



DATA SHEET

(DOC No. HX8227-A-DS)

HX8227-A01

720CH TFT LCD Source Driver
with Built-in TCON

Preliminary version 04, March 2006

1. General Description

HX8227-A is a 720-channel output source driver with built-in TCON (Timing Controller). The source driver receives 24-bit digital display data with single clock edge and generates corresponding 256 level gray scale voltage outputs to realize 16M colors display. Positive and negative polarity voltages can be alternately output from each channel in line (row) inversion or frame inversion driving methods.

2. Features

Source Driver

- 720 channels output source driver for TFT LCD panel
- Support 8-bit data input for 256 level gray scales
- Dynamic range: AVSS+0.2V ~ AVDD-0.2V
- Output voltage deviation: $\pm 20\text{mV}$.
- Driver power supply voltage (AVDD): 4.8 ~ 5.2V
- Bare chip with gold bumper for COG solution.

Embedded Timing Controller

- Support 480 RGBx272, 480RGBx240, 240RGBx320, and 240RGBx240 resolutions
- Supporting 24-bit (8 bits x 3) parallel RGB and 8-bit serial RGB input interfaces
- Operation frequency: 15 MHz max in parallel RGB interface. 33MHz max in serial RGB interface.
- Support PAL decimation in 480RGBx240 or 240RGBx240 resolutions.
- Selectable line (row) inversion and frame inversion driving schemes.
- Provide the control timing of the source driver and the gate driver.
- Logic power supply voltage (DVDD): 2.25V ~ 3.6V

3. Block Diagram

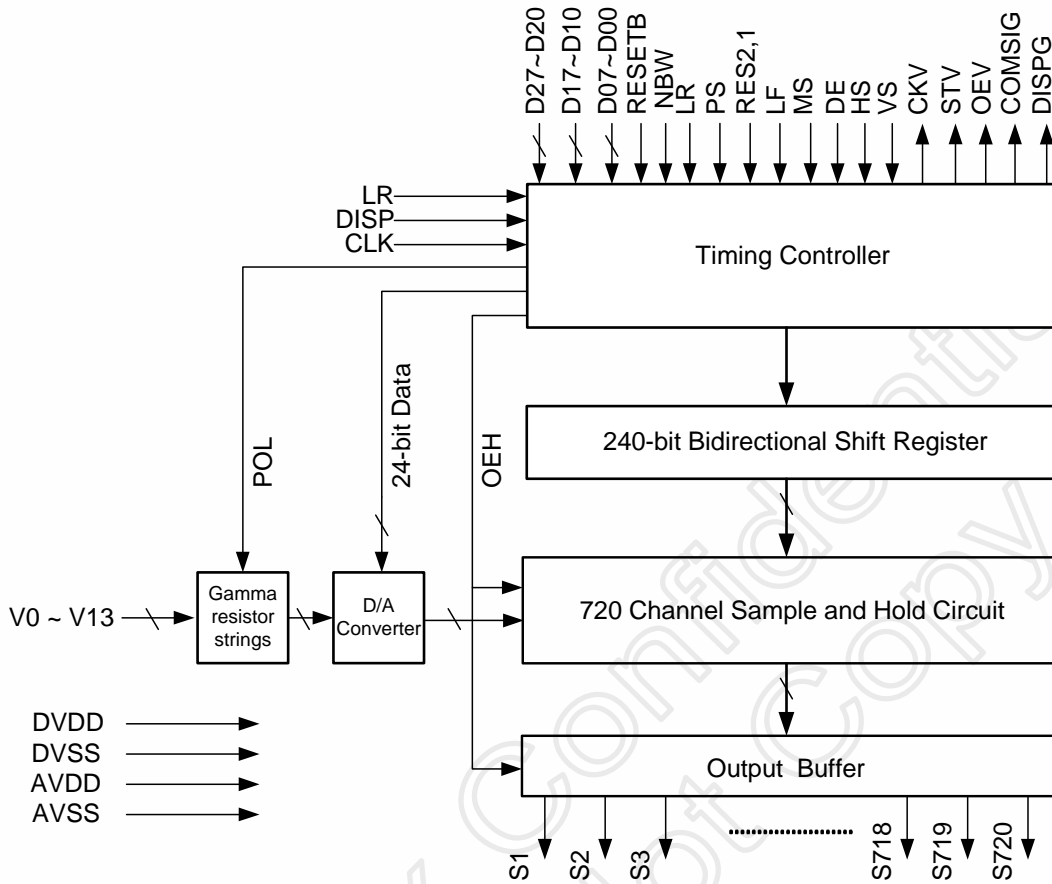


Figure 3. 1 Block diagram

4. PAD Location (IC Face View)

Remark DUMMY(*) are used to measure to contact resistance

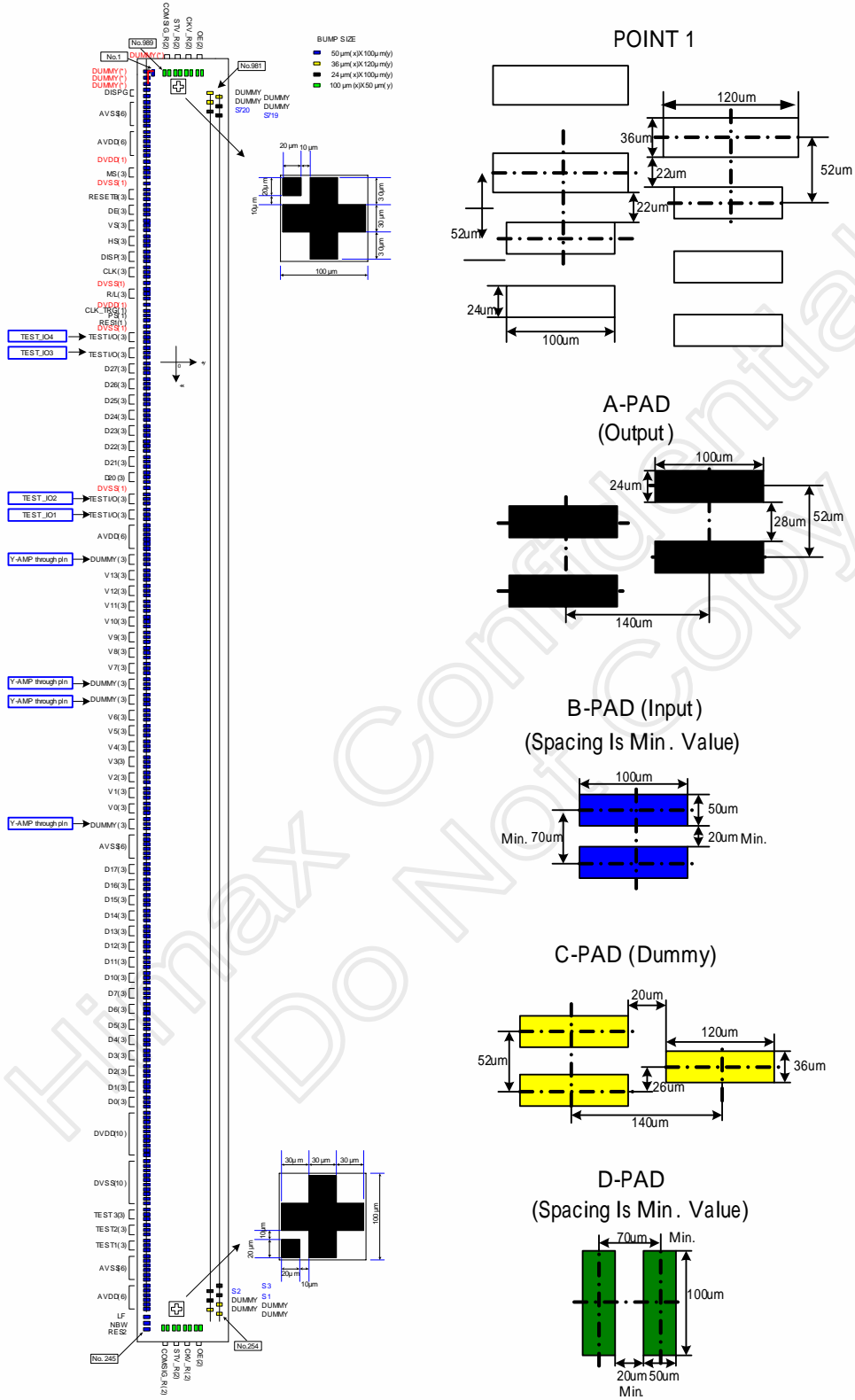


Figure 4. 1 Pad location

Chip Information

| Items | Pad name | Size | | Unit |
|-----------------|---------------------|-------|------|------|
| | | X | Y | |
| Chip size | - | 19100 | 1300 | um |
| Wafer thickness | - | 400 | | |
| Bump size | Output pad (Type A) | 24 | 100 | |
| | Input pad (Type B) | 50 | 100 | |
| | Dummy pad (Type C) | 36 | 120 | |

Table 4. 1

Alignment Mark Configuration and Coordinate

(1-a) (x, y) = (-9201.80, -344.00)

(1-b) (x, y) = (9201.80, -344.00)

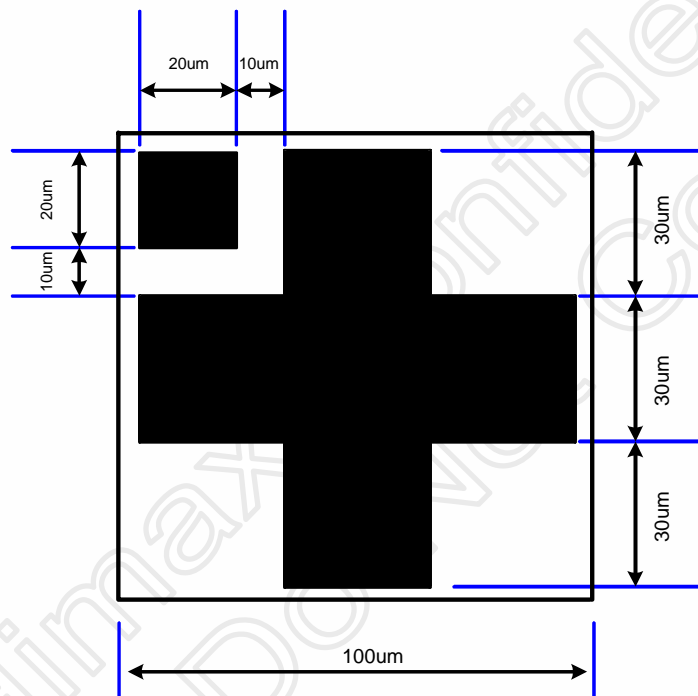


Figure 4. 2 Alignment mark configuration

Pad layout coordinate (Unit: μm)

