

360/396-OUTPUT TFT-LCD SOURCE DRIVER
(COMPATIBLE WITH 64-GRAY SCALES)**DESCRIPTION**

The μ PD161602A/B is a source driver for TFT-LCDs supporting 64 gray-scale display and can operate with a supply voltage of 2.5 V for the logic block and 5.0 V for the driver block. Data input as 6-bit x 3-dot digital data is output as 64 γ -corrected values using an internal D/A converter and 5 external power modules, thus achieving a 260,000-color (full-color) display. In addition, the difference with A articles and B articles is only a difference in γ compensation resistance.

FEATURES

- CMOS level input
- 360/396 outputs
- Input of 6 bits (gray-scale data) by 3 dots
- Capable of outputting 64 values by means of 5 external power modules and a D/A converter
- Output dynamic range: V_{SS2} to V_{DD2}
- High-speed data transfer: $f_{CLK} = 15$ MHz MAX. (internal data transfer speed when operating at $V_{DD1} = 2.5$ V)
- Level inversion γ -correction power supply is possible
- Logic power supply voltage (V_{DD1}): 2.2 to 3.6 V
- Driver power supply voltage (V_{DD2}): 4.5 to 5.5 V

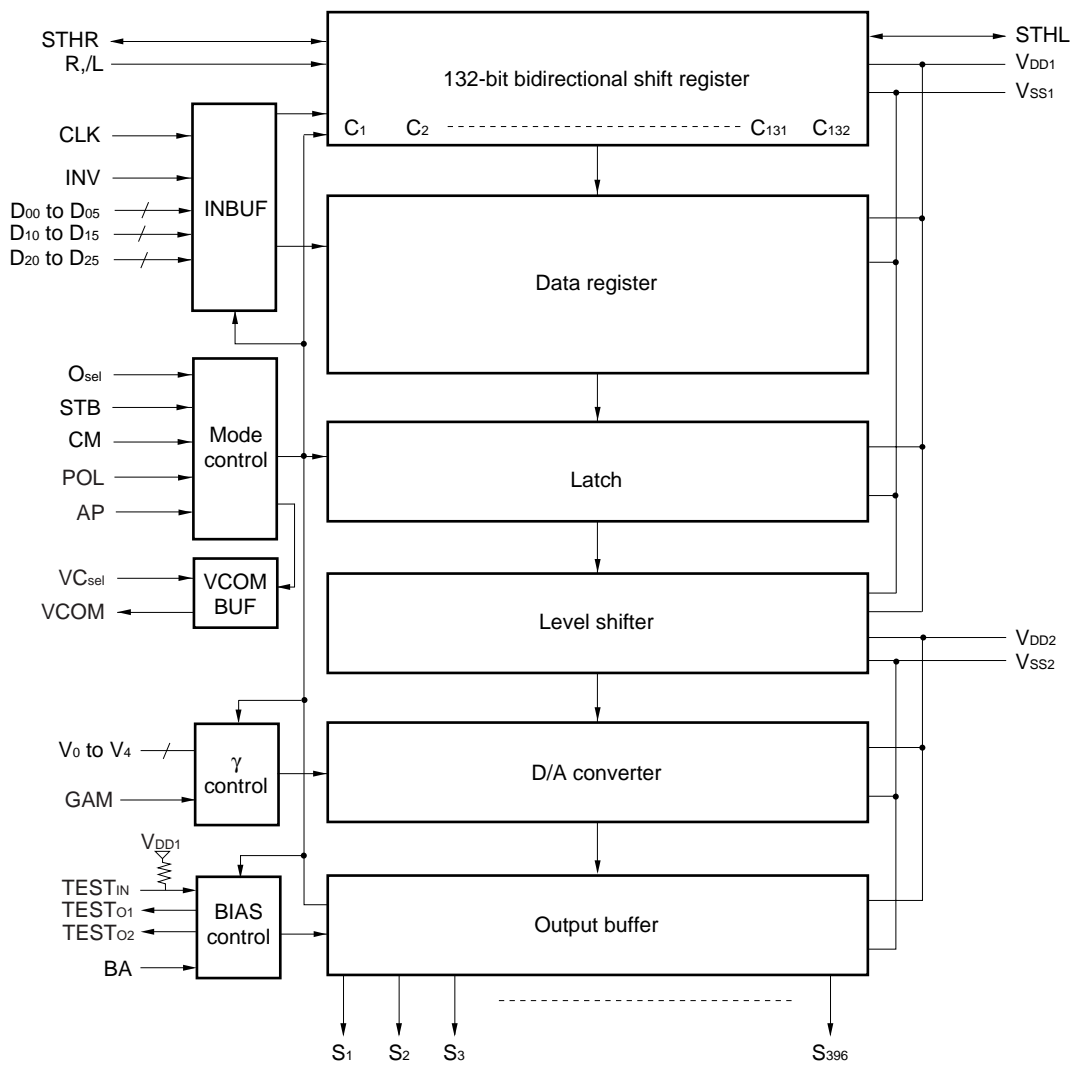
★ **ORDERING INFORMATION**

| Part Number | Package |
|------------------|---------|
| μ PD161602AP | Chip |
| μ PD161602BP | Chip |

Remark Purchasing the above chip entail the exchange of documents such as a separate memorandum or product quality, so please contact one of our sales representatives.

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

★ 1. BLOCK DIAGRAM



★ **Remark** /xxx indicates active low signal.

2. PIN CONFIGURATION (Pad Layout)

Chip size: 16980 x 1620 μm²

Bump size (Input/VCOM/test/dummy): 86 x 80 μm²

Bump size (Output): 33 x 120 μm²

Alignment Mark (μm)

X: -8284.4 Y: 600

X: 8284.4 Y: 600

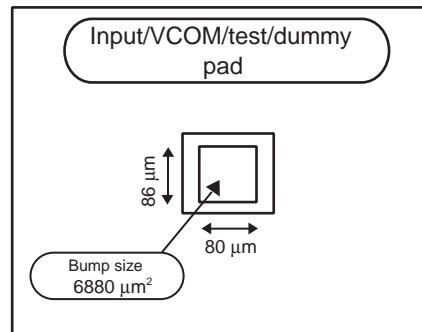
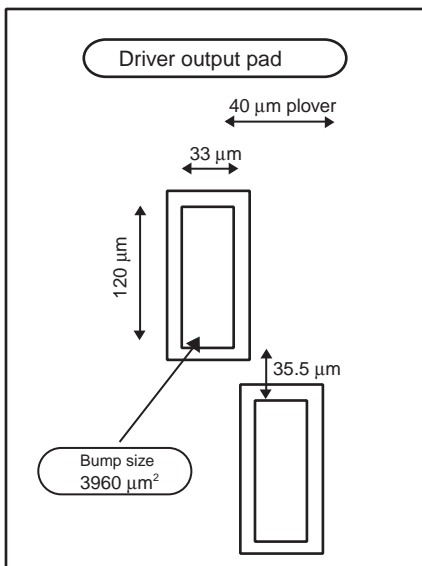
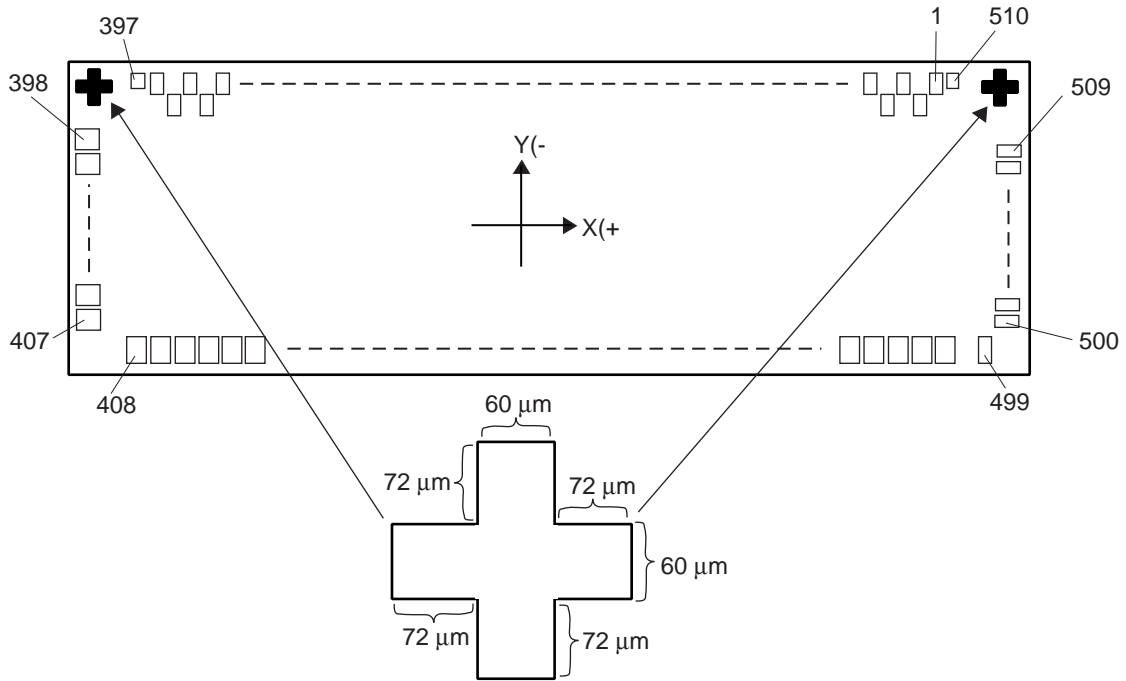


Table 2-1. Pad Layout (1/3)

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|--------|--------|
| 1 | S1 | 7900.0 | 667.7 |
| 2 | S2 | 7860.0 | 512.2 |
| 3 | S3 | 7820.0 | 667.7 |
| 4 | S4 | 7780.0 | 512.2 |
| 5 | S5 | 7740.0 | 667.7 |
| 6 | S6 | 7700.0 | 512.2 |
| 7 | S7 | 7660.0 | 667.7 |
| 8 | S8 | 7620.0 | 512.2 |
| 9 | S9 | 7580.0 | 667.7 |
| 10 | S10 | 7540.0 | 512.2 |
| 11 | S11 | 7500.0 | 667.7 |
| 12 | S12 | 7460.0 | 512.2 |
| 13 | S13 | 7420.0 | 667.7 |
| 14 | S14 | 7380.0 | 512.2 |
| 15 | S15 | 7340.0 | 667.7 |
| 16 | S16 | 7300.0 | 512.2 |
| 17 | S17 | 7260.0 | 667.7 |
| 18 | S18 | 7220.0 | 512.2 |
| 19 | S19 | 7180.0 | 667.7 |
| 20 | S20 | 7140.0 | 512.2 |
| 21 | S21 | 7100.0 | 667.7 |
| 22 | S22 | 7060.0 | 512.2 |
| 23 | S23 | 7020.0 | 667.7 |
| 24 | S24 | 6980.0 | 512.2 |
| 25 | S25 | 6940.0 | 667.7 |
| 26 | S26 | 6900.0 | 512.2 |
| 27 | S27 | 6860.0 | 667.7 |
| 28 | S28 | 6820.0 | 512.2 |
| 29 | S29 | 6780.0 | 667.7 |
| 30 | S30 | 6740.0 | 512.2 |
| 31 | S31 | 6700.0 | 667.7 |
| 32 | S32 | 6660.0 | 512.2 |
| 33 | S33 | 6620.0 | 667.7 |
| 34 | S34 | 6580.0 | 512.2 |
| 35 | S35 | 6540.0 | 667.7 |
| 36 | S36 | 6500.0 | 512.2 |
| 37 | S37 | 6460.0 | 667.7 |
| 38 | S38 | 6420.0 | 512.2 |
| 39 | S39 | 6380.0 | 667.7 |
| 40 | S40 | 6340.0 | 512.2 |
| 41 | S41 | 6300.0 | 667.7 |
| 42 | S42 | 6260.0 | 512.2 |
| 43 | S43 | 6220.0 | 667.7 |
| 44 | S44 | 6180.0 | 512.2 |
| 45 | S45 | 6140.0 | 667.7 |
| 46 | S46 | 6100.0 | 512.2 |
| 47 | S47 | 6060.0 | 667.7 |
| 48 | S48 | 6020.0 | 512.2 |
| 49 | S49 | 5980.0 | 667.7 |
| 50 | S50 | 5940.0 | 512.2 |
| 51 | S51 | 5900.0 | 667.7 |
| 52 | S52 | 5860.0 | 512.2 |
| 53 | S53 | 5820.0 | 667.7 |
| 54 | S54 | 5780.0 | 512.2 |
| 55 | S55 | 5740.0 | 667.7 |
| 56 | S56 | 5700.0 | 512.2 |
| 57 | S57 | 5660.0 | 667.7 |
| 58 | S58 | 5620.0 | 512.2 |

