 | 15x110 |
| 1296 | G497 | -5880 | 270 | 15x110 |
| 1297 | G495 | -5895 | 130 | 15x110 |
| 1298 | G493 | -5910 | 270 | 15x110 |
| 1299 | G491 | -5925 | 130 | 15x110 |
| 1300 | G489 | -5940 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1301 | G487 | -5955 | 130 | 15x110 |
| 1302 | G485 | -5970 | 270 | 15x110 |
| 1303 | G483 | -5985 | 130 | 15x110 |
| 1304 | G481 | -6000 | 270 | 15x110 |
| 1305 | G479 | -6015 | 130 | 15x110 |
| 1306 | G477 | -6030 | 270 | 15x110 |
| 1307 | G475 | -6045 | 130 | 15x110 |
| 1308 | G473 | -6060 | 270 | 15x110 |
| 1309 | G471 | -6075 | 130 | 15x110 |
| 1310 | G469 | -6090 | 270 | 15x110 |
| 1311 | G467 | -6105 | 130 | 15x110 |
| 1312 | G465 | -6120 | 270 | 15x110 |
| 1313 | G463 | -6135 | 130 | 15x110 |
| 1314 | G461 | -6150 | 270 | 15x110 |
| 1315 | G459 | -6165 | 130 | 15x110 |
| 1316 | G457 | -6180 | 270 | 15x110 |
| 1317 | G455 | -6195 | 130 | 15x110 |
| 1318 | G453 | -6210 | 270 | 15x110 |
| 1319 | G451 | -6225 | 130 | 15x110 |
| 1320 | G449 | -6240 | 270 | 15x110 |
| 1321 | G447 | -6255 | 130 | 15x110 |
| 1322 | G445 | -6270 | 270 | 15x110 |
| 1323 | G443 | -6285 | 130 | 15x110 |
| 1324 | G441 | -6300 | 270 | 15x110 |
| 1325 | G439 | -6315 | 130 | 15x110 |
| 1326 | G437 | -6330 | 270 | 15x110 |
| 1327 | G435 | -6345 | 130 | 15x110 |
| 1328 | G433 | -6360 | 270 | 15x110 |
| 1329 | G431 | -6375 | 130 | 15x110 |
| 1330 | G429 | -6390 | 270 | 15x110 |
| 1331 | G427 | -6405 | 130 | 15x110 |
| 1332 | G425 | -6420 | 270 | 15x110 |
| 1333 | G423 | -6435 | 130 | 15x110 |
| 1334 | G421 | -6450 | 270 | 15x110 |
| 1335 | G419 | -6465 | 130 | 15x110 |
| 1336 | G417 | -6480 | 270 | 15x110 |
| 1337 | G415 | -6495 | 130 | 15x110 |
| 1338 | G413 | -6510 | 270 | 15x110 |
| 1339 | G411 | -6525 | 130 | 15x110 |
| 1340 | G409 | -6540 | 270 | 15x110 |
| 1341 | G407 | -6555 | 130 | 15x110 |
| 1342 | G405 | -6570 | 270 | 15x110 |
| 1343 | G403 | -6585 | 130 | 15x110 |
| 1344 | G401 | -6600 | 270 | 15x110 |
| 1345 | G399 | -6615 | 130 | 15x110 |
| 1346 | G397 | -6630 | 270 | 15x110 |
| 1347 | G395 | -6645 | 130 | 15x110 |
| 1348 | G393 | -6660 | 270 | 15x110 |
| 1349 | G391 | -6675 | 130 | 15x110 |
| 1350 | G389 | -6690 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1351 | G387 | -6705 | 130 | 15x110 |
| 1352 | G385 | -6720 | 270 | 15x110 |
| 1353 | G383 | -6735 | 130 | 15x110 |
| 1354 | G381 | -6750 | 270 | 15x110 |
| 1355 | G379 | -6765 | 130 | 15x110 |
| 1356 | G377 | -6780 | 270 | 15x110 |
| 1357 | G375 | -6795 | 130 | 15x110 |
| 1358 | G373 | -6810 | 270 | 15x110 |
| 1359 | G371 | -6825 | 130 | 15x110 |
| 1360 | G369 | -6840 | 270 | 15x110 |
| 1361 | G367 | -6855 | 130 | 15x110 |
| 1362 | G365 | -6870 | 270 | 15x110 |
| 1363 | G363 | -6885 | 130 | 15x110 |
| 1364 | G361 | -6900 | 270 | 15x110 |
| 1365 | G359 | -6915 | 130 | 15x110 |
| 1366 | G357 | -6930 | 270 | 15x110 |
| 1367 | G355 | -6945 | 130 | 15x110 |
| 1368 | G353 | -6960 | 270 | 15x110 |
| 1369 | G351 | -6975 | 130 | 15x110 |
| 1370 | G349 | -6990 | 270 | 15x110 |
| 1371 | G347 | -7005 | 130 | 15x110 |
| 1372 | G345 | -7020 | 270 | 15x110 |
| 1373 | G343 | -7035 | 130 | 15x110 |
| 1374 | G341 | -7050 | 270 | 15x110 |
| 1375 | G339 | -7065 | 130 | 15x110 |
| 1376 | G337 | -7080 | 270 | 15x110 |
| 1377 | G335 | -7095 | 130 | 15x110 |
| 1378 | G333 | -7110 | 270 | 15x110 |
| 1379 | G331 | -7125 | 130 | 15x110 |
| 1380 | G329 | -7140 | 270 | 15x110 |
| 1381 | G327 | -7155 | 130 | 15x110 |
| 1382 | G325 | -7170 | 270 | 15x110 |
| 1383 | G323 | -7185 | 130 | 15x110 |
| 1384 | G321 | -7200 | 270 | 15x110 |
| 1385 | G319 | -7215 | 130 | 15x110 |
| 1386 | G317 | -7230 | 270 | 15x110 |
| 1387 | G315 | -7245 | 130 | 15x110 |
| 1388 | G313 | -7260 | 270 | 15x110 |
| 1389 | G311 | -7275 | 130 | 15x110 |
| 1390 | G309 | -7290 | 270 | 15x110 |
| 1391 | G307 | -7305 | 130 | 15x110 |
| 1392 | G305 | -7320 | 270 | 15x110 |
| 1393 | G303 | -7335 | 130 | 15x110 |
| 1394 | G301 | -7350 | 270 | 15x110 |
| 1395 | G299 | -7365 | 130 | 15x110 |
| 1396 | G297 | -7380 | 270 | 15x110 |
| 1397 | G295 | -7395 | 130 | 15x110 |
| 1398 | G293 | -7410 | 270 | 15x110 |
| 1399 | G291 | -7425 | 130 | 15x110 |
| 1400 | G289 | -7440 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1401 | G287 | -7455 | 130 | 15x110 |
| 1402 | G285 | -7470 | 270 | 15x110 |
| 1403 | G283 | -7485 | 130 | 15x110 |
| 1404 | G281 | -7500 | 270 | 15x110 |
| 1405 | G279 | -7515 | 130 | 15x110 |
| 1406 | G277 | -7530 | 270 | 15x110 |
| 1407 | G275 | -7545 | 130 | 15x110 |
| 1408 | G273 | -7560 | 270 | 15x110 |
| 1409 | G271 | -7575 | 130 | 15x110 |
| 1410 | G269 | -7590 | 270 | 15x110 |
| 1411 | G267 | -7605 | 130 | 15x110 |
| 1412 | G265 | -7620 | 270 | 15x110 |
| 1413 | G263 | -7635 | 130 | 15x110 |
| 1414 | G261 | -7650 | 270 | 15x110 |
| 1415 | G259 | -7665 | 130 | 15x110 |
| 1416 | G257 | -7680 | 270 | 15x110 |
| 1417 | G255 | -7695 | 130 | 15x110 |
| 1418 | G253 | -7710 | 270 | 15x110 |
| 1419 | G251 | -7725 | 130 | 15x110 |
| 1420 | G249 | -7740 | 270 | 15x110 |
| 1421 | G247 | -7755 | 130 | 15x110 |
| 1422 | G245 | -7770 | 270 | 15x110 |
| 1423 | G243 | -7785 | 130 | 15x110 |
| 1424 | G241 | -7800 | 270 | 15x110 |
| 1425 | G239 | -7815 | 130 | 15x110 |
| 1426 | G237 | -7830 | 270 | 15x110 |
| 1427 | G235 | -7845 | 130 | 15x110 |
| 1428 | G233 | -7860 | 270 | 15x110 |
| 1429 | G231 | -7875 | 130 | 15x110 |
| 1430 | G229 | -7890 | 270 | 15x110 |
| 1431 | G227 | -7905 | 130 | 15x110 |
| 1432 | G225 | -7920 | 270 | 15x110 |
| 1433 | G223 | -7935 | 130 | 15x110 |
| 1434 | G221 | -7950 | 270 | 15x110 |
| 1435 | G219 | -7965 | 130 | 15x110 |
| 1436 | G217 | -7980 | 270 | 15x110 |
| 1437 | G215 | -7995 | 130 | 15x110 |
| 1438 | G213 | -8010 | 270 | 15x110 |
| 1439 | G211 | -8025 | 130 | 15x110 |
| 1440 | G209 | -8040 | 270 | 15x110 |
| 1441 | G207 | -8055 | 130 | 15x110 |
| 1442 | G205 | -8070 | 270 | 15x110 |
| 1443 | G203 | -8085 | 130 | 15x110 |
| 1444 | G201 | -8100 | 270 | 15x110 |
| 1445 | G199 | -8115 | 130 | 15x110 |
| 1446 | G197 | -8130 | 270 | 15x110 |
| 1447 | G195 | -8145 | 130 | 15x110 |
| 1448 | G193 | -8160 | 270 | 15x110 |
| 1449 | G191 | -8175 | 130 | 15x110 |
| 1450 | G189 | -8190 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1451 | G187 | -8205 | 130 | 15x110 |
| 1452 | G185 | -8220 | 270 | 15x110 |
| 1453 | G183 | -8235 | 130 | 15x110 |
| 1454 | G181 | -8250 | 270 | 15x110 |
| 1455 | G179 | -8265 | 130 | 15x110 |
| 1456 | G177 | -8280 | 270 | 15x110 |
| 1457 | G175 | -8295 | 130 | 15x110 |
| 1458 | G173 | -8310 | 270 | 15x110 |
| 1459 | G171 | -8325 | 130 | 15x110 |
| 1460 | G169 | -8340 | 270 | 15x110 |
| 1461 | G167 | -8355 | 130 | 15x110 |
| 1462 | G165 | -8370 | 270 | 15x110 |
| 1463 | G163 | -8385 | 130 | 15x110 |
| 1464 | G161 | -8400 | 270 | 15x110 |
| 1465 | G159 | -8415 | 130 | 15x110 |
| 1466 | G157 | -8430 | 270 | 15x110 |
| 1467 | G155 | -8445 | 130 | 15x110 |
| 1468 | G153 | -8460 | 270 | 15x110 |
| 1469 | G151 | -8475 | 130 | 15x110 |
| 1470 | G149 | -8490 | 270 | 15x110 |
| 1471 | G147 | -8505 | 130 | 15x110 |
| 1472 | G145 | -8520 | 270 | 15x110 |
| 1473 | G143 | -8535 | 130 | 15x110 |
| 1474 | G141 | -8550 | 270 | 15x110 |
| 1475 | G139 | -8565 | 130 | 15x110 |
| 1476 | G137 | -8580 | 270 | 15x110 |
| 1477 | G135 | -8595 | 130 | 15x110 |
| 1478 | G133 | -8610 | 270 | 15x110 |
| 1479 | G131 | -8625 | 130 | 15x110 |
| 1480 | G129 | -8640 | 270 | 15x110 |
| 1481 | G127 | -8655 | 130 | 15x110 |
| 1482 | G125 | -8670 | 270 | 15x110 |
| 1483 | G123 | -8685 | 130 | 15x110 |
| 1484 | G121 | -8700 | 270 | 15x110 |
| 1485 | G119 | -8715 | 130 | 15x110 |
| 1486 | G117 | -8730 | 270 | 15x110 |
| 1487 | G115 | -8745 | 130 | 15x110 |
| 1488 | G113 | -8760 | 270 | 15x110 |
| 1489 | G111 | -8775 | 130 | 15x110 |
| 1490 | G109 | -8790 | 270 | 15x110 |
| 1491 | G107 | -8805 | 130 | 15x110 |
| 1492 | G105 | -8820 | 270 | 15x110 |
| 1493 | G103 | -8835 | 130 | 15x110 |
| 1494 | G101 | -8850 | 270 | 15x110 |
| 1495 | G99 | -8865 | 130 | 15x110 |
| 1496 | G97 | -8880 | 270 | 15x110 |
| 1497 | G95 | -8895 | 130 | 15x110 |
| 1498 | G93 | -8910 | 270 | 15x110 |
| 1499 | G91 | -8925 | 130 | 15x110 |
| 1500 | G89 | -8940 | 270 | 15x110 |

| No. | Name | X | Y | Bump Size |
|---|---|---|---|---|
| 1501 | G87 | -8955 | 130 | 15x110 |
| 1502 | G85 | -8970 | 270 | 15x110 |
| 1503 | G83 | -8985 | 130 | 15x110 |
| 1504 | G81 | -9000 | 270 | 15x110 |
| 1505 | G79 | -9015 | 130 | 15x110 |
| 1506 | G77 | -9030 | 270 | 15x110 |
| 1507 | G75 | -9045 | 130 | 15x110 |
| 1508 | G73 | -9060 | 270 | 15x110 |
| 1509 | G71 | -9075 | 130 | 15x110 |
| 1510 | G69 | -9090 | 270 | 15x110 |
| 1511 | G67 | -9105 | 130 | 15x110 |
| 1512 | G65 | -9120 | 270 | 15x110 |
| 1513 | G63 | -9135 | 130 | 15x110 |
| 1514 | G61 | -9150 | 270 | 15x110 |
| 1515 | G59 | -9165 | 130 | 15x110 |
| 1516 | G57 | -9180 | 270 | 15x110 |
| 1517 | G55 | -9195 | 130 | 15x110 |
| 1518 | G53 | -9210 | 270 | 15x110 |
| 1519 | G51 | -9225 | 130 | 15x110 |
| 1520 | G49 | -9240 | 270 | 15x110 |
| 1521 | G47 | -9255 | 130 | 15x110 |
| 1522 | G45 | -9270 | 270 | 15x110 |
| 1523 | G43 | -9285 | 130 | 15x110 |
| 1524 | G41 | -9300 | 270 | 15x110 |
| 1525 | G39 | -9315 | 130 | 15x110 |
| 1526 | G37 | -9330 | 270 | 15x110 |
| 1527 | G35 | -9345 | 130 | 15x110 |
| 1528 | G33 | -9360 | 270 | 15x110 |
| 1529 | G31 | -9375 | 130 | 15x110 |
| 1530 | G29 | -9390 | 270 | 15x110 |
| 1531 | G27 | -9405 | 130 | 15x110 |
| 1532 | G25 | -9420 | 270 | 15x110 |
| 1533 | G23 | -9435 | 130 | 15x110 |
| 1534 | G21 | -9450 | 270 | 15x110 |
| 1535 | G19 | -9465 | 130 | 15x110 |
| 1536 | G17 | -9480 | 270 | 15x110 |
| 1537 | G15 | -9495 | 130 | 15x110 |
| 1538 | G13 | -9510 | 270 | 15x110 |
| 1539 | G11 | -9525 | 130 | 15x110 |
| 1540 | G9 | -9540 | 270 | 15x110 |
| 1541 | G7 | -9555 | 130 | 15x110 |
| 1542 | G5 | -9570 | 270 | 15x110 |
| 1543 | G3 | -9585 | 130 | 15x110 |
| 1544 | G1 | -9600 | 270 | 15x110 |
| 1545 | DUMMY | -9615 | 130 | 15x110 |
| 1546 | THROUGH7 | -9630 | 270 | 15x110 |
| 1547 | DUMMY | -9645 | 130 | 15x110 |
| 1548 | THROUGH8 | -9660 | 270 | 15x110 |
| 1549 | L_MARK | -9605 | -142.5 | NA |

# 6. Pin Description

| Pin name | I/O | Description |
|---|---|---|
| S[1:720] | O | Source driver output. |
| D27~D20<br>D17~D10<br>D07~D00 | I | Digital data input. Internally pulled low.<br>(a) PS=H (parallel RGB interface): Dx7~Dx0 are used.<br>(b) PS=L (serial RGB interface): only D07~D00 are used. |
| G[1:544] | O | Gate driver output. If RES=L, G481 ~ G544 are disabled. |
| LR | I | Shift direction selection signal. Internally pulled high. Shift direction of the internal shift register is controlled by this pin as shown below:<br>(a) LR=H: S1→S2 →• • •→S720<br>(b) LR=L: S720→S719→• • •→S1 |
| UD | I | Scan direction selection signal. Internally pulled high.<br>(a) UD=H: G1→G2 →• • •→G544<br>(b) UD=L: G544→G543 →• • •→G1 |
| CLK | I | Clock signal for data latching and internal counter of the timing controller. |
| CLK_TRG | I | Clock edge selection signal for the data sampling. Internally pulled high.<br>(a) CLK_TRG=H: Data sampling at the CLK falling edge.<br>(b) CLK_TRG=L: Data sampling at the CLK rising edge. |
| HS | I | Horizontal sync input with negative polarity. Internally pull high. |
| VS | I | Vertical sync input with negative polarity. Internally pull high. |
| DE | I | Input data enable control. Internally pulled low. |
| DISP | I | Display on/off mode control. Internally pulled high.<br>(a) DISP=L, standby mode.<br>(b) DISP=H, normal display mode. |
| RESETB | I | Active low global reset signal input. Internally pulled high. |
| PS | I | Input data format select signal. Internally pulled high.<br>(a) PS=H: Parallel RGB<br>(b) PS=L: Serial RGB |
| RES | I | Resolution select signal. Internally pulled high.<br>(a) RES=H: 480RGB x 272<br>(b) RES=L: 480RGB x 240 |
| NBW | I | LC type selection. Internally pulled high.<br>(a) NBW=H: Normally black LC.<br>(b) NBW=L: Normally white LC. |
| POL | O | Polarity signal to monitor VCOM signal. |
| PSHUT | I | Input pin to enable internal charge pump circuit. Internal pull high.<br>- Connect to VDDIO to enable internal charge pump VCL, VGH, VGL, VCIX2 and VCOM.<br>- Connect to DVSS to disable internal charge pump VGH, VGL, VCIX2 and VCOM. |
| CSB | I | Chip select pin of serial interface. Internal pull high.<br>- Leave it OPEN when not used (Refer to Serial Interface block) |
| SCL | I | Clock pin of serial interface. Internal pull high.<br>- Leave it OPEN when not used (Refer to Serial Interface block) |
| SDI | I | Data input pin in serial mode. Internal pull high.<br>- Leave it OPEN when not used (Refer to Serial Interface block) |
| SDO | O | Data output pin in serial mode.<br>- Leave it OPEN when not used (Refer to Serial Interface block) |

| Pin name | I/O | Description |
|---|---|---|
| VGR | O | Output pin of internal regulator circuit. |
| COMH | O | Output pin of regulator for COMMON output high level. |
| COML | O | Output pin of regulator for COMMON output low level. |
| COMPP | I | Adjust the amplitude voltage level for COMMON output. If not used, please leave it open. |
| COMC | I | Adjust the DC voltage level for COMMON output. If not used, please leave it open. |
| VCOM | O | This is output pin for COMMON signal of a TFT panel. |
| VDDIO | VI | Voltage input pin for I/O logic. |
| VCI | VI | Booster input voltage pin. |
| VCIP | VI | Voltage supply pin for analog circuit. This pin requires a noise free path for providing accurate LCD driving voltages. Can be connected to VCI on system board or FPC. |
| VDD | V | Internal regulator output voltage for logic circuit. Connect a capacitor for stabilization. |
| VCIX2 | V | Equal to 2 x VCI. Connect a capacitor for stabilization. |
| VCIX2J | V | This is the power supply used for analog blocks and VLCD/VDC regulation. |
| VLCD | V | Internal generated power for gamma circuit. Connect a capacitor for stabilization. |
| VDC | V | Power for reference voltage of VGH/VGL pumping. |
| VGH | V | Positive power pin for gate driver. |
| VGL | V | Negative power pin for gate driver. |
| VCL | V | Negative voltage of VCI. Connect a capacitor for stabilization. |
| C1AP/C1BP, C1N, C2P, C2N C3P, C3N C4P, C4N C5P, C5N CX1P, CX1N CX2P, CX2N | I | Connect 0.1uF capacitor between CnP and CnN pins. |
| DVSS | VI | Digital ground. |
| AVSS | VI | Analog ground. |
| VCHS | VI | Ground for booster circuit. |
| VSSRC | VI | Ground for analog circuit. This pin requires a noise free path for providing accurate LCD driving voltages. |
| EXVR | I | External reference of internal gamma resistor. |
| DRV1 | O | Power transistor gate signal for the boost converter 1. 1st PWM can be used for LED backlight power. |
| VFB1 | I | Main boost regulator feedback input 1. Connect feedback resistive divider to GND. If 1st PWM is not used, please connect VFB1 to GND. VFB1 default threshold is 1.0 V. |

| Pin name | I/O | Description |
|---|---|---|
| DRV2 | O | Power transistor gate signal for the boost converter 2. 2nd PWM can be used for generate VCIX2J power if needed. |
| VFB2 | I | Main boost regulator feedback input 2. Connect feedback resistive divider to GND. If 2nd PWM is not used, please connect VFB2 to GND. VFB2 default threshold is 1.0 V. |
| DU[4:0] | I | Set 1st PWM duty cycle for LED backlight. This setting is only effective when DUS bit = 1(R05h). If this function is not used, connect DU[4:0] to VDDIO or floating them. Internally pull high. |
| CPWM | O | Duty cycle control signal of CABC function output. |
| PSW | I | Internal switch input. This is used only for 2nd PWM (PWM B). If 2nd PWM is not used, please leave it open. |
| TEST1~10 | O | Test pins. Floating it on panel. |
| PRT1 | - | Dummy pads. These two pins are short circuited within the chip |
| PRB1 | | |
| PRT2 | - | Dummy pads. These two pins are short circuited within the chip |
| PRB2 | | |
| PRT3 | - | Dummy pads. These two pins are short circuited within the chip |
| PRB3 | | |
| PRT4 | - | Dummy pads. These two pins are short circuited within the chip |
| PRB4 | | |
| PLT1 | - | Dummy pads. These two pins are short circuited within the chip |
| PLB1 | | |
| PLT2 | - | Dummy pads. These two pins are short circuited within the chip |
| PLB2 | | |
| PLT3 | - | Dummy pads. These two pins are short circuited within the chip |
| PLB3 | | |
| PLT4 | - | Dummy pads. These two pins are short circuited within the chip |
| PLB4 | | |
| THROUGH5 | - | Dummy pads. Used to measure the COG contact resistance. These two pins are short circuited within the chip |
| THROUGH6 | | |
| THROUGH7 | - | Dummy pads. Used to measure the COG contact resistance. These two pins are short circuited within the chip |
| THROUGH8 | | |
| DUMMY | - | Dummy pins. Floating it on panel. |

