# SOLOMON SYSTECH SEMICONDUCTOR TECHNICAL DATA

# SSD1301

Advance Information

# **OLED/PLED Segment/Common Driver with Controller CMOS**

SSD1301 is a single-chip CMOS OLED/PLED driver with controller for organic/polymer light emitting diode dot-matrix graphic display system. SSD1301 consists of 132 high voltage/current driving output pins for driving 132 segments and 64 commons plus 1 icon line driving common. This IC is designed for Common Cathode type OLED panel.

SSD1301 displays data directly from its internal 132x65 bit Graphic Display Data RAM (GDDRAM). Data/Commands are sent from general MCU through a pin selectable 6800-/8080-series compatible Parallel Interface or Serial Peripheral Interface or I<sup>2</sup> C Interface.

SSD1301 embeds a contrast control function and an on-chip oscillator for reducing the number of external components.

# **FEATURES**

Support max. 132 x (64+1) matrix panel Power supply to logic system, 2.4V-3.5V Power supply to OLED system, 7.0V-16.5V Segment output maximum current: 400uA Common sink maximum current: 50mA Half range and full range current mode selection Low current sleep mode (<5.0uA) External current reference control by external resistor 256 steps contrast control on monochrome passive OLED panel On-Chip Oscillator Programmable Frame Rate Solomon Systech Limited's Proprietary OLED Driving Scheme 8-bit 6800-series Parallel Interface, 8-bit 8080-series Parallel Interface, Serial Peripheral Interface and I<sup>2</sup>C Interface Embedded 132 x 65 bit SRAM display buffer Row re-mapping and Column re-mapping Vertical scrolling con Support Partial display Wide range of operating temperatures: -30 to 85 °C

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

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### **ORDERING INFORMATION**

| Ordering Part Number | Package Form |
|----------------------|--------------|
| SSD1301TR1           | ТАВ          |

## **BLOCK DIAGRAM**

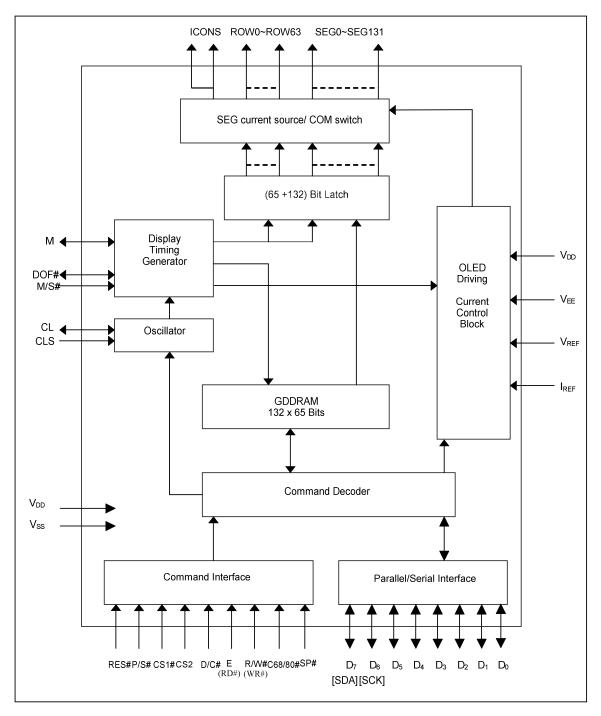


Figure 1 - Block Diagram

SSD1301U/SSD1301Z 3

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SSD1301TR1 PIN ASSIGNMENT

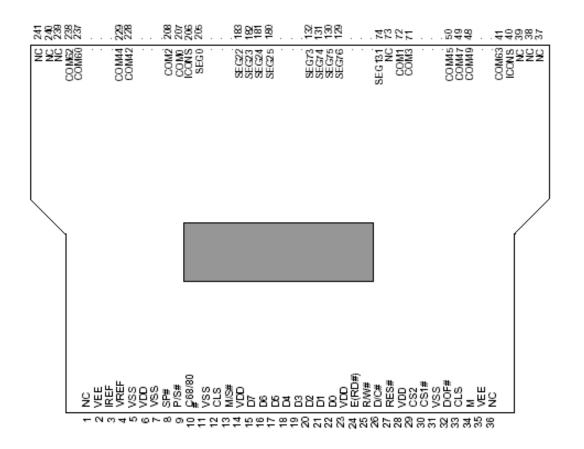


Figure 2 – SSD1301TR1 pin assignment (Copper View)

