

# SSD1353

## *Advance Information*

### **160RGB x 132 Dot Matrix OLED/PLED Segment/Common Driver with Controller**

This document contains information on a new product. Specifications and information herein are subject to change without notice.

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SSD1353

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## 1 GENERAL DESCRIPTION

The SSD1353 is a CMOS OLED/PLED driver with 480 segments and 132 commons output, supporting up to 160RGB x 132 dot matrix display. This chip is designed for Common Cathode type OLED/PLED panel.

The SSD1353 had embedded Graphic Display Data RAM (GDDRAM). It supports with 8, 9, 16, 18 bits 8080 / 6800 parallel interface as well as Serial Peripheral Interface. It has 256-step contrast and 262K color control, giving vivid color display to OLED panels. This driver IC can be widely used in many applications such as MP3, PDA, PMP, mobile phone and Digital Camera.

## 2 FEATURES

- Resolution: 160 RGB x 132 dot matrix panel
- Portrait and Landscape mode data input
- 262k color depth supported by embedded 160x132x18 bit SRAM display buffer
- Power supply
  - $V_{DD} = 2.4V - 2.6V$  (Core  $V_{DD}$  power supply)
  - $V_{DDIO} = 1.6V - V_{CI}$  (MCU interface logic level)
  - $V_{CI} = 2.4V - 3.5V$  (Low voltage power supply)
  - $V_{CC} = 10.0V - 21.0V$  (Panel driving power supply)
- Segment maximum source current: 160uA
- Common maximum sink current: 60mA
- 256 step brightness current control for the each color component plus 16 step master current control
- Pin selectable MCU Interfaces:
  - 8/9/16/18 bits 6800-series parallel interface
  - 8/9/16/18 bits 8080-series parallel interface
  - Serial Peripheral Interface
- Color swapping function (RGB – BGR)
- Support various color depth
  - 262k color (6:6:6)
  - 65k color (5:6:5)
  - 256 color (3:3:2)
- Screen saving continuous scrolling function in both horizontal and vertical action
- Graphic Accelerating Command (GAC) set
- Programmable Gamma functions
- RAM write synchronization signal
- Programmable Frame Rate
- On Chip Oscillator
- Power saving mode
- Dim mode
- Non-Volatile Memory (OTP) for color coordinate calibration
- Slim chip layout best suit for COF
- Operating temperature range -40°C to 85°C.

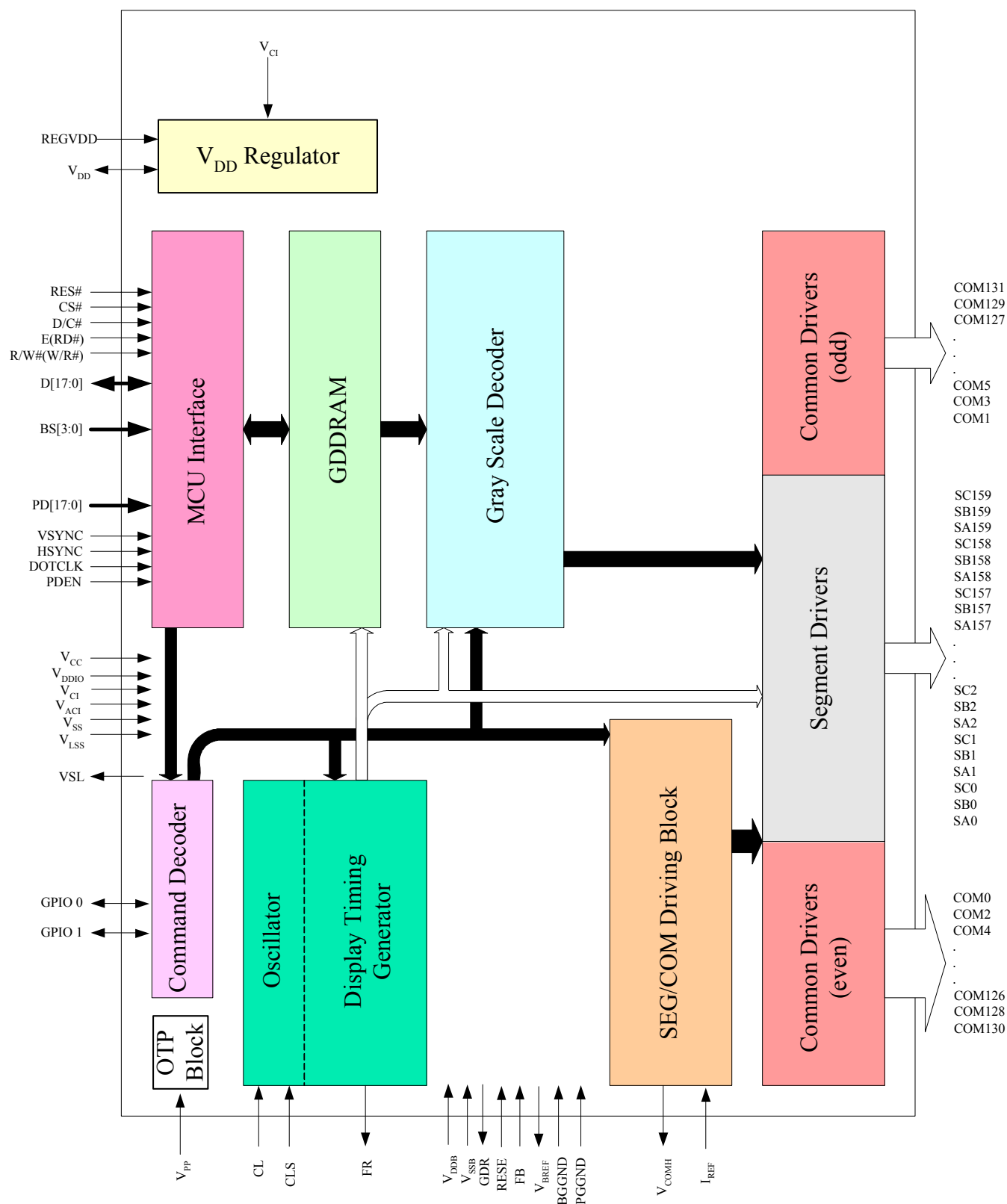
### 3 ORDERING INFORMATION

Table 3-1 : Ordering Information

| Ordering Part Number | SEG    | COM | Package Form  | Reference   | Remark                                                                                                                                                                                                                                                                                            |
|----------------------|--------|-----|---------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SSD1353U4R1          | 160RGB | 128 | COF           | Page 15, 72 | <ul style="list-style-type: none"><li>• 48mm film, 5 sprocket holes</li><li>• Output lead pitch:<ul style="list-style-type: none"><li>• SEG: 0.05mm x 0.999=0.04995mm</li><li>• COM: 0.07mm x 0.999=0.06993mm</li></ul></li><li>• 8-/9-/16-/18-bit 80 / 68 parallel &amp; SPI interface</li></ul> |
| SSD1353Z             | 160RGB | 128 | Gold Bump Die | Page 9, 74  | <ul style="list-style-type: none"><li>• Min SEG pad pitch : 40.1um</li><li>• Min COM pad pitch : 40um</li></ul>                                                                                                                                                                                   |

## 4 BLOCK DIAGRAM

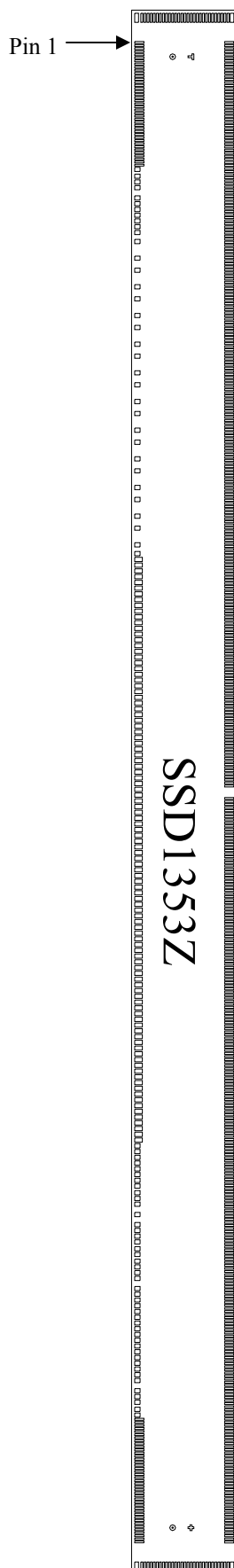
Figure 4-1 : SSD1353 Block Diagram





## 5 DIE FLOOR PLAN

**Figure 5-1 SSD1353Z Die drawing**



### Alignment marks

(For details dimension please refer to Figure 5-2)

|         | Position            | Size                |
|---------|---------------------|---------------------|
| o shape | (9594.26, -152.08)  | R37.5um, inner 18um |
| + shape | (9594.26, 86.2)     | 75um x 75um         |
| o shape | (-9594.27, -152.08) | R37.5um, inner 18um |
| T shape | (-9594.27, 86.2)    | 75um x 75um         |

|                   |                |
|-------------------|----------------|
| Die Size          | 20.4mm x 1.4mm |
| Die Thickness     | 457um          |
| Min I/O pad pitch | 75um           |
| Min SEG pad pitch | 40.1um         |
| Min COM pad pitch | 40um           |
| Bump Height       | nominal 15um   |

### Bump Size

| Pad #                                        | size [ $\mu\text{m}^2$ ] |
|----------------------------------------------|--------------------------|
| Pad 2-42, 223-263, 265-293, 295-780, 782-810 | 25um x 120um             |
| Pad 43-76, 179-222                           | 55um x 70um              |
| Pad 77-178                                   | 55um x 100um             |
| Pad 1, 264, 294, 781                         | 120um x 50um             |

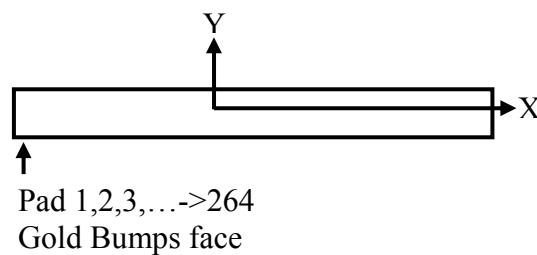


Table 5-1 : SSD1353Z Die Pad Coordinates

| Pad no. | Pad Name | X-Axis   | Y-Axis | Pad no. | Pad Name | X-Axis  | Y-Axis | Pad no. | Pad Name | X-Axis | Y-Axis |
|---------|----------|----------|--------|---------|----------|---------|--------|---------|----------|--------|--------|
| 1       | NC       | -10101.4 | -620.0 | 81      | GDR      | -2737.0 | -595.0 | 161     | D11      | 3263.0 | -595.0 |
| 2       | NC       | -9779.9  | -585.0 | 82      | GDR      | -2662.0 | -595.0 | 162     | D12      | 3338.0 | -595.0 |
| 3       | NC       | -9739.9  | -585.0 | 83      | GDR      | -2587.0 | -595.0 | 163     | D13      | 3413.0 | -595.0 |
| 4       | COM95    | -9699.9  | -585.0 | 84      | GDR      | -2512.0 | -595.0 | 164     | D14      | 3488.0 | -595.0 |
| 5       | COM96    | -9659.9  | -585.0 | 85      | VDDb     | -2437.0 | -595.0 | 165     | D15      | 3563.0 | -595.0 |
| 6       | COM97    | -9619.9  | -585.0 | 86      | VDDb     | -2362.0 | -595.0 | 166     | D16      | 3638.0 | -595.0 |
| 7       | COM98    | -9579.9  | -585.0 | 87      | FB       | -2287.0 | -595.0 | 167     | D17      | 3713.0 | -595.0 |
| 8       | COM99    | -9539.9  | -585.0 | 88      | VBREF    | -2212.0 | -595.0 | 168     | VSS      | 3788.0 | -595.0 |
| 9       | COM100   | -9499.9  | -585.0 | 89      | BGGND    | -2137.0 | -595.0 | 169     | CLS      | 3863.0 | -595.0 |
| 10      | COM101   | -9459.9  | -585.0 | 90      | BGGND    | -2062.0 | -595.0 | 170     | VDDIO    | 3938.0 | -595.0 |
| 11      | COM102   | -9419.9  | -585.0 | 91      | VSS      | -1987.0 | -595.0 | 171     | VDDIO    | 4013.0 | -595.0 |
| 12      | COM103   | -9379.9  | -585.0 | 92      | PGGND    | -1912.0 | -595.0 | 172     | VCI      | 4088.0 | -595.0 |
| 13      | COM104   | -9339.9  | -585.0 | 93      | RESE     | -1837.0 | -595.0 | 173     | VCI      | 4163.0 | -595.0 |
| 14      | COM105   | -9299.9  | -585.0 | 94      | VCI      | -1762.0 | -595.0 | 174     | VCI      | 4238.0 | -595.0 |
| 15      | COM106   | -9259.9  | -585.0 | 95      | VDDb     | -1687.0 | -595.0 | 175     | VDD      | 4313.0 | -595.0 |
| 16      | COM107   | -9219.9  | -585.0 | 96      | VSL      | -1612.0 | -595.0 | 176     | VDD      | 4388.0 | -595.0 |
| 17      | COM108   | -9179.9  | -585.0 | 97      | VSL      | -1537.0 | -595.0 | 177     | VDD      | 4463.0 | -595.0 |
| 18      | COM109   | -9139.9  | -585.0 | 98      | VSL      | -1462.0 | -595.0 | 178     | VDD      | 4538.0 | -595.0 |
| 19      | COM110   | -9099.9  | -585.0 | 99      | VSL      | -1387.0 | -595.0 | 179     | NC       | 4613.0 | -610.0 |
| 20      | COM111   | -9059.9  | -585.0 | 100     | VACI     | -1312.0 | -595.0 | 180     | NC       | 4688.0 | -610.0 |
| 21      | COM112   | -9019.9  | -585.0 | 101     | VACI     | -1237.0 | -595.0 | 181     | NC       | 4763.0 | -610.0 |
| 22      | COM113   | -8979.9  | -585.0 | 102     | VCI      | -1162.0 | -595.0 | 182     | IREF     | 4838.0 | -610.0 |
| 23      | COM114   | -8939.9  | -585.0 | 103     | VCI      | -1087.0 | -595.0 | 183     | VCI      | 4913.0 | -610.0 |
| 24      | COM115   | -8899.9  | -585.0 | 104     | VCC      | -1012.0 | -595.0 | 184     | VCI      | 4988.0 | -610.0 |
| 25      | COM116   | -8859.9  | -585.0 | 105     | VCC      | -937.0  | -595.0 | 185     | VCI      | 5063.0 | -610.0 |
| 26      | COM117   | -8819.9  | -585.0 | 106     | VCC      | -862.0  | -595.0 | 186     | VCI      | 5138.0 | -610.0 |
| 27      | COM118   | -8779.9  | -585.0 | 107     | VLSS     | -787.0  | -595.0 | 187     | VCI      | 5213.0 | -610.0 |
| 28      | COM119   | -8739.9  | -585.0 | 108     | VLSS     | -712.0  | -595.0 | 188     | VCI      | 5288.0 | -610.0 |
| 29      | COM120   | -8699.9  | -585.0 | 109     | VLSS     | -637.0  | -595.0 | 189     | VCI      | 5363.0 | -610.0 |
| 30      | COM121   | -8659.9  | -585.0 | 110     | VLSS     | -562.0  | -595.0 | 190     | NC       | 5438.0 | -610.0 |
| 31      | COM122   | -8619.9  | -585.0 | 111     | VPP      | -487.0  | -595.0 | 191     | VCC      | 5513.0 | -610.0 |
| 32      | COM123   | -8579.9  | -585.0 | 112     | VPP      | -412.0  | -595.0 | 192     | VCC      | 5588.0 | -610.0 |
| 33      | COM124   | -8539.9  | -585.0 | 113     | VPP      | -337.0  | -595.0 | 193     | VCC      | 5663.0 | -610.0 |
| 34      | COM125   | -8499.9  | -585.0 | 114     | VPP      | -262.0  | -595.0 | 194     | VCC      | 5738.0 | -610.0 |
| 35      | COM126   | -8459.9  | -585.0 | 115     | VPP      | -187.0  | -595.0 | 195     | VDD      | 5813.0 | -610.0 |
| 36      | COM127   | -8419.9  | -585.0 | 116     | VDD      | -112.0  | -595.0 | 196     | VDD      | 5888.0 | -610.0 |
| 37      | COM128   | -8379.9  | -585.0 | 117     | VDD      | -37.0   | -595.0 | 197     | VDD      | 5963.0 | -610.0 |
| 38      | COM129   | -8339.9  | -585.0 | 118     | VDD      | 38.0    | -595.0 | 198     | VDD      | 6038.0 | -610.0 |
| 39      | COM130   | -8299.9  | -585.0 | 119     | VDD      | 113.0   | -595.0 | 199     | VDD      | 6113.0 | -610.0 |
| 40      | COM131   | -8259.9  | -585.0 | 120     | VDD      | 188.0   | -595.0 | 200     | VDD      | 6188.0 | -610.0 |
| 41      | NC       | -8219.9  | -585.0 | 121     | VDD      | 263.0   | -595.0 | 201     | VDD      | 6263.0 | -610.0 |
| 42      | NC       | -8179.9  | -585.0 | 122     | VSS      | 338.0   | -595.0 | 202     | VDD      | 6338.0 | -610.0 |
| 43      | NC       | -8124.9  | -610.0 | 123     | VDDIO    | 413.0   | -595.0 | 203     | VSS      | 6413.0 | -610.0 |
| 44      | VCC      | -8035.3  | -610.0 | 124     | VDDIO    | 488.0   | -595.0 | 204     | VSS      | 6488.0 | -610.0 |
| 45      | VCC      | -7960.3  | -610.0 | 125     | VSS      | 563.0   | -595.0 | 205     | VSS      | 6563.0 | -610.0 |
| 46      | VCC      | -7885.3  | -610.0 | 126     | REGVDD   | 638.0   | -595.0 | 206     | VLSS     | 6638.0 | -610.0 |
| 47      | VCOMH    | -7751.4  | -610.0 | 127     | VDDIO    | 713.0   | -595.0 | 207     | VLSS     | 6713.0 | -610.0 |
| 48      | VCOMH    | -7676.4  | -610.0 | 128     | GP0      | 788.0   | -595.0 | 208     | VLSS     | 6788.0 | -610.0 |
| 49      | VLSS     | -7601.4  | -610.0 | 129     | VSS      | 863.0   | -595.0 | 209     | VLSS     | 6863.0 | -610.0 |
| 50      | VLSS     | -7526.4  | -610.0 | 130     | GP1      | 938.0   | -595.0 | 210     | VLSS     | 6938.0 | -610.0 |
| 51      | VSS      | -7451.4  | -610.0 | 131     | VDDIO    | 1013.0  | -595.0 | 211     | VLSS     | 7013.0 | -610.0 |
| 52      | VSS      | -7376.4  | -610.0 | 132     | BS0      | 1088.0  | -595.0 | 212     | VLSS     | 7088.0 | -610.0 |
| 53      | VSS      | -7301.4  | -610.0 | 133     | VSS      | 1163.0  | -595.0 | 213     | VLSS     | 7163.0 | -610.0 |
| 54      | PDEN     | -7183.6  | -610.0 | 134     | BS1      | 1238.0  | -595.0 | 214     | VCOMH    | 7238.0 | -610.0 |
| 55      | PD17     | -6966.3  | -610.0 | 135     | VDDIO    | 1313.0  | -595.0 | 215     | VCOMH    | 7313.0 | -610.0 |
| 56      | PD16     | -6809.7  | -610.0 | 136     | BS2      | 1388.0  | -595.0 | 216     | VCOMH    | 7388.0 | -610.0 |
| 57      | PD15     | -6592.4  | -610.0 | 137     | VSS      | 1463.0  | -595.0 | 217     | VCOMH    | 7463.0 | -610.0 |
| 58      | PD14     | -6435.7  | -610.0 | 138     | BS3      | 1538.0  | -595.0 | 218     | VCC      | 7538.0 | -610.0 |
| 59      | PD13     | -6218.4  | -610.0 | 139     | VDDIO    | 1613.0  | -595.0 | 219     | VCC      | 7613.0 | -610.0 |
| 60      | PD12     | -6061.7  | -610.0 | 140     | FR       | 1688.0  | -595.0 | 220     | VCC      | 7688.0 | -610.0 |
| 61      | PD11     | -5844.5  | -610.0 | 141     | CL       | 1763.0  | -595.0 | 221     | NC       | 7763.0 | -610.0 |
| 62      | PD10     | -5687.8  | -610.0 | 142     | VSS      | 1838.0  | -595.0 | 222     | NC       | 7838.0 | -610.0 |
| 63      | PD9      | -5470.5  | -610.0 | 143     | CS#      | 1913.0  | -595.0 | 223     | NC       | 7913.0 | -585.0 |
| 64      | PD8      | -5313.8  | -610.0 | 144     | RES#     | 1988.0  | -595.0 | 224     | NC       | 7988.0 | -585.0 |
| 65      | PD7      | -5096.5  | -610.0 | 145     | D/C#     | 2063.0  | -595.0 | 225     | COM65    | 8063.0 | -585.0 |
| 66      | PD6      | -4939.9  | -610.0 | 146     | VSS      | 2138.0  | -595.0 | 226     | COM64    | 8138.0 | -585.0 |
| 67      | PD5      | -4722.6  | -610.0 | 147     | R/W#     | 2213.0  | -595.0 | 227     | COM63    | 8213.0 | -585.0 |
| 68      | PD4      | -4565.9  | -610.0 | 148     | E        | 2288.0  | -595.0 | 228     | COM62    | 8288.0 | -585.0 |
| 69      | PD3      | -4348.6  | -610.0 | 149     | VDDIO    | 2363.0  | -595.0 | 229     | COM61    | 8363.0 | -585.0 |
| 70      | PD2      | -4191.9  | -610.0 | 150     | D0       | 2438.0  | -595.0 | 230     | COM60    | 8438.0 | -585.0 |
| 71      | PD1      | -3974.7  | -610.0 | 151     | D1       | 2513.0  | -595.0 | 231     | COM59    | 8513.0 | -585.0 |
| 72      | PD0      | -3818.0  | -610.0 | 152     | D2       | 2588.0  | -595.0 | 232     | COM58    | 8588.0 | -585.0 |
| 73      | HSYNC    | -3600.7  | -610.0 | 153     | D3       | 2663.0  | -595.0 | 233     | COM57    | 8663.0 | -585.0 |
| 74      | VSNC     | -3444.0  | -610.0 | 154     | D4       | 2738.0  | -595.0 | 234     | COM56    | 8738.0 | -585.0 |
| 75      | DOTCLK   | -3226.7  | -610.0 | 155     | D5       | 2813.0  | -595.0 | 235     | COM55    | 8813.0 | -585.0 |
| 76      | VSS      | -3112.0  | -610.0 | 156     | D6       | 2888.0  | -595.0 | 236     | COM54    | 8888.0 | -585.0 |
| 77      | VSSB     | -3037.0  | -595.0 | 157     | D7       | 2963.0  | -595.0 | 237     | COM53    | 8963.0 | -585.0 |
| 78      | VSSB     | -2962.0  | -595.0 | 158     | D8       | 3038.0  | -595.0 | 238     | COM52    | 9038.0 | -585.0 |
| 79      | GDR      | -2887.0  | -595.0 | 159     | D9       | 3113.0  | -595.0 | 239     | COM51    | 9113.0 | -585.0 |
| 80      | GDR      | -2812.0  | -595.0 | 160     | D10      | 3188.0  | -595.0 | 240     | COM50    | 9188.0 | -585.0 |

| Pad no. | Pad Name | X-Axis  | Y-Axis | Pad no. | Pad Name | X-Axis | Y-Axis | Pad no. | Pad Name | X-Axis | Y-Axis |
|---------|----------|---------|--------|---------|----------|--------|--------|---------|----------|--------|--------|
| 241     | COM49    | 8899.9  | -585.0 | 321     | SA8      | 8737.4 | 585.0  | 401     | SC34     | 5531.0 | 585.0  |
| 242     | COM48    | 8939.9  | -585.0 | 322     | SB8      | 8697.4 | 585.0  | 402     | SA35     | 5491.0 | 585.0  |
| 243     | COM47    | 8979.9  | -585.0 | 323     | SC8      | 8657.3 | 585.0  | 403     | SB35     | 5450.9 | 585.0  |
| 244     | COM46    | 9019.9  | -585.0 | 324     | SA9      | 8617.2 | 585.0  | 404     | SC35     | 5410.8 | 585.0  |
| 245     | COM45    | 9059.9  | -585.0 | 325     | SB9      | 8577.1 | 585.0  | 405     | SA36     | 5370.7 | 585.0  |
| 246     | COM44    | 9099.9  | -585.0 | 326     | SC9      | 8537.0 | 585.0  | 406     | SB36     | 5330.6 | 585.0  |
| 247     | COM43    | 9139.9  | -585.0 | 327     | SA10     | 8497.0 | 585.0  | 407     | SC36     | 5290.6 | 585.0  |
| 248     | COM42    | 9179.9  | -585.0 | 328     | SB10     | 8456.9 | 585.0  | 408     | SA37     | 5250.5 | 585.0  |
| 249     | COM41    | 9219.9  | -585.0 | 329     | SC10     | 8416.8 | 585.0  | 409     | SB37     | 5210.4 | 585.0  |
| 250     | COM40    | 9259.9  | -585.0 | 330     | SA11     | 8376.7 | 585.0  | 410     | SC37     | 5170.3 | 585.0  |
| 251     | COM39    | 9299.9  | -585.0 | 331     | SB11     | 8336.6 | 585.0  | 411     | SA38     | 5130.2 | 585.0  |
| 252     | COM38    | 9339.9  | -585.0 | 332     | SC11     | 8296.6 | 585.0  | 412     | SB38     | 5090.2 | 585.0  |
| 253     | COM37    | 9379.9  | -585.0 | 333     | SA12     | 8256.5 | 585.0  | 413     | SC38     | 5050.1 | 585.0  |
| 254     | COM36    | 9419.9  | -585.0 | 334     | SB12     | 8216.4 | 585.0  | 414     | SA39     | 5010.0 | 585.0  |
| 255     | COM35    | 9459.9  | -585.0 | 335     | SC12     | 8176.3 | 585.0  | 415     | SB39     | 4969.9 | 585.0  |
| 256     | COM34    | 9499.9  | -585.0 | 336     | SA13     | 8136.2 | 585.0  | 416     | SC39     | 4929.8 | 585.0  |
| 257     | COM33    | 9539.9  | -585.0 | 337     | SB13     | 8096.2 | 585.0  | 417     | SA40     | 4889.8 | 585.0  |
| 258     | COM32    | 9579.9  | -585.0 | 338     | SC13     | 8056.1 | 585.0  | 418     | SB40     | 4849.7 | 585.0  |
| 259     | COM31    | 9619.9  | -585.0 | 339     | SA14     | 8016.0 | 585.0  | 419     | SC40     | 4809.6 | 585.0  |
| 260     | COM30    | 9659.9  | -585.0 | 340     | SB14     | 7975.9 | 585.0  | 420     | SA41     | 4769.5 | 585.0  |
| 261     | COM29    | 9699.9  | -585.0 | 341     | SC14     | 7935.8 | 585.0  | 421     | SB41     | 4729.4 | 585.0  |
| 262     | NC       | 9739.9  | -585.0 | 342     | SA15     | 7895.8 | 585.0  | 422     | SC41     | 4689.4 | 585.0  |
| 263     | NC       | 9779.9  | -585.0 | 343     | SB15     | 7855.7 | 585.0  | 423     | SA42     | 4649.3 | 585.0  |
| 264     | NC       | 10101.4 | -620.0 | 344     | SC15     | 7815.6 | 585.0  | 424     | SB42     | 4609.2 | 585.0  |
| 265     | COM28    | 10101.4 | -552.5 | 345     | SA16     | 7775.5 | 585.0  | 425     | SC42     | 4569.1 | 585.0  |
| 266     | COM27    | 10101.4 | -512.5 | 346     | SB16     | 7735.4 | 585.0  | 426     | SA43     | 4529.0 | 585.0  |
| 267     | COM26    | 10101.4 | -472.5 | 347     | SC16     | 7695.4 | 585.0  | 427     | SB43     | 4489.0 | 585.0  |
| 268     | COM25    | 10101.4 | -432.5 | 348     | SA17     | 7655.3 | 585.0  | 428     | SC43     | 4448.9 | 585.0  |
| 269     | COM24    | 10101.4 | -392.5 | 349     | SB17     | 7615.2 | 585.0  | 429     | SA44     | 4408.8 | 585.0  |
| 270     | COM23    | 10101.4 | -352.5 | 350     | SC17     | 7575.1 | 585.0  | 430     | SB44     | 4368.7 | 585.0  |
| 271     | COM22    | 10101.4 | -312.5 | 351     | SA18     | 7535.0 | 585.0  | 431     | SC44     | 4328.6 | 585.0  |
| 272     | COM21    | 10101.4 | -272.5 | 352     | SB18     | 7495.0 | 585.0  | 432     | SA45     | 4288.6 | 585.0  |
| 273     | COM20    | 10101.4 | -232.5 | 353     | SC18     | 7454.9 | 585.0  | 433     | SB45     | 4248.5 | 585.0  |
| 274     | COM19    | 10101.4 | -192.5 | 354     | SA19     | 7414.8 | 585.0  | 434     | SC45     | 4208.4 | 585.0  |
| 275     | COM18    | 10101.4 | -152.5 | 355     | SB19     | 7374.7 | 585.0  | 435     | SA46     | 4168.3 | 585.0  |
| 276     | COM17    | 10101.4 | -112.5 | 356     | SC19     | 7334.6 | 585.0  | 436     | SB46     | 4128.2 | 585.0  |
| 277     | COM16    | 10101.4 | -72.5  | 357     | SA20     | 7294.6 | 585.0  | 437     | SC46     | 4088.2 | 585.0  |
| 278     | COM15    | 10101.4 | -32.5  | 358     | SB20     | 7254.5 | 585.0  | 438     | SA47     | 4048.1 | 585.0  |
| 279     | COM14    | 10101.4 | 7.5    | 359     | SC20     | 7214.4 | 585.0  | 439     | SB47     | 4008.0 | 585.0  |
| 280     | COM13    | 10101.4 | 47.5   | 360     | SA21     | 7174.3 | 585.0  | 440     | SC47     | 3967.9 | 585.0  |
| 281     | COM12    | 10101.4 | 87.5   | 361     | SB21     | 7134.2 | 585.0  | 441     | SA48     | 3927.8 | 585.0  |
| 282     | COM11    | 10101.4 | 127.5  | 362     | SC21     | 7094.2 | 585.0  | 442     | SB48     | 3887.8 | 585.0  |
| 283     | COM10    | 10101.4 | 167.5  | 363     | SA22     | 7054.1 | 585.0  | 443     | SC48     | 3847.7 | 585.0  |
| 284     | COM9     | 10101.4 | 207.5  | 364     | SB22     | 7014.0 | 585.0  | 444     | SA49     | 3807.6 | 585.0  |
| 285     | COM8     | 10101.4 | 247.5  | 365     | SC22     | 6973.9 | 585.0  | 445     | SB49     | 3767.5 | 585.0  |
| 286     | COM7     | 10101.4 | 287.5  | 366     | SA23     | 6933.8 | 585.0  | 446     | SC49     | 3727.4 | 585.0  |
| 287     | COM6     | 10101.4 | 327.5  | 367     | SB23     | 6893.8 | 585.0  | 447     | SA50     | 3687.4 | 585.0  |
| 288     | COM5     | 10101.4 | 367.5  | 368     | SC23     | 6853.7 | 585.0  | 448     | SB50     | 3647.3 | 585.0  |
| 289     | COM4     | 10101.4 | 407.5  | 369     | SA24     | 6813.6 | 585.0  | 449     | SC50     | 3607.2 | 585.0  |
| 290     | COM3     | 10101.4 | 447.5  | 370     | SB24     | 6773.5 | 585.0  | 450     | SA51     | 3567.1 | 585.0  |
| 291     | COM2     | 10101.4 | 487.5  | 371     | SC24     | 6733.4 | 585.0  | 451     | SB51     | 3527.0 | 585.0  |
| 292     | COM1     | 10101.4 | 527.5  | 372     | SA25     | 6693.4 | 585.0  | 452     | SC51     | 3487.0 | 585.0  |
| 293     | COM0     | 10101.4 | 567.5  | 373     | SB25     | 6653.3 | 585.0  | 453     | SA52     | 3446.9 | 585.0  |
| 294     | NC       | 10101.4 | 620.0  | 374     | SC25     | 6613.2 | 585.0  | 454     | SB52     | 3406.8 | 585.0  |
| 295     | NC       | 9780.2  | 585.0  | 375     | SA26     | 6573.1 | 585.0  | 455     | SC52     | 3366.7 | 585.0  |
| 296     | NC       | 9740.2  | 585.0  | 376     | SB26     | 6533.0 | 585.0  | 456     | SA53     | 3326.6 | 585.0  |
| 297     | SA0      | 9699.4  | 585.0  | 377     | SC26     | 6493.0 | 585.0  | 457     | SB53     | 3286.6 | 585.0  |
| 298     | SB0      | 9659.3  | 585.0  | 378     | SA27     | 6452.9 | 585.0  | 458     | SC53     | 3246.5 | 585.0  |
| 299     | SC0      | 9619.2  | 585.0  | 379     | SB27     | 6412.8 | 585.0  | 459     | SA54     | 3206.4 | 585.0  |
| 300     | SA1      | 9579.1  | 585.0  | 380     | SC27     | 6372.7 | 585.0  | 460     | SB54     | 3166.3 | 585.0  |
| 301     | SB1      | 9539.0  | 585.0  | 381     | SA28     | 6332.6 | 585.0  | 461     | SC54     | 3126.2 | 585.0  |
| 302     | SC1      | 9499.0  | 585.0  | 382     | SB28     | 6292.6 | 585.0  | 462     | SA55     | 3086.2 | 585.0  |
| 303     | SA2      | 9458.9  | 585.0  | 383     | SC28     | 6252.5 | 585.0  | 463     | SB55     | 3046.1 | 585.0  |
| 304     | SB2      | 9418.8  | 585.0  | 384     | SA29     | 6212.4 | 585.0  | 464     | SC55     | 3006.0 | 585.0  |
| 305     | SC2      | 9378.7  | 585.0  | 385     | SB29     | 6172.3 | 585.0  | 465     | SA56     | 2965.9 | 585.0  |
| 306     | SA3      | 9338.6  | 585.0  | 386     | SC29     | 6132.2 | 585.0  | 466     | SB56     | 2925.8 | 585.0  |
| 307     | SB3      | 9298.6  | 585.0  | 387     | SA30     | 6092.2 | 585.0  | 467     | SC56     | 2885.8 | 585.0  |
| 308     | SC3      | 9258.5  | 585.0  | 388     | SB30     | 6052.1 | 585.0  | 468     | SA57     | 2845.7 | 585.0  |
| 309     | SA4      | 9218.4  | 585.0  | 389     | SC30     | 6012.0 | 585.0  | 469     | SB57     | 2805.6 | 585.0  |
| 310     | SB4      | 9178.3  | 585.0  | 390     | SA31     | 5971.9 | 585.0  | 470     | SC57     | 2765.5 | 585.0  |
| 311     | SC4      | 9138.2  | 585.0  | 391     | SB31     | 5931.8 | 585.0  | 471     | SA58     | 2725.4 | 585.0  |
| 312     | SA5      | 9098.2  | 585.0  | 392     | SC31     | 5891.8 | 585.0  | 472     | SB58     | 2685.4 | 585.0  |
| 313     | SB5      | 9058.1  | 585.0  | 393     | SA32     | 5851.7 | 585.0  | 473     | SC58     | 2645.3 | 585.0  |
| 314     | SC5      | 9018.0  | 585.0  | 394     | SB32     | 5811.6 | 585.0  | 474     | SA59     | 2605.2 | 585.0  |
| 315     | SA6      | 8977.9  | 585.0  | 395     | SC32     | 5771.5 | 585.0  | 475     | SB59     | 2565.1 | 585.0  |
| 316     | SB6      | 8937.8  | 585.0  | 396     | SA33     | 5731.4 | 585.0  | 476     | SC59     | 2525.0 | 585.0  |
| 317     | SC6      | 8897.8  | 585.0  | 397     | SB33     | 5691.4 | 585.0  | 477     | SA60     | 2485.0 | 585.0  |
| 318     | SA7      | 8857.7  | 585.0  | 398     | SC33     | 5651.3 | 585.0  | 478     | SB60     | 2444.9 | 585.0  |
| 319     | SB7      | 8817.6  | 585.0  | 399     | SA34     | 5611.2 | 585.0  | 479     | SC60     | 2404.8 | 585.0  |
| 320     | SC7      | 8777.5  | 585.0  | 400     | SB34     | 5571.1 | 585.0  | 480     | SA61     | 2364.7 | 585.0  |

| Pad no. | Pad Name | X-Axis | Y-Axis |
|---------|----------|--------|--------|
| 481     | SB61     | 2324.6 | 585.0  |
| 482     | SC61     | 2284.6 | 585.0  |
| 483     | SA62     | 2244.5 | 585.0  |
| 484     | SB62     | 2204.4 | 585.0  |
| 485     | SC62     | 2164.3 | 585.0  |
| 486     | SA63     | 2124.2 | 585.0  |
| 487     | SB63     | 2084.2 | 585.0  |
| 488     | SC63     | 2044.1 | 585.0  |
| 489     | SA64     | 2004.0 | 585.0  |
| 490     | SB64     | 1963.9 | 585.0  |
| 491     | SC64     | 1923.8 | 585.0  |
| 492     | SA65     | 1883.8 | 585.0  |
| 493     | SB65     | 1843.7 | 585.0  |
| 494     | SC65     | 1803.6 | 585.0  |
| 495     | SA66     | 1763.5 | 585.0  |
| 496     | SB66     | 1723.4 | 585.0  |
| 497     | SC66     | 1683.4 | 585.0  |
| 498     | SA67     | 1643.3 | 585.0  |
| 499     | SB67     | 1603.2 | 585.0  |
| 500     | SC67     | 1563.1 | 585.0  |
| 501     | SA68     | 1523.0 | 585.0  |
| 502     | SB68     | 1483.0 | 585.0  |
| 503     | SC68     | 1442.9 | 585.0  |
| 504     | SA69     | 1402.8 | 585.0  |
| 505     | SB69     | 1362.7 | 585.0  |
| 506     | SC69     | 1322.6 | 585.0  |
| 507     | SA70     | 1282.6 | 585.0  |
| 508     | SB70     | 1242.5 | 585.0  |
| 509     | SC70     | 1202.4 | 585.0  |
| 510     | SA71     | 1162.3 | 585.0  |
| 511     | SB71     | 1122.2 | 585.0  |
| 512     | SC71     | 1082.2 | 585.0  |
| 513     | SA72     | 1042.1 | 585.0  |
| 514     | SB72     | 1002.0 | 585.0  |
| 515     | SC72     | 961.9  | 585.0  |
| 516     | SA73     | 921.8  | 585.0  |
| 517     | SB73     | 881.8  | 585.0  |
| 518     | SC73     | 841.7  | 585.0  |
| 519     | SA74     | 801.6  | 585.0  |
| 520     | SB74     | 761.5  | 585.0  |
| 521     | SC74     | 721.4  | 585.0  |
| 522     | SA75     | 681.4  | 585.0  |
| 523     | SB75     | 641.3  | 585.0  |
| 524     | SC75     | 601.2  | 585.0  |
| 525     | SA76     | 561.1  | 585.0  |
| 526     | SB76     | 521.0  | 585.0  |
| 527     | SC76     | 481.0  | 585.0  |
| 528     | SA77     | 440.9  | 585.0  |
| 529     | SB77     | 400.8  | 585.0  |
| 530     | SC77     | 360.7  | 585.0  |
| 531     | SA78     | 320.6  | 585.0  |
| 532     | SB78     | 280.6  | 585.0  |
| 533     | SC78     | 240.5  | 585.0  |
| 534     | SA79     | 200.4  | 585.0  |
| 535     | SB79     | 160.3  | 585.0  |
| 536     | SC79     | 120.2  | 585.0  |
| 537     | NC       | 80.2   | 585.0  |
| 538     | NC       | -80.2  | 585.0  |
| 539     | SA80     | -120.3 | 585.0  |
| 540     | SB80     | -160.3 | 585.0  |
| 541     | SC80     | -200.4 | 585.0  |
| 542     | SA81     | -240.5 | 585.0  |
| 543     | SB81     | -280.6 | 585.0  |
| 544     | SC81     | -320.7 | 585.0  |
| 545     | SA82     | -360.7 | 585.0  |
| 546     | SB82     | -400.8 | 585.0  |
| 547     | SC82     | -440.9 | 585.0  |
| 548     | SA83     | -481.0 | 585.0  |
| 549     | SB83     | -521.1 | 585.0  |
| 550     | SC83     | -561.1 | 585.0  |
| 551     | SA84     | -601.2 | 585.0  |
| 552     | SB84     | -641.3 | 585.0  |
| 553     | SC84     | -681.4 | 585.0  |
| 554     | SA85     | -721.5 | 585.0  |
| 555     | SB85     | -761.5 | 585.0  |
| 556     | SC85     | -801.6 | 585.0  |
| 557     | SA86     | -841.7 | 585.0  |
| 558     | SB86     | -881.8 | 585.0  |
| 559     | SC86     | -921.9 | 585.0  |
| 560     | SA87     | -961.9 | 585.0  |