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|--------|--------|
| 59 | S59 | 5580.0 | 667.7 |
| 60 | S60 | 5540.0 | 512.2 |
| 61 | S61 | 5500.0 | 667.7 |
| 62 | S62 | 5460.0 | 512.2 |
| 63 | S63 | 5420.0 | 667.7 |
| 64 | S64 | 5380.0 | 512.2 |
| 65 | S65 | 5340.0 | 667.7 |
| 66 | S66 | 5300.0 | 512.2 |
| 67 | S67 | 5260.0 | 667.7 |
| 68 | S68 | 5220.0 | 512.2 |
| 69 | S69 | 5180.0 | 667.7 |
| 70 | S70 | 5140.0 | 512.2 |
| 71 | S71 | 5100.0 | 667.7 |
| 72 | S72 | 5060.0 | 512.2 |
| 73 | S73 | 5020.0 | 667.7 |
| 74 | S74 | 4980.0 | 512.2 |
| 75 | S75 | 4940.0 | 667.7 |
| 76 | S76 | 4900.0 | 512.2 |
| 77 | S77 | 4860.0 | 667.7 |
| 78 | S78 | 4820.0 | 512.2 |
| 79 | S79 | 4780.0 | 667.7 |
| 80 | S80 | 4740.0 | 512.2 |
| 81 | S81 | 4700.0 | 667.7 |
| 82 | S82 | 4660.0 | 512.2 |
| 83 | S83 | 4620.0 | 667.7 |
| 84 | S84 | 4580.0 | 512.2 |
| 85 | S85 | 4540.0 | 667.7 |
| 86 | S86 | 4500.0 | 512.2 |
| 87 | S87 | 4460.0 | 667.7 |
| 88 | S88 | 4420.0 | 512.2 |
| 89 | S89 | 4380.0 | 667.7 |
| 90 | S90 | 4340.0 | 512.2 |
| 91 | S91 | 4300.0 | 667.7 |
| 92 | S92 | 4260.0 | 512.2 |
| 93 | S93 | 4220.0 | 667.7 |
| 94 | S94 | 4180.0 | 512.2 |
| 95 | S95 | 4140.0 | 667.7 |
| 96 | S96 | 4100.0 | 512.2 |
| 97 | S97 | 4060.0 | 667.7 |
| 98 | S98 | 4020.0 | 512.2 |
| 99 | S99 | 3980.0 | 667.7 |
| 100 | S100 | 3940.0 | 512.2 |
| 101 | S101 | 3900.0 | 667.7 |
| 102 | S102 | 3860.0 | 512.2 |
| 103 | S103 | 3820.0 | 667.7 |
| 104 | S104 | 3780.0 | 512.2 |
| 105 | S105 | 3740.0 | 667.7 |
| 106 | S106 | 3700.0 | 512.2 |
| 107 | S107 | 3660.0 | 667.7 |
| 108 | S108 | 3620.0 | 512.2 |
| 109 | S109 | 3580.0 | 667.7 |
| 110 | S110 | 3540.0 | 512.2 |
| 111 | S111 | 3500.0 | 667.7 |
| 112 | S112 | 3460.0 | 512.2 |
| 113 | S113 | 3420.0 | 667.7 |
| 114 | S114 | 3380.0 | 512.2 |
| 115 | S115 | 3340.0 | 667.7 |
| 116 | S116 | 3300.0 | 512.2 |

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|--------|--------|
| 117 | S117 | 3260.0 | 667.7 |
| 118 | S118 | 3220.0 | 512.2 |
| 119 | S119 | 3180.0 | 667.7 |
| 120 | S120 | 3140.0 | 512.2 |
| 121 | S121 | 3100.0 | 667.7 |
| 122 | S122 | 3060.0 | 512.2 |
| 123 | S123 | 3020.0 | 667.7 |
| 124 | S124 | 2980.0 | 512.2 |
| 125 | S125 | 2940.0 | 667.7 |
| 126 | S126 | 2900.0 | 512.2 |
| 127 | S127 | 2860.0 | 667.7 |
| 128 | S128 | 2820.0 | 512.2 |
| 129 | S129 | 2780.0 | 667.7 |
| 130 | S130 | 2740.0 | 512.2 |
| 131 | S131 | 2700.0 | 667.7 |
| 132 | S132 | 2660.0 | 512.2 |
| 133 | S133 | 2620.0 | 667.7 |
| 134 | S134 | 2580.0 | 512.2 |
| 135 | S135 | 2540.0 | 667.7 |
| 136 | S136 | 2500.0 | 512.2 |
| 137 | S137 | 2460.0 | 667.7 |
| 138 | S138 | 2420.0 | 512.2 |
| 139 | S139 | 2380.0 | 667.7 |
| 140 | S140 | 2340.0 | 512.2 |
| 141 | S141 | 2300.0 | 667.7 |
| 142 | S142 | 2260.0 | 512.2 |
| 143 | S143 | 2220.0 | 667.7 |
| 144 | S144 | 2180.0 | 512.2 |
| 145 | S145 | 2140.0 | 667.7 |
| 146 | S146 | 2100.0 | 512.2 |
| 147 | S147 | 2060.0 | 667.7 |
| 148 | S148 | 2020.0 | 512.2 |
| 149 | S149 | 1980.0 | 667.7 |
| 150 | S150 | 1940.0 | 512.2 |
| 151 | S151 | 1900.0 | 667.7 |
| 152 | S152 | 1860.0 | 512.2 |
| 153 | S153 | 1820.0 | 667.7 |
| 154 | S154 | 1780.0 | 512.2 |
| 155 | S155 | 1740.0 | 667.7 |
| 156 | S156 | 1700.0 | 512.2 |
| 157 | S157 | 1660.0 | 667.7 |
| 158 | S158 | 1620.0 | 512.2 |
| 159 | S159 | 1580.0 | 667.7 |
| 160 | S160 | 1540.0 | 512.2 |
| 161 | S161 | 1500.0 | 667.7 |
| 162 | S162 | 1460.0 | 512.2 |
| 163 | S163 | 1420.0 | 667.7 |
| 164 | S164 | 1380.0 | 512.2 |
| 165 | S165 | 1340.0 | 667.7 |
| 166 | S166 | 1300.0 | 512.2 |
| 167 | S167 | 1260.0 | 667.7 |
| 168 | S168 | 1220.0 | 512.2 |
| 169 | S169 | 1180.0 | 667.7 |
| 170 | S170 | 1140.0 | 512.2 |
| 171 | S171 | 1100.0 | 667.7 |
| 172 | S172 | 1060.0 | 512.2 |
| 173 | S173 | 1020.0 | 667.7 |
| 174 | S174 | 980.0 | 512.2 |

Table 2-1. Pad Layout (2/3)

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|---------|--------|
| 175 | S175 | 940.0 | 667.7 |
| 176 | S176 | 900.0 | 512.2 |
| 177 | S177 | 860.0 | 667.7 |
| 178 | S178 | 820.0 | 512.2 |
| 179 | S179 | 780.0 | 667.7 |
| 180 | S180 | 740.0 | 512.2 |
| 181 | S181 | 700.0 | 667.7 |
| 182 | S182 | 660.0 | 512.2 |
| 183 | S183 | 620.0 | 667.7 |
| 184 | S184 | 580.0 | 512.2 |
| 185 | S185 | 540.0 | 667.7 |
| 186 | S186 | 500.0 | 512.2 |
| 187 | S187 | 460.0 | 667.7 |
| 188 | S188 | 420.0 | 512.2 |
| 189 | S189 | 380.0 | 667.7 |
| 190 | S190 | 340.0 | 512.2 |
| 191 | S191 | 300.0 | 667.7 |
| 192 | S192 | 260.0 | 512.2 |
| 193 | S193 | 220.0 | 667.7 |
| 194 | S194 | 180.0 | 512.2 |
| 195 | S195 | 140.0 | 667.7 |
| 196 | S196 | 100.0 | 512.2 |
| 197 | S197 | 60.0 | 667.7 |
| 198 | S198 | 20.0 | 512.2 |
| 199 | S199 | -20.0 | 667.7 |
| 200 | S200 | -60.0 | 512.2 |
| 201 | S201 | -100.0 | 667.7 |
| 202 | S202 | -140.0 | 512.2 |
| 203 | S203 | -180.0 | 667.7 |
| 204 | S204 | -220.0 | 512.2 |
| 205 | S205 | -260.0 | 667.7 |
| 206 | S206 | -300.0 | 512.2 |
| 207 | S207 | -340.0 | 667.7 |
| 208 | S208 | -380.0 | 512.2 |
| 209 | S209 | -420.0 | 667.7 |
| 210 | S210 | -460.0 | 512.2 |
| 211 | S211 | -500.0 | 667.7 |
| 212 | S212 | -540.0 | 512.2 |
| 213 | S213 | -580.0 | 667.7 |
| 214 | S214 | -620.0 | 512.2 |
| 215 | S215 | -660.0 | 667.7 |
| 216 | S216 | -700.0 | 512.2 |
| 217 | S217 | -740.0 | 667.7 |
| 218 | S218 | -780.0 | 512.2 |
| 219 | S219 | -820.0 | 667.7 |
| 220 | S220 | -860.0 | 512.2 |
| 221 | S221 | -900.0 | 667.7 |
| 222 | S222 | -940.0 | 512.2 |
| 223 | S223 | -980.0 | 667.7 |
| 224 | S224 | -1020.0 | 512.2 |
| 225 | S225 | -1060.0 | 667.7 |
| 226 | S226 | -1100.0 | 512.2 |
| 227 | S227 | -1140.0 | 667.7 |
| 228 | S228 | -1180.0 | 512.2 |
| 229 | S229 | -1220.0 | 667.7 |
| 230 | S230 | -1260.0 | 512.2 |
| 231 | S231 | -1300.0 | 667.7 |
| 232 | S232 | -1340.0 | 512.2 |