# 7. Function Description

## 7.1 Power relationship

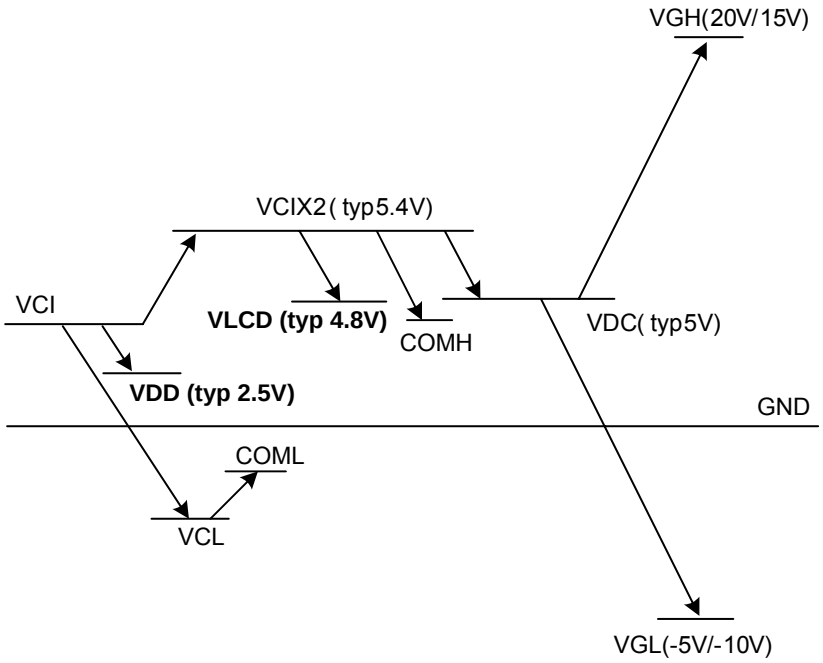



**Figure 7.1 Power Block**

You can get different VGH/VGL voltage by following different component configuration.

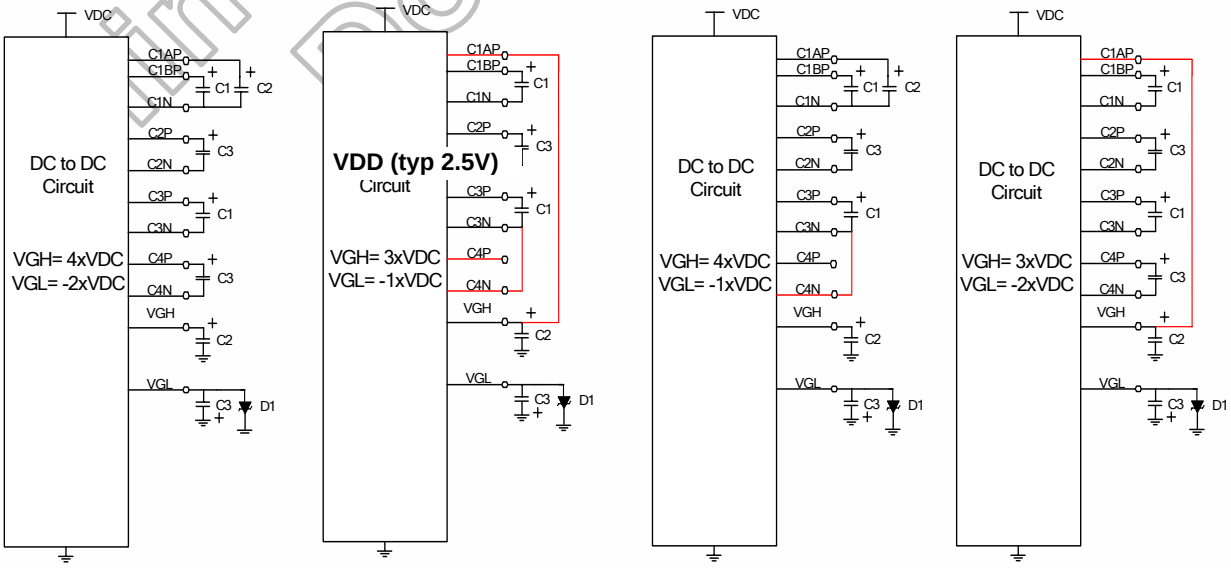



**Figure 7.2 VGH/VGL External Setting**

## 7.2 VCOM block

You can use internal circuit to generate COMPP and COMC voltage level. Register VDV[4:0] and VMC[4:0] are used to adjust COMPP and COMC voltage. If you want to set COMPP and COMC voltage level from external, just set VDV[4:0]=00000 and VMC[4:0]=00000. Then you can input COMPP and COMC from hardware pins. The HX8257-A has a regulator circuit for VGR output power level. Connect VGR with outside resistor strings. These resistor strings can generate COMPP and COMC voltage levels for internal VCOM generation circuit. VGR voltage level is 4.5V. (Typ.) If COMC/COMPP is generated internally, VGR circuit will be disabled.

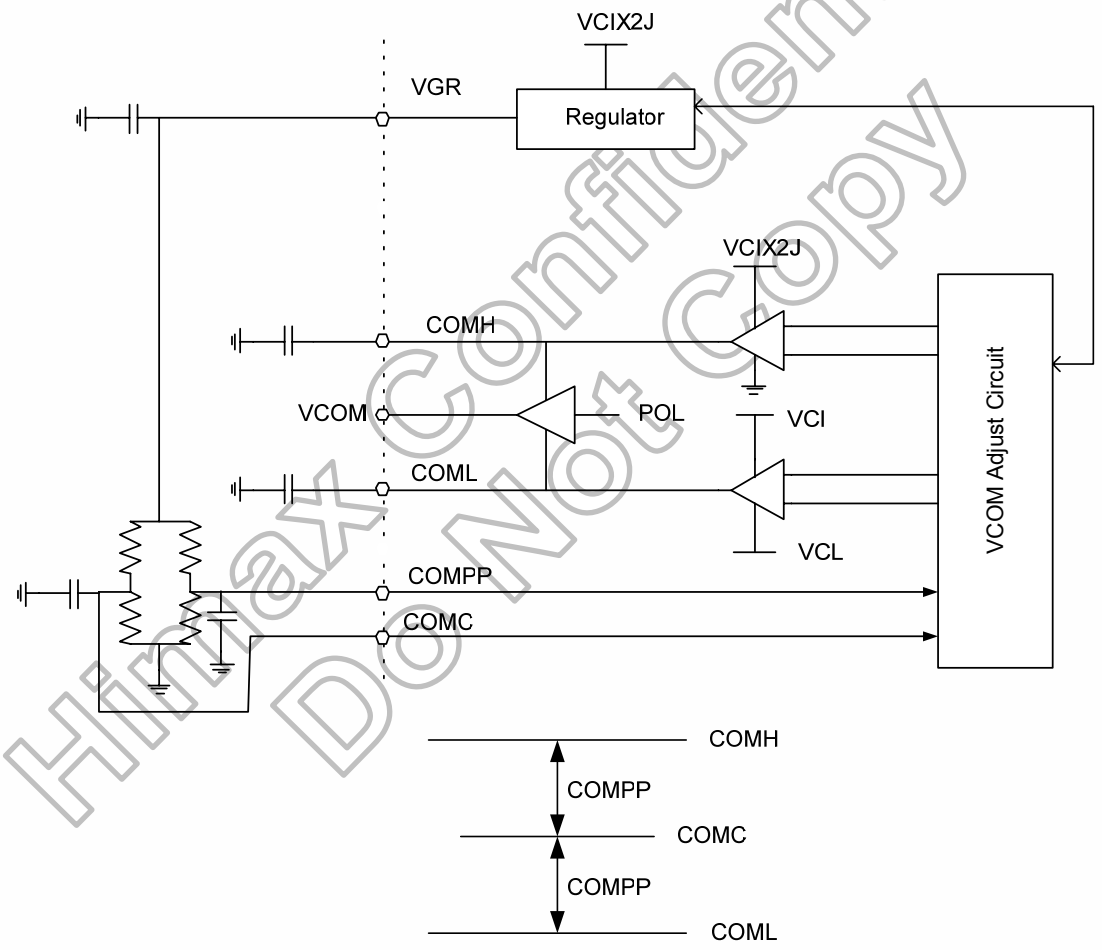



**Figure 7.3 VCOM Block**

### 7.3 Gate driver

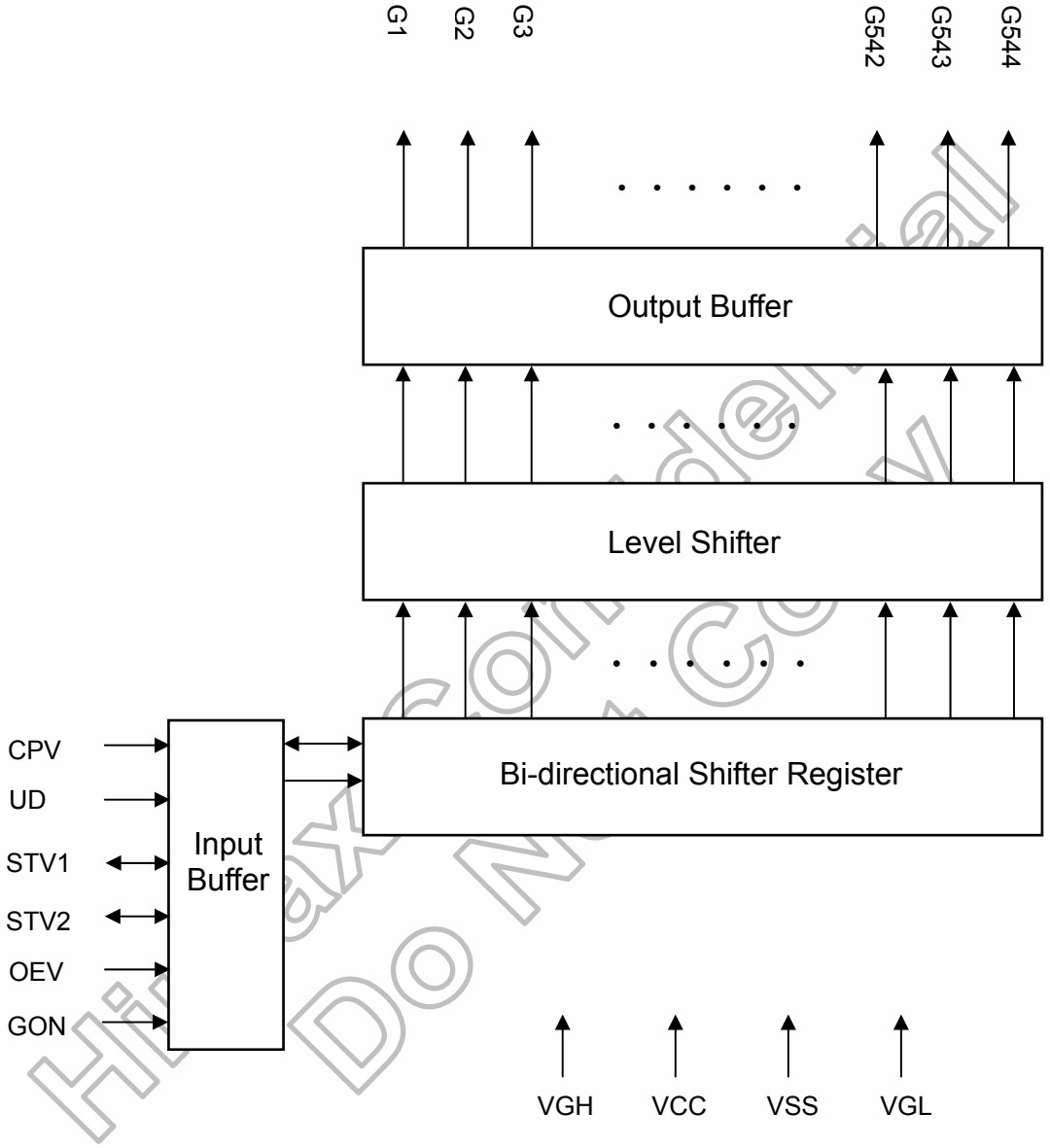



**Figure 7.4 Gate Driver**

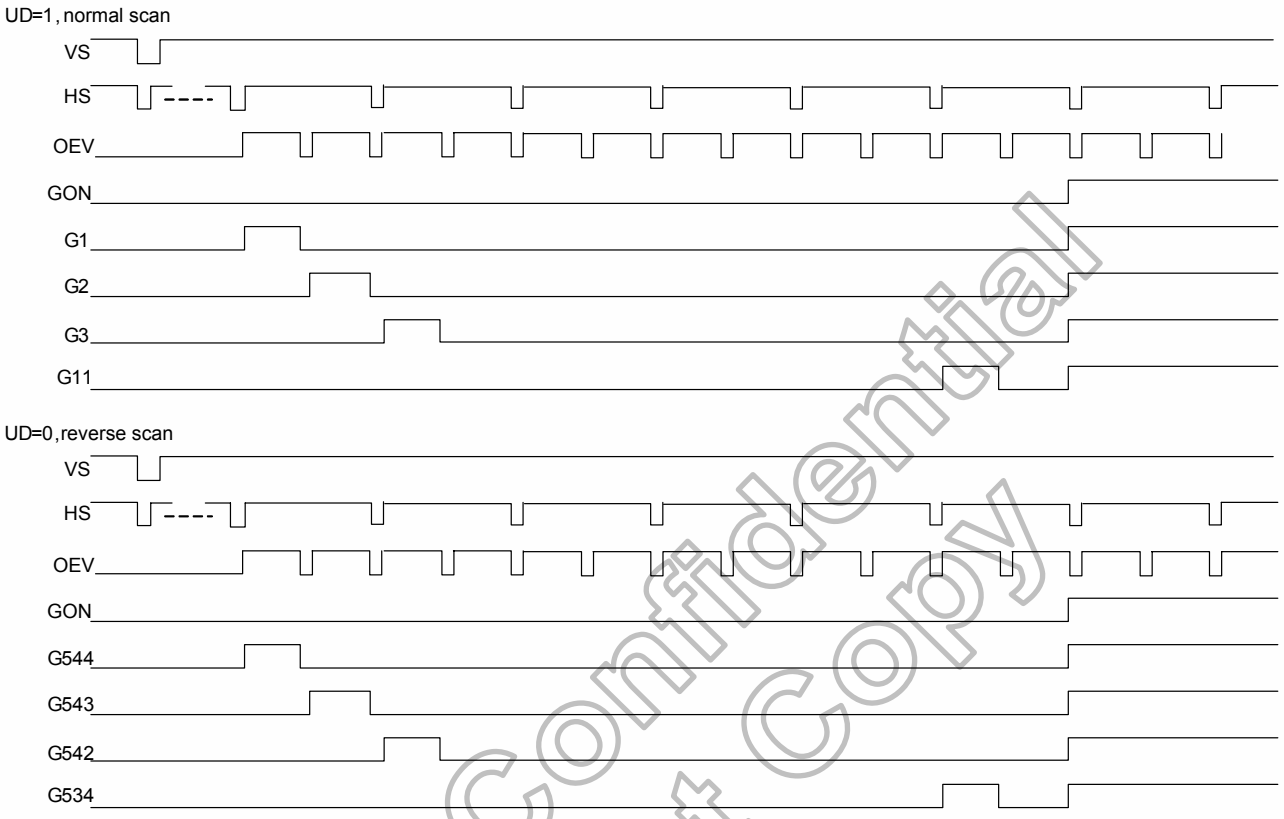



**Figure 7.5 Gate Sequence**

## 7.4 Source driver

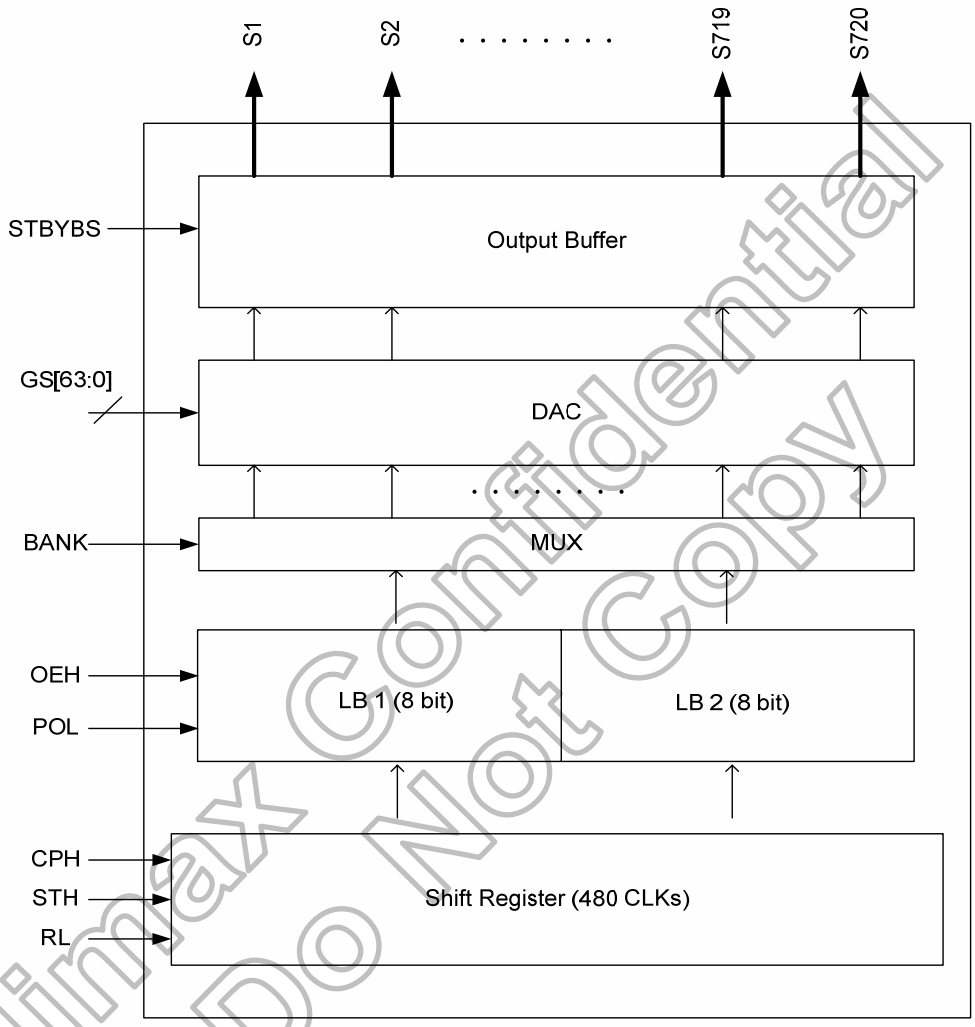



**Figure 7.6 Source Block**

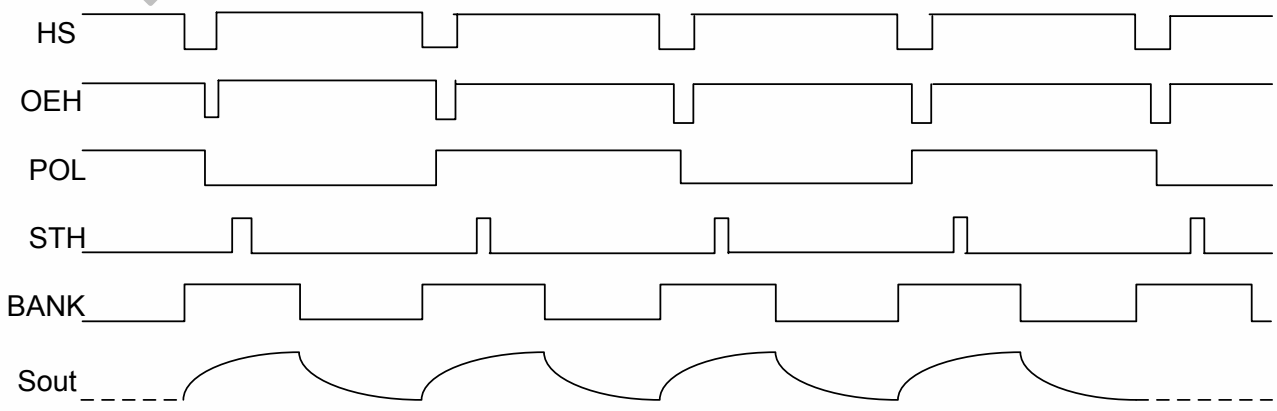



**Figure 7.7 Source Sequence**

## 7.5 Gamma adjustment

The HX8257-A incorporates gamma adjustment function for the 256-color display. Gamma adjustment is implemented by deciding the 6-grayscale levels with gradient adjustment and micro adjustment register. Also, gradient adjustment and micro adjustment is fixed for each of the internal positive and negative polarity. Set up by the liquid crystal panel's specification.