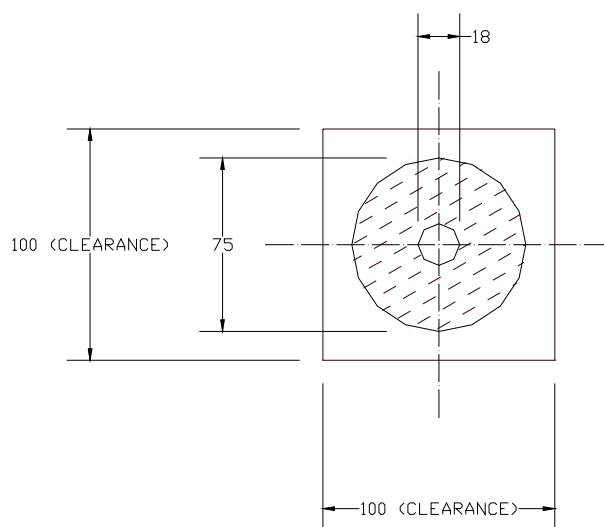
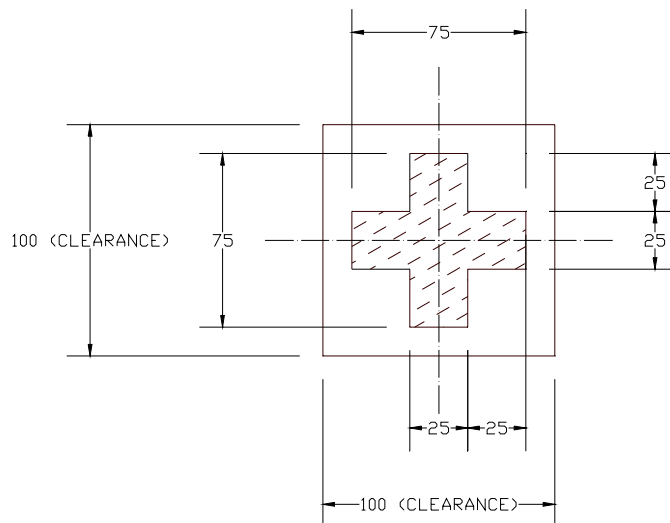
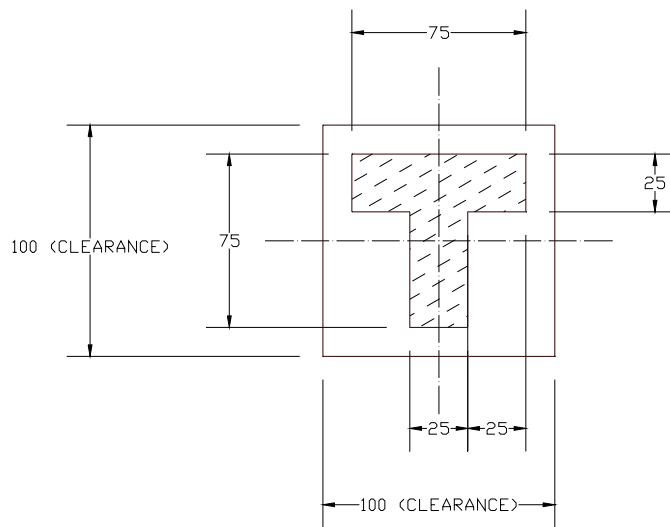
| Pad no. | Pad Name | X-Axis  | Y-Axis |
|---------|----------|---------|--------|
| 561     | SB87     | -1002.0 | 585.0  |
| 562     | SC87     | -1042.1 | 585.0  |
| 563     | SA88     | -1082.2 | 585.0  |
| 564     | SB88     | -1122.3 | 585.0  |
| 565     | SC88     | -1162.3 | 585.0  |
| 566     | SA89     | -1202.4 | 585.0  |
| 567     | SB89     | -1242.5 | 585.0  |
| 568     | SC89     | -1282.6 | 585.0  |
| 569     | SA90     | -1322.7 | 585.0  |
| 570     | SB90     | -1362.7 | 585.0  |
| 571     | SC90     | -1402.8 | 585.0  |
| 572     | SA91     | -1442.9 | 585.0  |
| 573     | SB91     | -1483.0 | 585.0  |
| 574     | SC91     | -1523.1 | 585.0  |
| 575     | SA92     | -1563.1 | 585.0  |
| 576     | SB92     | -1603.2 | 585.0  |
| 577     | SC92     | -1643.3 | 585.0  |
| 578     | SA93     | -1683.4 | 585.0  |
| 579     | SB93     | -1723.5 | 585.0  |
| 580     | SC93     | -1763.5 | 585.0  |
| 581     | SA94     | -1803.6 | 585.0  |
| 582     | SB94     | -1843.7 | 585.0  |
| 583     | SC94     | -1883.8 | 585.0  |
| 584     | SA95     | -1923.9 | 585.0  |
| 585     | SB95     | -1963.9 | 585.0  |
| 586     | SC95     | -2004.0 | 585.0  |
| 587     | SA96     | -2044.1 | 585.0  |
| 588     | SB96     | -2084.2 | 585.0  |
| 589     | SC96     | -2124.3 | 585.0  |
| 590     | SA97     | -2164.3 | 585.0  |
| 591     | SB97     | -2204.4 | 585.0  |
| 592     | SC97     | -2244.5 | 585.0  |
| 593     | SA98     | -2284.6 | 585.0  |
| 594     | SB98     | -2324.7 | 585.0  |
| 595     | SC98     | -2364.7 | 585.0  |
| 596     | SA99     | -2404.8 | 585.0  |
| 597     | SB99     | -2444.9 | 585.0  |
| 598     | SC99     | -2485.0 | 585.0  |
| 599     | SA100    | -2525.1 | 585.0  |
| 600     | SB100    | -2565.1 | 585.0  |
| 601     | SC100    | -2605.2 | 585.0  |
| 602     | SA101    | -2645.3 | 585.0  |
| 603     | SB101    | -2685.4 | 585.0  |
| 604     | SC101    | -2725.5 | 585.0  |
| 605     | SA102    | -2765.5 | 585.0  |
| 606     | SB102    | -2805.6 | 585.0  |
| 607     | SC102    | -2845.7 | 585.0  |
| 608     | SA103    | -2885.8 | 585.0  |
| 609     | SB103    | -2925.9 | 585.0  |
| 610     | SC103    | -2965.9 | 585.0  |
| 611     | SA104    | -3006.0 | 585.0  |
| 612     | SB104    | -3046.1 | 585.0  |
| 613     | SC104    | -3086.2 | 585.0  |
| 614     | SA105    | -3126.3 | 585.0  |
| 615     | SB105    | -3166.3 | 585.0  |
| 616     | SC105    | -3206.4 | 585.0  |
| 617     | SA106    | -3246.5 | 585.0  |
| 618     | SB106    | -3286.6 | 585.0  |
| 619     | SC106    | -3326.7 | 585.0  |
| 620     | SA107    | -3366.7 | 585.0  |
| 621     | SB107    | -3406.8 | 585.0  |
| 622     | SC107    | -3446.9 | 585.0  |
| 623     | SA108    | -3487.0 | 585.0  |
| 624     | SB108    | -3527.1 | 585.0  |
| 625     | SC108    | -3567.1 | 585.0  |
| 626     | SA109    | -3607.2 | 585.0  |
| 627     | SB109    | -3647.3 | 585.0  |
| 628     | SC109    | -3687.4 | 585.0  |
| 629     | SA110    | -3727.5 | 585.0  |
| 630     | SB110    | -3767.5 | 585.0  |
| 631     | SC110    | -3807.6 | 585.0  |
| 632     | SA111    | -3847.7 | 585.0  |
| 633     | SB111    | -3887.8 | 585.0  |
| 634     | SC111    | -3927.9 | 585.0  |
| 635     | SA112    | -3967.9 | 585.0  |
| 636     | SB112    | -4008.0 | 585.0  |
| 637     | SC112    | -4048.1 | 585.0  |
| 638     | SA113    | -4088.2 | 585.0  |
| 639     | SB113    | -4128.3 | 585.0  |
| 640     | SC113    | -4168.3 | 585.0  |

| Pad no. | Pad Name | X-Axis  | Y-Axis |
|---------|----------|---------|--------|
| 641     | SA114    | -4208.4 | 585.0  |
| 642     | SB114    | -4248.5 | 585.0  |
| 643     | SC114    | -4288.6 | 585.0  |
| 644     | SA115    | -4328.7 | 585.0  |
| 645     | SB115    | -4368.7 | 585.0  |
| 646     | SC115    | -4408.8 | 585.0  |
| 647     | SA116    | -4448.9 | 585.0  |
| 648     | SB116    | -4489.0 | 585.0  |
| 649     | SC116    | -4529.1 | 585.0  |
| 650     | SA117    | -4569.1 | 585.0  |
| 651     | SB117    | -4609.2 | 585.0  |
| 652     | SC117    | -4649.3 | 585.0  |
| 653     | SA118    | -4689.4 | 585.0  |
| 654     | SB118    | -4729.5 | 585.0  |
| 655     | SC118    | -4769.5 | 585.0  |
| 656     | SA119    | -4809.6 | 585.0  |
| 657     | SB119    | -4849.7 | 585.0  |
| 658     | SC119    | -4889.8 | 585.0  |
| 659     | SA120    | -4929.9 | 585.0  |
| 660     | SB120    | -4969.9 | 585.0  |
| 661     | SC120    | -5010.0 | 585.0  |
| 662     | SA121    | -5050.1 | 585.0  |
| 663     | SB121    | -5090.2 | 585.0  |
| 664     | SC121    | -5130.3 | 585.0  |
| 665     | SA122    | -5170.3 | 585.0  |
| 666     | SB122    | -5210.4 | 585.0  |
| 667     | SC122    | -5250.5 | 585.0  |
| 668     | SA123    | -5290.6 | 585.0  |
| 669     | SB123    | -5330.7 | 585.0  |
| 670     | SC123    | -5370.7 | 585.0  |
| 671     | SA124    | -5410.8 | 585.0  |
| 672     | SB124    | -5450.9 | 585.0  |
| 673     | SC124    | -5491.0 | 585.0  |
| 674     | SA125    | -5531.1 | 585.0  |
| 675     | SB125    | -5571.1 | 585.0  |
| 676     | SC125    | -5611.2 | 585.0  |
| 677     | SA126    | -5651.3 | 585.0  |
| 678     | SB126    | -5691.4 | 585.0  |
| 679     | SC126    | -5731.5 | 585.0  |
| 680     | SA127    | -5771.5 | 585.0  |
| 681     | SB127    | -5811.6 | 585.0  |
| 682     | SC127    | -5851.7 | 585.0  |
| 683     | SA128    | -5891.8 | 585.0  |
| 684     | SB128    | -5931.9 | 585.0  |
| 685     | SC128    | -5971.9 | 585.0  |
| 686     | SA129    | -6012.0 | 585.0  |
| 687     | SB129    | -6052.1 | 585.0  |
| 688     | SC129    | -6092.2 | 585.0  |
| 689     | SA130    | -6132.3 | 585.0  |
| 690     | SB130    | -6172.3 | 585.0  |
| 691     | SC130    | -6212.4 | 585.0  |
| 692     | SA131    | -6252.5 | 585.0  |
| 693     | SB131    | -6292.6 | 585.0  |
| 694     | SC131    | -6332.7 | 585.0  |
| 695     | SA132    | -6372.7 | 585.0  |
| 696     | SB132    | -6412.8 | 585.0  |
| 697     | SC132    | -6452.9 | 585.0  |
| 698     | SA133    | -6493.0 | 585.0  |
| 699     | SB133    | -6533.1 | 585.0  |
| 700     | SC133    | -6573.1 | 585.0  |
| 701     | SA134    | -6613.2 | 585.0  |
| 702     | SB134    | -6653.3 | 585.0  |
| 703     | SC134    | -6693.4 | 585.0  |
| 704     | SA135    | -6733.5 | 585.0  |
| 705     | SB135    | -6773.5 | 585.0  |
| 706     | SC135    | -6813.6 | 585.0  |
| 707     | SA136    | -6853.7 | 585.0  |
| 708     | SB136    | -6893.8 | 585.0  |
| 709     | SC136    | -6933.9 | 585.0  |
| 710     | SA137    | -6973.9 | 585.0  |
| 711     | SB137    | -7014.0 | 585.0  |
| 712     | SC137    | -7054.1 | 585.0  |
| 713     | SA138    | -7094.2 | 585.0  |
| 714     | SB138    | -7134.3 | 585.0  |
| 715     | SC138    | -7174.3 | 585.0  |
| 716     | SA139    | -7214.4 | 585.0  |
| 717     | SB139    | -7254.5 | 585.0  |
| 718     | SC139    | -7294.6 | 585.0  |
| 719     | SA140    | -7334.7 | 585.0  |
| 720     | SB140    | -7374.7 | 585.0  |

| Pad no. | Pad Name | X-Axis   | Y-Axis |
|---------|----------|----------|--------|
| 721     | SC140    | -7414.8  | 585.0  |
| 722     | SA141    | -7454.9  | 585.0  |
| 723     | SB141    | -7495.0  | 585.0  |
| 724     | SC141    | -7535.1  | 585.0  |
| 725     | SA142    | -7575.1  | 585.0  |
| 726     | SB142    | -7615.2  | 585.0  |
| 727     | SC142    | -7655.3  | 585.0  |
| 728     | SA143    | -7695.4  | 585.0  |
| 729     | SB143    | -7735.5  | 585.0  |
| 730     | SC143    | -7775.5  | 585.0  |
| 731     | SA144    | -7815.6  | 585.0  |
| 732     | SB144    | -7855.7  | 585.0  |
| 733     | SC144    | -7895.8  | 585.0  |
| 734     | SA145    | -7935.9  | 585.0  |
| 735     | SB145    | -7975.9  | 585.0  |
| 736     | SC145    | -8016.0  | 585.0  |
| 737     | SA146    | -8056.1  | 585.0  |
| 738     | SB146    | -8096.2  | 585.0  |
| 739     | SC146    | -8136.3  | 585.0  |
| 740     | SA147    | -8176.3  | 585.0  |
| 741     | SB147    | -8216.4  | 585.0  |
| 742     | SC147    | -8256.5  | 585.0  |
| 743     | SA148    | -8296.6  | 585.0  |
| 744     | SB148    | -8336.7  | 585.0  |
| 745     | SC148    | -8376.7  | 585.0  |
| 746     | SA149    | -8416.8  | 585.0  |
| 747     | SB149    | -8456.9  | 585.0  |
| 748     | SC149    | -8497.0  | 585.0  |
| 749     | SA150    | -8537.1  | 585.0  |
| 750     | SB150    | -8577.1  | 585.0  |
| 751     | SC150    | -8617.2  | 585.0  |
| 752     | SA151    | -8657.3  | 585.0  |
| 753     | SB151    | -8697.4  | 585.0  |
| 754     | SC151    | -8737.5  | 585.0  |
| 755     | SA152    | -8777.5  | 585.0  |
| 756     | SB152    | -8817.6  | 585.0  |
| 757     | SC152    | -8857.7  | 585.0  |
| 758     | SA153    | -8897.8  | 585.0  |
| 759     | SB153    | -8937.9  | 585.0  |
| 760     | SC153    | -8977.9  | 585.0  |
| 761     | SA154    | -9018.0  | 585.0  |
| 762     | SB154    | -9058.1  | 585.0  |
| 763     | SC154    | -9098.2  | 585.0  |
| 764     | SA155    | -9138.3  | 585.0  |
| 765     | SB155    | -9178.3  | 585.0  |
| 766     | SC155    | -9218.4  | 585.0  |
| 767     | SA156    | -9258.5  | 585.0  |
| 768     | SB156    | -9298.6  | 585.0  |
| 769     | SC156    | -9338.7  | 585.0  |
| 770     | SA157    | -9378.7  | 585.0  |
| 771     | SB157    | -9418.8  | 585.0  |
| 772     | SC157    | -9458.9  | 585.0  |
| 773     | SA158    | -9499.0  | 585.0  |
| 774     | SB158    | -9539.1  | 585.0  |
| 775     | SC158    | -9579.1  | 585.0  |
| 776     | SA159    | -9619.2  | 585.0  |
| 777     | SB159    | -9659.3  | 585.0  |
| 778     | SC159    | -9699.4  | 585.0  |
| 779     | NC       | -9740.2  | 585.0  |
| 780     | NC       | -9780.2  | 585.0  |
| 781     | NC       | -10101.4 | 620.0  |
| 782     | COM66    | -10101.4 | 567.5  |
| 783     | COM67    | -10101.4 | 527.5  |
| 784     | COM68    | -10101.4 | 487.5  |
| 785     | COM69    | -10101.4 | 447.5  |
| 786     | COM70    | -10101.4 | 407.5  |
| 787     | COM71    | -10101.4 | 367.5  |
| 788     | COM72    | -10101.4 | 327.5  |
| 789     | COM73    | -10101.4 | 287.5  |
| 790     | COM74    | -10101.4 | 247.5  |
| 791     | COM75    | -10101.4 | 207.5  |
| 792     | COM76    | -10101.4 | 167.5  |
| 793     | COM77    | -10101.4 | 127.5  |
| 794     | COM78    | -10101.4 | 87.5   |
| 795     | COM79    | -10101.4 | 47.5   |
| 796     | COM80    | -10101.4 | 7.5    |
| 797     | COM81    | -10101.4 | -32.5  |
| 798     | COM82    | -10101.4 | -72.5  |
| 799     | COM83    | -10101.4 | -112.5 |
| 800     | COM84    | -10101.4 | -152.5 |

| Pad no. | Pad Name | X-Axis   | Y-Axis |
|---------|----------|----------|--------|
| 801     | COM85    | -10101.4 | -192.5 |
| 802     | COM86    | -10101.4 | -232.5 |
| 803     | COM87    | -10101.4 | -272.5 |
| 804     | COM88    | -10101.4 | -312.5 |
| 805     | COM89    | -10101.4 | -352.5 |
| 806     | COM90    | -10101.4 | -392.5 |
| 807     | COM91    | -10101.4 | -432.5 |
| 808     | COM92    | -10101.4 | -472.5 |
| 809     | COM93    | -10101.4 | -512.5 |
| 810     | COM94    | -10101.4 | -552.5 |

**Figure 5-2: SSD1335Z Alignment Mark Dimensions**



## 6 PIN ASSIGNMENT

### 6.1 SSD1353U4R1 pin assignment

Table 6-1 : SSD1353U4R1 Pin assignment

| Pad No. | Pad Name | Pad No. | Pad Name | Pad No. | Pad Name | Pad No. | Pad Name | Pad No. | Pad Name |
|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| 1       | NC       | 81      | COM61    | 161     | SA148    | 241     | SB121    | 321     | SC94     |
| 2       | VCC      | 82      | COM59    | 162     | SC147    | 242     | SA121    | 322     | SB94     |
| 3       | VCOMH    | 83      | COM57    | 163     | SB147    | 243     | SC120    | 323     | SA94     |
| 4       | VLSS     | 84      | COM55    | 164     | SA147    | 244     | SB120    | 324     | SC93     |
| 5       | VSS      | 85      | COM53    | 165     | SC146    | 245     | SA120    | 325     | SB93     |
| 6       | IREF     | 86      | COM51    | 166     | SB146    | 246     | SC119    | 326     | SA93     |
| 7       | D17      | 87      | COM49    | 167     | SA146    | 247     | SB119    | 327     | SC92     |
| 8       | D16      | 88      | COM47    | 168     | SC145    | 248     | SA119    | 328     | SB92     |
| 9       | D15      | 89      | COM45    | 169     | SB145    | 249     | SC118    | 329     | SA92     |
| 10      | D14      | 90      | COM43    | 170     | SA145    | 250     | SB118    | 330     | SC91     |
| 11      | D13      | 91      | COM41    | 171     | SC144    | 251     | SA118    | 331     | SB91     |
| 12      | D12      | 92      | COM39    | 172     | SB144    | 252     | SC117    | 332     | SA91     |
| 13      | D11      | 93      | COM37    | 173     | SA144    | 253     | SB117    | 333     | SC90     |
| 14      | D10      | 94      | COM35    | 174     | SC143    | 254     | SA117    | 334     | SB90     |
| 15      | D9       | 95      | COM33    | 175     | SB143    | 255     | SC116    | 335     | SA90     |
| 16      | D8       | 96      | COM31    | 176     | SA143    | 256     | SB116    | 336     | SC89     |
| 17      | D7       | 97      | COM29    | 177     | SC142    | 257     | SA116    | 337     | SB89     |
| 18      | D6       | 98      | COM27    | 178     | SB142    | 258     | SC115    | 338     | SA89     |
| 19      | D5       | 99      | COM25    | 179     | SA142    | 259     | SB115    | 339     | SC88     |
| 20      | D4       | 100     | COM23    | 180     | SC141    | 260     | SA115    | 340     | SB88     |
| 21      | D3       | 101     | COM21    | 181     | SB141    | 261     | SC114    | 341     | SA88     |
| 22      | D2       | 102     | COM19    | 182     | SA141    | 262     | SB114    | 342     | SC87     |
| 23      | D1       | 103     | COM17    | 183     | SC140    | 263     | SA114    | 343     | SB87     |
| 24      | D0       | 104     | COM15    | 184     | SB140    | 264     | SC113    | 344     | SA87     |
| 25      | E        | 105     | COM13    | 185     | SA140    | 265     | SB113    | 345     | SC86     |
| 26      | R/W#     | 106     | COM11    | 186     | SC139    | 266     | SA113    | 346     | SB86     |
| 27      | D/C#     | 107     | COM9     | 187     | SB139    | 267     | SC112    | 347     | SA86     |
| 28      | RESB     | 108     | COM7     | 188     | SA139    | 268     | SB112    | 348     | SC85     |
| 29      | CSB      | 109     | COM5     | 189     | SC138    | 269     | SA112    | 349     | SB85     |
| 30      | FR       | 110     | COM3     | 190     | SB138    | 270     | SC111    | 350     | SA85     |
| 31      | BS3      | 111     | COM1     | 191     | SA138    | 271     | SB111    | 351     | SC84     |
| 32      | BS2      | 112     | NC       | 192     | SC137    | 272     | SA111    | 352     | SB84     |
| 33      | BS1      | 113     | NC       | 193     | SB137    | 273     | SC110    | 353     | SA84     |
| 34      | BS0      | 114     | NC       | 194     | SA137    | 274     | SB110    | 354     | SC83     |
| 35      | REGVDD   | 115     | NC       | 195     | SC136    | 275     | SA110    | 355     | SB83     |
| 36      | VDDIO    | 116     | NC       | 196     | SB136    | 276     | SC109    | 356     | SA83     |
| 37      | VDD      | 117     | NC       | 197     | SA136    | 277     | SB109    | 357     | SC82     |
| 38      | VPP      | 118     | NC       | 198     | SC135    | 278     | SA109    | 358     | SB82     |
| 39      | VCI      | 119     | NC       | 199     | SB135    | 279     | SC108    | 359     | SA82     |
| 40      | VSL      | 120     | NC       | 200     | SA135    | 280     | SB108    | 360     | SC81     |
| 41      | VBREF    | 121     | NC       | 201     | SC134    | 281     | SA108    | 361     | SB81     |
| 42      | VSS      | 122     | NC       | 202     | SB134    | 282     | SC107    | 362     | SA81     |
| 43      | VLSS     | 123     | NC       | 203     | SA134    | 283     | SB107    | 363     | SC80     |
| 44      | VCOMH    | 124     | NC       | 204     | SC133    | 284     | SA107    | 364     | SB80     |
| 45      | VCC      | 125     | NC       | 205     | SB133    | 285     | SC106    | 365     | SA80     |
| 46      | NC       | 126     | SC159    | 206     | SA133    | 286     | SB106    | 366     | SC79     |
| 47      | NC       | 127     | SB159    | 207     | SC132    | 287     | SA106    | 367     | SB79     |
| 48      | COM127   | 128     | SA159    | 208     | SB132    | 288     | SC105    | 368     | SA79     |
| 49      | COM125   | 129     | SC158    | 209     | SA132    | 289     | SB105    | 369     | SC78     |
| 50      | COM123   | 130     | SB158    | 210     | SC131    | 290     | SA105    | 370     | SB78     |
| 51      | COM121   | 131     | SA158    | 211     | SB131    | 291     | SC104    | 371     | SA78     |
| 52      | COM119   | 132     | SC157    | 212     | SA131    | 292     | SB104    | 372     | SC77     |
| 53      | COM117   | 133     | SB157    | 213     | SC130    | 293     | SA104    | 373     | SB77     |
| 54      | COM115   | 134     | SA157    | 214     | SB130    | 294     | SC103    | 374     | SA77     |
| 55      | COM113   | 135     | SC156    | 215     | SA130    | 295     | SB103    | 375     | SC76     |
| 56      | COM111   | 136     | SB156    | 216     | SC129    | 296     | SA103    | 376     | SB76     |
| 57      | COM109   | 137     | SA156    | 217     | SB129    | 297     | SC102    | 377     | SA76     |
| 58      | COM107   | 138     | SC155    | 218     | SA129    | 298     | SB102    | 378     | SC75     |
| 59      | COM105   | 139     | SB155    | 219     | SC128    | 299     | SA102    | 379     | SB75     |
| 60      | COM103   | 140     | SA155    | 220     | SB128    | 300     | SC101    | 380     | SA75     |
| 61      | COM101   | 141     | SC154    | 221     | SA128    | 301     | SB101    | 381     | SC74     |
| 62      | COM99    | 142     | SB154    | 222     | SC127    | 302     | SA101    | 382     | SB74     |
| 63      | COM97    | 143     | SA154    | 223     | SB127    | 303     | SC100    | 383     | SA74     |
| 64      | COM95    | 144     | SC153    | 224     | SA127    | 304     | SB100    | 384     | SC73     |
| 65      | COM93    | 145     | SB153    | 225     | SC126    | 305     | SA100    | 385     | SB73     |
| 66      | COM91    | 146     | SA153    | 226     | SB126    | 306     | SC99     | 386     | SA73     |
| 67      | COM89    | 147     | SC152    | 227     | SA126    | 307     | SB99     | 387     | SC72     |
| 68      | COM87    | 148     | SB152    | 228     | SC125    | 308     | SA99     | 388     | SB72     |
| 69      | COM85    | 149     | SA152    | 229     | SB125    | 309     | SC98     | 389     | SA72     |
| 70      | COM83    | 150     | SC151    | 230     | SA125    | 310     | SB98     | 390     | SC71     |
| 71      | COM81    | 151     | SB151    | 231     | SC124    | 311     | SA98     | 391     | SB71     |
| 72      | COM79    | 152     | SA151    | 232     | SB124    | 312     | SC97     | 392     | SA71     |
| 73      | COM77    | 153     | SC150    | 233     | SA124    | 313     | SB97     | 393     | SC70     |
| 74      | COM75    | 154     | SB150    | 234     | SC123    | 314     | SA97     | 394     | SB70     |
| 75      | COM73    | 155     | SA150    | 235     | SB123    | 315     | SC96     | 395     | SA70     |
| 76      | COM71    | 156     | SC149    | 236     | SA123    | 316     | SB96     | 396     | SC69     |
| 77      | COM69    | 157     | SB149    | 237     | SC122    | 317     | SA96     | 397     | SB69     |
| 78      | COM67    | 158     | SA149    | 238     | SB122    | 318     | SC95     | 398     | SA69     |
| 79      | COM65    | 159     | SC148    | 239     | SA122    | 319     | SB95     | 399     | SC68     |
| 80      | COM63    | 160     | SB148    | 240     | SC121    | 320     | SA95     | 400     | SB68     |

| Pad No. | Pad Name |
|---------|----------|
| 401     | SA68     |
| 402     | SC67     |
| 403     | SB67     |
| 404     | SA67     |
| 405     | SC66     |
| 406     | SB66     |
| 407     | SA66     |
| 408     | SC65     |
| 409     | SB65     |
| 410     | SA65     |
| 411     | SC64     |
| 412     | SB64     |
| 413     | SA64     |
| 414     | SC63     |
| 415     | SB63     |
| 416     | SA63     |
| 417     | SC62     |
| 418     | SB62     |
| 419     | SA62     |
| 420     | SC61     |
| 421     | SB61     |
| 422     | SA61     |
| 423     | SC60     |
| 424     | SB60     |
| 425     | SA60     |
| 426     | SC59     |
| 427     | SB59     |
| 428     | SA59     |
| 429     | SC58     |
| 430     | SB58     |
| 431     | SA58     |
| 432     | SC57     |
| 433     | SB57     |
| 434     | SA57     |
| 435     | SC56     |
| 436     | SB56     |
| 437     | SA56     |
| 438     | SC55     |
| 439     | SB55     |
| 440     | SA55     |
| 441     | SC54     |
| 442     | SB54     |
| 443     | SA54     |
| 444     | SC53     |
| 445     | SB53     |
| 446     | SA53     |
| 447     | SC52     |
| 448     | SB52     |
| 449     | SA52     |
| 450     | SC51     |
| 451     | SB51     |
| 452     | SA51     |
| 453     | SC50     |
| 454     | SB50     |
| 455     | SA50     |
| 456     | SC49     |
| 457     | SB49     |
| 458     | SA49     |
| 459     | SC48     |
| 460     | SB48     |
| 461     | SA48     |
| 462     | SC47     |
| 463     | SB47     |
| 464     | SA47     |
| 465     | SC46     |
| 466     | SB46     |
| 467     | SA46     |
| 468     | SC45     |
| 469     | SB45     |
| 470     | SA45     |
| 471     | SC44     |
| 472     | SB44     |
| 473     | SA44     |
| 474     | SC43     |
| 475     | SB43     |
| 476     | SA43     |
| 477     | SC42     |
| 478     | SB42     |
| 479     | SA42     |
| 480     | SC41     |