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|---------|--------|
| 233 | S233 | -1380.0 | 667.7 |
| 234 | S234 | -1420.0 | 512.2 |
| 235 | S235 | -1460.0 | 667.7 |
| 236 | S236 | -1500.0 | 512.2 |
| 237 | S237 | -1540.0 | 667.7 |
| 238 | S238 | -1580.0 | 512.2 |
| 239 | S239 | -1620.0 | 667.7 |
| 240 | S240 | -1660.0 | 512.2 |
| 241 | S241 | -1700.0 | 667.7 |
| 242 | S242 | -1740.0 | 512.2 |
| 243 | S243 | -1780.0 | 667.7 |
| 244 | S244 | -1820.0 | 512.2 |
| 245 | S245 | -1860.0 | 667.7 |
| 246 | S246 | -1900.0 | 512.2 |
| 247 | S247 | -1940.0 | 667.7 |
| 248 | S248 | -1980.0 | 512.2 |
| 249 | S249 | -2020.0 | 667.7 |
| 250 | S250 | -2060.0 | 512.2 |
| 251 | S251 | -2100.0 | 667.7 |
| 252 | S252 | -2140.0 | 512.2 |
| 253 | S253 | -2180.0 | 667.7 |
| 254 | S254 | -2220.0 | 512.2 |
| 255 | S255 | -2260.0 | 667.7 |
| 256 | S256 | -2300.0 | 512.2 |
| 257 | S257 | -2340.0 | 667.7 |
| 258 | S258 | -2380.0 | 512.2 |
| 259 | S259 | -2420.0 | 667.7 |
| 260 | S260 | -2460.0 | 512.2 |
| 261 | S261 | -2500.0 | 667.7 |
| 262 | S262 | -2540.0 | 512.2 |
| 263 | S263 | -2580.0 | 667.7 |
| 264 | S264 | -2620.0 | 512.2 |
| 265 | S265 | -2660.0 | 667.7 |
| 266 | S266 | -2700.0 | 512.2 |
| 267 | S267 | -2740.0 | 667.7 |
| 268 | S268 | -2780.0 | 512.2 |
| 269 | S269 | -2820.0 | 667.7 |
| 270 | S270 | -2860.0 | 512.2 |
| 271 | S271 | -2900.0 | 667.7 |
| 272 | S272 | -2940.0 | 512.2 |
| 273 | S273 | -2980.0 | 667.7 |
| 274 | S274 | -3020.0 | 512.2 |
| 275 | S275 | -3060.0 | 667.7 |
| 276 | S276 | -3100.0 | 512.2 |
| 277 | S277 | -3140.0 | 667.7 |
| 278 | S278 | -3180.0 | 512.2 |
| 279 | S279 | -3220.0 | 667.7 |
| 280 | S280 | -3260.0 | 512.2 |
| 281 | S281 | -3300.0 | 667.7 |
| 282 | S282 | -3340.0 | 512.2 |
| 283 | S283 | -3380.0 | 667.7 |
| 284 | S284 | -3420.0 | 512.2 |
| 285 | S285 | -3460.0 | 667.7 |
| 286 | S286 | -3500.0 | 512.2 |
| 287 | S287 | -3540.0 | 667.7 |
| 288 | S288 | -3580.0 | 512.2 |
| 289 | S289 | -3620.0 | 667.7 |
| 290 | S290 | -3660.0 | 512.2 |

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|---------|--------|
| 291 | S291 | -3700.0 | 667.7 |
| 292 | S292 | -3740.0 | 512.2 |
| 293 | S293 | -3780.0 | 667.7 |
| 294 | S294 | -3820.0 | 512.2 |
| 295 | S295 | -3860.0 | 667.7 |
| 296 | S296 | -3900.0 | 512.2 |
| 297 | S297 | -3940.0 | 667.7 |
| 298 | S298 | -3980.0 | 512.2 |
| 299 | S299 | -4020.0 | 667.7 |
| 300 | S300 | -4060.0 | 512.2 |
| 301 | S301 | -4100.0 | 667.7 |
| 302 | S302 | -4140.0 | 512.2 |
| 303 | S303 | -4180.0 | 667.7 |
| 304 | S304 | -4220.0 | 512.2 |
| 305 | S305 | -4260.0 | 667.7 |
| 306 | S306 | -4300.0 | 512.2 |
| 307 | S307 | -4340.0 | 667.7 |
| 308 | S308 | -4380.0 | 512.2 |
| 309 | S309 | -4420.0 | 667.7 |
| 310 | S310 | -4460.0 | 512.2 |
| 311 | S311 | -4500.0 | 667.7 |
| 312 | S312 | -4540.0 | 512.2 |
| 313 | S313 | -4580.0 | 667.7 |
| 314 | S314 | -4620.0 | 512.2 |
| 315 | S315 | -4660.0 | 667.7 |
| 316 | S316 | -4700.0 | 512.2 |
| 317 | S317 | -4740.0 | 667.7 |
| 318 | S318 | -4780.0 | 512.2 |
| 319 | S319 | -4820.0 | 667.7 |
| 320 | S320 | -4860.0 | 512.2 |
| 321 | S321 | -4900.0 | 667.7 |
| 322 | S322 | -4940.0 | 512.2 |
| 323 | S323 | -4980.0 | 667.7 |
| 324 | S324 | -5020.0 | 512.2 |
| 325 | S325 | -5060.0 | 667.7 |
| 326 | S326 | -5100.0 | 512.2 |
| 327 | S327 | -5140.0 | 667.7 |
| 328 | S328 | -5180.0 | 512.2 |
| 329 | S329 | -5220.0 | 667.7 |
| 330 | S330 | -5260.0 | 512.2 |
| 331 | S331 | -5300.0 | 667.7 |
| 332 | S332 | -5340.0 | 512.2 |
| 333 | S333 | -5380.0 | 667.7 |
| 334 | S334 | -5420.0 | 512.2 |
| 335 | S335 | -5460.0 | 667.7 |
| 336 | S336 | -5500.0 | 512.2 |
| 337 | S337 | -5540.0 | 667.7 |
| 338 | S338 | -5580.0 | 512.2 |
| 339 | S339 | -5620.0 | 667.7 |
| 340 | S340 | -5660.0 | 512.2 |
| 341 | S341 | -5700.0 | 667.7 |
| 342 | S342 | -5740.0 | 512.2 |
| 343 | S343 | -5780.0 | 667.7 |
| 344 | S344 | -5820.0 | 512.2 |
| 345 | S345 | -5860.0 | 667.7 |
| 346 | S346 | -5900.0 | 512.2 |
| 347 | S347 | -5940.0 | 667.7 |
| 348 | S348 | -5980.0 | 512.2 |

Table 2-1. Pad Layout (3/3)

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|---------|--------|
| 349 | S349 | -6020.0 | 667.7 |
| 350 | S350 | -6060.0 | 512.2 |
| 351 | S351 | -6100.0 | 667.7 |
| 352 | S352 | -6140.0 | 512.2 |
| 353 | S353 | -6180.0 | 667.7 |
| 354 | S354 | -6220.0 | 512.2 |
| 355 | S355 | -6260.0 | 667.7 |
| 356 | S356 | -6300.0 | 512.2 |
| 357 | S357 | -6340.0 | 667.7 |
| 358 | S358 | -6380.0 | 512.2 |
| 359 | S359 | -6420.0 | 667.7 |
| 360 | S360 | -6460.0 | 512.2 |
| 361 | S361 | -6500.0 | 667.7 |
| 362 | S362 | -6540.0 | 512.2 |
| 363 | S363 | -6580.0 | 667.7 |
| 364 | S364 | -6620.0 | 512.2 |
| 365 | S365 | -6660.0 | 667.7 |
| 366 | S366 | -6700.0 | 512.2 |
| 367 | S367 | -6740.0 | 667.7 |
| 368 | S368 | -6780.0 | 512.2 |
| 369 | S369 | -6820.0 | 667.7 |
| 370 | S370 | -6860.0 | 512.2 |
| 371 | S371 | -6900.0 | 667.7 |
| 372 | S372 | -6940.0 | 512.2 |
| 373 | S373 | -6980.0 | 667.7 |
| 374 | S374 | -7020.0 | 512.2 |
| 375 | S375 | -7060.0 | 667.7 |
| 376 | S376 | -7100.0 | 512.2 |
| 377 | S377 | -7140.0 | 667.7 |
| 378 | S378 | -7180.0 | 512.2 |
| 379 | S379 | -7220.0 | 667.7 |
| 380 | S380 | -7260.0 | 512.2 |
| 381 | S381 | -7300.0 | 667.7 |
| 382 | S382 | -7340.0 | 512.2 |
| 383 | S383 | -7380.0 | 667.7 |
| 384 | S384 | -7420.0 | 512.2 |
| 385 | S385 | -7460.0 | 667.7 |
| 386 | S386 | -7500.0 | 512.2 |
| 387 | S387 | -7540.0 | 667.7 |
| 388 | S388 | -7580.0 | 512.2 |
| 389 | S389 | -7620.0 | 667.7 |
| 390 | S390 | -7660.0 | 512.2 |
| 391 | S391 | -7700.0 | 667.7 |
| 392 | S392 | -7740.0 | 512.2 |
| 393 | S393 | -7780.0 | 667.7 |
| 394 | S394 | -7820.0 | 512.2 |
| 395 | S395 | -7860.0 | 667.7 |
| 396 | S396 | -7900.0 | 512.2 |
| 397 | Dummy1 | -8031.4 | 687.0 |
| 398 | Dummy2 | -8367.0 | 347.0 |
| 399 | Dummy3 | -8367.0 | 247.0 |
| 400 | Dummy4 | -8367.0 | 147.0 |
| 401 | Dummy5 | -8367.0 | 47.0 |
| 402 | Dummy6 | -8367.0 | -53.1 |
| 403 | Dummy7 | -8367.0 | -153.1 |
| 404 | Dummy8 | -8367.0 | -253.1 |
| 405 | Dummy9 | -8367.0 | -353.1 |
| 406 | Dummy10 | -8367.0 | -453.2 |

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|---------|--------|
| 407 | Dummy11 | -8367.0 | -553.2 |
| 408 | Dummy12 | -8254.8 | -687.0 |
| 409 | VCOM | -8079.8 | -687.0 |
| 410 | STHL | -7829.8 | -687.0 |
| 411 | Dummy13 | -7654.8 | -687.0 |
| 412 | VDD2 | -7393.4 | -687.0 |
| 413 | VDD2 | -7293.4 | -687.0 |
| 414 | VDD2 | -7193.4 | -687.0 |
| 415 | Dummy14 | -6932.0 | -687.0 |
| 416 | VDD1 | -6831.9 | -687.0 |
| 417 | VDD1 | -6732.0 | -687.0 |
| 418 | VDD1 | -6632.0 | -687.0 |
| 419 | Dummy15 | -6456.9 | -687.0 |
| 420 | VSS1 | -6278.6 | -687.0 |
| 421 | VSS1 | -6178.7 | -687.0 |
| 422 | VSS1 | -6078.7 | -687.0 |
| 423 | Dummy16 | -5903.7 | -686.9 |
| 424 | VSS2 | -5728.7 | -687.0 |
| 425 | VSS2 | -5628.7 | -687.0 |
| 426 | VSS2 | -5528.7 | -687.0 |
| 427 | Dummy17 | -5350.4 | -687.0 |
| 428 | VCSEL | -5175.4 | -687.0 |
| 429 | R/L | -4925.3 | -687.0 |
| 430 | OSEL | -4675.3 | -687.0 |
| 431 | BA | -4425.3 | -687.0 |
| 432 | GAM | -4175.3 | -687.0 |
| 433 | CM | -3925.3 | -687.0 |
| 434 | POL | -3675.2 | -687.0 |
| 435 | AP | -3425.2 | -687.0 |
| 436 | STB | -3175.2 | -687.0 |
| 437 | D25 | -2925.2 | -687.0 |
| 438 | D24 | -2675.2 | -687.0 |
| 439 | D23 | -2425.1 | -687.0 |
| 440 | D22 | -2175.1 | -687.0 |
| 441 | D21 | -1925.1 | -687.0 |
| 442 | D20 | -1675.1 | -687.0 |
| 443 | CLK | -1425.1 | -687.0 |
| 444 | Dummy18 | -1250.0 | -687.0 |
| 445 | V4 | -1075.0 | -687.0 |
| 446 | V4 | -975.0 | -687.0 |
| 447 | V4 | -875.1 | -687.0 |
| 448 | Dummy19 | -700.0 | -687.0 |
| 449 | V3 | -525.0 | -687.0 |
| 450 | V3 | -425.0 | -687.0 |
| 451 | V3 | -325.1 | -687.0 |
| 452 | Dummy20 | -150.0 | -687.0 |
| 453 | V2 | 25.1 | -687.0 |
| 454 | V2 | 125.0 | -687.0 |
| 455 | V2 | 225.0 | -687.0 |
| 456 | Dummy21 | 400.0 | -687.0 |
| 457 | V1 | 575.1 | -687.0 |
| 458 | V1 | 675.0 | -687.0 |
| 459 | V1 | 775.0 | -687.0 |
| 460 | Dummy22 | 950.0 | -687.0 |
| 461 | V0 | 1125.1 | -687.0 |
| 462 | V0 | 1225.1 | -687.0 |
| 463 | V0 | 1325.0 | -687.0 |
| 464 | Dummy23 | 1500.1 | -687.0 |