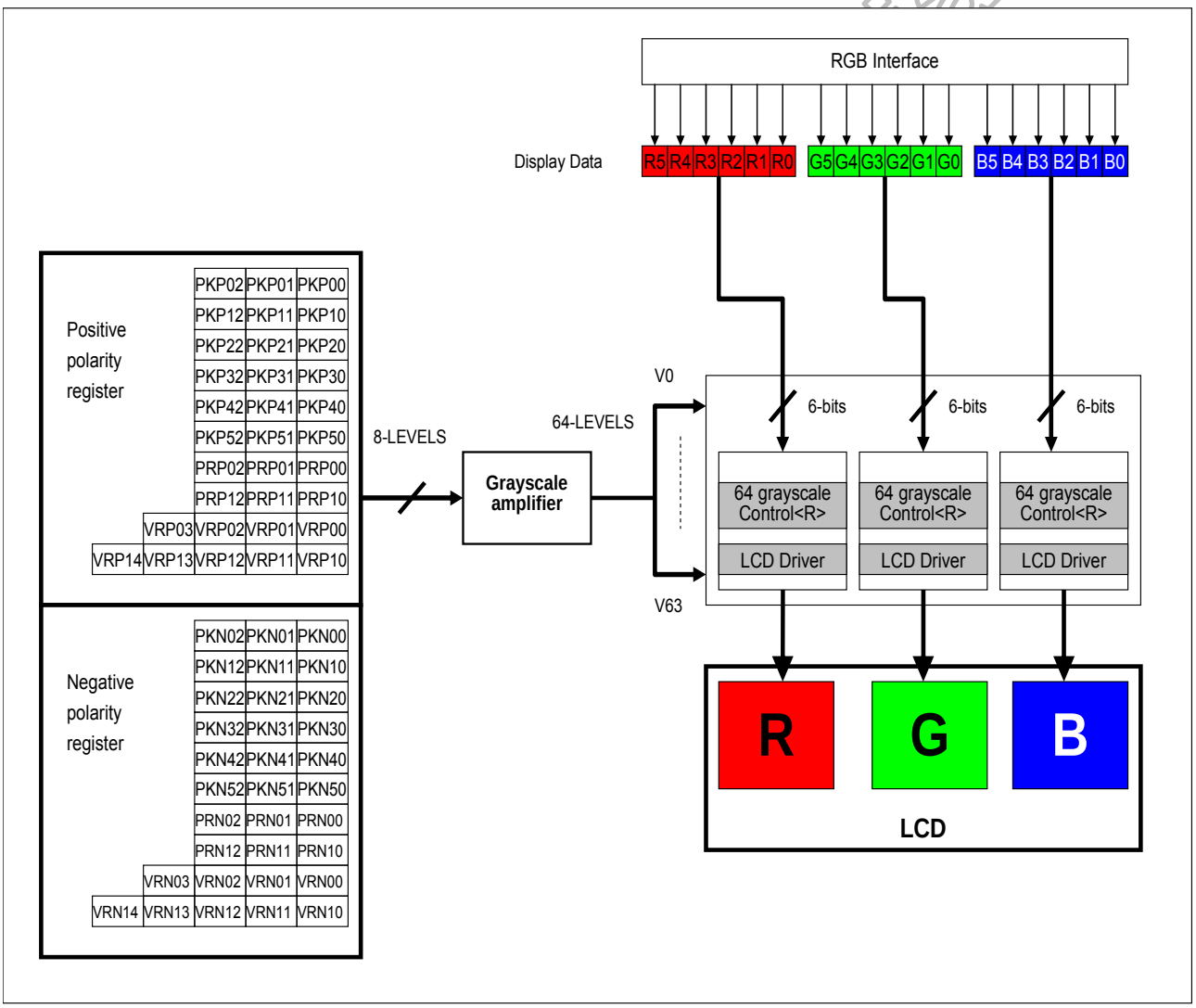



**Figure 7.8 Grayscale Control Block**

### 7.5.1 Structure of grayscale amplifier

Below figure indicates the structure of the grayscale amplifier (Positive Gray Scale). Different voltages are decided by the gradient adjustment register and the micro adjustment register, which are used for the Grayscale Amplifier. Then HX8257-A will generate 64 voltages（GS0 to GS63）by ladder resistors.

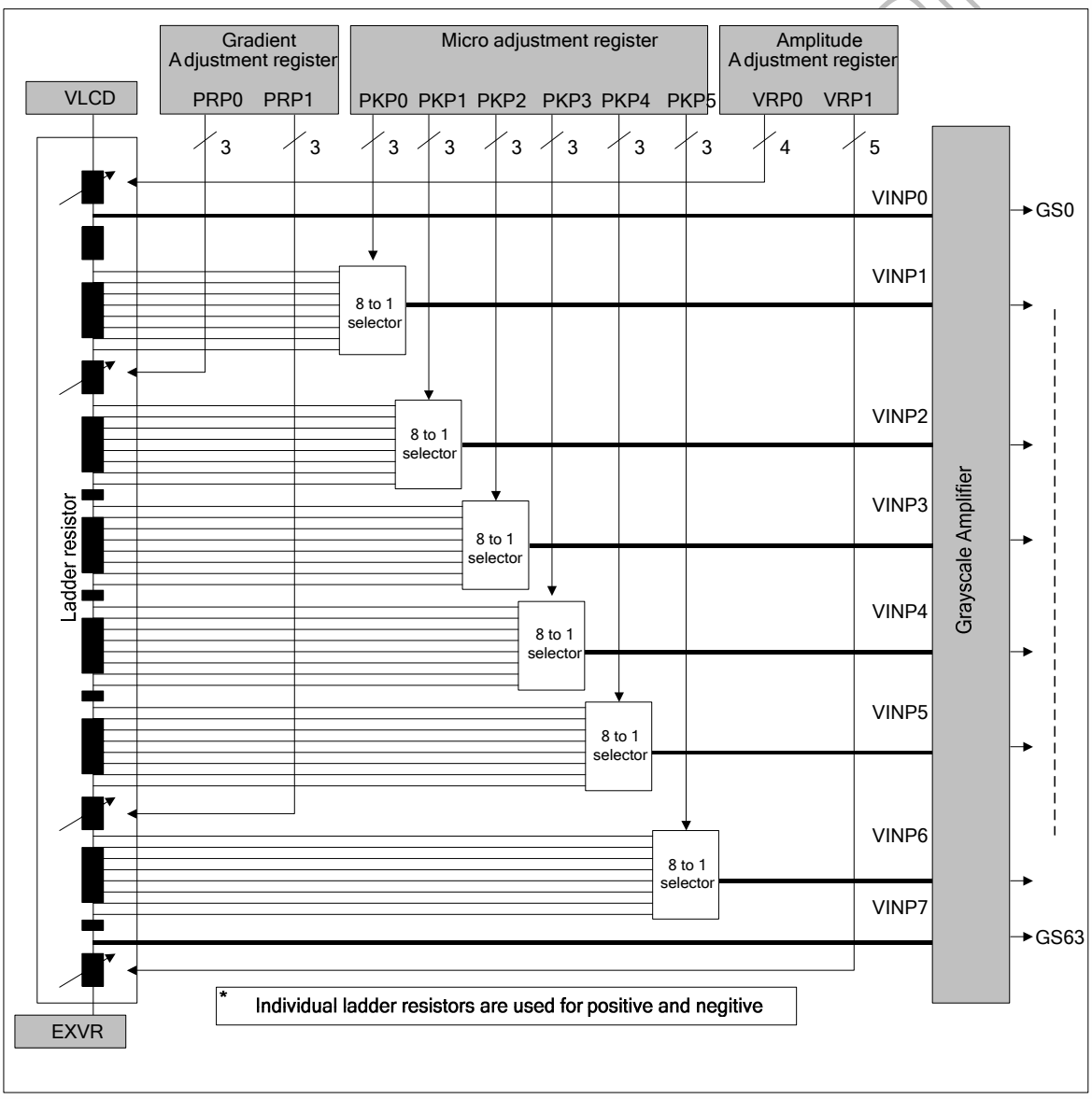



**Figure 7.9 Grayscale Amplifier**

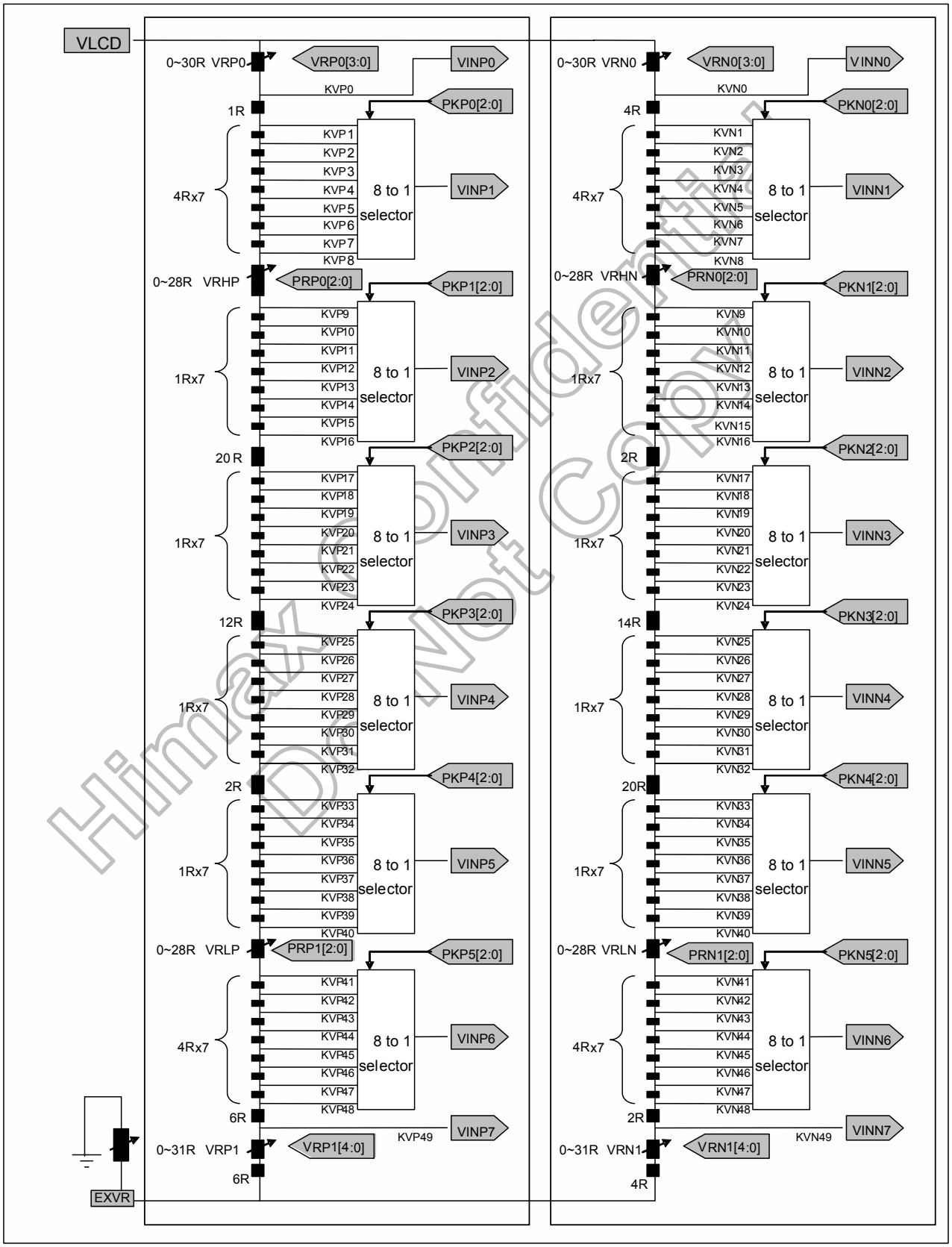





**Figure 7.10 Resistor Ladder for Gamma Voltages Generation**

### 7.5.2 Gamma adjustment register

This block is the register to set up the grayscale voltage adjusting to the gamma specification of the LCD panel. This register can independent set up to positive/negative polarities and there are three types of register groups to adjust gradient, amplitude, and micro-adjustment on number of the grayscale, characteristics of the grayscale voltage. (Use the same setting for Reference-value and R.G.B.) Following graphics indicates the operation of each adjusting register.

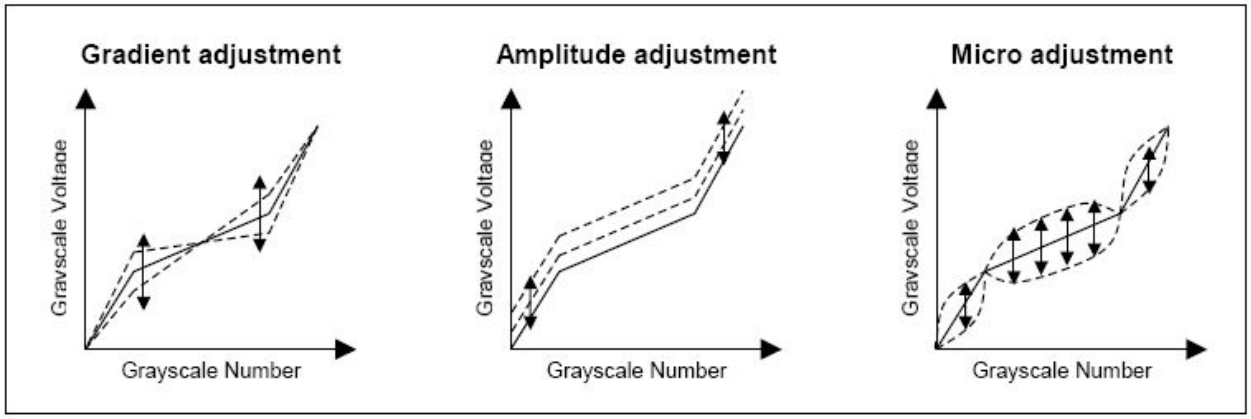



**Figure 7.11 Gamma Adjustment Function**

#### 7.5.2.1 Gradient adjusting register

The gradient-adjusting resistor is to adjust around middle gradient, specification of the grayscale number and the grayscale voltage without changing the dynamic range. To accomplish the adjustment, it controls the variable resistors in the middle of the ladder resistor by registers (PRP(N)0 / PRP(N)1) for the grayscale voltage generator. Also, there is an independent resistor on the positive/negative polarities in order for corresponding to asymmetry drive.

#### 7.5.2.2 Amplitude adjusting register

The amplitude-adjusting resistor is to adjust amplitude of the grayscale voltage. To accomplish the adjustment, it controls the variable resistors in the boundary of the ladder resistor by registers (VRP(N)0 / VRP(N)1) for the grayscale voltage generator. Also, there is an independent resistor on the positive/negative polarities as well as the gradient-adjusting resistor.

#### 7.5.2.3 Micro adjusting register

The micro-adjusting register is to make subtle adjustment of the grayscale voltage level. To accomplish the adjustment, it controls each reference voltage level by the 8 to 1 selector towards the 8-level reference voltage generated from the ladder resistor. Also, there is an independent resistor on the positive/negative polarities as well as other adjusting resistors.

### 7.5.3 Ladder resistor / 8 to 1 selector

This block outputs the reference voltage of the grayscale voltage. There are two ladder resistors including the variable resistor and the 8 to 1 selector selecting voltage generated by the ladder resistor. The gamma registers control the variable resistors and 8 to 1 selector resistors. Also, there has pin (EXVR) that can be connected to VSS or an external variable resistor for compensating the dispersion of length according to different panels.

**Variable resistor**

There are 3 types of the variable resistors that are for the gradient and amplitude adjustment. The resistance is set by the resistor (PRP(N)0 / PRP(N)1) and (VRP(N)0 / VRP(N)1) as below.

| PRP(N)[0:1] | Resistance |
|---|---|
| 000 | 0R |
| 001 | 4R |
| 010 | 8R |
| 011 | 12R |
| 100 | 16R |
| 101 | 20R |
| 110 | 24R |
| 111 | 28R |

**PRP(N)**

| VRP(N)0 | Resistance |
|---|---|
| 0000 | 0R |
| 0001 | 2R |
| 0010 | 4R |
| : | |
| Step = 2R | |
| : | |
| 1110 | 28R |
| 1111 | 30R |

**VRP(N)0**

| VRP(N)1 | Resistance |
|---|---|
| 00000 | 0R |
| 00001 | 1R |
| 00010 | 2R |
| : | |
| Step = 1R | |
| : | |
| 11110 | 30R |
| 11111 | 31R |

**VRP(N)1**

**Table 7.1 Variable Resistor**

**8 to 1 selector**

In the 8 to 1 selector, a reference voltage VIN can be selected from the levels which are generated by the ladder resistors. There are six types of reference voltage (VIN1 to VIN6) and totally 48 divided voltages can be selected in one ladder resistor. Following figure explains the relationship between the micro adjusting register and the selecting voltage.

| Positive polarity | | | | | | | Negative polarity | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Register | Selected voltage | | | | | | Register | Selected voltage | | | | | |
| PKP[2:0] | VINP1 | VINP2 | VINP3 | VINP4 | VINP5 | VINP6 | PKN[2:0] | VINN1 | VINN2 | VINN3 | VINN4 | VINN5 | VINN6 |
| 000 | KVP1 | KVP9 | KVP17 | KVP25 | KVP33 | KVP41 | 000 | KVN1 | KVN9 | KVN17 | KVN25 | KVN33 | KVN41 |
| 001 | KVP2 | KVP10 | KVP18 | KVP26 | KVP34 | KVP42 | 001 | KVN2 | KVN10 | KVN18 | KVN26 | KVN34 | KVN42 |
| 010 | KVP3 | KVP11 | KVP19 | KVP27 | KVP35 | KVP43 | 010 | KVN3 | KVN11 | KVN19 | KVN27 | KVN35 | KVN43 |
| 011 | KVP4 | KVP12 | KVP20 | KVP28 | KVP36 | KVP44 | 011 | KVN4 | KVN12 | KVN20 | KVN28 | KVN36 | KVN44 |
| 100 | KVP5 | KVP13 | KVP21 | KVP29 | KVP37 | KVP45 | 100 | KVN5 | KVN13 | KVN21 | KVN29 | KVN37 | KVN45 |
| 101 | KVP6 | KVP14 | KVP22 | KVP30 | KVP38 | KVP46 | 101 | KVN6 | KVN14 | KVN22 | KVN30 | KVN38 | KVN46 |
| 110 | KVP7 | KVP15 | KVP23 | KVP31 | KVP39 | KVP47 | 110 | KVN7 | KVN15 | KVN23 | KVN31 | KVN39 | KVN47 |
| 111 | KVP8 | KVP16 | KVP24 | KVP32 | KVP40 | KVP48 | 111 | KVN8 | KVN16 | KVN24 | KVN32 | KVN40 | KVN48 |