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|----------|-------|------|-----------|---------|---------|-----|----------|-------|------|-----------|---------|---------|
| 1 | DUMMY(*) | -9422 | -427 | B | -25 | -95 | 51 | TEST I/O | -5125 | -522 | B | 70 | 0 |
| 2 | DUMMY(*) | -9447 | -522 | B | 70 | 0 | 52 | TEST I/O | -5055 | -522 | B | 70 | 0 |
| 3 | DUMMY(*) | -9377 | -522 | B | 70 | 0 | 53 | TEST I/O | -4985 | -522 | B | 80 | 0 |
| 4 | DUMMY(*) | -9307 | -522 | B | 160 | 0 | 54 | TEST I/O | -4905 | -522 | B | 70 | 0 |
| 5 | DISPG | -9147 | -522 | B | 70 | 0 | 55 | TEST I/O | -4835 | -522 | B | 70 | 0 |
| 6 | DISPG | -9077 | -522 | B | 677 | 0 | 56 | TEST I/O | -4765 | -522 | B | 75 | 0 |
| 7 | AVSS | -8400 | -522 | B | 70 | 0 | 57 | D27 | -4690 | -522 | B | 70 | 0 |
| 8 | AVSS | -8330 | -522 | B | 70 | 0 | 58 | D27 | -4620 | -522 | B | 70 | 0 |
| 9 | AVSS | -8260 | -522 | B | 70 | 0 | 59 | D27 | -4550 | -522 | B | 80 | 0 |
| 10 | AVSS | -8190 | -522 | B | 70 | 0 | 60 | D26 | -4470 | -522 | B | 70 | 0 |
| 11 | AVSS | -8120 | -522 | B | 70 | 0 | 61 | D26 | -4400 | -522 | B | 70 | 0 |
| 12 | AVSS | -8050 | -522 | B | 100 | 0 | 62 | D26 | -4330 | -522 | B | 80 | 0 |
| 13 | AVDD | -7950 | -522 | B | 70 | 0 | 63 | D25 | -4250 | -522 | B | 70 | 0 |
| 14 | AVDD | -7880 | -522 | B | 70 | 0 | 64 | D25 | -4180 | -522 | B | 70 | 0 |
| 15 | AVDD | -7810 | -522 | B | 70 | 0 | 65 | D25 | -4110 | -522 | B | 80 | 0 |
| 16 | AVDD | -7740 | -522 | B | 70 | 0 | 66 | D24 | -4030 | -522 | B | 70 | 0 |
| 17 | AVDD | -7670 | -522 | B | 70 | 0 | 67 | D24 | -3960 | -522 | B | 70 | 0 |
| 18 | AVDD | -7600 | -522 | B | 100 | 0 | 68 | D24 | -3890 | -522 | B | 80 | 0 |
| 19 | DVDD* | -7500 | -522 | B | 80 | 0 | 69 | D23 | -3810 | -522 | B | 70 | 0 |
| 20 | MS | -7420 | -522 | B | 70 | 0 | 70 | D23 | -3740 | -522 | B | 70 | 0 |
| 21 | MS | -7350 | -522 | B | 70 | 0 | 71 | D23 | -3670 | -522 | B | 80 | 0 |
| 22 | MS | -7280 | -522 | B | 70 | 0 | 72 | D22 | -3590 | -522 | B | 70 | 0 |
| 23 | DVSS* | -7210 | -522 | B | 80 | 0 | 73 | D22 | -3520 | -522 | B | 70 | 0 |
| 24 | RESETB | -7130 | -522 | B | 70 | 0 | 74 | D22 | -3450 | -522 | B | 80 | 0 |
| 25 | RESETB | -7060 | -522 | B | 70 | 0 | 75 | D21 | -3370 | -522 | B | 70 | 0 |
| 26 | RESETB | -6990 | -522 | B | 80 | 0 | 76 | D21 | -3300 | -522 | B | 70 | 0 |
| 27 | DE | -6910 | -522 | B | 70 | 0 | 77 | D21 | -3230 | -522 | B | 80 | 0 |
| 28 | DE | -6840 | -522 | B | 70 | 0 | 78 | D20 | -3150 | -522 | B | 70 | 0 |
| 29 | DE | -6770 | -522 | B | 80 | 0 | 79 | D20 | -3080 | -522 | B | 70 | 0 |
| 30 | VSC | -6690 | -522 | B | 70 | 0 | 80 | D20 | -3010 | -522 | B | 80 | 0 |
| 31 | VSC | -6620 | -522 | B | 70 | 0 | 81 | DVSS | -2930 | -522 | B | 85 | 0 |
| 32 | VSC | -6550 | -522 | B | 80 | 0 | 82 | TEST I/O | -2845 | -522 | B | 70 | 0 |
| 33 | HSC | -6470 | -522 | B | 70 | 0 | 83 | TEST I/O | -2775 | -522 | B | 70 | 0 |
| 34 | HSC | -6400 | -522 | B | 70 | 0 | 84 | TEST I/O | -2705 | -522 | B | 80 | 0 |
| 35 | HSC | -6330 | -522 | B | 80 | 0 | 85 | TEST I/O | -2625 | -522 | B | 70 | 0 |
| 36 | DISP | -6250 | -522 | B | 70 | 0 | 86 | TEST I/O | -2555 | -522 | B | 70 | 0 |
| 37 | DISP | -6180 | -522 | B | 70 | 0 | 87 | TEST I/O | -2485 | -522 | B | 95 | 0 |
| 38 | DISP | -6110 | -522 | B | 80 | 0 | 88 | AVDD | -2390 | -522 | B | 70 | 0 |
| 39 | CLK | -6030 | -522 | B | 70 | 0 | 89 | AVDD | -2320 | -522 | B | 70 | 0 |
| 40 | CLK | -5960 | -522 | B | 70 | 0 | 90 | AVDD | -2250 | -522 | B | 70 | 0 |
| 41 | CLK | -5890 | -522 | B | 80 | 0 | 91 | AVDD | -2180 | -522 | B | 70 | 0 |
| 42 | DVSS* | -5810 | -522 | B | 80 | 0 | 92 | AVDD | -2110 | -522 | B | 70 | 0 |
| 43 | R/L | -5730 | -522 | B | 70 | 0 | 93 | AVDD | -2040 | -522 | B | 100 | 0 |
| 44 | R/L | -5660 | -522 | B | 70 | 0 | 94 | DUMMY | -1940 | -522 | B | 70 | 0 |
| 45 | R/L | -5590 | -522 | B | 80 | 0 | 95 | DUMMY | -1870 | -522 | B | 70 | 0 |
| 46 | DVDD | -5510 | -522 | B | 80 | 0 | 96 | DUMMY | -1800 | -522 | B | 80 | 0 |
| 47 | CLK_TRG | -5430 | -522 | B | 70 | 0 | 97 | V13 | -1720 | -522 | B | 70 | 0 |
| 48 | PS | -5360 | -522 | B | 70 | 0 | 98 | V13 | -1650 | -522 | B | 70 | 0 |
| 49 | RES1 | -5290 | -522 | B | 80 | 0 | 99 | V13 | -1580 | -522 | B | 80 | 0 |
| 50 | DVSS* | -5210 | -522 | B | 85 | 0 | 100 | V12 | -1500 | -522 | B | 70 | 0 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|-------|-------|------|-----------|---------|---------|-----|------|------|------|-----------|---------|---------|
| 101 | V12 | -1430 | -522 | B | 70 | 0 | 151 | AVSS | 2250 | -522 | B | 70 | 0 |
| 102 | V12 | -1360 | -522 | B | 80 | 0 | 152 | AVSS | 2320 | -522 | B | 70 | 0 |
| 103 | V11 | -1280 | -522 | B | 70 | 0 | 153 | AVSS | 2390 | -522 | B | 100 | 0 |
| 104 | V11 | -1210 | -522 | B | 70 | 0 | 154 | D17 | 2490 | -522 | B | 70 | 0 |
| 105 | V11 | -1140 | -522 | B | 80 | 0 | 155 | D17 | 2560 | -522 | B | 70 | 0 |
| 106 | V10 | -1060 | -522 | B | 70 | 0 | 156 | D17 | 2630 | -522 | B | 80 | 0 |
| 107 | V10 | -990 | -522 | B | 70 | 0 | 157 | D16 | 2710 | -522 | B | 70 | 0 |
| 108 | V10 | -920 | -522 | B | 80 | 0 | 158 | D16 | 2780 | -522 | B | 70 | 0 |
| 109 | V9 | -840 | -522 | B | 70 | 0 | 159 | D16 | 2850 | -522 | B | 80 | 0 |
| 110 | V9 | -770 | -522 | B | 70 | 0 | 160 | D15 | 2930 | -522 | B | 70 | 0 |
| 111 | V9 | -700 | -522 | B | 80 | 0 | 161 | D15 | 3000 | -522 | B | 70 | 0 |
| 112 | V8 | -620 | -522 | B | 70 | 0 | 162 | D15 | 3070 | -522 | B | 80 | 0 |
| 113 | V8 | -550 | -522 | B | 70 | 0 | 163 | D14 | 3150 | -522 | B | 70 | 0 |
| 114 | V8 | -480 | -522 | B | 80 | 0 | 164 | D14 | 3220 | -522 | B | 70 | 0 |
| 115 | V7 | -400 | -522 | B | 70 | 0 | 165 | D14 | 3290 | -522 | B | 80 | 0 |
| 116 | V7 | -330 | -522 | B | 70 | 0 | 166 | D13 | 3370 | -522 | B | 70 | 0 |
| 117 | V7 | -260 | -522 | B | 80 | 0 | 167 | D13 | 3440 | -522 | B | 70 | 0 |
| 118 | DUMMY | -180 | -522 | B | 70 | 0 | 168 | D13 | 3510 | -522 | B | 80 | 0 |
| 119 | DUMMY | -110 | -522 | B | 70 | 0 | 169 | D12 | 3590 | -522 | B | 70 | 0 |
| 120 | DUMMY | -40 | -522 | B | 80 | 0 | 170 | D12 | 3660 | -522 | B | 70 | 0 |
| 121 | DUMMY | 40 | -522 | B | 70 | 0 | 171 | D12 | 3730 | -522 | B | 80 | 0 |
| 122 | DUMMY | 110 | -522 | B | 70 | 0 | 172 | D11 | 3810 | -522 | B | 70 | 0 |
| 123 | DUMMY | 180 | -522 | B | 80 | 0 | 173 | D11 | 3880 | -522 | B | 70 | 0 |
| 124 | V6 | 260 | -522 | B | 70 | 0 | 174 | D11 | 3950 | -522 | B | 80 | 0 |
| 125 | V6 | 330 | -522 | B | 70 | 0 | 175 | D10 | 4030 | -522 | B | 70 | 0 |
| 126 | V6 | 400 | -522 | B | 80 | 0 | 176 | D10 | 4100 | -522 | B | 70 | 0 |
| 127 | V5 | 480 | -522 | B | 70 | 0 | 177 | D10 | 4170 | -522 | B | 80 | 0 |
| 128 | V5 | 550 | -522 | B | 70 | 0 | 178 | D7 | 4250 | -522 | B | 70 | 0 |
| 129 | V5 | 620 | -522 | B | 80 | 0 | 179 | D7 | 4320 | -522 | B | 70 | 0 |
| 130 | V4 | 700 | -522 | B | 70 | 0 | 180 | D7 | 4390 | -522 | B | 80 | 0 |
| 131 | V4 | 770 | -522 | B | 70 | 0 | 181 | D6 | 4470 | -522 | B | 70 | 0 |
| 132 | V4 | 840 | -522 | B | 80 | 0 | 182 | D6 | 4540 | -522 | B | 70 | 0 |
| 133 | V3 | 920 | -522 | B | 70 | 0 | 183 | D6 | 4610 | -522 | B | 80 | 0 |
| 134 | V3 | 990 | -522 | B | 70 | 0 | 184 | D5 | 4690 | -522 | B | 70 | 0 |
| 135 | V3 | 1060 | -522 | B | 80 | 0 | 185 | D5 | 4760 | -522 | B | 70 | 0 |
| 136 | V2 | 1140 | -522 | B | 70 | 0 | 186 | D5 | 4830 | -522 | B | 80 | 0 |
| 137 | V2 | 1210 | -522 | B | 70 | 0 | 187 | D4 | 4910 | -522 | B | 70 | 0 |
| 138 | V2 | 1280 | -522 | B | 80 | 0 | 188 | D4 | 4980 | -522 | B | 70 | 0 |
| 139 | V1 | 1360 | -522 | B | 70 | 0 | 189 | D4 | 5050 | -522 | B | 80 | 0 |
| 140 | V1 | 1430 | -522 | B | 70 | 0 | 190 | D3 | 5130 | -522 | B | 70 | 0 |
| 141 | V1 | 1500 | -522 | B | 80 | 0 | 191 | D3 | 5200 | -522 | B | 70 | 0 |
| 142 | V0 | 1580 | -522 | B | 70 | 0 | 192 | D3 | 5270 | -522 | B | 80 | 0 |
| 143 | V0 | 1650 | -522 | B | 70 | 0 | 193 | D2 | 5350 | -522 | B | 70 | 0 |
| 144 | V0 | 1720 | -522 | B | 80 | 0 | 194 | D2 | 5420 | -522 | B | 70 | 0 |
| 145 | DUMMY | 1800 | -522 | B | 70 | 0 | 195 | D2 | 5490 | -522 | B | 80 | 0 |
| 146 | DUMMY | 1870 | -522 | B | 70 | 0 | 196 | D1 | 5570 | -522 | B | 70 | 0 |
| 147 | DUMMY | 1940 | -522 | B | 100 | 0 | 197 | D1 | 5640 | -522 | B | 70 | 0 |
| 148 | AVSS | 2040 | -522 | B | 70 | 0 | 198 | D1 | 5710 | -522 | B | 80 | 0 |
| 149 | AVSS | 2110 | -522 | B | 70 | 0 | 199 | D0 | 5790 | -522 | B | 70 | 0 |
| 150 | AVSS | 2180 | -522 | B | 70 | 0 | 200 | D0 | 5860 | -522 | B | 70 | 0 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|----------|------|------|-----------|---------|---------|-----|-------|------|-----|-----------|---------|---------|
| 201 | D0 | 5930 | -522 | B | 100 | 0 | 251 | CKV_R | 9422 | 110 | B | 0 | 80 |
| 202 | DVDD | 6030 | -522 | B | 70 | 0 | 252 | OE | 9422 | 190 | B | 0 | 70 |
| 203 | DVDD | 6100 | -522 | B | 70 | 0 | 253 | OE | 9422 | 260 | B | | |
| 204 | DVDD | 6170 | -522 | B | 70 | 0 | 254 | DUMMY | 9451 | 512 | C | -26 | -140 |
| 205 | DVDD | 6240 | -522 | B | 70 | 0 | 255 | DUMMY | 9425 | 372 | C | -26 | 140 |
| 206 | DVDD | 6310 | -522 | B | 70 | 0 | 256 | DUMMY | 9399 | 512 | C | -26 | -130 |
| 207 | DVDD | 6380 | -522 | B | 70 | 0 | 257 | DUMMY | 9373 | 382 | A | -26 | 140 |
| 208 | DVDD | 6450 | -522 | B | 70 | 0 | 258 | S1 | 9347 | 522 | A | -26 | -140 |
| 209 | DVDD | 6520 | -522 | B | 70 | 0 | 259 | S2 | 9321 | 382 | A | -26 | 140 |
| 210 | DVDD | 6590 | -522 | B | 70 | 0 | 260 | S3 | 9295 | 522 | A | -26 | -140 |
| 211 | DVDD | 6660 | -522 | B | 200 | 0 | 261 | S4 | 9269 | 382 | A | -26 | 140 |
| 212 | DVSS | 6860 | -522 | B | 70 | 0 | 262 | S5 | 9243 | 522 | A | -26 | -140 |
| 213 | DVSS | 6930 | -522 | B | 70 | 0 | 263 | S6 | 9217 | 382 | A | -26 | 140 |
| 214 | DVSS | 7000 | -522 | B | 70 | 0 | 264 | S7 | 9191 | 522 | A | -26 | -140 |
| 215 | DVSS | 7070 | -522 | B | 70 | 0 | 265 | S8 | 9165 | 382 | A | -26 | 140 |
| 216 | DVSS | 7140 | -522 | B | 70 | 0 | 266 | S9 | 9139 | 522 | A | -26 | -140 |
| 217 | DVSS | 7210 | -522 | B | 70 | 0 | 267 | S10 | 9113 | 382 | A | -26 | 140 |
| 218 | DVSS | 7280 | -522 | B | 70 | 0 | 268 | S11 | 9087 | 522 | A | -26 | -140 |
| 219 | DVSS | 7350 | -522 | B | 70 | 0 | 269 | S12 | 9061 | 382 | A | -26 | 140 |
| 220 | DVSS | 7420 | -522 | B | 70 | 0 | 270 | S13 | 9035 | 522 | A | -26 | -140 |
| 221 | DVSS | 7490 | -522 | B | 200 | 0 | 271 | S14 | 9009 | 382 | A | -26 | 140 |
| 222 | TEST3 | 7690 | -522 | B | 70 | 0 | 272 | S15 | 8983 | 522 | A | -26 | -140 |
| 223 | TEST3 | 7760 | -522 | B | 70 | 0 | 273 | S16 | 8957 | 382 | A | -26 | 140 |
| 224 | TEST3 | 7830 | -522 | B | 80 | 0 | 274 | S17 | 8931 | 522 | A | -26 | -140 |
| 225 | TEST2 | 7910 | -522 | B | 70 | 0 | 275 | S18 | 8905 | 382 | A | -26 | 140 |
| 226 | TEST2 | 7980 | -522 | B | 70 | 0 | 276 | S19 | 8879 | 522 | A | -26 | -140 |
| 227 | TEST2 | 8050 | -522 | B | 80 | 0 | 277 | S20 | 8853 | 382 | A | -26 | 140 |
| 228 | TEST1 | 8130 | -522 | B | 70 | 0 | 278 | S21 | 8827 | 522 | A | -26 | -140 |
| 229 | TEST1 | 8200 | -522 | B | 70 | 0 | 279 | S22 | 8801 | 382 | A | -26 | 140 |
| 230 | TEST1 | 8270 | -522 | B | 100 | 0 | 280 | S23 | 8775 | 522 | A | -26 | -140 |
| 231 | AVSS | 8370 | -522 | B | 70 | 0 | 281 | S24 | 8749 | 382 | A | -26 | 140 |
| 232 | AVSS | 8440 | -522 | B | 70 | 0 | 282 | S25 | 8723 | 522 | A | -26 | -140 |
| 233 | AVSS | 8510 | -522 | B | 70 | 0 | 283 | S26 | 8697 | 382 | A | -26 | 140 |
| 234 | AVSS | 8580 | -522 | B | 70 | 0 | 284 | S27 | 8671 | 522 | A | -26 | -140 |
| 235 | AVSS | 8650 | -522 | B | 70 | 0 | 285 | S28 | 8645 | 382 | A | -26 | 140 |
| 236 | AVSS | 8720 | -522 | B | 100 | 0 | 286 | S29 | 8619 | 522 | A | -26 | -140 |
| 237 | AVDD | 8820 | -522 | B | 70 | 0 | 287 | S30 | 8593 | 382 | A | -26 | 140 |
| 238 | AVDD | 8890 | -522 | B | 70 | 0 | 288 | S31 | 8567 | 522 | A | -26 | -140 |
| 239 | AVDD | 8960 | -522 | B | 70 | 0 | 289 | S32 | 8541 | 382 | A | -26 | 140 |
| 240 | AVDD | 9030 | -522 | B | 70 | 0 | 290 | S33 | 8515 | 522 | A | -26 | -140 |
| 241 | AVDD | 9100 | -522 | B | 70 | 0 | 291 | S34 | 8489 | 382 | A | -26 | 140 |
| 242 | AVDD | 9170 | -522 | B | 137 | 0 | 292 | S35 | 8463 | 522 | A | -26 | -140 |
| 243 | LF | 9307 | -522 | B | 70 | 0 | 293 | S36 | 8437 | 382 | A | -26 | 140 |
| 244 | NBW | 9377 | -522 | B | 70 | 0 | 294 | S37 | 8411 | 522 | A | -26 | -140 |
| 245 | RES2 | 9447 | -522 | B | | | 295 | S38 | 8385 | 382 | A | -26 | 140 |
| 246 | COMSIG_R | 9422 | -260 | B | 0 | 70 | 296 | S39 | 8359 | 522 | A | -26 | -140 |
| 247 | COMSIG_R | 9422 | -190 | B | 0 | 80 | 297 | S40 | 8333 | 382 | A | -26 | 140 |
| 248 | STV_R | 9422 | -110 | B | 0 | 70 | 298 | S41 | 8307 | 522 | A | -26 | -140 |
| 249 | STV_R | 9422 | -40 | B | 0 | 80 | 299 | S42 | 8281 | 382 | A | -26 | 140 |
| 250 | CKV_R | 9422 | 40 | B | 0 | 70 | 300 | S43 | 8255 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|------|-----|-----------|---------|---------|-----|------|------|-----|-----------|---------|---------|
| 301 | S44 | 8229 | 382 | A | -26 | 140 | 351 | S94 | 6929 | 382 | A | -26 | 140 |
| 302 | S45 | 8203 | 522 | A | -26 | -140 | 352 | S95 | 6903 | 522 | A | -26 | -140 |
| 303 | S46 | 8177 | 382 | A | -26 | 140 | 353 | S96 | 6877 | 382 | A | -26 | 140 |
| 304 | S47 | 8151 | 522 | A | -26 | -140 | 354 | S97 | 6851 | 522 | A | -26 | -140 |
| 305 | S48 | 8125 | 382 | A | -26 | 140 | 355 | S98 | 6825 | 382 | A | -26 | 140 |
| 306 | S49 | 8099 | 522 | A | -26 | -140 | 356 | S99 | 6799 | 522 | A | -26 | -140 |
| 307 | S50 | 8073 | 382 | A | -26 | 140 | 357 | S100 | 6773 | 382 | A | -26 | 140 |
| 308 | S51 | 8047 | 522 | A | -26 | -140 | 358 | S101 | 6747 | 522 | A | -26 | -140 |
| 309 | S52 | 8021 | 382 | A | -26 | 140 | 359 | S102 | 6721 | 382 | A | -26 | 140 |
| 310 | S53 | 7995 | 522 | A | -26 | -140 | 360 | S103 | 6695 | 522 | A | -26 | -140 |
| 311 | S54 | 7969 | 382 | A | -26 | 140 | 361 | S104 | 6669 | 382 | A | -26 | 140 |
| 312 | S55 | 7943 | 522 | A | -26 | -140 | 362 | S105 | 6643 | 522 | A | -26 | -140 |
| 313 | S56 | 7917 | 382 | A | -26 | 140 | 363 | S106 | 6617 | 382 | A | -26 | 140 |
| 314 | S57 | 7891 | 522 | A | -26 | -140 | 364 | S107 | 6591 | 522 | A | -26 | -140 |
| 315 | S58 | 7865 | 382 | A | -26 | 140 | 365 | S108 | 6565 | 382 | A | -26 | 140 |
| 316 | S59 | 7839 | 522 | A | -26 | -140 | 366 | S109 | 6539 | 522 | A | -26 | -140 |
| 317 | S60 | 7813 | 382 | A | -26 | 140 | 367 | S110 | 6513 | 382 | A | -26 | 140 |
| 318 | S61 | 7787 | 522 | A | -26 | -140 | 368 | S111 | 6487 | 522 | A | -26 | -140 |
| 319 | S62 | 7761 | 382 | A | -26 | 140 | 369 | S112 | 6461 | 382 | A | -26 | 140 |
| 320 | S63 | 7735 | 522 | A | -26 | -140 | 370 | S113 | 6435 | 522 | A | -26 | -140 |
| 321 | S64 | 7709 | 382 | A | -26 | 140 | 371 | S114 | 6409 | 382 | A | -26 | 140 |
| 322 | S65 | 7683 | 522 | A | -26 | -140 | 372 | S115 | 6383 | 522 | A | -26 | -140 |
| 323 | S66 | 7657 | 382 | A | -26 | 140 | 373 | S116 | 6357 | 382 | A | -26 | 140 |
| 324 | S67 | 7631 | 522 | A | -26 | -140 | 374 | S117 | 6331 | 522 | A | -26 | -140 |
| 325 | S68 | 7605 | 382 | A | -26 | 140 | 375 | S118 | 6305 | 382 | A | -26 | 140 |
| 326 | S69 | 7579 | 522 | A | -26 | -140 | 376 | S119 | 6279 | 522 | A | -26 | -140 |
| 327 | S70 | 7553 | 382 | A | -26 | 140 | 377 | S120 | 6253 | 382 | A | -26 | 140 |
| 328 | S71 | 7527 | 522 | A | -26 | -140 | 378 | S121 | 6227 | 522 | A | -26 | -140 |
| 329 | S72 | 7501 | 382 | A | -26 | 140 | 379 | S122 | 6201 | 382 | A | -26 | 140 |
| 330 | S73 | 7475 | 522 | A | -26 | -140 | 380 | S123 | 6175 | 522 | A | -26 | -140 |
| 331 | S74 | 7449 | 382 | A | -26 | 140 | 381 | S124 | 6149 | 382 | A | -26 | 140 |
| 332 | S75 | 7423 | 522 | A | -26 | -140 | 382 | S125 | 6123 | 522 | A | -26 | -140 |
| 333 | S76 | 7397 | 382 | A | -26 | 140 | 383 | S126 | 6097 | 382 | A | -26 | 140 |
| 334 | S77 | 7371 | 522 | A | -26 | -140 | 384 | S127 | 6071 | 522 | A | -26 | -140 |
| 335 | S78 | 7345 | 382 | A | -26 | 140 | 385 | S128 | 6045 | 382 | A | -26 | 140 |
| 336 | S79 | 7319 | 522 | A | -26 | -140 | 386 | S129 | 6019 | 522 | A | -26 | -140 |
| 337 | S80 | 7293 | 382 | A | -26 | 140 | 387 | S130 | 5993 | 382 | A | -26 | 140 |
| 338 | S81 | 7267 | 522 | A | -26 | -140 | 388 | S131 | 5967 | 522 | A | -26 | -140 |
| 339 | S82 | 7241 | 382 | A | -26 | 140 | 389 | S132 | 5941 | 382 | A | -26 | 140 |
| 340 | S83 | 7215 | 522 | A | -26 | -140 | 390 | S133 | 5915 | 522 | A | -26 | -140 |
| 341 | S84 | 7189 | 382 | A | -26 | 140 | 391 | S134 | 5889 | 382 | A | -26 | 140 |
| 342 | S85 | 7163 | 522 | A | -26 | -140 | 392 | S135 | 5863 | 522 | A | -26 | -140 |
| 343 | S86 | 7137 | 382 | A | -26 | 140 | 393 | S136 | 5837 | 382 | A | -26 | 140 |
| 344 | S87 | 7111 | 522 | A | -26 | -140 | 394 | S137 | 5811 | 522 | A | -26 | -140 |
| 345 | S88 | 7085 | 382 | A | -26 | 140 | 395 | S138 | 5785 | 382 | A | -26 | 140 |
| 346 | S89 | 7059 | 522 | A | -26 | -140 | 396 | S139 | 5759 | 522 | A | -26 | -140 |
| 347 | S90 | 7033 | 382 | A | -26 | 140 | 397 | S140 | 5733 | 382 | A | -26 | 140 |
| 348 | S91 | 7007 | 522 | A | -26 | -140 | 398 | S141 | 5707 | 522 | A | -26 | -140 |
| 349 | S92 | 6981 | 382 | A | -26 | 140 | 399 | S142 | 5681 | 382 | A | -26 | 140 |
| 350 | S93 | 6955 | 522 | A | -26 | -140 | 400 | S143 | 5655 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|------|-----|-----------|---------|---------|-----|------|------|-----|-----------|---------|---------|
| 401 | S144 | 5629 | 382 | A | -26 | 140 | 451 | S194 | 4329 | 382 | A | -26 | 140 |
| 402 | S145 | 5603 | 522 | A | -26 | -140 | 452 | S195 | 4303 | 522 | A | -26 | -140 |
| 403 | S146 | 5577 | 382 | A | -26 | 140 | 453 | S196 | 4277 | 382 | A | -26 | 140 |
| 404 | S147 | 5551 | 522 | A | -26 | -140 | 454 | S197 | 4251 | 522 | A | -26 | -140 |
| 405 | S148 | 5525 | 382 | A | -26 | 140 | 455 | S198 | 4225 | 382 | A | -26 | 140 |
| 406 | S149 | 5499 | 522 | A | -26 | -140 | 456 | S199 | 4199 | 522 | A | -26 | -140 |
| 407 | S150 | 5473 | 382 | A | -26 | 140 | 457 | S200 | 4173 | 382 | A | -26 | 140 |
| 408 | S151 | 5447 | 522 | A | -26 | -140 | 458 | S201 | 4147 | 522 | A | -26 | -140 |
| 409 | S152 | 5421 | 382 | A | -26 | 140 | 459 | S202 | 4121 | 382 | A | -26 | 140 |
| 410 | S153 | 5395 | 522 | A | -26 | -140 | 460 | S203 | 4095 | 522 | A | -26 | -140 |
| 411 | S154 | 5369 | 382 | A | -26 | 140 | 461 | S204 | 4069 | 382 | A | -26 | 140 |
| 412 | S155 | 5343 | 522 | A | -26 | -140 | 462 | S205 | 4043 | 522 | A | -26 | -140 |
| 413 | S156 | 5317 | 382 | A | -26 | 140 | 463 | S206 | 4017 | 382 | A | -26 | 140 |
| 414 | S157 | 5291 | 522 | A | -26 | -140 | 464 | S207 | 3991 | 522 | A | -26 | -140 |
| 415 | S158 | 5265 | 382 | A | -26 | 140 | 465 | S208 | 3965 | 382 | A | -26 | 140 |
| 416 | S159 | 5239 | 522 | A | -26 | -140 | 466 | S209 | 3939 | 522 | A | -26 | -140 |
| 417 | S160 | 5213 | 382 | A | -26 | 140 | 467 | S210 | 3913 | 382 | A | -26 | 140 |
| 418 | S161 | 5187 | 522 | A | -26 | -140 | 468 | S211 | 3887 | 522 | A | -26 | -140 |
| 419 | S162 | 5161 | 382 | A | -26 | 140 | 469 | S212 | 3861 | 382 | A | -26 | 140 |
| 420 | S163 | 5135 | 522 | A | -26 | -140 | 470 | S213 | 3835 | 522 | A | -26 | -140 |
| 421 | S164 | 5109 | 382 | A | -26 | 140 | 471 | S214 | 3809 | 382 | A | -26 | 140 |
| 422 | S165 | 5083 | 522 | A | -26 | -140 | 472 | S215 | 3783 | 522 | A | -26 | -140 |
| 423 | S166 | 5057 | 382 | A | -26 | 140 | 473 | S216 | 3757 | 382 | A | -26 | 140 |
| 424 | S167 | 5031 | 522 | A | -26 | -140 | 474 | S217 | 3731 | 522 | A | -26 | -140 |
| 425 | S168 | 5005 | 382 | A | -26 | 140 | 475 | S218 | 3705 | 382 | A | -26 | 140 |
| 426 | S169 | 4979 | 522 | A | -26 | -140 | 476 | S219 | 3679 | 522 | A | -26 | -140 |
| 427 | S170 | 4953 | 382 | A | -26 | 140 | 477 | S220 | 3653 | 382 | A | -26 | 140 |
| 428 | S171 | 4927 | 522 | A | -26 | -140 | 478 | S221 | 3627 | 522 | A | -26 | -140 |
| 429 | S172 | 4901 | 382 | A | -26 | 140 | 479 | S222 | 3601 | 382 | A | -26 | 140 |
| 430 | S173 | 4875 | 522 | A | -26 | -140 | 480 | S223 | 3575 | 522 | A | -26 | -140 |
| 431 | S174 | 4849 | 382 | A | -26 | 140 | 481 | S224 | 3549 | 382 | A | -26 | 140 |
| 432 | S175 | 4823 | 522 | A | -26 | -140 | 482 | S225 | 3523 | 522 | A | -26 | -140 |
| 433 | S176 | 4797 | 382 | A | -26 | 140 | 483 | S226 | 3497 | 382 | A | -26 | 140 |
| 434 | S177 | 4771 | 522 | A | -26 | -140 | 484 | S227 | 3471 | 522 | A | -26 | -140 |
| 435 | S178 | 4745 | 382 | A | -26 | 140 | 485 | S228 | 3445 | 382 | A | -26 | 140 |
| 436 | S179 | 4719 | 522 | A | -26 | -140 | 486 | S229 | 3419 | 522 | A | -26 | -140 |
| 437 | S180 | 4693 | 382 | A | -26 | 140 | 487 | S230 | 3393 | 382 | A | -26 | 140 |
| 438 | S181 | 4667 | 522 | A | -26 | -140 | 488 | S231 | 3367 | 522 | A | -26 | -140 |
| 439 | S182 | 4641 | 382 | A | -26 | 140 | 489 | S232 | 3341 | 382 | A | -26 | 140 |
| 440 | S183 | 4615 | 522 | A | -26 | -140 | 490 | S233 | 3315 | 522 | A | -26 | -140 |
| 441 | S184 | 4589 | 382 | A | -26 | 140 | 491 | S234 | 3289 | 382 | A | -26 | 140 |
| 442 | S185 | 4563 | 522 | A | -26 | -140 | 492 | S235 | 3263 | 522 | A | -26 | -140 |
| 443 | S186 | 4537 | 382 | A | -26 | 140 | 493 | S236 | 3237 | 382 | A | -26 | 140 |
| 444 | S187 | 4511 | 522 | A | -26 | -140 | 494 | S237 | 3211 | 522 | A | -26 | -140 |
| 445 | S188 | 4485 | 382 | A | -26 | 140 | 495 | S238 | 3185 | 382 | A | -26 | 140 |
| 446 | S189 | 4459 | 522 | A | -26 | -140 | 496 | S239 | 3159 | 522 | A | -26 | -140 |
| 447 | S190 | 4433 | 382 | A | -26 | 140 | 497 | S240 | 3133 | 382 | A | -26 | 140 |
| 448 | S191 | 4407 | 522 | A | -26 | -140 | 498 | S241 | 3107 | 522 | A | -26 | -140 |
| 449 | S192 | 4381 | 382 | A | -26 | 140 | 499 | S242 | 3081 | 382 | A | -26 | 140 |
| 450 | S193 | 4355 | 522 | A | -26 | -140 | 500 | S243 | 3055 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|------|-----|-----------|---------|---------|-----|------|------|-----|-----------|---------|---------|
| 501 | S244 | 3029 | 382 | A | -26 | 140 | 551 | S294 | 1729 | 382 | A | -26 | 140 |
| 502 | S245 | 3003 | 522 | A | -26 | -140 | 552 | S295 | 1703 | 522 | A | -26 | -140 |
| 503 | S246 | 2977 | 382 | A | -26 | 140 | 553 | S296 | 1677 | 382 | A | -26 | 140 |
| 504 | S247 | 2951 | 522 | A | -26 | -140 | 554 | S297 | 1651 | 522 | A | -26 | -140 |
| 505 | S248 | 2925 | 382 | A | -26 | 140 | 555 | S298 | 1625 | 382 | A | -26 | 140 |
| 506 | S249 | 2899 | 522 | A | -26 | -140 | 556 | S299 | 1599 | 522 | A | -26 | -140 |
| 507 | S250 | 2873 | 382 | A | -26 | 140 | 557 | S300 | 1573 | 382 | A | -26 | 140 |
| 508 | S251 | 2847 | 522 | A | -26 | -140 | 558 | S301 | 1547 | 522 | A | -26 | -140 |
| 509 | S252 | 2821 | 382 | A | -26 | 140 | 559 | S302 | 1521 | 382 | A | -26 | 140 |
| 510 | S253 | 2795 | 522 | A | -26 | -140 | 560 | S303 | 1495 | 522 | A | -26 | -140 |
| 511 | S254 | 2769 | 382 | A | -26 | 140 | 561 | S304 | 1469 | 382 | A | -26 | 140 |
| 512 | S255 | 2743 | 522 | A | -26 | -140 | 562 | S305 | 1443 | 522 | A | -26 | -140 |
| 513 | S256 | 2717 | 382 | A | -26 | 140 | 563 | S306 | 1417 | 382 | A | -26 | 140 |
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| 515 | S258 | 2665 | 382 | A | -26 | 140 | 565 | S308 | 1365 | 382 | A | -26 | 140 |
| 516 | S259 | 2639 | 522 | A | -26 | -140 | 566 | S309 | 1339 | 522 | A | -26 | -140 |
| 517 | S260 | 2613 | 382 | A | -26 | 140 | 567 | S310 | 1313 | 382 | A | -26 | 140 |
| 518 | S261 | 2587 | 522 | A | -26 | -140 | 568 | S311 | 1287 | 522 | A | -26 | -140 |
| 519 | S262 | 2561 | 382 | A | -26 | 140 | 569 | S312 | 1261 | 382 | A | -26 | 140 |
| 520 | S263 | 2535 | 522 | A | -26 | -140 | 570 | S313 | 1235 | 522 | A | -26 | -140 |
| 521 | S264 | 2509 | 382 | A | -26 | 140 | 571 | S314 | 1209 | 382 | A | -26 | 140 |
| 522 | S265 | 2483 | 522 | A | -26 | -140 | 572 | S315 | 1183 | 522 | A | -26 | -140 |
| 523 | S266 | 2457 | 382 | A | -26 | 140 | 573 | S316 | 1157 | 382 | A | -26 | 140 |
| 524 | S267 | 2431 | 522 | A | -26 | -140 | 574 | S317 | 1131 | 522 | A | -26 | -140 |
| 525 | S268 | 2405 | 382 | A | -26 | 140 | 575 | S318 | 1105 | 382 | A | -26 | 140 |
| 526 | S269 | 2379 | 522 | A | -26 | -140 | 576 | S319 | 1079 | 522 | A | -26 | -140 |
| 527 | S270 | 2353 | 382 | A | -26 | 140 | 577 | S320 | 1053 | 382 | A | -26 | 140 |
| 528 | S271 | 2327 | 522 | A | -26 | -140 | 578 | S321 | 1027 | 522 | A | -26 | -140 |
| 529 | S272 | 2301 | 382 | A | -26 | 140 | 579 | S322 | 1001 | 382 | A | -26 | 140 |
| 530 | S273 | 2275 | 522 | A | -26 | -140 | 580 | S323 | 975 | 522 | A | -26 | -140 |
| 531 | S274 | 2249 | 382 | A | -26 | 140 | 581 | S324 | 949 | 382 | A | -26 | 140 |
| 532 | S275 | 2223 | 522 | A | -26 | -140 | 582 | S325 | 923 | 522 | A | -26 | -140 |
| 533 | S276 | 2197 | 382 | A | -26 | 140 | 583 | S326 | 897 | 382 | A | -26 | 140 |
| 534 | S277 | 2171 | 522 | A | -26 | -140 | 584 | S327 | 871 | 522 | A | -26 | -140 |
| 535 | S278 | 2145 | 382 | A | -26 | 140 | 585 | S328 | 845 | 382 | A | -26 | 140 |
| 536 | S279 | 2119 | 522 | A | -26 | -140 | 586 | S329 | 819 | 522 | A | -26 | -140 |
| 537 | S280 | 2093 | 382 | A | -26 | 140 | 587 | S330 | 793 | 382 | A | -26 | 140 |
| 538 | S281 | 2067 | 522 | A | -26 | -140 | 588 | S331 | 767 | 522 | A | -26 | -140 |
| 539 | S282 | 2041 | 382 | A | -26 | 140 | 589 | S332 | 741 | 382 | A | -26 | 140 |
| 540 | S283 | 2015 | 522 | A | -26 | -140 | 590 | S333 | 715 | 522 | A | -26 | -140 |
| 541 | S284 | 1989 | 382 | A | -26 | 140 | 591 | S334 | 689 | 382 | A | -26 | 140 |
| 542 | S285 | 1963 | 522 | A | -26 | -140 | 592 | S335 | 663 | 522 | A | -26 | -140 |
| 543 | S286 | 1937 | 382 | A | -26 | 140 | 593 | S336 | 637 | 382 | A | -26 | 140 |
| 544 | S287 | 1911 | 522 | A | -26 | -140 | 594 | S337 | 611 | 522 | A | -26 | -140 |
| 545 | S288 | 1885 | 382 | A | -26 | 140 | 595 | S338 | 585 | 382 | A | -26 | 140 |
| 546 | S289 | 1859 | 522 | A | -26 | -140 | 596 | S339 | 559 | 522 | A | -26 | -140 |
| 547 | S290 | 1833 | 382 | A | -26 | 140 | 597 | S340 | 533 | 382 | A | -26 | 140 |
| 548 | S291 | 1807 | 522 | A | -26 | -140 | 598 | S341 | 507 | 522 | A | -26 | -140 |
| 549 | S292 | 1781 | 382 | A | -26 | 140 | 599 | S342 | 481 | 382 | A | -26 | 140 |
| 550 | S293 | 1755 | 522 | A | -26 | -140 | 600 | S343 | 455 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|------|-----|-----------|---------|---------|-----|------|-------|-----|-----------|---------|---------|
| 601 | S344 | 429 | 382 | A | -26 | 140 | 651 | S394 | -871 | 382 | A | -26 | 140 |
| 602 | S345 | 403 | 522 | A | -26 | -140 | 652 | S395 | -897 | 522 | A | -26 | -140 |
| 603 | S346 | 377 | 382 | A | -26 | 140 | 653 | S396 | -923 | 382 | A | -26 | 140 |
| 604 | S347 | 351 | 522 | A | -26 | -140 | 654 | S397 | -949 | 522 | A | -26 | -140 |
| 605 | S348 | 325 | 382 | A | -26 | 140 | 655 | S398 | -975 | 382 | A | -26 | 140 |
| 606 | S349 | 299 | 522 | A | -26 | -140 | 656 | S399 | -1001 | 522 | A | -26 | -140 |
| 607 | S350 | 273 | 382 | A | -26 | 140 | 657 | S400 | -1027 | 382 | A | -26 | 140 |
| 608 | S351 | 247 | 522 | A | -26 | -140 | 658 | S401 | -1053 | 522 | A | -26 | -140 |
| 609 | S352 | 221 | 382 | A | -26 | 140 | 659 | S402 | -1079 | 382 | A | -26 | 140 |
| 610 | S353 | 195 | 522 | A | -26 | -140 | 660 | S403 | -1105 | 522 | A | -26 | -140 |
| 611 | S354 | 169 | 382 | A | -26 | 140 | 661 | S404 | -1131 | 382 | A | -26 | 140 |
| 612 | S355 | 143 | 522 | A | -26 | -140 | 662 | S405 | -1157 | 522 | A | -26 | -140 |
| 613 | S356 | 117 | 382 | A | -26 | 140 | 663 | S406 | -1183 | 382 | A | -26 | 140 |
| 614 | S357 | 91 | 522 | A | -26 | -140 | 664 | S407 | -1209 | 522 | A | -26 | -140 |
| 615 | S358 | 65 | 382 | A | -26 | 140 | 665 | S408 | -1235 | 382 | A | -26 | 140 |
| 616 | S359 | 39 | 522 | A | -26 | -140 | 666 | S409 | -1261 | 522 | A | -26 | -140 |
| 617 | S360 | 13 | 382 | A | -26 | 140 | 667 | S410 | -1287 | 382 | A | -26 | 140 |
| 618 | S361 | -13 | 522 | A | -26 | -140 | 668 | S411 | -1313 | 522 | A | -26 | -140 |
| 619 | S362 | -39 | 382 | A | -26 | 140 | 669 | S412 | -1339 | 382 | A | -26 | 140 |
| 620 | S363 | -65 | 522 | A | -26 | -140 | 670 | S413 | -1365 | 522 | A | -26 | -140 |
| 621 | S364 | -91 | 382 | A | -26 | 140 | 671 | S414 | -1391 | 382 | A | -26 | 140 |
| 622 | S365 | -117 | 522 | A | -26 | -140 | 672 | S415 | -1417 | 522 | A | -26 | -140 |
| 623 | S366 | -143 | 382 | A | -26 | 140 | 673 | S416 | -1443 | 382 | A | -26 | 140 |
| 624 | S367 | -169 | 522 | A | -26 | -140 | 674 | S417 | -1469 | 522 | A | -26 | -140 |
| 625 | S368 | -195 | 382 | A | -26 | 140 | 675 | S418 | -1495 | 382 | A | -26 | 140 |
| 626 | S369 | -221 | 522 | A | -26 | -140 | 676 | S419 | -1521 | 522 | A | -26 | -140 |
| 627 | S370 | -247 | 382 | A | -26 | 140 | 677 | S420 | -1547 | 382 | A | -26 | 140 |
| 628 | S371 | -273 | 522 | A | -26 | -140 | 678 | S421 | -1573 | 522 | A | -26 | -140 |
| 629 | S372 | -299 | 382 | A | -26 | 140 | 679 | S422 | -1599 | 382 | A | -26 | 140 |
| 630 | S373 | -325 | 522 | A | -26 | -140 | 680 | S423 | -1625 | 522 | A | -26 | -140 |
| 631 | S374 | -351 | 382 | A | -26 | 140 | 681 | S424 | -1651 | 382 | A | -26 | 140 |
| 632 | S375 | -377 | 522 | A | -26 | -140 | 682 | S425 | -1677 | 522 | A | -26 | -140 |
| 633 | S376 | -403 | 382 | A | -26 | 140 | 683 | S426 | -1703 | 382 | A | -26 | 140 |
| 634 | S377 | -429 | 522 | A | -26 | -140 | 684 | S427 | -1729 | 522 | A | -26 | -140 |
| 635 | S378 | -455 | 382 | A | -26 | 140 | 685 | S428 | -1755 | 382 | A | -26 | 140 |
| 636 | S379 | -481 | 522 | A | -26 | -140 | 686 | S429 | -1781 | 522 | A | -26 | -140 |
| 637 | S380 | -507 | 382 | A | -26 | 140 | 687 | S430 | -1807 | 382 | A | -26 | 140 |
| 638 | S381 | -533 | 522 | A | -26 | -140 | 688 | S431 | -1833 | 522 | A | -26 | -140 |
| 639 | S382 | -559 | 382 | A | -26 | 140 | 689 | S432 | -1859 | 382 | A | -26 | 140 |
| 640 | S383 | -585 | 522 | A | -26 | -140 | 690 | S433 | -1885 | 522 | A | -26 | -140 |
| 641 | S384 | -611 | 382 | A | -26 | 140 | 691 | S434 | -1911 | 382 | A | -26 | 140 |
| 642 | S385 | -637 | 522 | A | -26 | -140 | 692 | S435 | -1937 | 522 | A | -26 | -140 |
| 643 | S386 | -663 | 382 | A | -26 | 140 | 693 | S436 | -1963 | 382 | A | -26 | 140 |
| 644 | S387 | -689 | 522 | A | -26 | -140 | 694 | S437 | -1989 | 522 | A | -26 | -140 |
| 645 | S388 | -715 | 382 | A | -26 | 140 | 695 | S438 | -2015 | 382 | A | -26 | 140 |
| 646 | S389 | -741 | 522 | A | -26 | -140 | 696 | S439 | -2041 | 522 | A | -26 | -140 |
| 647 | S390 | -767 | 382 | A | -26 | 140 | 697 | S440 | -2067 | 382 | A | -26 | 140 |
| 648 | S391 | -793 | 522 | A | -26 | -140 | 698 | S441 | -2093 | 522 | A | -26 | -140 |
| 649 | S392 | -819 | 382 | A | -26 | 140 | 699 | S442 | -2119 | 382 | A | -26 | 140 |
| 650 | S393 | -845 | 522 | A | -26 | -140 | 700 | S443 | -2145 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|-------|-----|-----------|---------|---------|-----|------|-------|-----|-----------|---------|---------|
| 701 | S444 | -2171 | 382 | A | -26 | 140 | 751 | S494 | -3471 | 382 | A | -26 | 140 |
| 702 | S445 | -2197 | 522 | A | -26 | -140 | 752 | S495 | -3497 | 522 | A | -26 | -140 |
| 703 | S446 | -2223 | 382 | A | -26 | 140 | 753 | S496 | -3523 | 382 | A | -26 | 140 |
| 704 | S447 | -2249 | 522 | A | -26 | -140 | 754 | S497 | -3549 | 522 | A | -26 | -140 |
| 705 | S448 | -2275 | 382 | A | -26 | 140 | 755 | S498 | -3575 | 382 | A | -26 | 140 |
| 706 | S449 | -2301 | 522 | A | -26 | -140 | 756 | S499 | -3601 | 522 | A | -26 | -140 |
| 707 | S450 | -2327 | 382 | A | -26 | 140 | 757 | S500 | -3627 | 382 | A | -26 | 140 |
| 708 | S451 | -2353 | 522 | A | -26 | -140 | 758 | S501 | -3653 | 522 | A | -26 | -140 |
| 709 | S452 | -2379 | 382 | A | -26 | 140 | 759 | S502 | -3679 | 382 | A | -26 | 140 |
| 710 | S453 | -2405 | 522 | A | -26 | -140 | 760 | S503 | -3705 | 522 | A | -26 | -140 |
| 711 | S454 | -2431 | 382 | A | -26 | 140 | 761 | S504 | -3731 | 382 | A | -26 | 140 |
| 712 | S455 | -2457 | 522 | A | -26 | -140 | 762 | S505 | -3757 | 522 | A | -26 | -140 |
| 713 | S456 | -2483 | 382 | A | -26 | 140 | 763 | S506 | -3783 | 382 | A | -26 | 140 |
| 714 | S457 | -2509 | 522 | A | -26 | -140 | 764 | S507 | -3809 | 522 | A | -26 | -140 |
| 715 | S458 | -2535 | 382 | A | -26 | 140 | 765 | S508 | -3835 | 382 | A | -26 | 140 |
| 716 | S459 | -2561 | 522 | A | -26 | -140 | 766 | S509 | -3861 | 522 | A | -26 | -140 |
| 717 | S460 | -2587 | 382 | A | -26 | 140 | 767 | S510 | -3887 | 382 | A | -26 | 140 |
| 718 | S461 | -2613 | 522 | A | -26 | -140 | 768 | S511 | -3913 | 522 | A | -26 | -140 |
| 719 | S462 | -2639 | 382 | A | -26 | 140 | 769 | S512 | -3939 | 382 | A | -26 | 140 |
| 720 | S463 | -2665 | 522 | A | -26 | -140 | 770 | S513 | -3965 | 522 | A | -26 | -140 |
| 721 | S464 | -2691 | 382 | A | -26 | 140 | 771 | S514 | -3991 | 382 | A | -26 | 140 |
| 722 | S465 | -2717 | 522 | A | -26 | -140 | 772 | S515 | -4017 | 522 | A | -26 | -140 |
| 723 | S466 | -2743 | 382 | A | -26 | 140 | 773 | S516 | -4043 | 382 | A | -26 | 140 |
| 724 | S467 | -2769 | 522 | A | -26 | -140 | 774 | S517 | -4069 | 522 | A | -26 | -140 |
| 725 | S468 | -2795 | 382 | A | -26 | 140 | 775 | S518 | -4095 | 382 | A | -26 | 140 |
| 726 | S469 | -2821 | 522 | A | -26 | -140 | 776 | S519 | -4121 | 522 | A | -26 | -140 |
| 727 | S470 | -2847 | 382 | A | -26 | 140 | 777 | S520 | -4147 | 382 | A | -26 | 140 |
| 728 | S471 | -2873 | 522 | A | -26 | -140 | 778 | S521 | -4173 | 522 | A | -26 | -140 |
| 729 | S472 | -2899 | 382 | A | -26 | 140 | 779 | S522 | -4199 | 382 | A | -26 | 140 |
| 730 | S473 | -2925 | 522 | A | -26 | -140 | 780 | S523 | -4225 | 522 | A | -26 | -140 |
| 731 | S474 | -2951 | 382 | A | -26 | 140 | 781 | S524 | -4251 | 382 | A | -26 | 140 |
| 732 | S475 | -2977 | 522 | A | -26 | -140 | 782 | S525 | -4277 | 522 | A | -26 | -140 |
| 733 | S476 | -3003 | 382 | A | -26 | 140 | 783 | S526 | -4303 | 382 | A | -26 | 140 |
| 734 | S477 | -3029 | 522 | A | -26 | -140 | 784 | S527 | -4329 | 522 | A | -26 | -140 |
| 735 | S478 | -3055 | 382 | A | -26 | 140 | 785 | S528 | -4355 | 382 | A | -26 | 140 |
| 736 | S479 | -3081 | 522 | A | -26 | -140 | 786 | S529 | -4381 | 522 | A | -26 | -140 |
| 737 | S480 | -3107 | 382 | A | -26 | 140 | 787 | S530 | -4407 | 382 | A | -26 | 140 |
| 738 | S481 | -3133 | 522 | A | -26 | -140 | 788 | S531 | -4433 | 522 | A | -26 | -140 |
| 739 | S482 | -3159 | 382 | A | -26 | 140 | 789 | S532 | -4459 | 382 | A | -26 | 140 |
| 740 | S483 | -3185 | 522 | A | -26 | -140 | 790 | S533 | -4485 | 522 | A | -26 | -140 |
| 741 | S484 | -3211 | 382 | A | -26 | 140 | 791 | S534 | -4511 | 382 | A | -26 | 140 |
| 742 | S485 | -3237 | 522 | A | -26 | -140 | 792 | S535 | -4537 | 522 | A | -26 | -140 |
| 743 | S486 | -3263 | 382 | A | -26 | 140 | 793 | S536 | -4563 | 382 | A | -26 | 140 |
| 744 | S487 | -3289 | 522 | A | -26 | -140 | 794 | S537 | -4589 | 522 | A | -26 | -140 |
| 745 | S488 | -3315 | 382 | A | -26 | 140 | 795 | S538 | -4615 | 382 | A | -26 | 140 |
| 746 | S489 | -3341 | 522 | A | -26 | -140 | 796 | S539 | -4641 | 522 | A | -26 | -140 |
| 747 | S490 | -3367 | 382 | A | -26 | 140 | 797 | S540 | -4667 | 382 | A | -26 | 140 |
| 748 | S491 | -3393 | 522 | A | -26 | -140 | 798 | S541 | -4693 | 522 | A | -26 | -140 |
| 749 | S492 | -3419 | 382 | A | -26 | 140 | 799 | S542 | -4719 | 382 | A | -26 | 140 |
| 750 | S493 | -3445 | 522 | A | -26 | -140 | 800 | S543 | -4745 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch | No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|-------|-----|-----------|---------|---------|-----|------|-------|-----|-----------|---------|---------|
| 801 | S544 | -4771 | 382 | A | -26 | 140 | 851 | S594 | -6071 | 382 | A | -26 | 140 |
| 802 | S545 | -4797 | 522 | A | -26 | -140 | 852 | S595 | -6097 | 522 | A | -26 | -140 |
| 803 | S546 | -4823 | 382 | A | -26 | 140 | 853 | S596 | -6123 | 382 | A | -26 | 140 |
| 804 | S547 | -4849 | 522 | A | -26 | -140 | 854 | S597 | -6149 | 522 | A | -26 | -140 |
| 805 | S548 | -4875 | 382 | A | -26 | 140 | 855 | S598 | -6175 | 382 | A | -26 | 140 |
| 806 | S549 | -4901 | 522 | A | -26 | -140 | 856 | S599 | -6201 | 522 | A | -26 | -140 |
| 807 | S550 | -4927 | 382 | A | -26 | 140 | 857 | S600 | -6227 | 382 | A | -26 | 140 |
| 808 | S551 | -4953 | 522 | A | -26 | -140 | 858 | S601 | -6253 | 522 | A | -26 | -140 |
| 809 | S552 | -4979 | 382 | A | -26 | 140 | 859 | S602 | -6279 | 382 | A | -26 | 140 |
| 810 | S553 | -5005 | 522 | A | -26 | -140 | 860 | S603 | -6305 | 522 | A | -26 | -140 |
| 811 | S554 | -5031 | 382 | A | -26 | 140 | 861 | S604 | -6331 | 382 | A | -26 | 140 |
| 812 | S555 | -5057 | 522 | A | -26 | -140 | 862 | S605 | -6357 | 522 | A | -26 | -140 |
| 813 | S556 | -5083 | 382 | A | -26 | 140 | 863 | S606 | -6383 | 382 | A | -26 | 140 |
| 814 | S557 | -5109 | 522 | A | -26 | -140 | 864 | S607 | -6409 | 522 | A | -26 | -140 |
| 815 | S558 | -5135 | 382 | A | -26 | 140 | 865 | S608 | -6435 | 382 | A | -26 | 140 |
| 816 | S559 | -5161 | 522 | A | -26 | -140 | 866 | S609 | -6461 | 522 | A | -26 | -140 |
| 817 | S560 | -5187 | 382 | A | -26 | 140 | 867 | S610 | -6487 | 382 | A | -26 | 140 |
| 818 | S561 | -5213 | 522 | A | -26 | -140 | 868 | S611 | -6513 | 522 | A | -26 | -140 |
| 819 | S562 | -5239 | 382 | A | -26 | 140 | 869 | S612 | -6539 | 382 | A | -26 | 140 |
| 820 | S563 | -5265 | 522 | A | -26 | -140 | 870 | S613 | -6565 | 522 | A | -26 | -140 |
| 821 | S564 | -5291 | 382 | A | -26 | 140 | 871 | S614 | -6591 | 382 | A | -26 | 140 |
| 822 | S565 | -5317 | 522 | A | -26 | -140 | 872 | S615 | -6617 | 522 | A | -26 | -140 |
| 823 | S566 | -5343 | 382 | A | -26 | 140 | 873 | S616 | -6643 | 382 | A | -26 | 140 |
| 824 | S567 | -5369 | 522 | A | -26 | -140 | 874 | S617 | -6669 | 522 | A | -26 | -140 |
| 825 | S568 | -5395 | 382 | A | -26 | 140 | 875 | S618 | -6695 | 382 | A | -26 | 140 |
| 826 | S569 | -5421 | 522 | A | -26 | -140 | 876 | S619 | -6721 | 522 | A | -26 | -140 |
| 827 | S570 | -5447 | 382 | A | -26 | 140 | 877 | S620 | -6747 | 382 | A | -26 | 140 |
| 828 | S571 | -5473 | 522 | A | -26 | -140 | 878 | S621 | -6773 | 522 | A | -26 | -140 |
| 829 | S572 | -5499 | 382 | A | -26 | 140 | 879 | S622 | -6799 | 382 | A | -26 | 140 |
| 830 | S573 | -5525 | 522 | A | -26 | -140 | 880 | S623 | -6825 | 522 | A | -26 | -140 |
| 831 | S574 | -5551 | 382 | A | -26 | 140 | 881 | S624 | -6851 | 382 | A | -26 | 140 |
| 832 | S575 | -5577 | 522 | A | -26 | -140 | 882 | S625 | -6877 | 522 | A | -26 | -140 |
| 833 | S576 | -5603 | 382 | A | -26 | 140 | 883 | S626 | -6903 | 382 | A | -26 | 140 |
| 834 | S577 | -5629 | 522 | A | -26 | -140 | 884 | S627 | -6929 | 522 | A | -26 | -140 |
| 835 | S578 | -5655 | 382 | A | -26 | 140 | 885 | S628 | -6955 | 382 | A | -26 | 140 |
| 836 | S579 | -5681 | 522 | A | -26 | -140 | 886 | S629 | -6981 | 522 | A | -26 | -140 |
| 837 | S580 | -5707 | 382 | A | -26 | 140 | 887 | S630 | -7007 | 382 | A | -26 | 140 |
| 838 | S581 | -5733 | 522 | A | -26 | -140 | 888 | S631 | -7033 | 522 | A | -26 | -140 |
| 839 | S582 | -5759 | 382 | A | -26 | 140 | 889 | S632 | -7059 | 382 | A | -26 | 140 |
| 840 | S583 | -5785 | 522 | A | -26 | -140 | 890 | S633 | -7085 | 522 | A | -26 | -140 |
| 841 | S584 | -5811 | 382 | A | -26 | 140 | 891 | S634 | -7111 | 382 | A | -26 | 140 |
| 842 | S585 | -5837 | 522 | A | -26 | -140 | 892 | S635 | -7137 | 522 | A | -26 | -140 |
| 843 | S586 | -5863 | 382 | A | -26 | 140 | 893 | S636 | -7163 | 382 | A | -26 | 140 |
| 844 | S587 | -5889 | 522 | A | -26 | -140 | 894 | S637 | -7189 | 522 | A | -26 | -140 |
| 845 | S588 | -5915 | 382 | A | -26 | 140 | 895 | S638 | -7215 | 382 | A | -26 | 140 |
| 846 | S589 | -5941 | 522 | A | -26 | -140 | 896 | S639 | -7241 | 522 | A | -26 | -140 |
| 847 | S590 | -5967 | 382 | A | -26 | 140 | 897 | S640 | -7267 | 382 | A | -26 | 140 |
| 848 | S591 | -5993 | 522 | A | -26 | -140 | 898 | S641 | -7293 | 522 | A | -26 | -140 |
| 849 | S592 | -6019 | 382 | A | -26 | 140 | 899 | S642 | -7319 | 382 | A | -26 | 140 |
| 850 | S593 | -6045 | 522 | A | -26 | -140 | 900 | S643 | -7345 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|------|-------|-----|-----------|---------|---------|
| 901 | S644 | -7371 | 382 | A | -26 | 140 |
| 902 | S645 | -7397 | 522 | A | -26 | -140 |
| 903 | S646 | -7423 | 382 | A | -26 | 140 |
| 904 | S647 | -7449 | 522 | A | -26 | -140 |
| 905 | S648 | -7475 | 382 | A | -26 | 140 |
| 906 | S649 | -7501 | 522 | A | -26 | -140 |
| 907 | S650 | -7527 | 382 | A | -26 | 140 |
| 908 | S651 | -7553 | 522 | A | -26 | -140 |
| 909 | S652 | -7579 | 382 | A | -26 | 140 |
| 910 | S653 | -7605 | 522 | A | -26 | -140 |
| 911 | S654 | -7631 | 382 | A | -26 | 140 |
| 912 | S655 | -7657 | 522 | A | -26 | -140 |
| 913 | S656 | -7683 | 382 | A | -26 | 140 |
| 914 | S657 | -7709 | 522 | A | -26 | -140 |
| 915 | S658 | -7735 | 382 | A | -26 | 140 |
| 916 | S659 | -7761 | 522 | A | -26 | -140 |
| 917 | S660 | -7787 | 382 | A | -26 | 140 |
| 918 | S661 | -7813 | 522 | A | -26 | -140 |
| 919 | S662 | -7839 | 382 | A | -26 | 140 |
| 920 | S663 | -7865 | 522 | A | -26 | -140 |
| 921 | S664 | -7891 | 382 | A | -26 | 140 |
| 922 | S665 | -7917 | 522 | A | -26 | -140 |
| 923 | S666 | -7943 | 382 | A | -26 | 140 |
| 924 | S667 | -7969 | 522 | A | -26 | -140 |
| 925 | S668 | -7995 | 382 | A | -26 | 140 |
| 926 | S669 | -8021 | 522 | A | -26 | -140 |
| 927 | S670 | -8047 | 382 | A | -26 | 140 |
| 928 | S671 | -8073 | 522 | A | -26 | -140 |
| 929 | S672 | -8099 | 382 | A | -26 | 140 |
| 930 | S673 | -8125 | 522 | A | -26 | -140 |
| 931 | S674 | -8151 | 382 | A | -26 | 140 |
| 932 | S675 | -8177 | 522 | A | -26 | -140 |
| 933 | S676 | -8203 | 382 | A | -26 | 140 |
| 934 | S677 | -8229 | 522 | A | -26 | -140 |
| 935 | S678 | -8255 | 382 | A | -26 | 140 |
| 936 | S679 | -8281 | 522 | A | -26 | -140 |
| 937 | S680 | -8307 | 382 | A | -26 | 140 |
| 938 | S681 | -8333 | 522 | A | -26 | -140 |
| 939 | S682 | -8359 | 382 | A | -26 | 140 |
| 940 | S683 | -8385 | 522 | A | -26 | -140 |
| 941 | S684 | -8411 | 382 | A | -26 | 140 |
| 942 | S685 | -8437 | 522 | A | -26 | -140 |
| 943 | S686 | -8463 | 382 | A | -26 | 140 |
| 944 | S687 | -8489 | 522 | A | -26 | -140 |
| 945 | S688 | -8515 | 382 | A | -26 | 140 |
| 946 | S689 | -8541 | 522 | A | -26 | -140 |
| 947 | S690 | -8567 | 382 | A | -26 | 140 |
| 948 | S691 | -8593 | 522 | A | -26 | -140 |
| 949 | S692 | -8619 | 382 | A | -26 | 140 |
| 950 | S693 | -8645 | 522 | A | -26 | -140 |