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| 1      NC      61      COM23      121      SE034      1611      SE024        2      VEE      62      COM19      122      SE033      183      SE022        4      VRF      63      COM17      124      SE031      183      SE022        5      VSS      66      COM13      126      SE379      186      SE02        6      VDD      66      COM11      127      SE077      188      SE018        7      VSS      67      COM11      126      SE377      188      SE015        10      C68/80#      70      COM15      130      SE375      190      SE015        112      VLS      72      COM1      132      SE372      193      SE015        131      M'S#      73      NC      133      SE372      193      SE015        14      VDD      75      SE0131      134      SE071      194      SE014        141      SE012      133      SE372      193      SE362 </th <th>PIN NO</th> <th>PIN NAME</th> <th>PIN NO</th> <th>PIN NAME</th> <th>PIN NO</th> <th>PIN NAME</th> <th>PIN NO</th> <th>PIN NAME</th> | PIN NO | PIN NAME |
|--|--------|----------|--------|----------|--------|----------|--------|----------|
| 2      VFE      62      COM21      122      SEG81      183      SEG22        4      VREF      63      COM17      124      SEG81      183      SEG22        5      VSS      65      COM17      125      SEG80      185      SEG20        6      VDD      66      COM13      126      SEG76      186      SEG18        8      SP#      68      COM6      128      SEG76      189      SEG16        10      C68/80#      70      COM8      130      SEG74      191      SEG15        11      VSS      71      COM3      131      SEG74      191      SEG15        133      M/S#      73      NC      133      SEG71      192      SEG13        14      VDD      74      SEG129      136      SEG69      196      SEG19        15      D7      75      SEG120      138      SEG66      197      SEG3        16      D6      76      SEG127      138      SEG66   |        |          |        |          |        |          |        |          |
| 3      IRF      63      COM19      123      SE082      183      SE022        4      VRF      64      COM15      124      SE081      184      SE021        5      VSS      66      COM15      125      SE380      185      SE019        7      VSS      67      COM11      127      SE078      186      SE019        7      VSS      68      COM9      128      SE077      188      SE017        9      P/S#      68      COM9      130      SE076      190      SE016        11      VSS      71      COM1      132      SE073      192      SE013        133      M/S#      73      NC      133      SE072      193      SE012        14      VDD      75      SE0130      135      SE070      195      SE0110        16      D6      76      SE0126      139      SE066      196      SE03        17      D5      77      SE0126      140      SE066   | 2      |          | 62     |          |        |          | 182    |          |
| 4      VREF      64      COM17      124      SEG81      184      SEG21        5      VSS      65      COM13      125      SEG80      185      SEG20        6      VDD      66      COM11      127      SEG78      187      SEG18        8      SP#      69      COM9      128      SEG77      188      SEG16        10      C68/00#      70      COM5      130      SEG76      190      SEG16        11      VSS      71      COM3      131      SEG72      193      SEG13        12      CLS      72      COM1      132      SEG72      193      SEG13        13      M/SH      73      NC      133      SEG72      193      SEG13        15      D7      75      SEG130      136      SEG67      198      SEG63        17      D5      77      SEG120      136      SEG67      198      SEG6        20      D2      80      SEG125      140      SEG66   | 3      |          |        |          |        | SEG82    |        | SEG22    |
| 5      VSS      65      COM15      125      SEG80      185      SEG20        6      VDD      66      COM11      127      SE378      186      SEG19        7      VSS      67      COM11      128      SEG76      189      SEG16        19      P/SH      68      COM9      130      SEG76      189      SEG16        11      VSS      71      COM1      132      SEG73      192      SEG16        12      CLS      72      COM1      132      SEG71      194      SEG11        13      M/SH      73      NC      133      SEG71      194      SEG11        14      VDD      75      SEG120      136      SEG69      196      SEG9        17      D5      77 <seg126< td="">      137      SEG66      199      SEG6        18      D4      78      SEG126      140      SEG62      200      SEG2        19      D3      79      SEG126      140      SEG63      200</seg126<>   |        |          |        |          |        |          |        |          |
| 6      VDD      66      COM13      126      SEG78      186      SEG19        7      VSS      68      COM2      127      SEG78      187      SEG18        8      SP#      69      COM3      129      SEG76      189      SEG16        10      C68(40#      70      COM5      130      SEG76      190      SEG14        12      CLS      72      COM1      132      SEG76      192      SEG14        13      M(S#)      73      NC      133      SEG70      192      SEG12        14      VDD      74      SEG120      135      SEG70      195      SEG19        17      D5      77      SEG126      139      SEG66      199      SEG62        20      D2      80      SEG125      140      SEG66      200      SEG51        21      D1      81      SEG120      145      SEG66      200      SEG4        22      D0      82      SEG112      144      SEG66   |        |          |        |          |        |          |        |          |
| 7      VSS      67      COM11      127      SEG76      187      SEG18        8      SP#      68      COM2      129      SEG76      188      SEG17        10      C68/80#      70      COM5      130      SEG76      190      SEG18        11      VSS      71      COM3      131      SEG74      191      SEG13        13      M/S#      73      NC      133      SEG71      194      SEG11        14      VDD      74      SEG131      136      SEG91      194      SEG12        16      D6      76      SEG129      136      SEG9      196      SEG3        19      D3      79      SEG126      140      SEG66      199      SEG3        22      D0      82      SEG121      144      SEG61      200      SEG3        23      VDD      83      SEG121      144      SEG61      204      SEG3        24      ERD#      86      SEG119      146      SEG59   |        |          |        |          |        |          |        |          |
| 8      SP#      68      COM9      128      SEG77      188      SEG17        9      P/S#      69      COM7      129      SEG76      189      SEG16        11      VSS      7.1      COM5      130      SEG75      190      SEG14        12      CLS      7.1      COM3      131      SEG71      192      SEG11        13      M/S#      73      NC      133      SEG72      193      SEG12        14      VDD      74      SEG120      136      SEG70      195      SEG12        17      D5      7.7      SEG126      139      SEG67      198      SEG7        19      D3      79      SEG126      139      SEG67      198      SEG3        22      D0      82      SEG123      142      SEG61      200      SEG3        23      VDD      83      SEG123      144      SEG67      208      SEG3        24      ERD#1      84      SEG12      145      SEG66   | 7      |          |        |          |        |          |        |          |