**Table 7.2 PKP and PKN**

| Grayscale voltage | Positive Polarity | Negative Polarity |
|---|---|---|
| V0 | VINP0 | VINN7 |
| V1 | VINP1 | VINN6 |
| V2 | V8+(V1-V8)*(167/222) | V1+(V8-V1)*(55/222) |
| V3 | V8+(V1-V8)*(124/222) | V1+(V8-V1)*(98/222) |
| V4 | V8+(V1-V8)*(90/222) | V1+(V8-V1)*(132/222) |
| V5 | V8+(V1-V8)*(61/222) | V1+(V8-V1)*(161/222) |
| V6 | V8+(V1-V8)*(37/222) | V1+(V8-V1)*(185/222) |
| V7 | V8+(V1-V8)*(17/222) | V1+(V8-V1)*(205/222) |
| V8 | VINP2 | VINN5 |
| V9 | V20+(V8-V20)*(108/124) | V8+(V20-V8)*(16/124) |
| V10 | V20+(V8-V20)*(94/124) | V8+(V20-V8)*(30/124) |
| V11 | V20+(V8-V20)*(81/124) | V8+(V20-V8)*(43/124) |
| V12 | V20+(V8-V20)*(70/124) | V8+(V20-V8)*(54/124) |
| V13 | V20+(V8-V20)*(59/124) | V8+(V20-V8)*(65/124) |
| V14 | V20+(V8-V20)*(49/124) | V8+(V20-V8)*(75/124) |
| V15 | V20+(V8-V20)*(39/124) | V8+(V20-V8)*(85/124) |
| V16 | V20+(V8-V20)*(31/124) | V8+(V20-V8)*(93/124) |
| V17 | V20+(V8-V20)*(22/124) | V8+(V20-V8)*(102/124) |
| V18 | V20+(V8-V20)*(15/124) | V8+(V20-V8)*(109/124) |
| V19 | V20+(V8-V20)*(7/124) | V8+(V20-V8)*(117/124) |
| V20 | VINP3 | VINN4 |
| V21 | V43+(V20-V43)*(115/122) | V20+(V43-V20)*(7/122) |
| V22 | V43+(V20-V43)*(108/122) | V20+(V43-V20)*(14/122) |
| V23 | V43+(V20-V43)*(102/122) | V20+(V43-V20)*(20/122) |
| V24 | V43+(V20-V43)*(96/122) | V20+(V43-V20)*(26/122) |
| V25 | V43+(V20-V43)*(90/122) | V20+(V43-V20)*(32/122) |
| V26 | V43+(V20-V43)*(84/122) | V20+(V43-V20)*(38/122) |
| V27 | V43+(V20-V43)*(78/122) | V20+(V43-V20)*(44/122) |
| V28 | V43+(V20-V43)*(73/122) | V20+(V43-V20)*(49/122) |
| V29 | V43+(V20-V43)*(68/122) | V20+(V43-V20)*(54/122) |
| V30 | V43+(V20-V43)*(63/122) | V20+(V43-V20)*(59/122) |
| V31 | V43+(V20-V43)*(58/122) | V20+(V43-V20)*(64/122) |
| V32 | V43+(V20-V43)*(53/122) | V20+(V43-V20)*(69/122) |
| V33 | V43+(V20-V43)*(48/122) | V20+(V43-V20)*(74/122) |
| V34 | V43+(V20-V43)*(43/122) | V20+(V43-V20)*(79/122) |
| V35 | V43+(V20-V43)*(38/122) | V20+(V43-V20)*(84/122) |
| V36 | V43+(V20-V43)*(33/122) | V20+(V43-V20)*(89/122) |
| V37 | V43+(V20-V43)*(28/122) | V20+(V43-V20)*(94/122) |
| V38 | V43+(V20-V43)*(24/122) | V20+(V43-V20)*(98/122) |
| V39 | V43+(V20-V43)*(19/122) | V20+(V43-V20)*(103/122) |
| V40 | V43+(V20-V43)*(14/122) | V20+(V43-V20)*(108/122) |
| V41 | V43+(V20-V43)*(9/122) | V20+(V43-V20)*(113/122) |
| V42 | V43+(V20-V43)*(5/122) | V20+(V43-V20)*(117/122) |
| V43 | VINP4 | VINN3 |
| V44 | V55+(V43-V55)*(61/65) | V43+(V55-V43)*(4/65) |
| V45 | V55+(V43-V55)*(56/65) | V43+(V55-V43)*(9/65) |
| V46 | V55+(V43-V55)*(51/65) | V43+(V55-V43)*(14/65) |
| V47 | V55+(V43-V55)*(46/65) | V43+(V55-V43)*(19/65) |
| V48 | V55+(V43-V55)*(41/65) | V43+(V55-V43)*(24/65) |
| V49 | V55+(V43-V55)*(35/65) | V43+(V55-V43)*(30/65) |
| V50 | V55+(V43-V55)*(30/65) | V43+(V55-V43)*(35/65) |
| V51 | V55+(V43-V55)*(24/65) | V43+(V55-V43)*(41/65) |
| V52 | V55+(V43-V55)*(19/65) | V43+(V55-V43)*(46/65) |
| V53 | V55+(V43-V55)*(13/65) | V43+(V55-V43)*(52/65) |
| V54 | V55+(V43-V55)*(7/65) | V43+(V55-V43)*(58/65) |
| V55 | VINP5 | VINN2 |
| V56 | V62+(V55-V62)*(70/77) | V55+(V62-V55)*(7/77) |
| V57 | V62+(V55-V62)*(62/77) | V55+(V62-V55)*(15/77) |
| V58 | V62+(V55-V62)*(54/77) | V55+(V62-V55)*(23/77) |
| V59 | V62+(V55-V62)*(45/77) | V55+(V62-V55)*(32/77) |
| V60 | V62+(V55-V62)*(33/77) | V55+(V62-V55)*(44/77) |
| V61 | V62+(V55-V62)*(20/77) | V55+(V62-V55)*(57/77) |
| V62 | VINP6 | VINN1 |
| V63 | VINP7 | VINN0 |

**Table 7.3 Grayscale Voltages Formulas**

| Reference | Formula | Micro-adjusting register | Reference voltage |
|---|---|---|---|
| KVP0 | VLCD63 - ΔV x VRP0 / SUMRP | - | VINP0 |
| KVP1 | VLCD63 - ΔV x (VRP0 + 1R) / SUMRP | PKP0[2:0] = ”000” | VINP1 |
| KVP2 | VLCD63 - ΔV x (VRP0 + 5R) / SUMRP | PKP0[2:0] = ”001” | |
| KVP3 | VLCD63 - ΔV x (VRP0 + 9R) / SUMRP | PKP0[2:0] = ”010” | |
| KVP4 | VLCD63 - ΔV x (VRP0 + 13R) / SUMRP | PKP0[2:0] = ”011” | |
| KVP5 | VLCD63 - ΔV x (VRP0 + 17R) / SUMRP | PKP0[2:0] = ”100” | |
| KVP6 | VLCD63 - ΔV x (VRP0 + 21R) / SUMRP | PKP0[2:0] = ”101” | |
| KVP7 | VLCD63 - ΔV x (VRP0 + 25R) / SUMRP | PKP0[2:0] = ”110” | |
| KVP8 | VLCD63 - ΔV x (VRP0 + 29R) / SUMRP | PKP0[2:0] = ”111” | |
| KVP9 | VLCD63 - ΔV x (VRP0 + 29R + VRHP) / SUMRP | PKP1[2:0] = ”000” | VINP2 |
| KVP10 | VLCD63 - ΔV x (VRP0 + 30R + VRHP) / SUMRP | PKP1[2:0] = ”001” | |
| KVP11 | VLCD63 - ΔV x (VRP0 + 31R + VRHP) / SUMRP | PKP1[2:0] = ”010” | |
| KVP12 | VLCD63 - ΔV x (VRP0 + 32R + VRHP) / SUMRP | PKP1[2:0] = ”011” | |
| KVP13 | VLCD63 - ΔV x (VRP0 + 33R + VRHP) / SUMRP | PKP1[2:0] = ”100” | |
| KVP14 | VLCD63 - ΔV x (VRP0 + 34R + VRHP) / SUMRP | PKP1[2:0] = ”101” | |
| KVP15 | VLCD63 - ΔV x (VRP0 + 35R + VRHP) / SUMRP | PKP1[2:0] = ”110” | |
| KVP16 | VLCD63 - ΔV x (VRP0 + 36R + VRHP) / SUMRP | PKP1[2:0] = ”111” | |
| KVP17 | VLCD63 - ΔV x (VRP0 + 56R + VRHP) / SUMRP | PKP2[2:0] = ”000” | VINP3 |
| KVP18 | VLCD63 - ΔV x (VRP0 + 57R + VRHP) / SUMRP | PKP2[2:0] = ”001” | |
| KVP19 | VLCD63 - ΔV x (VRP0 + 58R + VRHP) / SUMRP | PKP2[2:0] = ”010” | |
| KVP20 | VLCD63 - ΔV x (VRP0 + 59R + VRHP) / SUMRP | PKP2[2:0] = ”011” | |
| KVP21 | VLCD63 - ΔV x (VRP0 + 60R + VRHP) / SUMRP | PKP2[2:0] = ”100” | |
| KVP22 | VLCD63 - ΔV x (VRP0 + 61R + VRHP) / SUMRP | PKP2[2:0] = ”101” | |
| KVP23 | VLCD63 - ΔV x (VRP0 + 62R + VRHP) / SUMRP | PKP2[2:0] = ”110” | |
| KVP24 | VLCD63 - ΔV x (VRP0 + 63R + VRHP) / SUMRP | PKP2[2:0] = ”111” | |
| KVP25 | VLCD63 - ΔV x (VRP0 + 75R + VRHP) / SUMRP | PKP3[2:0] = ”000” | VINP4 |
| KVP26 | VLCD63 - ΔV x (VRP0 + 76R + VRHP) / SUMRP | PKP3[2:0] = ”001” | |
| KVP27 | VLCD63 - ΔV x (VRP0 + 77R + VRHP) / SUMRP | PKP3[2:0] = ”010” | |
| KVP28 | VLCD63 - ΔV x (VRP0 + 78R + VRHP) / SUMRP | PKP3[2:0] = ”011” | |
| KVP29 | VLCD63 - ΔV x (VRP0 + 79R + VRHP) / SUMRP | PKP3[2:0] = ”100” | |
| KVP30 | VLCD63 - ΔV x (VRP0 + 80R + VRHP) / SUMRP | PKP3[2:0] = ”101” | |
| KVP31 | VLCD63 - ΔV x (VRP0 + 81R + VRHP) / SUMRP | PKP3[2:0] = ”110” | |
| KVP32 | VLCD63 - ΔV x (VRP0 + 82R + VRHP) / SUMRP | PKP3[2:0] = ”111” | |
| KVP33 | VLCD63 - ΔV x (VRP0 + 84R + VRHP) / SUMRP | PKP4[2:0] = ”000” | VINP5 |
| KVP34 | VLCD63 - ΔV x (VRP0 + 85R + VRHP) / SUMRP | PKP4[2:0] = ”001” | |
| KVP35 | VLCD63 - ΔV x (VRP0 + 86R + VRHP) / SUMRP | PKP4[2:0] = ”010” | |
| KVP36 | VLCD63 - ΔV x (VRP0 + 87R + VRHP) / SUMRP | PKP4[2:0] = ”011” | |
| KVP37 | VLCD63 - ΔV x (VRP0 + 88R + VRHP) / SUMRP | PKP4[2:0] = ”100” | |
| KVP38 | VLCD63 - ΔV x (VRP0 + 89R + VRHP) / SUMRP | PKP4[2:0] = ”101” | |
| KVP39 | VLCD63 - ΔV x (VRP0 + 90R + VRHP) / SUMRP | PKP4[2:0] = ”110” | |
| KVP40 | VLCD63 - ΔV x (VRP0 + 91R + VRHP) / SUMRP | PKP4[2:0] = ”111” | |
| KVP41 | VLCD63 - ΔV x (VRP0 + 91R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”000” | VINP6 |
| KVP42 | VLCD63 - ΔV x (VRP0 + 95R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”001” | |
| KVP43 | VLCD63 - ΔV x (VRP0 + 99R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”010” | |
| KVP44 | VLCD63 - ΔV x (VRP0 + 103R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”011” | |
| KVP45 | VLCD63 - ΔV x (VRP0 + 107R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”100” | |
| KVP46 | VLCD63 - ΔV x (VRP0 + 111R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”101” | |
| KVP47 | VLCD63 - ΔV x (VRP0 + 115R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”110” | |
| KVP48 | VLCD63 - ΔV x (VRP0 + 119R + VRHP + VRLP) / SUMRP | PKP5[2:0] = ”111” | |
| KVP49 | VLCD63 - ΔV x (VRP0 + 125R + VRHP + VRLP) / SUMRP | - | VINP7 |

SUMRP: Total of the positive polarity ladder resistance = 131R + VRHP + VRLP + VRP0 + VRP1
ΔV: Voltage difference between VLCD and EXVR.

**Table 7.4 Reference Voltages of Positive Polarity**

| Reference | Formula | Micro-adjusting register | Reference voltage |
|---|---|---|---|
| KVN0 | VLCD63 - ΔV x VRN0 / SUMRN | - | VINN0 |
| KVN1 | VLCD63 - ΔV x (VRN0 + 4R) / SUMRN | PKN0[2:0] = ”000” | VINN1 |
| KVN2 | VLCD63 - ΔV x (VRN0 + 8R) / SUMRN | PKN0[2:0] = ”001” | |
| KVN3 | VLCD63 - ΔV x (VRN0 + 12R) / SUMRN | PKN0[2:0] = ”010” | |
| KVN4 | VLCD63 - ΔV x (VRN0 + 16R) / SUMRN | PKN0[2:0] = ”011” | |
| KVN5 | VLCD63 - ΔV x (VRN0 + 20R) / SUMRN | PKN0[2:0] = ”100” | |
| KVN6 | VLCD63 - ΔV x (VRN0 + 24R) / SUMRN | PKN0[2:0] = ”101” | |
| KVN7 | VLCD63 - ΔV x (VRN0 + 28R) / SUMRN | PKN0[2:0] = ”110” | |
| KVN8 | VLCD63 - ΔV x (VRN0 + 32R) / SUMRN | PKN0[2:0] = ”111” | |
| KVN9 | VLCD63 - ΔV x (VRN0 + 32R + VRHN) / SUMRN | PKN1[2:0] = ”000” | VINN2 |
| KVN10 | VLCD63 - ΔV x (VRN0 + 33R + VRHN) / SUMRN | PKN1[2:0] = ”001” | |
| KVN11 | VLCD63 - ΔV x (VRN0 + 34R + VRHN) / SUMRN | PKN1[2:0] = ”010” | |
| KVN12 | VLCD63 - ΔV x (VRN0 + 35R + VRHN) / SUMRN | PKN1[2:0] = ”011” | |
| KVN13 | VLCD63 - ΔV x (VRN0 + 36R + VRHN) / SUMRN | PKN1[2:0] = ”100” | |
| KVN14 | VLCD63 - ΔV x (VRN0 + 37R + VRHN) / SUMRN | PKN1[2:0] = ”101” | |
| KVN15 | VLCD63 - ΔV x (VRN0 + 38R + VRHN) / SUMRN | PKN1[2:0] = ”110” | |
| KVN16 | VLCD63 - ΔV x (VRN0 + 39R + VRHN) / SUMRN | PKN1[2:0] = ”111” | |
| KVN17 | VLCD63 - ΔV x (VRN0 + 41R + VRHN) / SUMRN | PKN2[2:0] = ”000” | VINN3 |
| KVN18 | VLCD63 - ΔV x (VRN0 + 42R + VRHN) / SUMRN | PKN2[2:0] = ”001” | |
| KVN19 | VLCD63 - ΔV x (VRN0 + 43R + VRHN) / SUMRN | PKN2[2:0] = ”010” | |
| KVN20 | VLCD63 - ΔV x (VRN0 + 44R + VRHN) / SUMRN | PKN2[2:0] = ”011” | |
| KVN21 | VLCD63 - ΔV x (VRN0 + 45R + VRHN) / SUMRN | PKN2[2:0] = ”100” | |
| KVN22 | VLCD63 - ΔV x (VRN0 + 46R + VRHN) / SUMRN | PKN2[2:0] = ”101” | |
| KVN23 | VLCD63 - ΔV x (VRN0 + 47R + VRHN) / SUMRN | PKN2[2:0] = ”110” | |
| KVN24 | VLCD63 - ΔV x (VRN0 + 48R + VRHN) / SUMRN | PKN2[2:0] = ”111” | |
| KVN25 | VLCD63 - ΔV x (VRN0 + 62R + VRHN) / SUMRN | PKN3[2:0] = ”000” | VINN4 |
| KVN26 | VLCD63 - ΔV x (VRN0 + 63R + VRHN) / SUMRN | PKN3[2:0] = ”001” | |
| KVN27 | VLCD63 - ΔV x (VRN0 + 64R + VRHN) / SUMRN | PKN3[2:0] = ”010” | |
| KVN28 | VLCD63 - ΔV x (VRN0 + 65R + VRHN) / SUMRN | PKN3[2:0] = ”011” | |
| KVN29 | VLCD63 - ΔV x (VRN0 + 66R + VRHN) / SUMRN | PKN3[2:0] = ”100” | |
| KVN30 | VLCD63 - ΔV x (VRN0 + 67R + VRHN) / SUMRN | PKN3[2:0] = ”101” | |
| KVN31 | VLCD63 - ΔV x (VRN0 + 68R + VRHN) / SUMRN | PKN3[2:0] = ”110” | |
| KVN32 | VLCD63 - ΔV x (VRN0 + 69R + VRHN) / SUMRN | PKN3[2:0] = ”111” | |
| KVN33 | VLCD63 - ΔV x (VRN0 + 89R + VRHN) / SUMRN | PKN4[2:0] = ”000” | VINN5 |
| KVN34 | VLCD63 - ΔV x (VRN0 + 90R + VRHN) / SUMRN | PKN4[2:0] = ”001” | |
| KVN35 | VLCD63 - ΔV x (VRN0 + 91R + VRHN) / SUMRN | PKN4[2:0] = ”010” | |
| KVN36 | VLCD63 - ΔV x (VRN0 + 92R + VRHN) / SUMRN | PKN4[2:0] = ”011” | |
| KVN37 | VLCD63 - ΔV x (VRN0 + 93R + VRHN) / SUMRN | PKN4[2:0] = ”100” | |
| KVN38 | VLCD63 - ΔV x (VRN0 + 94R + VRHN) / SUMRN | PKN4[2:0] = ”101” | |
| KVN39 | VLCD63 - ΔV x (VRN0 + 95R + VRHN) / SUMRN | PKN4[2:0] = ”110” | |
| KVN40 | VLCD63 - ΔV x (VRN0 + 96R + VRHN) / SUMRN | PKN4[2:0] = ”111” | |
| KVN41 | VLCD63 - ΔV x (VRN0 + 96R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”000” | VINN6 |
| KVN42 | VLCD63 - ΔV x (VRN0 + 100R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”001” | |
| KVN43 | VLCD63 - ΔV x (VRN0 + 104R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”010” | |
| KVN44 | VLCD63 - ΔV x (VRN0 + 108R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”011” | |
| KVN45 | VLCD63 - ΔV x (VRN0 + 112R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”100” | |
| KVN46 | VLCD63 - ΔV x (VRN0 + 116R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”101” | |
| KVN47 | VLCD63 - ΔV x (VRN0 + 120R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”110” | |
| KVN48 | VLCD63 - ΔV x (VRN0 + 124R + VRHN + VRLN) / SUMRN | PKN5[2:0] = ”111” | |
| KVN49 | VLCD63 - ΔV x (VRN0 + 126R + VRHN + VRLN) / SUMRN | - | VINN7 |

SUMRN: Total of the negative polarity ladder resistance = 130R + VRHN + VRLN + VRN0 + VRN1
ΔV: Voltage difference between VLCD and EXVR.

**Table 7.5 Reference Voltages of Negative Polarity**

## 7.6 PWM

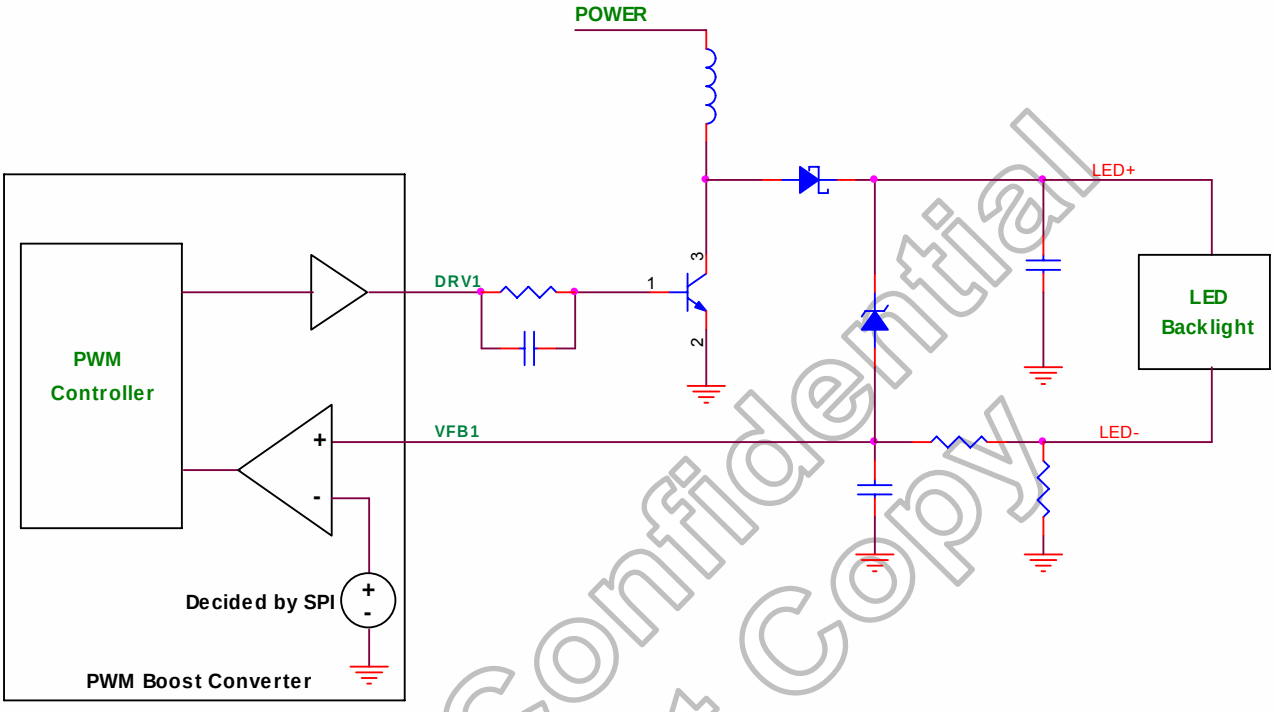



**Figure 7.12 PWM Block**

The HX8257-A is built in 2 independent PWM control circuits. The internal reference voltage is adjustable by FBA[2:0] and FBB[2:0] in R05h. By adjusting the voltage, you can get different VO to meet your system application. For 1st PWM, the VO also can be adjusted by DU[4:0] setting. (Input pins or register setting) This setting is combined with CABC function to provide power for LED backlight. 2nd PWM is designed to generate VCIX2J if charge pump circuit is not used.