| No. | Name | X | Y | BUMP size | X Pitch | Y Pitch |
|-----|----------|-------|------|-----------|---------|---------|
| 951 | S694 | -8671 | 382 | A | -26 | 140 |
| 952 | S695 | -8697 | 522 | A | -26 | -140 |
| 953 | S696 | -8723 | 382 | A | -26 | 140 |
| 954 | S697 | -8749 | 522 | A | -26 | -140 |
| 955 | S698 | -8775 | 382 | A | -26 | 140 |
| 956 | S699 | -8801 | 522 | A | -26 | -140 |
| 957 | S700 | -8827 | 382 | A | -26 | 140 |
| 958 | S701 | -8853 | 522 | A | -26 | -140 |
| 959 | S702 | -8879 | 382 | A | -26 | 140 |
| 960 | S703 | -8905 | 522 | A | -26 | -140 |
| 961 | S704 | -8931 | 382 | A | -26 | 140 |
| 962 | S705 | -8957 | 522 | A | -26 | -140 |
| 963 | S706 | -8983 | 382 | A | -26 | 140 |
| 964 | S707 | -9009 | 522 | A | -26 | -140 |
| 965 | S708 | -9035 | 382 | A | -26 | 140 |
| 966 | S709 | -9061 | 522 | A | -26 | -140 |
| 967 | S710 | -9087 | 382 | A | -26 | 140 |
| 968 | S711 | -9113 | 522 | A | -26 | -140 |
| 969 | S712 | -9139 | 382 | A | -26 | 140 |
| 970 | S713 | -9165 | 522 | A | -26 | -140 |
| 971 | S714 | -9191 | 382 | A | -26 | 140 |
| 972 | S715 | -9217 | 522 | A | -26 | -140 |
| 973 | S716 | -9243 | 382 | A | -26 | 140 |
| 974 | S717 | -9269 | 522 | A | -26 | -140 |
| 975 | S718 | -9295 | 382 | A | -26 | 140 |
| 976 | S719 | -9321 | 522 | A | -26 | -140 |
| 977 | S720 | -9347 | 382 | A | -26 | 140 |
| 978 | DUMMY | -9373 | 522 | A | -26 | -150 |
| 979 | DUMMY | -9399 | 372 | C | -26 | 140 |
| 980 | DUMMY | -9425 | 512 | C | -26 | -140 |
| 981 | DUMMY | -9451 | 372 | C | | |
| 982 | OE_L | -9422 | 260 | B | 0 | -70 |
| 983 | OE_L | -9422 | 190 | B | 0 | -80 |
| 984 | CKV_L | -9422 | 110 | B | 0 | -70 |
| 985 | CKV_L | -9422 | 40 | B | 0 | -80 |
| 986 | STV_L | -9422 | -40 | B | 0 | -70 |
| 987 | STV_L | -9422 | -110 | B | 0 | -80 |
| 988 | COMSIG_L | -9422 | -190 | B | 0 | -70 |
| 989 | COMSIG_L | -9422 | -260 | B | | |