| 9      P/S#      69      COM7      129      SEG76      189      SEG16        10      C68/80#      70      COM5      130      SEG75      190      SEG15        11      VSS      71      COM3      131      SEG74      191      SEG15        13      M/S#      72      COM1      132      SEG72      193      SEG11        14      VDD      74      SEG120      136      SEG70      194      SEG11        15      D7      75      SEG120      136      SEG69      196      SEG31        16      D6      76      SEG126      140      SEG67      198      SEG3        17      D5      77      SEG126      140      SEG67      198      SEG3        21      D1      81      SEG124      141      SEG64      201      SEG3        23      VDD      82      SEG112      144      SEG41      204      SEG1        26      D/C#      86      SEG116      143      SEG42 </td <td>8</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>  | 8      |          |        |          |        |          |        |          |
| 10      C68/80#      70      COM5      130      SEG75      190      SEG15        11      VSS      71      COM4      131      SEG73      192      SEG14        12      CLS      72      COM1      132      SEG73      192      SEG14        14      VDD      74      SEG130      134      SEG71      193      SEG11        15      D7      75      SEG130      136      SEG60      196      SEG31        16      D6      76      SEG128      137      SEG68      199      SEG31        17      D5      77      SEG126      139      SEG66      199      SEG3        20      D2      80      SEG122      143      SEG62      200      SEG3        21      D1      81      SEG12      143      SEG62      201      SEG4        22      D0      82      SEG12      143      SEG62      203      SEG3        23      VDD      83      SEG121      144      SEG51  |        |          |        |          |        |          |        |          |
| 11      VSS      71      COM3      131      SEG74      191      SEG14        12      CLS      72      COM1      132      SEG73      192      SEG13        13      MK S#      73      NC      133      SEG72      192      SEG13        14      VDD      74      SEG130      135      SEG70      194      SEG11        15      D7      75      SEG120      136      SEG69      196      SE03        16      D6      76      SEG126      139      SEG66      199      SEG3        18      D4      78      SEG127      138      SEG67      198      SEG7        19      D3      79      SEG126      140      SEG64      201      SEG3        21      D1      81      SEG121      144      SEG61      204      SEG3        22      D0      82      SEG121      144      SEG61      204      SEG3        23      VDD      83      SEG121      144      SEG56  |        |          |        |          |        |          |        |          |
| 12      CLS      72      COM1      132      SEG73      192      SEG13        13      M'S#      73      NC      133      SEG71      193      SEG13        14      VDD      74      SEG131      134      SEG71      194      SEG11        15      D7      75      SEG120      136      SEG67      195      SEG11        16      D6      76      SEG120      138      SEG67      198      SEG3        17      D5      77      SEG126      139      SEG66      199      SEG6        20      D2      80      SEG122      140      SEG64      201      SEG3        21      D1      81      SEG121      144      SEG61      204      SEG3        23      VDD      83      SEG121      144      SEG61      204      SEG3        24      ERD##      86      SEG119      146      SEG57      208      COM2        25      D/C#      86      SEG111      144      SEG56   |        |          |        |          |        |          |        |          |
| 13      M/ S#      73      NC      133      SEG72      193      SEG12        14      VDD      74      SEG131      134      SEG72      194      SEG12        16      D6      76      SEG122      136      SEG70      195      SEG10        17      D5      77      SEG128      137      SEG63      197      SEG32        19      D3      79      SEG126      140      SEG65      199      SEG3        20      D2      80      SEG121      141      SEG64      201      SEG4        21      D1      81      SEG121      144      SEG62      203      SEG2        24      ERD#)      84      SEG121      144      SEG59      206      ICOM2        25      R/W#      85      SEG110      145      SEG59      206      ICOM2        26      D/C#      86      SEG111      144      SEG51      204      SEG1        29      SE3      SEG116      150      SEG56      2  |        |          |        |          |        |          |        |          |
| 14      VDD      74      SEG131      134      SEG71      194      SEG11        15      D7      75      SEG120      135      SEG69      196      SEG19        17      D5      77      SEG128      137      SEG69      197      SEG3        18      D4      78      SEG127      138      SEG68      198      SEG3        20      D2      80      SEG126      140      SEG66      200      SEG3        21      D1      81      SEG121      141      SEG64      201      SEG3        23      VDD      82      SEG121      144      SEG61      200      SEG3        24      ERD#)      84      SEG121      144      SEG57      208      SEG3        27      RES#      87      SEG116      149      SEG55      210      COM2        33      CLS      90      SEG116      149      SEG55      210      COM2        29      CS2      89      SEG116      149      SEG52 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   |        |          |        |          |        |          |        |          |
| 15      D7      75      SEG130      135      SEG70      195      SEG10        16      D6      76      SEG120      136      SEG68      197      SEG18        18      D4      78      SEG126      137      SEG68      198      SEG7        19      D3      79      SEG126      139      SEG66      199      SEG7        20      D2      80      SEG122      140      SEG65      200      SEG4        21      D1      81      SEG121      141      SEG62      203      SEG2        24      ERD#)      84      SEG121      144      SEG51      204      SEG1        26      D/C#      86      SEG112      144      SEG56      209      COM4        30      CS1#      90      SEG116      150      SEG52      210      COM5        31      VSS      91      SEG112      153      SEG52      210      COM4        32      D0F#      92      SEG112      153      SEG52<  |        |          |        |          |        |          |        |          |