## 7.7 TCON

The HX8257-A has 2 modes for input interface, parallel and serial interface. In parallel interface (PS="H"), 24-bit data are transferred into the HX8257-A each cycle when DE is activated. D07 to D00 is displayed for R dot on panel, D17 to D10 are displayed for G data, and D27 to D20 are displayed for B data. The relationship between display data and source output is shown in the following figure.

| | |
|---|---|
| Input data format | 24-bit RGB, 3 dots (sub-pixels) per clock |
| Input data width | 24 bits with Dx7 is MSB and Dx0 is LSB, x = 1 ~ 3 |

| LR | First | | | → | Last | | |
|---|---|---|---|---|---|---|---|
| | D00~ D07 | D10~ D17 | D20~ D27 | ... | D00~ D07 | D10~ D17 | D20~ D27 |
| H | R1 | G1 | B1 | ... | R480 | G480 | B480 |

| LR | Last | | | ← | First | | |
|---|---|---|---|---|---|---|---|
| | D00~ D07 | D10~ D17 | D20~ D27 | ... | D00~ D07 | D10~ D17 | D20~ D27 |
| L | R1 | G1 | B1 | ... | R480 | G480 | B480 |

In serial interface (PS="L"), 8-bit data are transferred into the HX8257-A through D07~D00 pins. The data are latched sequentially for display $R_n$, $G_n$, $B_n$, n=1, 2 … 480 when LR="H", and for $B_n$, $G_n$, $R_n$, n=480, 479, 478 … to 1 when LR="L".

| | |
|---|---|
| Input data format | 8-bit RGB, 1 dot (sub-pixel) per clock |
| Input data width | 8 bits with D07 is MSB and D00 is LSB |

| LR | First | | | → | | | Last |
|---|---|---|---|---|---|---|---|
| | D00~ D07 | D00~ D07 | D00~ D07 | ... | D00~ D07 | D00~ D07 | D00~ D07 |
| H | R1 | G1 | B1 | ... | R480 | G480 | B480 |

| LR | Last | | | ← | | | First |
|---|---|---|---|---|---|---|---|
| | D00~ D07 | D00~ D07 | D00~ D07 | ... | D00~ D07 | D00~ D07 | D00~ D07 |
| L | R1 | G1 | B1 | ... | R480 | G480 | B480 |

### 7.7.1 LR/UD function

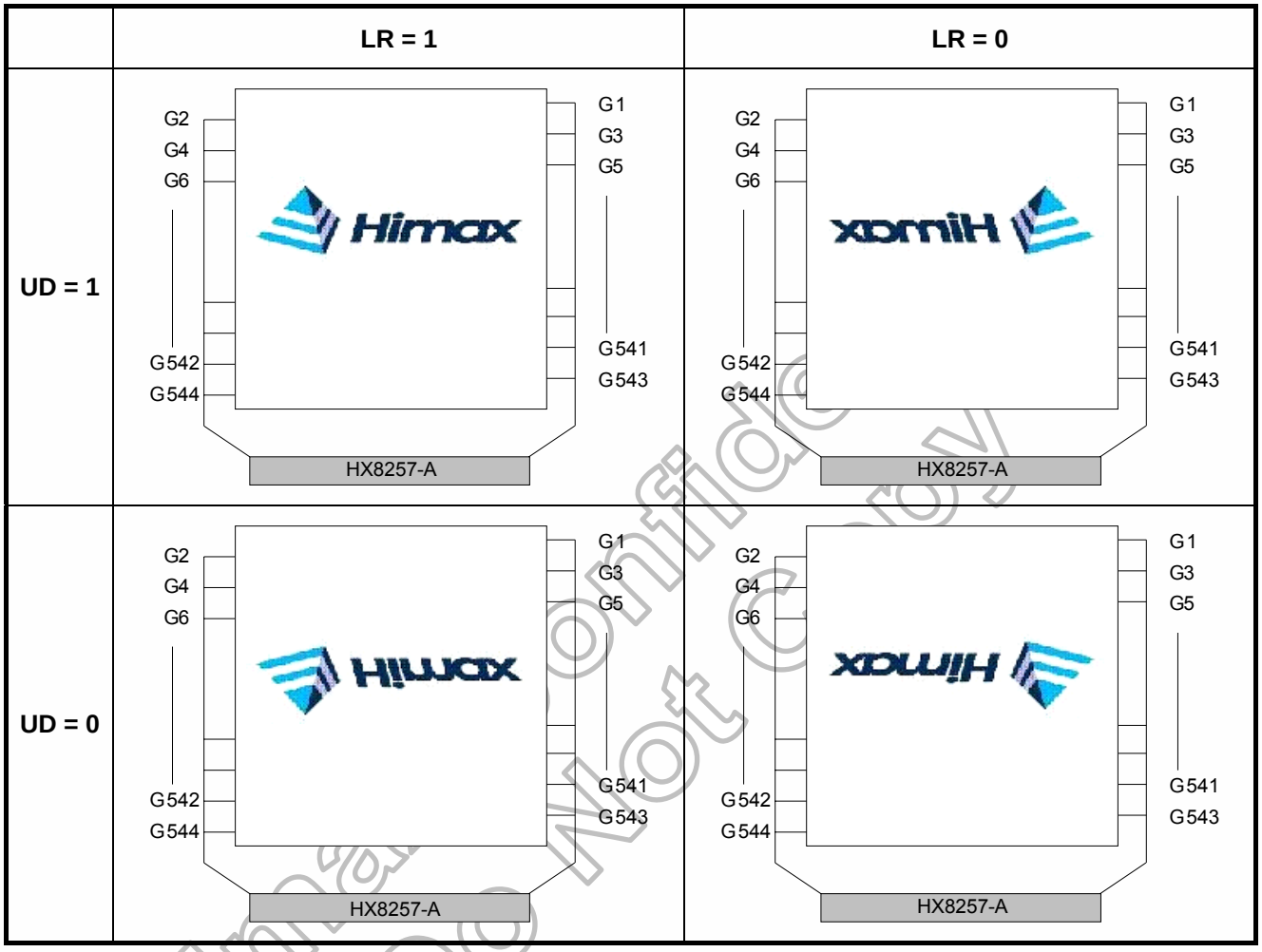



**Figure 7.13 LR/UD Function**

### 7.7.2 Aging mode

If only CLK is sent into driver IC without VS, HS, and DE signals, the HX8257-A will enter Aging Mode after power on. In Aging mode, the display picture can change automatically or be controlled manually by access register R04h.

### 7.7.3 TCON power on/off control

The HX8257-A has a power ON/OFF sequence control function. When DISP pin is pulled “H”, blank data is outputted for 10-frames first, from the falling edge of the following VSYNC signal. Similarly, when DISP is pulled “L”, 10-frames of blank data will be outputted from the falling edge of the following VSYNC, too. The blank data would be gray level 0 for normally black LC (NBW=”H”), and be gray level 255 for normally white LC (NBW=”L”).

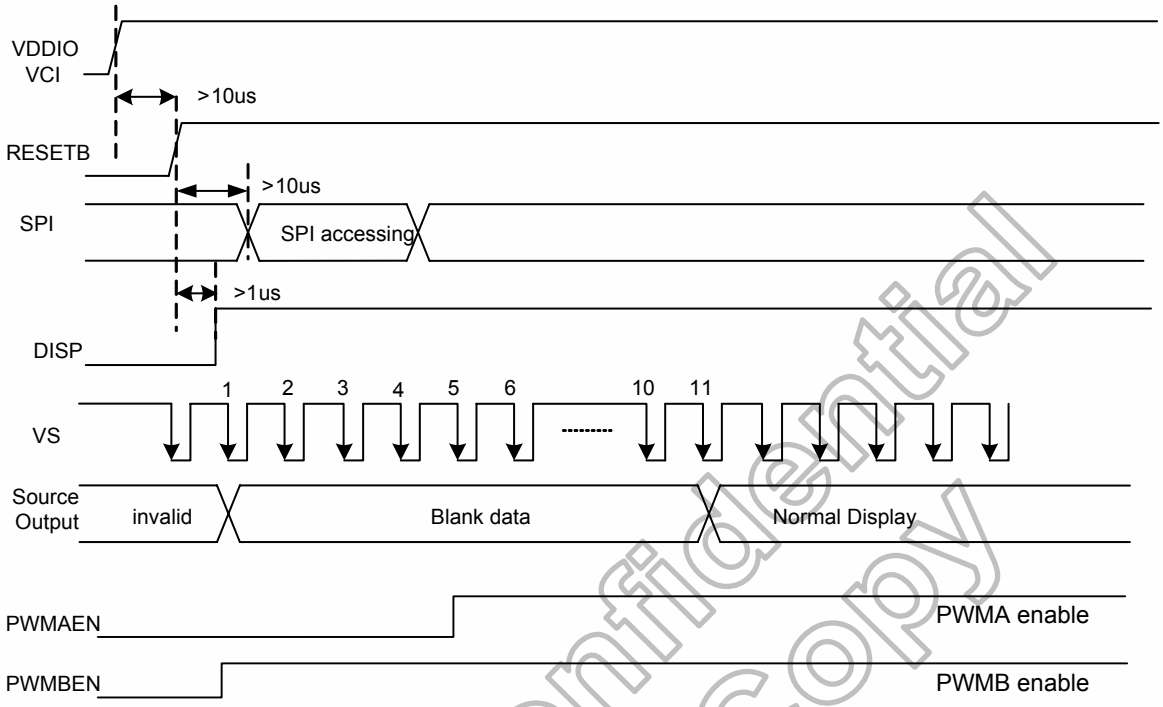



**Figure 7.14 Power On Sequence**

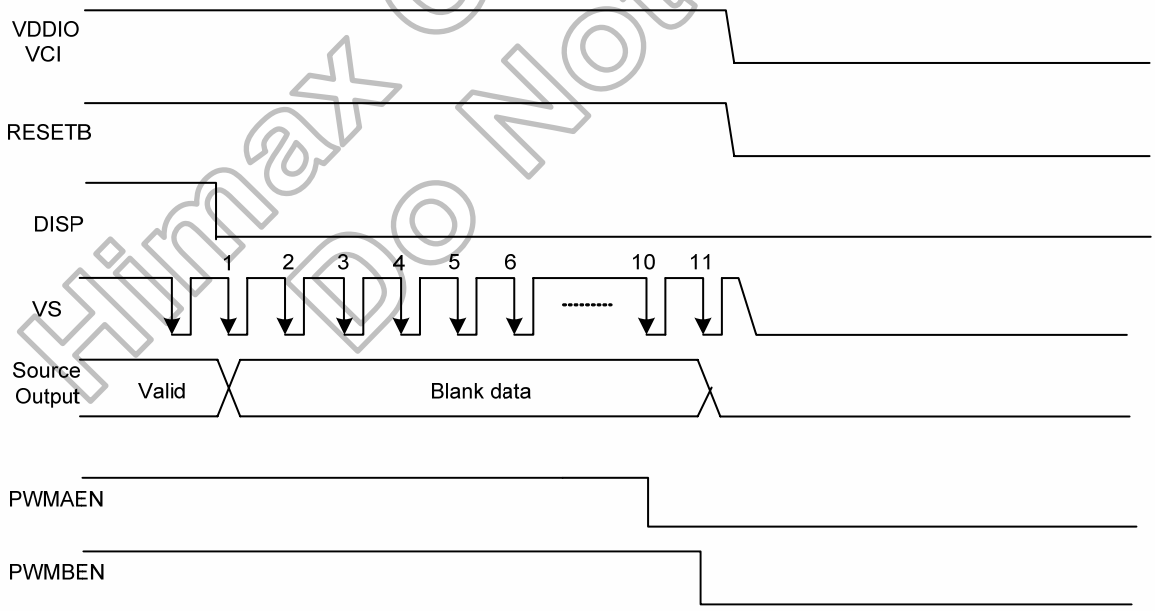



**Figure 7.15 Power Off Sequence**

# 8. SPI Register

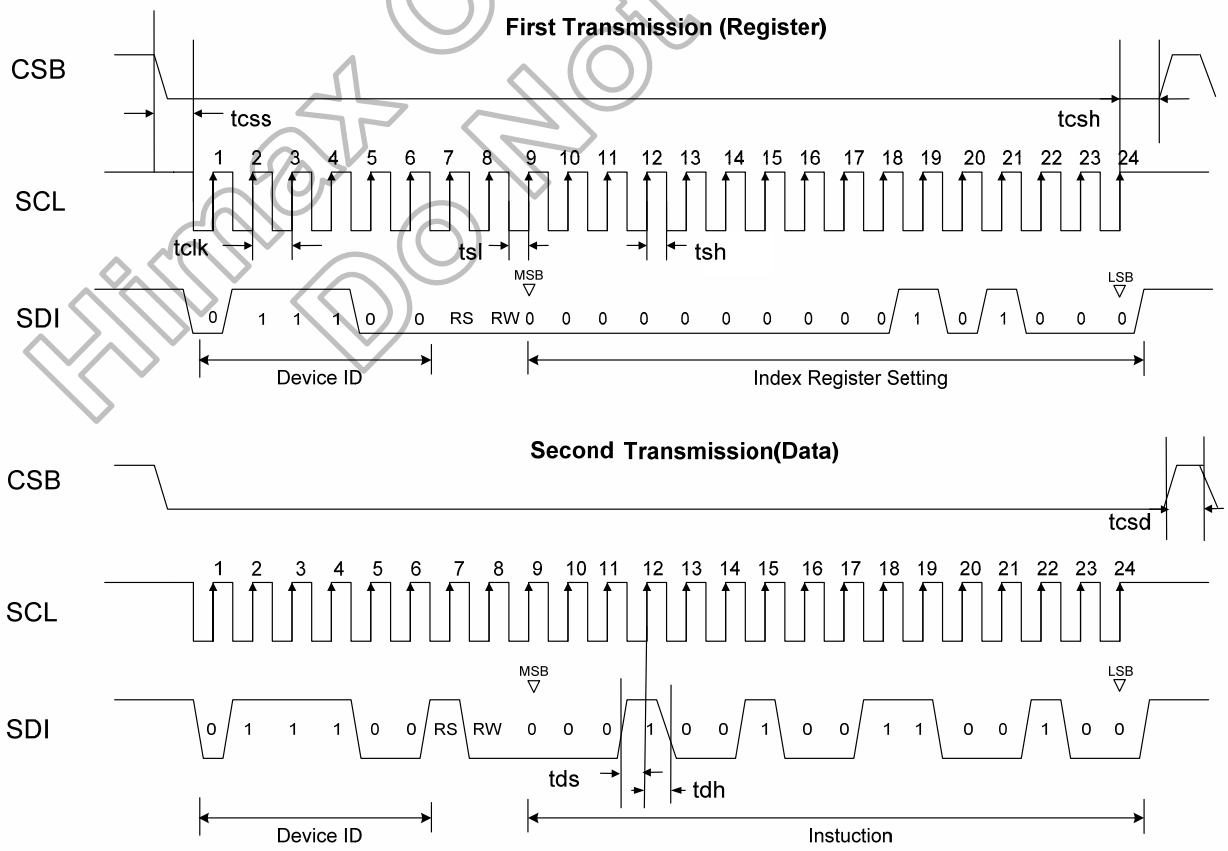
The HX8257-A is internally initialized by the global reset signal, RESETB. The reset input must be held for at least 1ms after power is stable.

HX8257-A supports 24-bit serial bus interface. 24-bit data are latched by SCL's rising edge step-by-step. Serial bus interface is active while CSB=L (from CSB's falling to CSB's rising). After CSB has transmitted twenty-four units of CLK, it has to change into High.

Under the standard condition, the number of SCL is twenty-four units. While CSB=L, if SCL < 24 cycles is input, then the input data won't be latched and will become invalid data. While CSB=L, if SCL >24 cycles is input, the 24-bit data in front of CSB's rising edge will become valid.

- Write

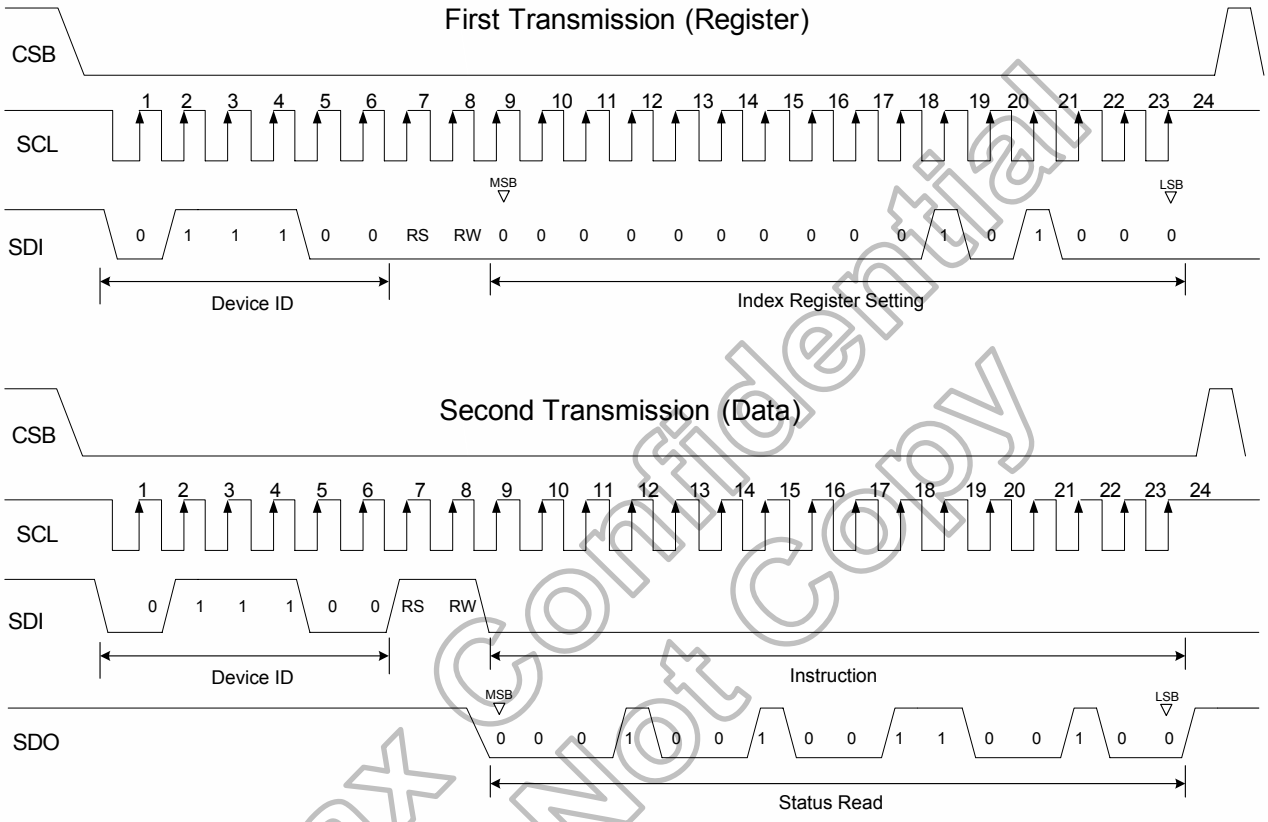
SPI




**Note:** The example writes "0x1264h" to register R28h.

**Figure 8.1 Write SPI Timing**

- Read SPI




**Note:** The example reads "0x1264h" from register R28h.

**Figure 8.2 Read SPI Timing**

| RS | RW | Status |
|---|---|---|
| 0 | 0 | Write SPI Address |
| 0 | 1 | NA |
| 1 | 0 | Write SPI Data |
| 1 | 1 | Read SPI Data |

| Parameter | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Serial Clock Frequency | fclk | - | - | 20 | MHz |
| Serial Clock Cycle Time | tclk | 50 | - | - | ns |
| Clock Low Width | tsl | 25 | - | - | ns |
| Clock High Width | tsh | 25 | - | - | ns |
| Chip Select Setup Time | tcss | 0 | - | - | ns |
| Chip Select Hold Time | tcsh | 10 | - | - | ns |
| Chip Select High Delay Time | tcsd | 20 | - | - | ns |
| Data Setup Time | tds | 5 | - | - | ns |
| Data Hold Time | tdh | 10 | - | - | ns |