| Name | X | Y |
|-----------|---------|------|
| Alignment | -9201.8 | -344 |
| Mark | 9201.8 | -344 |

5. Pin Description

| Pin name | I/O | Description |
|-------------------------------|-----|--|
| S[1:720] | O | Source driver output. |
| D27~D20 D17~D10 D07~D00 | I | Digital data input. Internally pulled low. (1) PS=H (parallel RGB interface): Dx7~Dx0 are used. (2) PS=L (serial RGB interface): only D07~D00 are used. |
| MS | I | Master or Slave mode selection. (1) MS=H: master mode (2) MS=L: slave mode |
| LR | I | Shift direction selection signal. Internally pulled high. Shift direction of the internal shift register is controlled by this pin as shown below: (1) LR=H: S1→S2→•••→S720 (2) LR=L: S720→S719→•••→S1 |
| 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. (1) CLK_TRG=H: Data sampling at the CLK falling edge. (2) CLK_TRG=L: Data sampling at the CLK rising edge. |
| HS | I | Horizontal sync input with negative polarity. |
| VS | I | Vertical sync input with negative polarity. |
| DE | I | Input data enable control. Internally pulled low. |
| CKV | O | Gate driver clock. |
| STV | O | Gate driver start pulse. |
| OEV | O | Gate driver output control. |
| COMSIG | O | Common control signal, output to gate driver to generate common signal. |
| RESETB | I | Active low global reset signal input. Internally pulled high. |
| DISP | I | Display on/off mode control. Internally pulled high. When DISP=L, input data are invalid and blank data are written to data register automatically. |
| DISPG | O | Display on/off mode control output pin to gate driver. |
| V0 ~ V13 | I/O | Gamma reference voltage input pins. Supply these voltages from outside with operational amplifiers. Make sure to maintain the following relationships: AVDD-0.2V > V0 > V1 > ... > V5 > V6 > AVSS+0.2V AVDD-0.2V > V7 > V8 > ... > V12 > V13 > AVSS+0.2V |
| PS | I | Input data format select signal. Internally pulled high. (1) PS=H: Parallel RGB (2) PS=L: Serial RGB |
| LF | I | Line / Frame inversion select signal. Internally pulled high. (1) LF=H: Line inversion (2) LF=L: Frame inversion |
| RES1, RES2 | I | Resolution select signal. Internally pulled high. (1) RES2=H, RES1=H: 480RGB x 272 (2) RES2=H, RES1=L: 480RGB x 240 (3) RES2=L, RES1=H: 240RGB x 320 (4) RES2=L, RES1=L: 240RGB x 240 |
| NBW | I | LC type selection. Internally pulled high. (1) NBW=H: Normally black LC. (2) NBW=L: Normally white LC. |

| Pin name | I/O | Description |
|----------|-----|---|
| TEST1 | I | Test mode pin. Set "H" or OPEN for normal operation. Internally pulled high. |
| TEST2 | I | Test mode pin. Set "H" or OPEN for normal operation. Internally pulled high. |
| TEST3 | I | Test mode pin. Set "H" or OPEN for normal operation. Internally pulled high. |
| TEST_IO1 | I/O | Monitor pin for TEST mode. In normal mode, this pin has two function. One is strapping pin to enable/disable charge pump clock output at TEST_IO4. Internally pulled low. (1) TEST_IO1=H : Enable charge pump clock output (2) TEST_IO1=L : Disable charge pump clock output Another function is input pin of Slave IC. Please reference the description of TEST_IO3 |
| TEST_IO2 | I/O | Monitor pin for TEST mode. In normal mode, this is strapping pin to select MS and LR function (please see 6.1). Internally pulled low. (1) TEST_IO2=H : Internal MS signal is decided by RES2, MS and LR pins (2) TEST_IO2=L : Internal MS signal is decided by RES2 and MS pins |
| TEST_IO3 | I/O | Monitor pin for TEST mode. In normal mode, this pin is POL (gamma polarity) signal output of Master IC, and used to connect TEST_IO1 of Slave IC that sync 2 IC's gamma polarity |
| TEST_IO4 | I/O | Monitor pin for TEST mode. In normal mode, this pin is charge pump clock signal. Internally pulled low |
| DVDD | VI | Digital power supply. 2.25V ~ 3.6V |
| DVSS | VI | Digital GND. |
| AVDD | VI | Analog power supply. 4.8V ~ 5.2V |
| AVSS | VI | Analog GND. |

Cautions

1. Please power on following the sequence DVDD → logic input → AVDD and V0 ~ V13. Reverse the sequence to shut down.
2. To stabilize the supply voltages, please be sure to insert a 0.1uF bypass capacitor between DVDD-DVSS and AVDD-AVSS. Furthermore, for increased precision of the D/A converter, insertion of a bypass capacitor of about 0.01uF is also advised between the gamma-corrected power supply terminals (V0, V1, ..., V13) and AVSS.