| No. | Pad Name | X [μm] | Y [μm] |
|-----|----------|--------|--------|
| 465 | INV | 1675.1 | -687.0 |
| 466 | D15 | 1925.1 | -687.0 |
| 467 | D14 | 2175.1 | -687.0 |
| 468 | D13 | 2425.1 | -687.0 |
| 469 | D12 | 2675.2 | -687.0 |
| 470 | D11 | 2925.2 | -687.0 |
| 471 | D10 | 3175.2 | -687.0 |
| 472 | D05 | 3425.2 | -687.0 |
| 473 | D04 | 3675.2 | -687.0 |
| 474 | D03 | 3925.3 | -687.0 |
| 475 | D02 | 4175.3 | -687.0 |
| 476 | D01 | 4425.3 | -687.0 |
| 477 | D00 | 4675.3 | -687.0 |
| 478 | TESTO1 | 4925.3 | -687.0 |
| 479 | TESTO2 | 5175.4 | -687.0 |
| 480 | TESTIN | 5425.4 | -687.0 |
| 481 | Dummy24 | 5600.4 | -687.0 |
| 482 | VDD1 | 5775.5 | -687.0 |
| 483 | VDD1 | 5875.5 | -687.0 |
| 484 | VDD1 | 5975.4 | -687.0 |
| 485 | Dummy25 | 6075.5 | -687.0 |
| 486 | VSS1 | 6253.8 | -687.0 |
| 487 | VSS1 | 6353.8 | -687.0 |
| 488 | VSS1 | 6453.8 | -687.0 |
| 489 | Dummy26 | 6628.8 | -687.0 |
| 490 | VSS2 | 6803.8 | -687.0 |
| 491 | VSS2 | 6903.8 | -687.0 |
| 492 | VSS2 | 7003.7 | -687.0 |
| 493 | Dummy27 | 7182.0 | -687.0 |
| 494 | VDD2 | 7443.5 | -687.0 |
| 495 | VDD2 | 7543.4 | -687.0 |
| 496 | VDD2 | 7643.4 | -687.0 |
| 497 | Dummy28 | 7904.8 | -687.0 |
| 498 | STHR | 8079.8 | -687.0 |
| 499 | Dummy29 | 8254.8 | -687.0 |
| 500 | Dummy30 | 8367.0 | -553.2 |
| 501 | Dummy31 | 8367.0 | -453.2 |
| 502 | Dummy32 | 8367.0 | -353.1 |
| 503 | Dummy33 | 8367.0 | -253.1 |
| 504 | Dummy34 | 8367.0 | -153.1 |
| 505 | Dummy35 | 8367.0 | -53.1 |
| 506 | Dummy36 | 8367.0 | 47.0 |
| 507 | Dummy37 | 8367.0 | 147.0 |
| 508 | Dummy38 | 8367.0 | 247.0 |
| 509 | Dummy39 | 8367.0 | 347.0 |
| 510 | Dummy40 | 8031.4 | 687.0 |

★ 3. PIN FUNCTIONS

(1/2)

| Pin Symbol | Pin Name | Pad No. | I/O | Description |
|------------------------------------|--------------------------------------|------------|--------|---|
| S ₁ to S ₃₉₆ | Driver output | 1 to 396 | Output | The D/A converted 64-gray-scale analog voltage is output. O _{sel} = L: S ₁ to S ₃₉₆ O _{sel} = H: S ₁₉ to S ₃₇₈ |
| D ₀₀ to D ₀₅ | Display data input | 477 to 472 | Input | The display data is input with a width of 18 bits, viz., the gray scale data (6 bits) by 3 dots (1 pixels). D _{X0} : LSB, D _{X5} : MSB |
| D ₁₀ to D ₁₅ | | 471 to 466 | | |
| D ₂₀ to D ₂₅ | | 442 to 437 | | |
| R,/L | Shift direction control input | 429 | Input | These refer to the shift direction control input. The shift directions of the shift registers are as follows. <When in O _{sel} = L> R,/L = L (left shift): STHL (input), S ₃₉₆ → S ₁ → STHR (output) R,/L = H (right shift) : STHR (input), S ₁ → S ₃₉₆ → STHL (output) <When in O _{sel} = H> R,/L = L (left shift): STHL (input), S ₃₇₈ → S ₁₉ → STHR (output) R,/L = H (right shift) : STHR (input), S ₁₉ → S ₃₇₈ → STHL (output) |
| STHR | Right shift start pulse input/output | 498 | I/O | These refer to the start pulse I/O pins when driver ICs are connected in cascade. Fetching of display data starts when H is read at the rising edge of CLK. R,/L = H (right shift): STHR input, STHL output R,/L = L (left shift): STHL input, STHR output |
| STHL | Left shift start pulse input/output | 410 | I/O | |
| CLK | Shift clock input | 443 | Input | This pin is the shift clock input of the shift register. Display data is captured into the data register at the rising edge. O _{sel} = L: The start pulse output enters high level at the rising edge of the 132 th clock following the start pulse input, and becomes the start pulse of the next level driver. The 133th clock of the first driver becomes the start pulse input of the next driver O _{sel} = H: The start pulse output enters high level at the rising edge of the 120th clock following the start pulse input, and becomes the start pulse of the next driver. The 121th clock of the first driver becomes the start pulse input of the next driver. |
| STB | Latch input | 436 | Input | A timing signal that latches the contents of the data register. When an H level is read at the rising edge of CLK, the contents of the data register are latched and transferred to the D/A converter, and analog voltage corresponding to the display data is output. Also, because the internal operation via CLK continues even after the STB latch, do not stop CLK. The contents of the shift register are cleared at the rising edge of STB. Following a 1-pulse input at startup, this IC will operate normally. Note that the output switch is turned off at the rising edge of STB. For the STB input timing, refer to Switching Characteristics Waveform . |
| POL | Polarity inversion signal | 434 | Input | This pin inverts the output polarity. The polarity inversion signal data is captured at the rising edge of STB. The γ-resistor is switched in accordance with the positive/negative polarity. POL = L: Negative polarity POL = H: Positive polarity |
| INV | Data inversion | 465 | Input | This pin inverts the input data. Input data in synchronization with the shift clock. INV = L: Normal input INV = H: Data inversion input |
| VCOM | COM amplitude output | 409 | Output | This pin inverts the signal input from the POL pin and outputs it following conversion to the V _{DD2} potential at the rising edge of STB. When the VCOM output is not used, VC _{sel} must be fixed to L. |

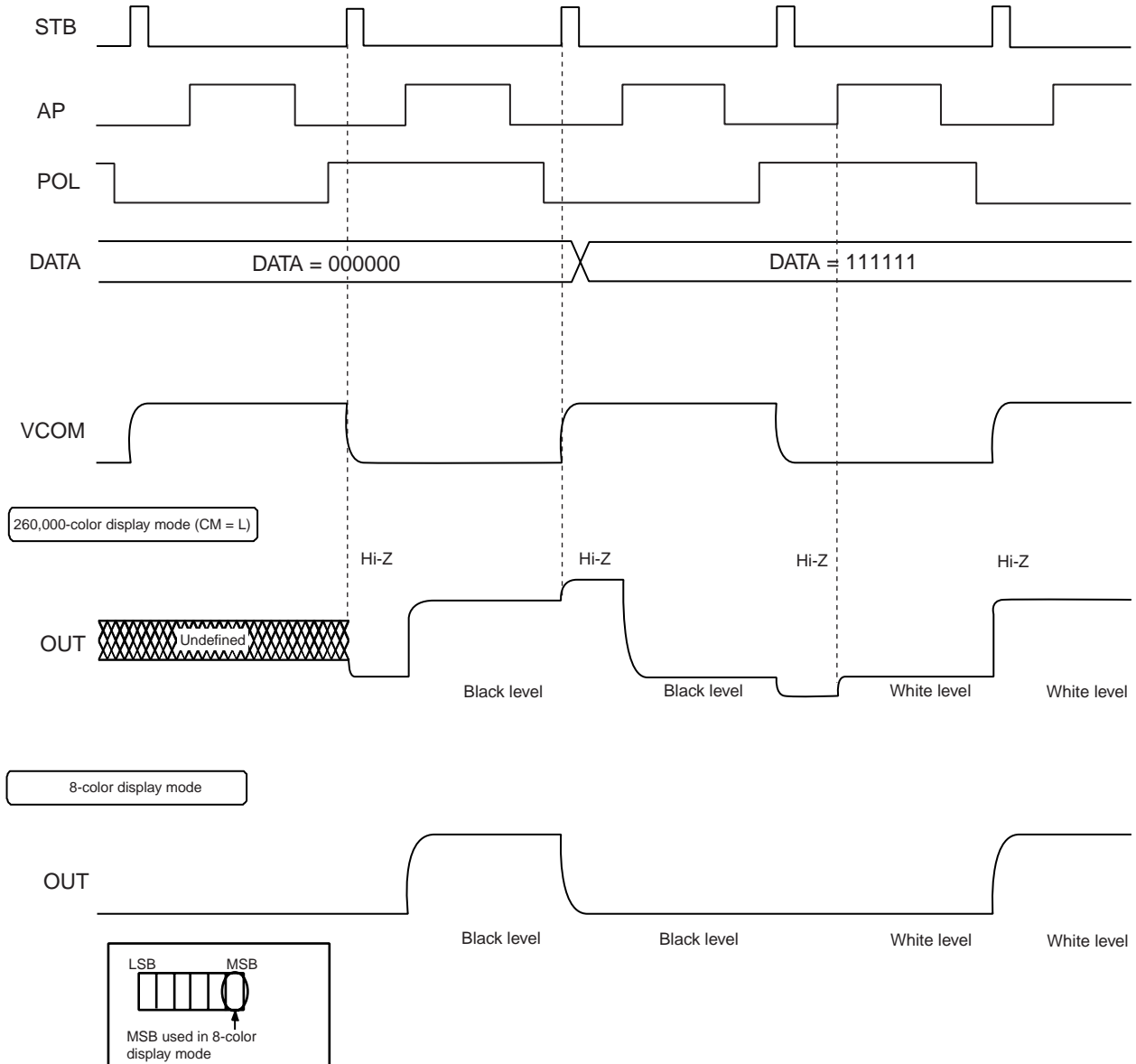
| Pin Symbol | Pin Name | Pad No. | I/O | Description |
|---|------------------------------------|--|--------|--|
| VC _{sel} | COM amplitude output fixing signal | 428 | Input | The VCOM output is fixed to L. When the VCOM output is not used, VC _{sel} needs to be fixed to L. VC _{sel} = L: VCOM output fixed to L VC _{sel} = H: VCOM signal output in correspondence with POL signal |
| CM | 8-color display mode switching | 433 | Input | The operating mode is switched to 8-color mode. In this mode, turn off the γ -resistor, amplifier, and BIAS circuit. However, when the γ -correction power supply is input externally, the γ -circuit current will flow continuously. CM = L: Normal display mode CM = H: 8-color display mode |
| AP | Output SW ON/OFF | 435 | Input | This pin turns ON/OFF the BIAS circuit and turns on the output SW and amplifier. When AP is H, the amplifier is set and the LCD is driving. The amplifier output and output SW are turned on at the rising edge of AP, starting the LCD drive. Note that the output SW is turned off at the rising edge of STB and the output becomes Hi-Z. For the AP input timing, refer to Switching Characteristics Waveform . |
| GAM | External γ usage selection | 432 | Input | When the γ -correction power supply is input externally, switch GAM to H. If two or more chips are used, be sure to input the γ -correction power supply externally. Figure 4-1 shows an input example of the γ -correction power supply. GAM = L: External γ -correction power supply not input (open) GAM = H: External γ -correction power supply input |
| O _{sel} | Driver output count switching | 430 | Input | The output count can be selected. When O _{sel} = H, the unused pins S ₁ to S ₁₈ and S ₃₇₉ to S ₃₉₆ always become Hi-Z. O _{sel} = L: 396 outputs O _{sel} = H: 360 outputs |
| V ₀ to V ₄ | γ -corrected power supplies | 461 to 463, 457 to 459, 453 to 455, 449 to 451, 445 to 447 | – | These pins input the γ -corrected power supplies from outside, the relationship below must be observed. Also, be sure to stabilize the gray-scale-level power supply during gray-scale voltage output. $V_{SS2} \leq V_4 \leq V_3 \leq V_2 \leq V_1 \leq V_0 \leq V_{DD2}$ |
| BA | BIAS current adjustment function | 431 | Input | This pin adjusts the BIAS current. Select either the high power mode or low power mode. BA = L: Low power mode BA = H: high power mode |
| TEST _{IN} | TEST input pin | 480 | Input | Set to H or leave open |
| TEST _{O1} , TEST _{O2} | TEST output pin | 478, 479 | Output | Leave open. |
| V _{DD1} | Logic power supply | 416 to 418, 482 to 484 | – | 2.2 to 3.6 V |
| V _{DD2} | Driver power supply | 412 to 414, 494 to 496 | – | 4.5 to 5.5 V |
| V _{SS1} | Logic ground | 420 to 422, 486 to 488 | – | Ground |
| V _{SS2} | Driver ground | 424 to 426, 490 to 492 | – | Ground |
| Dummy1 to dummy40 | Dummy | 397 to 408, 411, 415, 419, 423, 427, 444, 448, 452, 456, 460, 464, 481, 485, 489, 493, 487, 499 to 510 | – | This pin is dummy. |