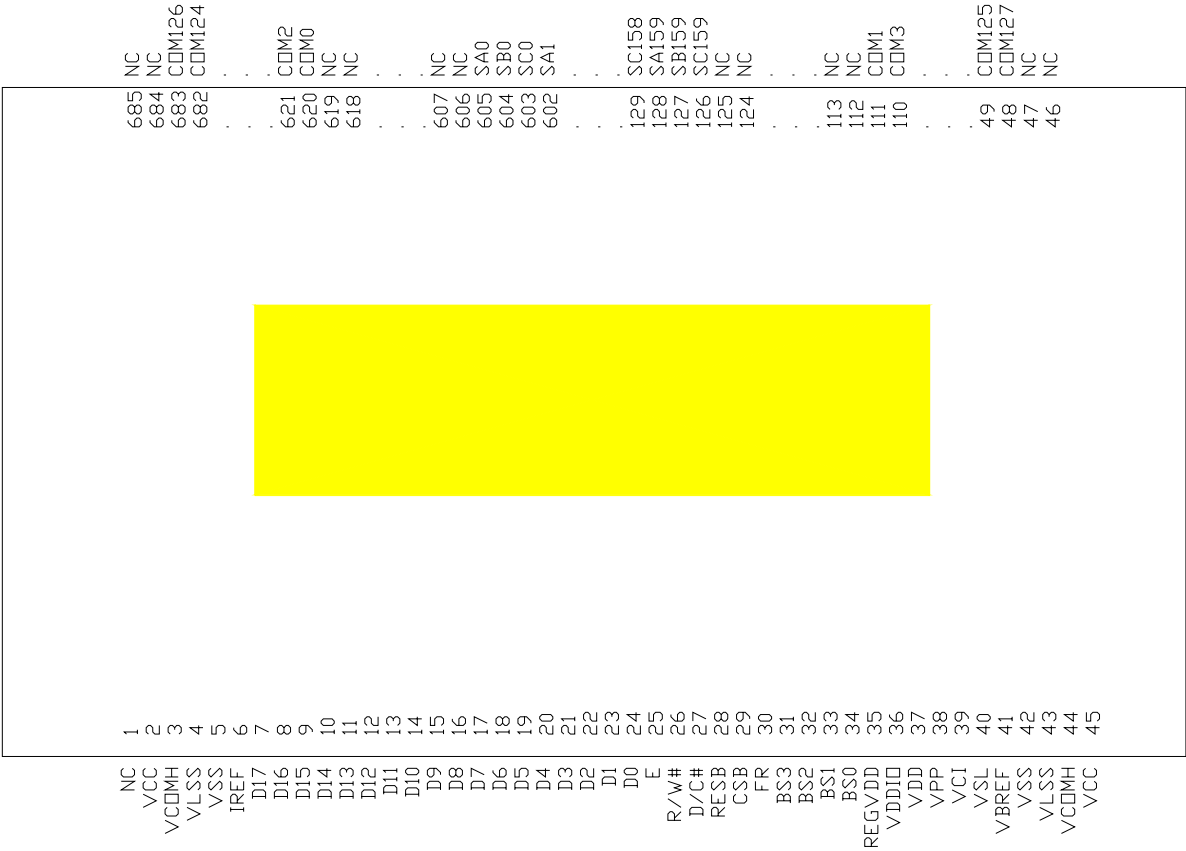
| Pad No. | Pad Name |
|---------|----------|
| 481     | SB41     |
| 482     | SA41     |
| 483     | SC40     |
| 484     | SB40     |
| 485     | SA40     |
| 486     | SC39     |
| 487     | SB39     |
| 488     | SA39     |
| 489     | SC38     |
| 490     | SB38     |
| 491     | SA38     |
| 492     | SC37     |
| 493     | SB37     |
| 494     | SA37     |
| 495     | SC36     |
| 496     | SB36     |
| 497     | SA36     |
| 498     | SC35     |
| 499     | SB35     |
| 500     | SA35     |
| 501     | SC34     |
| 502     | SB34     |
| 503     | SA34     |
| 504     | SC33     |
| 505     | SB33     |
| 506     | SA33     |
| 507     | SC32     |
| 508     | SB32     |
| 509     | SA32     |
| 510     | SC31     |
| 511     | SB31     |
| 512     | SA31     |
| 513     | SC30     |
| 514     | SB30     |
| 515     | SA30     |
| 516     | SC29     |
| 517     | SB29     |
| 518     | SA29     |
| 519     | SC28     |
| 520     | SB28     |
| 521     | SA28     |
| 522     | SC27     |
| 523     | SB27     |
| 524     | SA27     |
| 525     | SC26     |
| 526     | SB26     |
| 527     | SA26     |
| 528     | SC25     |
| 529     | SB25     |
| 530     | SA25     |
| 531     | SC24     |
| 532     | SB24     |
| 533     | SA24     |
| 534     | SC23     |
| 535     | SB23     |
| 536     | SA23     |
| 537     | SC22     |
| 538     | SB22     |
| 539     | SA22     |
| 540     | SC21     |
| 541     | SB21     |
| 542     | SA21     |
| 543     | SC20     |
| 544     | SB20     |
| 545     | SA20     |
| 546     | SC19     |
| 547     | SB19     |
| 548     | SA19     |
| 549     | SC18     |
| 550     | SB18     |
| 551     | SA18     |
| 552     | SC17     |
| 553     | SB17     |
| 554     | SA17     |
| 555     | SC16     |
| 556     | SB16     |
| 557     | SA16     |
| 558     | SC15     |
| 559     | SB15     |
| 560     | SA15     |

| Pad No. | Pad Name |
|---------|----------|
| 561     | SC14     |
| 562     | SB14     |
| 563     | SA14     |
| 564     | SC13     |
| 565     | SB13     |
| 566     | SA13     |
| 567     | SC12     |
| 568     | SB12     |
| 569     | SA12     |
| 570     | SC11     |
| 571     | SB11     |
| 572     | SA11     |
| 573     | SC10     |
| 574     | SB10     |
| 575     | SA10     |
| 576     | SC9      |
| 577     | SB9      |
| 578     | SA9      |
| 579     | SC8      |
| 580     | SB8      |
| 581     | SA8      |
| 582     | SC7      |
| 583     | SB7      |
| 584     | SA7      |
| 585     | SC6      |
| 586     | SB6      |
| 587     | SA6      |
| 588     | SC5      |
| 589     | SB5      |
| 590     | SA5      |
| 591     | SC4      |
| 592     | SB4      |
| 593     | SA4      |
| 594     | SC3      |
| 595     | SB3      |
| 596     | SA3      |
| 597     | SC2      |
| 598     | SB2      |
| 599     | SA2      |
| 600     | SC1      |
| 601     | SB1      |
| 602     | SA1      |
| 603     | SC0      |
| 604     | SB0      |
| 605     | SA0      |
| 606     | NC       |
| 607     | NC       |
| 608     | NC       |
| 609     | NC       |
| 610     | NC       |
| 611     | NC       |
| 612     | NC       |
| 613     | NC       |
| 614     | NC       |
| 615     | NC       |
| 616     | NC       |
| 617     | NC       |
| 618     | NC       |
| 619     | NC       |
| 620     | COM0     |
| 621     | COM2     |
| 622     | COM4     |
| 623     | COM6     |
| 624     | COM8     |
| 625     | COM10    |
| 626     | COM12    |
| 627     | COM14    |
| 628     | COM16    |
| 629     | COM18    |
| 630     | COM20    |
| 631     | COM22    |
| 632     | COM24    |
| 633     | COM26    |
| 634     | COM28    |
| 635     | COM30    |
| 636     | COM32    |
| 637     | COM34    |
| 638     | COM36    |
| 639     | COM38    |
| 640     | COM40    |

| Pad No. | Pad Name |
|---------|----------|
| 641     | COM42    |
| 642     | COM44    |
| 643     | COM46    |
| 644     | COM48    |
| 645     | COM50    |
| 646     | COM52    |
| 647     | COM54    |
| 648     | COM56    |
| 649     | COM58    |
| 650     | COM60    |
| 651     | COM62    |
| 652     | COM64    |
| 653     | COM66    |
| 654     | COM68    |
| 655     | COM70    |
| 656     | COM72    |
| 657     | COM74    |
| 658     | COM76    |
| 659     | COM78    |
| 660     | COM80    |
| 661     | COM82    |
| 662     | COM84    |
| 663     | COM86    |
| 664     | COM88    |
| 665     | COM90    |
| 666     | COM92    |
| 667     | COM94    |
| 668     | COM96    |
| 669     | COM98    |
| 670     | COM100   |
| 671     | COM102   |
| 672     | COM104   |
| 673     | COM106   |
| 674     | COM108   |
| 675     | COM110   |
| 676     | COM112   |
| 677     | COM114   |
| 678     | COM116   |
| 679     | COM118   |
| 680     | COM120   |
| 681     | COM122   |
| 682     | COM124   |
| 683     | COM126   |
| 684     | NC       |
| 685     | NC       |



Figure 6-1 : SSD1353U4R1 Pin assignment



Note:

<sup>(1)</sup> COM sequence (Split) is under command setting: ADh, 60h

## 7 PIN DESCRIPTIONS

Key:

|                                    |                                  |
|------------------------------------|----------------------------------|
| I = Input                          | NC = Not Connected               |
| O = Output                         | Pull LOW= connect to Ground      |
| IO = Bi-directional (input/output) | Pull HIGH= connect to $V_{DDIO}$ |
| P = Power pin                      |                                  |

**Table 7-1: SSD1353 Pin Description**

| Pin Name   | Pin Type | Description                                                                                                                                                                                                          |
|------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{DD}$   | P        | Power supply pin for core logic operation<br>Refer to Section 8.10 for details.                                                                                                                                      |
| $V_{DDIO}$ | P        | Power supply for interface logic level. It should be match with the MCU interface voltage level.<br>Refer to Section 8.10 for details.                                                                               |
| $V_{CI}$   | P        | Low voltage power supply<br>$V_{CI}$ must always be equal or higher than $V_{DD}$ and $V_{DDIO}$ .<br>Refer to Section 8.10 for details.                                                                             |
| $V_{ACI}$  | P        | Analog Low voltage power supply<br>Connect to $V_{CI}$ .                                                                                                                                                             |
| $V_{CC}$   | P        | Power supply for panel driving voltage. This is also the most positive power voltage supply pin.                                                                                                                     |
| $V_{PP}$   | P        | Power supply for programming OTP. In OTP programming, this pin is powered up to 7.5V. In operation mode (without programming OTP), this pin must be connected to $V_{DD}$ .                                          |
| $V_{SS}$   | P        | Ground pin                                                                                                                                                                                                           |
| $V_{LSS}$  | P        | Analog system ground pin                                                                                                                                                                                             |
| $V_{COMH}$ | P        | COM signal deselected voltage level.<br>A capacitor should be connected between this pin and $V_{SS}$ .                                                                                                              |
| REGVDD     | I        | Internal $V_{DD}$ regulator selection pin.<br>When this pin is pulled HIGH, internal $V_{DD}$ regulator is enabled.<br>When this pin is pulled LOW, external $V_{DD}$ is used.<br>Refer to Section 8.10 for details. |
| BGGND      | P        | This is a reserved pin. It should be connected to Ground.                                                                                                                                                            |
| PGGND      | P        | This is a reserved pin. It should be connected to Ground.                                                                                                                                                            |
| $V_{DDB}$  | P        | This is a reserved pin. It should be connected to $V_{CI}$ .                                                                                                                                                         |
| $V_{SSB}$  | P        | This is a reserved pin. It should be connected to Ground                                                                                                                                                             |
| GDR        | O        | This is a reserved pin. It should be kept NC.                                                                                                                                                                        |
| RESE       | I        | This is a reserved pin. It should be kept NC.                                                                                                                                                                        |
| FB         | I        | This is a reserved pin. It should be kept NC.                                                                                                                                                                        |

| Pin Name          | Pin Type                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
|-------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------|------|------------|------|---------|------|---------|------|---------|------|---------------------|------|----------------------|------|---------------------|------|----------------------|------|---------|------|---------|------|---------|------|---------|------|---------------------|------|----------------------|------|---------------------|------|----------------------|
| V <sub>BREF</sub> | O                       | This is an internal voltage reference pin. A capacitor should be connected to this pin and V <sub>SS</sub> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| GPIO0             | I/O                     | This is a reserved pin. It should be kept NC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| GPIO1             | I/O                     | This is a reserved pin. It should be kept NC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| VSL               | P                       | This is segment voltage reference pin.<br>When external VSL is not used, this pin should be left open.<br>When external VSL is used, connect with resistor and diode to ground. (details depend on application)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| BS[3:0]           | I                       | MCU bus interface selection pins. Select appropriate logic setting as described in the following table.<br><br><div>Table 7-2 : Bus Interface selection</div> <table><tr><th>BS[3:0]</th><th>Bus Interface Selection</th></tr><tr><td>0000</td><td>4 line SPI</td></tr><tr><td>0001</td><td>Invalid</td></tr><tr><td>0010</td><td>Invalid</td></tr><tr><td>0011</td><td>Invalid</td></tr><tr><td>0100</td><td>8-bit 6800 parallel</td></tr><tr><td>0101</td><td>16-bit 6800 parallel</td></tr><tr><td>0110</td><td>8-bit 8080 parallel</td></tr><tr><td>0111</td><td>16-bit 8080 parallel</td></tr><tr><td>1000</td><td>Invalid</td></tr><tr><td>1001</td><td>Invalid</td></tr><tr><td>1010</td><td>Invalid</td></tr><tr><td>1011</td><td>Invalid</td></tr><tr><td>1100</td><td>9-bit 6800 parallel</td></tr><tr><td>1101</td><td>18-bit 6800 parallel</td></tr><tr><td>1110</td><td>9-bit 8080 parallel</td></tr><tr><td>1111</td><td>18-bit 8080 parallel</td></tr></table><br><div>Note<br/>(1) 0 is connected to V<sub>SS</sub><br/>(2) 1 is connected to V<sub>DDIO</sub></div> | BS[3:0] | Bus Interface Selection | 0000 | 4 line SPI | 0001 | Invalid | 0010 | Invalid | 0011 | Invalid | 0100 | 8-bit 6800 parallel | 0101 | 16-bit 6800 parallel | 0110 | 8-bit 8080 parallel | 0111 | 16-bit 8080 parallel | 1000 | Invalid | 1001 | Invalid | 1010 | Invalid | 1011 | Invalid | 1100 | 9-bit 6800 parallel | 1101 | 18-bit 6800 parallel | 1110 | 9-bit 8080 parallel | 1111 | 18-bit 8080 parallel |
| BS[3:0]           | Bus Interface Selection |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0000              | 4 line SPI              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0001              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0010              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0011              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0100              | 8-bit 6800 parallel     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0101              | 16-bit 6800 parallel    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0110              | 8-bit 8080 parallel     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 0111              | 16-bit 8080 parallel    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1000              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1001              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1010              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1011              | Invalid                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1100              | 9-bit 6800 parallel     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1101              | 18-bit 6800 parallel    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1110              | 9-bit 8080 parallel     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| 1111              | 18-bit 8080 parallel    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| I <sub>REF</sub>  | I                       | This pin is the segment output current reference pin.<br>A resistor should be connected between this pin and V <sub>SS</sub> to maintain the current around 10uA. Please refer to section 8.6 for the formula of resistor value from I <sub>REF</sub> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| CL                | I                       | External clock input pin.<br>When internal clock is enable (i.e. pull HIGH in CLS pin), this pin is not used and should be connected to Ground.<br>When internal clock is disable (i.e. pull LOW is CLS pin), this pin is the external clock source input pin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| CLS               | I                       | Internal clock selection pin.<br>When this pin is pulled HIGH, internal oscillator is enabled (normal operation).<br>When this pin is pulled LOW, an external clock signal should be connected to CL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| CS#               | I                       | This pin is the chip select input connecting to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |
| RES#              | I                       | This pin is reset signal input.<br>When the pin is pulled LOW, initialization of the chip is executed.<br>Keep this pin pull HIGH during normal operation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                         |      |            |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |      |         |      |         |      |         |      |         |      |                     |      |                      |      |                     |      |                      |

| Pin Name                            | Pin Type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D/C#                                | I        | This pin is Data/Command control pin connecting to the MCU.<br>When the pin is pulled HIGH, the content at D[17:0] will be interpreted as data.<br>When the pin is pulled LOW, the content at D[17:0] will be interpreted as command.                                                                                                                                                                                                                                                                                                                                 |
| R/W# (WR#)                          | I        | This pin is read / write control input pin connecting to the MCU interface.<br><br>When interfacing to a 6800-series microprocessor, this pin will be used as Read/Write (R/W#) selection input. Read mode will be carried out when this pin is pulled HIGH and write mode when LOW.<br><br>When 8080 interface mode is selected, this pin will be the Write (WR#) input. Data write operation is initiated when this pin is pulled LOW and the chip is selected.<br><br>When serial interface is selected, this pin R/W (WR#) must be connected to V <sub>SS</sub> . |
| E (RD#)                             | I        | This pin is MCU interface input.<br><br>When interfacing to a 6800-series microprocessor, this pin will be used as the Enable (E) signal. Read/write operation is initiated when this pin is pulled HIGH and the chip is selected.<br><br>When connecting to an 8080-microprocessor, this pin receives the Read (RD#) signal. Read operation is initiated when this pin is pulled LOW and the chip is selected.<br><br>When serial interface is selected, this pin E(RD#) must be connected to V <sub>SS</sub> .                                                      |
| D[17:0]                             | I/O      | These pins are bi-directional data bus connecting to the MCU data bus.<br>Unused pins are recommended to tie LOW. (Except for D2 pin in SPI mode)<br><br>Refer to Section 8.1 for different bus interface connection.                                                                                                                                                                                                                                                                                                                                                 |
| PD[17:0]                            | I        | These are reserved pins. They should be connected to Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| PDEN                                | I        | This is a reserved pin. It should be connected to Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| VSYNC                               | I        | This is a reserved pin. It should be connected to Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| HSYNC                               | I        | This is a reserved pin. It should be connected to Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| DOTCLK                              | I        | This is a reserved pin. It should be connected to Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| FR                                  | O        | Ram Write Synchronization output<br>Details refer to section 8.5.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| SA[159:0]<br>SB[159:0]<br>SC[159:0] | O        | These pins provide the OLED segment driving signals. These pins are V <sub>SS</sub> state when display is OFF.<br><br>The 480 segment pins are divided into 3 groups, SA, SB and SC. Each group can have different color settings for color A, B and C.                                                                                                                                                                                                                                                                                                               |
| COM[131:0]                          | I/O      | These pins provide the Common switch signals to the OLED panel. These pins are in high impedance state when display is OFF.                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## 8 FUNCTIONAL BLOCK DESCRIPTIONS

### 8.1 MCU Interface

SSD1353 MCU interface consist of 18 data pin and 5 control pins. The pin assignment at different interface mode is summarized in Table 8-1. Different MCU mode can be set by hardware selection on BS[3:0] pins (refer to Table 7-2 for BS[3:0] pins setting)

**Table 8-1 : MCU interface assignment under different bus interface mode**

| Pin Name      | Data / Command Interface |         |     |     |     |     |     |     |    |    |         |    |    |    |    |      |      |         | Control Signal |      |      |      |      |
|---------------|--------------------------|---------|-----|-----|-----|-----|-----|-----|----|----|---------|----|----|----|----|------|------|---------|----------------|------|------|------|------|
| Bus Interface | D17                      | D16     | D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7      | D6 | D5 | D4 | D3 | D2   | D1   | D0      | E              | R/W# | CS#  | D/C# | RES# |
| 8b / 8080     | Tie Low                  |         |     |     |     |     |     |     |    |    | D[7:0]  |    |    |    |    |      |      |         | RD#            | WR#  | CS#  | D/C# | RES# |
| 8b / 6800     | Tie Low                  |         |     |     |     |     |     |     |    |    | D[7:0]  |    |    |    |    |      |      |         | E              | R/W# | CS#  | D/C# | RES# |
| 9b / 8080     | Tie Low                  |         |     |     |     |     |     |     |    |    | D[8:0]  |    |    |    |    |      |      |         | RD#            | WR#  | CS#  | D/C# | RES# |
| 9b / 6800     | Tie Low                  |         |     |     |     |     |     |     |    |    | D[8:0]  |    |    |    |    |      |      |         | E              | R/W# | CS#  | D/C# | RES# |
| 16b / 8080    | Tie Low                  | D[15:0] |     |     |     |     |     |     |    |    |         |    |    |    |    |      |      | RD#     | WR#            | CS#  | D/C# | RES# |      |
| 16b / 6800    | Tie Low                  | D[15:0] |     |     |     |     |     |     |    |    |         |    |    |    |    |      |      | E       | R/W#           | CS#  | D/C# | RES# |      |
| 18b / 8080    |                          |         |     |     |     |     |     |     |    |    | D[17:0] |    |    |    |    |      |      |         | RD#            | WR#  | CS#  | D/C# | RES# |
| 18b / 6800    |                          |         |     |     |     |     |     |     |    |    | D[17:0] |    |    |    |    |      |      |         | E              | R/W# | CS#  | D/C# | RES# |
| SPI           | Tie Low                  |         |     |     |     |     |     |     |    |    |         |    |    |    | NC | SDIN | SCLK | Tie Low |                | CS#  | D/C# | RES# |      |

#### 8.1.1 MCU Parallel 6800-series Interface

The parallel interface consists of 18 bi-directional data pins (D[17:0]), R/W#, D/C#, E and CS#.

A LOW in R/W# indicates WRITE operation and HIGH in R/W# indicates READ operation.

A LOW in D/C# indicates COMMAND read/write and HIGH in D/C# indicates DATA read/write.

The E input serves as data latch signal while CS# is LOW. Data is latched at the falling edge of E signal.

**Table 8-2 : Control pins of 6800 interface**

| Function      | E | R/W# | CS# | D/C# |
|---------------|---|------|-----|------|
| Write command | ↓ | L    | L   | L    |
| Read status   | ↓ | H    | L   | L    |
| Write data    | ↓ | L    | L   | H    |
| Read data     | ↓ | H    | L   | H    |

#### Note

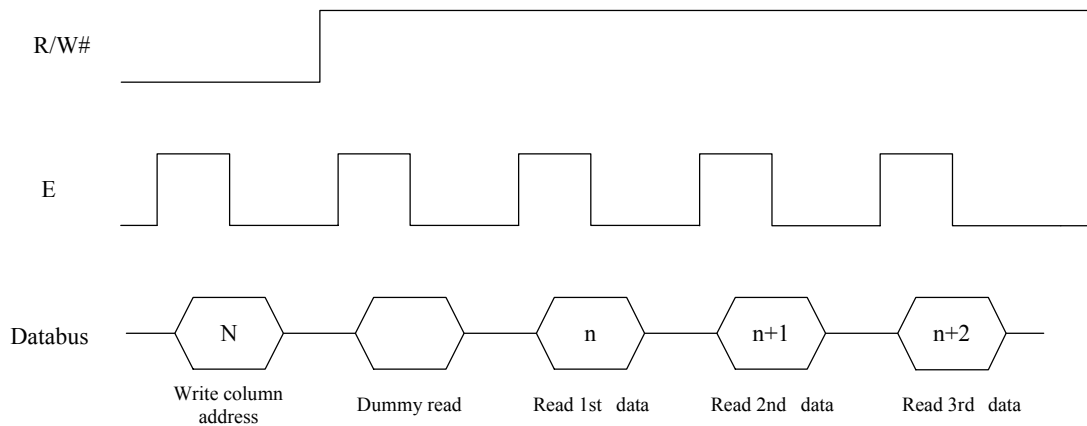
<sup>(1)</sup> ↓ stands for falling edge of signal

<sup>(2)</sup> H stands for HIGH in signal

<sup>(3)</sup> L stands for LOW in signal

In order to match the operating frequency of display RAM with that of the microprocessor, some pipeline processing is internally performed which requires the insertion of a dummy read before the first actual display data read. This is shown in Figure 8-1.

**Figure 8-1 : Data read back procedure - insertion of dummy read**



### 8.1.2 MCU Parallel 8080-series Interface

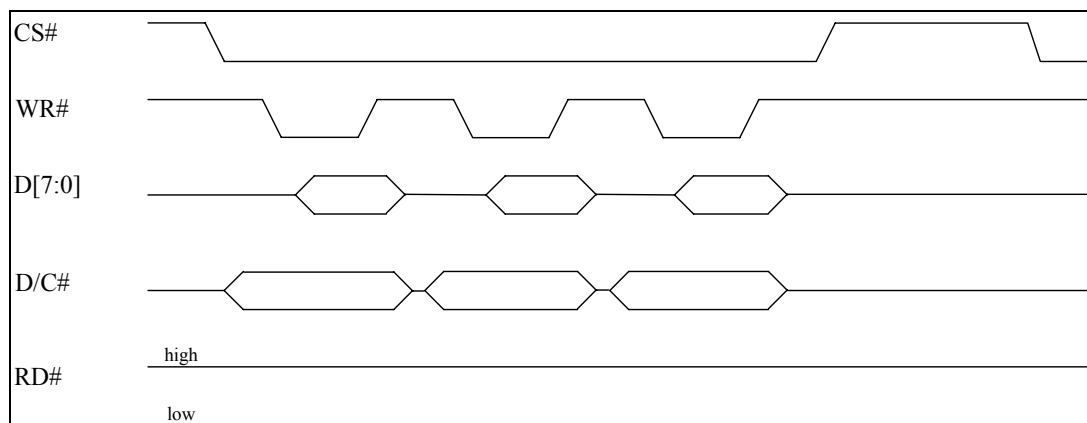
The parallel interface consists of 18 bi-directional data pins (D[17:0]), RD#, WR#, D/C# and CS#.

A LOW in D/C# indicates COMMAND read/write and HIGH in D/C# indicates DATA read/write.

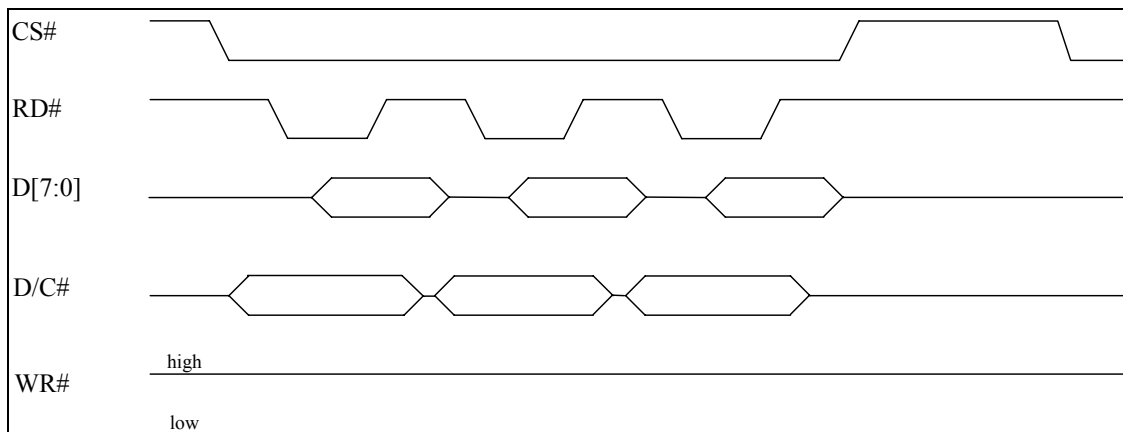
A rising edge of RD# input serves as a data READ latch signal while CS# is kept LOW.

A rising edge of WR# input serves as a data/command WRITE latch signal while CS# is kept LOW.

**Figure 8-2 : Example of Write procedure in 8080 parallel interface mode**



**Figure 8-3 : Example of Read procedure in 8080 parallel interface mode**



**Table 8-3 : Control pins of 8080 interface (Form 1)**

| Function      | RD# | WR# | CS# | D/C# |
|---------------|-----|-----|-----|------|
| Write command | H   | ↑   | L   | L    |
| Read status   | ↑   | H   | L   | L    |
| Write data    | H   | ↑   | L   | H    |
| Read data     | ↑   | H   | L   | H    |

**Note**

- (1) ↑ stands for rising edge of signal  
(2) H stands for HIGH in signal  
(3) L stands for LOW in signal  
(4) Refer to Figure 13-2 for Form 1 8080-Series MPU Parallel Interface Timing Characteristics

Alternatively, RD# and WR# can be keep stable while CS# serves as the data/command latch signal.

**Table 8-4 : Control pins of 8080 interface (Form 2)**

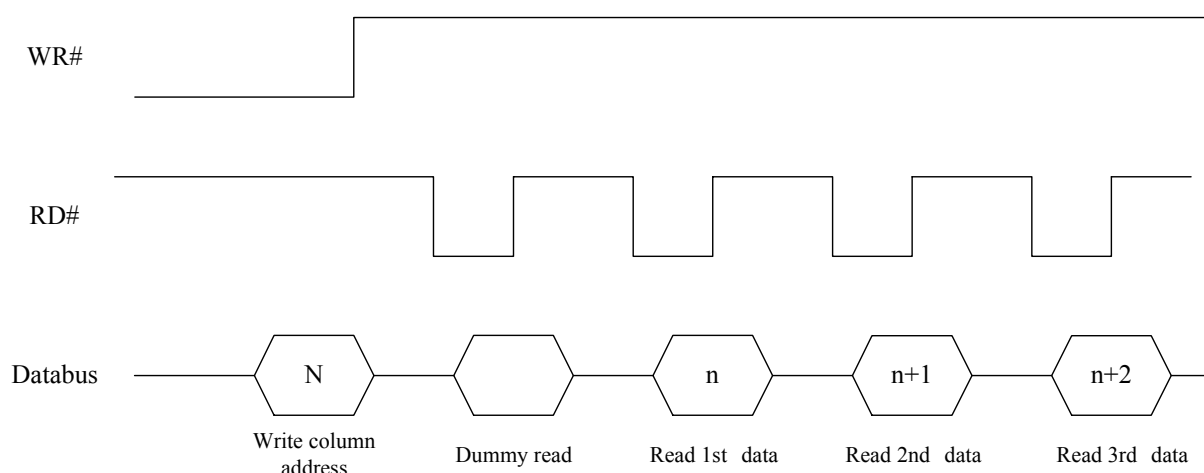
| Function      | RD# | WR# | CS# | D/C# |
|---------------|-----|-----|-----|------|
| Write command | H   | L   | ↑   | L    |
| Read status   | L   | H   | ↑   | L    |
| Write data    | H   | L   | ↑   | H    |
| Read data     | L   | H   | ↑   | H    |

**Note**

- (1) ↑ stands for rising edge of signal  
(2) H stands for HIGH in signal  
(3) L stands for LOW in signal  
(4) Refer to Figure 13-3 for Form 2 8080-Series MPU Parallel Interface Timing Characteristics

In order to match the operating frequency of display RAM with that of the microprocessor, some pipeline processing is internally performed which requires the insertion of a dummy read before the first actual display data read. This is shown in Figure 8-4.

**Figure 8-4 : Display data read back procedure - insertion of dummy read**



### 8.1.3 MCU Serial Interface

The serial interface consists of serial clock SCLK, serial data SDIN, D/C#, CS#. In SPI mode, D0 acts as SCLK, D1 acts as SDIN. For the unused data pins, D2 should be left open. The pins from D3 to D17, E and R/W# can be connected to an external ground.

**Table 8-5 : Control pins of Serial interface**

| Function      | E       | R/W#    | CS# | D/C# |
|---------------|---------|---------|-----|------|
| Write command | Tie LOW | Tie LOW | L   | L    |
| Write data    | Tie LOW | Tie LOW | L   | H    |

**Note**

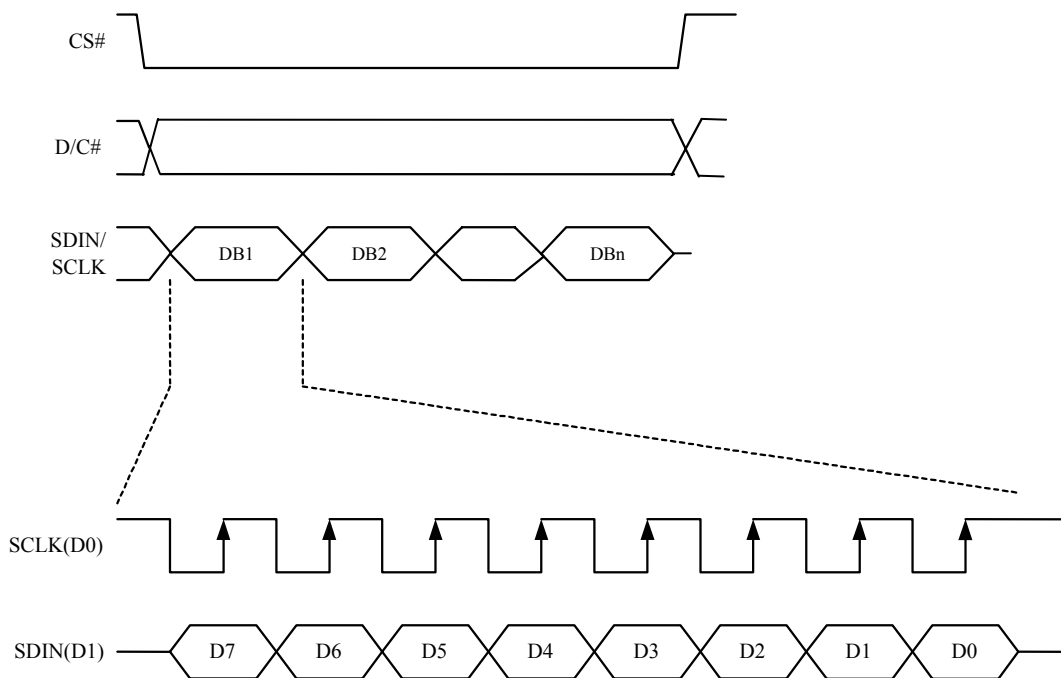
<sup>(1)</sup> H stands for HIGH in signal

<sup>(2)</sup> L stands for LOW in signal

SDIN is shifted into an 8-bit shift register on every rising edge of SCLK in the order of D7, D6, ... D0. D/C# is sampled on every eighth clock and the data byte in the shift register is written to the Graphic Display Data RAM (GDDRAM) or command register in the same clock.

Under serial mode, only write operations are allowed.