| Reg# | Register | R/W | R/S | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R01h | Driver data control | 0 | 1 | OEA1 | OEA0 | PALM | DEO | DEP | HSP | VSP | CLK_ TRG | GON | DIT | PINV | BGR | 0 | UD | LR | NBW |
| R02h | Power control (1) | 0 | 1 | 0 | 0 | VDS1 | VDS0 | 0 | EQ2 | EQ1 | EQ0 | DC3 | DC2 | DC1 | DC0 | 0 | AP2 | AP1 | AP0 |
| R03h | Power control (2) | 0 | 1 | X2EN | XDK | VRC1 | VRC0 | VDC3 | VDC2 | VDC1 | VDC0 | 0 | 0 | VRH5 | VRH4 | VRH3 | VRH2 | VRH1 | VRH0 |
| R04h | Function control | 0 | 1 | 0 | 0 | 0 | 0 | REV | PA2 | PA1 | PA0 | AGM | SEQ | PS | 0 | REG | PSHUT | GDIS | COMG |
| R05h | PWM control | | | 0 | PSWE | DUS | DU4 | DU3 | DU2 | DU1 | DU0 | PWMA | FBA2 | FBA1 | FBA0 | PWMB | FBB2 | FBB1 | FBB0 |
| R06h | VCOM control | 0 | 1 | 0 | 0 | nOTP | VMC4 | VMC3 | VMC2 | VMC1 | VMC0 | 0 | 0 | eOTP | VDV4 | VDV3 | VDV2 | VDV1 | VDV0 |
| R07h | Vertical Porch | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | VBP6 | VBP5 | VBP4 | VBP3 | VBP2 | VBP1 | VBP0 |
| R08h | Horizontal Porch | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | STH1 | STH0 | HBP7 | HBP6 | HBP5 | HBP4 | HBP3 | HBP2 | HBP1 | HBP0 |
| R09h | Contrast/ Brightness control | 0 | 1 | 0 | BR6 | BR5 | BR4 | BR3 | BR2 | BR1 | BR0 | 0 | 0 | 0 | CON4 | CON3 | CON2 | CON1 | CON0 |
| R0Fh | CABC function control | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Dout | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | DBEN |
| R10h | γ control (1) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PKP 12 | PKP 11 | PKP 10 | 0 | 0 | 0 | 0 | 0 | PKP 02 | PKP 01 | PKP 00 |
| R11h | γ control (2) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PKP 32 | PKP 31 | PKP 30 | 0 | 0 | 0 | 0 | 0 | PKP 22 | PKP 21 | PKP 20 |
| R12h | γ control (3) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PKP 52 | PKP 51 | PKP 50 | 0 | 0 | 0 | 0 | 0 | PKP 42 | PKP 41 | PKP 40 |
| R13h | γ control (4) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PRP 12 | PRP 11 | PRP 10 | 0 | 0 | 0 | 0 | 0 | PRP 02 | PRP 01 | PRP 00 |
| R14h | γ control (5) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PKN 12 | PKN 11 | PKN 10 | 0 | 0 | 0 | 0 | 0 | PKN 02 | PKN 01 | PKN 00 |
| R15h | γ control (6) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PKN 32 | PKN 31 | PKN 30 | 0 | 0 | 0 | 0 | 0 | PKN 22 | PKN 21 | PKN 20 |
| R16h | γ control (7) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PKN 52 | PKN 51 | PKN 50 | 0 | 0 | 0 | 0 | 0 | PKN 42 | PKN 41 | PKN 40 |
| R17h | γ control (8) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | PRN 12 | PRN 11 | PRN 10 | 0 | 0 | 0 | 0 | 0 | PRN 02 | PRN 01 | PRN 00 |
| R18h | γ control (9) | 0 | 1 | 0 | 0 | 0 | VRP 14 | VRP 13 | VRP 12 | VRP 11 | VRP 10 | 0 | 0 | 0 | 0 | VRP 03 | VRP 02 | VRP 01 | VRP 00 |
| R19h | γ control (10) | 0 | 1 | 0 | 0 | 0 | VRN 14 | VRN 13 | VRN 12 | VRN 11 | VRN 10 | 0 | 0 | 0 | 0 | VRN 03 | VRN 02 | VRN 01 | VRN 00 |

**Note:** Software settings will override hardware pin (Example： UD bits override UD pin definition)



## Driver Data Control (R01h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | OEA1 | OEA0 | PALM | DEO | DEP | HSP | VSP | CLK_TRG | GON | DIT | PINV | BGR | 0 | UD | LR | NBW |
| Default | | 0 | 1 | 1 | 1 | 1 | 0 | 0 | x | 0 | 1 | 0 | 0 | 0 | x | x | x |

**Table 8.1 Driver Output Control (“x” means default value is set by hardware pin)**

**NBW:** Define LC type of panel. NBW=1, normally black panel. (TCON send POLB to VCOM circuit) NBW=0, normally white panel. (TCON send POL to VCOM circuit)

**LR:** Set display shift direction. LR=1, S1 → S720. LR=0, S720 → S1.

**UD:** Set display scan direction. UD=1, G1 → G544. UD=0, G544 → G1.

**BGR:** Selects the <R><G><B> arrangement. When BGR = “0”, <R><G><B> color is assigned from S1. When BGR = “1”, <B><G><R> color is assigned from S1.

**PINV:** When PINV=0, POL output is normal. When PINV=1, POL output phase is reversed with internal POL signal.

**DIT:** When DIT=0, dithering function is turned off. When DIT=1, dithering function is enabled.

**GON:** When GON=0, gate driver is normal operation. When GON=1, gate driver output keep high voltage.

**CLK_TRG:** Clock edge selection signal for the data sampling.

CLK_TRG=1: Data sampling at the CLK falling edge.

CLK_TRG=0: Data sampling at the CLK rising edge.

**VSP:** When VSP=0, VSYNC is negative polarity. When VSP=1, VSYNC is positive polarity.

**HSP:** When HSP=0, HSYNC is negative polarity. When HSP=1, HSYNC is positive polarity.

**DEP:** When DEP=0, DEN is negative polarity active. When DEP=1, DEN is positive polarity active.

**DEO:** When DEO=0, VSYNC/HSYNC are also needed in DE mode. Under this condition, vertical back porch is defined by VBP[6:0] and the horizontal first valid data is defined by DE signal. When DEO=1, only DEN signal is needed in DE mode.

**PALM:** Set the input data line number in PAL mode. **Only effective in 480RGBx240 resolution**. Our driver IC will auto detect NTSC/PAL mode under 480RGBx240 resolution)
0: 280 lines
1: 288 lines

**OEA1-0:** Odd/Even field advanced function. **Only effective in SYNC mode.**

| OEA1 | OEA0 | Description |
|---|---|---|
| 0 | 0 | Start pulse start @ VBP delay for Odd field and @ ***VBP-1*** for Even field. |
| 0 | 1 | Start pulse start @ VBP delay for Odd field and @ ***VBP*** for Even field. |
| 1 | 0 | Start pulse start @ VBP delay for Odd field and @ ***VBP+1*** for Even field. |
| 1 | 1 | No use |

**Power Control 1 (R02h)**

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | VDS1 | VDS0 | 0 | EQ2 | EQ1 | EQ0 | DC3 | DC2 | DC1 | DC0 | 0 | AP2 | AP1 | AP0 |
| Default | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |

**AP2-0:** Adjust the amount of current from the stable-current source in the internal operational amplifier circuit. When the amount of current becomes large, the driving ability of the operational-amplifier circuits increase. Adjust the current taking into account the power consumption. During times when there is no display, such as when the system is in a sleep mode, set AP2-0 = “000” to halt the operational amplifier circuit and the step-up circuits to reduce current consumption.

| AP2 | AP1 | AP0 | Op-amp power |
|---|---|---|---|
| 0 | 0 | 0 | Least |
| 0 | 0 | 1 | Small |
| 0 | 1 | 0 | Small to medium |
| 0 | 1 | 1 | Medium |
| 1 | 0 | 0 | Medium to large |
| 1 | 0 | 1 | Large |
| 1 | 1 | 0 | Large to Maximum |
| 1 | 1 | 1 | Maximum |

**DC3-0:** Set the step-up cycle of the step-up circuit. When the cycle is accelerated, the VCL and VCIX2 driving ability of the step-up circuit increase, but their current consumption increase, too. Adjust the cycle taking into account the display quality and power consumption.

| DC3 | DC2 | DC1 | DC0 | Step-up cycle |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | Fline x 14 |
| 0 | 0 | 0 | 1 | Fline x 12 |
| 0 | 0 | 1 | 0 | Fline x 10 |
| 0 | 0 | 1 | 1 | Fline x 8 |
| 0 | 1 | 0 | 0 | Fline x 7 |
| 0 | 1 | 0 | 1 | Fline x 6 |
| 0 | 1 | 1 | 0 | Fline x 5 |
| 0 | 1 | 1 | 1 | Fline x 4 |
| 1 | 0 | 0 | 0 | Fline x 3 |
| 1 | 0 | 0 | 1 | Fline x 2 |
| 1 | 0 | 1 | 0 | Fline x 1 |
| 1 | 0 | 1 | 1 | Fline x 0.5 |
| 1 | 1 | 0 | 0 | Fline x 0.25 |
| 1 | 1 | 0 | 1 | Reserved |
| 1 | 1 | 1 | 0 | Reserved |
| 1 | 1 | 1 | 1 | Reserved |

**Note:** Fline = horizontal frequency (Fline Typ. 17 KHz)

**EQ2-0:** Sets the equalizing period.

| EQ2 | EQ1 | EQ0 | EQ period |
|---|---|---|---|
| 0 | 0 | 0 | No EQ |
| 0 | 0 | 1 | 1 us |
| 0 | 1 | 0 | 2 us |
| 0 | 1 | 1 | 3 us |
| 1 | 0 | 0 | 4 us |
| 1 | 0 | 1 | 5 us |
| 1 | 1 | 0 | 6 us |
| 1 | 1 | 1 | 7 us |

**VDS1-0:** Set the VDD regulator voltage.

VDS[1:0]=00, 1.8V
VDS[1:0]=11, 2.0V
VDS[1:0]=10, 2.2V
VDS[1:0]=01, 2.5V

**Power Control 2 (R03h)**

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | X2EN | XDK | VRC1 | VRC0 | VDC3 | VDC2 | VDC1 | VDC0 | 0 | 0 | VRH5 | VRH4 | VRH3 | VRH2 | VRH1 | VRH0 |
| Default | | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |

**VRH5-0:** Set amplitude magnification of VLCD. These bits amplify the VLCD voltage 2.464 to 4.456 times the Vref voltage set by VRH5-0.

| VRH5 | VRH4 | VRH3 | VRH2 | VRH1 | VRH0 | VLCD Voltage |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | Vref x 2.456 |
| 0 | 0 | 0 | 0 | 0 | 1 | Vref x 2.488 |
| 0 | 0 | 0 | 0 | 1 | 0 | Vref x 2.520 |
| 0 | 0 | 0 | 0 | 1 | 1 | Vref x 2.552 |
| 0 | 0 | 0 | 1 | 0 | 0 | Vref x 2.584 |
| 0 | 0 | 0 | 1 | 0 | 1 | Vref x 2.616 |
| 0 | 0 | 0 | 1 | 1 | 0 | Vref x 2.648 |
| 0 | 0 | 0 | 1 | 1 | 1 | Vref x 2.680 |
| 0 | 0 | 1 | 0 | 0 | 0 | Vref x 2.712 |
| 0 | 0 | 1 | 0 | 0 | 1 | Vref x 2.744 |
| 0 | 0 | 1 | 0 | 1 | 0 | Vref x 2.776 |
| 0 | 0 | 1 | 0 | 1 | 1 | Vref x 2.808 |
| 0 | 0 | 1 | 1 | 0 | 0 | Vref x 2.840 |
| 0 | 0 | 1 | 1 | 0 | 1 | Vref x 2.872 |
| 0 | 0 | 1 | 1 | 1 | 0 | Vref x 2.904 |
| 0 | 0 | 1 | 1 | 1 | 1 | Vref x 2.936 |
| 0 | 1 | 0 | 0 | 0 | 0 | Vref x 2.968 |
| 0 | 1 | 0 | 0 | 0 | 1 | Vref x 3.000 |
| 0 | 1 | 0 | 0 | 1 | 0 | Vref x 3.032 |
| 0 | 1 | 0 | 0 | 1 | 1 | Vref x 3.064 |
| 0 | 1 | 0 | 1 | 0 | 0 | Vref x 3.096 |
| 0 | 1 | 0 | 1 | 0 | 1 | Vref x 3.128 |
| 0 | 1 | 0 | 1 | 1 | 0 | Vref x 3.160 |
| 0 | 1 | 0 | 1 | 1 | 1 | Vref x 3.192 |
| 0 | 1 | 1 | 0 | 0 | 0 | Vref x 3.224 |
| 0 | 1 | 1 | 0 | 0 | 1 | Vref x 3.256 |
| 0 | 1 | 1 | 0 | 1 | 0 | Vref x 3.288 |
| 0 | 1 | 1 | 0 | 1 | 1 | Vref x 3.320 |
| 0 | 1 | 1 | 1 | 0 | 0 | Vref x 3.352 |
| 0 | 1 | 1 | 1 | 0 | 1 | Vref x 3.384 |
| 0 | 1 | 1 | 1 | 1 | 0 | Vref x 3.416 |
| 0 | 1 | 1 | 1 | 1 | 1 | Vref x 3.448 |
| 1 | 0 | 0 | 0 | 0 | 0 | Vref x 3.480 |
| 1 | 0 | 0 | 0 | 0 | 1 | Vref x 3.512 |
| 1 | 0 | 0 | 0 | 1 | 0 | Vref x 3.544 |
| 1 | 0 | 0 | 0 | 1 | 1 | Vref x 3.576 |
| 1 | 0 | 0 | 1 | 0 | 0 | Vref x 3.608 |
| 1 | 0 | 0 | 1 | 0 | 1 | Vref x 3.640 |
| 1 | 0 | 0 | 1 | 1 | 0 | Vref x 3.672 |
| 1 | 0 | 0 | 1 | 1 | 1 | Vref x 3.704 |
| 1 | 0 | 1 | 0 | 0 | 0 | Vref x 3.736 |
| 1 | 0 | 1 | 0 | 0 | 1 | Vref x 3.768 |
| 1 | 0 | 1 | 0 | 1 | 0 | Vref x 3.800 |
| 1 | 0 | 1 | 0 | 1 | 1 | Vref x 3.832 |
| 1 | 0 | 1 | 1 | 0 | 0 | Vref x 3.864 |
| 1 | 0 | 1 | 1 | 0 | 1 | Vref x 3.896 |
| 1 | 0 | 1 | 1 | 1 | 0 | Vref x 3.928 |
| 1 | 0 | 1 | 1 | 1 | 1 | Vref x 3.960 |
| 1 | 1 | 0 | 0 | 0 | 0 | Vref x 3.992 |
| 1 | 1 | 0 | 0 | 0 | 1 | Vref x 4.024 |
| 1 | 1 | 0 | 0 | 1 | 0 | Vref x 4.056 |
| 1 | 1 | 0 | 0 | 1 | 1 | Vref x 4.088 |
| 1 | 1 | 0 | 1 | 0 | 0 | Vref x 4.120 |
| 1 | 1 | 0 | 1 | 0 | 1 | Vref x 4.152 |
| 1 | 1 | 0 | 1 | 1 | 0 | Vref x 4.184 |
| 1 | 1 | 0 | 1 | 1 | 1 | Vref x 4.216 |
| 1 | 1 | 1 | 0 | 0 | 0 | Vref x 4.248 |
| 1 | 1 | 1 | 0 | 0 | 1 | Vref x 4.280 |
| 1 | 1 | 1 | 0 | 1 | 0 | Vref x 4.312 |
| 1 | 1 | 1 | 0 | 1 | 1 | Vref x 4.344 |
| 1 | 1 | 1 | 1 | 0 | 0 | Vref x 4.376 |
| 1 | 1 | 1 | 1 | 0 | 1 | Vref x 4.408 |
| 1 | 1 | 1 | 1 | 1 | 0 | Vref x 4.440 |
| 1 | 1 | 1 | 1 | 1 | 1 | Vref x 4.472 |

**Note:** Vref is the internal reference voltage equals to 1.25V.

**VDC3-0:** Set amplitude magnification of VDC. These bits amplify the VDC voltage 2.9 to 4.4 times the Vref voltage set by VDC3-0.

| VDC3 | VDC2 | VDC1 | VDC0 | VDC Voltage |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | Vref x 2.9 |
| 0 | 0 | 0 | 1 | Vref x 3.0 |
| 0 | 0 | 1 | 0 | Vref x 3.1 |
| 0 | 0 | 1 | 1 | Vref x 3.2 |
| 0 | 1 | 0 | 0 | Vref x 3.3 |
| 0 | 1 | 0 | 1 | Vref x 3.4 |
| 0 | 1 | 1 | 0 | Vref x 3.5 |
| 0 | 1 | 1 | 1 | Vref x 3.6 |
| 1 | 0 | 0 | 0 | Vref x 3.7 |
| 1 | 0 | 0 | 1 | Vref x 3.8 |
| 1 | 0 | 1 | 0 | Vref x 3.9 |
| 1 | 0 | 1 | 1 | Vref x 4.0 |
| 1 | 1 | 0 | 0 | Vref x 4.1 |
| 1 | 1 | 0 | 1 | Vref x 4.2 |
| 1 | 1 | 1 | 0 | Vref x 4.3 |
| 1 | 1 | 1 | 1 | Vref x 4.4 |

**Note:** Vref is the internal reference voltage equals to 1.25V.

**VRC1-0:** Set the VCIX2 charge pump voltage clamp.
VRC[1:0]=00, 5.2V
VRC[1:0]=01, 5.4V
VRC[1:0]=10, 5.6V
VRC[1:0]=11, 5.8V

**XDK:** When XDK=0, VCIX2 is 2 stage pumping from VCI. (VCIX2=3 x VCI) When XDK=1, VCIX2 is 2 phase pumping from VCI. (VCIX2=2 x VCI)

**X2EN:** When X2EN=0, VCIX2 pumping circuit is disabled. When X2EN=1, VCIX2 pumping circuit is enabled.

**Function Control (R04h)**

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | REV | PA2 | PA1 | PA0 | AGM | SEQ | PS | 0 | REG | PSHUT | GDIS | COMG |
| Default | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | x | 0 | 1 | x | 1 | 1 |

**COMG:** When COMG=0, VCOM circuit is disabled. When COMG=1, VCOM circuit is enabled.

**GDIS:** When GDIS=0, VGL has no discharge path to VSS in standby mode. When GDIS=1, VGL will discharge to VSS in standby mode.

**PSHUT:** When PSHUT=0, all power circuits are shut down. When PSHUT=1, all internal power circuits are enabled.

**REG:** REG=1, internal VDD regulator is turn on. REG=0, VDD should be shorted to VDDIO on system.

**PS:** PS=1, parallel RGB input interface. PS=0, serial RGB input interface.

**SEQ:** SEQ=1, reverse data pin sequence. SEQ=0, data pin sequence is as pad define.

**AGM:** AGM=1, aging mode pattern is auto changed. AGM=0, aging mode pattern is controlled by PA2-0.

**PA2-0:** Define the display pattern in aging mode when AGM=0.

**REV:** REV=1, input data is inverted. REV=0, input data is send to display without inversion.

## PWM Control (R05h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | PSWE | DUS | DU4 | DU3 | DU2 | DU1 | DU0 | PWMA | FBA2 | FBA1 | FBA0 | PWMB | FBB2 | FBB1 | FBB0 |
| Default | | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |

**FBB2-0:** Set 2nd PWM feedback level adjustment.
000: 0.8V
001: 0.85V
010: 0.9V
011: 0.95V
100: 1.0V
101: 1.05V
110: 1.1V
111: 1.15V

**PWMB:** When PWMB=0, 2nd PWM function is disabled. When PWMB=1, 2nd PWM function is enabled.

**FBA2-0:** Set 1st PWM feedback level adjustment.
000: 0.8V
001: 0.85V
010: 0.9V
011: 0.95V
100: 1.0V
101: 1.05V
110: 1.1V
111: 1.15V

**PWMA:** When PWMA=0, 1st PWM function is disabled. When PWMA=1, 1st PWM function is enabled.

**DU4-0:** Define the supply current of 1st PWM (PWM A) for LED backlight. The register value is effective only when DUS bit=0. This setting will combine with CABC function to control the LED backlight brightness dynamically.

| DU4-0 | Supply current | DU4-0 | Supply current |
|---|---|---|---|
| 00000 | 1/32 | 10000 | 17/32 |
| 00001 | 2/32 | 10001 | 18/32 |
| 00010 | 3/32 | 10010 | 19/32 |
| 00011 | 4/32 | 10011 | 20/32 |
| 00100 | 5/32 | 10100 | 21/32 |
| 00101 | 6/32 | 10101 | 22/32 |
| 00110 | 7/32 | 10110 | 23/32 |
| 00111 | 8/32 | 10111 | 24/32 |
| 01000 | 9/32 | 11000 | 25/32 |
| 01001 | 10/32 | 11001 | 26/32 |
| 01010 | 11/32 | 11010 | 27/32 |
| 01011 | 12/32 | 11011 | 28/32 |
| 01100 | 13/32 | 11100 | 29/32 |
| 01101 | 14/32 | 11101 | 30/32 |
| 01110 | 15/32 | 11110 | 31/32 |
| 01111 | 16/32 | 11111 | 32/32 |

**DUS:** Set the DU4-0 is defined by SPI register or hardware pins. When DUS=0, SPI register is effective. When DUS=1, hardware pins are effective.