6. Function Description

6.1 Resolutions and Master / Slave Modes

HX8227-A has 4 different resolutions, set by RES1, RES2 pins as table 6.1. Since HX8227-A has 720 channels, two HX8227-A source drivers can be cascaded for extended 1440 channels of the 480RGB resolutions (RES2 = H).

| RES2 | RES1 | Display Resolution |
|------|------|--------------------|
| H | H | 480RGB x 272 |
| H | L | 480RGB x 240 |
| L | H | 240RGB x 320 |
| L | L | 240RGB x 240 |

Table 6. 1 Resolution setting

For 480RGB resolutions, HX8227-A has 2 modes of timing control circuit, the Master mode or the Slave mode. And these modes are decided by Internal MS signal (IMS), IMS value is decided by RES2, MS, LR and TEST_IO2 pins as table 6.2. When HX8227-A is set as Master mode, it latches the display data from the 1st clock at DE active regions. Otherwise, HX8227-A starts latching data from either the 241st clock in parallel interface (PS="H"), or from the 721st clock in serial interface (PS="L"). On the contrary, when HX8227-A is set in 240RGB resolutions (RES2="L"), it is always considered as the master, and starts latching data from the 1st clock at DE active region.

| RES2 | MS | LR | TEST_IO2 | IMS(Internal MS signal) |
|------|----|----|----------|-------------------------|
| L | X | X | X | Master mode |
| H | L | X | L | Slave mode |
| H | H | X | L | Master mode |
| H | L | H | H | Slave mode |
| H | H | H | H | Master mode |
| H | L | L | H | Master mode |
| H | H | L | H | Slave mode |

Table 6. 2 IMS value

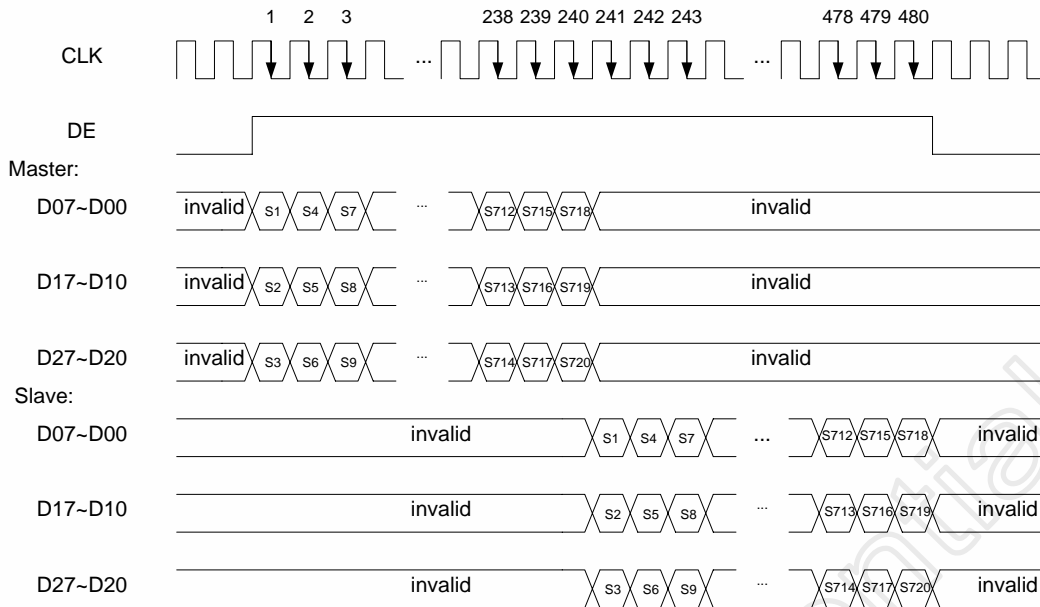


Figure 6. 1 Example of 480RGBx272, parallel RGB

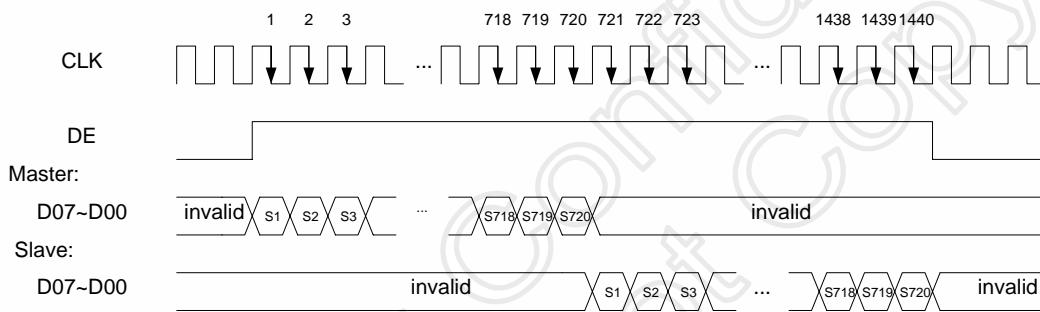


Figure 6. 2 Example of 480RGBx272, serial RGB

6.2 Parallel / Serial Mode and LR function

HX8227-A has 2 modes for input interface, parallel and serial interface. In parallel interface (PS="H"), 24-bit data are transferred into HX8227-A each cycle when DE is activated. Meanwhile, if LR="H" (right shift), D07 to D00 is displayed for output channel S_{3n-2} , D17 to D10 are displayed for channel S_{3n-1} , and D27 to D20 are displayed for channel S_{3n} , where $n=1, 2, \dots$ to 240 sequentially. The relationship between display data and source output is shown in the following figure.

If LR="L" (left shift), D07 to D00, D17 to D10, and D27 to D20 are still displayed for channel S_{3n-2} , S_{3n-1} , and S_{3n} , respectively, but $n=240, 239, \dots$ to 1 sequentially.

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, $x = 1 \sim 3$

| LR | First | | | Last | | |
|----|---------|---------|---------|---------|---------|---------|
| | D00~D07 | D10~D17 | D20~D27 | D00~D07 | D10~D17 | D20~D27 |
| H | S1 | S2 | S3 | S718 | S719 | S720 |

| LR | Last | | | First | | |
|----|---------|---------|---------|---------|---------|---------|
| | D00~D07 | D10~D17 | D20~D27 | D00~D07 | D10~D17 | D20~D27 |
| L | S1 | S2 | S3 | S718 | S719 | S720 |

In serial interface (PS="L"), 8-bit data are transferred into HX8227-A through D07~D00 pins. The data are latched sequentially for channel S_{3n-2} , S_{3n-1} , S_{3n} , $n=1, 2, \dots, 240$ when LR="H", and for S_{3n} , S_{3n-1} , S_{3n-2} , $n=240, 239, 238, \dots$ 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 | S1 | S2 | S3 | S718 | S719 | S720 |

| LR | Last | | | First | | |
|----|---------|---------|---------|---------|---------|---------|
| | D00~D07 | D00~D07 | D00~D07 | D00~D07 | D00~D07 | D00~D07 |
| L | S1 | S2 | S3 | S718 | S719 | S720 |

6.3 Source Driver Function

HX8227-A incorporates 8-bit D/A Converters to transfer input digital data into output analog voltage for each channel. The D/A converters are consists of ladder resistors and switches. The ladder resistors (R0 to R254) are designed so that the ratio of LCD panel gamma-compensated voltages V_{0p} to V_{255p} for positive and V_{0n} to V_{255n} for negative polarity. There are two sets of 7 gamma-compensated power supplies, which are V0 to V6, V7 to V13.

Figure 6. 3 shows relationship between the internal gamma-compensation circuit and the converted analog voltages for both polarities. Gamma-compensation circuit is consisted of gamma-ladder resistors and polarity select switches. The polarity select switches change the connection of gamma-resistor and D/A converter according to the timing of driving polarity.

The converted analog voltages VR, VG, and VB are then sampled, and held by the 720-channel driver, then output through unit gain buffers. The relationship between the source driver output and the input data are shown in Figure 6. 4.

For the gamma-correction reference voltages V0 to V13, AVDD, and AVSS, be sure to maintain the voltage relationships of the following power supplies:

$$\begin{aligned} \text{AVDD} - 0.2\text{V} & \quad V0 > V1 > V2 > V3 > \dots > V6 & \quad \text{AVSS} + 0.2 \text{ V.} \\ \text{AVDD} - 0.2\text{V} & \quad V7 > V8 > V9 > V10 > \dots > V13 & \quad \text{AVSS} + 0.2 \text{ V.} \end{aligned}$$

Table 6. 3 and Table 6. 4 show the relationship between the input data and the output voltage. The resistance value of the resistor strings is also listed.

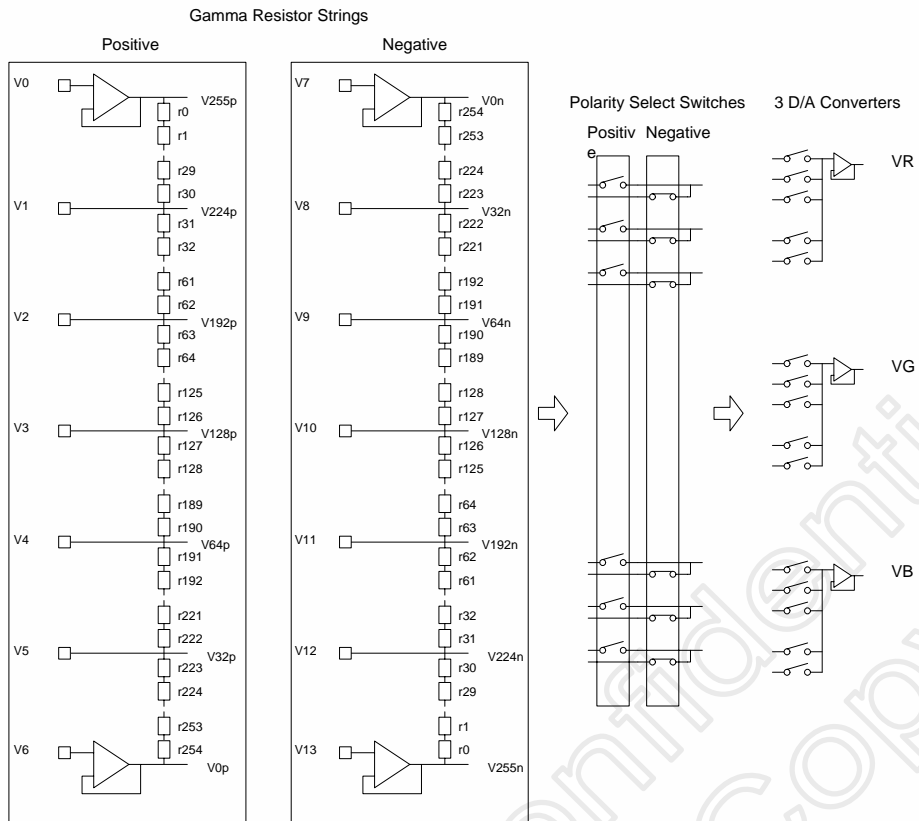


Figure 6. 3 Relationship between the internal gamma-compensation circuits

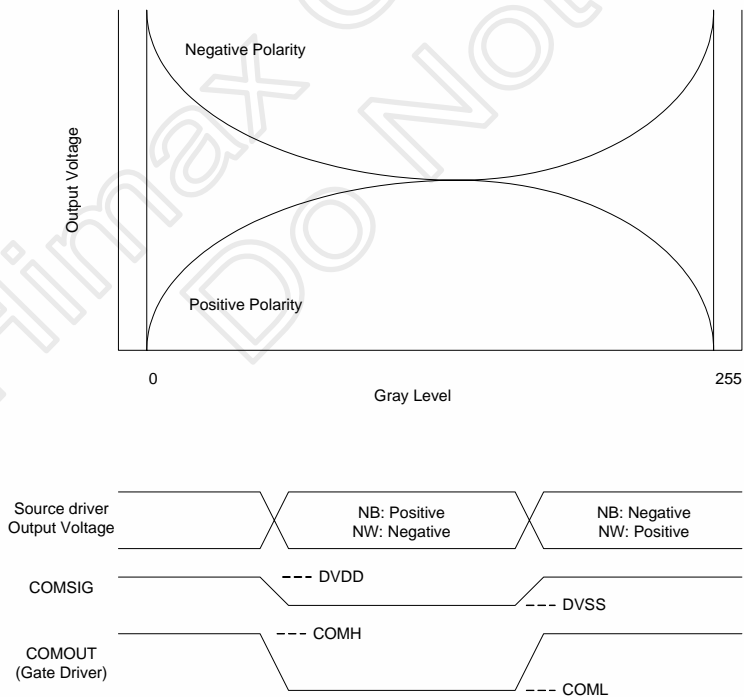


Figure 6. 4 Relationship between NB and NW output polarity

Ladder resistors ratio

| Rn | Ω | Rn | Ω | Rn | Ω | Rn | Ω | Rn | Ω |
|-----|-------|------|------|------|------|------|--------------|----------------|-------|
| R0 | 627.2 | R51 | 37.6 | R102 | 27.0 | R153 | 42.1 | R204 | 60.1 |
| R1 | 627.2 | R52 | 37.6 | R103 | 27.0 | R154 | 42.1 | R205 | 58.6 |
| R2 | 627.2 | R53 | 34.5 | R104 | 27.0 | R155 | 42.1 | R206 | 58.6 |
| R3 | 627.2 | R54 | 34.5 | R105 | 18.0 | R156 | 42.1 | R207 | 58.6 |
| R4 | 627.2 | R55 | 34.5 | R106 | 18.0 | R157 | 36.0 | R208 | 58.6 |
| R5 | 148.7 | R56 | 34.5 | R107 | 18.0 | R158 | 36.0 | R209 | 67.6 |
| R6 | 148.7 | R57 | 36.0 | R108 | 18.0 | R159 | 36.0 | R210 | 67.6 |
| R7 | 148.7 | R58 | 36.0 | R109 | 39.1 | R160 | 36.0 | R211 | 67.6 |
| R8 | 148.7 | R59 | 36.0 | R110 | 39.1 | R161 | 39.1 | R212 | 67.6 |
| R9 | 102.1 | R60 | 36.0 | R111 | 39.1 | R162 | 39.1 | R213 | 75.1 |
| R10 | 102.1 | R61 | 33.0 | R112 | 39.1 | R163 | 39.1 | R214 | 75.1 |
| R11 | 102.1 | R62 | 33.0 | R113 | 34.5 | R164 | 39.1 | R215 | 75.1 |
| R12 | 102.1 | R63 | 33.0 | R114 | 34.5 | R165 | 40.6 | R216 | 75.1 |
| R13 | 82.6 | R64 | 33.0 | R115 | 34.5 | R166 | 40.6 | R217 | 78.1 |
| R14 | 82.6 | R65 | 40.6 | R116 | 34.5 | R167 | 40.6 | R218 | 78.1 |
| R15 | 82.6 | R66 | 40.6 | R117 | 31.5 | R168 | 40.6 | R219 | 78.1 |
| R16 | 82.6 | R67 | 40.6 | R118 | 31.5 | R169 | 37.6 | R220 | 78.1 |
| R17 | 64.6 | R68 | 40.6 | R119 | 31.5 | R170 | 37.6 | R221 | 79.6 |
| R18 | 64.6 | R69 | 40.6 | R120 | 31.5 | R171 | 37.6 | R222 | 79.6 |
| R19 | 64.6 | R70 | 40.6 | R121 | 45.1 | R172 | 37.6 | R223 | 79.6 |
| R20 | 64.6 | R71 | 40.6 | R122 | 45.1 | R173 | 45.1 | R224 | 79.6 |
| R21 | 58.6 | R72 | 40.6 | R123 | 45.1 | R174 | 45.1 | R225 | 100.6 |
| R22 | 58.6 | R73 | 42.1 | R124 | 45.1 | R175 | 45.1 | R226 | 100.6 |
| R23 | 58.6 | R74 | 42.1 | R125 | 21.0 | R176 | 45.1 | R227 | 100.6 |
| R24 | 58.6 | R75 | 42.1 | R126 | 21.0 | R177 | 39.1 | R228 | 100.6 |
| R25 | 54.1 | R76 | 42.1 | R127 | 21.0 | R178 | 39.1 | R229 | 108.1 |
| R26 | 54.1 | R77 | 21.0 | R128 | 21.0 | R179 | 39.1 | R230 | 108.1 |
| R27 | 54.1 | R78 | 21.0 | R129 | 33.0 | R180 | 39.1 | R231 | 108.1 |
| R28 | 54.1 | R79 | 21.0 | R130 | 33.0 | R181 | 43.6 | R232 | 108.1 |
| R29 | 54.1 | R80 | 21.0 | R131 | 33.0 | R182 | 43.6 | R233 | 114.2 |
| R30 | 54.1 | R81 | 30.0 | R132 | 33.0 | R183 | 43.6 | R234 | 114.2 |
| R31 | 54.1 | R82 | 30.0 | R133 | 36.0 | R184 | 43.6 | R235 | 114.2 |
| R32 | 54.1 | R83 | 30.0 | R134 | 36.0 | R185 | 52.6 | R236 | 114.2 |
| R33 | 45.1 | R84 | 30.0 | R135 | 36.0 | R186 | 52.6 | R237 | 120.2 |
| R34 | 45.1 | R85 | 36.0 | R136 | 36.0 | R187 | 52.6 | R238 | 120.2 |
| R35 | 45.1 | R86 | 36.0 | R137 | 24.0 | R188 | 52.6 | R239 | 120.2 |
| R36 | 45.1 | R87 | 36.0 | R138 | 24.0 | R189 | 48.1 | R240 | 120.2 |
| R37 | 33.0 | R88 | 36.0 | R139 | 24.0 | R190 | 48.1 | R241 | 105.1 |
| R38 | 33.0 | R89 | 27.0 | R140 | 24.0 | R191 | 48.1 | R242 | 105.1 |
| R39 | 33.0 | R90 | 27.0 | R141 | 34.5 | R192 | 48.1 | R243 | 105.1 |
| R40 | 33.0 | R91 | 27.0 | R142 | 34.5 | R193 | 57.1 | R244 | 105.1 |
| R41 | 39.1 | R92 | 27.0 | R143 | 34.5 | R194 | 57.1 | R245 | 120.2 |
| R42 | 39.1 | R93 | 33.0 | R144 | 34.5 | R195 | 57.1 | R246 | 120.2 |
| R43 | 39.1 | R94 | 33.0 | R145 | 34.5 | R196 | 57.1 | R247 | 120.2 |
| R44 | 39.1 | R95 | 33.0 | R146 | 34.5 | R197 | 54.1 | R248 | 120.2 |
| R45 | 39.1 | R96 | 33.0 | R147 | 34.5 | R198 | 54.1 | R249 | 198.3 |
| R46 | 39.1 | R97 | 30.0 | R148 | 34.5 | R199 | 54.1 | R250 | 198.3 |
| R47 | 39.1 | R98 | 30.0 | R149 | 33.0 | R200 | 54.1 | R251 | 204.3 |
| R48 | 39.1 | R99 | 30.0 | R150 | 33.0 | R201 | 60.1 | R252 | 198.3 |
| R49 | 37.6 | R100 | 30.0 | R151 | 33.0 | R202 | 60.1 | R253 | 198.3 |
| R50 | 37.6 | R101 | 27.0 | R152 | 33.0 | R203 | 60.1 | R254 | 204.3 |
| | | | | | | | Total | 17123.0 | |