Caution To avoid latchup failure, the sequence when turning on the power must be V_{DD1} → logic input → V_{DD2} → gray-scale power supply (V₀ to V₄), and the reverse sequence when turning off the power. Follow this sequence during shift periods as well.

4. EXAMPLES OF EACH SIGNAL INPUT OR OUTPUT

Examples of the input/output timing of each signal during white and black display are shown below.

Figure 4-1. Timing Chart

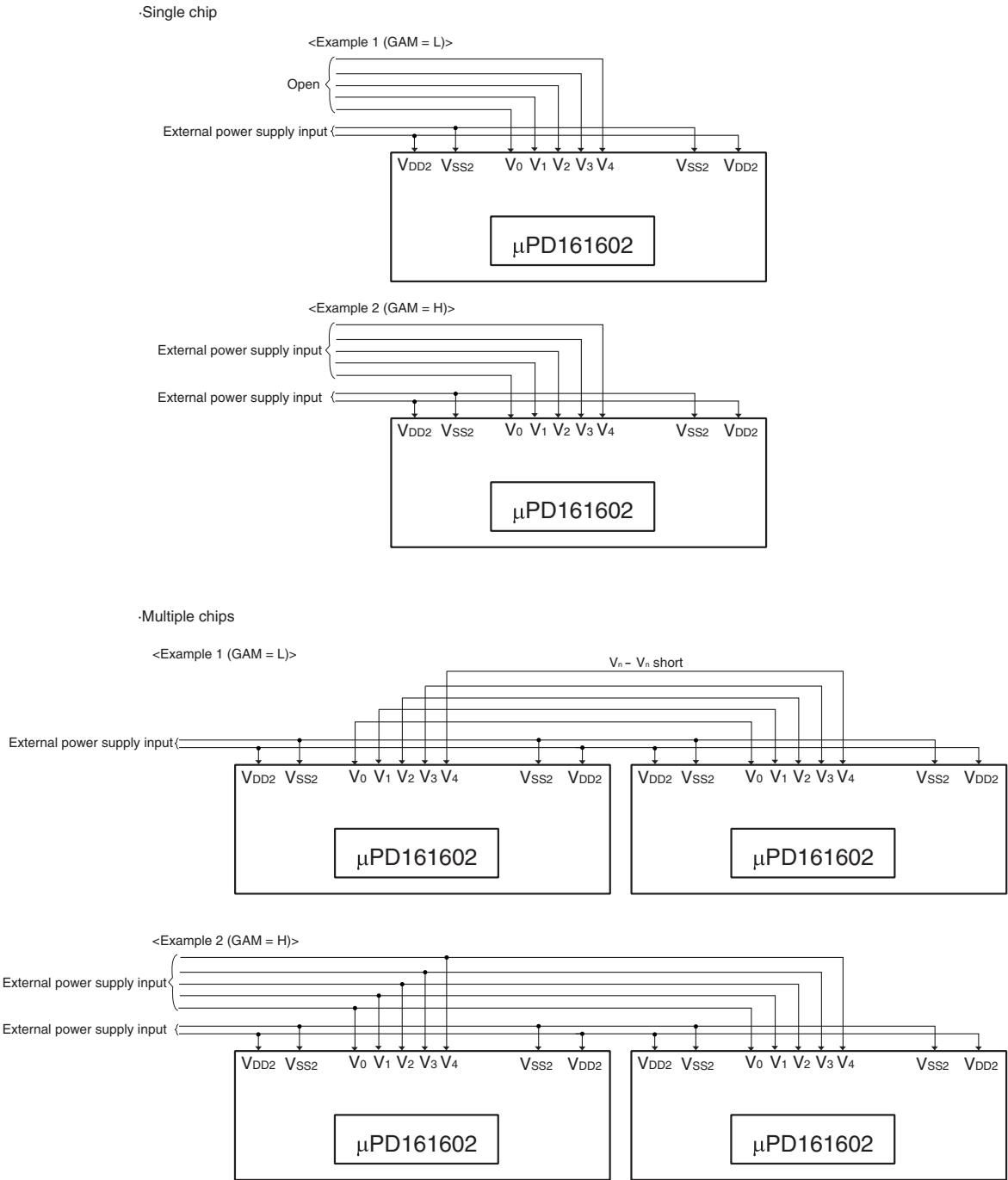


4.1 γ -Correction Power Supply Connection Example

The μ PD161602A/B enables customization of the γ -correction power supply on both the positive and negative polarity sides (refer to 6. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT VOLTAGE VALUE). Consequently, a γ -correction power supply does not have to be input externally when a single source-driver chip is being used in the panel.

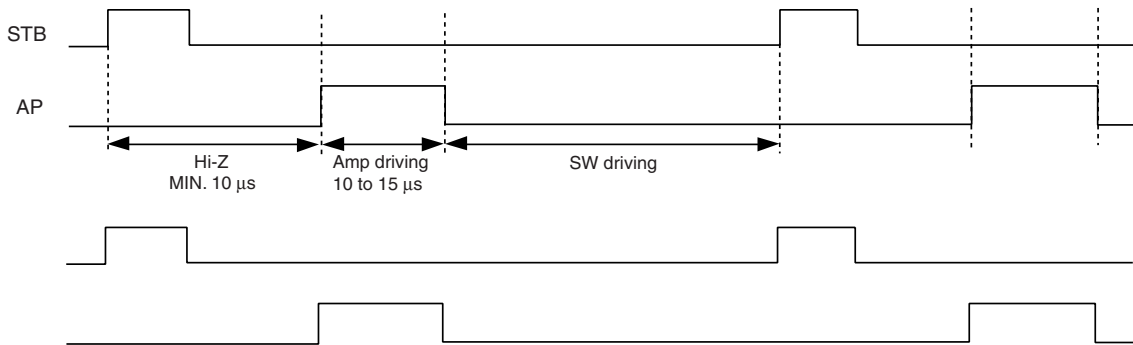
Multiple chips can also be used without having to input a γ -correction power supply externally because the error between the chips can be absorbed by shorting the γ -correction power supply pins, as shown in Figure 4–2.

Figure 4–2. γ -Correction Power-Supply Connection Example



4.2 AP Signal Timing

The driver power consumption is dependent on the high period of the AP signal because the operational amplifier in the IC is operation and current is constantly flowing in this period. A chart indication the recommended timing of inputting the AP signal vis-a-vis the STB signal is shown below.

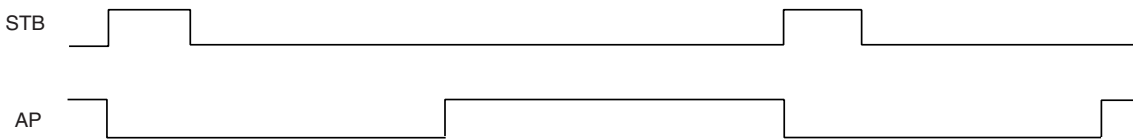


Note that the ideal AP signal high period differs depending on the load of the liquid crystal. The AP period must therefore be able to be adjusted using a controller.

The AP signal can also be used as shown below. However, in these cases, be sure to perform sufficient evaluation before use.

<When SW drive in not used>

Only the amp is driven (SW drive is not used) if one horizontal period is short (40 μs or less) or the liquid crystal load is large (50 pF or more).



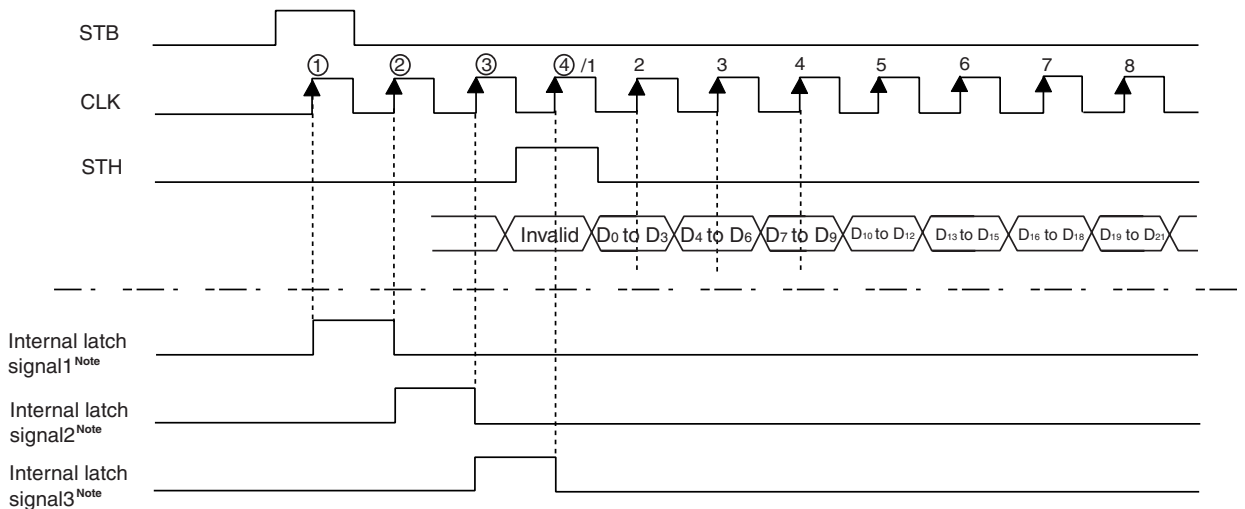
<When the AP signal high period is 10 μs or less>

The amp drive period is shortened and the SW drive period lengthened when one horizontal period is long (100 μs or more) and the liquid crystal load is small (20 pF).



4.3 CLK Signal Input

Input at least 4 clocks of the CLK signal after the rising of the STB signal.



Note Internal latch signal : It is the signal that do latch the display data put in data register in output latch circuit.

5. MODE EXPLANATION

Normal Mode/ 8-clor Display Mode

| CM | POL | Data | Driver Output Status | Driver Output (in normally white) |
|----|-----|-------------|----------------------|-----------------------------------|
| H | H | MSB = H | 8-color mode | White level display |
| | | MSB = L | | Black level display |
| | L | MSB = H | | White level display |
| | | MSB = L | | Black level display |
| L | H | All bit = H | 260,000-color mode | White level display |
| | | All bit = L | | Black level display |
| | L | All bit = H | | White level display |
| | | All bit = L | | Black level display |

6. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT VOLTAGE VALUE

The relation between input data and output voltage are shown in Table 6–2, 6–3.