**Figure 8-5 : Write procedure in SPI mode**



### 8.2 Reset Circuit

When RES# input is pulled LOW, the chip is initialized with the following status:

1. Display is OFF
2. 132 MUX Display Mode
3. Normal segment and display data column address and row address mapping (SEG0 mapped to address 00h and COM0 mapped to address 00h)
4. Display start line is set at display RAM address 0
5. Column address counter is set at 0
6. Normal scan direction of the COM outputs
7. Individual contrast control registers of color A, B, and C are set at 80h



## 8.3 GDDRAM

### 8.3.1 GDDRAM structure

The GDDRAM is a bit mapped static RAM holding the pattern to be displayed. The RAM size is 160 x 132 x 18bits. For mechanical flexibility, re-mapping on both Segment and Common outputs can be selected by software. For vertical scrolling of the display, an internal register storing display start line can be set to control the portion of the RAM data to be mapped to the display. Each pixel has 18-bit data. Each sub-pixels for color A, B and C have 6 bits. The arrangement of data pixel in graphic display data RAM is shown in Table 8-6

**Table 8-6 : 262k Color Depth Graphic Display Data RAM Structure**

| Segment Address | Normal   | 0   |    |                         | 1   |    |    | 2     | ..... | ..... | 158 | 159 |    |    |
|-----------------|----------|-----|----|-------------------------|-----|----|----|-------|-------|-------|-----|-----|----|----|
|                 | Remapped | 159 |    |                         | 158 |    |    | 157   | ..... | ..... | 1   | 0   |    |    |
| Color           |          | A   | B  | C                       | A   | B  | C  | A     | ..... | ..... | C   | A   | B  | C  |
| Data Format     |          | A5  | B5 | C5                      | A5  | B5 | C5 | A5    | ..... | ..... | C5  | A5  | B5 | C5 |
|                 |          | A4  | B4 | C4                      | A4  | B4 | C4 | A4    | ..... | ..... | C4  | A4  | B4 | C4 |
|                 |          | A3  | B3 | C3                      | A3  | B3 | C3 | A3    | ..... | ..... | C3  | A3  | B3 | C3 |
|                 |          | A2  | B2 | C2                      | A2  | B2 | C2 | A2    | ..... | ..... | C2  | A2  | B2 | C2 |
|                 |          | A1  | B1 | C1                      | A1  | B1 | C1 | A1    | ..... | ..... | C1  | A1  | B1 | C1 |
| Common Address  |          | A0  | B0 | C0                      | A0  | B0 | C0 | A0    | ..... | ..... | C0  | A0  | B0 | C0 |
|                 |          |     |    |                         |     |    |    |       |       |       |     |     |    |    |
|                 |          |     |    |                         |     |    |    |       |       |       |     |     |    |    |
|                 |          |     |    |                         |     |    |    |       |       |       |     |     |    |    |
|                 |          |     |    |                         |     |    |    |       |       |       |     |     |    |    |
| Normal          | Remapped |     |    |                         |     |    |    |       |       |       |     |     |    |    |
| 0               | 131      | 6   | 6  | 6                       | 6   | 6  | 6  | ..... | ..... | 6     | 6   | 6   | 6  |    |
| 1               | 130      | 6   | 6  | 6                       |     |    |    | ..... | ..... |       |     |     |    |    |
| 2               | 129      |     |    |                         |     |    |    | ..... | ..... |       |     |     |    |    |
| 3               | 128      |     |    |                         |     |    |    | ..... | ..... |       |     |     |    |    |
| 4               | 127      |     |    |                         |     |    |    | ..... | ..... |       |     |     |    |    |
| 5               | 126      |     |    |                         |     |    |    | ..... | ..... |       |     |     |    |    |
| 6               | 125      |     |    | no of bits in this cell |     |    |    |       | ..... | ..... |     |     |    |    |
| 7               | 124      |     |    |                         |     |    |    | ..... | ..... |       |     |     |    |    |
| :               | :        | :   | :  | :                       | :   | :  | :  | :     | ..... | ..... | :   | :   | :  | :  |
| :               | :        | :   | :  | :                       | :   | :  | :  | :     | ..... | ..... | :   | :   | :  | :  |
| :               | :        | :   | :  | :                       | :   | :  | :  | :     | ..... | ..... | :   | :   | :  | :  |
| 127             | 4        |     |    |                         |     |    |    |       | ..... | ..... |     |     |    |    |
| 128             | 3        |     |    |                         |     |    |    |       | ..... | ..... |     |     |    |    |
| 129             | 2        |     |    |                         |     |    |    |       | ..... | ..... |     |     |    |    |
| 130             | 1        |     |    |                         |     |    |    |       | ..... | ..... |     |     |    |    |
| 131             | 0        |     |    |                         |     |    |    |       | ..... | ..... |     |     |    |    |

Common output

COM0

COM1

COM2

COM3

COM4

COM5

COM6

COM7

COM128

COM129

COM130

COM131

|            |     |     |     |     |     |     |     |       |       |       |       |       |       |
|------------|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|
| SEG output | SA0 | SB0 | SC0 | SA1 | SB1 | SC1 | SA2 | ..... | ..... | SC158 | SA159 | SB159 | SC159 |
|------------|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|

### 8.3.2 Data bus to RAM mapping under different input mode

Table 8-7 : Data bus usage under different bus width and color depth mode

|           |               |             | Data bus       |                |                |                |                 |                 |                 |                 |                 |                 |                |                |                 |                 |                 |                 |                 |                 |
|-----------|---------------|-------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Bus width | Color Depth   | Input order | D17            | D16            | D15            | D14            | D13             | D12             | D11             | D10             | D9              | D8              | D7             | D6             | D5              | D4              | D3              | D2              | D1              | D0              |
| 8 bits    | 256           |             | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub>  | B <sub>2</sub>  | B <sub>1</sub>  | B <sub>0</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 16 bits   | 65k           |             | X              | X              | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub>  | C <sub>1</sub>  | C <sub>0</sub>  | B <sub>5</sub>  | B <sub>4</sub>  | B <sub>3</sub>  | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub>  | A <sub>4</sub>  | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 8 bits    | 65k           | 1st         | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub>  | C <sub>1</sub>  | C <sub>0</sub>  | B <sub>5</sub>  | B <sub>4</sub>  | B <sub>3</sub>  |
|           |               | 2nd         | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub>  | A <sub>4</sub>  | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 8 bits    | 262k          | 1st         | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | X              | X              | C <sub>5</sub>  | C <sub>4</sub>  | C <sub>3</sub>  | C <sub>2</sub>  | C <sub>1</sub>  | C <sub>0</sub>  |
|           |               | 2nd         | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | X              | X              | B <sub>5</sub>  | B <sub>4</sub>  | B <sub>3</sub>  | B <sub>2</sub>  | B <sub>1</sub>  | B <sub>0</sub>  |
|           |               | 3rd         | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | X              | X              | A <sub>5</sub>  | A <sub>4</sub>  | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 16 bits   | 262k format 1 | 1st         | X              | X              | X              | X              | X               | X               | X               | X               | X               | X               | X              | X              | C <sub>5</sub>  | C <sub>4</sub>  | C <sub>3</sub>  | C <sub>2</sub>  | C <sub>1</sub>  | C <sub>0</sub>  |
|           |               | 2nd         | X              | X              | X              | X              | B <sub>5</sub>  | B <sub>4</sub>  | B <sub>3</sub>  | B <sub>2</sub>  | B <sub>1</sub>  | B <sub>0</sub>  | X              | X              | A <sub>5</sub>  | A <sub>4</sub>  | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 16 bits   | 262k format 2 | 1st         | X              | X              | X              | X              | C <sub>15</sub> | C <sub>14</sub> | C <sub>13</sub> | C <sub>12</sub> | C <sub>11</sub> | C <sub>10</sub> | X              | X              | B <sub>15</sub> | B <sub>14</sub> | B <sub>13</sub> | B <sub>12</sub> | B <sub>11</sub> | B <sub>10</sub> |
|           |               | 2nd         | X              | X              | X              | X              | A <sub>15</sub> | A <sub>14</sub> | A <sub>13</sub> | A <sub>12</sub> | A <sub>11</sub> | A <sub>10</sub> | X              | X              | C <sub>25</sub> | C <sub>24</sub> | C <sub>23</sub> | C <sub>22</sub> | C <sub>21</sub> | C <sub>20</sub> |
|           |               | 3rd         | X              | X              | X              | X              | B <sub>25</sub> | B <sub>24</sub> | B <sub>23</sub> | B <sub>22</sub> | B <sub>21</sub> | B <sub>20</sub> | X              | X              | A <sub>25</sub> | A <sub>24</sub> | A <sub>23</sub> | A <sub>22</sub> | A <sub>21</sub> | A <sub>20</sub> |
| 9 bits    | 262k          | 1st         | X              | X              | X              | X              | X               | X               | X               | X               | X               | C <sub>5</sub>  | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub>  | C <sub>1</sub>  | C <sub>0</sub>  | B <sub>5</sub>  | B <sub>4</sub>  | B <sub>3</sub>  |
|           |               | 2nd         | X              | X              | X              | X              | X               | X               | X               | X               | X               | B <sub>2</sub>  | B <sub>1</sub> | B <sub>0</sub> | A <sub>5</sub>  | A <sub>4</sub>  | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 18 bits   | 262k          |             | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub>  | C <sub>0</sub>  | B <sub>5</sub>  | B <sub>4</sub>  | B <sub>3</sub>  | B <sub>2</sub>  | B <sub>1</sub> | B <sub>0</sub> | A <sub>5</sub>  | A <sub>4</sub>  | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |

### 8.3.3 RAM mapping and Different color depth mode

At 262k color depth mode, color A, B, C are directly mapped to the RAM content. At 256 and 65k color mode, the RAM content will be filled up to 262k format.

Table 8-8 : 256 and 65k color mode mapping

|            | SC <sub>n</sub> |                |                |                 |                 |                 | SB <sub>n</sub> |                |                |                 |                 |                 | SA <sub>n</sub> |                |                 |                 |                 |                 |
|------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| 262k color | C <sub>5</sub>  | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub>  | C <sub>1</sub>  | C <sub>0</sub>  | B <sub>5</sub>  | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub>  | B <sub>1</sub>  | B <sub>0</sub>  | A <sub>5</sub>  | A <sub>4</sub> | A <sub>3</sub>  | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  |
| 65k color  | C <sub>4</sub>  | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub>  | C <sub>0</sub>  | *C <sub>4</sub> | B <sub>5</sub>  | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub>  | B <sub>1</sub>  | B <sub>0</sub>  | A <sub>4</sub>  | A <sub>3</sub> | A <sub>2</sub>  | A <sub>1</sub>  | A <sub>0</sub>  | *A <sub>4</sub> |
| 256 color  | C <sub>2</sub>  | C <sub>1</sub> | C <sub>0</sub> | *C <sub>2</sub> | *C <sub>2</sub> | *C <sub>2</sub> | B <sub>2</sub>  | B <sub>1</sub> | B <sub>0</sub> | *B <sub>2</sub> | *B <sub>2</sub> | *B <sub>2</sub> | A <sub>1</sub>  | A <sub>0</sub> | *A <sub>1</sub> | *A <sub>1</sub> | *A <sub>1</sub> | *A <sub>1</sub> |

#### Note

<sup>(1)</sup> n = 0 ~ 159d

<sup>(2)</sup> bits with \* are copied from corresponding bits in order to fill up 262K format.

## 8.4 Command Decoder

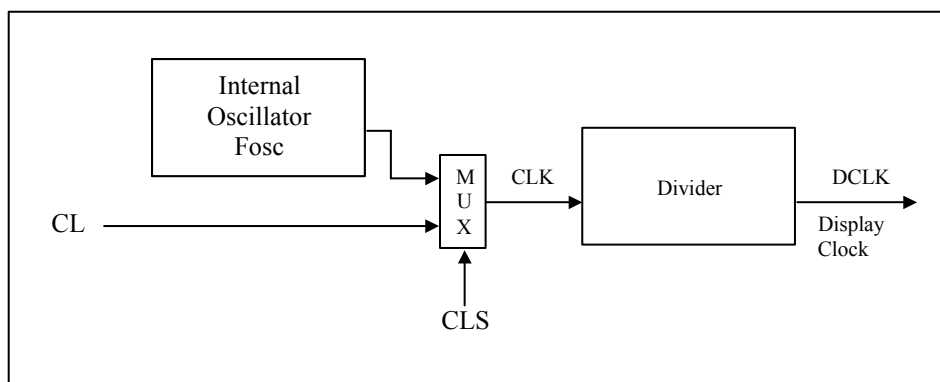
This module determines whether the input should be interpreted as data or command based upon the input of the D/C# pin.

If D/C# pin is HIGH, data is written to Graphic Display Data RAM (GDDRAM). If it is LOW, the inputs at D0-D17 are interpreted as a Command and it will be decoded and be written to the corresponding command register.

## 8.5 Oscillator & Timing Generator

### 8.5.1 Oscillator

Figure 8-6 : Oscillator Circuit



This module is an On-Chip low power RC oscillator circuitry (Figure 8-6). The operation clock (CLK) can be generated either from internal oscillator or external source CL pin by CLS pin. If CLS pin is HIGH, internal oscillator is selected. If CLS pin is LOW, external clock from CL pin will be used for CLK. The frequency of internal oscillator  $F_{OSC}$  can be programmed by command B3h.

The display clock (DCLK) for the Display Timing Generator is derived from CLK. The division factor “D” can be programmed from 1 to 16 by command B3h.

$$DCLK = F_{OSC} / D$$

The frame frequency of display is determined by the following formula:

$$F_{FRM} = \frac{F_{osc}}{D \times K \times \text{No. of Mux}}$$

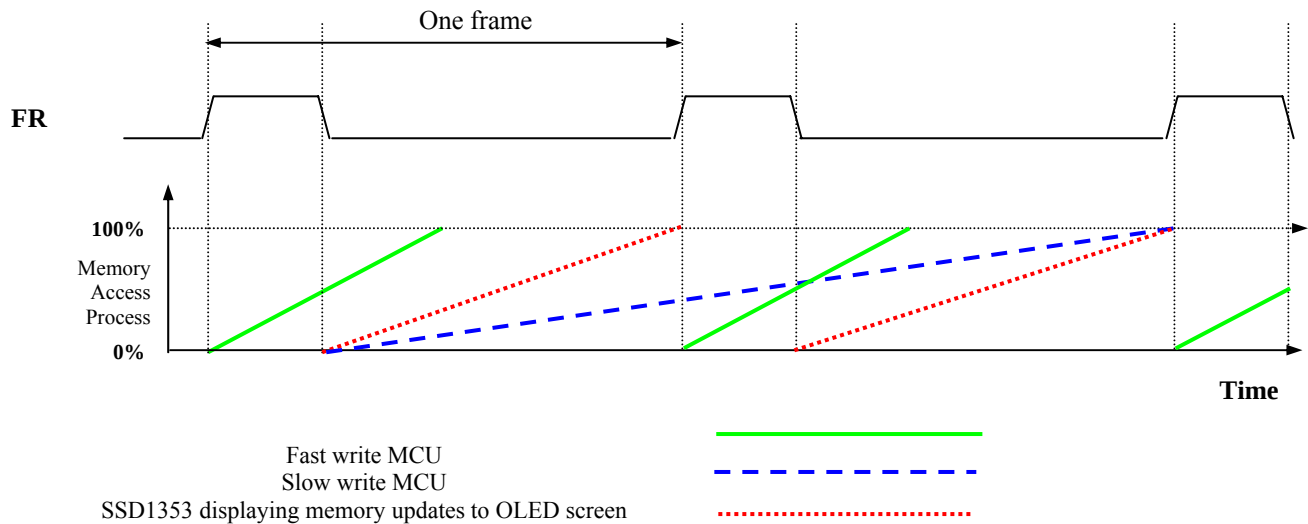
where

- D stands for clock divide ratio. It is set by command B3h A[3:0]. The divide ratio has the range from 1 to 16.
- K is the number of display clocks per row. The value is derived by  
 $K = \text{Phase 1 period} + \text{Phase 2 period} + 98$   
 $= 9 + 7 + 98 = 114$  (reset)
- Number of multiplex ratio is set by command A8h. The reset value is 131 (i.e. 132MUX).
- $F_{osc}$  is the oscillator frequency. It can be changed by command B3h A[7:4]. The higher the register setting results in higher frequency.

If the frame frequency is set too low, flickering may occur. On the other hand, higher frame frequency leads to higher power consumption on the whole system.

## 8.5.2 FR synchronization

FR synchronization signal can be used to prevent tearing effect.



The starting time to write a new image to OLED driver is depended on the MCU writing speed. If MCU can finish writing a frame image within one frame period, it is classified as fast write MCU. For MCU needs longer writing time to complete ( more than one frame but within two frames), it is a slow write one.

**For fast write MCU:** MCU should start to write new frame of ram data just after rising edge of FR pulse and should be finished well before the rising edge of the next FR pulse.

**For slow write MCU:** MCU should start to write new frame ram data after the falling edge of the 1<sup>st</sup> FR pulse and must be finished before the rising edge of the 3<sup>rd</sup> FR pulse.

## 8.6 SEG/COM Driving block

This block is used to derive the incoming power sources into the different levels of internal use voltage and current.

- $V_{CC}$  is the most positive voltage supply.
- $V_{COMH}$  is the Common deselected level. It is internally regulated.
- $V_{LSS}$  is the ground path of the analog and panel current.
- $I_{REF}$  is a reference current source for segment current drivers  $I_{SEG}$ . The relationship between reference current and segment current of a color is:

$$I_{SEG} = \text{Contrast} / 256 * I_{REF} * \text{scale factor}$$

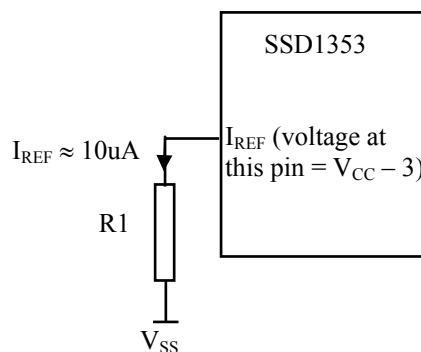
in which

the contrast (0~255) is set by Set Contrast command (81h,82h,83h); and  
the scale factor (1 ~ 16) is set by Master Current Control command (87h).

For example, in order to achieve  $I_{SEG} = 160\mu\text{A}$  at maximum contrast 255,  $I_{REF}$  is set to around  $10\mu\text{A}$ . This current value is obtained by connecting an appropriate resistor from IREF pin to  $V_{SS}$  as shown in Figure 8-7.

Recommended  $I_{REF} = 10\mu\text{A}$

**Figure 8-7 :  $I_{REF}$  Current Setting by Resistor Value**



Since the voltage at  $I_{REF}$  pin is  $V_{CC} - 3V$ , the value of resistor  $R1$  can be found as below:

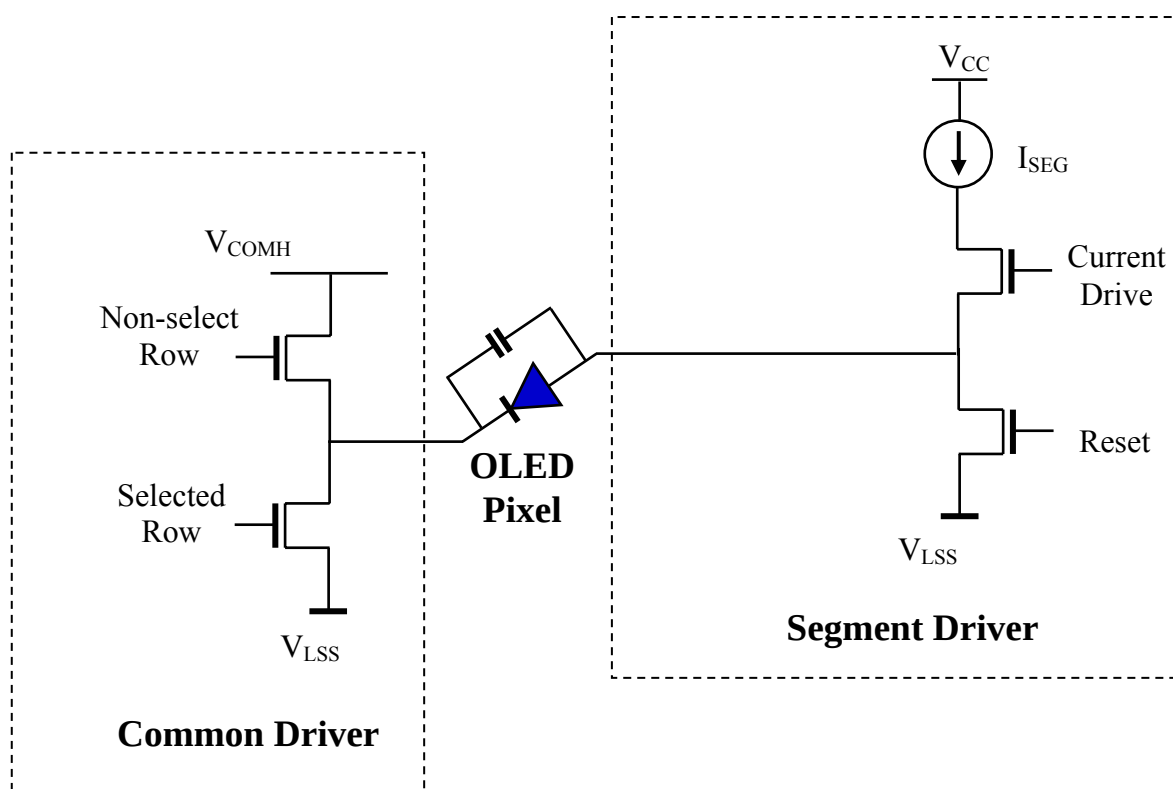
For  $I_{REF} = 10\mu\text{A}$ ,  $V_{CC} = 18V$ :

$$\begin{aligned} R1 &= (\text{Voltage at } I_{REF} - V_{SS}) / I_{REF} \\ &= (18 - 3) / 10\mu\text{A} \\ &= \approx 1.5M \Omega \end{aligned}$$

## 8.7 SEG / COM Driver

Segment drivers consist of 480 (160 x 3 colors) current sources to drive OLED panel. The driving current can be adjusted from 0 to 160uA with 256 steps by contrast setting command (81h, 82h, 83h). Common drivers generate scanning voltage pulse. The block diagrams and waveforms of the segment and common driver are shown as follow.

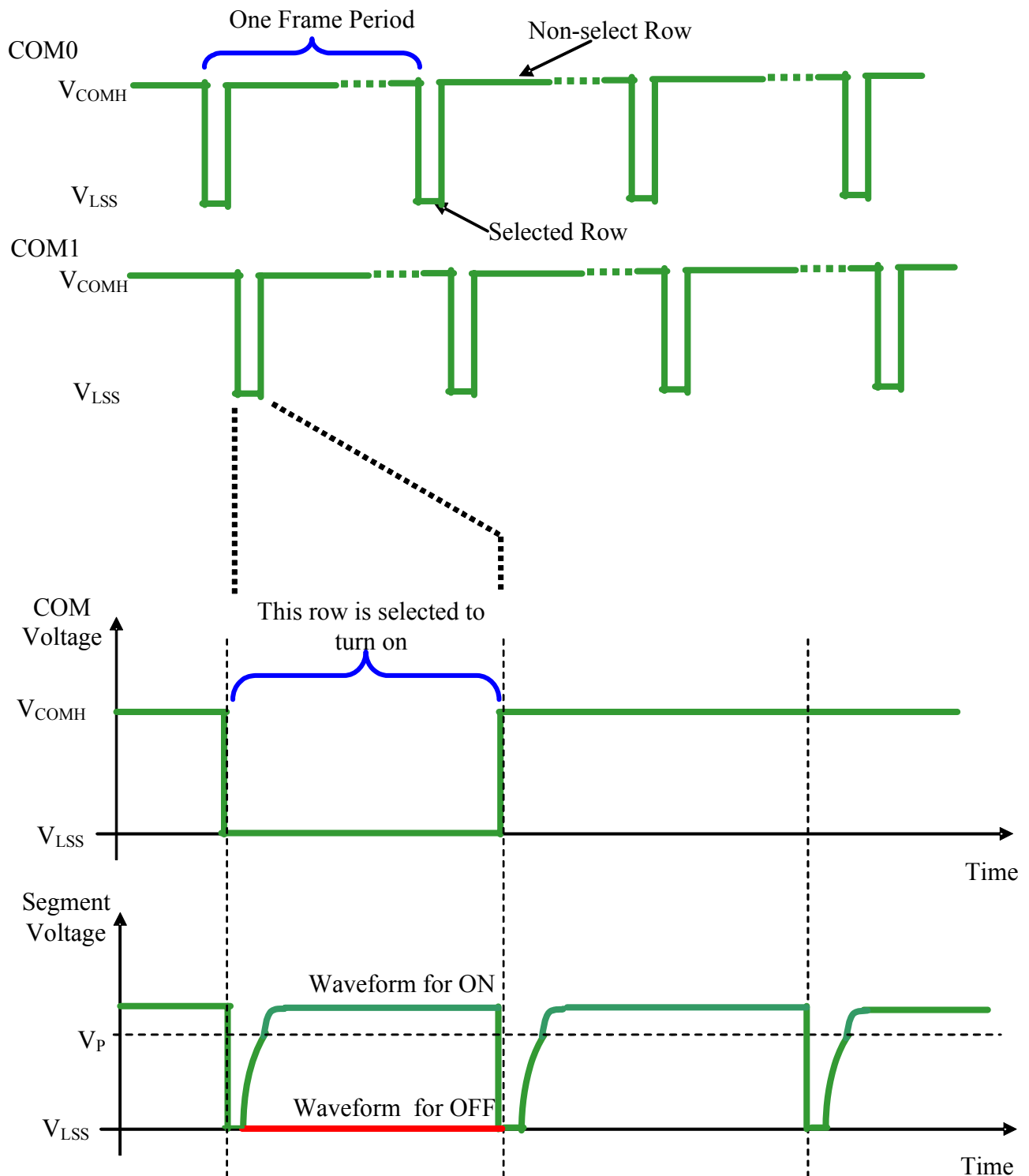
Figure 8-8 : Segment and Common Driver Block Diagram



The commons are scanned sequentially, row by row. If a row is not selected, all the pixels on the row are in reverse bias by driving those commons to voltage  $V_{COMH}$  as shown in Figure 8-9.

In the scanned row, the pixels on the row will be turned ON or OFF by sending the corresponding data signal to the segment pins. If the pixel is turned OFF, the segment current is kept at 0. On the other hand, the segment drives to  $I_{SEG}$  when the pixel is turned ON.

**Figure 8-9 : Segment and Common Driver Signal Waveform**



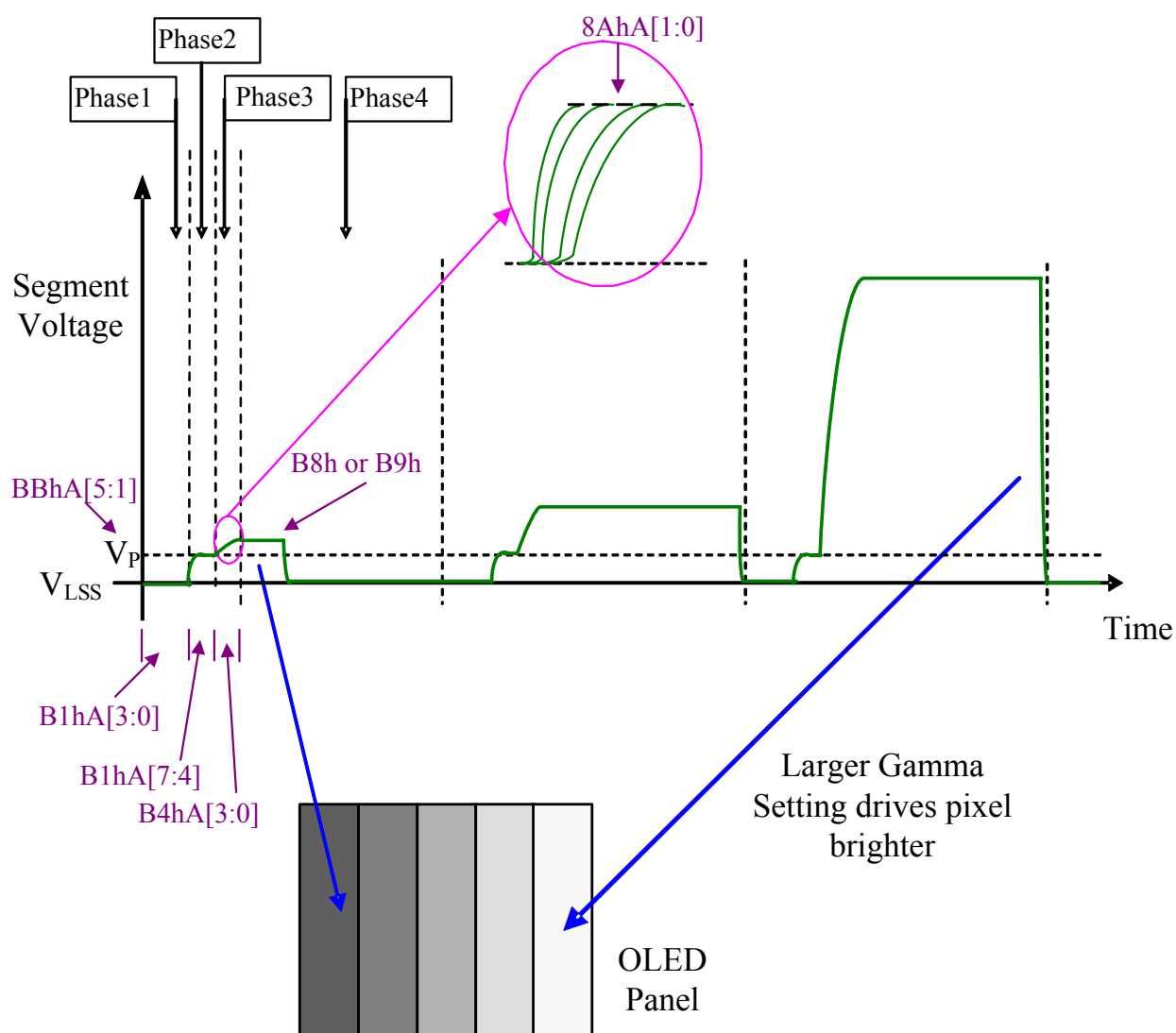
There are four phases to driving an OLED a pixel. In phase 1, the pixel is reset by the segment driver to  $V_{LSS}$  in order to discharge the previous data charge stored in the parasitic capacitance along the segment electrode. The period of phase 1 can be programmed by command B1h A[3:0]. An OLED panel with larger capacitance requires a longer period for discharging.

In phase 2, first pre-charge is performed. The pixel is driven to attain the corresponding voltage level  $V_P$  from  $V_{LSS}$ . The amplitude of  $V_P$  can be programmed by the command BBh. The period of phase 2 can be programmed by command B1h A[7:4]. If the capacitance value of the pixel of OLED panel is larger, a longer period is required to charge up the capacitor to reach the desired voltage.

In phase 3, the OLED pixel is driven to the targeted driving voltage through second pre-charge. The second pre-charge can control the speed of the charging process. The period of phase 3 can be programmed by command B4h.

Last phase (phase 4) is current drive stage. The current source in the segment driver delivers constant current to the pixel. The driver IC employs PAM+PWM (Pulse Area Modulation + Pulse Width Modulation) method to control the gray scale of each pixel individually. The gray scale can be programmed into different Gamma settings by command B8h/B9h. The bigger gamma setting in the current drive stage results in brighter pixels and vice versa (Details refer to Section 8.8). This is shown in the following figure.

**Figure 8-10: Gray Scale Control in Segment**



After finishing phase 4, the driver IC will go back to phase 1 to display the next row image data. This four-step cycle is run continuously to refresh image display on OLED panel.



## 8.8 Gray Scale Decoder

The gray scale effect is generated by controlling the segment current in current drive phase. The segment current is controlled by the Gamma Settings (Setting 0~ Setting 128). The larger the setting, the brighter the pixel will be. The Gray Scale Table stores the corresponding Gamma Setting of the 64 gray scale levels (GS0~GS63) through the software commands B8h or B9h. A single Gray Scale Table supports all the three colors A, B and C.

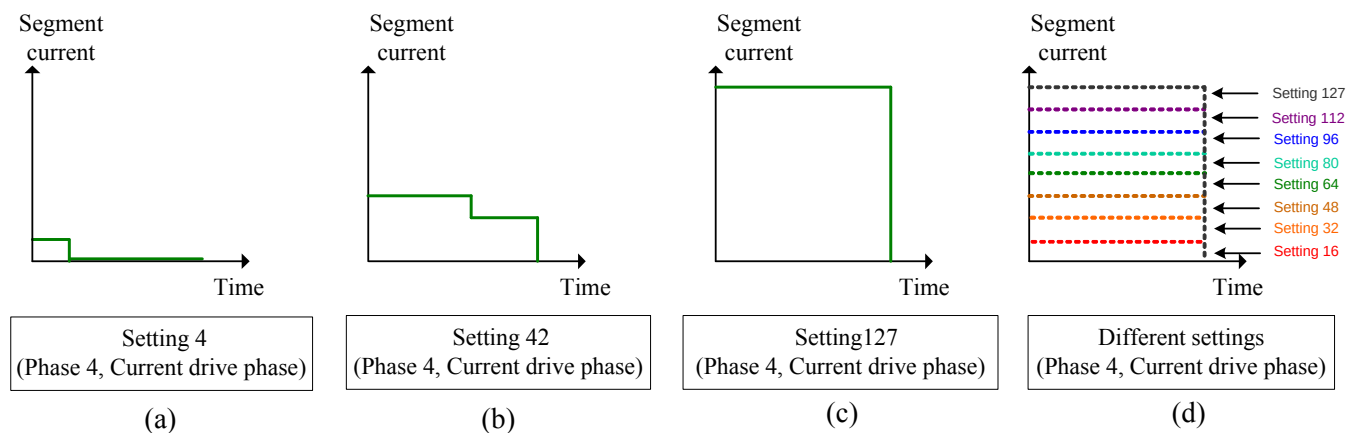
As shown in Figure 8-11, color A, B, C sub-pixel RAM data has 6 bits, represent the 64 gray scale level from GS0 to GS63.

**Figure 8-11 : Relation between GDDRAM content and Gray Scale table entry for three colors in 262K color mode (under command B9h Enable Linear Gray Scale Table)**

| Color A,B ,C<br>GDDRAM data (6 bits) | Gray Scale Table | Default Gamma Setting<br>(Command B9h) |
|--------------------------------------|------------------|----------------------------------------|
| 000000                               | GS0              | Setting 0                              |
| 000001                               | GS1              | Setting 2                              |
| 000010                               | GS2              | Setting 4                              |
| 000011                               | GS3              | Setting 6                              |
| 000100                               | GS4              | Setting 8                              |
| ⋮                                    | ⋮                | ⋮                                      |
| 011111                               | GS31             | Setting 62                             |
| 100000                               | GS32             | Setting 65                             |
| 100001                               | GS33             | Setting 67                             |
| ⋮                                    | ⋮                | ⋮                                      |
| 111100                               | GS60             | Setting 121                            |
| 111101                               | GS61             | Setting 123                            |
| 111110                               | GS62             | Setting 125                            |
| 111111                               | GS63             | Setting 127                            |

The Gray Scale Table can be programmed into different Gamma setting by command B8h. For example, if GS2 is programmed into Gamma setting 4, and the color A, B or C of GDDRAM is set as “000010b”, then the current drive phase will be similar to the illustration in Figure 8-12(a).

**Figure 8-12 : Illustration of current drive phase (phase 4) under different Gamma Settings.**



There are total 128 Gamma Settings (Setting 0 to Setting 127) available for the Gray Scale table. GS0 has no pre-charge and current drive stages so it is in Gamma Setting 0.

When setting the Gray Scale Table, the rules below must follow:

- 1) The gray scale is defined in incremental way, with reference to the length of previous table entry:  
0 < Setting of GS1 < Setting of GS2 < Setting of GS3..... Setting 62 < Setting 63.
- 2) Different GSs should be set within the maximum Gamma Setting as follow:

**Table 8-9 : Maximum Gamma setting in different Gray Scale ranges**

| Gary Scale Range | Maximum Gamma Setting allowed |
|------------------|-------------------------------|
| GS0              | Setting 0                     |
| GS1 ~ G7         | Setting 15                    |
| GS8 ~ GS15       | Setting 31                    |
| GS16 ~ GS31      | Setting 63                    |
| GS32 ~ GS63      | Setting 127                   |

It should be notice that, the brightness under the following pairs of Gamma Setting will be the same:

**Table 8-10 : Gamma Settings with identical brightness in current drive phase**

|                         |                         |                           |
|-------------------------|-------------------------|---------------------------|
| Setting 15 & Setting 16 | Setting 63 & Setting 64 | Setting 111 & Setting 112 |
| Setting 31 & Setting 32 | Setting 79 & Setting 80 |                           |
| Setting 47 & Setting 48 | Setting 95 & Setting 96 |                           |

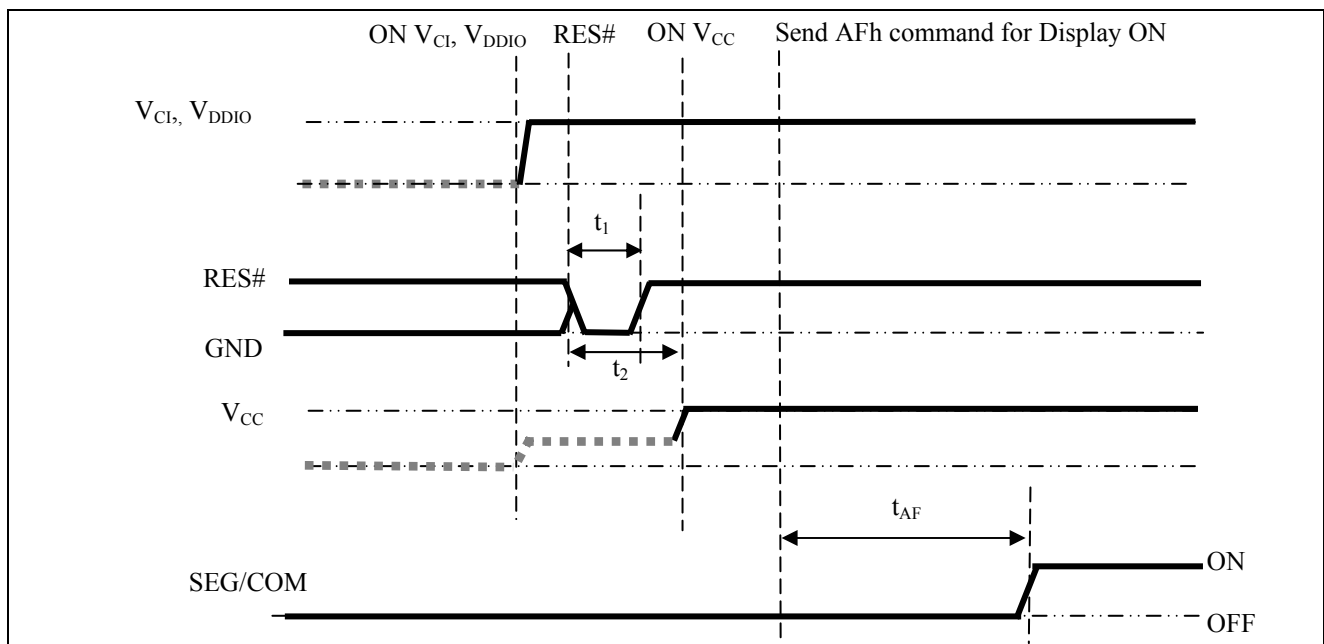
## 8.9 Power ON and OFF sequence

The following figures illustrate the recommended power ON and power OFF sequence of SSD1353 (assume  $V_{CI}$  and  $V_{DDIO}$  are at the same voltage level and internal  $V_{DD}$  is used).

### Power ON sequence:

1. Power ON  $V_{CI}$ ,  $V_{DDIO}$ .
2. After  $V_{CI}$ ,  $V_{DDIO}$  become stable, set RES# pin LOW (logic low) for at least 100us ( $t_1$ ) and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 100us ( $t_2$ ). Then Power ON  $V_{CC}$ .<sup>(1)</sup>
4. After  $V_{CC}$  become stable, send command AFh for display ON. SEG/COM will be ON after 200ms ( $t_{AF}$ ).