Input data and output voltage

| INPUT DATA | | | | | | | | | OUTPUT VOLTAGE | |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|------------------------------|------------------------------|
| Hex | Dx7 | Dx6 | Dx5 | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | Positive | Negative |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | V6 | V7 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $V6+(V5-V6)*(204.3/4034.4)$ | $V8+(V7-V8)*(3830.1/4034.4)$ |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $V6+(V5-V6)*(402.5/4034.4)$ | $V8+(V7-V8)*(3631.9/4034.4)$ |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | $V6+(V5-V6)*(600.8/4034.4)$ | $V8+(V7-V8)*(3433.6/4034.4)$ |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | $V6+(V5-V6)*(805.1/4034.4)$ | $V8+(V7-V8)*(3229.3/4034.4)$ |
| 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | $V6+(V5-V6)*(1003.3/4034.4)$ | $V8+(V7-V8)*(3031.1/4034.4)$ |
| 6 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | $V6+(V5-V6)*(1201.6/4034.4)$ | $V8+(V7-V8)*(2832.8/4034.4)$ |
| 7 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | $V6+(V5-V6)*(1321.8/4034.4)$ | $V8+(V7-V8)*(2712.6/4034.4)$ |
| 8 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | $V6+(V5-V6)*(1441.9/4034.4)$ | $V8+(V7-V8)*(2592.5/4034.4)$ |
| 9 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | $V6+(V5-V6)*(1562.1/4034.4)$ | $V8+(V7-V8)*(2472.3/4034.4)$ |
| 0A | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | $V6+(V5-V6)*(1682.3/4034.4)$ | $V8+(V7-V8)*(2352.3/4034.4)$ |
| 0B | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | $V6+(V5-V6)*(1787.4/4034.4)$ | $V8+(V7-V8)*(2247.0/4034.4)$ |
| 0C | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | $V6+(V5-V6)*(1892.5/4034.4)$ | $V8+(V7-V8)*(2141.9/4034.4)$ |
| 0D | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | $V6+(V5-V6)*(1997.7/4034.4)$ | $V8+(V7-V8)*(2036.7/4034.4)$ |
| 0E | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | $V6+(V5-V6)*(2102.8/4034.4)$ | $V8+(V7-V8)*(1931.6/4034.4)$ |
| 0F | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | $V6+(V5-V6)*(2223.0/4034.4)$ | $V8+(V7-V8)*(1811.4/4034.4)$ |
| 10 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | $V6+(V5-V6)*(2343.1/4034.4)$ | $V8+(V7-V8)*(1691.3/4034.4)$ |
| 11 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | $V6+(V5-V6)*(2463.3/4034.4)$ | $V8+(V7-V8)*(1571.1/4034.4)$ |
| 12 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | $V6+(V5-V6)*(2583.5/4034.4)$ | $V8+(V7-V8)*(1450.9/4034.4)$ |
| 13 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | $V6+(V5-V6)*(2697.6/4034.4)$ | $V8+(V7-V8)*(1336.8/4034.4)$ |
| 14 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | $V6+(V5-V6)*(2811.8/4034.4)$ | $V8+(V7-V8)*(1222.6/4034.4)$ |
| 15 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | $V6+(V5-V6)*(2925.9/4034.4)$ | $V8+(V7-V8)*(1108.5/4034.4)$ |
| 16 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | $V6+(V5-V6)*(3040.1/4034.4)$ | $V8+(V7-V8)*(994.3/4034.4)$ |
| 17 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | $V6+(V5-V6)*(3148.2/4034.4)$ | $V8+(V7-V8)*(886.2/4034.4)$ |
| 18 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | $V6+(V5-V6)*(3256.4/4034.4)$ | $V8+(V7-V8)*(778.0/4034.4)$ |
| 19 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | $V6+(V5-V6)*(3364.5/4034.4)$ | $V8+(V7-V8)*(669.6/4034.4)$ |
| 1A | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | $V6+(V5-V6)*(3472.7/4034.4)$ | $V8+(V7-V8)*(561.8/4034.4)$ |
| 1B | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | $V6+(V5-V6)*(3573.3/4034.4)$ | $V8+(V7-V8)*(461.1/4034.4)$ |
| 1C | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | $V6+(V5-V6)*(3673.9/4034.4)$ | $V8+(V7-V8)*(360.5/4034.4)$ |
| 1D | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | $V6+(V5-V6)*(3774.6/4034.4)$ | $V8+(V7-V8)*(259.8/4034.4)$ |
| 1E | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | $V6+(V5-V6)*(3875.2/4034.4)$ | $V8+(V7-V8)*(159.2/4034.4)$ |
| 1F | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | $V6+(V5-V6)*(3954.8/4034.4)$ | $V8+(V7-V8)*(79.6/4034.4)$ |
| 20 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | V5 | V8 |
| 21 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | $V5+(V4-V5)*(79.6/2057.8)$ | $V9+(V8-V9)*(1978.2/2057.8)$ |
| 22 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | $V5+(V4-V5)*(159.2/2057.8)$ | $V9+(V8-V9)*(1898.6/2057.8)$ |
| 23 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | $V5+(V4-V5)*(237.3/2057.8)$ | $V9+(V8-V9)*(1820.4/2057.8)$ |
| 24 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | $V5+(V4-V5)*(315.41/2057.8)$ | $V9+(V8-V9)*(1742.3/2057.8)$ |
| 25 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | $V5+(V4-V5)*(393.5/2057.8)$ | $V9+(V8-V9)*(1664.2/2057.8)$ |
| 26 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | $V5+(V4-V5)*(471.6/2057.8)$ | $V9+(V8-V9)*(1586.1/2057.8)$ |
| 27 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | $V5+(V4-V5)*(546.7/2057.8)$ | $V9+(V8-V9)*(1511.0/2057.8)$ |
| 28 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | $V5+(V4-V5)*(621.8/2057.8)$ | $V9+(V8-V9)*(1435.9/2057.8)$ |
| 29 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | $V5+(V4-V5)*(696.9/2057.8)$ | $V9+(V8-V9)*(1360.8/2057.8)$ |
| 2A | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | $V5+(V4-V5)*(772.0/2057.8)$ | $V9+(V8-V9)*(1285.7/2057.8)$ |
| 2B | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | $V5+(V4-V5)*(839.6/2057.8)$ | $V9+(V8-V9)*(1218.1/2057.8)$ |
| 2C | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | $V5+(V4-V5)*(907.2/2057.8)$ | $V9+(V8-V9)*(1150.5/2057.8)$ |
| 2D | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | $V5+(V4-V5)*(974.8/2057.8)$ | $V9+(V8-V9)*(1083.0/2057.8)$ |
| 2E | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | $V5+(V4-V5)*(1042.4/2057.8)$ | $V9+(V8-V9)*(1015.4/2057.8)$ |
| 2F | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | $V5+(V4-V5)*(1101.0/2057.8)$ | $V9+(V8-V9)*(956.8/2057.8)$ |
| 30 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | $V5+(V4-V5)*(1159.6/2057.8)$ | $V9+(V8-V9)*(898.2/2057.8)$ |
| 31 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | $V5+(V4-V5)*(1218.1/2057.8)$ | $V9+(V8-V9)*(839.6/2057.8)$ |
| 32 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | $V5+(V4-V5)*(1276.7/2057.8)$ | $V9+(V8-V9)*(781.0/2057.8)$ |
| 33 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | $V5+(V4-V5)*(1336.8/2057.8)$ | $V9+(V8-V9)*(721.0/2057.8)$ |
| 34 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | $V5+(V4-V5)*(1396.9/2057.8)$ | $V9+(V8-V9)*(660.9/2057.8)$ |
| 35 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | $V5+(V4-V5)*(1457.0/2057.8)$ | $V9+(V8-V9)*(600.8/2057.8)$ |
| 36 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | $V5+(V4-V5)*(1517.0/2057.8)$ | $V9+(V8-V9)*(540.7/2057.8)$ |
| 37 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | $V5+(V4-V5)*(1571.1/2057.8)$ | $V9+(V8-V9)*(486.7/2057.8)$ |
| 38 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | $V5+(V4-V5)*(1625.2/2057.8)$ | $V9+(V8-V9)*(432.6/2057.8)$ |
| 39 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | $V5+(V4-V5)*(1679.3/2057.8)$ | $V9+(V8-V9)*(378.5/2057.8)$ |
| 3A | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | $V5+(V4-V5)*(1733.3/2057.8)$ | $V9+(V8-V9)*(324.4/2057.8)$ |
| 3B | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | $V5+(V4-V5)*(1790.4/2057.8)$ | $V9+(V8-V9)*(267.4/2057.8)$ |
| 3C | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | $V5+(V4-V5)*(1847.5/2057.8)$ | $V9+(V8-V9)*(210.3/2057.8)$ |
| 3D | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | $V5+(V4-V5)*(1904.6/2057.8)$ | $V9+(V8-V9)*(153.2/2057.8)$ |
| 3E | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | $V5+(V4-V5)*(1961.6/2057.8)$ | $V9+(V8-V9)*(96.1/2057.8)$ |
| 3F | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | $V5+(V4-V5)*(2009.7/2057.8)$ | $V9+(V8-V9)*(48.1/2057.8)$ |

| Hex | INPUT DATA | | | | | | | | OUTPUT VOLTAGE | |
|-----|------------|-----|-----|-----|-----|-----|-----|-----|----------------------------|------------------------------|
| | Dx7 | Dx6 | Dx5 | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | Positive | Negative |
| | | | | | | | | | V4 | V9 |
| 40 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | V4+(V3-V4)*(48.1/2421.3) | V10+(V9-V10)*(2373.2/2421.3) |
| 41 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | V4+(V3-V4)*(96.1/2421.3) | V10+(V9-V10)*(2352.1/2421.3) |
| 42 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | V4+(V3-V4)*(148.7/2421.3) | V10+(V9-V10)*(2272.6/2421.3) |
| 43 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | V4+(V3-V4)*(201.3/2421.3) | V10+(V9-V10)*(2220.0/2421.3) |
| 44 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | V4+(V3-V4)*(253.8/2421.3) | V10+(V9-V10)*(2167.4/2421.3) |
| 45 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | V4+(V3-V4)*(306.4/2421.3) | V10+(V9-V10)*(2114.8/2421.3) |
| 46 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | V4+(V3-V4)*(350.0/2421.3) | V10+(V9-V10)*(2071.3/2421.3) |
| 47 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | V4+(V3-V4)*(393.5/2421.3) | V10+(V9-V10)*(2027.7/2421.3) |
| 48 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | V4+(V3-V4)*(437.1/2421.3) | V10+(V9-V10)*(1984.2/2421.3) |
| 49 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | V4+(V3-V4)*(480.6/2421.3) | V10+(V9-V10)*(1940.6/2421.3) |
| 4A | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | V4+(V3-V4)*(519.7/2421.3) | V10+(V9-V10)*(1901.6/2421.3) |
| 4B | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | V4+(V3-V4)*(558.8/2421.3) | V10+(V9-V10)*(1862.5/2421.3) |
| 4C | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | V4+(V3-V4)*(597.8/2421.3) | V10+(V9-V10)*(1823.4/2421.3) |
| 4D | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | V4+(V3-V4)*(636.9/2421.3) | V10+(V9-V10)*(1784.4/2421.3) |
| 4E | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | V4+(V3-V4)*(681.9/2421.3) | V10+(V9-V10)*(1739.3/2421.3) |
| 4F | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | V4+(V3-V4)*(727.0/2421.3) | V10+(V9-V10)*(1694.3/2421.3) |
| 50 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | V4+(V3-V4)*(772.0/2421.3) | V10+(V9-V10)*(1649.2/2421.3) |
| 51 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | V4+(V3-V4)*(817.1/2421.3) | V10+(V9-V10)*(1604.2/2421.3) |
| 52 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | V4+(V3-V4)*(854.6/2421.3) | V10+(V9-V10)*(1566.6/2421.3) |
| 53 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | V4+(V3-V4)*(892.2/2421.3) | V10+(V9-V10)*(1529.1/2421.3) |
| 54 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | V4+(V3-V4)*(929.7/2421.3) | V10+(V9-V10)*(1491.5/2421.3) |
| 55 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | V4+(V3-V4)*(967.3/2421.3) | V10+(V9-V10)*(1454.0/2421.3) |
| 56 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | V4+(V3-V4)*(1007.9/2421.3) | V10+(V9-V10)*(1413.4/2421.3) |
| 57 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | V4+(V3-V4)*(1048.4/2421.3) | V10+(V9-V10)*(1372.8/2421.3) |
| 58 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | V4+(V3-V4)*(1089.0/2421.3) | V10+(V9-V10)*(1332.3/2421.3) |
| 59 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | V4+(V3-V4)*(1129.5/2421.3) | V10+(V9-V10)*(1291.7/2421.3) |
| 5A | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | V4+(V3-V4)*(1168.6/2421.3) | V10+(V9-V10)*(1252.7/2421.3) |
| 5B | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | V4+(V3-V4)*(1207.6/2421.3) | V10+(V9-V10)*(1213.6/2421.3) |
| 5C | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | V4+(V3-V4)*(1246.7/2421.3) | V10+(V9-V10)*(1174.6/2421.3) |
| 5D | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | V4+(V3-V4)*(1285.7/2421.3) | V10+(V9-V10)*(1135.5/2421.3) |
| 5E | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | V4+(V3-V4)*(1321.8/2421.3) | V10+(V9-V10)*(1099.5/2421.3) |
| 5F | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | V4+(V3-V4)*(1357.8/2421.3) | V10+(V9-V10)*(1063.4/2421.3) |
| 60 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | V4+(V3-V4)*(1393.9/2421.3) | V10+(V9-V10)*(1027.4/2421.3) |
| 61 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | V4+(V3-V4)*(1429.9/2421.3) | V10+(V9-V10)*(991.3/2421.3) |
| 62 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | V4+(V3-V4)*(1472.0/2421.3) | V10+(V9-V10)*(949.3/2421.3) |
| 63 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | V4+(V3-V4)*(1514.0/2421.3) | V10+(V9-V10)*(907.2/2421.3) |
| 64 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | V4+(V3-V4)*(1556.1/2421.3) | V10+(V9-V10)*(865.2/2421.3) |
| 65 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | V4+(V3-V4)*(1598.1/2421.3) | V10+(V9-V10)*(823.1/2421.3) |
| 66 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | V4+(V3-V4)*(1631.2/2421.3) | V10+(V9-V10)*(790.1/2421.3) |
| 67 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | V4+(V3-V4)*(1664.2/2421.3) | V10+(V9-V10)*(757.0/2421.3) |
| 68 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | V4+(V3-V4)*(1697.3/2421.3) | V10+(V9-V10)*(724.0/2421.3) |
| 69 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | V4+(V3-V4)*(1730.3/2421.3) | V10+(V9-V10)*(690.9/2421.3) |
| 6A | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | V4+(V3-V4)*(1764.9/2421.3) | V10+(V9-V10)*(656.4/2421.3) |
| 6B | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | V4+(V3-V4)*(1799.4/2421.3) | V10+(V9-V10)*(621.8/2421.3) |
| 6C | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | V4+(V3-V4)*(1834.0/2421.3) | V10+(V9-V10)*(587.3/2421.3) |
| 6D | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | V4+(V3-V4)*(1868.5/2421.3) | V10+(V9-V10)*(552.7/2421.3) |
| 6E | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | V4+(V3-V4)*(1903.1/2421.3) | V10+(V9-V10)*(518.2/2421.3) |
| 6F | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | V4+(V3-V4)*(1937.6/2421.3) | V10+(V9-V10)*(483.6/2421.3) |
| 70 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | V4+(V3-V4)*(1972.1/2421.3) | V10+(V9-V10)*(449.1/2421.3) |
| 71 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | V4+(V3-V4)*(2006.7/2421.3) | V10+(V9-V10)*(414.6/2421.3) |
| 72 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | V4+(V3-V4)*(2030.7/2421.3) | V10+(V9-V10)*(390.5/2421.3) |
| 73 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | V4+(V3-V4)*(2054.8/2421.3) | V10+(V9-V10)*(366.5/2421.3) |
| 74 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | V4+(V3-V4)*(2078.8/2421.3) | V10+(V9-V10)*(342.5/2421.3) |
| 75 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | V4+(V3-V4)*(2102.8/2421.3) | V10+(V9-V10)*(318.4/2421.3) |
| 76 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | V4+(V3-V4)*(2138.9/2421.3) | V10+(V9-V10)*(282.4/2421.3) |
| 77 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | V4+(V3-V4)*(2174.9/2421.3) | V10+(V9-V10)*(246.3/2421.3) |
| 78 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | V4+(V3-V4)*(2211.0/2421.3) | V10+(V9-V10)*(210.3/2421.3) |
| 79 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | V4+(V3-V4)*(2247.0/2421.3) | V10+(V9-V10)*(174.2/2421.3) |
| 7A | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | V4+(V3-V4)*(2283.1/2421.3) | V10+(V9-V10)*(141.2/2421.3) |
| 7B | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | V4+(V3-V4)*(2313.1/2421.3) | V10+(V9-V10)*(108.1/2421.3) |
| 7C | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | V4+(V3-V4)*(2346.2/2421.3) | V10+(V9-V10)*(75.1/2421.3) |
| 7D | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | V4+(V3-V4)*(2379.2/2421.3) | V10+(V9-V10)*(42.1/2421.3) |
| 7E | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | V4+(V3-V4)*(2400.2/2421.3) | V10+(V9-V10)*(21.0/2421.3) |
| 7F | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |