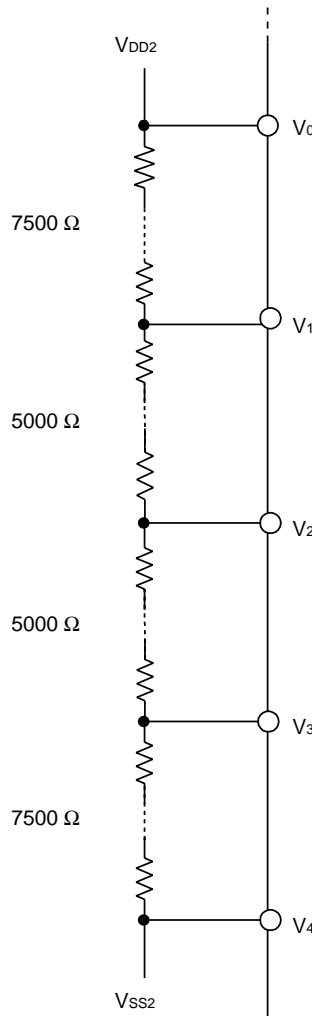
Any 3 major points V₁ to V₃ from the LCD panel γ-characteristics curve can be used as the external power supplies.

The relationship V₀ to V₄ external power supplies and γ-correction resistance is shown in Table 6–1, Figure 6–1.

Table 6–1. Relationship between External Power Supply Pins and γ-correction Resistance

| Pin Name | Voltage (V) | Resistance (Ω) |
|----------------|-------------|----------------|
| V ₀ | 5.0 | 0 |
| V ₁ | 3.5 | 7,500 |
| V ₂ | 2.5 | 12,500 |
| V ₃ | 1.5 | 17,500 |
| V ₄ | 0 | 25,000 |

Figure 6–1. Relationship between External Power Supply Pins and γ-correction Resistance



This external power supply pins (V₀ to V₄) can customize the γ-correction voltage by selecting the desired voltage from one of 250 divisions of the string resistor between V_{SS2} and V_{DD2}, which generated γ-correction voltage. Note that the voltage can be selected individually for both positive and negative polarity.

Table 6-2. Relation of Input Data and Output Voltage in μPD161602A

| Input Data | Gray Scale | Positive Polarity Side (V) | Negative Polarity Side (V) | Positive Polarity Side (Ω) | Negative Polarity Side (Ω) |
|------------|------------|----------------------------|----------------------------|----------------------------|----------------------------|
| 00H | 0 | 5.000 | 0.000 | 0 | 25000 |
| 01H | 1 | 4.920 | 0.080 | 400 | 24600 |
| 02H | 2 | 4.760 | 0.260 | 1200 | 23700 |
| 03H | 3 | 4.540 | 0.480 | 2300 | 22600 |
| 04H | 4 | 4.280 | 0.760 | 3600 | 21200 |
| 05H | 5 | 3.960 | 1.080 | 5200 | 19600 |
| 06H | 6 | 3.840 | 1.200 | 5800 | 19000 |
| 07H | 7 | 3.740 | 1.300 | 6300 | 18500 |
| 08H | 8 | 3.640 | 1.400 | 6800 | 18000 |
| 09H | 9 | 3.540 | 1.520 | 7300 | 17400 |
| 0AH | 10 | 3.480 | 1.580 | 7600 | 17100 |
| 0BH | 11 | 3.400 | 1.660 | 8000 | 16700 |
| 0CH | 12 | 3.320 | 1.740 | 8400 | 16300 |
| 0DH | 13 | 3.240 | 1.840 | 8800 | 15800 |
| 0EH | 14 | 3.160 | 1.920 | 9200 | 15400 |
| 0FH | 15 | 3.100 | 2.000 | 9500 | 15000 |
| 10H | 16 | 3.060 | 2.060 | 9700 | 14700 |
| 11H | 17 | 3.000 | 2.100 | 10000 | 14500 |
| 12H | 18 | 2.960 | 2.160 | 10200 | 14200 |
| 13H | 19 | 2.900 | 2.220 | 10500 | 13900 |
| 14H | 20 | 2.860 | 2.280 | 10700 | 13600 |
| 15H | 21 | 2.820 | 2.320 | 10900 | 13400 |
| 16H | 22 | 2.780 | 2.360 | 11100 | 13200 |
| 17H | 23 | 2.740 | 2.400 | 11300 | 13000 |
| 18H | 24 | 2.700 | 2.440 | 11500 | 12800 |
| 19H | 25 | 2.680 | 2.480 | 11600 | 12600 |
| 1AH | 26 | 2.640 | 2.520 | 11800 | 12400 |
| 1BH | 27 | 2.620 | 2.560 | 11900 | 12200 |
| 1CH | 28 | 2.600 | 2.580 | 12000 | 12100 |
| 1DH | 29 | 2.560 | 2.620 | 12200 | 11900 |
| 1EH | 30 | 2.540 | 2.660 | 12300 | 11700 |
| 1FH | 31 | 2.500 | 2.700 | 12500 | 11500 |

| Input Data | Gray Scale | Positive Polarity Side (V) | Negative Polarity Side (V) | Positive Polarity Side (Ω) | Negative Polarity Side (Ω) |
|------------|------------|----------------------------|----------------------------|----------------------------|----------------------------|
| 20H | 32 | 2.480 | 2.720 | 12600 | 11400 |
| 21H | 33 | 2.460 | 2.760 | 12700 | 11200 |
| 22H | 34 | 2.420 | 2.800 | 12900 | 11000 |
| 23H | 35 | 2.400 | 2.820 | 13000 | 10900 |
| 24H | 36 | 2.360 | 2.860 | 13200 | 10700 |
| 25H | 37 | 2.340 | 2.900 | 13300 | 10500 |
| 26H | 38 | 2.300 | 2.940 | 13500 | 10300 |
| 27H | 39 | 2.280 | 2.960 | 13600 | 10200 |
| 28H | 40 | 2.240 | 3.000 | 13800 | 10000 |
| 29H | 41 | 2.220 | 3.040 | 13900 | 9800 |
| 2AH | 42 | 2.180 | 3.080 | 14100 | 9600 |
| 2BH | 43 | 2.160 | 3.100 | 14200 | 9500 |
| 2CH | 44 | 2.140 | 3.140 | 14300 | 9300 |
| 2DH | 45 | 2.120 | 3.180 | 14400 | 9100 |
| 2EH | 46 | 2.080 | 3.200 | 14600 | 9000 |
| 2FH | 47 | 2.060 | 3.240 | 14700 | 8800 |
| 30H | 48 | 2.040 | 3.260 | 14800 | 8700 |
| 31H | 49 | 2.020 | 3.300 | 14900 | 8500 |
| 32H | 50 | 1.980 | 3.340 | 15100 | 8300 |
| 33H | 51 | 1.960 | 3.360 | 15200 | 8200 |
| 34H | 52 | 1.920 | 3.400 | 15400 | 8000 |
| 35H | 53 | 1.900 | 3.440 | 15500 | 7800 |
| 36H | 54 | 1.860 | 3.480 | 15700 | 7600 |
| 37H | 55 | 1.840 | 3.520 | 15800 | 7400 |
| 38H | 56 | 1.780 | 3.580 | 16100 | 7100 |
| 39H | 57 | 1.740 | 3.620 | 16300 | 6900 |
| 3AH | 58 | 1.680 | 3.680 | 16600 | 6600 |
| 3BH | 59 | 1.620 | 3.760 | 16900 | 6200 |
| 3CH | 60 | 1.520 | 3.860 | 17400 | 5700 |
| 3DH | 61 | 1.360 | 4.040 | 18200 | 4800 |
| 3EH | 62 | 1.180 | 4.220 | 19100 | 3900 |
| 3FH | 63 | 0.400 | 5.000 | 23000 | 0 |

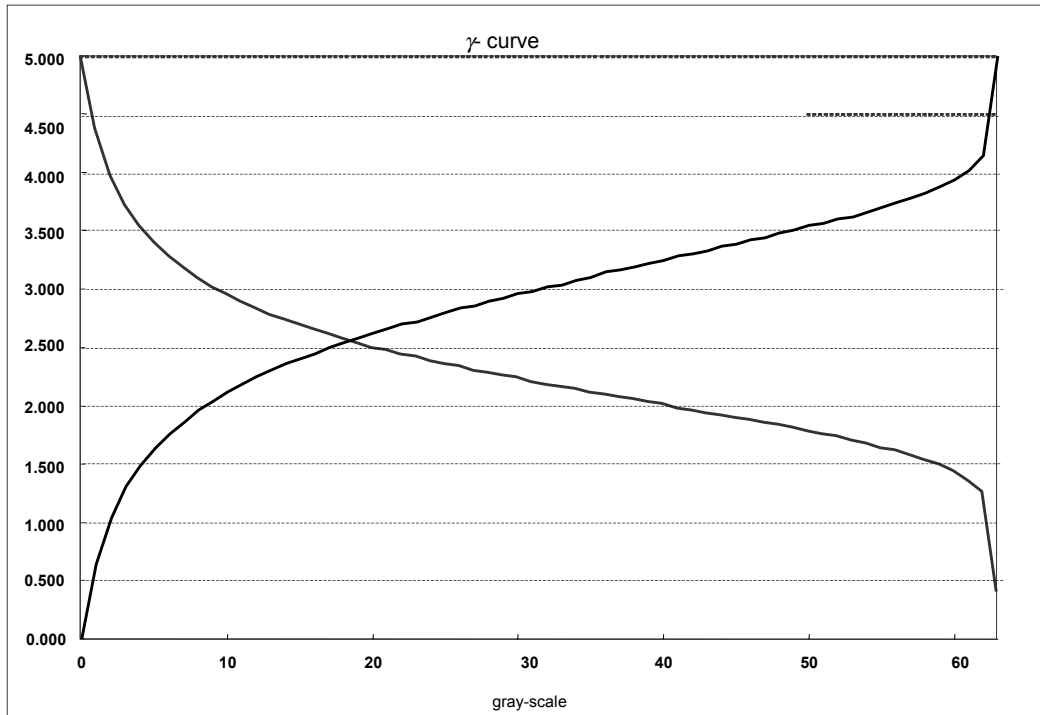
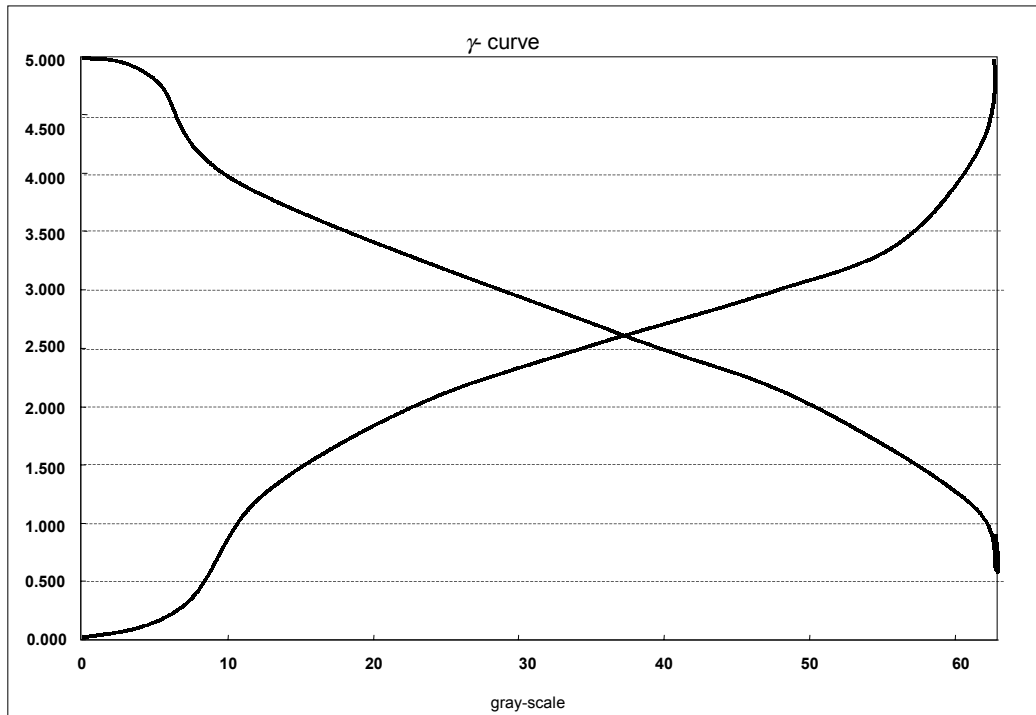