| 16      D6      76      SEG129      136      SEG69      196      SEG3        17      D5      77      SEG126      137      SEG68      197      SEG32        19      D3      79      SEG126      139      SEG66      199      SEG4        20      D2      80      SEG125      140      SEG66      200      SEG4        21      D1      81      SEG122      141      SEG42      201      SEG4        22      D0      82      SEG123      142      SEG62      203      SEG22        24      ERD#)      84      SEG120      145      SEG60      205      SEG32        25      R/W#      85      SEG110      146      SEG57      208      COM4        26      SEG142      144      SEG56      209      COM4        30      CS1#      90      SEG116      149      SEG56      209      COM4        32      DOF#      92      SEG110      152      SEG51      211      CO  |        |          |        |          |        |          |        |          |
| 17      D5      77      SEG128      137      SEG8      197      SEG3        18      D4      78      SEG127      138      SEG67      198      SEG3        20      D2      80      SEG125      140      SEG66      200      SEG3        21      D1      81      SEG124      141      SEG64      201      SEG3        22      D0      83      SEG121      1442      SEG61      202      SEG3        23      VDD      83      SEG121      1443      SEG61      204      SEG3        24      E(RD#)      84      SEG119      145      SEG58      207      COMS        25      R/W#      86      SEG119      146      SEG56      206      ICOMS        29      CS2      89      SEG116      149      SEG56      207      COM4        31      VSS      91      SEG110      155      SEG55      211      COM4        32      DOF#      92      SEG110      155      SEG51  |        |          |        |          |        |          |        |          |
| 18      D4      78      SEG127      138      SEG67      198      SEG7        19      D3      79      SEG126      139      SEG66      199      SEG3        20      D2      80      SEG126      140      SEG65      200      SEG3        21      D1      81      SEG122      144      SEG63      202      SEG3        23      VDD      83      SEG122      144      SEG62      203      SEG2        24      ERD#)      84      SEG112      144      SEG60      205      SEG3        26      D/ C#      86      SEG119      146      SEG57      208      COM2        29      CS2      89      SEG116      149      SEG56      209      COM2        31      VSS      91      SEG113      152      SEG53      212      COM6        33      CLS      93      SEG110      155      SEG50      215      COM4        36      NC      96      SEG107      158      SEG47 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   |        |          |        |          |        |          |        |          |
| 19      D3      79      SEG126      139      SEG66      199      SEG        20      D2      80      SEG125      140      SEG65      200      SEG        21      D1      81      SEG123      141      SEG62      201      SEG        22      D0      82      SEG123      142      SEG62      203      SEG        24      ERD#)      84      SEG120      145      SEG60      206      SEG        25      R/W#      85      SEG119      146      SEG57      206      CONS        26      D/C#      86      SEG116      147      SEG56      209      COM        29      CS2      89      SEG116      149      SEG57      208      COM2        29      CS2      89      SEG111      151      SEG54      211      COM4        32      DOF#      92      SEG111      153      SEG54      211      COM6        33      CLS      93      SEG112      153      SEG54   |        |          |        |          |        |          |        |          |
| 20      D2      80      SEG125      140      SEG65      200      SEG5        21      D1      81      SEG124      141      SEG63      202      SEG3        22      D0      82      SEG123      142      SEG62      203      SEG2        24      ERD#)      84      SEG120      145      SEG60      206      ICOM3        26      D/C#      86      SEG110      145      SEG59      206      ICOM3        29      CS2      89      SEG116      149      SEG56      208      COM2        29      CS2      89      SEG116      150      SEG55      210      COM4        30      CS1#      90      SEG111      151      SEG56      210      COM4        32      DOF#      92      SEG111      155      SEG51      211      COM12        33      CLS      93      SEG110      155      SEG51      214      COM14        35      VE      95      SEG101      155      SE  |        |          |        |          |        |          |        |          |
| 21      D1      81      SEG124      141      SEG64      201      SEG4        22      D0      82      SEG122      142      SEG63      203      SEG32        23      VDD      83      SEG122      143      SEG61      204      SEG12        24      ERD#)      84      SEG120      144      SEG61      205      SEG0        25      R/W#      85      SEG110      146      SEG59      206      ICONS        27      RES#      87      SEG116      149      SEG56      209      COM4        30      CS1#      90      SEG115      150      SEG51      211      COM6        31      VSS      93      SEG112      153      SEG51      213      COM12        33      CLS      93      SEG110      156      SEG51      214      COM12        34      M      94      SEG101      156      SEG47      216      COM12        36      NC      96      SEG105      156      S  |        |          |        |          |        |          |        |          |
| 22      D0      82      SEG123      142      SEG63      202      SE33        23      VDD      83      SEG122      143      SEG62      203      SEG2        24      E(RD#)      84      SEG121      144      SEG62      203      SEG2        26      D/C#      86      SEG119      1445      SEG60      206      ICONS        27      RES#      87      SEG118      147      SEG56      208      COM2        29      CS2      89      SEG116      149      SEG56      209      COM4        30      CS1#      90      SEG111      150      SEG55      210      COM6        31      VSS      93      SEG111      154      SEG51      211      COM12        34      M      94      SEG111      154      SEG51      214      COM12        34      M      94      SEG109      156      SEG49      216      COM14        35      VEE      95      SEG106      157      S  |        |          |        |          |        |          |        |          |
| 23      VDD      83      SEG122      143      SEG2      203      SEG2        24      ER0#)      84      SEG121      144      SEG61      204      SEG1        25      R/W#      85      SEG120      145      SEG0      205      SEG1        26      D/C#      86      SEG119      144      SEG59      206      ICONS        27      RES#      87      SEG118      147      SEG58      207      COM0        28      VDD      88      SEG115      150      SEG56      208      COM2        30      CS1#      90      SEG115      150      SEG55      210      COM6        31      VSS      91      SEG1112      153      SEG52      213      COM12        33      CLS      93      SEG1110      155      SEG50      215      COM12        34      M      94      SEG109      156      SEG49      216      COM14        35      VEE      95      SEG100      156 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>   |        |          |        |          |        |          |        |          |