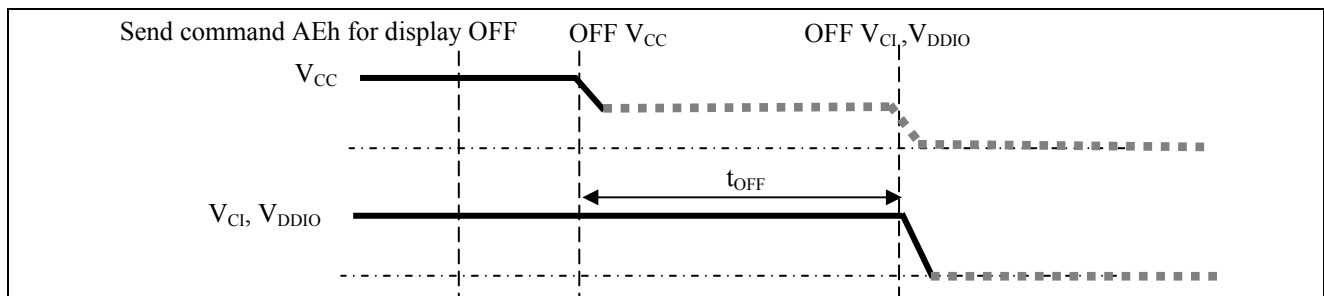
**Figure 8-13: The Power ON sequence.**



### Power OFF sequence:

1. Send command AEh for display OFF.
2. Power OFF  $V_{CC}$ .<sup>(1), (2)</sup>
3. Wait for  $t_{OFF}$ . Power OFF  $V_{CI}$ ,  $V_{DDIO}$ . (where Minimum  $t_{OFF}$ =0ms, Typical  $t_{OFF}$ =100ms)

**Figure 8-14: The Power OFF sequence**



### Note:

<sup>(1)</sup> Since an ESD protection circuit is connected between  $V_{CI}$ ,  $V_{DDIO}$  and  $V_{CC}$ ,  $V_{CC}$  becomes lower than  $V_{CI}$  whenever  $V_{CI}$ ,  $V_{DDIO}$  is ON and  $V_{CC}$  is OFF as shown in the dotted line of  $V_{CC}$  in Figure 8-13 and Figure 8-14.

<sup>(2)</sup>  $V_{CC}$  should be kept float when it is OFF.

## 8.10 V<sub>DD</sub> Regulator

In SSD1353, the power supply pin for core logic operation: V<sub>DD</sub>, can be supplied by external source or internally regulated through the V<sub>DD</sub> regulator.

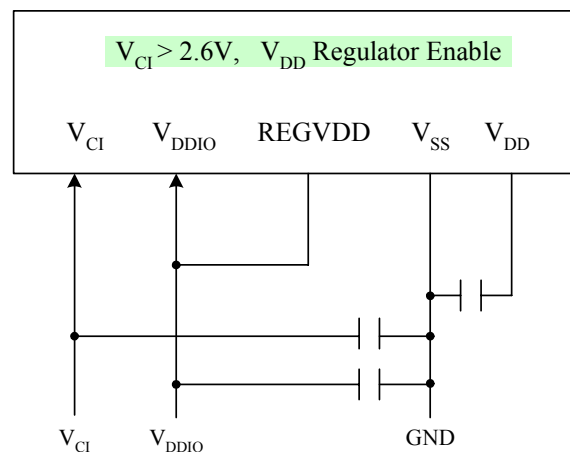
When the Internal V<sub>DD</sub> regulator selections pin: REGVDD is pulled HIGH (i.e. connect to V<sub>DDIO</sub>), the internal V<sub>DD</sub> regulator is enabled. V<sub>CI</sub> should be larger than 2.6V when using the internal V<sub>DD</sub> regulator. The typical regulated V<sub>DD</sub> is about 2.5V

When the Internal V<sub>DD</sub> regulator selection pin: REGVDD is pulled LOW (i.e. connect to Ground), external V<sub>DD</sub> should be used. (external V<sub>DD</sub> range : 2.4V~2.6V)

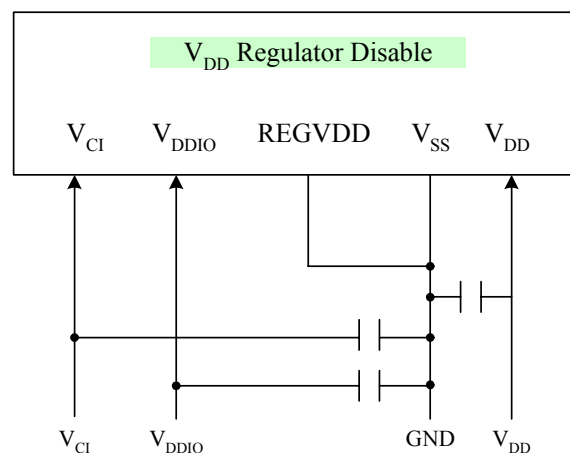
It should be notice that, no matter V<sub>DD</sub> is supplied by external source or internally regulated, V<sub>CI</sub> must always be equal or higher than V<sub>DD</sub> and V<sub>DDIO</sub>.

The following figure shows the V<sub>DD</sub> regulator pin connection scheme:

**Figure 8-15 V<sub>CI</sub> > 2.6V, V<sub>DD</sub> regulator enable pin connection scheme**



**Figure 8-16 V<sub>DD</sub> regulator disable pin connection scheme**



## 9 COMMAND TABLE

**Table 9-1 : Command table**

(D/C#=0, R/W#(WR#) = 0, E(RD#)=1) unless specific setting is stated)

| Fundamental Command Table |                        |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                            |                                                                                                                                                                                  |                                                                                                                      |
|---------------------------|------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| D/C#                      | Hex                    | D7                                    | D6                                    | D5                                    | D4                                    | D3                                    | D2                                    | D1                                    | D0                                    | Command                    | Description                                                                                                                                                                      |                                                                                                                      |
| 0<br>1<br>1               | 15<br>A[7:0]<br>B[7:0] | 0<br>A <sub>7</sub><br>B <sub>7</sub> | 0<br>A <sub>6</sub><br>B <sub>6</sub> | 0<br>A <sub>5</sub><br>B <sub>5</sub> | 1<br>A <sub>4</sub><br>B <sub>4</sub> | 0<br>A <sub>3</sub><br>B <sub>3</sub> | 1<br>A <sub>2</sub><br>B <sub>2</sub> | 0<br>A <sub>1</sub><br>B <sub>1</sub> | 1<br>A <sub>0</sub><br>B <sub>0</sub> | Set Column Address         | Set Column start and end address<br><br>A[7:0]: Set start column address from 00d-159d [reset= 0d (00h)]<br><br>B[7:0]: Set end column address from 00d-159d [reset= 159d (9Fh)] |                                                                                                                      |
| 0                         | 5C                     | 0                                     | 1                                     | 0                                     | 1                                     | 1                                     | 1                                     | 0                                     | 0                                     |                            | Write RAM Command                                                                                                                                                                | Enable MCU to write Data into RAM                                                                                    |
| 0                         | 5D                     | 0                                     | 1                                     | 0                                     | 1                                     | 1                                     | 1                                     | 0                                     | 1                                     |                            | Read RAM Command                                                                                                                                                                 | Enable MCU to read Data from RAM                                                                                     |
| 0<br>1<br>1               | 75<br>A[7:0]<br>B[7:0] | 0<br>A <sub>7</sub><br>B <sub>7</sub> | 1<br>A <sub>6</sub><br>B <sub>6</sub> | 1<br>A <sub>5</sub><br>B <sub>5</sub> | 1<br>A <sub>4</sub><br>B <sub>4</sub> | 0<br>A <sub>3</sub><br>B <sub>3</sub> | 1<br>A <sub>2</sub><br>B <sub>2</sub> | 0<br>A <sub>1</sub><br>B <sub>1</sub> | 1<br>A <sub>0</sub><br>B <sub>0</sub> | Set Row Address            | Set Row start and end address<br><br>A[7:0]: Set start row address from 00d-131d [reset= 0d (00h)]<br>B[7:0]: Set end row address from 00d-131d [reset= 131d (83h)]              |                                                                                                                      |
| 0<br>1                    | 81<br>A[7:0]           | 1<br>A <sub>7</sub>                   | 0<br>A <sub>6</sub>                   | 0<br>A <sub>5</sub>                   | 0<br>A <sub>4</sub>                   | 0<br>A <sub>3</sub>                   | 0<br>A <sub>2</sub>                   | 0<br>A <sub>1</sub>                   | 1<br>A <sub>0</sub>                   |                            | Set Contrast for Color "A"                                                                                                                                                       | Set contrast for all color "A" segment (Pins :SA0 – SA159)<br><br>A[7:0] valid range: 00d to 255d [reset=128d (80h)] |
| 0<br>1                    | 82<br>A[7:0]           | 1<br>A <sub>7</sub>                   | 0<br>A <sub>6</sub>                   | 0<br>A <sub>5</sub>                   | 0<br>A <sub>4</sub>                   | 0<br>A <sub>3</sub>                   | 0<br>A <sub>2</sub>                   | 1<br>A <sub>1</sub>                   | 0<br>A <sub>0</sub>                   |                            | Set Contrast for Color "B"                                                                                                                                                       | Set contrast for all color "B" segment (Pins :SB0 – SB159)<br><br>A[7:0] valid range: 00d to 255d [reset=128d (80h)] |
| 0<br>1                    | 83<br>A[7:0]           | 1<br>A <sub>7</sub>                   | 0<br>A <sub>6</sub>                   | 0<br>A <sub>5</sub>                   | 0<br>A <sub>4</sub>                   | 0<br>A <sub>3</sub>                   | 0<br>A <sub>2</sub>                   | 1<br>A <sub>1</sub>                   | 1<br>A <sub>0</sub>                   | Set Contrast for Color "C" | Set contrast for all color "C" segment (Pins :SC0 – SC159)<br><br>A[7:0] valid range: 00d to 255d [reset=128d (80h)]                                                             |                                                                                                                      |
| 0<br>1                    | 87<br>A[3:0]           | 1<br>*                                | 0<br>*                                | 0<br>*                                | 0<br>*                                | A <sub>3</sub>                        | A <sub>2</sub>                        | A <sub>1</sub>                        | A <sub>0</sub>                        | Master Current Control     | Set master current attenuation factor<br><br>A[3:0] can be set from 00d to 15d corresponding to 1/16, 2/16... to 16/16 attenuation. [reset= 15d (0Fh)]                           |                                                                                                                      |

| Fundamental Command Table |                      |                     |                     |                     |                     |                     |                     |                     |                     |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D/C#                      | Hex                  | D7                  | D6                  | D5                  | D4                  | D3                  | D2                  | D1                  | D0                  | Command                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 0<br>1                    | 8A<br>A[1:0]         | 1<br>0              | 0<br>0              | 0<br>0              | 0<br>0              | 1<br>0              | 0<br>0              | 1<br>A <sub>1</sub> | 0<br>A <sub>0</sub> | Set Second Pre-charge speed | Set Second Pre-charge speed<br>A[1:0]= 00b, Second Pre-charge speed =slowest<br>A[1:0]= 01b, Second Pre-charge speed =slow<br>A[1:0]= 10b, Second Pre-charge speed =normal [reset]<br>A[1:0]= 11b, Second Pre-charge speed =Fast                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 0<br>1                    | A0<br>A[7:0]         | 1<br>A <sub>7</sub> | 0<br>A <sub>6</sub> | 1<br>A <sub>5</sub> | 0<br>A <sub>4</sub> | 0<br>A <sub>3</sub> | 0<br>A <sub>2</sub> | 0<br>A <sub>1</sub> | 0<br>A <sub>0</sub> | Remap & Color Depth setting | Set driver remap and color depth<br><br>A[0]=0, Horizontal address increment [reset]<br>A[0]=1, Vertical address increment<br><br>A[1]=0, RAM Column 0 to 159 maps to Pin SEG (SA,SB,SC) 0 to 159 [reset]<br>A[1]=1, RAM Column 0 to 159 maps to Pin SEG (SA,SB,SC) 159 to 0<br><br>A[2]=0, normal order SA,SB,SC (e.g. RGB) [reset]<br>A[2]=1, reverse order SC,SB,SA (e.g. BGR)<br><br>A[3]=0, Disable left-right swapping on COM [reset]<br>A[3]=1, Set left-right swapping on COM<br><br>A[4]=0, Scan from COM0 to COM[N-1] [reset]<br>A[4]=1, Scan from COM[N-1] to COM0. Where N is the multiplex ratio.<br><br>A[5]=0, Disable COM Split Odd Even [reset]<br>A[5]=1, Enable COM Split Odd Even<br><br>Refer to Figure 10-5 for details.<br><br>A[7:6] = 00; 256 color format<br>A[7:6] = 01; 65k color format [RESET]<br>A[7:6] = 10; 256k color format<br>A[7:6] = 11; 256k color 16-bit format 2<br><br>If 9-/18-bit mode is selected, color depth will be fixed to 256k regardless of the setting.<br><br>Refer to Table 8-7 for details. |
| 0<br>1                    | A1<br>A[7:0]         | 1<br>A <sub>7</sub> | 0<br>A <sub>6</sub> | 1<br>A <sub>5</sub> | 0<br>A <sub>4</sub> | 0<br>A <sub>3</sub> | 0<br>A <sub>2</sub> | 0<br>A <sub>1</sub> | 1<br>A <sub>0</sub> | Set Display Start Line      | Set display start line register by Row<br>A[7:0]: from 00d to 131d [reset = 0d (00h)]<br><br><b>Note</b><br>(1) A[7:0] must be set to 0 when using A3h command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 0<br>1                    | A2<br>A[7:0]         | 1<br>A <sub>7</sub> | 0<br>A <sub>6</sub> | 1<br>A <sub>5</sub> | 0<br>A <sub>4</sub> | 0<br>A <sub>3</sub> | 0<br>A <sub>2</sub> | 1<br>A <sub>1</sub> | 0<br>A <sub>0</sub> | Set Display Offset          | Set vertical offset by COM<br>A[7:0]: from 00d to 131d [reset = 0d (00h)]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 0<br>0<br>0<br>0          | A4<br>A5<br>A6<br>A7 | 1<br>1<br>1<br>1    | 0<br>0<br>0<br>0    | 1<br>1<br>1<br>1    | 0<br>0<br>0<br>0    | 0<br>0<br>0<br>0    | 1<br>1<br>1<br>1    | 0<br>0<br>1<br>1    | 0<br>1<br>0<br>1    | Set Display Mode            | A4h=Normal Display [reset]<br>A5h=Entire Display ON, all pixels turn ON at GS63<br>A6h=Entire Display OFF, all pixels turn OFF<br>A7h=Inverse Display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Fundamental Command Table  |                                                      |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
|----------------------------|------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------|------|---------|------|---------|------|---------|------|---------|------|-----------------|---|---|------|----------|--------|----------------|------|---------|------|---------|------|---------|------|---------|---|---|------|----------------|---|---|------|
| D/C#                       | Hex                                                  | D7                                                                             | D6                                                                             | D5                                                                             | D4                                                                                          | D3                                                                                          | D2                                                                                          | D1                                                                                          | D0                                                                                          | Command                         | Description                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0<br>1                     | A8<br>A[7:0]                                         | 1<br>A <sub>7</sub>                                                            | 0<br>A <sub>6</sub>                                                            | 1<br>A <sub>5</sub>                                                            | 0<br>A <sub>4</sub>                                                                         | 1<br>A <sub>3</sub>                                                                         | 0<br>A <sub>2</sub>                                                                         | 0<br>A <sub>1</sub>                                                                         | 0<br>A <sub>0</sub>                                                                         | Set Multiplex Ratio             | Set MUX ratio to N+1 Mux<br>N = A[7:0] from 15d to 131d (i.e.16MUX -132 MUX)<br>A[7:0] from 00d to 14d are invalid entry<br>[reset= 131d (83h)] |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0<br>1<br>1<br>1<br>1<br>1 | AB<br>A[7:0]<br>B[7:0]<br>C[7:0]<br>D[7:0]<br>E[4:0] | 1<br>A <sub>7</sub><br>B <sub>7</sub><br>C <sub>7</sub><br>D <sub>7</sub><br>* | 0<br>A <sub>6</sub><br>B <sub>6</sub><br>C <sub>6</sub><br>D <sub>6</sub><br>* | 1<br>A <sub>5</sub><br>B <sub>5</sub><br>C <sub>5</sub><br>D <sub>5</sub><br>* | 0<br>A <sub>4</sub><br>B <sub>4</sub><br>C <sub>4</sub><br>D <sub>4</sub><br>E <sub>4</sub> | 1<br>A <sub>3</sub><br>B <sub>3</sub><br>C <sub>3</sub><br>D <sub>3</sub><br>E <sub>3</sub> | 0<br>A <sub>2</sub><br>B <sub>2</sub><br>C <sub>2</sub><br>D <sub>2</sub><br>E <sub>2</sub> | 1<br>A <sub>1</sub><br>B <sub>1</sub><br>C <sub>1</sub><br>D <sub>1</sub><br>E <sub>1</sub> | 1<br>A <sub>0</sub><br>B <sub>0</sub><br>C <sub>0</sub><br>D <sub>0</sub><br>E <sub>0</sub> |                                 | Dim Mode setting                                                                                                                                | Configure dim mode setting<br><br>A[7:0] = Reserved. (Set as 00h)<br><br>B[7:0] = Contrast setting for Color A, valid range 0 to 255d.<br><br>C[7:0] = Contrast setting for Color B, valid range 0 to 255d.<br><br>D[7:0] = Contrast setting for Color C, valid range 0 to 255d.<br><br>E[4:0] = Pre-charge voltage setting, valid range 0 to 31d. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0<br>0<br>0                | AC<br>AE<br>AF                                       | 1<br>1<br>1                                                                    | 0<br>0<br>0                                                                    | 1<br>1<br>1                                                                    | 0<br>0<br>0                                                                                 | 1<br>1<br>1                                                                                 | 1<br>1<br>1                                                                                 | 0<br>1<br>1                                                                                 | 0<br>0<br>1                                                                                 |                                 |                                                                                                                                                 | Set Display ON/OFF                                                                                                                                                                                                                                                                                                                                 | ACh = Display ON in dim mode<br><br>AEh = Display OFF (sleep mode) [reset]<br><br>AFh = Display ON in normal mode<br><br>Refer to Figure 10-12 for transitions between different modes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0<br>1                     | B1<br>A[7:0]                                         | 1<br>A <sub>7</sub>                                                            | 0<br>A <sub>6</sub>                                                            | 1<br>A <sub>5</sub>                                                            | 1<br>A <sub>4</sub>                                                                         | 0<br>A <sub>3</sub>                                                                         | 0<br>A <sub>2</sub>                                                                         | 0<br>A <sub>1</sub>                                                                         | 1<br>A <sub>0</sub>                                                                         | Phase 1 and 2 period adjustment |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    | A[3:0] : Phase 1 period in N DCLKs. 3~31 DCLKs allowed as follow: <table><tr><td>A[3:0]</td><td>Phase 1 period</td></tr><tr><td>0000</td><td>invalid</td></tr><tr><td>0001</td><td>3 DCLKs</td></tr><tr><td>0010</td><td>5 DCLKs</td></tr><tr><td>0011</td><td>7 DCLKs</td></tr><tr><td>0100</td><td>9 DCLKs [reset]</td></tr><tr><td>:</td><td>:</td></tr><tr><td>1111</td><td>31 DCLKs</td></tr></table><br><br>A[7:4] : Phase 2 period in N DCLKs. 2~15 DCLKs allowed. <table><tr><td>A[7:4]</td><td>Phase 2 period</td></tr><tr><td>0000</td><td>invalid</td></tr><tr><td>0001</td><td>invalid</td></tr><tr><td>0010</td><td>2 DCLKs</td></tr><tr><td>0011</td><td>3 DCLKs</td></tr><tr><td>:</td><td>:</td></tr><tr><td>0111</td><td>7 DCLKs[reset]</td></tr><tr><td>:</td><td>:</td></tr><tr><td>1111</td><td>15 DCLKs</td></tr></table> | A[3:0] | Phase 1 period | 0000 | invalid | 0001 | 3 DCLKs | 0010 | 5 DCLKs | 0011 | 7 DCLKs | 0100 | 9 DCLKs [reset] | : | : | 1111 | 31 DCLKs | A[7:4] | Phase 2 period | 0000 | invalid | 0001 | invalid | 0010 | 2 DCLKs | 0011 | 3 DCLKs | : | : | 0111 | 7 DCLKs[reset] | : | : | 1111 |
| A[3:0]                     | Phase 1 period                                       |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0000                       | invalid                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0001                       | 3 DCLKs                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0010                       | 5 DCLKs                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0011                       | 7 DCLKs                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0100                       | 9 DCLKs [reset]                                      |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| :                          | :                                                    |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 1111                       | 31 DCLKs                                             |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| A[7:4]                     | Phase 2 period                                       |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0000                       | invalid                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0001                       | invalid                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0010                       | 2 DCLKs                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0011                       | 3 DCLKs                                              |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| :                          | :                                                    |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 0111                       | 7 DCLKs[reset]                                       |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| :                          | :                                                    |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |
| 1111                       | 15 DCLKs                                             |                                                                                |                                                                                |                                                                                |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                                                                             |                                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                |      |         |      |         |      |         |      |         |      |                 |   |   |      |          |        |                |      |         |      |         |      |         |      |         |   |   |      |                |   |   |      |

| Fundamental Command Table                                |                                                                                                                     |                                                          |                                                          |                                                          |                                                          |                                                                                                                                                                                    |                                                                                                                                                                                    |                                                                                                                                                                                    |                                                                                                                                                                                    |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D/C#                                                     | Hex                                                                                                                 | D7                                                       | D6                                                       | D5                                                       | D4                                                       | D3                                                                                                                                                                                 | D2                                                                                                                                                                                 | D1                                                                                                                                                                                 | D0                                                                                                                                                                                 | Command                                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 0<br>1                                                   | B3<br>A[7:0]                                                                                                        | 1<br>A <sub>7</sub>                                      | 0<br>A <sub>6</sub>                                      | 1<br>A <sub>5</sub>                                      | 1<br>A <sub>4</sub>                                      | 0<br>A <sub>3</sub>                                                                                                                                                                | 0<br>A <sub>2</sub>                                                                                                                                                                | 1<br>A <sub>1</sub>                                                                                                                                                                | 1<br>A <sub>0</sub>                                                                                                                                                                | Display Clock<br>Divider / Oscillator<br>Frequency | A[3:0] Divider<br><br>DCLK is generated from CLK divided by DIVIDER<br>+1 (i.e., 1 to 16) [reset=0000b]<br><br>A[7:4] Fosc frequency<br><br>Frequency increases as setting value increases<br>[reset=1100b]                                                                                                                                                                                                                                                                                   |
| 0<br>1                                                   | B4<br>A[3:0]                                                                                                        | 1<br>*                                                   | 0<br>*                                                   | 1<br>*                                                   | 1<br>*                                                   | 0<br>A <sub>3</sub>                                                                                                                                                                | 1<br>A <sub>2</sub>                                                                                                                                                                | 0<br>A <sub>1</sub>                                                                                                                                                                | 0<br>A <sub>0</sub>                                                                                                                                                                | Set Second Pre-<br>charge Period                   | A[3:0] Set Second Pre-charge Period<br><br>0000b 0 DCLKS<br>0001b 1 DCLKS<br>0010b 2 DCLKS<br>....<br>0111 7 DCLKS [reset]<br>....<br>1111 15 DCLKS                                                                                                                                                                                                                                                                                                                                           |
| 0<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | B8<br>A1[3:0]<br>:<br>A7[3:0]<br>A8[4:0]<br>:<br>A15[4:0]<br>A16[5:0]<br>:<br>A31[5:0]<br>A32[6:0]<br>:<br>A63[6:0] | 1<br>*<br>:<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>* | 0<br>*<br>:<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>* | 1<br>*<br>:<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>* | 1<br>*<br>:<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>* | 1<br>A1 <sub>3</sub><br>:<br>A7 <sub>3</sub><br>A8 <sub>4</sub><br>:<br>A15 <sub>4</sub><br>A16 <sub>5</sub><br>:<br>A31 <sub>5</sub><br>A32 <sub>6</sub><br>:<br>A63 <sub>6</sub> | 0<br>A1 <sub>2</sub><br>:<br>A7 <sub>2</sub><br>A8 <sub>3</sub><br>:<br>A15 <sub>3</sub><br>A16 <sub>4</sub><br>:<br>A31 <sub>4</sub><br>A32 <sub>5</sub><br>:<br>A63 <sub>5</sub> | 0<br>A1 <sub>1</sub><br>:<br>A7 <sub>1</sub><br>A8 <sub>2</sub><br>:<br>A15 <sub>2</sub><br>A16 <sub>3</sub><br>:<br>A31 <sub>3</sub><br>A32 <sub>4</sub><br>:<br>A63 <sub>4</sub> | 0<br>A1 <sub>0</sub><br>:<br>A7 <sub>0</sub><br>A8 <sub>1</sub><br>:<br>A15 <sub>1</sub><br>A16 <sub>2</sub><br>:<br>A31 <sub>2</sub><br>A32 <sub>3</sub><br>:<br>A63 <sub>3</sub> | Set Gray Scale Table                               | These 63 parameters define Gray Scale (GS) Table<br>in terms of Gamma Setting<br><br>A1[3:0]: Gamma Setting for GS1,<br>A2[3:0]: Gamma Setting for GS2,<br>:<br>A62[6:0]: Gamma Setting for GS62,<br>A63[6:0]: Gamma Setting for GS63.<br><br><b>Note</b><br>(1) Input 1d for Gamma Setting 1, 2d for Gamma<br>setting 2, ... ,127d for Gamma Setting127<br><br>(2) 0 < Setting of GS1 < Setting of GS2 < Setting of<br>GS3..... Setting 62 < Setting 63<br>Refer to Section 8.8 for details. |
| 0                                                        | B9                                                                                                                  | 1                                                        | 0                                                        | 1                                                        | 1                                                        | 1                                                                                                                                                                                  | 0                                                                                                                                                                                  | 0                                                                                                                                                                                  | 1                                                                                                                                                                                  | Enable Linear Gray<br>Scale Table                  | Reset built in Linear Gray Scale table<br><br>GS0 = Gamma Setting 0;<br>GS1 = Gamma Setting 2<br>GS2 = Gamma Setting 4;<br>GS3 = Gamma Setting 6;<br>:<br>GS31 = Gamma Setting 62<br>GS32 = Gamma Setting 65;<br>GS33 = Gamma Setting 67;<br>:<br>GS62 = Gamma Setting 125;<br>GS63 = Gamma Setting 127;<br><br>Refer to Section 8.8 for details.                                                                                                                                             |



| Fundamental Command Table |              |                        |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
|---------------------------|--------------|------------------------|------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|--------------------|-------|-----|------------------------|------|-----|------------------------|-------|-----|------------------------|------|-----|------------------------|------|-----|------------------------|------|-----|------------------------|
| D/C#                      | Hex          | D7                     | D6         | D5                  | D4                  | D3                  | D2                  | D1                  | D0         | Command               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0<br>1                    | BB<br>A[5:1] | 1<br>0                 | 0<br>0     | 1<br>A <sub>5</sub> | 1<br>A <sub>4</sub> | 1<br>A <sub>3</sub> | 0<br>A <sub>2</sub> | 1<br>A <sub>1</sub> | 1<br>0     | Set Pre-charge level  | Set pre-charge voltage level. All three colors share the same pre-charge voltage. [RESET =3Eh]<br><table><tr><th>A[5:1]</th><th>Hex code</th><th>pre-charge voltage</th></tr><tr><td>00000</td><td>00h</td><td>0.10 x V<sub>CC</sub></td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>11111</td><td>3Eh</td><td>0.55 x V<sub>CC</sub></td></tr></table>                                                                                                                                                   | A[5:1] | Hex code | pre-charge voltage | 00000 | 00h | 0.10 x V <sub>CC</sub> | ⋮    | ⋮   | ⋮                      | 11111 | 3Eh | 0.55 x V <sub>CC</sub> |      |     |                        |      |     |                        |      |     |                        |
| A[5:1]                    | Hex code     | pre-charge voltage     |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 00000                     | 00h          | 0.10 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| ⋮                         | ⋮            | ⋮                      |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 11111                     | 3Eh          | 0.55 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0<br>1                    | BE<br>A[5:2] | 1<br>0                 | 0<br>0     | 1<br>A <sub>5</sub> | 1<br>A <sub>4</sub> | 1<br>A <sub>3</sub> | 1<br>A <sub>2</sub> | 1<br>0              | 0<br>0     | Set V <sub>COMH</sub> | Set COM deselect voltage level [reset =3Ch]<br>A[5:2] = <table><tr><th>A[5:2]</th><th>Hex code</th><th>V<sub>COMH</sub></th></tr><tr><td>0000</td><td>00h</td><td>0.51 x V<sub>CC</sub></td></tr><tr><td>0001</td><td>04h</td><td>0.53 x V<sub>CC</sub></td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td></tr><tr><td>1101</td><td>34h</td><td>0.79 x V<sub>CC</sub></td></tr><tr><td>1110</td><td>38h</td><td>0.81 x V<sub>CC</sub></td></tr><tr><td>1111</td><td>3Ch</td><td>0.84 x V<sub>CC</sub></td></tr></table> | A[5:2] | Hex code | V <sub>COMH</sub>  | 0000  | 00h | 0.51 x V <sub>CC</sub> | 0001 | 04h | 0.53 x V <sub>CC</sub> | ⋮     | ⋮   | ⋮                      | 1101 | 34h | 0.79 x V <sub>CC</sub> | 1110 | 38h | 0.81 x V <sub>CC</sub> | 1111 | 3Ch | 0.84 x V <sub>CC</sub> |
| A[5:2]                    | Hex code     | V <sub>COMH</sub>      |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0000                      | 00h          | 0.51 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0001                      | 04h          | 0.53 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| ⋮                         | ⋮            | ⋮                      |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 1101                      | 34h          | 0.79 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 1110                      | 38h          | 0.81 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 1111                      | 3Ch          | 0.84 x V <sub>CC</sub> |            |                     |                     |                     |                     |                     |            |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0<br>1<br>1               | C0           | 1<br>CBTR3             | 1<br>CBTR2 | 0<br>CBTR1          | 0<br>CBTR0          | 0<br>CATR3          | 0<br>CATR2          | 0<br>CATR1          | 0<br>CATR0 | OTP Write             | Program data from MCU to OTP for color co-ordinate tuning. Details refer to section 10.1.22 “OTP Write (C0h)”.                                                                                                                                                                                                                                                                                                                                                                                                   |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0                         | E2           | 1                      | 1          | 1                   | 0                   | 0                   | 0                   | 1                   | 0          | Software Reset        | Reset display circuit and stop Graphic Acceleration operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0                         | E3           | 1                      | 1          | 1                   | 0                   | 0                   | 0                   | 1                   | 1          | NOP                   | Command for no operation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |
| 0<br>1                    | FD<br>A[2]   | 1<br>0                 | 1<br>0     | 1<br>0              | 1<br>1              | 1<br>0              | 1<br>A <sub>2</sub> | 0<br>1              | 1<br>0     | Set Command Lock      | A[2]: MCU protection status [RESET = 12h]<br>A[2] = 0b, Unlock OLED driver IC MCU interface from entering command [RESET]<br><br>A[2] = 1b, Lock OLED driver IC MCU interface from entering command<br><br><b>Note</b><br>(1) The locked OLED driver IC MCU interface prohibits all commands and memory access except the FDh command.                                                                                                                                                                           |        |          |                    |       |     |                        |      |     |                        |       |     |                        |      |     |                        |      |     |                        |      |     |                        |

#### Note

<sup>(1)</sup> “\*” stands for “Don’t care”.