**PSWE:** When PSWE=0, internal switch for 2nd PWM is disabled. When PSWE=1, internal switch for 2nd PWM is enabled.

### VCOM Control (R06h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | nOTP | VMC4 | VMC3 | VMC2 | VMC1 | VMC0 | 0 | 0 | eOTP | VDV4 | VDV3 | VDV2 | VDV1 | VDV0 |
| Default | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |

**VDV4-0:** Set the COMPP voltage. These bits define the VCOMPP voltage 1.5 to 2.7 times the Vref voltage.

| VDV4 | VDV3 | VDV2 | VDV1 | VDV0 | COMPP |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | Reference from external voltage |
| 0 | 0 | 0 | 0 | 1 | Vref x 1.50 |
| 0 | 0 | 0 | 1 | 0 | Vref x 1.54 |
| 0 | 0 | 0 | 1 | 1 | Vref x 1.58 |
| 0 | 0 | 1 | 0 | 0 | Vref x 1.62 |
| : | : | : | : | : | : Step = 0.04 : |
| 1 | 1 | 1 | 0 | 0 | Vref x 2.58 |
| 1 | 1 | 1 | 0 | 1 | Vref x 2.62 |
| 1 | 1 | 1 | 1 | 0 | Vref x 2.66 |
| 1 | 1 | 1 | 1 | 1 | Vref x 2.70 |

**Note:** Vref is the internal reference voltage equals to 1.25V.

**eOTP:** eOTP=0, COMPP voltage is set by programmed OTP value. eOTP=1, COMPP voltage is set by VD4-0 SPI register.

**VMC4-0:** Set the COMC voltage. These bits define the VCOM DC voltage 0.22 to 2.02 times the Vref voltage.

| VMC4 | VMC3 | VMC2 | VMC1 | VMC0 | COMC |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | Reference from external voltage |
| 0 | 0 | 0 | 0 | 1 | Vref x 0.22 |
| 0 | 0 | 0 | 1 | 0 | Vref x 0.28 |
| 0 | 0 | 0 | 1 | 1 | Vref x 0.34 |
| 0 | 0 | 1 | 0 | 0 | Vref x 0.40 |
| : | : | : | : | : | : Step = 0.06 : |
| 1 | 1 | 1 | 0 | 0 | Vref x 1.84 |
| 1 | 1 | 1 | 0 | 1 | Vref x 1.90 |
| 1 | 1 | 1 | 1 | 0 | Vref x 1.96 |
| 1 | 1 | 1 | 1 | 1 | Vref x 2.02 |

**Note:** Vref is the internal reference voltage equals to 1.25V.

**nOTP:** nOTP=0, COMC voltage is set by programmed OTP value. nOTP=1, COMC voltage is set by VMC4-0 SPI register.

## Vertical Porch (R07h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | VBP6 | VBP5 | VBP4 | VBP3 | VBP2 | VBP1 | VBP0 |
| Default | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x |

PS: RES=1, VBP default value: 0001100, RES=0, VBP default value: 0010010

**VBP6-0:** Set the delay period from falling edge of VSYNC to first valid line. The line data within this delay period will be treated as dummy line. The setting is only effective in SYNC mode timing.

| VBP6 | VBP5 | VBP4 | VBP3 | VBP2 | VBP1 | VBP0 | No. of clock cycle of HSYNC |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| | | | | | | | :<br>Step = 1<br>: |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 124 |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 125 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 126 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 127 |

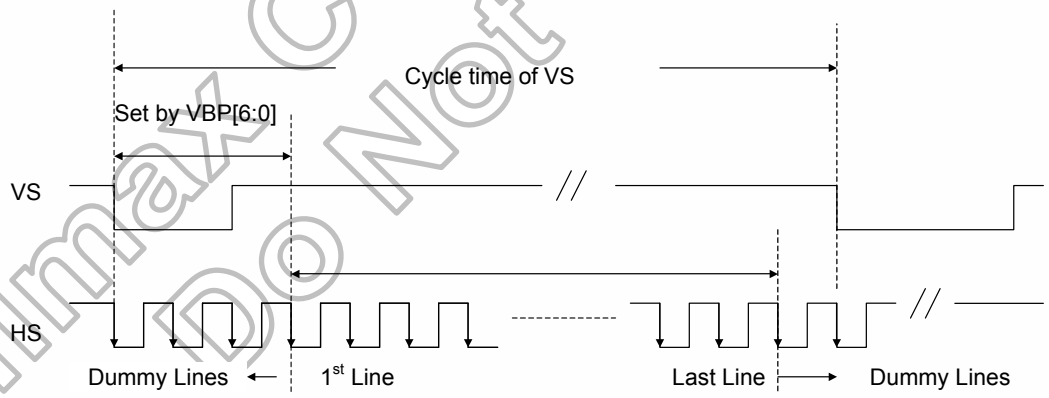



**Figure 8.3 Vertical Data**

## Horizontal Porch (R08h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | 0 | STH1 | STH0 | HBP7 | HBP6 | HBP5 | HBP4 | HBP3 | HBP2 | HBP1 | HBP0 |
| Default | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |

**Note:** RES=1, HBP default value: 00101011, RES=0, HBP default value: 01100110

**HBP7-0:** Set the delay period from falling edge of HSYNC signal to first valid data. The data exceeds 480 pixels and before the first valid data will be treated as dummy data. The setting is only effective in SYNC mode timing.

| HBP7 | HBP6 | HBP5 | HBP4 | HBP3 | HBP2 | HBP1 | HBP0 | No. of clock cycle |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | Can't set |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | Can't set |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | Can't set |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 9 |
| | | | | | | | | :<br>Step = 1<br>: |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 254 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 |

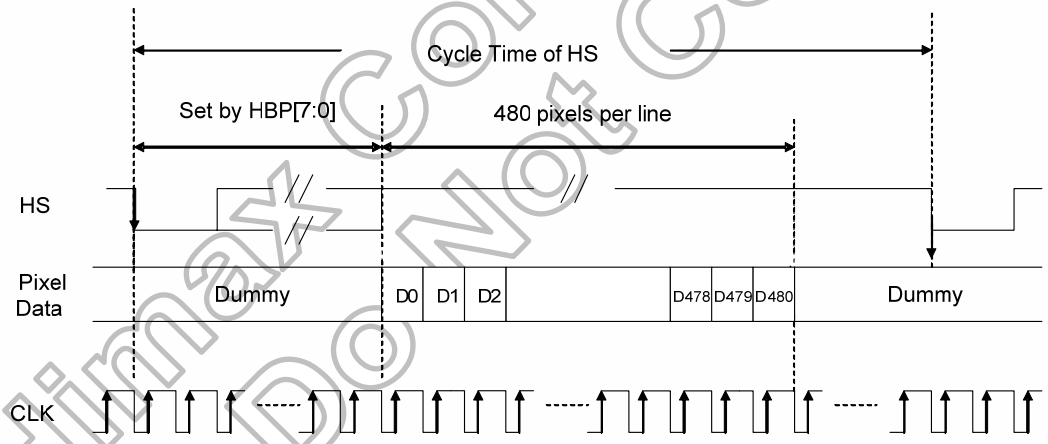



**Figure 8.4 Horizontal Data**

**STH1-0:** Adjust the first valid data by dot clock. This setting is only valid in serial RGB input interface.
STH=00: +0 dot clock
STH=01: +1 dot clock
STH=10: +2 dot clock
STH=11: +3 dot clock

### Brightness/contrast control (R09h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | BR6 | BR5 | BR4 | BR3 | BR2 | BR1 | BR0 | 0 | 0 | 0 | CON4 | CON3 | CON2 | CON1 | CON0 |
| Default | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

**CON4-0:** Display Contrast level adjustment. (0.125/step) Adjust range from 00h (level=0) to 1Fh(level=3.875). Default value is 08h(level=1).
**BR6-0:** Display Brightness level adjustment. (2/step) Adjust range from 00h (level=-128) to 7Fh(level=+126). Default value is 40h(level=0).

### CABC function control (R0Fh)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Dout | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | DBEN |
| Default | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

**DBEN:** DBEN=0, CABC function is disabled. DBEN=1, CABC function is enabled.
**Dout:** When use CPWM signal to drive external LED driver, please set Dout bit to 1.

### Gamma control 1 (R10h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PKP 12 | PKP 11 | PKP 10 | 0 | 0 | 0 | 0 | 0 | PKP 02 | PKP 01 | PKP 00 |
| Default | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### Gamma control 2 (R11h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PKP 32 | PKP 31 | PKP 30 | 0 | 0 | 0 | 0 | 0 | PKP 22 | PKP 21 | PKP 20 |
| Default | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

### Gamma control 3 (R12h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PKP 52 | PKP 51 | PKP 50 | 0 | 0 | 0 | 0 | 0 | PKP 42 | PKP 41 | PKP 40 |
| Default | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |

### Gamma control 4 (R13h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PRP 12 | PRP 11 | PRP 10 | 0 | 0 | 0 | 0 | 0 | PRP 02 | PRP 01 | PRP 00 |
| Default | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### Gamma control 5 (R14h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PKN 12 | PKN 11 | PKN 10 | 0 | 0 | 0 | 0 | 0 | PKN 02 | PKN 01 | PKN 00 |
| Default | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |

### Gamma control 6 (R15h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PKN 32 | PKN 31 | PKN 30 | 0 | 0 | 0 | 0 | 0 | PKN 22 | PKN 21 | PKN 20 |
| Default | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |

## Gamma control 7 (R16h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PKN 52 | PKN 51 | PKN 50 | 0 | 0 | 0 | 0 | 0 | PKN 42 | PKN 41 | PKN 40 |
| Default | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

## Gamma control 8 (R17h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | 0 | 0 | PRN 12 | PRN 11 | PRN 10 | 0 | 0 | 0 | 0 | 0 | PRN 02 | PRN 01 | PRN 00 |
| Default | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Gamma control 9 (R18h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | VRP 14 | VRP 13 | VRP 12 | VRP 11 | VRP 10 | 0 | 0 | 0 | 0 | VRP 03 | VRP 02 | VRP 01 | VRP 00 |
| Default | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |

## Gamma control 10 (R19h)

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 0 | 0 | 0 | VRN 14 | VRN 13 | VRN 12 | VRN 11 | VRN 10 | 0 | 0 | 0 | 0 | VRN 03 | VRN 02 | VRN 01 | VRN 00 |
| Default | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# 9. OTP Programming

### OTP write sequence

| Step | VMC OTP Operation |
|---|---|
| 1 | Power up the module. Set nOTP=1 and find out the appropriate value of VMC[4:0] and power off the system. |
| 2 | Power up the system with VDD=VDDIO=2.5V. If REG bit=1, set R02h=16'h3662. |
| 3 | Set appropriate values found from step 1 to register of VMC (R06h) |
| 4 | Set 04h=16'h0001 to stop internal power circuit. Wait 0.5s. |
| 5 | Set R60h=16'h8000 |
| 6 | Set R60h=16'hC000 |
| 7 | Connect 7.3V to VGH and 0V to VGL |
| 8 | Set R60h=16'hC200 |
| 9 | Set R60h=16'hC280 |
| 10 | Wait 200us for completing this program |
| 11 | Set R60h=16'hC200 |
| 12 | Remove 7.3V from VGH and 0V from VGL |
| 13 | Set R60h=16'h8200 |
| 14 | Set R60h=16'h0200 |
| 15 | Set R60h=16'h0040 |
| 16 | Set R60h=16'h0000 |

| Step | VDV OTP Operation |
|---|---|
| 1 | Power up the module. Set eOTP=1 and find out the appropriate value of VDV[4:0] and power off the system. |
| 2 | Power up the system with VDD=VDDIO=2.5V. If REG bit=1, set R02h=16'h3662. |
| 3 | Set appropriate values found from step 1 to register of VDV (R06h) |
| 4 | Set 04h=16'h0001 to stop internal power circuit. Wait 0.5s. |
| 5 | Set R60h=16'h8000 |
| 6 | Set R60h=16'hC000 |
| 7 | Connect 7.3V to VGH and 0V to VGL |
| 8 | Set R60h=16'hC000 |
| 9 | Set R60h=16'hC080 |
| 10 | Wait 200us for completing this program |
| 11 | Set R60h=16'hC000 |
| 12 | Remove 7.3V from VGH and 0V from VGL |
| 13 | Set R60h=16'h8000 |
| 14 | Set R60h=16'h0000 |
| 15 | Set R60h=16'h0040 |
| 16 | Set R60h=16'h0000 |



If you want to check if the OTP cell is still available for COMC/COMPP programming, you can read the current status from R61h shown below. R61h is only for read.

| R/W | RS | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9 | IB8 | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | 1 | 0 | 0 | IDA | VDV 4 | VDV 3 | VDV 2 | VDV 1 | VDV 0 | 0 | 0 | IDC | VMC 4 | VMC 3 | VMC 2 | VMC 1 | VMC 0 |

You can check the IDC/IDA bit to see if the VMC/VDV is still programmable or not. If IDC=0, you can program new VMC[4:0] value to OTP. If IDC=1, it means that the OTP cell have already programmed twice and you can't program it any more. The meaning of IDA is the same.

## OTP programming circuit

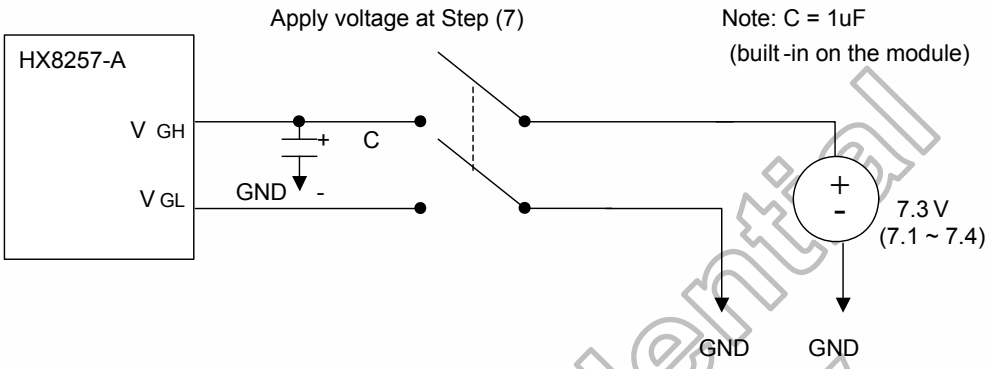



**Figure 9.1 OTP Programming Circuit**

# 10. DC Characteristics

## Absolute Maximum Rating

(DVSS = AVSS = VCHS = VSSRC = 0V)

| Symbol | Parameter | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| VDDIO | Logic Power Supply | -0.3 | - | 4.0 | V |
| VCI | Booster Power Supply | -0.3 | - | 5.0 | V |
| VCIP | Analog Circuit Power Supply | -0.3 | - | 5.0 | V |
| VCIX2J | Power supply of analog block and VLCD/VDC regulation | -0.3 | - | 6.0 | V |
| VDD | Power pin for internal logic circuit | -0.3 | - | 2.7 | V |
| VGH-VGL | Using External VGH、VGL | -0.3 | - | 45.0 | V |
| $T_A$ | Operating Temperature | -30 | - | 85 | V |
| $T_{STG}$ | Storage Temperature | -55 | - | 125 | ℃ |

## DC characteristics

(Unless otherwise specified, Voltage Referenced to DVSS, VDDIO = 2.2V, $T_A$ = 25℃)

| Symbol | Parameter | Test condition | Spec. | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| VDDIO | Power supply pin of IO pins | Recommend Operating Voltage Possible Operating Voltage | 1.8 | - | 3.6 | V |
| VCI | Booster Reference Supply Voltage Range | Recommend Operating Voltage Possible Operating Voltage | ≧VDDIO & ≧3 | - | 3.6 | V |
| $I_{sleep}$ | Sleep mode current | - | - | 50 | | μA |
| $I_{VCI}$ | VCI Operating mode current | VCI=3.3V、VDDIO=3.3V at Black Pattern with 4.3” Panel | - | 13 | 16 | mA |
| VCL | Negative $V_{CI}$ Output Voltage | No panel loading | - VCI | - | - VCI+0.7 | V |
| VCIX2 | VCIX2 primary booster efficiency(3) | No panel loading, ITO for VCIX2,VCI and VCHS = 10 Ohm | 5.2 | 5.4 | 5.6 | V |
| VDC | VDC Output Voltage | VDC[3:0]=1011 | 4.9 | 5 | 5.1 | V |
| VGH | Gate driver High Output Voltage Booster efficiency(1) | No panel loading; 3x booster | 84 | 89.5 | - | % |
| | | No panel loading; 4x booster | 80 | 88.5 | - | % |
| VGL | Gate driver Low Output Voltage | VGL= -2 x VDC VDC[3:0]=1011 | -10 | -10 | -9 | V |
| COMH | VCOM High Output Voltage(2) | - | -3% | COMC+COMPP | 3% | V |
| COML | VCOM Low Output Voltage(2) | - | -3% | COMC-COMPP | 3% | V |
| VLCD | VLCD Output Voltage | VRH[5:0]=110011 | 5.0 | 5.1 | 5.2 | V |
| $V_{OH1}$ | Logic High Output Voltage | I out = -100μA | 0.9*VDDIO | - | VDDIO | V |
| $V_{VD}$ | Source Output Voltage Deviation | - | - | ±20 | ±30 | mV |
| $V_{OS}$ | Source Output Voltage Offset | - | - | - | ±30 | mV |
| $V_{OL1}$ | Logic Low Output Voltage | I out = 100μA | 0 | - | 0.1*VDDIO | V |
| $V_{IH1}$ | Logic High Input voltage | 2.5V < VDDIO < 3.6V<br>1.8V < VDDIO ≦ 2.5V | 0.7*VDDIO<br>0.8*VDDIO | - | VDDIO | V |
| $V_{IL1}$ | Logic Low Input voltage | 2.5V < VDDIO < 3.6V<br>1.8V < VDDIO ≦ 2.5V | 0 | - | 0.3*VDDIO<br>0.2*VDDIO | V |
| $I_{OH}$ | Logic High Output Current Source | V out = VDD – 0.4V | 50 | - | - | μA |
| $I_{OL}$ | Logic Low Output Current Drain | V out = 0.4V | - | - | -50 | μA |
| $I_{OZ}$ | Logic Output Tri-state Current Drain Source | - | -1 | - | 1 | μA |
| $I_{IL/I IH}$ | Logic Input Current | - | -1 | - | 1 | μA |

**Note :** (1) VGH efficiency = VGH / (VDC x n) x 100% (where n = booster factor)
(2) COML < 0V, COMH < VCIX2J, COMH > VCI
(3) VCIX2 voltage is related with VCI voltage & VCIX2 loading.Figure10.1 shows the estimated VCIX2 voltage under different VCIX2 current loading when ITO for VCIX2、VCI and VCHS = 10Ω.

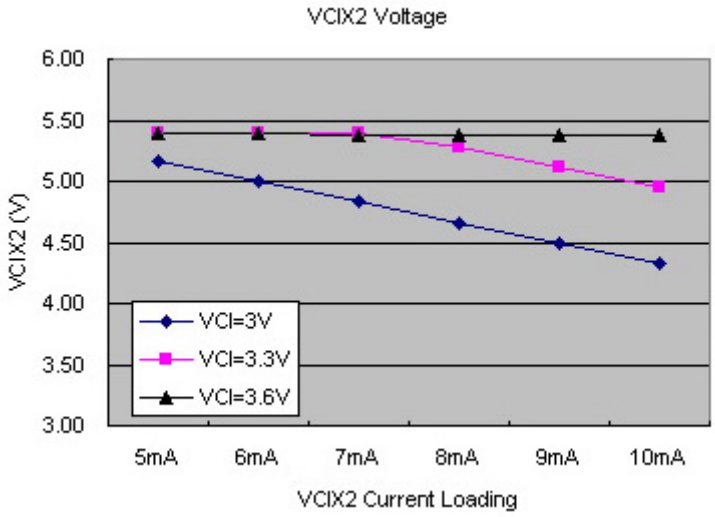



**Figure 10.1 VCIX2 Voltage**

# 11. AC Characteristics

The HX8257-A both supports DE mode and Sync mode timing. The mode was decided by DE signal internally. When DE is pulled low, the HX8257-A uses HS+VS for timing control and this timing mode is sync mode. When DE is pulled high for active data and pulled low for blanking data, the HX8257-A uses DE for timing control and this timing mode is DE mode. The detail timing chart showed below.