| 24      ERD#)      84      SEG121      144      SEG61      204      SEG1        25      RVW#      85      SEG120      145      SEG60      205      SEG0        26      D/C#      86      SEG119      146      SEG59      206      ICONS        27      RES#      87      SEG116      144      SEG57      208      COM2        29      CS2      89      SEG116      148      SEG56      207      COM0        30      CS1#      90      SEG115      150      SEG54      211      COM4        31      VSS      91      SEG112      153      SEG52      212      COM10        33      CLS      93      SEG110      155      SEG50      214      COM12        34      M      94      SEG109      156      SEG49      216      COM12        36      NC      96      SEG109      157      SEG48      217      COM20        38      NC      98      SEG107      158  |        |          |        |          |        |          |        |          |
| 25      R/W#      85      SEG120      145      SEG0      205      SEG0        26      D/C#      86      SEG119      147      SEG59      206      ICONS        27      RES#      87      SEG118      147      SEG58      207      COM0        28      VDD      88      SEG116      144      SEG57      208      COM2        29      CS2      89      SEG115      149      SEG56      209      COM4        30      CS1#      90      SEG114      151      SEG53      212      COM10        33      CLS      93      SEG112      153      SEG52      213      COM12        34      M      94      SEG110      155      SEG50      216      COM12       36      NC      98      SEG107      156      SE649      216      COM18        37      NC      97      SEG106      157      SEG48      217      COM20        38      NC      98      SEG107      159      SEG46   |        |          |        |          |        |          |        |          |
| 26      D/C#      86      SEG119      146      SEG59      206      ICONS        27      RES#      87      SEG118      147      SEG59      207      COMO        28      VDD      88      SEG117      149      SEG56      209      COM4        30      CS1#      90      SEG115      150      SEG55      210      COM6        31      VSS      91      SEG114      151      SEG55      210      COM4        32      DOF#      92      SEG111      154      SEG51      214      COM12        33      CLS      93      SEG101      155      SEG50      215      COM12        34      M      96      SEG101      155      SEG50      216      COM12        36      NC      96      SEG102      156      SEG49      216      COM14        37      NC      97      SEG108      157      SEG48      217      COM20        38      NC      99      SEG105      160      SE  |        |          |        |          |        |          |        |          |
| 27      RES#      87      SEG118      147      SEG58      207      COM0        28      VDD      88      SEG117      148      SEG57      209      COM4        30      CS1#      90      SEG115      150      SEG55      210      COM4        31      VSS      91      SEG116      151      SEG55      211      COM6        33      CLS      93      SEG112      153      SEG52      213      COM12        34      M      94      SEG110      155      SEG50      214      COM14        35      VE      93      SEG109      156      SEG49      216      COM12        36      NC      97      SEG108      157      SEG48      217      COM22        39      NC      99      SEG105      161      SEG47      218      COM22        40      ICONS      101      SEG102      163      SEG42      222      COM34        41      COM63      106      SEG30      166 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>   |        |          |        |          |        |          |        |          |
| 28      VDD      88      SEG117      148      SEG57      208      COM2        29      CS2      89      SEG116      150      SEG56      209      COM4        30      CS1#      90      SEG115      151      SEG55      210      COM6        31      VSS      91      SEG113      152      SEG55      211      COM6        32      DOF#      92      SEG111      153      SEG52      213      COM12        34      M      94      SEG110      155      SEG50      216      COM14        35      VEE      95      SEG109      156      SEG49      216      COM16        36      NC      98      SEG107      159      SEG48      217      COM20        38      NC      99      SEG106      156      SEG47      218      COM22        39      NC      99      SEG102      163      SEG44      220      COM24        40      ICONS      100      SEG101      162      S  |        |          |        |          |        |          |        |          |
| 29      CS2      89      SEG116      149      SEG56      209      COM4        30      CS1#      90      SEG115      150      SEG55      211      COM6        31      VSS      91      SEG114      152      SEG55      211      COM6        33      CLS      93      SEG112      153      SEG52      213      COM10        34      M      94      SEG111      155      SEG50      215      COM10        35      VEE      95      SEG100      156      SEG49      216      COM14        36      NC      96      SEG108      157      SEG49      217      COM20        38      NC      98      SEG106      158      SEG47      218      COM20        39      NC      99      SEG102      161      SEG44      221      COM24        40      ICONS      100      SEG102      163      SEG41      222      COM24        44      COM65      105      SEG100      164 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>  |        |          |        |          |        |          |        |          |
| 30      CS1#      90      SEG115      150      SEG55      210      COM6        31      VSS      91      SEG114      151      SEG53      211      COM6        32      DOF#      92      SEG113      153      SEG53      211      COM6        33      CLS      93      SEG112      153      SEG52      213      COM12        34      M      94      SEG110      155      SEG50      215      COM14        35      VEE      95      SEG109      156      SEG49      216      COM14        36      NC      96      SEG109      156      SEG48      217      COM22        38      NC      99      SEG106      159      SEG47      218      COM22        40      ICONS      100      SEG102      160      SEG42      221      COM24        42      COM61      102      SEG101      161      SEG41      222      COM32        43      COM55      104      SEG101      162   |        |          |        |          |        |          |        |          |