**Graphic Acceleration Command Table**

| D/C# | Hex    | D7             | D6             | D5             | D4             | D3             | D2             | D1             | D0             | Command           | Description                                                                                                                                                                                                                                                                                                                                       |
|------|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | 21     | 0              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Draw Line         | A[7:0] : Column Address of Start<br>B[7:0] : Row Address of Start<br>C[7:0] : Column Address of End<br>D[7:0] : Row Address of End<br>E[5:0] : Color C of the line<br>F[5:0] : Color B of the line<br>G[5:0] : Color A of the line                                                                                                                |
| 1    | A[7:0] | A <sub>7</sub> | A <sub>6</sub> | A <sub>5</sub> | A <sub>4</sub> | A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> |                   | <b>Note</b><br>( <sup>1</sup> ) Please enter all 6 bits for Color setting:<br>E[5:0], F[5:0] and G[5:0] , despite of the color format setting in command A0h                                                                                                                                                                                      |
| 1    | B[7:0] | B <sub>7</sub> | B <sub>6</sub> | B <sub>5</sub> | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | C[7:0] | C <sub>7</sub> | C <sub>6</sub> | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | D[7:0] | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | E[5:0] | *              | *              | E <sub>5</sub> | E <sub>4</sub> | E <sub>3</sub> | E <sub>2</sub> | E <sub>1</sub> | E <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | F[5:0] | *              | *              | F <sub>5</sub> | F <sub>4</sub> | F <sub>3</sub> | F <sub>2</sub> | F <sub>1</sub> | F <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | G[5:0] | *              | *              | G <sub>5</sub> | G <sub>4</sub> | G <sub>3</sub> | G <sub>2</sub> | G <sub>1</sub> | G <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 0    | 22     | 0              | 0              | 1              | 0              | 0              | 0              | 1              | 0              | Drawing Rectangle | A[7:0] : Column Address of Start<br>B[7:0] : Row Address of Start<br>C[7:0] : Column Address of End<br>D[7:0] : Row Address of End<br>E[5:0] : Color C of the line<br>F[5:0] : Color B of the line<br>G[5:0] : Color A of the line<br>H[5:0] : Color C of the fill area<br>I[5:0] : Color B of the fill area<br>J[5:0] : Color A of the fill area |
| 1    | A[7:0] | A <sub>7</sub> | A <sub>6</sub> | A <sub>5</sub> | A <sub>4</sub> | A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> |                   | <b>Note</b><br>( <sup>1</sup> ) Please enter all 6 bits for Color setting:<br>E[5:0], F[5:0] , G[5:0], H[5:0]. I[5:0] and J[5:0] , despite of the color format setting in command A0h<br>( <sup>2</sup> ) 0<A[7:0] < C[7:0] <159<br>( <sup>3</sup> ) 0<B[7:0] < D[7:0] <131                                                                       |
| 1    | B[7:0] | B <sub>7</sub> | B <sub>6</sub> | B <sub>5</sub> | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | C[7:0] | C <sub>7</sub> | C <sub>6</sub> | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | D[7:0] | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | E[5:0] | *              | *              | E <sub>5</sub> | E <sub>4</sub> | E <sub>3</sub> | E <sub>2</sub> | E <sub>1</sub> | E <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | F[5:0] | *              | *              | F <sub>5</sub> | F <sub>4</sub> | F <sub>3</sub> | F <sub>2</sub> | F <sub>1</sub> | F <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | G[5:0] | *              | *              | G <sub>5</sub> | G <sub>4</sub> | G <sub>3</sub> | G <sub>2</sub> | G <sub>1</sub> | G <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | H[5:0] | *              | *              | H <sub>5</sub> | H <sub>4</sub> | H <sub>3</sub> | H <sub>2</sub> | H <sub>1</sub> | H <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | I[5:0] | *              | *              | I <sub>5</sub> | I <sub>4</sub> | I <sub>3</sub> | I <sub>2</sub> | I <sub>1</sub> | I <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | J[5:0] | *              | *              | J <sub>5</sub> | J <sub>4</sub> | J <sub>3</sub> | J <sub>2</sub> | J <sub>1</sub> | J <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 0    | 23     | 0              | 0              | 1              | 0              | 0              | 0              | 1              | 1              | Copy              | A[7:0] : Column Address of Start<br>B[7:0] : Row Address of Start<br>C[7:0] : Column Address of End<br>D[7:0] : Row Address of End<br>E[7:0] : Column Address of New Start<br>F[7:0] : Row Address of New Start                                                                                                                                   |
| 1    | A[7:0] | A <sub>7</sub> | A <sub>6</sub> | A <sub>5</sub> | A <sub>4</sub> | A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | B[7:0] | B <sub>7</sub> | B <sub>6</sub> | B <sub>5</sub> | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | C[7:0] | C <sub>7</sub> | C <sub>6</sub> | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | D[7:0] | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | E[7:0] | E <sub>7</sub> | E <sub>6</sub> | E <sub>5</sub> | E <sub>4</sub> | E <sub>3</sub> | E <sub>2</sub> | E <sub>1</sub> | E <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | F[7:0] | F <sub>7</sub> | F <sub>6</sub> | F <sub>5</sub> | F <sub>4</sub> | F <sub>3</sub> | F <sub>2</sub> | F <sub>1</sub> | F <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 0    | 24     | 0              | 0              | 1              | 0              | 0              | 1              | 0              | 0              | Dim Window        | A[7:0] : Column Address of Start<br>B[7:0] : Row Address of Start<br>C[7:0] : Column Address of End<br>D[7:0] : Row Address of End<br>The effect of dim window:<br>GS15~GS0 no change<br>GS19~GS16 become GS4<br>GS23~GS20 become GS5<br>...<br>GS63~GS60 become GS15                                                                             |
| 1    | A[7:0] | A <sub>7</sub> | A <sub>6</sub> | A <sub>5</sub> | A <sub>4</sub> | A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | B[7:0] | B <sub>7</sub> | B <sub>6</sub> | B <sub>5</sub> | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | C[7:0] | C <sub>7</sub> | C <sub>6</sub> | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |
| 1    | D[7:0] | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                   |                                                                                                                                                                                                                                                                                                                                                   |

| Graphic Acceleration Command Table |        |                |                |                |                |                |                |                |                |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D/C#                               | Hex    | D7             | D6             | D5             | D4             | D3             | D2             | D1             | D0             | Command                                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 0                                  | 25     | 0              | 0              | 1              | 0              | 0              | 1              | 0              | 1              | Clear Window                                     | A[7:0] : Column Address of Start<br>B[7:0] : Row Address of Start<br>C[7:0] : Column Address of End<br>D[7:0] : Row Address of End                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1                                  | A[7:0] | A <sub>7</sub> | A <sub>6</sub> | A <sub>5</sub> | A <sub>4</sub> | A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | B[7:0] | B <sub>7</sub> | B <sub>6</sub> | B <sub>5</sub> | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | C[7:0] | C <sub>7</sub> | C <sub>6</sub> | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | D[7:0] | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 0                                  | 26     | 0              | 0              | 1              | 0              | 0              | 1              | 1              | 0              | Fill Enable / Disable                            | A[0] :<br>0b = Disable Fill for Draw Rectangle Command<br>[reset]<br>1b = Enable Fill for Draw Rectangle Command<br><br>A[3:1] : 000 (Reserved values)<br><br>A[4] :<br>0b = Disable reverse copy (reset)<br>1b = Enable reverse during copy command.                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                                  | A[4:0] | *              | *              | *              | A <sub>4</sub> | 0              | 0              | 0              | A <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 0                                  | 27     | 0              | 0              | 1              | 0              | 0              | 1              | 1              | 1              | Continuous Horizontal & Vertical Scrolling Setup | A[7:0]: Set number of column as horizontal scroll offset<br>Range: 0d-131d ( no horizontal scroll if equals to 0)<br><br>B[7:0]: Define start row address<br><br>C[7:0]: Set number of rows to be horizontal scrolled<br>B[7:0]+C[7:0] <=132<br><br>D[7:0]: Set number of row as vertical scroll offset<br>Range: 0d-131d ( no vertical scroll if equals to 0)<br><br>E[1:0]: Set time interval between each scroll step<br>00b 3 frames<br>01b 5 frames<br>10b 50 frames<br>11b 100 frames<br><br><b>Note:</b><br>(1) Vertical scroll run with command A3h Set Vertical Scroll Area<br>(2) The parameters should not be changed after scrolling is activated |
| 1                                  | A[7:0] | A <sub>7</sub> | A <sub>6</sub> | A <sub>5</sub> | A <sub>4</sub> | A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | B[7:0] | B <sub>7</sub> | B <sub>6</sub> | B <sub>5</sub> | B <sub>4</sub> | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | C[7:0] | C <sub>7</sub> | C <sub>6</sub> | C <sub>5</sub> | C <sub>4</sub> | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | D[7:0] | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1                                  | E[1:0] | *              | *              | *              | *              | *              | *              | E <sub>1</sub> | E <sub>0</sub> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 0                                  | 2E     | 0              | 0              | 1              | 0              | 1              | 1              | 1              | 0              | Deactivate horizontal scroll                     | Deactivate horizontal scrolling.<br><br><b>Note</b><br>(1) After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritten.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Graphic Acceleration Command Table |                        |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------|------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D/C#                               | Hex                    | D7                                    | D6                                    | D5                                    | D4                                    | D3                                    | D2                                    | D1                                    | D0                                    | Command                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 0                                  | 2F                     | 0                                     | 0                                     | 1                                     | 0                                     | 1                                     | 1                                     | 1                                     | 1                                     | Activate horizontal scroll | <p>Activate horizontal scrolling.</p> <p>This command activates the scrolling function according to the setting done by command 27h Continuous Horizontal &amp; Vertical Scrolling Setup</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 0<br>1<br>1                        | A3<br>A[7:0]<br>B[7:0] | 1<br>A <sub>7</sub><br>B <sub>7</sub> | 0<br>A <sub>6</sub><br>B <sub>6</sub> | 1<br>A <sub>5</sub><br>B <sub>5</sub> | 0<br>A <sub>4</sub><br>B <sub>4</sub> | 0<br>A <sub>3</sub><br>B <sub>3</sub> | 0<br>A <sub>2</sub><br>B <sub>2</sub> | 1<br>A <sub>1</sub><br>B <sub>1</sub> | 1<br>A <sub>0</sub><br>B <sub>0</sub> | Set Vertical Scroll Area   | <p>A[7:0] : Set No. of rows in top fixed area. The No. of rows in top fixed area is referenced to the top of the GDDRAM (i.e. row 0). [RESET = 0]</p> <p>B[7:0] : Set No. of rows in scroll area. This is the number of rows to be used for vertical scrolling. The scroll area starts in the first row below the top fixed area. [RESET = 132]</p> <p><b>Note</b></p> <p><sup>(1)</sup> A[7:0]+B[7:0] &lt;= MUX ratio</p> <p><sup>(2)</sup> B[7:0] &lt;= MUX ratio</p> <p><sup>(3)</sup> Set Display Start Line (A1h) must be set to 0 when using A3h command.</p> <p><sup>(4)</sup> The last row of the scroll area shifts to the first row of the scroll area.</p> <p><sup>(5)</sup> For 132d MUX display</p> <p>A[7:0] = 0, B[7:0]=132 : whole area scrolls</p> <p>A[7:0]= 0, B[7:0] &lt; 132 : top area scrolls</p> <p>A[7:0] + B[7:0] &lt; 132 : central area scrolls</p> <p>A[7:0] + B[7:0] = 132 : bottom area scrolls</p> <p>Refer to Figure 10-20 for details.</p> |

## 10 COMMAND DESCRIPTIONS

### 10.1 Fundamental Command

#### 10.1.1 Set Column Address (15h)

This command specifies column start address and end address of the display data RAM. This command also sets the column address pointer to column start address. This pointer is used to define the current read/write column address in graphic display data RAM. If horizontal address increment mode is enabled by command A0h, after finishing read/write one column data, it is incremented automatically to the next column address. Whenever the column address pointer finishes accessing the end column address, it is reset back to start column address.

#### 10.1.2 Write RAM Command (5Ch)

After this single byte command, data entries will be written into the display RAM until another command is written. Address pointer is increased accordingly. This command must be sent before write data into RAM.

#### 10.1.3 Read RAM Command (5Dh)

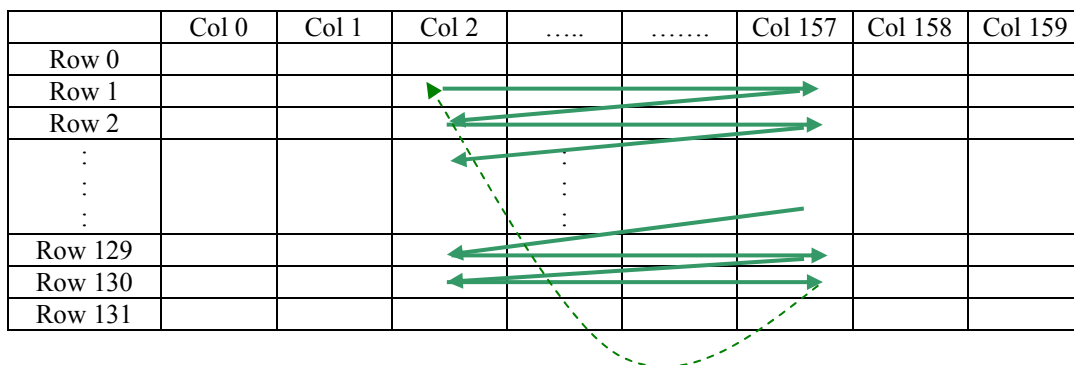
After this single byte command, data is read from display RAM until another command is written. Address pointer is increased accordingly. This command must be sent before read data from RAM.

#### 10.1.4 Set Row Address (75h)

This command specifies row start address and end address of the display data RAM. This command also sets the row address pointer to row start address. This pointer is used to define the current read/write row address in graphic display data RAM. If vertical address increment mode is enabled by command A0h, after finishing read/write one row data, it is incremented automatically to the next row address. Whenever the row address pointer finishes accessing the end row address, it is reset back to start row address.

The figure below shows the way of column and row address pointer movement through the example: column start address is set to 2 and column end address is set to 157, row start address is set to 1 and row end address is set to 130. Horizontal address increment mode is enabled by command A0h. In this case, the graphic display data RAM column accessible range is from column 2 to column 157 and from row 1 to row 130 only. In addition, the column address pointer is set to 2 and row address pointer is set to 1. After finishing read/write one pixel of data, the column address is increased automatically by 1 to access the next RAM location for next read/write operation (*solid line in Figure 10-1*). Whenever the column address pointer finishes accessing the end column 157, it is reset back to column 2 and row address is automatically increased by 1 (*solid line in Figure 10-1*). While the end row 130 and end column 157 RAM location is accessed, the row address is reset back to 1 (*dotted line in Figure 10-1*).

**Figure 10-1 : Example of Column and Row Address Pointer Movement**



### 10.1.5 Set Contrast for Color A, B, C (81h, 82h, 83h)

This command is to set Contrast Setting of each color A, B and C. The chip has three contrast control circuits for color A, B and C. Each contrast circuit has 256 contrast steps from 00h to FFh. The segment output current  $I_{SEG}$  increases with the contrast step, which results in brighter of the color.

### 10.1.6 Master Current Control (87h)

This command is to control the segment output current by a scaling factor. This factor is common to color A, B and C. The chip has 16 master control steps. The factor is ranged from 1 [0000b] to 16 [1111b]. Reset is 16 [1111b]. The smaller the master current value, the dimmer the OLED panel display is set. For example, if original segment output current of a color is 160uA at scale factor = 16, setting scale factor to 8 to reduce the current to 80uA.

### 10.1.7 Set Second Pre-charge speed (8Ah)

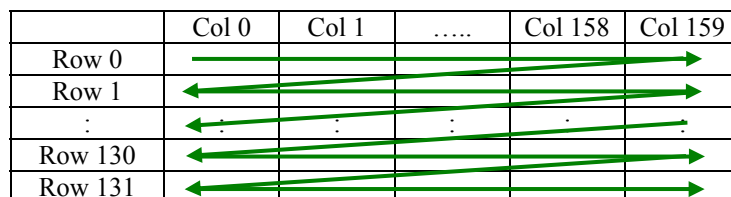
This command is used to set the speed of second pre-charge in phase 3. Please refer to Table 9-1 for the details of setting.

### 10.1.8 Set Re-map & Data Format (A0h)

This command has multiple configurations and each bit setting is described as follows.

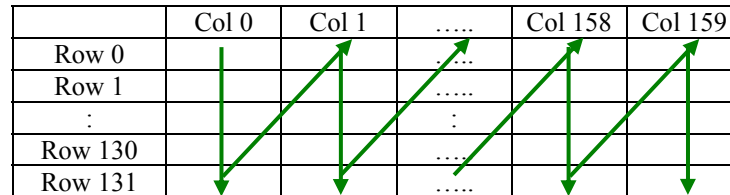
- Address increment mode (A[0])  
When it is set to 0, the driver is set as horizontal address increment mode. After the display RAM is read/written, the column address pointer is increased automatically by 1. If the column address pointer reaches column end address, the column address pointer is reset to column start address and row address pointer is increased by 1. The sequence of movement of the row and column address point for horizontal address increment mode is shown in Figure 10-2.

**Figure 10-2 : Address Pointer Movement of Horizontal Address Increment Mode**



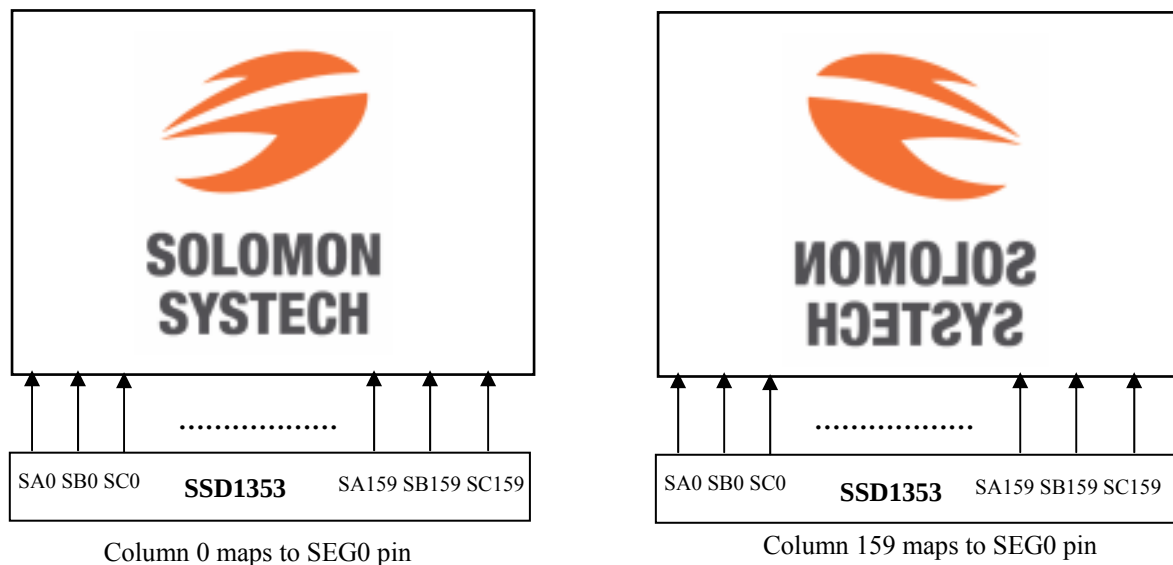
When A[0] is set to 1, the driver is set to vertical address increment mode. After the display RAM is read/written, the row address pointer is increased automatically by 1. If the row address pointer reaches the row end address, the row address pointer is reset to row start address and column address pointer is increased by 1. The sequence of movement of the row and column address point for vertical address increment mode is shown in Figure 10-3.

**Figure 10-3 : Address Pointer Movement of Vertical Address Increment Mode**



- **Column Address Mapping (A[1])**  
This command bit is made for flexible layout of segment signals in OLED module with segment arranged from left to right or vice versa. The display direction is either mapping display data RAM column 0 to SEG0 pin (A[1] = 0), or mapping display data RAM column 159 to SEG0 pin (A[1] = 1). The effects of both are shown in Figure 10-4.

**Figure 10-4 : Example of Column Address Mapping**



- **RGB Mapping (A[2])**  
This command bit is made for flexible layout of segment signals in OLED module to match filter design.
- **COM Left / Right Remap (A[3])**  
This command bit is made for flexible layout of common signals in OLED module with common 0 arranged on either left or right side. Details of pin arrangement can be found in Figure 10-5.

- **COM scan direction Remap (A[4])**  
This bit determines the scanning direction of the common for flexible layout of common signals in OLED module either from up to down or vice versa. Details of pin arrangement can be found in Figure 10-5.
- **Odd even split of COM pins (A[5])**  
This bit can set the odd even arrangement of COM pins.  
A[5] = 0: Disable COM split odd even, pin assignment of common is in sequential as  
COM131 COM130 .... COM 67 COM66..SC159...SA0..COM0 COM1.... COM64 COM65  
A[5] = 1: Enable COM split odd even, pin assignment of common is in odd even split as  
COM131 COM129.... COM3 COM1..SC159..SA0..COM0 COM2.... COM128 COM130  
Details of pin arrangement can be found in Figure 10-5.
- **Display color mode (A[7:6])**  
Select either 65k or 256 color mode. The display RAM data format in different mode is described in section 8.3.

**Figure 10-5 : COM Pins Hardware Configuration (MUX ratio: 132)**

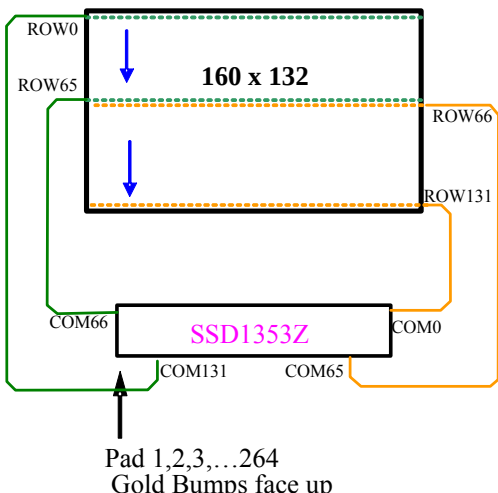
| Case and Conditions |  |  | COM pins Configurations |  |
|---------------------|--|--|-------------------------|--|
| A                   |  |  |                         |  |



C

|                                    |                                          |                                |
|------------------------------------|------------------------------------------|--------------------------------|
| A[5]=0                             | A[4]=1                                   | A[3]=0                         |
| Disable Odd Even Split of COM pins | COM Scan Direction : from COM131 to COM0 | Disable COM Left / Right Remap |

| Pin name | Panel   |
|----------|---------|
| COM 0    | Row 131 |
| COM 1    | Row 130 |
| COM 2    | Row 129 |
| ... ..   | ... ..  |
| COM 64   | Row 67  |
| COM 65   | Row 66  |
| COM 66   | Row 65  |
| COM 67   | Row 64  |
| ...      | ... ..  |
| COM 129  | Row 2   |
| COM 130  | Row 1   |
| COM 131  | Row 0   |

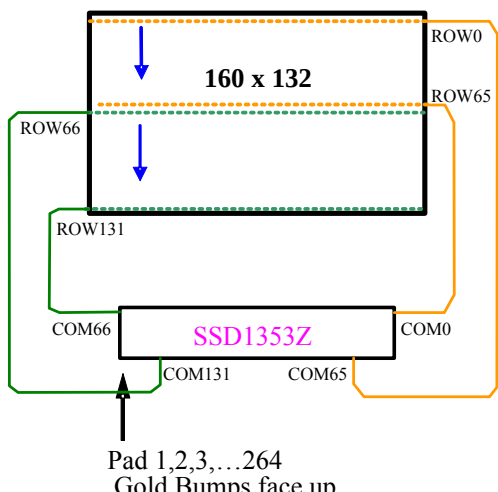


Pad 1,2,3,...264  
Gold Bumps face up

D

|                                    |                                          |                               |
|------------------------------------|------------------------------------------|-------------------------------|
| A[5]=0                             | A[4]=1                                   | A[3]=1                        |
| Disable Odd Even Split of COM pins | COM Scan Direction : from COM131 to COM0 | Enable COM Left / Right Remap |

| Pin name | Panel   |
|----------|---------|
| COM 0    | Row 65  |
| COM 1    | Row 64  |
| COM 2    | Row 63  |
| ... ..   | ... ..  |
| COM 64   | Row 1   |
| COM 65   | Row 0   |
| COM 66   | Row 131 |
| COM 67   | Row 130 |
| ...      | ... ..  |
| COM 129  | Row 68  |
| COM 130  | Row 67  |
| COM 131  | Row 66  |

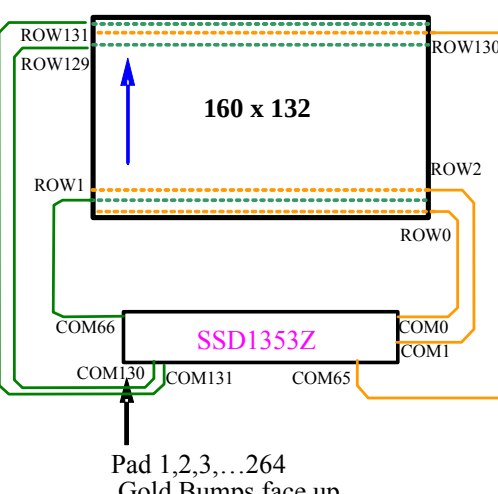


Pad 1,2,3,...264  
Gold Bumps face up

E

|                                   |                                          |                                |
|-----------------------------------|------------------------------------------|--------------------------------|
| A[5]=1                            | A[4]=0                                   | A[3]=0                         |
| Enable Odd Even Split of COM pins | COM Scan Direction : from COM0 to COM131 | Disable COM Left / Right Remap |

| Pin name | Panel   |
|----------|---------|
| COM 0    | Row 0   |
| COM 1    | Row 2   |
| COM 2    | Row 4   |
| ... ..   | ... ..  |
| COM 64   | Row 128 |
| COM 65   | Row 130 |
| COM 66   | Row 1   |
| COM 67   | Row 3   |
| ...      | ... ..  |
| COM 129  | Row 127 |
| COM 130  | Row 129 |
| COM 131  | Row 131 |



Pad 1,2,3,...264  
Gold Bumps face up



### 10.1.9 Set Display Start Line (A1h)

This command is to set Display Start Line register to determine starting address of display RAM to be displayed by selecting a value from 0 to 131. The figure below shows an example of this command. In there, “Row” means the graphic display data RAM row.

**Figure 10-6 : Example of Set Display Start Line with no Remap**

|                 | 132                                                                                 | 132                                                                                 | 100                                                                                 | 100                                                                                   | MUX ratio (A8h)                                                                       |
|-----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| COM Pin         | 0                                                                                   | 32                                                                                  | 0                                                                                   | 32                                                                                    | Display start line (A1h)                                                              |
| COM0            | Row0                                                                                | Row32                                                                               | Row0                                                                                | Row32                                                                                 |                                                                                       |
| COM1            | Row1                                                                                | Row33                                                                               | Row1                                                                                | Row33                                                                                 |                                                                                       |
| COM2            | Row2                                                                                | Row34                                                                               | Row2                                                                                | Row34                                                                                 |                                                                                       |
| COM3            | Row3                                                                                | Row35                                                                               | Row3                                                                                | Row35                                                                                 |                                                                                       |
| COM4            | Row4                                                                                | Row36                                                                               | Row4                                                                                | Row36                                                                                 |                                                                                       |
| COM5            | Row5                                                                                | Row37                                                                               | Row5                                                                                | Row37                                                                                 |                                                                                       |
| COM6            | Row6                                                                                | Row38                                                                               | Row6                                                                                | Row38                                                                                 |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| COM95           | Row95                                                                               | Row127                                                                              | Row95                                                                               | Row128                                                                                |                                                                                       |
| COM96           | Row96                                                                               | Row128                                                                              | Row96                                                                               | Row129                                                                                |                                                                                       |
| COM97           | Row97                                                                               | Row129                                                                              | Row97                                                                               | Row130                                                                                |                                                                                       |
| COM98           | Row98                                                                               | Row130                                                                              | Row98                                                                               | Row131                                                                                |                                                                                       |
| COM99           | Row99                                                                               | Row131                                                                              | Row99                                                                               | Row0                                                                                  |                                                                                       |
| COM100          | Row100                                                                              | Row0                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM101          | Row101                                                                              | Row1                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM102          | Row102                                                                              | Row2                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM103          | Row103                                                                              | Row3                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM104          | Row104                                                                              | Row4                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM105          | Row105                                                                              | Row5                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM106          | Row106                                                                              | Row6                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM107          | Row107                                                                              | Row7                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM108          | Row108                                                                              | Row8                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM109          | Row109                                                                              | Row9                                                                                | -                                                                                   | -                                                                                     |                                                                                       |
| COM110          | Row110                                                                              | Row10                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM111          | Row111                                                                              | Row11                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM112          | Row112                                                                              | Row12                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM113          | Row113                                                                              | Row13                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM114          | Row114                                                                              | Row14                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM115          | Row115                                                                              | Row15                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM116          | Row116                                                                              | Row16                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM117          | Row117                                                                              | Row17                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM118          | Row118                                                                              | Row18                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM119          | Row119                                                                              | Row19                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM120          | Row120                                                                              | Row20                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM121          | Row121                                                                              | Row21                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM122          | Row122                                                                              | Row22                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM123          | Row123                                                                              | Row23                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM124          | Row124                                                                              | Row24                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM125          | Row125                                                                              | Row25                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM126          | Row126                                                                              | Row26                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM127          | Row127                                                                              | Row27                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM128          | Row128                                                                              | Row28                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM129          | Row129                                                                              | Row29                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM130          | Row130                                                                              | Row30                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| COM131          | Row131                                                                              | Row31                                                                               | -                                                                                   | -                                                                                     |                                                                                       |
| Display example |  |  |  |  |  |
|                 | (a)                                                                                 | (b)                                                                                 | (c)                                                                                 | (d)                                                                                   | (GDDARAM)                                                                             |

### 10.1.10 Set Display Offset (A2h)

This command specifies the mapping of display start line (it is assumed that COM0 is the display start line, display start line register equals to 0) to one of COM0-131. For example, to move the COM16 towards the COM0 direction for 16 lines, the 6-bit data in the second command should be given by 0010000. The figure below shows an example of this command. In there, “Row” means the graphic display data RAM row.

**Figure 10-7 : Example of Set Display Offset with no Remap**

|                 | 132                                                                                 | 132                                                                                 | 100                                                                                 | 100                                                                                   | MUX ratio (A8h)                                                                       |
|-----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| COM Pin         | 0                                                                                   | 32                                                                                  | 0                                                                                   | 32                                                                                    | Display offset (A2h)                                                                  |
| COM0            | Row0                                                                                | Row32                                                                               | Row0                                                                                | Row32                                                                                 |                                                                                       |
| COM1            | Row1                                                                                | Row33                                                                               | Row1                                                                                | Row33                                                                                 |                                                                                       |
| COM2            | Row2                                                                                | Row34                                                                               | Row2                                                                                | Row34                                                                                 |                                                                                       |
| COM3            | Row3                                                                                | Row35                                                                               | Row3                                                                                | Row35                                                                                 |                                                                                       |
| COM4            | Row4                                                                                | Row36                                                                               | Row4                                                                                | Row36                                                                                 |                                                                                       |
| COM5            | Row5                                                                                | Row37                                                                               | Row5                                                                                | Row37                                                                                 |                                                                                       |
| COM6            | Row6                                                                                | Row38                                                                               | Row6                                                                                | Row38                                                                                 |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| COM66           | Row66                                                                               | Row98                                                                               | Row66                                                                               | Row98                                                                                 |                                                                                       |
| COM67           | Row67                                                                               | Row99                                                                               | Row67                                                                               | Row99                                                                                 |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| :               | :                                                                                   | :                                                                                   | :                                                                                   | :                                                                                     |                                                                                       |
| COM95           | Row95                                                                               | Row127                                                                              | Row95                                                                               | -                                                                                     |                                                                                       |
| COM96           | Row96                                                                               | Row128                                                                              | Row96                                                                               | -                                                                                     |                                                                                       |
| COM97           | Row97                                                                               | Row129                                                                              | Row97                                                                               | -                                                                                     |                                                                                       |
| COM98           | Row98                                                                               | Row130                                                                              | Row98                                                                               | -                                                                                     |                                                                                       |
| COM99           | Row99                                                                               | Row131                                                                              | Row99                                                                               | Row0                                                                                  |                                                                                       |
| COM100          | Row100                                                                              | Row0                                                                                | -                                                                                   | Row1                                                                                  |                                                                                       |
| COM101          | Row101                                                                              | Row1                                                                                | -                                                                                   | Row2                                                                                  |                                                                                       |
| COM102          | Row102                                                                              | Row2                                                                                | -                                                                                   | Row3                                                                                  |                                                                                       |
| COM103          | Row103                                                                              | Row3                                                                                | -                                                                                   | Row4                                                                                  |                                                                                       |
| COM104          | Row104                                                                              | Row4                                                                                | -                                                                                   | Row5                                                                                  |                                                                                       |
| COM105          | Row105                                                                              | Row5                                                                                | -                                                                                   | Row6                                                                                  |                                                                                       |
| COM106          | Row106                                                                              | Row6                                                                                | -                                                                                   | Row7                                                                                  |                                                                                       |
| COM107          | Row107                                                                              | Row7                                                                                | -                                                                                   | Row8                                                                                  |                                                                                       |
| COM108          | Row108                                                                              | Row8                                                                                | -                                                                                   | Row9                                                                                  |                                                                                       |
| COM109          | Row109                                                                              | Row9                                                                                | -                                                                                   | Row10                                                                                 |                                                                                       |
| COM110          | Row110                                                                              | Row10                                                                               | -                                                                                   | Row11                                                                                 |                                                                                       |
| COM111          | Row111                                                                              | Row11                                                                               | -                                                                                   | Row12                                                                                 |                                                                                       |
| COM112          | Row112                                                                              | Row12                                                                               | -                                                                                   | Row13                                                                                 |                                                                                       |
| COM113          | Row113                                                                              | Row13                                                                               | -                                                                                   | Row14                                                                                 |                                                                                       |
| COM114          | Row114                                                                              | Row14                                                                               | -                                                                                   | Row15                                                                                 |                                                                                       |
| COM115          | Row115                                                                              | Row15                                                                               | -                                                                                   | Row16                                                                                 |                                                                                       |
| COM116          | Row116                                                                              | Row16                                                                               | -                                                                                   | Row17                                                                                 |                                                                                       |
| COM117          | Row117                                                                              | Row17                                                                               | -                                                                                   | Row18                                                                                 |                                                                                       |
| COM118          | Row118                                                                              | Row18                                                                               | -                                                                                   | Row19                                                                                 |                                                                                       |
| COM119          | Row119                                                                              | Row19                                                                               | -                                                                                   | Row21                                                                                 |                                                                                       |
| COM120          | Row120                                                                              | Row20                                                                               | -                                                                                   | Row20                                                                                 |                                                                                       |
| COM121          | Row121                                                                              | Row21                                                                               | -                                                                                   | Row22                                                                                 |                                                                                       |
| COM122          | Row122                                                                              | Row22                                                                               | -                                                                                   | Row23                                                                                 |                                                                                       |
| COM123          | Row123                                                                              | Row23                                                                               | -                                                                                   | Row22                                                                                 |                                                                                       |
| COM124          | Row124                                                                              | Row24                                                                               | -                                                                                   | Row24                                                                                 |                                                                                       |
| COM125          | Row125                                                                              | Row25                                                                               | -                                                                                   | Row25                                                                                 |                                                                                       |
| COM126          | Row126                                                                              | Row26                                                                               | -                                                                                   | Row26                                                                                 |                                                                                       |
| COM127          | Row127                                                                              | Row27                                                                               | -                                                                                   | Row27                                                                                 |                                                                                       |
| COM128          | Row128                                                                              | Row28                                                                               | -                                                                                   | Row28                                                                                 |                                                                                       |
| COM129          | Row129                                                                              | Row29                                                                               | -                                                                                   | Row29                                                                                 |                                                                                       |
| COM130          | Row130                                                                              | Row30                                                                               | -                                                                                   | Row30                                                                                 |                                                                                       |
| COM131          | Row131                                                                              | Row31                                                                               | -                                                                                   | Row31                                                                                 |                                                                                       |
| Display example |  |  |  |  |  |
|                 | (a)                                                                                 | (b)                                                                                 | (c)                                                                                 | (d)                                                                                   | (GDDARAM)                                                                             |

### 10.1.11 Set Display Mode (A4h ~ A7h)

These are single byte command and they are used to set Normal Display, Entire Display ON, Entire Display OFF and Inverse Display.

- Normal Display (A4h)  
Reset the above effect and turn the data to ON at the corresponding gray level. Figure 10-8 shows an example of Normal Display.

**Figure 10-8 : Example of Normal Display**



- Set Entire Display ON (A5h)  
Forces the entire display to be at “GS63” regardless of the contents of the display data RAM as shown in Figure 10-9.

**Figure 10-9 : Example of Entire Display ON**



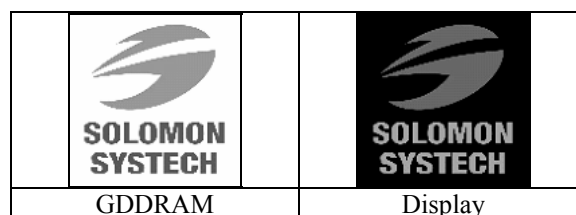
- Set Entire Display OFF (A6h)  
Forces the entire display to be at gray level “GS0” regardless of the contents of the display data RAM as shown in Figure 10-10.

**Figure 10-10 : Example of Entire Display OFF**



- Inverse Display (A7h)  
The gray level of display data are swapped such that “GS0” <-> “GS63”, “GS1” <-> “GS62”, .....  
Figure 10-11 shows an example of inverse display.

**Figure 10-11 : Example of Inverse Display**



### 10.1.12 Set Multiplex Ratio (A8h)

This command switches default 1:132 multiplex mode to any multiplex mode from 16 to 132. For example, when multiplex ratio is set to 16, only 16 common pins are enabled. The starting and the ending of the enabled common pins are depended on the setting of “Display Offset” register programmed by command A2h. Figure 10-6 and Figure 10-7 show examples of setting the multiplex ratio through command A8h.

### 10.1.13 Dim mode setting (ABh)

This command contains multiple bits to configure the dim mode display parameters. Contrast setting of color A, B, C and precharge voltage can be set different to normal mode (AFh).

### 10.1.14 Set Display ON/OFF (ACh / AEh / AFh)

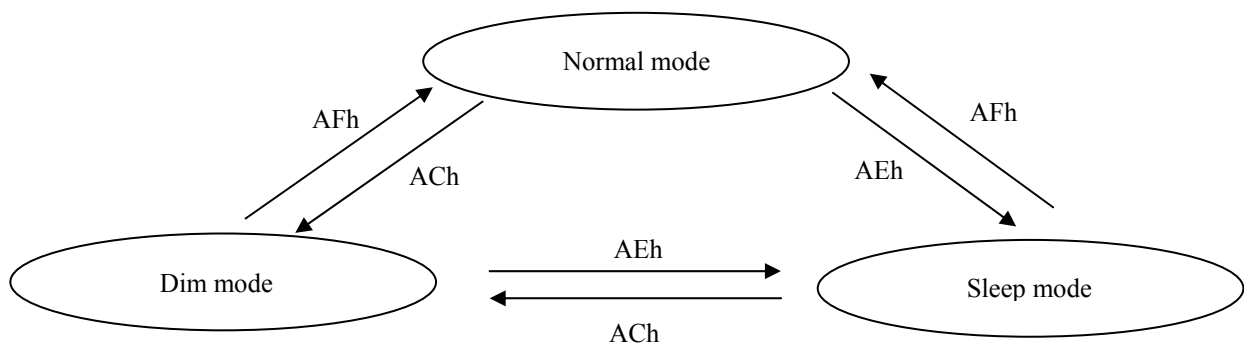
These single byte commands are used to turn the OLED panel display ON or OFF. When the display is ON, the selected circuits by Set Master Configuration command will be turned ON. When the display is OFF, those circuits will be turned off, the segment is in  $V_{SS}$  state and common is in high impedance state.

These commands set the display to one of the three states:

- o ACh : Dim Mode Display ON
- o AEh : Display OFF
- o AFh : Normal Brightness Display ON

where the dim mode settings are controlled by command ABh.

Figure 10-12 : Transition between different modes



### 10.1.15 Phase 1 and 2 Period Adjustment (B1h)

This command sets the length of phase 1 and 2 of segment waveform of the driver.

- Phase 1 (A[3:0]): Set the period from 3 to 31 in the unit of 2 DCLKs. A larger capacitance of the OLED pixel may require longer period to discharge the previous data charge completely.
- Phase 2 (A[7:4]): Set the period from 2 to 15 in the unit of DCLKs. A longer period is needed to charge up a larger capacitance of the OLED pixel to the target voltage  $V_p$  for color A, B and C.

### 10.1.16 Set Display Clock Divide Ratio/ Oscillator Frequency (B3h)

This command consists of two functions:

- Display Clock Divide Ratio (A[3:0])  
Set the divide ratio to generate DCLK (Display Clock) from CLK. The divide ratio is from 1 to 16, with reset value = 1. Please refer to section 8.5.1 for the details relationship of DCLK and CLK.

- Oscillator Frequency (A[7:4])  
Program the oscillator frequency Fosc which is the source of CLK if CLS pin is pulled HIGH. The 4-bit value results in 16 different frequency setting available.