| INPUT DATA | | | | | | | | | OUTPUT VOLTAGE | |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|----------------------------|-------------------------------|
| Hex | Dx7 | Dx6 | Dx5 | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | Positive V3 | Negative V10 |
| 80 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | V3+(V2-V3)*(21.0/2090.8) | V11+(V10-V11)*(2069.8/2090.8) |
| 81 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | V3+(V2-V3)*(42.1/2090.8) | V11+(V10-V11)*(2048.8/2090.8) |
| 82 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | V3+(V2-V3)*(87.1/2090.8) | V11+(V10-V11)*(2003.7/2090.8) |
| 83 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | V3+(V2-V3)*(132.2/2090.8) | V11+(V10-V11)*(1958.6/2090.8) |
| 84 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | V3+(V2-V3)*(177.2/2090.8) | V11+(V10-V11)*(1913.6/2090.8) |
| 85 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | V3+(V2-V3)*(222.3/2090.8) | V11+(V10-V11)*(1868.5/2090.8) |
| 86 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | V3+(V2-V3)*(253.8/2090.8) | V11+(V10-V11)*(1837.0/2090.8) |
| 87 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | V3+(V2-V3)*(285.4/2090.8) | V11+(V10-V11)*(1805.4/2090.8) |
| 88 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | V3+(V2-V3)*(316.9/2090.8) | V11+(V10-V11)*(1773.9/2090.8) |
| 89 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | V3+(V2-V3)*(348.5/2090.8) | V11+(V10-V11)*(1742.3/2090.8) |
| 8A | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | V3+(V2-V3)*(383.0/2090.8) | V11+(V10-V11)*(1707.8/2090.8) |
| 8B | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | V3+(V2-V3)*(417.6/2090.8) | V11+(V10-V11)*(1673.2/2090.8) |
| 8C | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | V3+(V2-V3)*(452.1/2090.8) | V11+(V10-V11)*(1638.7/2090.8) |
| 8D | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | V3+(V2-V3)*(486.7/2090.8) | V11+(V10-V11)*(1604.2/2090.8) |
| 8E | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | V3+(V2-V3)*(525.7/2090.8) | V11+(V10-V11)*(1565.1/2090.8) |
| 8F | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | V3+(V2-V3)*(564.8/2090.8) | V11+(V10-V11)*(1526.0/2090.8) |
| 90 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | V3+(V2-V3)*(603.8/2090.8) | V11+(V10-V11)*(1487.0/2090.8) |
| 91 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | V3+(V2-V3)*(642.9/2090.8) | V11+(V10-V11)*(1447.9/2090.8) |
| 92 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | V3+(V2-V3)*(660.9/2090.8) | V11+(V10-V11)*(1429.9/2090.8) |
| 93 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | V3+(V2-V3)*(678.9/2090.8) | V11+(V10-V11)*(1411.9/2090.8) |
| 94 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | V3+(V2-V3)*(696.9/2090.8) | V11+(V10-V11)*(1393.9/2090.8) |
| 95 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | V3+(V2-V3)*(715.0/2090.8) | V11+(V10-V11)*(1375.8/2090.8) |
| 96 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | V3+(V2-V3)*(742.0/2090.8) | V11+(V10-V11)*(1348.8/2090.8) |
| 97 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | V3+(V2-V3)*(769.0/2090.8) | V11+(V10-V11)*(1321.8/2090.8) |
| 98 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | V3+(V2-V3)*(796.1/2090.8) | V11+(V10-V11)*(1294.7/2090.8) |
| 99 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | V3+(V2-V3)*(823.1/2090.8) | V11+(V10-V11)*(1267.7/2090.8) |
| 9A | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | V3+(V2-V3)*(853.1/2090.8) | V11+(V10-V11)*(1237.7/2090.8) |
| 9B | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | V3+(V2-V3)*(883.2/2090.8) | V11+(V10-V11)*(1207.6/2090.8) |
| 9C | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | V3+(V2-V3)*(913.2/2090.8) | V11+(V10-V11)*(1177.6/2090.8) |
| 9D | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | V3+(V2-V3)*(943.3/2090.8) | V11+(V10-V11)*(1147.5/2090.8) |
| 9E | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | V3+(V2-V3)*(976.3/2090.8) | V11+(V10-V11)*(1114.5/2090.8) |
| 9F | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | V3+(V2-V3)*(1009.4/2090.8) | V11+(V10-V11)*(1081.5/2090.8) |
| A0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | V3+(V2-V3)*(1042.4/2090.8) | V11+(V10-V11)*(1048.4/2090.8) |
| A1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | V3+(V2-V3)*(1075.4/2090.8) | V11+(V10-V11)*(1015.4/2090.8) |
| A2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | V3+(V2-V3)*(1102.5/2090.8) | V11+(V10-V11)*(988.3/2090.8) |
| A3 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | V3+(V2-V3)*(1129.5/2090.8) | V11+(V10-V11)*(961.3/2090.8) |
| A4 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | V3+(V2-V3)*(1156.6/2090.8) | V11+(V10-V11)*(934.3/2090.8) |
| A5 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | V3+(V2-V3)*(1183.6/2090.8) | V11+(V10-V11)*(907.2/2090.8) |
| A6 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | V3+(V2-V3)*(1219.6/2090.8) | V11+(V10-V11)*(871.2/2090.8) |
| A7 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | V3+(V2-V3)*(1255.7/2090.8) | V11+(V10-V11)*(835.1/2090.8) |
| A8 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | V3+(V2-V3)*(1291.7/2090.8) | V11+(V10-V11)*(799.1/2090.8) |
| A9 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | V3+(V2-V3)*(1327.8/2090.8) | V11+(V10-V11)*(763.0/2090.8) |
| AA | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | V3+(V2-V3)*(1357.8/2090.8) | V11+(V10-V11)*(733.0/2090.8) |
| AB | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | V3+(V2-V3)*(1387.9/2090.8) | V11+(V10-V11)*(702.9/2090.8) |
| AC | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | V3+(V2-V3)*(1417.9/2090.8) | V11+(V10-V11)*(672.9/2090.8) |
| AD | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | V3+(V2-V3)*(1447.9/2090.8) | V11+(V10-V11)*(642.9/2090.8) |
| AE | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | V3+(V2-V3)*(1469.0/2090.8) | V11+(V10-V11)*(621.8/2090.8) |
| AF | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | V3+(V2-V3)*(1490.0/2090.8) | V11+(V10-V11)*(600.8/2090.8) |
| B0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | V3+(V2-V3)*(1511.0/2090.8) | V11+(V10-V11)*(579.8/2090.8) |
| B1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | V3+(V2-V3)*(1532.1/2090.8) | V11+(V10-V11)*(558.8/2090.8) |
| B2 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | V3+(V2-V3)*(1574.1/2090.8) | V11+(V10-V11)*(516.7/2090.8) |
| B3 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | V3+(V2-V3)*(1616.2/2090.8) | V11+(V10-V11)*(474.6/2090.8) |
| B4 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | V3+(V2-V3)*(1658.2/2090.8) | V11+(V10-V11)*(432.6/2090.8) |
| B5 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | V3+(V2-V3)*(1700.3/2090.8) | V11+(V10-V11)*(390.5/2090.8) |
| B6 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | V3+(V2-V3)*(1740.8/2090.8) | V11+(V10-V11)*(350.0/2090.8) |
| B7 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | V3+(V2-V3)*(1781.4/2090.8) | V11+(V10-V11)*(309.4/2090.8) |
| B8 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | V3+(V2-V3)*(1821.9/2090.8) | V11+(V10-V11)*(268.9/2090.8) |
| B9 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | V3+(V2-V3)*(1862.5/2090.8) | V11+(V10-V11)*(228.3/2090.8) |
| BA | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | V3+(V2-V3)*(1903.1/2090.8) | V11+(V10-V11)*(187.8/2090.8) |
| BB | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | V3+(V2-V3)*(1943.6/2090.8) | V11+(V10-V11)*(147.2/2090.8) |
| BC | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | V3+(V2-V3)*(1984.2/2090.8) | V11+(V10-V11)*(106.6/2090.8) |
| BD | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | V3+(V2-V3)*(2024.7/2090.8) | V11+(V10-V11)*(66.1/2090.8) |
| BE | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | V3+(V2-V3)*(2057.8/2090.8) | V11+(V10-V11)*(33.0/2090.8) |
| BF | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |

| Hex | INPUT DATA | | | | | | | | OUTPUT DATA | |
|-----|------------|-----|-----|-----|-----|-----|-----|-----|----------------------------|-------------------------------|
| | Dx7 | Dx6 | Dx5 | Dx4 | Dx3 | Dx2 | Dx1 | Dx0 | Positive | Negative |
| | | | | | | | | | V2 | V11 |
| C0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | V2+(V1-V2)*(33.0/1231.7) | V12+(V11-V12)*(1198.6/1231.7) |
| C1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | V2+(V1-V2)*(66.1/1231.7) | V12+(V11-V12)*(1165.6/1231.7) |
| C2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | V2+(V1-V2)*(102.1/1231.7) | V12+(V11-V12)*(1129.5/1231.7) |
| C3 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | V2+(V1-V2)*(138.2/1231.7) | V12+(V11-V12)*(1093.5/1231.7) |
| C4 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | V2+(V1-V2)*(174.2/1231.7) | V12+(V11-V12)*(1057.4/1231.7) |
| C5 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | V2+(V1-V2)*(210.3/1231.7) | V12+(V11-V12)*(1021.4/1231.7) |
| C6 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | V2+(V1-V2)*(244.8/1231.7) | V12+(V11-V12)*(986.8/1231.7) |
| C7 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | V2+(V1-V2)*(279.4/1231.7) | V12+(V11-V12)*(952.3/1231.7) |
| C8 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | V2+(V1-V2)*(313.9/1231.7) | V12+(V11-V12)*(917.7/1231.7) |
| C9 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | V2+(V1-V2)*(348.5/1231.7) | V12+(V11-V12)*(883.2/1231.7) |
| CA | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | V2+(V1-V2)*(386.0/1231.7) | V12+(V11-V12)*(845.6/1231.7) |
| CB | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | V2+(V1-V2)*(423.6/1231.7) | V12+(V11-V12)*(808.1/1231.7) |
| CC | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | V2+(V1-V2)*(461.1/1231.7) | V12+(V11-V12)*(770.5/1231.7) |
| CD | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | V2+(V1-V2)*(498.7/1231.7) | V12+(V11-V12)*(733.0/1231.7) |
| CE | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | V2+(V1-V2)*(537.7/1231.7) | V12+(V11-V12)*(693.9/1231.7) |
| CF | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | V2+(V1-V2)*(576.8/1231.7) | V12+(V11-V12)*(654.9/1231.7) |
| D0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | V2+(V1-V2)*(615.8/1231.7) | V12+(V11-V12)*(615.8/1231.7) |
| D1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | V2+(V1-V2)*(654.9/1231.7) | V12+(V11-V12)*(576.8/1231.7) |
| D2 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | V2+(V1-V2)*(693.9/1231.7) | V12+(V11-V12)*(537.7/1231.7) |
| D3 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | V2+(V1-V2)*(733.0/1231.7) | V12+(V11-V12)*(498.7/1231.7) |
| D4 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | V2+(V1-V2)*(772.0/1231.7) | V12+(V11-V12)*(459.6/1231.7) |
| D5 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | V2+(V1-V2)*(811.1/1231.7) | V12+(V11-V12)*(420.6/1231.7) |
| D6 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | V2+(V1-V2)*(844.1/1231.7) | V12+(V11-V12)*(387.5/1231.7) |
| D7 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | V2+(V1-V2)*(877.2/1231.7) | V12+(V11-V12)*(354.5/1231.7) |
| D8 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | V2+(V1-V2)*(910.2/1231.7) | V12+(V11-V12)*(321.4/1231.7) |
| D9 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | V2+(V1-V2)*(943.3/1231.7) | V12+(V11-V12)*(288.4/1231.7) |
| DA | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | V2+(V1-V2)*(988.3/1231.7) | V12+(V11-V12)*(243.3/1231.7) |
| DB | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | V2+(V1-V2)*(1033.4/1231.7) | V12+(V11-V12)*(198.3/1231.7) |
| DC | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | V2+(V1-V2)*(1078.4/1231.7) | V12+(V11-V12)*(153.2/1231.7) |
| DD | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | V2+(V1-V2)*(1123.5/1231.7) | V12+(V11-V12)*(108.1/1231.7) |
| DE | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | V2+(V1-V2)*(1177.6/1231.7) | V12+(V11-V12)*(54.1/1231.7) |
| DF | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | V1+(V0-V1)*(54.1/5287.1) | 13+(V12-V13)*(5233.0/5287.1) |
| E0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | V1+(V0-V1)*(108.1/5287.1) | 13+(V12-V13)*(5179.0/5287.1) |
| E1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | V1+(V0-V1)*(162.2/5287.1) | 13+(V12-V13)*(5124.9/5287.1) |
| E2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | V1+(V0-V1)*(216.3/5287.1) | 13+(V12-V13)*(5070.8/5287.1) |
| E3 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | V1+(V0-V1)*(270.4/5287.1) | 13+(V12-V13)*(5016.7/5287.1) |
| E4 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | V1+(V0-V1)*(324.4/5287.1) | 13+(V12-V13)*(4962.7/5287.1) |
| E5 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | V1+(V0-V1)*(383.0/5287.1) | 13+(V12-V13)*(4904.1/5287.1) |
| E6 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | V1+(V0-V1)*(441.6/5287.1) | 13+(V12-V13)*(4845.5/5287.1) |
| E7 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | V1+(V0-V1)*(500.2/5287.1) | 13+(V12-V13)*(4786.9/5287.1) |
| E8 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | V1+(V0-V1)*(558.8/5287.1) | 13+(V12-V13)*(4728.4/5287.1) |
| E9 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | V1+(V0-V1)*(623.3/5287.1) | 13+(V12-V13)*(4663.8/5287.1) |
| EA | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | V1+(V0-V1)*(687.9/5287.1) | 13+(V12-V13)*(4599.2/5287.1) |
| EB | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | V1+(V0-V1)*(752.5/5287.1) | 13+(V12-V13)*(4534.6/5287.1) |
| EC | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | V1+(V0-V1)*(817.1/5287.1) | 13+(V12-V13)*(4470.0/5287.1) |
| ED | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | V1+(V0-V1)*(899.7/5287.1) | 13+(V12-V13)*(4387.4/5287.1) |
| EE | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | V1+(V0-V1)*(982.3/5287.1) | 13+(V12-V13)*(4304.8/5287.1) |
| EF | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | V1+(V0-V1)*(1064.9/5287.1) | 13+(V12-V13)*(4222.2/5287.1) |
| F0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | V1+(V0-V1)*(1147.5/5287.1) | 13+(V12-V13)*(4139.6/5287.1) |
| F1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | V1+(V0-V1)*(1249.7/5287.1) | 13+(V12-V13)*(4037.4/5287.1) |
| F2 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | V1+(V0-V1)*(1351.8/5287.1) | 13+(V12-V13)*(3935.3/5287.1) |
| F3 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | V1+(V0-V1)*(1454.0/5287.1) | 13+(V12-V13)*(3833.1/5287.1) |
| F4 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | V1+(V0-V1)*(1556.1/5287.1) | 13+(V12-V13)*(3731.0/5287.1) |
| F5 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | V1+(V0-V1)*(1704.8/5287.1) | 13+(V12-V13)*(3582.3/5287.1) |
| F6 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | V1+(V0-V1)*(1853.5/5287.1) | 13+(V12-V13)*(3433.6/5287.1) |
| F7 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | V1+(V0-V1)*(2002.2/5287.1) | 13+(V12-V13)*(3284.9/5287.1) |
| F8 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | V1+(V0-V1)*(2150.9/5287.1) | 13+(V12-V13)*(3136.2/5287.1) |
| F9 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | V1+(V0-V1)*(2778.1/5287.1) | 13+(V12-V13)*(2509.0/5287.1) |
| FA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | V1+(V0-V1)*(3405.4/5287.1) | 13+(V12-V13)*(1881.7/5287.1) |
| FB | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | V1+(V0-V1)*(4032.6/5287.1) | 13+(V12-V13)*(1254.5/5287.1) |
| FC | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | V1+(V0-V1)*(4659.9/5287.1) | 13+(V12-V13)*(627.2/5287.1) |
| FD | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | V0 | V13 |
| FE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | |
| FF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |

6.4 Gate Driver Timing Control

HX8227-A incorporates a timing controller to generate signals for the gate driver IC. HX8227-A outputs gate driver timing signals from CKV, STV, and OEV pins.

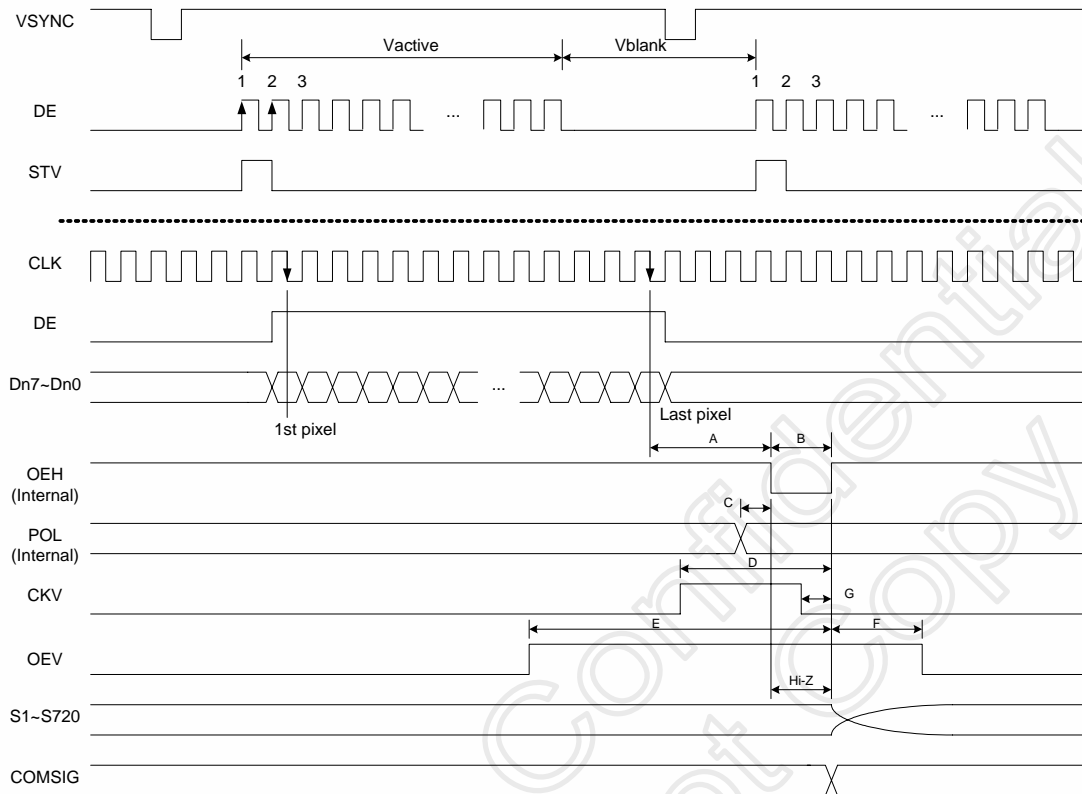


Figure 6. 5 Gate driver timing control

| Timing | 480RGBx272 | 480RGBx240 | 240RGBx320 | 240RGBx240 |
|--------|------------|------------|------------|------------|
| A | 8 | 8 | 4 | 4 |
| B | 4 | 4 | 2 | 2 |
| C | 0 | 0 | 0 | 0 |
| D | 10 | 10 | 5 | 5 |
| E | 34 | 34 | 17 | 17 |
| F | 6 | 6 | 3 | 3 |
| G | 2 | 2 | 1 | 1 |

Table 6. 3 Relationship between resolution and output timing

Note: The above parameters are for 24-bit parallel RGB interface. For 8-bit serial RGB interface, the parameters are all tripled.

6.5 Power ON/OFF Control

HX8227-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”).

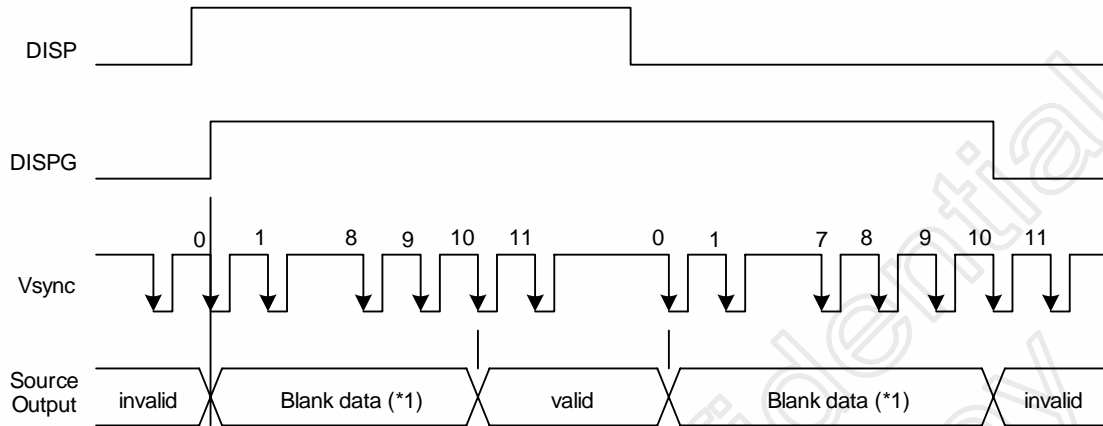


Figure 6. 6 Power on/off control

6.6 Reset

HX8227-A is internally initialized by the global reset signal, RESETB. The reset input must be held for at least 1ms after power is stable.