| 31      VSS      91      SEG114      151      SEG54      211      COM8        32      DOF#      92      SEG112      153      SEG52      213      COM10        33      CLS      93      SEG112      153      SEG52      213      COM12        34      M      94      SEG110      155      SEG50      214      COM14        35      VEE      95      SEG109      156      SEG40      215      COM16        36      NC      96      SEG107      158      SEG47      218      COM22        39      NC      99      SEG106      159      SEG45      220      COM24        40      ICONS      100      SEG103      161      SEG45      221      COM28        41      COM63      101      SEG101      163      SEG42      222      COM28        44      COM51      105      SEG100      165      SEG39      226      COM34        45      COM451      107      SEG39      166   |        |          |        |          |        |          |        |          |
| 32      DOF#      92      SEG113      152      SEG53      212      COM10        33      CLS      93      SEG112      153      SEG52      213      COM12        34      M      94      SEG111      154      SEG52      213      COM12        35      VE      95      SEG109      155      SEG50      215      COM14        36      NC      96      SEG109      156      SEG49      216      COM18        37      NC      97      SEG106      156      SEG49      217      COM20        38      NC      98      SEG107      158      SEG47      218      COM22        39      NC      99      SEG106      160      SEG45      220      COM24        40      ICONS      100      SEG102      163      SEG42      221      COM28        42      COM61      102      SEG101      164      SEG41      222      COM34        45      COM55      106      SEG99      166   |        |          |        |          |        |          |        |          |
| 33      CLS      93      SEG112      153      SEG52      213      COM12        34      M      94      SEG111      154      SEG52      213      COM12        35      VFE      95      SEG109      156      SEG50      215      COM14        36      NC      96      SEG109      156      SEG49      216      COM18        37      NC      97      SEG107      158      SEG47      218      COM22        39      NC      99      SEG107      158      SEG47      218      COM22        40      ICONS      100      SEG105      160      SEG45      220      COM24        41      COM63      101      SEG102      163      SEG42      223      COM28        42      COM57      104      SEG102      163      SEG40      224      COM34        45      COM55      105      SEG100      165      SEG40      225      COM34        47      COM51      107      SEG98      167  |        |          |        |          |        |          |        |          |
| 34      M      94      SEG111      154      SEG51      214      COM14        35      VEE      95      SEG110      155      SEG50      215      COM16        36      NC      96      SEG109      156      SEG49      216      COM18        37      NC      97      SEG106      156      SEG49      217      COM20        38      NC      98      SEG105      158      SEG47      219      COM22        39      NC      99      SEG105      160      SEG45      220      COM24        40      ICONS      100      SEG102      163      SEG42      221      COM26        41      COM63      101      SEG102      163      SEG42      223      COM26        44      COM57      104      SEG101      164      SEG37      226      COM33        47      COM47      109      SEG99      167      SEG36      227      COM40        48      COM49      108      SEG91      171  |        |          |        |          |        |          |        |          |
| 35      VEE      95      SEG110      155      SEG50      215      COM16        36      NC      96      SEG109      156      SEG49      216      COM18        37      NC      97      SEG108      157      SEG48      217      COM20        38      NC      98      SEG107      158      SEG47      218      COM22        39      NC      99      SEG106      159      SEG46      220      COM24        40      ICONS      100      SEG102      161      SEG43      222      COM28        41      COM63      101      SEG102      163      SEG42      223      COM28        42      COM57      104      SEG101      164      SEG39      226      COM38        44      COM45      105      SEG100      165      SEG30      226      COM38        47      COM47      109      SEG99      167      SEG35      229      COM44        50      COM45      111      SEG91      173 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   |        |          |        |          |        |          |        |          |
| 36      NC      96      SEG109      156      SEG49      216      COM18        37      NC      97      SEG108      157      SEG48      217      COM20        38      NC      98      SEG107      158      SEG47      218      COM22        39      NC      99      SEG105      160      SEG44      217      COM20        40      ICONS      100      SEG105      160      SEG42      218      COM22        41      COM61      101      SEG102      161      SEG44      221      COM28        42      COM61      102      SEG102      163      SEG42      223      COM30        43      COM55      105      SEG100      165      SEG30      226      COM34        45      COM45      107      SEG98      167      SEG36      229      COM44        50      COM45      110      SEG97      168      SEG37      230      COM42        51      COM45      111      SEG91      173<  |        |          |        |          |        |          |        |          |
| 37      NC      97      SEG108      157      SEG48      217      COM20        38      NC      98      SEG107      158      SEG47      218      COM22        39      NC      99      SEG105      159      SEG46      219      COM24        40      ICONS      101      SEG105      160      SEG45      220      COM26        41      COM63      101      SEG102      161      SEG42      222      COM30        43      COM55      103      SEG102      164      SEG41      224      COM30        45      COM55      105      SEG100      165      SEG40      225      COM30        46      COM45      107      SEG99      166      SEG37      226      COM43        47      COM45      110      SEG97      168      SEG37      229      COM44        50      COM45      111      SEG91      173      SEG32      231      COM42        51      COM43      1112      SEG91  |        |          |        |          |        |          |        |          |
| 38      NC      98      SEG107      158      SEG47      218      COM22        39      NC      99      SEG106      159      SEG46      219      COM24        40      ICONS      101      SEG105      160      SEG45      220      COM28        41      COM61      102      SEG103      162      SEG42      222      COM30        43      COM59      103      SEG102      163      SEG42      223      COM32        44      COM57      104      SEG100      165      SEG40      225      COM32        45      COM45      106      SEG99      166      SEG39      226      COM38        47      COM45      100      SEG96      166      SEG37      228      COM42        48      COM47      109      SEG96      169      SEG30      231      COM44        52      COM41      111      SEG91      173      SEG31      234      COM44        55      COM35      116      SEG91 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>  |        |          |        |          |        |          |        |          |