#### 10.1.17 Set Second Pre-charge period (B4h)

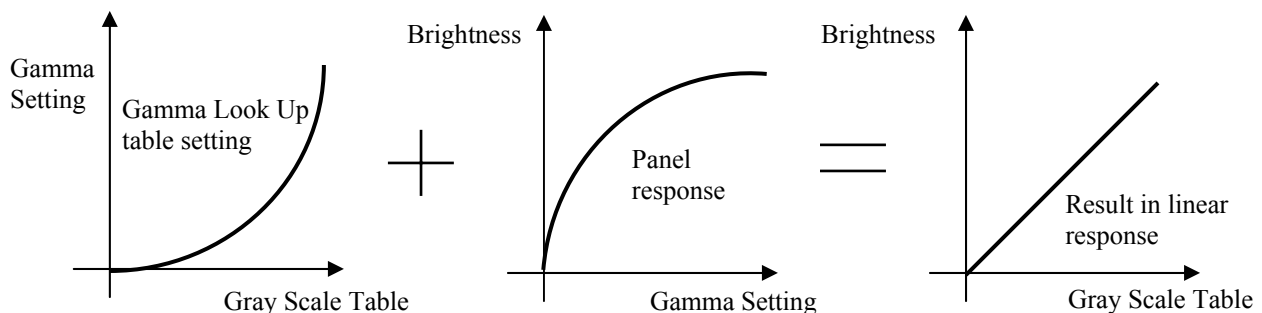
This double byte command is used to set the phase 3 second pre-charge period. The period of phase 3 can be programmed by command B4h and it is ranged from 0 to 15 DCLK's. Please refer to Table 9-1 for the details of setting.

#### 10.1.18 Set Gray Scale Table (B8h)

This command is used to set the Gray Scale (GS) table for the display. Except GS0, which is zero as it has no pre-charge and current drive, each entry GS level is programmed in the Gamma Setting. The larger value of Gamma Setting, the brighter is the OLED pixel when it's turned ON. Following the command B8h, the user has to set the Gamma Setting for GS1, GS2, GS3, ..., GS61, GS62, GS63 one by one in sequence. Refer to Section 8.8 for details.

The setting of Gray Scale entry can perform Gamma correction on OLED panel display. Normally, it is desired that the brightness response of the panel is linearly proportional to the image data value in display data RAM. However, the OLED panel is somehow responded in non-linear way. Appropriate Gray Scale table setting like example below can compensate this effect.

**Figure 10-13 : Example of Gamma correction by Gamma Look Up table setting**



#### 10.1.19 Enable Linear Gray Scale Table (B9h)

This command reloads the preset linear Gray Scale table as GS0 = Gamma Setting 0, GS1 = Gamma Setting 2, GS2 = Gamma Setting 4, ..., GS31 = Gamma Setting 62, GS32 = Gamma Setting 65, GS33 = Gamma Setting 67, ..., GS62 = Gamma Setting 125, GS63 = Gamma Setting 127. Refer to Section 8.8 for details.

#### 10.1.20 Set Pre- charge voltage (BBh)

This command sets the pre-charge voltage level of segment pins, The level of pre-charge is programmed with reference to  $V_{CC}$ .

#### 10.1.21 Set $V_{COMH}$ Voltage (BEh)

This command sets the high voltage level of common pins,  $V_{COMH}$ . The level of  $V_{COMH}$  is programmed with reference to  $V_{CC}$ .

### 10.1.22 OTP Write (C0h)

In SSD1353, the command C0h is used to program data from MCU to OTP. The following is the way to use the C0h command:

#### Stage 1 OTP offset Finding

- [1]. Hardware Reset (sending an active low reset pulse to RES# pin)
- [2]. Send original initialization routines
- [3]. Set and display any test patterns
- [4]. Adjust the color coordinate value through command C0h until there is the best visual performance

**Table 10-1 : Command table of Colour Coordination Tuning (C0h)**

| CO H                      | RGBCOORT (Colour Coordination Tuning )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-----|------------------------------------|--------|------|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|--------|
|                           | D/C#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RD#    | WR# | D7    | D6    | D5    | D4    | D3    | D2    | D1    | D0    | HEX |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
| Command                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1      | 0   | 1     | 1     | 0     | 0     | 0     | 0     | 0     | 0     | C0  |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
| 1 <sup>st</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1      | 0   | CBTR3 | CBTR2 | CBTR1 | CBTR0 | CATR3 | CATR2 | CATR1 | CATR0 | xx  |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
| 2 <sup>nd</sup> Parameter | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1      | 0   | xx    | xx    | xx    | xx    | CCTR3 | CCTR2 | CCTR1 | CCTR0 | xx  |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
| Description               | This command is used for testing and emulation of the color co-ordinate tuning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | <table><tr><th>CATR [3:0], CBTR [3:0], CATR [3:0]</th><th>Tuning</th></tr><tr><td>0000</td><td>0</td></tr><tr><td>0001</td><td>1/32</td></tr><tr><td>0010</td><td>2/32</td></tr><tr><td>0011</td><td>3/32</td></tr><tr><td>0100</td><td>4/32</td></tr><tr><td>0101</td><td>5/32</td></tr><tr><td>0110</td><td>6/32</td></tr><tr><td>0111</td><td>7/32</td></tr><tr><td>1000</td><td>- 8/32</td></tr><tr><td>1001</td><td>- 7/32</td></tr><tr><td>1010</td><td>- 6/32</td></tr><tr><td>1011</td><td>- 5/32</td></tr><tr><td>1100</td><td>- 4/32</td></tr><tr><td>1101</td><td>- 3/32</td></tr><tr><td>1110</td><td>- 2/32</td></tr><tr><td>1111</td><td>- 1/32</td></tr></table> |        |     |       |       |       |       |       |       |       |       |     | CATR [3:0], CBTR [3:0], CATR [3:0] | Tuning | 0000 | 0 | 0001 | 1/32 | 0010 | 2/32 | 0011 | 3/32 | 0100 | 4/32 | 0101 | 5/32 | 0110 | 6/32 | 0111 | 7/32 | 1000 | - 8/32 | 1001 | - 7/32 | 1010 | - 6/32 | 1011 | - 5/32 | 1100 | - 4/32 | 1101 | - 3/32 | 1110 | - 2/32 | 1111 | - 1/32 |
|                           | CATR [3:0], CBTR [3:0], CATR [3:0]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Tuning |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0      |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0010                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0011                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0101                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 5/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 6/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 0111                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 7/32   |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 8/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 7/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1010                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 6/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1011                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 5/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 4/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1101                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 3/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 2/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |
|                           | 1111                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | - 1/32 |     |       |       |       |       |       |       |       |       |     |                                    |        |      |   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |        |      |        |      |        |      |        |      |        |      |        |      |        |      |        |

- [5]. Record down fine-tuned color coordinate value for stage 2.



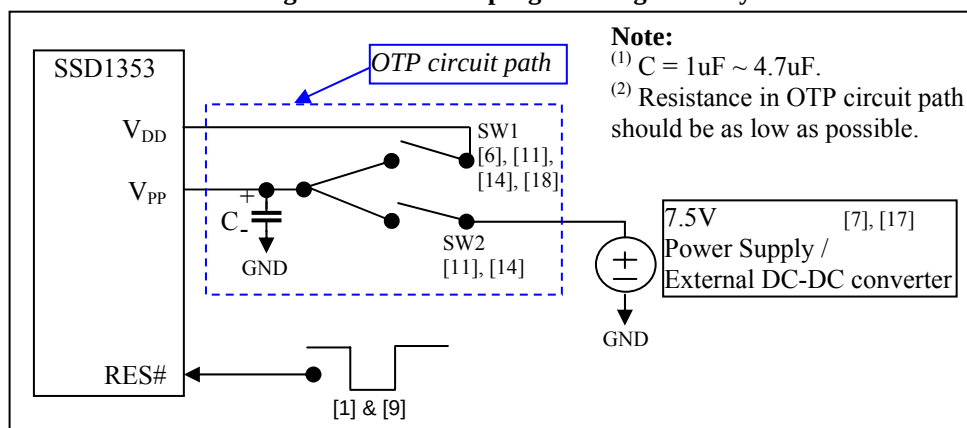
## Stage 2 OTP programming

- [6]. Connect  $V_{PP}$  externally by closing SW1 (see Figure 10-14 below)
- [7]. Power ON  $V_{PP}$  and wait for 500 us
- [8]. Power ON  $V_{DD}$  (regulated internally or supplied externally) and wait for 500 us
- [9]. Hardware Reset (sending an active low reset pulse to RES# pin)
- [10]. Send command C0h OTP Write and wait for 10ns
- [11]. Open SW1 and then close SW2
- [12]. Send 2 bytes data (from step [5] in stage 1) at frequency ~10KHz (9.5KHz ~10.5KHz) as follow:

| Data byte            | Content                                 | Bit7  | Bit6  | Bit5  | Bit4  | Bit3  | Bit2  | Bit1  | Bit0  |
|----------------------|-----------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 <sup>st</sup> byte | Color coordinate value from step [5] in | CBTR3 | CBTR2 | CBTR1 | CBTR0 | CATR3 | CATR2 | CATR1 | CATR0 |
| 2 <sup>nd</sup> byte | stage 1                                 | xx    | xx    | xx    | xx    | CCTR3 | CCTR2 | CCTR1 | CCTR0 |

- [13]. Send dummy byte 00h and wait for 500 us
- [14]. Open SW2 and then close SW1
- [15]. Send dummy byte 00h and wait for 500 us
- [16]. Power OFF  $V_{DD}$  and wait for 500 us
- [17]. Power OFF  $V_{PP}$  and wait for 500 us
- [18]. Open SW1
- [19]. Verify the result by repeating Stage 1. [2] – [3]

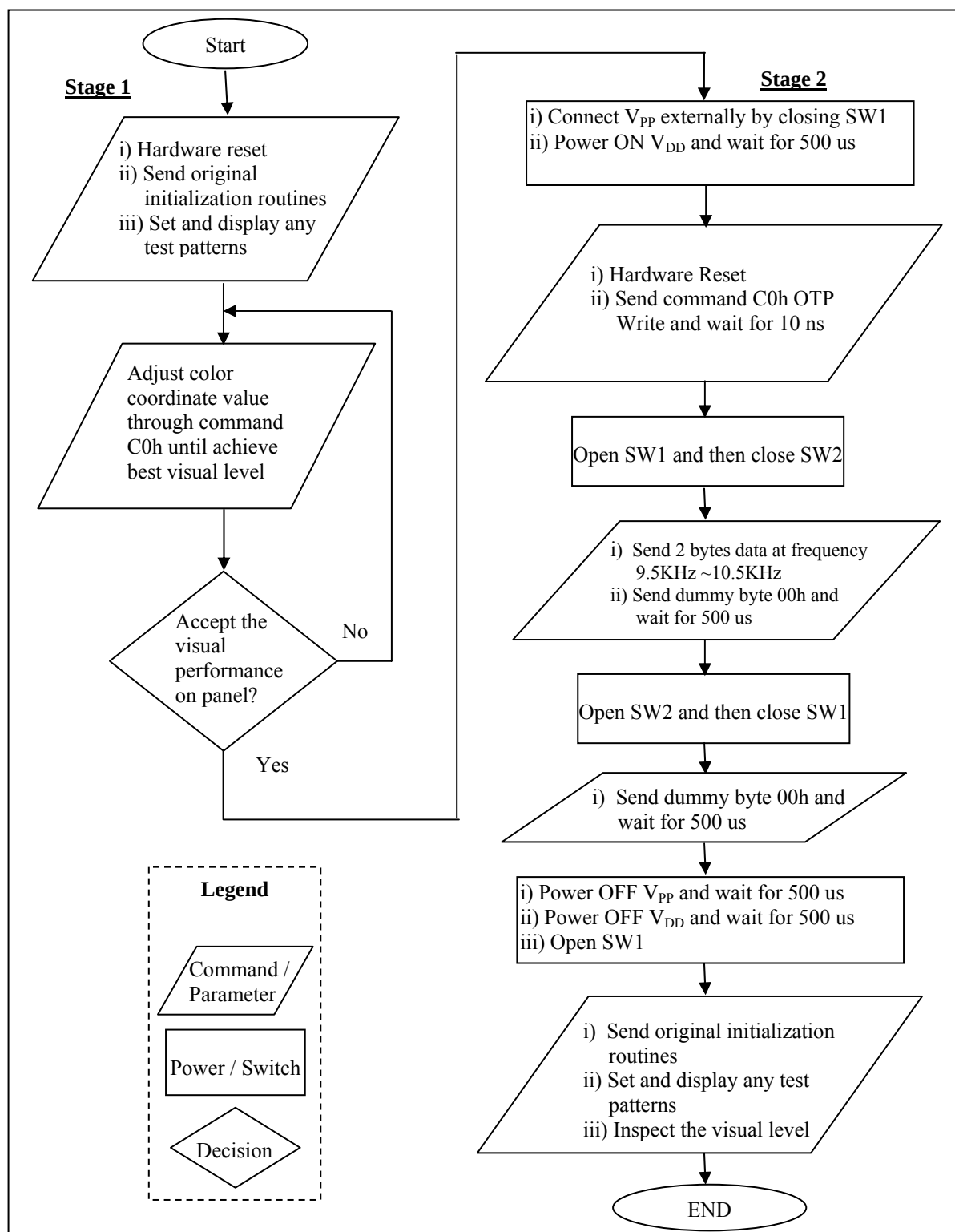
**Figure 10-14 : OTP programming circuitry**



## Note

- <sup>(1)</sup> In operation mode (without programming OTP),  $V_{PP}$  must be connected to  $V_{DD}$ .

**Figure 10-15 - Flow chart of OTP programming Procedure**



### **10.1.23 Software Reset (E2h)**

This command resets the display circuit and stops the Graphic Acceleration operations by generating an internal reset pulse.

### **10.1.24 NOP (E3h)**

This is the no operation command.

### **10.1.25 Set Command Lock (FDh)**

This command is used to lock the OLED driver IC from accepting any command except itself. After entering FDh 16h (A[2]=1b), the OLED driver IC will not respond to any newly-entered command (except FDh 12h A[2]=0b) and there will be no memory access. This is call “Lock” state. That means the OLED driver IC ignore all the commands (except FDh 12h A[2]=0b) during the “Lock” state.

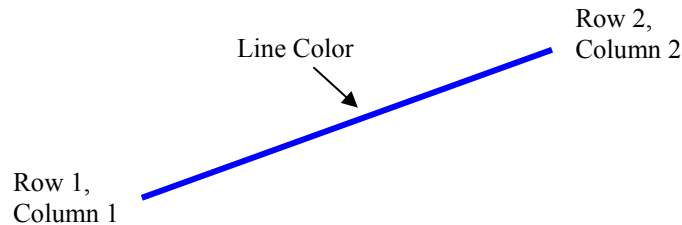
Entering FDh 12h (A[2]=0b) can unlock the OLED driver IC. That means the driver IC resume from the “Lock” state. And the driver IC will then respond to the command and memory access.

## 10.2 Graphic Acceleration Command

### 10.2.1 Draw Line (21h)

This command draws a line by the given start, end column and row coordinates and the color of the line.

**Figure 10-16 : Example of Draw Line Command**



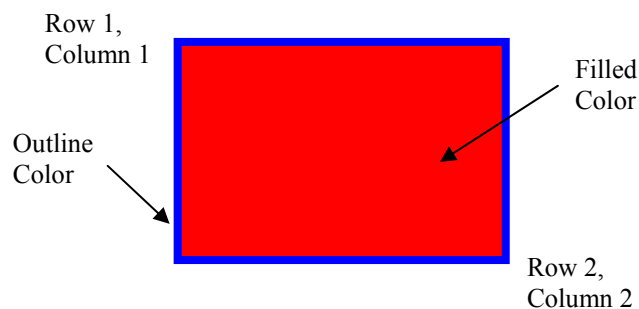
For example, the line above can be drawn by the following command sequence.

1. Enter into draw line mode by command 21h
2. Send column start address of line, column1, for example = 1h
3. Send row start address of line, row 1, for example = 10h
4. Send column end address of line, column 2, for example = 28h
5. Send row end address of line, row 2, for example = 4h
6. Send color C, B and A of line, for example = (3Fh, 0h, 0h)

### 10.2.2 Draw Rectangle (22h)

Given the starting point (Row 1, Column 1) and the ending point (Row 2, Column 2), specify the outline and fill area colors, a rectangle that will be drawn with the color specified. Remarks: If fill color option is disabled (refer to command 26h Fill Enable/Disable), the enclosed area will not be filled.

**Figure 10-17 : Example of Draw Rectangle Command**



The following example illustrates the rectangle drawing command sequence.

1. Enter the “draw rectangle mode” by execute the command 22h
2. Set the starting column coordinates, Column 1, for example = 03h
3. Set the starting row coordinates, Row 1, for example = 02h
4. Set the finishing column coordinates, Column 2, for example = 12h
5. Set the finishing row coordinates, Row 2, for example = 15h
6. Set the outline color C, B and A, for example = (63d, 0d, 0d)
7. Set the filled color C, B and A, for example = (0d, 0d, 63d)

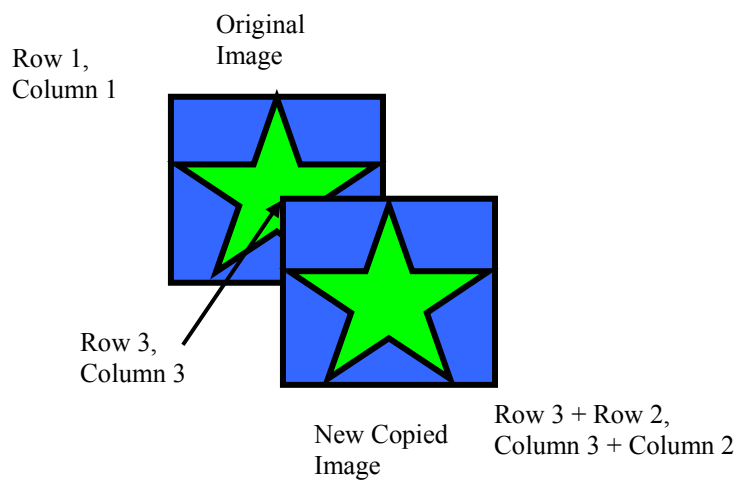
### 10.2.3 Copy (23h)

Copy the rectangular region defined by the starting point (Row 1, Column 1) and the ending point (Row 2, Column 2) to location (Row 3, Column 3). If the new coordinates are smaller than the ending points, the new image will overlap the original one.

The following example illustrates the copy procedure.

1. Enter the “copy mode” by execute the command 23h
2. Set the starting column coordinates, Column 1, for example = 00h.
3. Set the starting row coordinates, Row 1, for example = 00h.
4. Set the finishing column coordinates, Column 2, for example = 05h
5. Set the finishing row coordinates, Row 2, for example = 05h
6. Set the new column coordinates, Column 3, for example = 03h
7. Set the new row coordinates, Row 3, for example = 03h

**Figure 10-18 : Example of Copy Command**



### 10.2.4 Dim Window (24h)

This command will dim the window area specify by starting point (Row 1, Column 1) and the ending point (Row 2, Column 2). After the execution of this command, the selected window area will become darker as follow.

**Table 10-2 : Result of Change of Brightness by Dim Window Command**

| Original gray scale | New gray scale after dim window command |
|---------------------|-----------------------------------------|
| GS0 ~ GS15          | No change                               |
| GS16 ~ GS19         | GS4                                     |
| GS20 ~ GS23         | GS5                                     |
| :                   | :                                       |
| GS60 ~ GS63         | GS15                                    |

Additional execution of this command over the same window area will not change the data content.

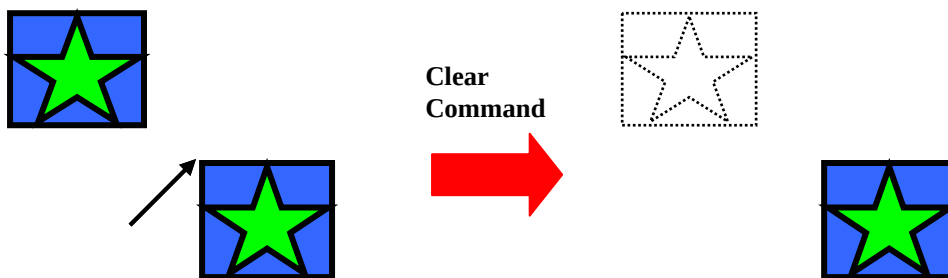
### 10.2.5 Clear Window (25h)

This command sets the window area specify by starting point (Row 1, Column 1) and the ending point (Row 2, Column 2) to clear the window display. The graphic display data RAM content of the specified window area will be set to zero.

This command can be combined with Copy command to make as a “move” result. The following example illustrates the copy plus clear procedure and results in moving the window object.

1. Enter the “copy mode” by execute the command 23h
2. Set the starting column coordinates, Column 1, for example = 00h.
3. Set the starting row coordinates, Row 1, for example = 00h.
4. Set the finishing column coordinates, Column 2, for example = 05h
5. Set the finishing row coordinates, Row 2, for example = 05h
6. Set the new column coordinates, Column 3, for example = 06h
7. Set the new row coordinates, Row 3, for example = 06h
8. Enter the “clear mode” by execute the command 24h
9. Set the starting column coordinates, Column 1, for example = 00h.
10. Set the starting row coordinates, Row 1, for example = 00h.
11. Set the finishing column coordinates, Column 2, for example = 05h
12. Set the finishing row coordinates, Row 2, for example = 05h

**Figure 10-19 : Example of Copy + Clear = Move Command**



### 10.2.6 Fill Enable/Disable (26h)

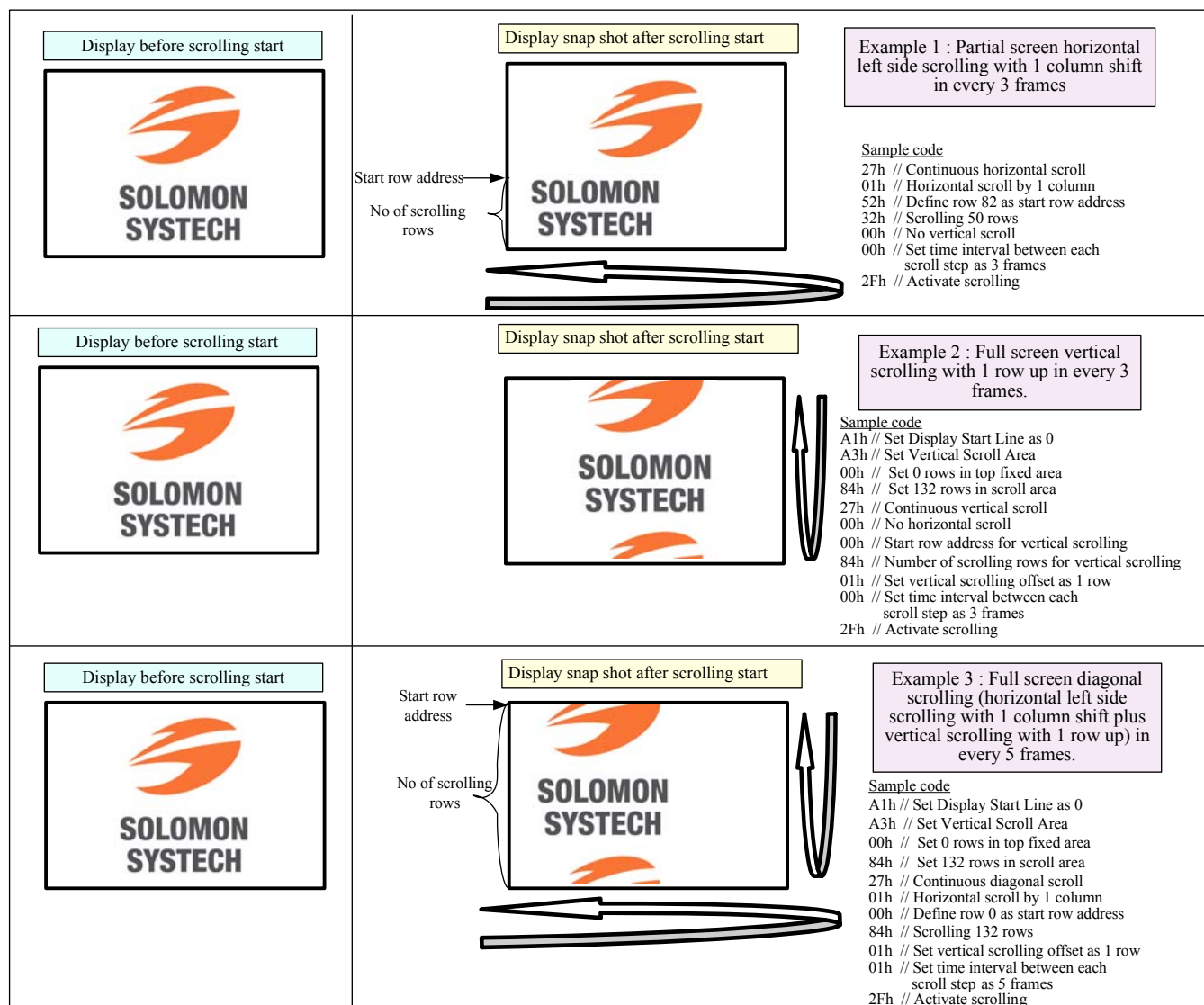
This command has two functions.

- Enable/Disable fill (A[0])
  - 0 = Disable filling of color into rectangle in draw rectangle command. (reset)
  - 1 = Enable filling of color into rectangle in draw rectangle command.
- Enable/Disable reverse copy (A[4])
  - 0 = Disable reverse copy (reset)
  - 1 = During copy command, the new image colors are swapped such that “GS0” <-> “GS63”, “GS1” <-> “GS62”, ....

### 10.2.7 Horizontal Scroll Setup (27h)

This command setup the parameters required for horizontal and vertical scrolling. The parameters should not be changed after scrolling is activated

**Figure 10-20 : Examples of Continuous Horizontal and Vertical Scrolling command setup**



### 10.2.8 Deactivate Horizontal Scroll (2Eh)

This command deactivates the scrolling function. After sending 2Eh command to deactivate the scrolling action, the ram data needs to be rewritten.

### 10.2.9 Activate Horizontal Scroll (2Fh)

This command activates the scrolling function according to the setting done by Continuous Horizontal & Vertical Scrolling Setup command 27h.

### 10.2.10 Set Vertical Scroll Area(A3h)

This command consists of 3 consecutive bytes to set up the vertical scroll area. For details please refer to Table 9-1.

## 11 MAXIMUM RATINGS

**Table 11-1 : Maximum Ratings**

(Voltage Reference to  $V_{SS}$ )

| Symbol     | Parameter                 | Value                          | Unit |
|------------|---------------------------|--------------------------------|------|
| $V_{DD}$   | Supply Voltage            | -0.5 to 2.75                   | V    |
| $V_{CC}$   |                           | -0.5 to 22.0                   | V    |
| $V_{DDIO}$ |                           | -0.5 to $V_{CI}$               | V    |
| $V_{CI}$   |                           | -0.3 to 4.0                    | V    |
| $V_{SEG}$  | SEG output voltage        | 0 to $V_{CC}$                  | V    |
| $V_{COM}$  | COM output voltage        | 0 to $0.9 \cdot V_{CC}$        | V    |
| $V_{in}$   | Input voltage             | $V_{SS}-0.3$ to $V_{DDIO}+0.3$ | V    |
| $T_A$      | Operating Temperature     | -40 to +85                     | °C   |
| $T_{stg}$  | Storage Temperature Range | -65 to +150                    | °C   |

\*Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the limits in the Electrical Characteristics tables or Pin Description.



## 12 DC CHARACTERISTICS

### Conditions:

Voltage referenced to  $V_{SS}$

$V_{DD} = 2.4$  to  $2.6V$

$V_{CI} = 2.4$  to  $3.5V$  ( $V_{CI}$  must be larger than or equal to  $V_{DD}$ )

$T_A = 25^\circ C$

**Table 12-1 : DC Characteristics**

| Symbol                 | Parameter                                                                         | Test Condition                                                                                                                                                                    | Min                                | Typ | Max                   | Unit |    |
|------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----|-----------------------|------|----|
| V <sub>CC</sub>        | Operating Voltage                                                                 | -                                                                                                                                                                                 | 10                                 | -   | 21                    | V    |    |
| V <sub>DD</sub>        | Logic Supply Voltage                                                              | -                                                                                                                                                                                 | 2.4                                | -   | 2.6                   | V    |    |
| V <sub>CI</sub>        | Low voltage power supply                                                          | -                                                                                                                                                                                 | 2.4                                | -   | 3.5                   | V    |    |
| V <sub>DDIO</sub>      | Power Supply for I/O pins                                                         | -                                                                                                                                                                                 | 1.6                                | -   | V <sub>CI</sub>       | V    |    |
| V <sub>OH</sub>        | High Logic Output Level                                                           | I <sub>out</sub> =100uA                                                                                                                                                           | 0.9*V <sub>DDIO</sub>              | -   | V <sub>DDIO</sub>     | V    |    |
| V <sub>OL</sub>        | Low Logic Output Level                                                            | I <sub>out</sub> =100uA                                                                                                                                                           | 0                                  | -   | 0.1*V <sub>DDIO</sub> | V    |    |
| V <sub>IH</sub>        | High Logic Input Level                                                            | -                                                                                                                                                                                 | 0.8*V <sub>DDIO</sub>              | -   | V <sub>DDIO</sub>     | V    |    |
| V <sub>IL</sub>        | Low Logic Input Level                                                             | -                                                                                                                                                                                 | 0                                  | -   | 0.2*V <sub>DDIO</sub> | V    |    |
| I <sub>SLP_VDD</sub>   | V <sub>DD</sub> Sleep mode Current                                                | V <sub>CI</sub> = 3.3V,<br>V <sub>DDIO</sub> = V <sub>DD</sub> (external) = 2.5V,<br>Display OFF, No panel attached                                                               | -                                  | -   | 15                    | uA   |    |
| I <sub>SLP_VDDIO</sub> | V <sub>DDIO</sub> Sleep mode Current                                              | V <sub>CI</sub> = 3.3V,<br>V <sub>DDIO</sub> = V <sub>DD</sub> (external) = 2.5V,<br>Display OFF, No panel attached                                                               | -                                  | -   | 15                    | uA   |    |
| I <sub>SLP_VCI</sub>   | V <sub>CI</sub> Sleep mode Current                                                | V <sub>CI</sub> = 3.3V,<br>V <sub>DDIO</sub> = V <sub>DD</sub> (external) = 2.5V,<br>Display OFF, No panel attached                                                               | -                                  | -   | 15                    | uA   |    |
| I <sub>SLP_VCC</sub>   | V <sub>CC</sub> Sleep mode Current                                                | V <sub>CI</sub> = 3.3V,<br>V <sub>DDIO</sub> = V <sub>DD</sub> (external) = 2.5V,<br>Display OFF, No panel attached                                                               | -                                  | -   | 15                    | uA   |    |
| I <sub>DD</sub>        | V <sub>DD</sub> Supply Current                                                    | V <sub>CI</sub> = 3.3V, V <sub>CC</sub> = 21V, V <sub>DDIO</sub> =2.5V,<br>External V <sub>DD</sub> = 2.5V, Display ON,<br>No panel attached, contrast = FF                       | -                                  | 950 | 1050                  | uA   |    |
| I <sub>DDIO</sub>      | V <sub>DDIO</sub> Supply Current                                                  | V <sub>CI</sub> = 3.3V, V <sub>CC</sub> = 21V,<br>V <sub>DDIO</sub> =2.5V, Display<br>ON, No panel attached,<br>contrast = FF                                                     | External<br>V <sub>DD</sub> = 2.5V | -   | 0.5                   | 15   | uA |
|                        |                                                                                   |                                                                                                                                                                                   | Internal<br>V <sub>DD</sub> = 2.5V | -   | 0.5                   | 15   | uA |
| I <sub>CI</sub>        | V <sub>CI</sub> Supply Current                                                    | V <sub>CI</sub> = 3.3V, V <sub>CC</sub> = 21V,<br>V <sub>DDIO</sub> =2.5V, Display<br>ON, No panel attached,<br>contrast = FF                                                     | External<br>V <sub>DD</sub> = 2.5V | -   | -110                  | -90  | uA |
|                        |                                                                                   |                                                                                                                                                                                   | Internal<br>V <sub>DD</sub> = 2.5V | -   | 890                   | 980  | uA |
| I <sub>CC</sub>        | V <sub>CC</sub> Supply Current                                                    | V <sub>CI</sub> = 3.3V, V <sub>CC</sub> = 21V,<br>V <sub>DDIO</sub> =2.5V, Display<br>ON, No panel attached,<br>contrast = FF                                                     | External<br>V <sub>DD</sub> = 2.5V | -   | 9.5                   | 10.8 | mA |
|                        |                                                                                   |                                                                                                                                                                                   | Internal<br>V <sub>DD</sub> = 2.5V | -   | 8.9                   | 10   | mA |
| I <sub>SEG</sub>       | Segment Output Current<br>Setting<br>V <sub>CC</sub> =18V, I <sub>REF</sub> =10uA | Contrast = FF , GS=127                                                                                                                                                            | -                                  | 160 | 175                   | uA   |    |
|                        |                                                                                   | Contrast = 7F, GS=127                                                                                                                                                             | -                                  | 80  | -                     | uA   |    |
|                        |                                                                                   | Contrast = 7F, GS= 63                                                                                                                                                             | -                                  | 40  | -                     | uA   |    |
| Dev                    | Segment output current<br>uniformity                                              | Dev = (I <sub>SEG</sub> – I <sub>MID</sub> )/I <sub>MID</sub><br>I <sub>MID</sub> = (I <sub>MAX</sub> + I <sub>MIN</sub> )/2<br>I <sub>SEG</sub> = Segment current at contrast FF | -3                                 | -   | 3                     | %    |    |
| Adj. Dev               | Adjacent pin output<br>current uniformity<br>(contrast = FF)                      | Adj Dev = (I[n]-I[n+1]) /<br>(I[n]+I[n+1])                                                                                                                                        | -2                                 | -   | 2                     | %    |    |

## 13 AC CHARACTERISTICS

### Conditions:

Voltage referenced to  $V_{SS}$

$V_{DD}=2.4$  to  $2.6V$

$T_A = 25^{\circ}C$

**Table 13-1 : AC Characteristics**

| Symbol          | Parameter                                         | Test Condition                                                        | Min  | Typ                                       | Max  | Unit |
|-----------------|---------------------------------------------------|-----------------------------------------------------------------------|------|-------------------------------------------|------|------|
| $F_{OSC}^{(1)}$ | Oscillation Frequency of Display Timing Generator | $V_{DD} = 2.5V$                                                       | 1.32 | 1.64                                      | 1.76 | MHz  |
| FFRM            | Frame Frequency for 132 MUX Mode                  | 160x132 Graphic Display Mode, Display ON, Internal Oscillator Enabled | -    | $F_{OSC} * 1/(D*K*132)$<br><sup>(2)</sup> | -    | Hz   |
| $t_{RES}$       | Reset low pulse width (RES#)                      | -                                                                     | 100  | -                                         | -    | us   |

### Note

<sup>(1)</sup>  $F_{OSC}$  stands for the frequency value of the internal oscillator and the value is measured when command B3h A[7:4] is in default value.