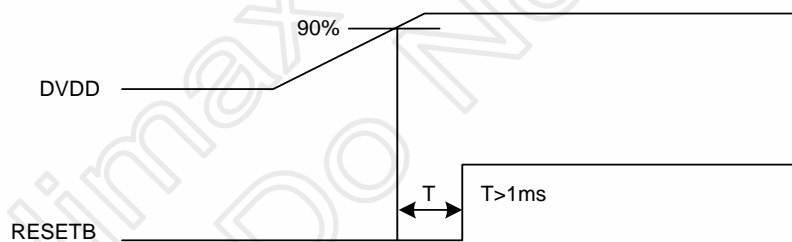


Figure 6. 7 Reset timing

7. DC Characteristics

7.1 Absolute maximum ratings

| Parameter | Symbol | Rating | | | Unit |
|-------------------------------|------------------|--------|----|-----------|------|
| Logic power supply | DVDD | -0.3 | to | 6.0 | V |
| Driver power supply | AVDD | -0.3 | to | 6.0 | V |
| Logic input voltage | V _{I1} | -0.3 | to | DVDD +0.3 | V |
| Driver input voltage | V _{I2} | -0.3 | to | AVDD +0.3 | V |
| Logic output voltage | V _{O1} | -0.3 | to | DVDD +0.3 | V |
| Driver output voltage | V _{O2} | -0.3 | to | AVDD +0.3 | V |
| Operation ambient temperature | T _A | -30 | to | 85 | V |
| Storage temperature | T _{STG} | -40 | to | 125 | °C |

7.2 Recommended operating conditions (T_A=25°C, DVSS=AVSS=0V)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------------------|----------|------|------------------|------|
| Logic power supply | DVDD | 2.25 | 2.5 | 3.6 | V |
| Driver power supply | AVDD | 4.8 | 5.0 | 5.2 | V |
| Input high voltage | V _{IH} | 0.7*DVDD | - | DVDD | V |
| Input low voltage | V _{IL} | 0 | - | 0.3*DVDD | V |
| Driver output voltage | V _O | 0.2 | - | AVDD-0.2 | V |
| Gamma voltage | V _N | 0.2 | - | AVDD-0.2 | V |
| Clock frequency | f _{CLK} ^{*1} | - | 9 | 15 ^{*1} | MHz |

Note:

1. For parallel RGB interface, maximum clock frequency is 15MHz. For serial RGB interface, the maximum clock frequency is 33MHz.

7.3 Electrical Characteristics

(T_A=25°C, DVDD=2.25V to 3.6V, AVDD=4.8V to 5.2V, DVSS=AVSS=0V)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|-------------------------------|---|----------|---------------------|---------------------|------|
| Input low leakage current | I _{IL} | No pull-up or pull-down | -1 | - | 1 | μA |
| Input high leakage current | I _{IH} | No pull-up or pull-down | -1 | - | 1 | μA |
| Output low voltage | V _{OL} ^{*1} | I _{OL} =1mA | DVSS | - | DVSS+0.4 | V |
| Output high voltage | V _{OH} ^{*1} | I _{OH} =-1mA | DVDD-0.4 | - | DVDD | V |
| Gamma resistor | R _{GMA} | AVDD=5V, T _A =25°C, V _O to V _n =4V | - | 17.1 | - | kΩ |
| Driver output current | I _{VOL} | AVDD=5V, V _O =0.2V, V _{IN} =0.7V | - | - | (80) | μA |
| | I _{VOH} | AVDD=5V, V _O =4.8V, V _{IN} =4.3V | (80) | - | - | μA |
| Average output deviation (chip to chip) | V _d | Center gary level | - | - | 10 | mV |
| Output deviation | V _{O1} | V _O =1.5V to AVDD-1.5V | - | (±10) | (±15) | mV |
| Output deviation | V _{O2} | V _O < 1.5V or > AVDD-1.5V | - | (±20) | (±40) | mV |
| Logic dynamic current | I _{DD1} | DVDD | - | (1.0) ^{*2} | (2.0) ^{*3} | mA |
| Driver dynamic current | I _{DD2} | AVDD | - | 8.75 ^{*4} | 10 ^{*5} | mA |
| Input pull up/down resistance | R _I | V _{IL} = 0V or V _{IH} = DVDD | 150 | - | - | kΩ |

Note:

1. CKV, STV, OEV pins
2. Parallel interface, f_{CLK}=9MHz, f_{STB}=17.14KHz, dot inversion pattern, DVDD=2.5V, TA=25°C
3. Parallel interface, f_{CLK}=9MHz, f_{STB}=17.14KHz, dot inversion pattern, DVDD=2.75V, TA=-30 to 85°C
4. Parallel interface, f_{CLK}=9MHz, f_{STB}=17.14KHz, all white (NBW="H") pattern, AVDD=5V, V_O=4.5V, V_n=0.2V, TA=25°C
5. Parallel interface, f_{CLK}=9MHz, f_{STB}=17.14KHz, all white (NBW="H") pattern, AVDD=5.2V, V_O=4.5V, V_n=0.2V, TA=-30 to 85°C

8. AC Characteristics

8.1 Switching characteristics

($T_A=25^\circ\text{C}$, $DVDD=2.25\text{V}$ to **3.6V**, $AVDD=4.8\text{V}$ to 5.2V , $DVSS=AVSS=0\text{V}$)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------|-----------------|------|------|------|---------------|
| Logic output delay time | T_{PLH1}^{*1} | - | - | 50 | ns |
| Driver output delay time | T_{PLH2}^{*2} | - | - | (10) | μs |
| | T_{PLH3}^{*3} | - | - | (12) | μs |
| | T_{PHL2}^{*2} | - | - | (10) | μs |
| | T_{PHL3}^{*3} | - | - | (12) | μs |
| Input Capacitance | C_{I1} | - | - | 10 | pF |

Note:

1. CLK edge to CKV, STV, OEV and COMSIG pins, $C_L = 15\text{pF}$
2. Specified when driver voltage reaches 10% or 90% of the target level. $R_L=17\text{ k}\Omega$, $C_L=40\text{pF}$, $DVDD=2.5\text{V}$, $AVDD=5\text{V}$.
3. Specified when driver voltage reaches 6-bit accuracy of the target level. $R_L=17\text{ k}\Omega$, $C_L=40\text{pF}$, $DVDD=2.5\text{V}$, $AVDD=5\text{V}$.

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8.2 Timing Requirement 1

(480RGBx272, T_A=25°C, DVDD=2.25V to 3.6V, DVSS= 0V)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit |
|---------------------------|--------------------------------|------|-------|------|------|
| Clock cycle | 1/t _C ^{*1} | - | 9 | 15 | MHz |
| Hsync cycle | 1/f _H | - | 17.14 | - | KHz |
| Vsync cycle | 1/f _V | - | 59.94 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th ^{*2} | - | 525 | - | CLK |
| Horizontal display period | thd | - | 480 | - | CLK |
| Horizontal front porch | thf | 2 | - | - | CLK |
| Horizontal pulse width | thp | 2 | 41 | - | CLK |
| Horizontal back porch | thb | 2 | 2 | - | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv | - | 286 | - | H |
| Vertical display period | tvd | - | 272 | - | H |
| Vertical front porch | tvf | 1 | 2 | - | H |
| Vertical pulse width | tvp | 1 | 10 | - | H |
| Vertical back porch | tvb | 1 | 2 | - | H |

Note:

1. Parallel interface. Clock frequency and horizontal signal parameters are tripled in serial interface. The Maximum clock frequency of serial interface is 33MHz
2. thd=480CLK, thf=2CLK, thp=41CLK, thb=2CLK, thf + fhp + ftb > 44

(480RGBx240, T_A=25°C, DVDD=2.25V to 3.6V, DVSS= 0V)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit |
|---------------------------|--------------------------------|------|-------|------|------|
| Clock cycle | 1/t _C ^{*1} | - | 9.6 | 15 | MHz |
| Hsync cycle | 1/f _H | - | 15.72 | - | KHz |
| Vsync cycle | 1/f _V | - | 60 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th ^{*2} | - | 612 | - | CLK |
| Horizontal display period | thd | - | 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 ^{*3} | - | 262 | - | H |
| Vertical display period | tvd | - | 240 | - | H |
| Vertical front porch | tvf | 1 | 4 | - | H |
| Vertical pulse width | tvp | 1 | 3 | - | H |
| Vertical back porch | tvb | 1 | 15 | - | H |

Note:

1. Parallel interface. Clock frequency and horizontal signal parameters are tripled in serial interface. The Maximum clock frequency of serial interface is 33MHz
2. thd=480CLK, thf=30CLK, thp=46CLK, thb=56CLK, thf + fhp + ftb > 44
3. Values in the table are for NTSC mode. For PAL mode, typical values are tv=312H, tvd=280H, tvf=6H, tvp=3H, tvb=23H

(240RGBx320, T_A=25°C, DVDD=2.25V to 3.6V, DVSS= 0V)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit |
|---------------------------|--------------------------------|------|-------|------|------|
| Clock cycle | 1/t _C ^{*1} | - | 5.5 | 15 | MHz |
| Hsync cycle | 1/f _H | - | 19.56 | - | KHz |
| Vsync cycle | 1/f _V | - | 60 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th ^{*2} | - | 280 | - | CLK |
| Horizontal display period | thd | - | 240 | - | CLK |
| Horizontal front porch | thf | 2 | 23 | - | CLK |
| Horizontal pulse width | thp | 2 | 10 | - | CLK |
| Horizontal back porch | thb | 2 | 7 | - | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv | - | 326 | - | H |
| Vertical display period | tvd | - | 320 | - | H |
| Vertical front porch | tvf | 1 | 2 | - | H |
| Vertical pulse width | tvp | 1 | 2 | - | H |
| Vertical back porch | tvb | 1 | 2 | - | H |

Note:

1. Parallel interface. Clock frequency and horizontal signal parameters are tripled in serial interface.
The Maximum clock frequency of serial interface is 33MHz
2. thd=240CLK, thf=23CLK, thp=10CLK, thb=7CLK, thf + fhp + ftb > 22

(240RGBx240, T_A=25°C, DVDD=2.25V to 3.6V, DVSS= 0V)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit |
|---------------------------|--------------------------------|------|-------|------|------|
| Clock cycle | 1/t _C ^{*1} | - | 4.8 | 15 | MHz |
| Hsync cycle | 1/f _H | - | 15.72 | - | KHz |
| Vsync cycle | 1/f _V | - | 60 | - | Hz |
| Horizontal Signal | | | | | |
| Horizontal cycle | th ^{*2} | - | 306 | - | CLK |
| Horizontal display period | thd | - | 240 | - | CLK |
| Horizontal front porch | thf | 2 | 15 | - | CLK |
| Horizontal pulse width | thp | 2 | 23 | - | CLK |
| Horizontal back porch | thb | 2 | 28 | - | CLK |
| Vertical Signal | | | | | |
| Vertical cycle | tv ^{*3} | - | 262 | - | H |
| Vertical display period | tvd | - | 240 | - | H |
| Vertical front porch | tvf | 1 | 4 | - | H |
| Vertical pulse width | tvp | 1 | 3 | - | H |
| Vertical back porch | tvb | 1 | 15 | - | H |

Note:

1. Parallel interface. Clock frequency and horizontal signal parameters are tripled in serial interface.
The Maximum clock frequency of serial interface is 33MHz
2. thd=240CLK, thf=15CLK, thp=23CLK, thb=28CLK, thf + fhp + ftb > 22
3. Values in the table are for NTSC mode. For PAL mode, typical values are tv=312H, tvd=280H, tvf=6H, tvp=3H, tvb=23H

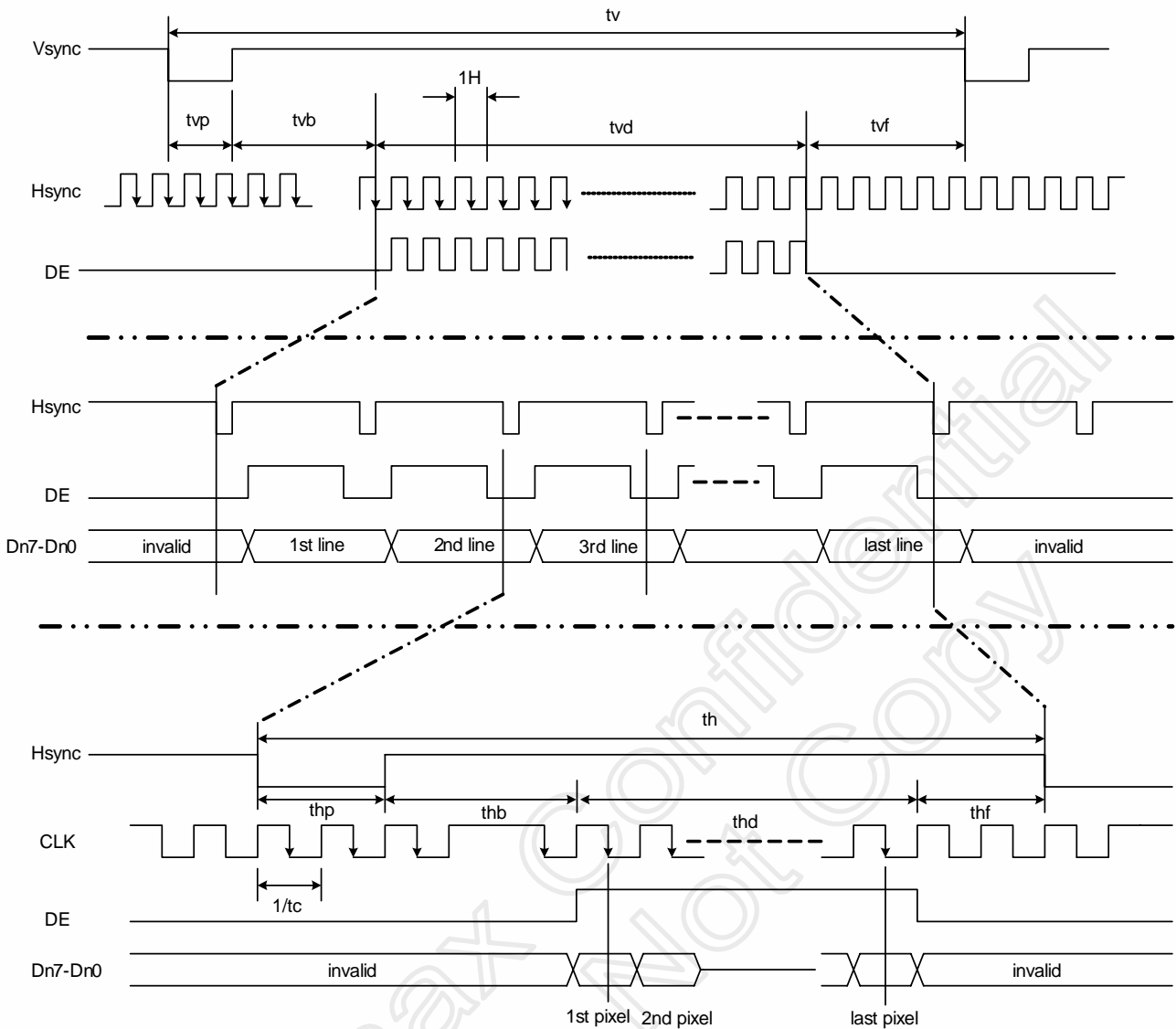


Figure 8. 1 Input timing

8.3 Timing Requirement 2

($T_A=25^{\circ}\text{C}$, $\text{DVDD}=2.25\text{V}$ to 3.6V , $\text{DVSS}=0\text{V}$, $t_r=t_f=2\text{ns}$)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit |
|-------------------------|-------------------------------|------|------|------|------|
| DISP setup time | t_{diss} | 10 | - | - | ns |
| DISP hold time | t_{dish} | 10 | - | - | ns |
| Clock period | $\text{PW}_{\text{CLK}}^{*1}$ | 66.7 | - | - | ns |
| Clock pulse high period | PWH^{*1} | 26.7 | - | - | ns |
| Clock pulse low period | PWL^{*1} | 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. For parallel interface, maximum clock frequency is 15MHz.
2. t_r , t_f is defined 10% to 90% of signal amplitude.

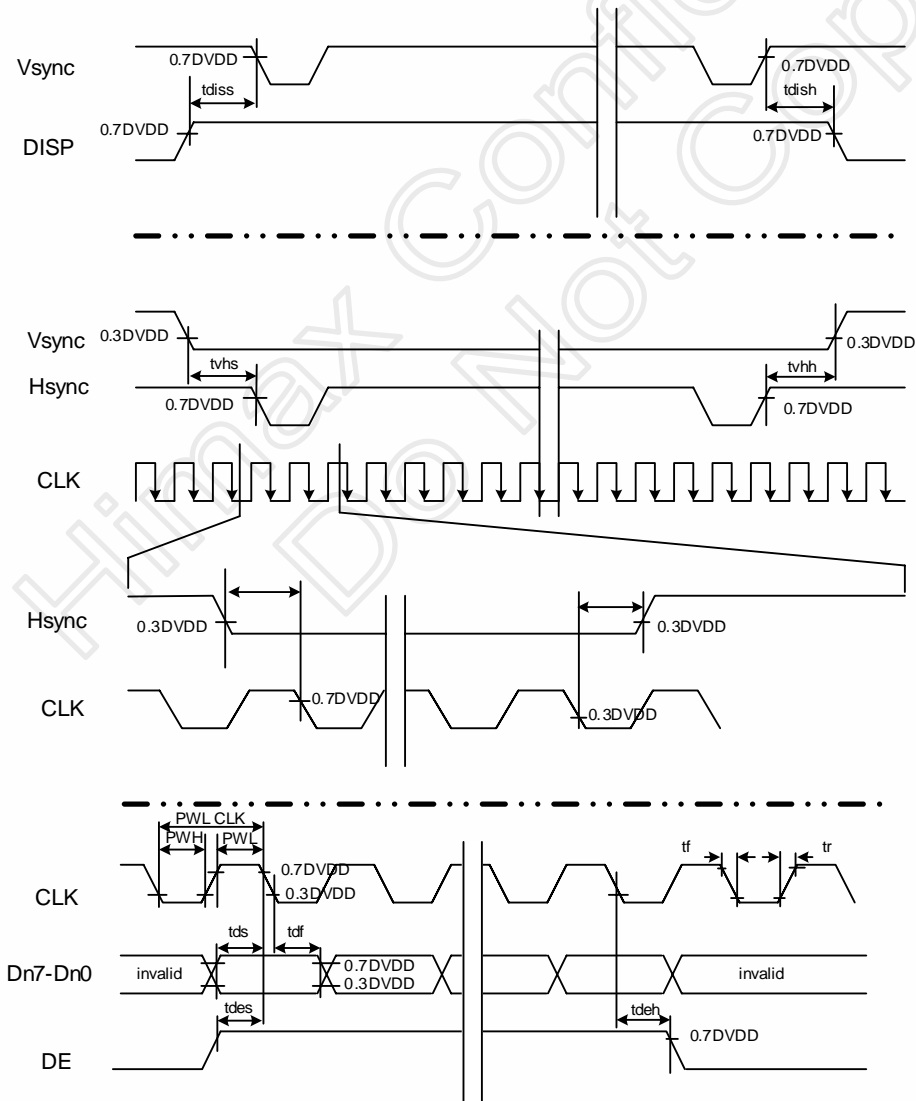


Figure 8. 2 Input setup timing

9. Ordering Information

| Part NO. | Package |
|--------------------------|--|
| HX8227-A010 <u>PDxxx</u> | PD : mean COG xxx : mean chip thickness (μm) , (default 400 μm) |

10. Revision History

| Version | EFF.DATE | DESCRIPTION OF CHANGES |
|---------|------------|---|
| 01 | 2005/03/28 | New setup |
| | 2005/04/08 | 1. Add new resolutions: 240RGBx320 and 240RGBx240 2. Add new pin RES2 to select new extra resolution |
| | 2005/04/26 | 1. Update: PAD location table 2. Update: Section 6.3 timing |
| | 2005/06/08 | 1. Update: AC spec about serial RGB interface 2. Update: DC spec max VDD 2.75V 3. Update: Charge pump clock optional function 4. Update: MS and LR optional function |
| | 2005/07/12 | 1. Update : Block Diagram(P.2) 2. Update : PAD location table(P.5) 3. Update : Driver dynamic current value(P.30) |
| 02 | 2005/07/29 | 1. Update : PAD location table(P.5) |
| | 2005/10/26 | 1. Modify figure 8.1 input timing 2. Modify figure 8.2 input setup timing |
| | 2005/11/07 | 1. Modify figure 6. 8 power on/off control |
| 03 | 2005/12/09 | 1. Modify Pad layout coordinate NO. 6, 7, 50, 56, 81, and 87 x pitch |
| | 2005/12/16 | 1. Page 15 pin CLK_TRIG description modifies (CLKIN to CLK.) 2. Modify figure 8. 3 Thd |
| | 2006/02/08 | 1. Update: DC spec max VDD 3.6V |
| | 2006/02/20 | 1. Adding driver dynamic current in page 30 2. Modify Fig. 4.1 pad location |
| 04 | 2006/03/15 | 1. Modify for new part HX8227-A01 2. Modify pin description TEST_IO1 and TEST_IO3(P.16) 3. Modify Ladder resistors ratio and Input data and output voltage(P.22~P.26) |