| 39      NC      99      SEG106      159      SEG46      219      COM24        40      ICONS      100      SEG105      160      SEG45      220      COM26        41      COM63      101      SEG103      162      SEG44      221      COM28        42      COM59      103      SEG102      163      SEG42      223      COM30        43      COM55      104      SEG101      164      SEG40      225      COM34        45      COM45      105      SEG99      166      SEG39      226      COM34        47      COM45      100      SEG97      169      SEG36      230      COM42        49      COM47      109      SEG96      169      SEG36      230      COM44        50      COM43      111      SEG91      171      SEG31      231      COM45        51      COM43      1112      SEG91      174      SEG31      232      COM46        55      COM33      116      SEG89  |        |          |        |          |        |          |        |          |
| 40      ICONS      100      SEG105      160      SEG45      220      COM26        41      COM63      101      SEG104      161      SEG44      221      COM28        42      COM61      102      SEG102      163      SEG42      223      COM30        43      COM55      105      SEG100      165      SEG40      225      COM34        45      COM51      106      SEG99      166      SEG39      226      COM36        46      COM51      107      SEG99      166      SEG39      227      COM40        48      COM49      108      SEG97      168      SEG37      228      COM42        49      COM47      109      SEG96      169      SEG36      230      COM44        50      COM43      111      SEG92      173      SEG32      231      COM48        52      COM31      114      SEG99      174      SEG31      235      COM52        54      COM35      116      SEG89  |        |          |        |          |        |          |        |          |
| 41      COM63      101      SEG104      161      SEG44      221      COM28        42      COM61      102      SEG103      162      SEG43      222      COM30        43      COM59      103      SEG102      163      SEG42      223      COM32        44      COM57      104      SEG101      164      SEG41      225      COM34        45      COM51      105      SEG100      165      SEG39      226      COM36        46      COM51      107      SEG99      166      SEG39      227      COM40        48      COM49      108      SEG97      169      SEG36      229      COM44        50      COM47      109      SEG96      169      SEG36      230      COM42        452      COM47      110      SEG92      171      SEG36      230      COM44        50      COM31      111      SEG91      174      SEG31      232      COM55        53      COM35      114      SEG99  |        |          |        |          |        |          |        |          |
| 42      COM61      102      SEG103      162      SEG43      222      COM30        43      COM59      103      SEG102      163      SEG42      223      COM32        44      COM57      104      SEG101      164      SEG41      224      COM34        45      COM55      105      SEG100      165      SEG40      225      COM36        46      COM51      107      SEG99      166      SEG39      226      COM38        47      COM51      107      SEG99      166      SEG39      227      COM40        48      COM47      109      SEG96      169      SEG36      229      COM442        50      COM45      111      SEG96      170      SEG36      230      COM42        51      COM43      111      SEG91      171      SEG31      232      COM42        52      COM41      112      SEG92      173      SEG32      233      COM52        53      COM35      114      SEG99   |        |          |        |          |        |          |        |          |
| 43      COM59      103      SEG102      163      SEG42      223      COM32        44      COM57      104      SEG101      164      SEG41      224      COM34        45      COM55      105      SEG100      165      SEG40      225      COM36        46      COM53      106      SEG99      166      SEG39      226      COM38        47      COM49      108      SEG97      168      SEG37      228      COM42        49      COM47      109      SEG94      169      SEG36      229      COM42        50      COM45      110      SEG92      173      SEG32      233      COM44        52      COM31      111      SEG91      174      SEG31      232      COM45        53      COM35      116      SEG99      176      SEG30      233      COM52        54      COM35      116      SEG89      177      SEG32      236      COM58        57      COM31      117      SEG86   |        |          |        |          |        |          |        |          |
| 44      COM57      104      SEG101      164      SEG41      224      COM34        45      COM55      105      SEG100      165      SEG40      225      COM36        46      COM53      106      SEG99      166      SEG39      226      COM38        47      COM45      107      SEG98      167      SEG38      227      COM40        48      COM47      109      SEG96      168      SEG37      229      COM42        50      COM45      110      SEG94      170      SEG35      230      COM44        52      COM43      111      SEG92      173      SEG32      233      COM46        53      COM37      114      SEG91      174      SEG30      235      COM55        54      COM35      116      SEG89      176      SEG20      236      COM56        55      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG86  |        |          |        |          |        |          |        |          |
| 45      COM55      105      SEG100      165      SEG40      225      COM36        46      COM53      106      SEG99      166      SEG39      226      COM38        47      COM51      107      SEG98      167      SEG38      227      COM40        48      COM47      109      SEG96      168      SEG37      228      COM42        50      COM45      110      SEG95      170      SEG35      230      COM44        51      COM43      111      SEG92      173      SEG32      233      COM55        53      COM35      116      SEG99      176      SEG30      235      COM56        56      COM31      117      SEG88      177      SEG28      237      COM58        57      COM31      117      SEG86      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM58        59      COM27      119      SEG86   |        |          |        |          |        |          |        |          |
| 46      COM53      106      SEG99      166      SEG39      226      COM38        47      COM51      107      SEG98      167      SEG38      227      COM40        48      COM49      108      SEG97      168      SEG37      228      COM42        49      COM47      109      SEG96      169      SEG36      230      COM42        50      COM43      111      SEG95      170      SEG36      230      COM46        51      COM43      111      SEG93      171      SEG34      231      COM48        52      COM41      112      SEG92      173      SEG32      233      COM45        53      COM37      114      SEG91      174      SEG31      235      COM56        55      COM33      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG86  |        |          |        |          |        |          |        |          |