<sup>(2)</sup> D: divide ratio

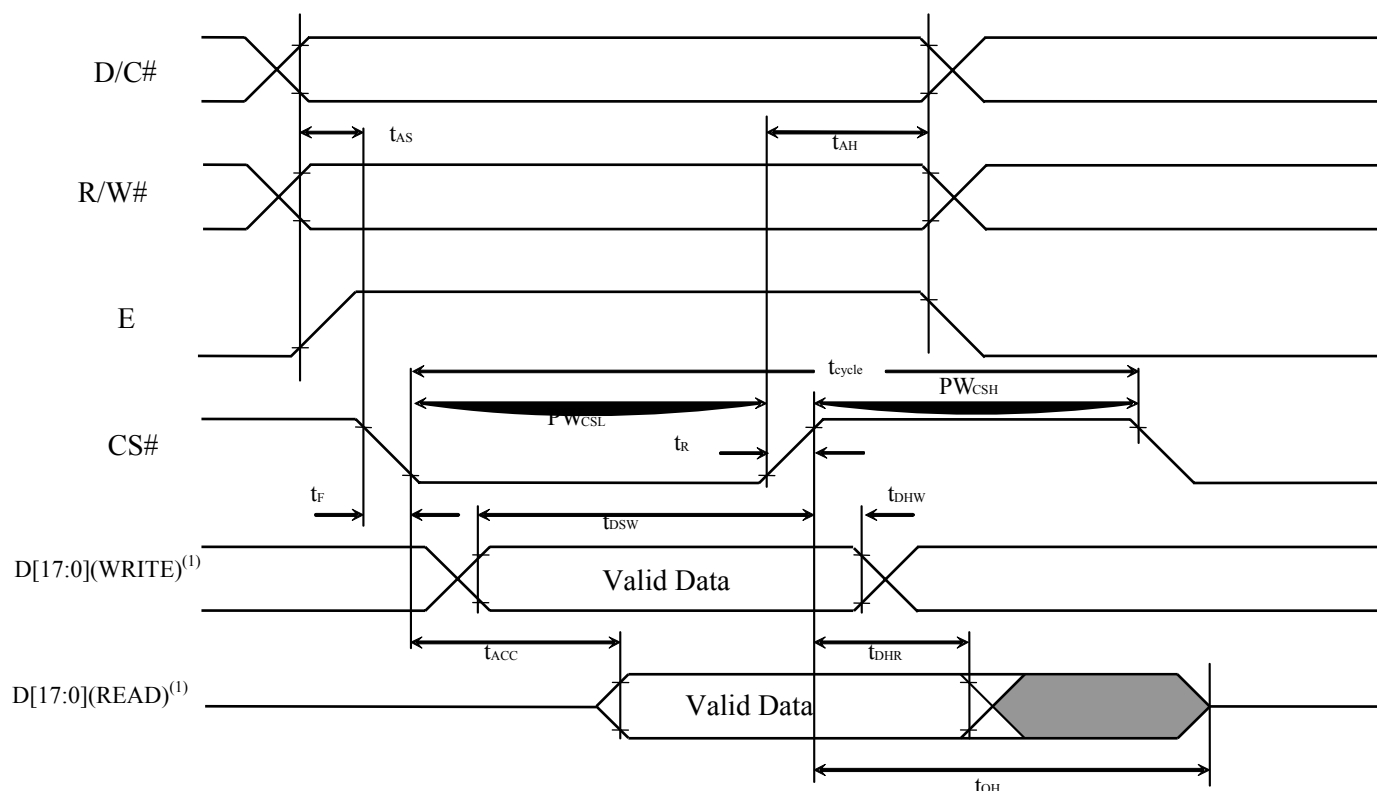
K: Phase 1 period +Phase 2 period + 98

**Table 13-2 : 6800-Series MCU Parallel Interface Timing Characteristics**

( $V_{DD} - V_{SS} = 2.4$  to  $2.6V$ ,  $V_{DDIO} = 1.6V$ ,  $V_{CI} = 3.3V$ ,  $T_A = 25^\circ C$ )

| Symbol      | Parameter                                                                   | Min       | Typ | Max | Unit |
|-------------|-----------------------------------------------------------------------------|-----------|-----|-----|------|
| $t_{cycle}$ | Clock Cycle Time                                                            | 300       | -   | -   | ns   |
| $t_{AS}$    | Address Setup Time                                                          | 0         | -   | -   | ns   |
| $t_{AH}$    | Address Hold Time                                                           | 0         | -   | -   | ns   |
| $t_{DSW}$   | Write Data Setup Time                                                       | 40        | -   | -   | ns   |
| $t_{DHW}$   | Write Data Hold Time                                                        | 7         | -   | -   | ns   |
| $t_{DHR}$   | Read Data Hold Time                                                         | 20        | -   | -   | ns   |
| $t_{OH}$    | Output Disable Time                                                         | -         | -   | 70  | ns   |
| $t_{ACC}$   | Access Time                                                                 | -         | -   | 140 | ns   |
| $PW_{CSL}$  | Chip Select Low Pulse Width (read)<br>Chip Select Low Pulse Width (write)   | 120<br>60 | -   | -   | ns   |
| $PW_{CSH}$  | Chip Select High Pulse Width (read)<br>Chip Select High Pulse Width (write) | 60<br>60  | -   | -   | ns   |
| $t_R$       | Rise Time                                                                   | -         | -   | 15  | ns   |
| $t_F$       | Fall Time                                                                   | -         | -   | 15  | ns   |

**Figure 13-1 : 6800-series MCU parallel interface characteristics**



**Note**

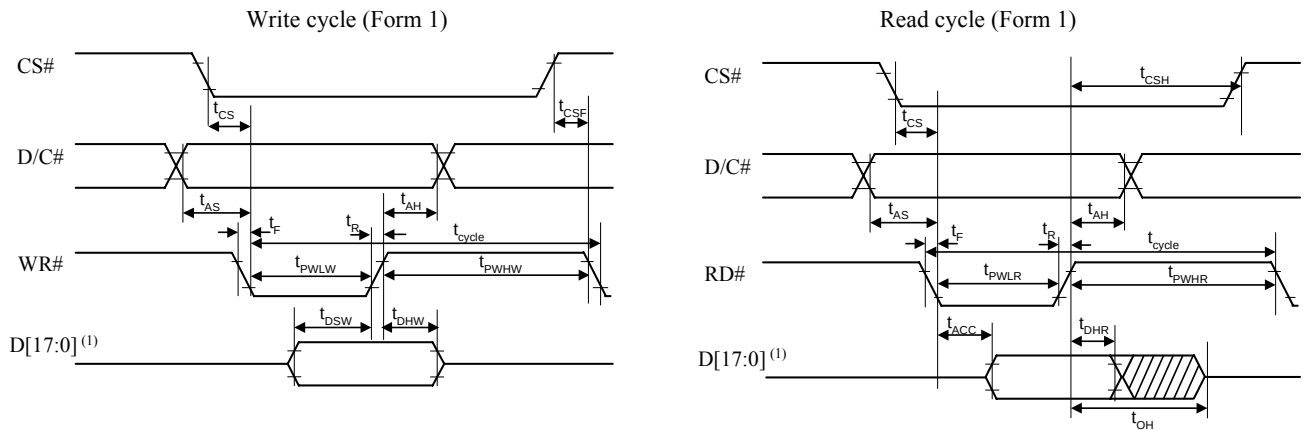
<sup>(1)</sup> when 8 bit used:  $D[7:0]$  instead; when 9 bit used:  $D[8:0]$  instead; when 16 bit used:  $[15:0]$  instead; when 18 bit used:  $D[17:0]$  instead.

**Table 13-3 : 8080-Series MCU Parallel Interface Timing Characteristics**

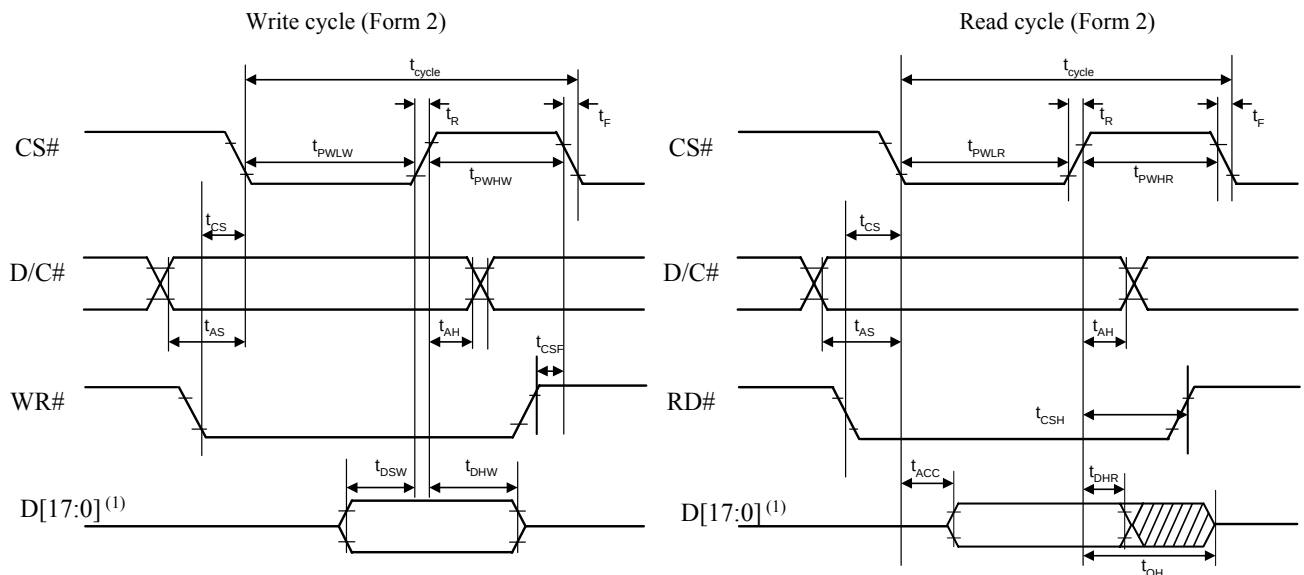
( $V_{DD} - V_{SS} = 2.4$  to  $2.6V$ ,  $V_{DDIO}=1.6V$ ,  $V_{CI} = 3.3V$ ,  $T_A = 25^{\circ}C$ )

| Symbol      | Parameter                            | Min | Typ | Max | Unit |
|-------------|--------------------------------------|-----|-----|-----|------|
| $t_{cclk}$  | Clock Cycle Time                     | 300 | -   | -   | ns   |
| $t_{AS}$    | Address Setup Time                   | 10  | -   | -   | ns   |
| $t_{AH}$    | Address Hold Time                    | 0   | -   | -   | ns   |
| $t_{DSW}$   | Write Data Setup Time                | 40  | -   | -   | ns   |
| $t_{DHW}$   | Write Data Hold Time                 | 7   | -   | -   | ns   |
| $t_{DHR}$   | Read Data Hold Time                  | 20  | -   | -   | ns   |
| $t_{OH}$    | Output Disable Time                  | -   | -   | 70  | ns   |
| $t_{ACC}$   | Access Time                          | -   | -   | 140 | ns   |
| $t_{PWL R}$ | Read Low Time                        | 150 | -   | -   | ns   |
| $t_{PWL W}$ | Write Low Time                       | 60  | -   | -   | ns   |
| $t_{PWH R}$ | Read High Time                       | 60  | -   | -   | ns   |
| $t_{PWH W}$ | Write High Time                      | 60  | -   | -   | ns   |
| $t_R$       | Rise Time                            | -   | -   | 15  | ns   |
| $t_F$       | Fall Time                            | -   | -   | 15  | ns   |
| $t_{CS}$    | Chip select setup time               | 0   | -   | -   | ns   |
| $t_{CSH}$   | Chip select hold time to read signal | 0   | -   | -   | ns   |
| $t_{CSF}$   | Chip select hold time                | 20  | -   | -   | ns   |

**Figure 13-2 : 8080-series MCU parallel interface characteristics (Form 1)**



**Figure 13-3 : 8080-series MCU parallel interface characteristics (Form 2)**



**Note**

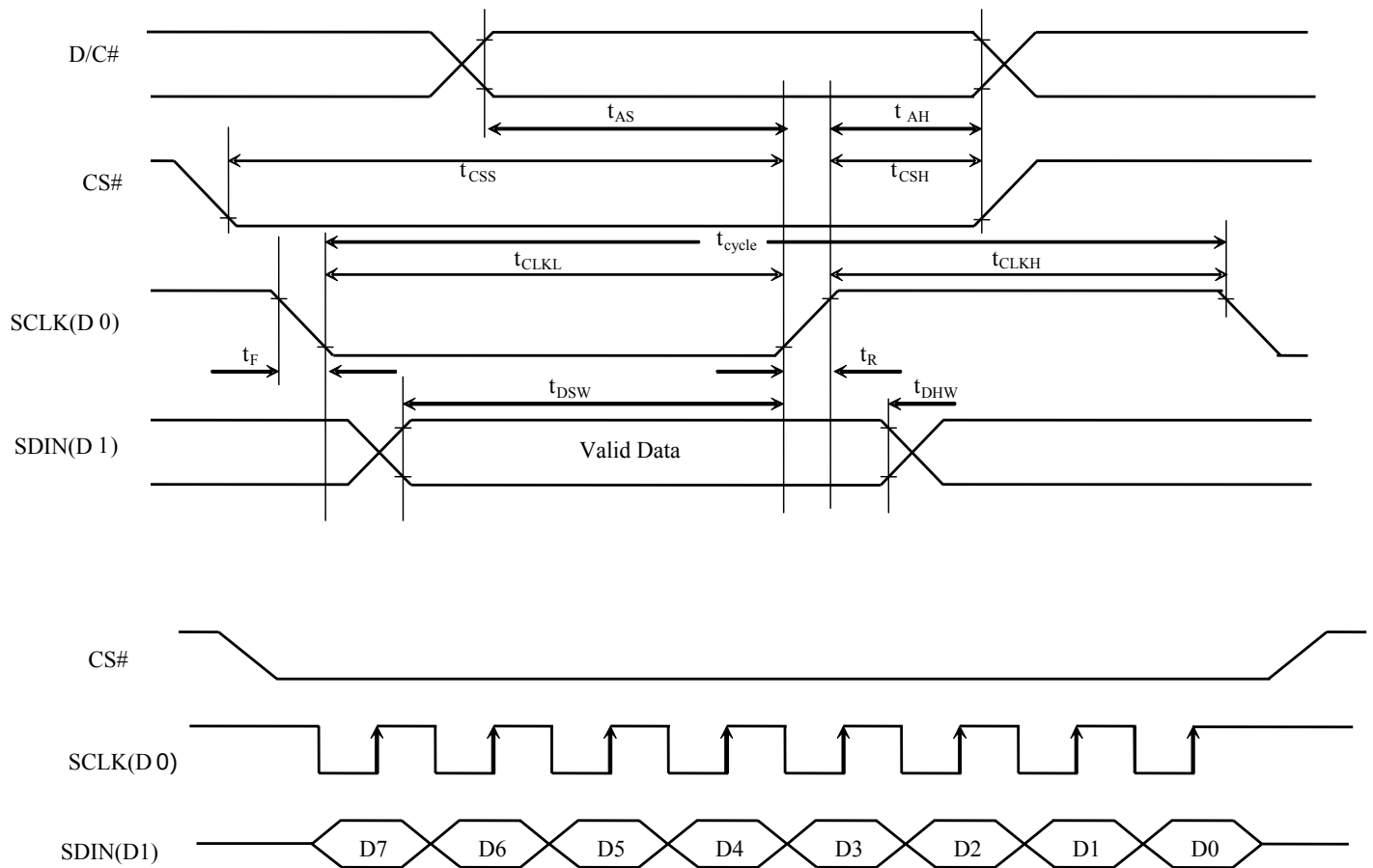
<sup>(1)</sup> when 8 bit used: D[7:0] instead; when 9 bit used: D[8:0] instead; when 16 bit used: [15:0] instead; when 18 bit used: D[17:0] instead.

**Table 13-4 : Serial Interface Timing Characteristics**

( $V_{DD} - V_{SS} = 2.4$  to  $2.6V$ ,  $V_{DDIO} = 1.6V$ ,  $V_{CI} = 3.3V$ ,  $T_A = 25^\circ C$ )

| Symbol      | Parameter              | Min | Typ | Max | Unit |
|-------------|------------------------|-----|-----|-----|------|
| $t_{cycle}$ | Clock Cycle Time       | 250 | -   | -   | ns   |
| $t_{AS}$    | Address Setup Time     | 150 | -   | -   | ns   |
| $t_{AH}$    | Address Hold Time      | 150 | -   | -   | ns   |
| $t_{CSS}$   | Chip Select Setup Time | 120 | -   | -   | ns   |
| $t_{CSH}$   | Chip Select Hold Time  | 60  | -   | -   | ns   |
| $t_{DSW}$   | Write Data Setup Time  | 100 | -   | -   | ns   |
| $t_{DHW}$   | Write Data Hold Time   | 100 | -   | -   | ns   |
| $t_{CLKL}$  | Clock Low Time         | 100 | -   | -   | ns   |
| $t_{CLKH}$  | Clock High Time        | 100 | -   | -   | ns   |
| $t_R$       | Rise Time              | -   | -   | 15  | ns   |
| $t_F$       | Fall Time              | -   | -   | 15  | ns   |

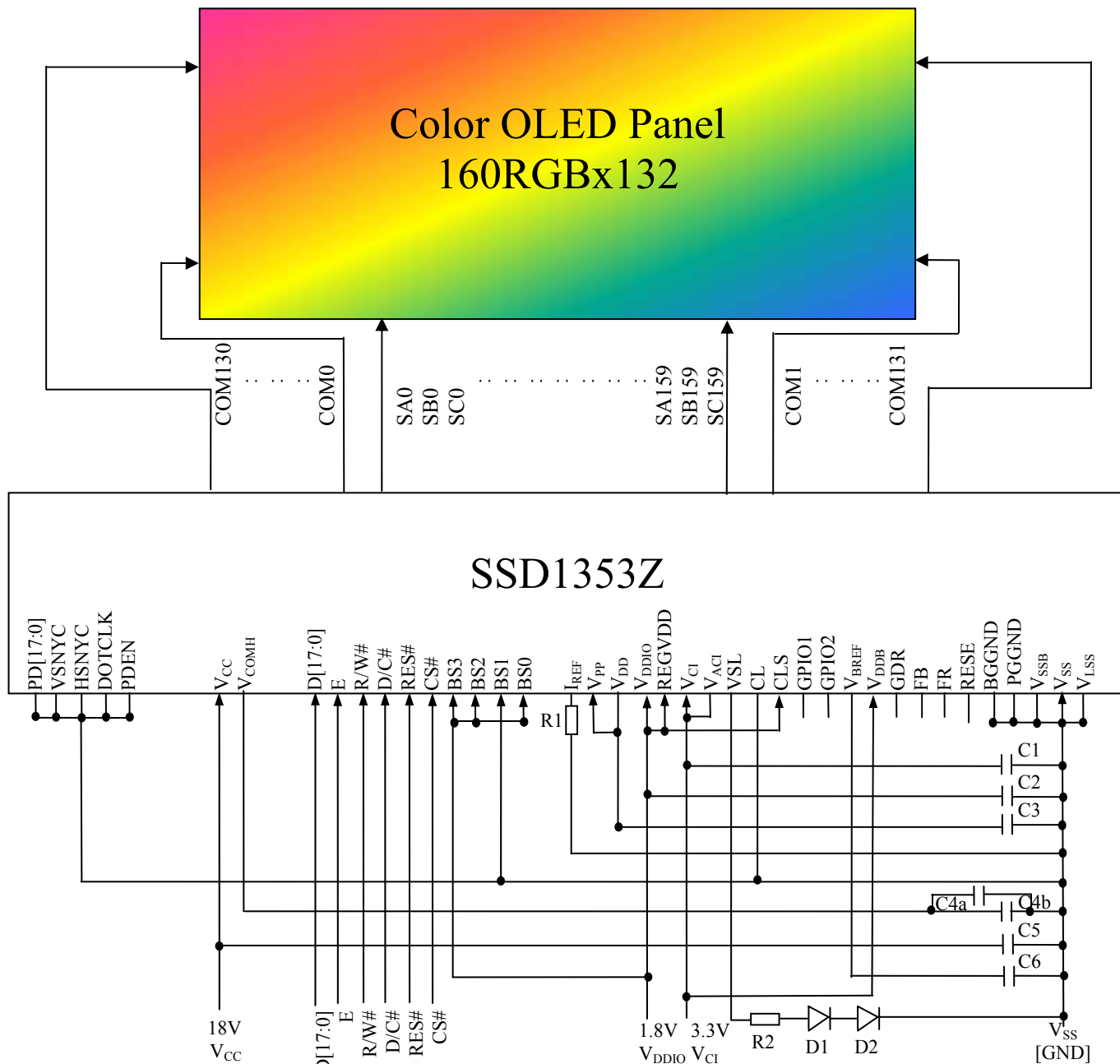
**Figure 13-4 : Serial interface characteristics**



## 14 APPLICATION EXAMPLE

**Figure 14-1 : SSD1353 application example for 18-bit 6800-parallel interface mode (Internal regulated V<sub>DD</sub>)**

The configuration for 18-bit 6800-parallel interface mode, externally V<sub>CC</sub> is shown in the following diagram:  
(V<sub>CI</sub> = 3.3V (V<sub>CI</sub> must be > 2.6V), Internal regulated V<sub>DD</sub> = 2.5V, V<sub>DDIO</sub> = 1.8V, external V<sub>CC</sub> = 18V, I<sub>REF</sub> = 10uA)



Voltage at I<sub>REF</sub> = V<sub>CC</sub> - 3V. For V<sub>CC</sub> = 18V, I<sub>REF</sub> = 10uA:

$$R1 = (V_{\text{Voltage at } I_{\text{REF}}} - V_{\text{SS}}) / I_{\text{REF}}$$

$$= (18-3)/10\mu$$

$$= 1.5M\Omega$$

R2 = 50Ω, 1/8W<sup>(1)</sup>

D1-D2 = V<sub>th</sub> = 0.7V, 1N4148<sup>(1)</sup>

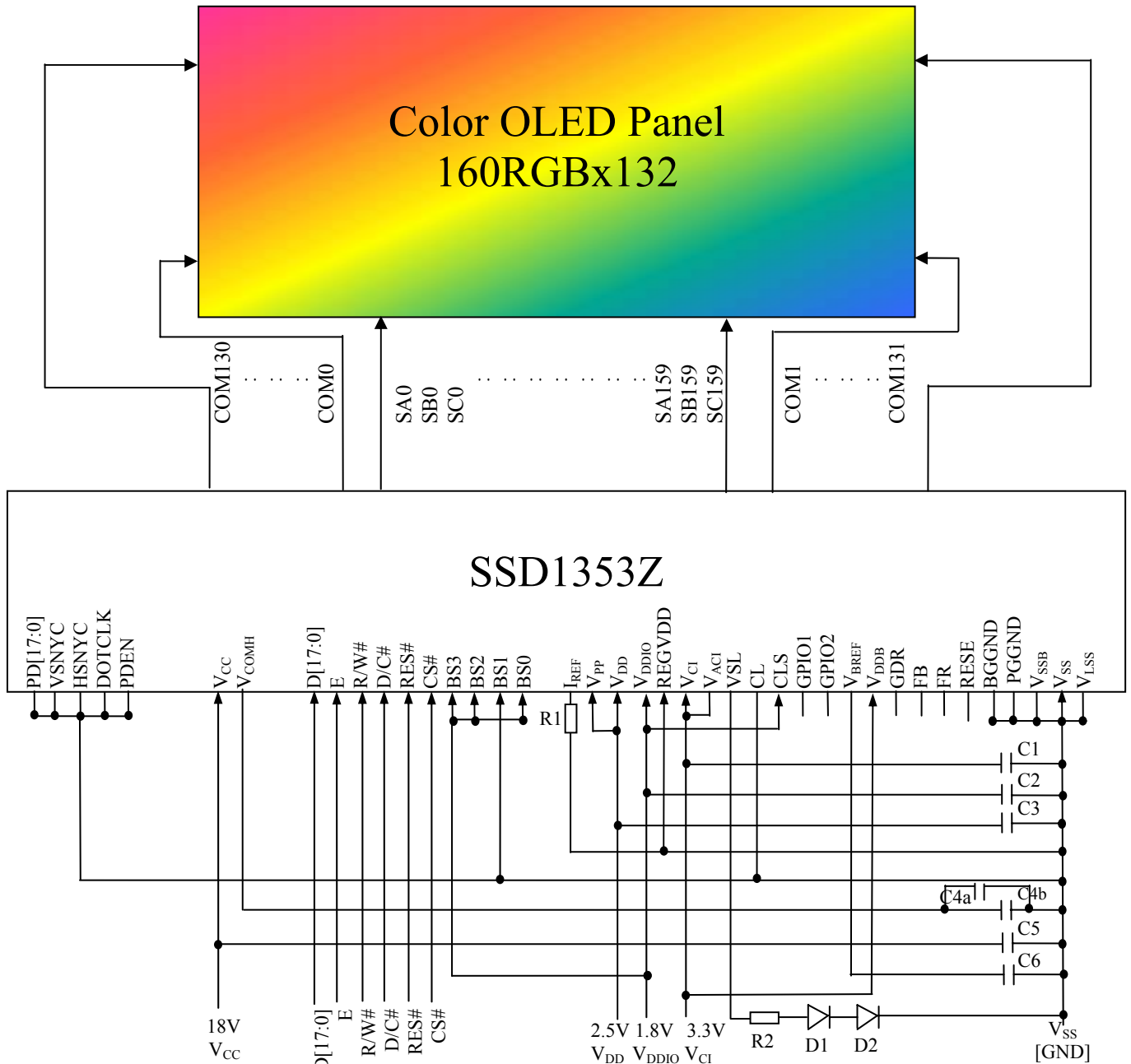
C1-C3: 1uF, C4a, C5: 4.7uF, C4b: 0.1uF, C6: 68nF<sup>(1)</sup>

### Note

<sup>(1)</sup> The value is recommended value. Select appropriate value against module application.

**Figure 14-2 : SSD1353 application example for 18-bit 6800-parallel interface mode (External V<sub>DD</sub>)**

The configuration for 18-bit 6800-parallel interface mode, externally V<sub>CC</sub> is shown in the following diagram:  
(V<sub>CI</sub>=3.3V (2.4V < V<sub>CI</sub> < 3.5V), External V<sub>DD</sub>= 2.5V, V<sub>DDIO</sub>=1.8V, external V<sub>CC</sub>= 18V, I<sub>REF</sub>= 10uA)



Voltage at I<sub>REF</sub> = V<sub>CC</sub> - 3V. For V<sub>CC</sub> = 18V, I<sub>REF</sub> = 10uA:

$$R1 = (\text{Voltage at } I_{REF} - V_{SS}) / I_{REF} \\ = (18-3)/10\mu \\ = 1.5M\Omega$$

$$R2 = 50\Omega, 1/8W^{(1)}$$

$$D1-D2 = V_{th}=0.7V, 1N4148^{(1)}$$

$$C1-C3: 1\mu F, C4a, C5: 4.7\mu F, C4b=0.1\mu F, C6: 68nF^{(1)}$$

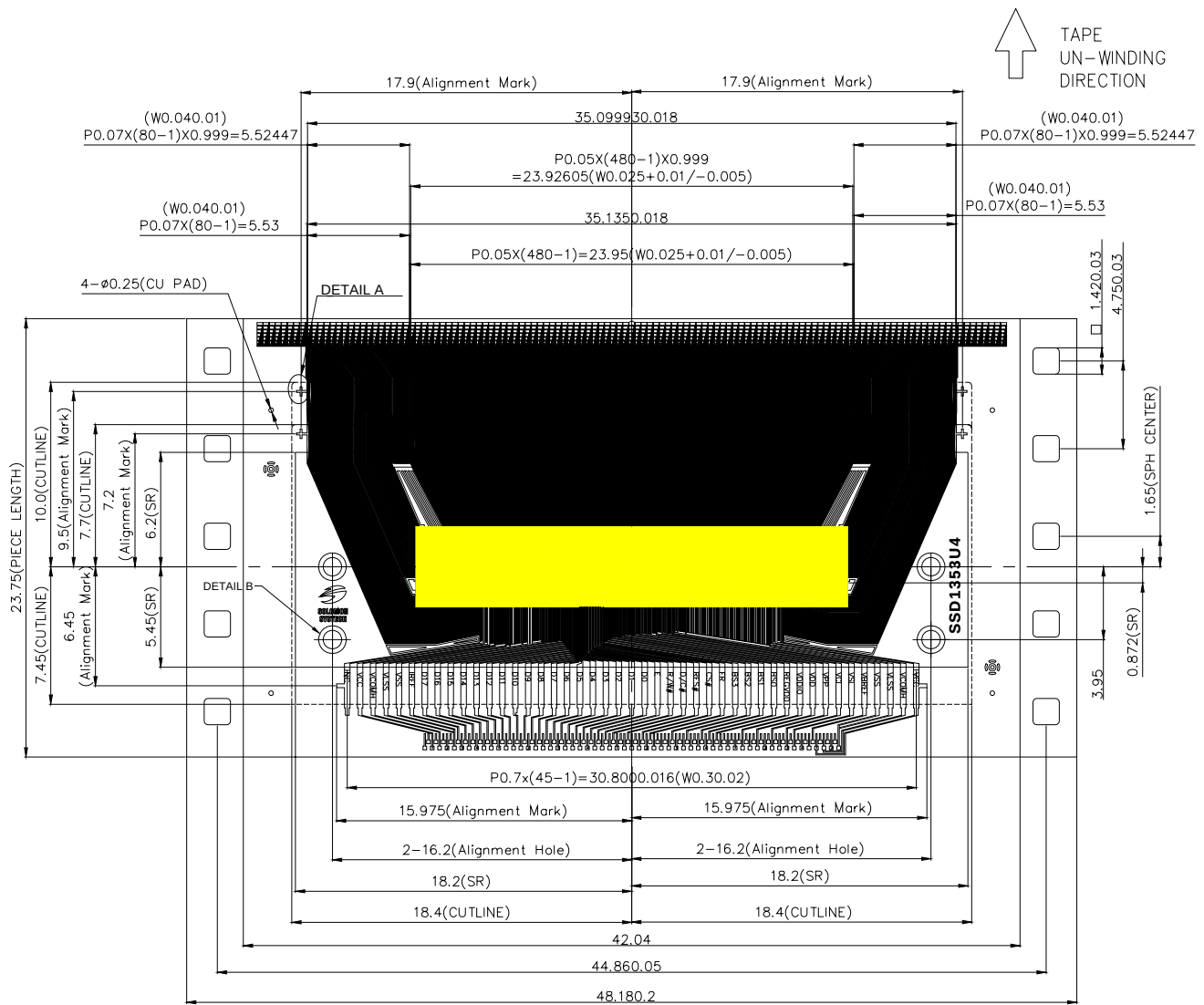
**Note**

<sup>(1)</sup> The value is recommended value. Select appropriate value against module application.

## 15 PACKAGE DIMENSION

### 15.1 SSD1353U4R1 Detail Dimension

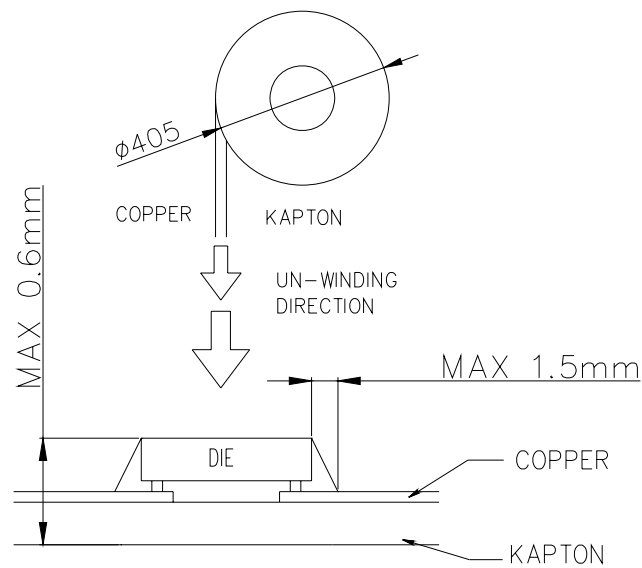
Figure 15-1: SSD1353U4R1 detail dimension



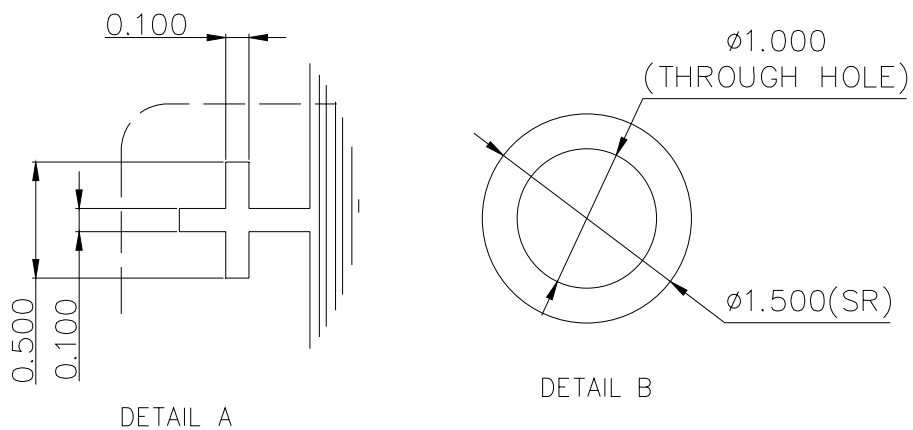


NOTE:

1. GENERAL TOLERANCE:  $\pm 0.05\text{mm}$
2. MATERIAL
  - PI:  $38 \pm 4\mu\text{m}$
  - CU:  $8 \pm 2\mu\text{m}$
  - SR:  $15 \pm 10\mu\text{m}$
  - (OTHER TOLERANCE:  $\pm 0.200\text{mm}$ )
3. Sn PLATING  $0.23 \pm 0.050\text{mm}$
4. TAP SITE: 5 SPH,  $23.75\text{mm}$

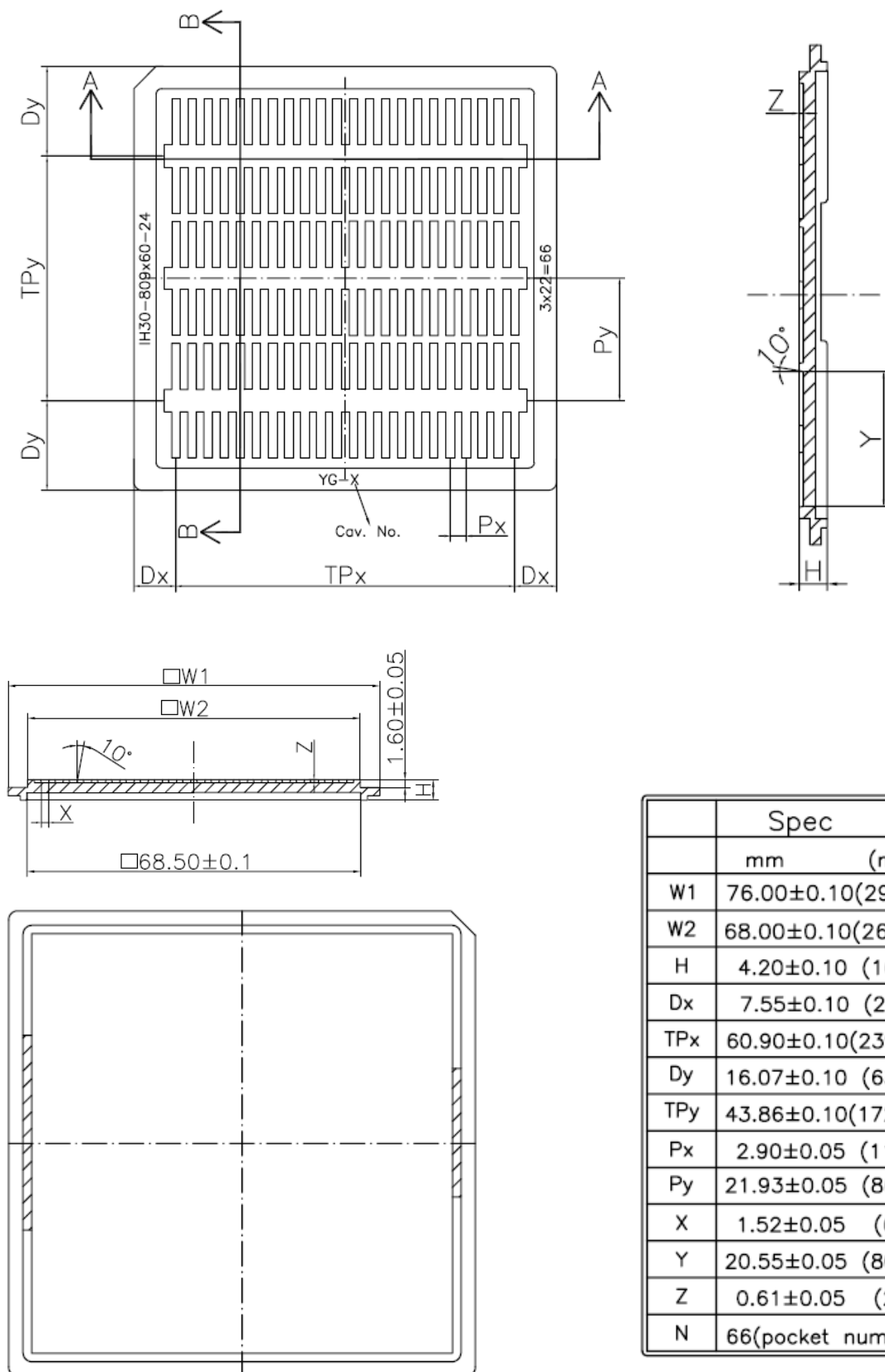


MIRROR DESIGN



## 15.2 SSD1353Z Die Tray Information

Figure 15-2: SSD1353Z die tray dimension



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