## 11.1 Timing relationship among DE、Source Output、Gate Output、VCOM

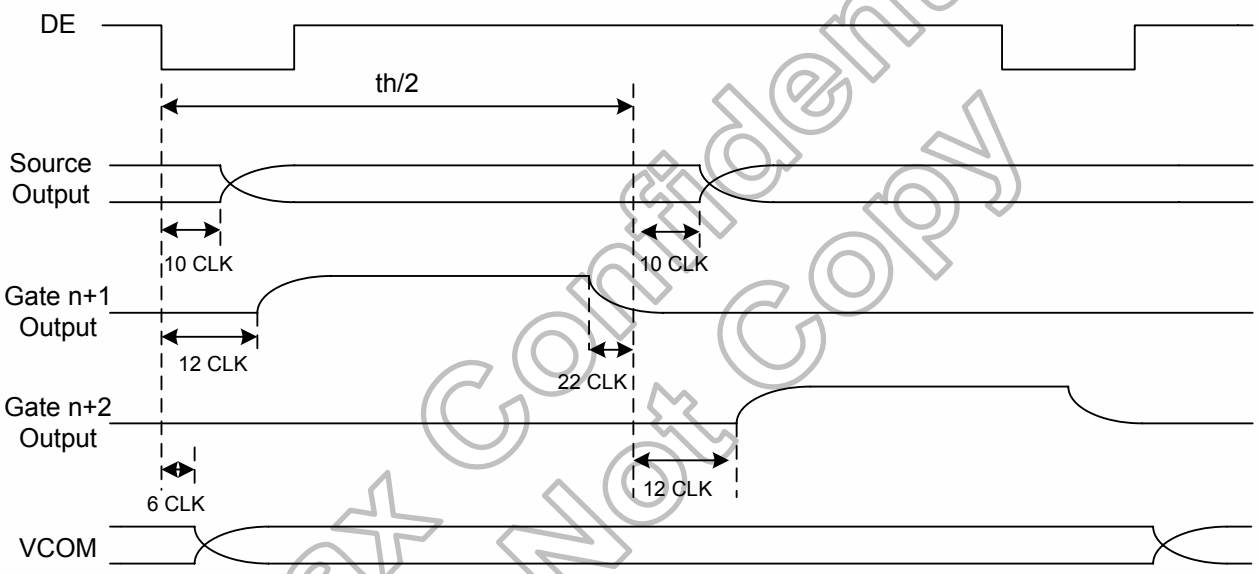



**Figure 11.1 Timing Relationship**

## 11.2 Parallel RGB input timing requirement

(480RGBx272, $T_A$=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

| Parameter | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Clock cycle | $f_{CLK}$ (1) | - | 9 | 15 | MHz |
| Hsync cycle | 1/th | - | 17.14 | - | KHz |
| Vsync cycle | 1/tv | - | 59.94 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th | 525 | 525 | 605 | CLK |
| Horizontal display period | thd | 480 | 480 | 480 | CLK |
| Horizontal front porch | thf | 2 | 2 | 82 | CLK |
| Horizontal pulse width | thp (2) | 2 | 41 | 41 | CLK |
| Horizontal back porch | thb (2) | 2 | 2 | 41 | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv | 285 | 286 | 399 | H (1) |
| Vertical display period | tvd | 272 | 272 | 272 | H (1) |
| Vertical front porch | tvf | 1 | 2 | 227 | H (1) |
| Vertical pulse width | tvp (2) | 1 | 10 | 11 | H (1) |
| Vertical back porch | tvb (2) | 1 | 2 | 11 | H (1) |

**Note:** (1) Unit: CLK=1/ $f_{CLK}$ , H= th,
(2) It is necessary to keep tvp+tvb=12 and thp+thb=43 in sync mode. DE mode is unnecessary to keep it.

(480RGBx240, $T_A$=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

| Parameter | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Clock cycle | $f_{CLK}$(1) | - | 9.6 | 15 | MHz |
| Hsync cycle | 1/th | - | 15.72 | - | KHz |
| Vsync cycle | 1/tv | - | 60 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th | 525 | 612 | - | CLK |
| Horizontal display period | thd | 480 | 480 | 480 | CLK |
| Horizontal front porch | thf | 2 | 30 | - | CLK |
| Horizontal pulse width | thp | 2 | 46 | - | CLK |
| Horizontal back porch | thb | 2 | 56 | - | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv | - | 262 | 275 | H(1) |
| Vertical display period | tvd | - | 240 | - | H(1) |
| Vertical front porch | tvf | 1 | 4 | - | H(1) |
| Vertical pulse width | tvp | 1 | 3 | - | H(1) |
| Vertical back porch | tvb | 1 | 15 | - | H(1) |

**Note:** (1) Unit: CLK=1/ $f_{CLK}$ , H=th,

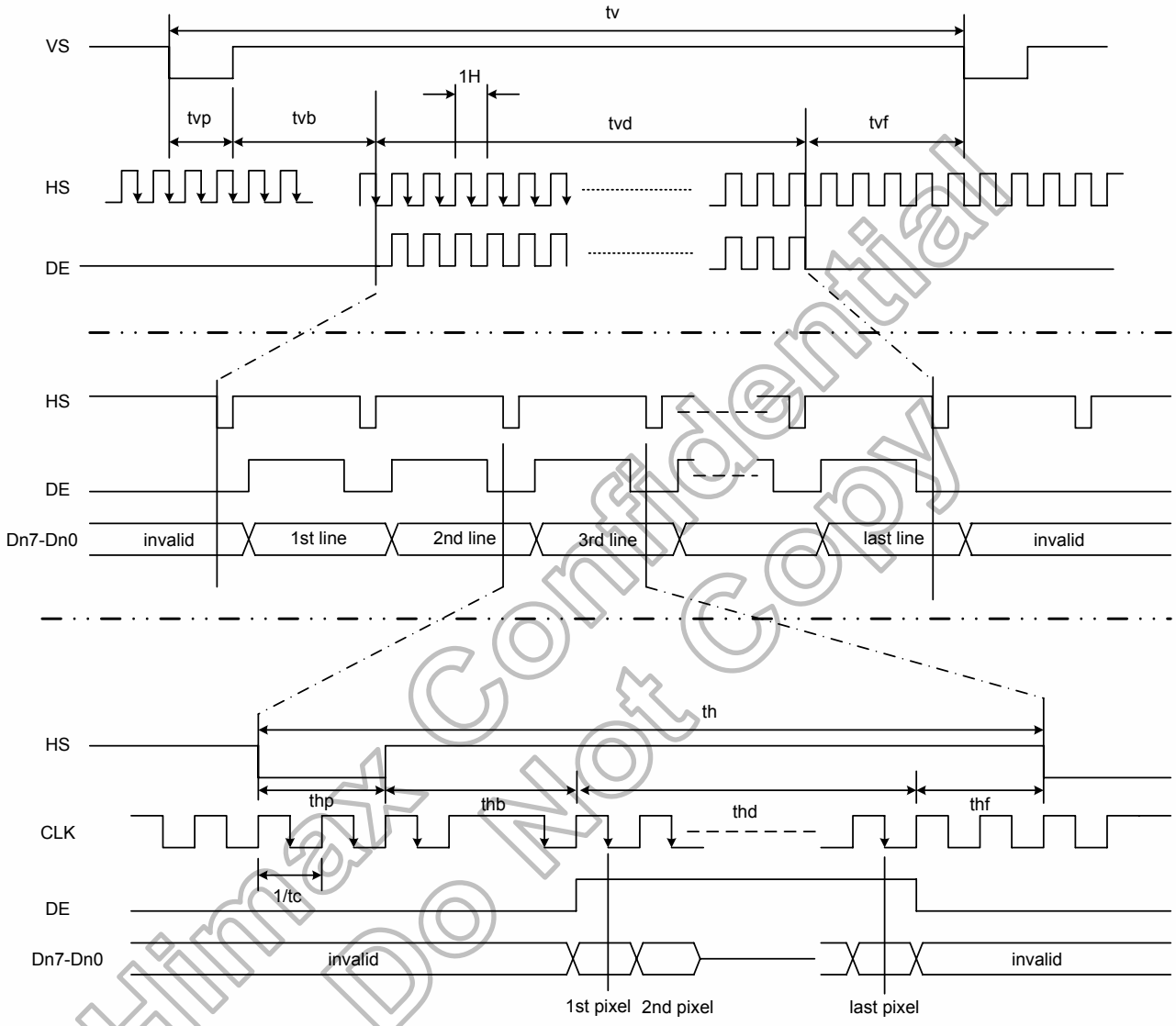



**Figure 11.2 Parallel RGB Input Timing**

## 11.3 Serial RGB input timing requirement

(480RGBx272, $T_A$=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

| Parameter | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Clock cycle | $f_{CLK}$(1) | - | 27 | 33 | MHz |
| Hsync cycle | 1/th | - | 17.14 | - | KHz |
| Vsync cycle | 1/tv | - | 59.94 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th | 1575 | 1575 | 1815 | CLK |
| Horizontal display period | thd | 1440 | 1440 | 1440 | CLK |
| Horizontal front porch | thf | 6 | 6 | 246 | CLK |
| Horizontal pulse width | thp | 6 | 123 | 123 | CLK |
| Horizontal back porch | thb | 6 | 6 | 123 | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv | 285 | 286 | 399 | H(1) |
| Vertical display period | tvd | 272 | 272 | 272 | H(1) |
| Vertical front porch | tvf | 1 | 2 | 227 | H(1) |
| Vertical pulse width | tvp | 1 | 10 | 11 | H(1) |
| Vertical back porch | tvb | 1 | 2 | 11 | H(1) |

**Note:** (1) Unit: CLK=1/ $f_{CLK}$ , H=th

(480RGBx240, $T_A$=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

| Parameter | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Clock cycle | $f_{CLK}$(1) | - | 28.8 | 33 | MHz |
| Hsync cycle | 1/th | - | 15.72 | - | KHz |
| Vsync cycle | 1/tv | - | 60 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th | 1575 | 1836 | - | CLK |
| Horizontal display period | thd | 1440 | 1440 | 1440 | CLK |
| Horizontal front porch | thf | 6 | 90 | - | CLK |
| Horizontal pulse width | thp | 6 | 138 | - | CLK |
| Horizontal back porch | thb | 6 | 168 | - | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv | - | 262 | 275 | H(1) |
| Vertical display period | tvd | - | 240 | - | H(1) |
| Vertical front porch | tvf | 1 | 4 | - | H(1) |
| Vertical pulse width | tvp | 1 | 3 | - | H(1) |
| Vertical back porch | tvb | 1 | 15 | - | H(1) |

**Note:** (1) Unit: CLK=1/ $f_{CLK}$ , H=th

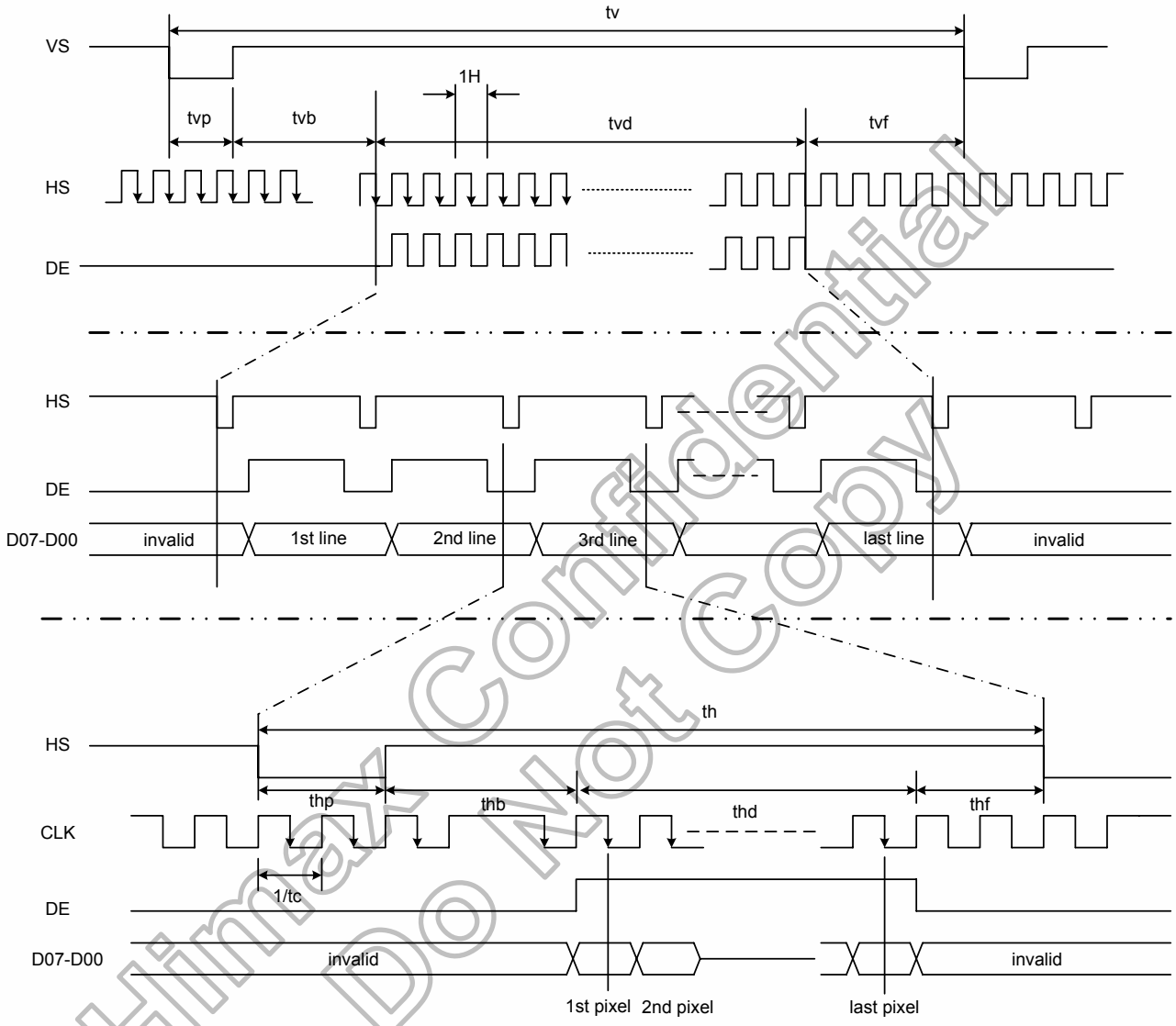



**Figure 11.3 Serial RGB Input Timing**

## 11.4 Input setup timing requirement

($T_A$=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V, tr [1]=tf [1]=2ns)

| Parameter | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| DISP setup time | $t_{diss}$ | 10 | - | - | ns |
| DISP hold time | $t_{dish}$ | 10 | - | - | ns |
| Clock period | $PW_{CLK}$ [2] | 66.7 | - | - | ns |
| Clock pulse high period | PWH [2] | 26.7 | - | - | ns |
| Clock pulse low period | PWL [2] | 26.7 | - | - | ns |
| Hsync setup time | $t_{hs}$ | 10 | - | - | ns |
| Hsync hold time | $t_{hh}$ | 10 | - | - | ns |
| Data setup time | $t_{ds}$ | 10 | - | - | ns |
| Data hold time | $t_{dh}$ | 10 | - | - | ns |
| DE setup time | $t_{des}$ | 10 | - | - | ns |
| DE hold time | $t_{deh}$ | 10 | - | - | ns |
| Vsync setup time | $t_{vhs}$ | 10 | - | - | ns |
| Vsync hold time | $t_{vhh}$ | 10 | - | - | ns |

**Note:** (1) tr, tf is defined 10% to 90% of signal amplitude.
(2) For parallel interface, maximum clock frequency is 15MHz.

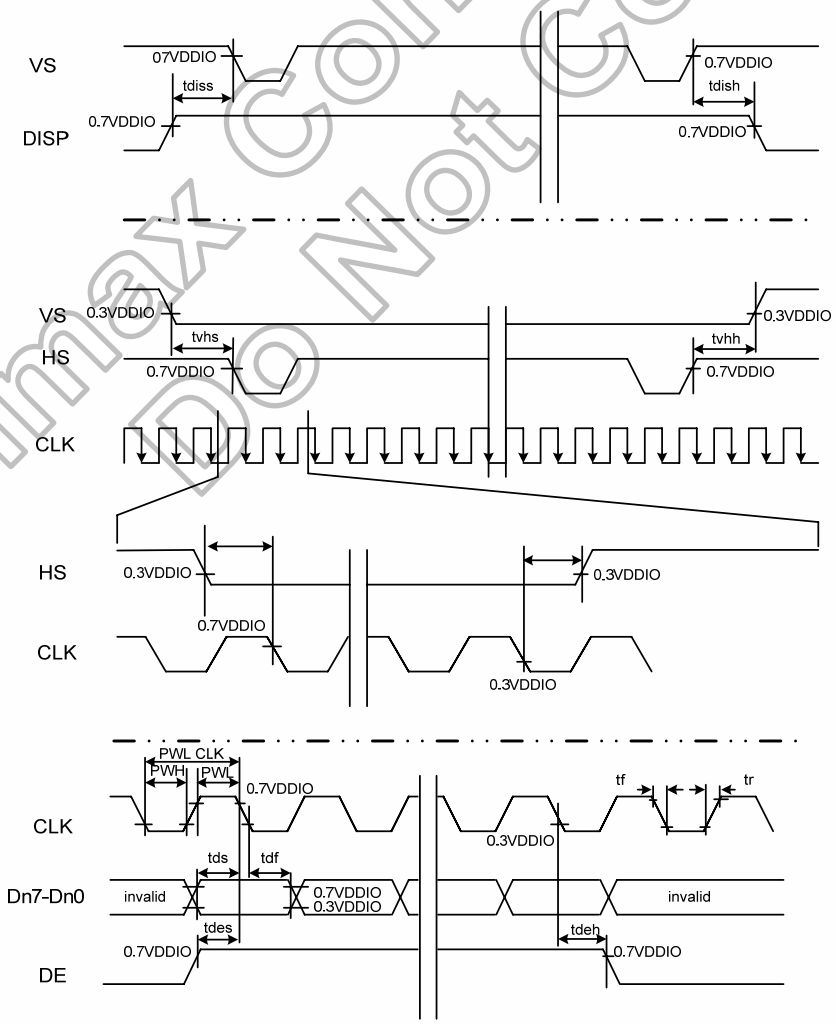



**Figure 11.4 Input Setup Timing Requirement**

# 12. Application Circuit

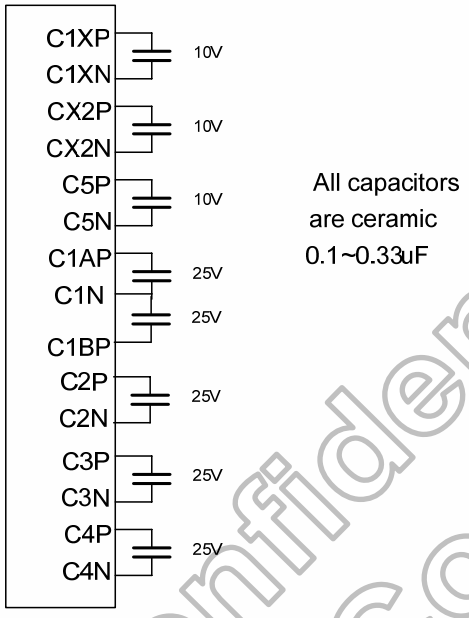



**Figure 12.1 Booster Capacitors (VGH=4VDC/VGL=-2VDC)**

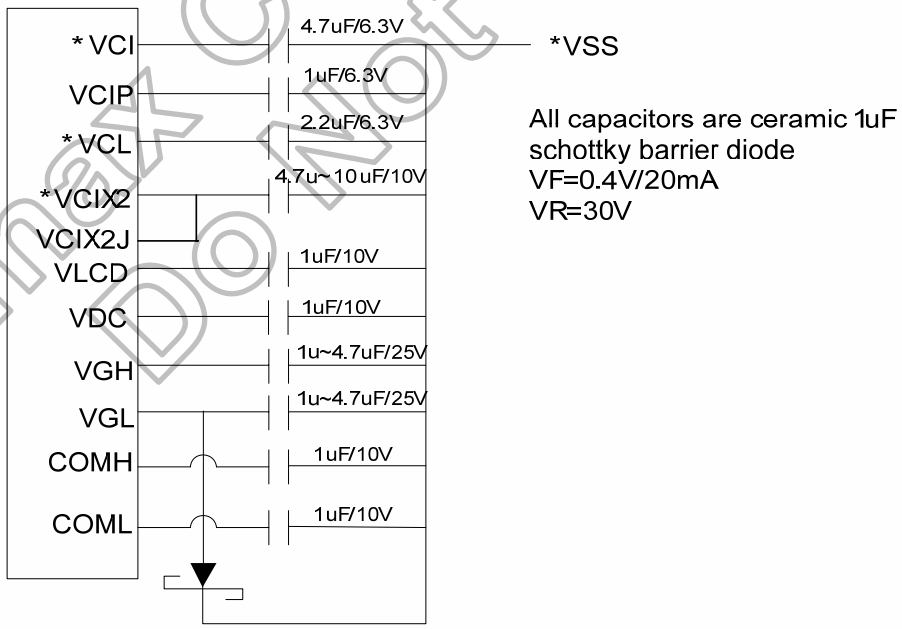



**Figure 12.2 Voltage Stable Capacitors & Schottky Diode**

(a) Capacitors on VCI should be 4.7uF.
(b) Capacitors on VCL should be 2.2uF
(c) Capacitors on VCIX2 should be 4.7~10uF
(d) Capacitors on VGH, VGL should be 1~4.7uF
(e) Other capacitors should be 1uF

**Note:** (1) VCI should be separated from VCIP at ITO layout on glass to provide noise free path
(2) DVSS, VCHS, AVSS, and VSSRC should be separated at ITO layout on glass to provide noise free path

# 13. Ordering Information

| Part NO. | Package |
|---|---|
| HX8257-A01BPDXXX | PD：means COG<br>XXX：means chip thickness(μm), default 400μm |

# 14. Revision History

| Version | Date | Description of Changes |
|---|---|---|
| 01 | 2008/11/30 | New setup |