Table 6-3. Relation of Input Data and Output Voltage in μPD161602B

| Input Data | Gray Scale | Positive Polarity Side (V) | Negative Polarity Side (V) | Positive Polarity Side (Ω) | Negative Polarity Side (Ω) |
|------------|------------|----------------------------|----------------------------|----------------------------|----------------------------|
| 00H | 0 | 5.000 | 0.000 | 0 | 25000 |
| 01H | 1 | 4.980 | 0.020 | 100 | 24900 |
| 02H | 2 | 4.960 | 0.060 | 200 | 24700 |
| 03H | 3 | 4.920 | 0.100 | 400 | 24500 |
| 04H | 4 | 4.880 | 0.140 | 600 | 24300 |
| 05H | 5 | 4.800 | 0.220 | 1000 | 23900 |
| 06H | 6 | 4.720 | 0.300 | 1400 | 23500 |
| 07H | 7 | 4.600 | 0.440 | 2000 | 22800 |
| 08H | 8 | 4.460 | 0.580 | 2700 | 22100 |
| 09H | 9 | 4.320 | 0.740 | 3400 | 21300 |
| 0AH | 10 | 4.160 | 0.920 | 4200 | 20400 |
| 0BH | 11 | 4.000 | 1.080 | 5000 | 19600 |
| 0CH | 12 | 3.860 | 1.240 | 5700 | 18800 |
| 0DH | 13 | 3.780 | 1.320 | 6100 | 18400 |
| 0EH | 14 | 3.700 | 1.420 | 6500 | 17900 |
| 0FH | 15 | 3.620 | 1.500 | 6900 | 17500 |
| 10H | 16 | 3.540 | 1.600 | 7300 | 17000 |
| 11H | 17 | 3.460 | 1.680 | 7700 | 16600 |
| 12H | 18 | 3.380 | 1.760 | 8100 | 16200 |
| 13H | 19 | 3.320 | 1.820 | 8400 | 15900 |
| 14H | 20 | 3.280 | 1.880 | 8600 | 15600 |
| 15H | 21 | 3.220 | 1.940 | 8900 | 15300 |
| 16H | 22 | 3.160 | 2.000 | 9200 | 15000 |
| 17H | 23 | 3.120 | 2.040 | 9400 | 14800 |
| 18H | 24 | 3.060 | 2.100 | 9700 | 14500 |
| 19H | 25 | 3.040 | 2.140 | 9800 | 14300 |
| 1AH | 26 | 3.000 | 2.180 | 10000 | 14100 |
| 1BH | 27 | 2.960 | 2.220 | 10200 | 13900 |
| 1CH | 28 | 2.940 | 2.240 | 10300 | 13800 |
| 1DH | 29 | 2.900 | 2.280 | 10500 | 13600 |
| 1EH | 30 | 2.860 | 2.320 | 10700 | 13400 |
| 1FH | 31 | 2.820 | 2.360 | 10900 | 13200 |
| 20H | 32 | 2.780 | 2.400 | 11100 | 13000 |
| 21H | 33 | 2.760 | 2.440 | 11200 | 12800 |
| 22H | 34 | 2.720 | 2.480 | 11400 | 12600 |
| 23H | 35 | 2.680 | 2.520 | 11600 | 12400 |
| 24H | 36 | 2.660 | 2.540 | 11700 | 12300 |
| 25H | 37 | 2.620 | 2.580 | 11900 | 12100 |
| 26H | 38 | 2.600 | 2.620 | 12000 | 11900 |
| 27H | 39 | 2.560 | 2.660 | 12200 | 11700 |
| 28H | 40 | 2.520 | 2.700 | 12400 | 11500 |
| 29H | 41 | 2.480 | 2.740 | 12600 | 11300 |
| 2AH | 42 | 2.460 | 2.780 | 12700 | 11100 |
| 2BH | 43 | 2.400 | 2.820 | 13000 | 10900 |
| 2CH | 44 | 2.360 | 2.860 | 13200 | 10700 |
| 2DH | 45 | 2.340 | 2.900 | 13300 | 10500 |
| 2EH | 46 | 2.300 | 2.940 | 13500 | 10300 |
| 2FH | 47 | 2.260 | 2.980 | 13700 | 10100 |
| 30H | 48 | 2.220 | 3.020 | 13900 | 9900 |
| 31H | 49 | 2.180 | 3.060 | 14100 | 9700 |
| 32H | 50 | 2.140 | 3.100 | 14300 | 9500 |
| 33H | 51 | 2.100 | 3.160 | 14500 | 9200 |
| 34H | 52 | 2.040 | 3.220 | 14800 | 8900 |
| 35H | 53 | 2.000 | 3.260 | 15000 | 8700 |
| 36H | 54 | 1.960 | 3.320 | 15200 | 8400 |
| 37H | 55 | 1.900 | 3.380 | 15500 | 8100 |
| 38H | 56 | 1.840 | 3.420 | 15800 | 7900 |
| 39H | 57 | 1.780 | 3.520 | 16100 | 7400 |
| 3AH | 58 | 1.700 | 3.600 | 16500 | 7000 |
| 3BH | 59 | 1.580 | 3.720 | 17100 | 6400 |
| 3CH | 60 | 1.460 | 3.840 | 17700 | 5800 |
| 3DH | 61 | 1.260 | 4.060 | 18700 | 4700 |
| 3EH | 62 | 1.080 | 4.280 | 19600 | 3600 |
| 3FH | 63 | 0.400 | 5.000 | 23000 | 0 |

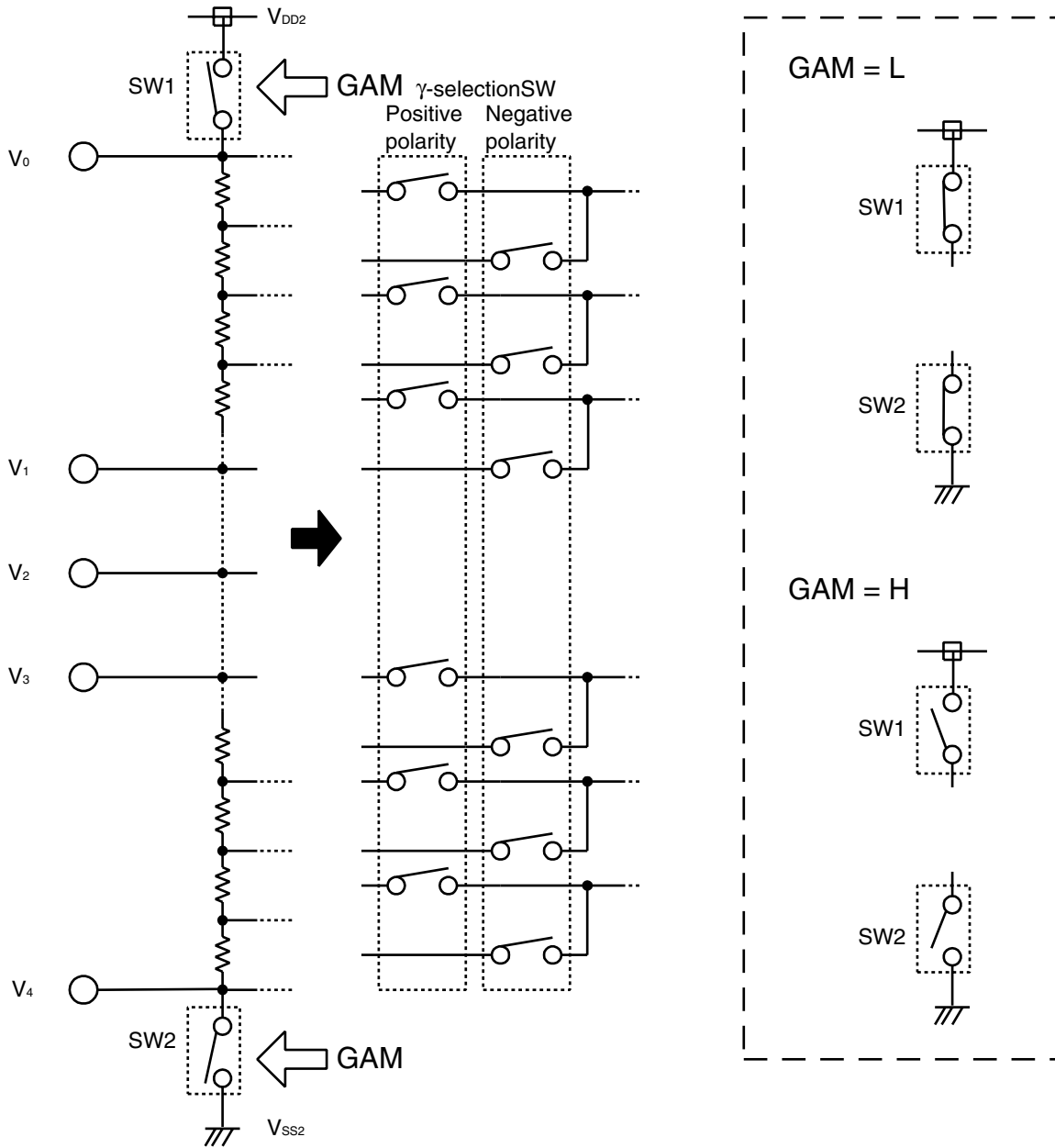


6.1 Connection between γ -correction Resistance, Power Supply, and GND Pin

Connection of γ compensation resistance power supply (V_0 - V_4) and a power supply pin (V_{DD2} and V_{SS2}) is indicated below to be γ compensation resistance of μPD161602 A/B.

By setup of a GAM pin, as for γ -compensation resistance, connection changes the highest minimum potential between V_{DD2} - V_{SS2} or among V_0 - V_4 .

Figure 6-2. GAM Pin Function



7. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT PIN

Data format: 6 bits x RGBs (3 dots)

Input width: 18 bits (1-pixel data)

R,/L = H (Right shift), O_{sel} = L (396 outputs)

| | | | | | | | |
|--------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-----|------------------------------------|------------------------------------|
| Output | S ₁ | S ₂ | S ₃ | S ₄ | ... | S ₃₉₅ | S ₃₉₆ |
| Data | D ₀₀ to D ₀₅ | D ₁₀ to D ₁₅ | D ₂₀ to D ₂₅ | D ₀₀ to D ₀₅ | ... | D ₁₀ to D ₁₅ | D ₂₀ to D ₂₅ |

R,/L = L (Left shift), O_{sel} = L (396 outputs)

| | | | | | | | |
|--------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-----|------------------------------------|------------------------------------|
| Output | S ₁ | S ₂ | S ₃ | S ₄ | ... | S ₃₉₅ | S ₃₉₆ |
| Data | D ₀₀ to D ₀₅ | D ₁₀ to D ₁₅ | D ₂₀ to D ₂₅ | D ₀₀ to D ₀₅ | ... | D ₁₀ to D ₁₅ | D ₂₀ to D ₂₅ |

8. ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings (T_A = 25°C, V_{SS1} = V_{SS2} = 0 V)

| Parameter | Symbol | Rating | Unit |
|-------------------------------|------------------|----------------------------------|------|
| Logic Part Supply Voltage | V _{DD1} | -0.3 to +4.5 | V |
| Driver Part Supply Voltage | V _{DD2} | -0.3 to +6.0 | V |
| Input Voltage | V _I | -0.3 to V _{DD1,2} + 0.3 | V |
| Output Voltage | V _O | -0.3 to V _{DD1,2} + 0.3 | V |
| Operating Ambient Temperature | T _A | -20 to +75 | °C |
| Storage Temperature | T _{stg} | -55 to +125 | °C |

Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

Recommended Operating Range (T_A = -20 to +75°C, V_{SS1} = V_{SS2} = 0 V)

| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|----------------------------|----------------------------------|-----------|----------------------|------|----------------------|------|
| Logic Part Supply Voltage | V _{DD1} | | 2.2 | | 3.6 | V |
| Driver Part Supply Voltage | V _{DD2} | | 4.5 | 5.0 | 5.5 | V |
| High-Level Input Voltage | V _{IH} | | 0.7 V _{DD1} | | V _{DD1} | V |
| Low-Level Input Voltage | V _{IL} | | 0 | | 0.3 V _{DD1} | V |
| γ-Corrected Voltage | V ₀ to V ₄ | | V _{SS2} | | V _{DD2} | V |
| Clock Frequency | f _{CLK} | | | | 15 | MHz |

Electrical Characteristics (T_A = -20 to +75°C, V_{DD1} = 2.2 to 3.6 V, V_{DD2} = 5.0 V ± 0.5 V, V_{SS1} = V_{SS2} = 0 V)

| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|--|-------------------|--|-------------------------|------|-------------------------|------|
| Input Leak Current | I _{IL} | D ₀₀ -D ₀₅ , D ₁₀ -D ₁₅ , D ₂₀ -D ₂₅ , R, /L, STB, CLK, STHR(L), INV, CM, AP, O _{sel} , BA, POL, GAM, VC _{sel} | | | ±1.0 | μA |
| Input Current | I _{IL2} | TEST _{IN} | 10 | 40 | 200 | μA |
| High-Level Output Voltage | V _{OH} | STHR (STHL), I _{OH} = -1.0 mA | V _{DD1} - 0.5 | | | V |
| Low-Level Output Voltage | V _{OL} | STHR (STHL), I _{OL} = +1.0 mA | | | 0.5 | V |
| VCOM Output Voltage | V _{OH2} | V _{DD2} = 5.0 V, I _O = -1.0 mA | V _{DD2} - 0.5 | | | V |
| | V _{OL2} | V _{DD2} = 5.0 V, I _O = +1.0 mA | | | 0.5 | V |
| γ-Correction Power-supply Static Current Consumption | I _γ | V ₀ = 5.0 V, V ₄ = 0 V (when in γ-correction power mode) | 100 | 200 | 400 | μA |
| Driver Output Current (AMP drive) | I _{VOH1} | V _{DD2} = 5.0 V, V _{OUT} = V _X - 1.0 V ^{Note1} Input data: 1FH | | -0.5 | -0.15 | mA |
| | I _{VOL1} | V _{DD2} = 5.0 V, V _{OUT} = V _X + 1.0 V ^{Note1} Input data: 20H | 0.15 | 0.50 | | mA |
| Driver Output Current (Switch drive) | I _{VOH2} | V _{DD2} = 5.0 V, V _{OUT} = V _X - 1.0 V ^{Note1} Input data: 1FH | | -50 | -15 | μA |
| | I _{VOL2} | V _{DD2} = 5.0 V, V _{OUT} = V _X + 1.0 V ^{Note1} Input data: 20H | 15 | 40 | | μA |
| Driver Output Current (8-color display mode) | V _{OH3} | V _{DD2} = 5.0 V, I _O = -50 μA | V _{DD2} - 0.5 | | | V |
| | V _{OL3} | V _{DD2} = 5.0 V, I _O = +50 μA | | | 0.5 | V |
| Output Voltage Deviation | ΔV _O | V _{DD1} = 2.5 V, V _{DD2} = 5.0 V, V _{OUT} = 2.5 V ^{Note1} | | ±10 | ±20 | mV |
| Output Voltage Range | V _O | Input data: 00H to 3FH | V _{SS2} + 0.05 | | V _{DD2} - 0.05 | V |
| Logic Part Dynamic Current Consumption | I _{DD1} | With no load ^{Note2} | | 0.4 | 0.8 | mA |
| Driver Part Dynamic Current Consumption | I _{DD2} | V _{DD} = 5.0 V, with no load ^{Note2} | | 0.9 | 1.5 | mA |

Notes 1. V_X refers to the output voltage of analog output pins S₁ to S₃₉₆.

V_{OUT} refers to the voltage applied to analog output pins S₁ to S₃₉₆.

2. f_{CLK} = 15 MHz, STB cycle = 60 μs, AP pulse width = 15 μs, BA = L (low power mode)

Switching Characteristics (T_A = -20 to +75°C, V_{DD1} = 2.2 to 3.6 V, V_{DD2} = 5.0 V ± 0.5 V, V_{SS1} = V_{SS2} = 0 V)

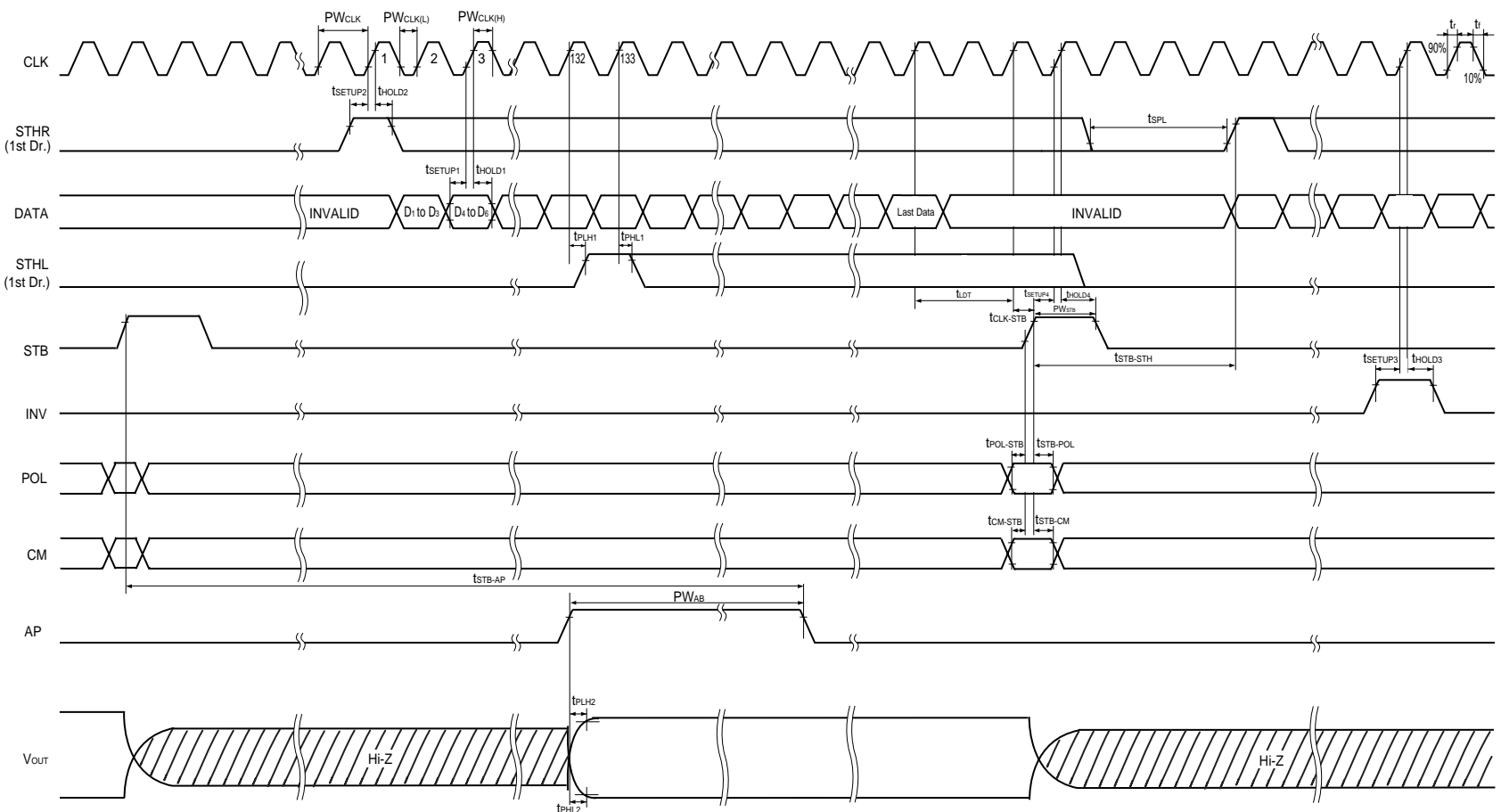
| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|---|--------------------|--|------|------|------|------|
| Start Pulse Delay Time | t _{PLH1} | C _L = 15 pF | | | 25 | ns |
| | t _{PHL1} | | | | 25 | ns |
| Driver Output Delay Time (High power mode) | t _{PLH2H} | C _L = 30 pF AP↓ → V _{OUT} - 100 mV or V _{OUT} + 100 mV | | | 12 | μs |
| | t _{PHL2H} | | | | 12 | μs |
| Driver Output Delay Time (Low power mode) | t _{PLH2L} | C _L = 30 pF AP↓ → V _{OUT} - 100 mV or V _{OUT} + 100 mV | | | 15 | μs |
| | t _{PHL2L} | | | | 15 | μs |
| Input Capacitance | C _{I1} | V ₀ to V ₄ , T _A = 25°C | | 5 | 15 | pF |
| | C _{I2} | Excluded V ₀ to V ₄ , T _A = 25°C | | 10 | 15 | pF |

★ **Timing Requirements (T_A = -20 to +75°C, V_{DD1} = 2.2 to 3.6 V, V_{SS1} = 0 V, t_r = t_f = 10 ns)**

| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|----------------------------------|----------------------|--|------|------|------|------|
| Clock Pulse Width | PW _{CLK} | | 65 | | | ns |
| Clock Pulse High Period | PW _{CLK(H)} | | 20 | | | ns |
| Clock Pulse Low Period | PW _{CLK(L)} | | 20 | | | ns |
| Data Setup Time | t _{SETUP1} | | 20 | | | ns |
| Data Hold Time | t _{HOLD1} | | 20 | | | ns |
| Start Pulse Setup Time | t _{SETUP2} | | 20 | | | ns |
| Start Pulse Hold Time | t _{HOLD2} | | 20 | | | ns |
| Start Pulse Low Period | t _{SPL} | | 3 | | | CLK |
| Last Data Timing | t _{LDT} | | 2 | | | CLK |
| CLK-STB Time | t _{CLK-STB} | CLK↑ → STB↑ | 20 | | | ns |
| STB Pulse Width | PW _{STB} | | 40 | | | ns |
| Start Pulse Rising Time | t _{STB-STH} | STB↑ → STH↑ | 3 | | | CLK |
| INV Set-up Time | t _{SETUP3} | | 20 | | | ns |
| INV Hold Time | t _{HOLD3} | | 20 | | | ns |
| STB Set-up Time | t _{SETUP4} | | 20 | | | ns |
| STB Hold Time | t _{HOLD4} | | 20 | | | ns |
| POL-STB Time | t _{POL-STB} | | 0 | | | ns |
| STB-POL Time | t _{STB-POL} | | 40 | | | ns |
| CM-STB Time | t _{CM-STB} | | 0 | | | ns |
| STB-CM Time | t _{STB-CM} | | 40 | | | ns |
| STB-AP Time | t _{STB-AP} | STB↑ → AP↓ | 20 | | | μs |
| AP Pulse Width (High power mode) | PW _{APH} | | 12 | | | μs |
| AP Pulse Width (Low power mode) | PW _{APL} | STB cycle 40μs, C _L = 30 pF | 15 | | | μs |

Switching Characteristic Waveform (R_L/L=H, OSEL=L)

Unless otherwise specified, the input level is defined to be V_{IH} = 0.7 V_{DD1}, V_{IL} = 0.3 V_{DD1}.



[MEMO]

NOTES FOR CMOS DEVICES**① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS**

Note:

Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note:

No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note:

Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.