| 47      COM51      107      SEG98      167      SEG38      227      COM40        48      COM49      108      SEG97      168      SEG37      228      COM42        49      COM47      109      SEG96      169      SEG36      229      COM44        50      COM45      110      SEG95      170      SEG36      230      COM46        51      COM43      111      SEG94      171      SEG33      232      COM46        52      COM41      112      SEG92      173      SEG32      233      COM50        53      COM37      114      SEG91      174      SEG30      235      COM54        55      COM33      116      SEG89      176      SEG29      236      COM56        56      COM31      117      SEG87      176      SEG29      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86  |        |          |        |          |        |          |        |          |
| 48      COM49      108      SEG97      168      SEG37      228      COM42        49      COM47      109      SEG96      169      SEG36      229      COM44        50      COM45      110      SEG95      170      SEG36      230      COM44        51      COM43      111      SEG94      171      SEG33      231      COM48        52      COM41      112      SEG92      173      SEG32      233      COM50        53      COM37      114      SEG91      174      SEG30      235      COM54        55      COM33      116      SEG89      176      SEG29      236      COM56        57      COM31      117      SEG87      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 49      COM47      109      SEG96      169      SEG36      229      COM44        50      COM45      110      SEG95      170      SEG35      230      COM46        51      COM43      111      SEG94      171      SEG34      231      COM48        52      COM41      112      SEG93      172      SEG33      232      COM50        53      COM39      113      SEG92      173      SEG31      234      COM52        54      COM35      115      SEG90      175      SEG30      235      COM56        55      COM31      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG86      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM50        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 50      COM45      110      SEG95      170      SEG35      230      COM46        51      COM43      111      SEG94      171      SEG34      231      COM48        52      COM41      112      SEG93      172      SEG33      232      COM48        53      COM39      113      SEG92      173      SEG32      233      COM52        54      COM35      115      SEG90      174      SEG30      235      COM54        55      COM35      116      SEG89      176      SEG29      236      COM55        57      COM31      117      SEG86      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM50        59      COM27      119      SEG86      179      SEG26      239      NC   |        |          |        |          |        |          |        |          |
| 51      COM43      111      SEG94      171      SEG34      231      COM48        52      COM41      112      SEG93      172      SEG33      232      COM50        53      COM39      113      SEG92      173      SEG32      233      COM52        54      COM35      115      SEG90      174      SEG30      235      COM54        55      COM33      116      SEG89      176      SEG30      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM50        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 52      COM41      112      SEG93      172      SEG33      232      COM50        53      COM39      113      SEG92      173      SEG32      233      COM50        54      COM37      114      SEG91      174      SEG31      234      COM54        55      COM35      115      SEG90      175      SEG30      235      COM56        56      COM31      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM52        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 53      COM39      113      SEG92      173      SEG32      233      COM52        54      COM37      114      SEG91      174      SEG31      234      COM54        55      COM35      115      SEG90      175      SEG30      235      COM56        56      COM33      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC   |        |          |        |          |        |          |        |          |
| 54      COM37      114      SEG91      174      SEG31      234      COM54        55      COM35      115      SEG90      175      SEG30      235      COM56        56      COM33      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 55      COM35      115      SEG90      175      SEG30      235      COM56        56      COM33      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC   |        |          |        |          |        |          |        |          |
| 56      COM33      116      SEG89      176      SEG29      236      COM58        57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 57      COM31      117      SEG88      177      SEG28      237      COM60        58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC   |        |          |        |          |        |          |        |          |
| 58      COM29      118      SEG87      178      SEG27      238      COM62        59      COM27      119      SEG86      179      SEG26      239      NC  |        |          |        |          |        |          |        |          |
| 59 COM27 119 SEG86 179 SEG26 239 NC  | 57     |          | 117    | SEG88    | 177    | SEG28    | 237    |          |
|  |        |          |        |          |        | SEG27    | 238    |          |
| 60 COM25 120 SEG85 180 SEG25 240 NC  |        | COM27    |        | SEG86    | 179    | SEG26    | 239    |          |
|  | 60     | COM25    | 120    | SEG85    | 180    | SEG25    | 240    | NC       |

PIN NO PIN NAME 241 NC

### Table 1 : SSD1301TR1 pin assignment

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## PIN DESCRIPTION

#### M, DOF#

These pins are No Connection pins. Nothing should be connected to these pins, nor they are connected together. These pins should be left open individually.

#### CL

This pin is the system clock input. When internal clock is enabled, this pin should be left open. Nothing should be connected to this pin. When internal oscillator is disabled, this pin receives display clock signal from external clock source.

#### CS1#, CS2

These pins are the chip select inputs. The chip is enabled for MCU communication only when CS1# is pulled low and CS2 is pulled high.

#### RES#

This pin is reset signal input. When the pin is low, initialization of the chip is executed.

#### D/C#

This pin is Data/Command control pin. When the pin is pulled high, the data at  $D_7$ - $D_0$  is treated as display data. When the pin is pulled low, the data at  $D_7$ - $D_0$  will be transferred to the command register. For detail relationship to MCU interface signals, please refer to the Timing Characteristics Diagrams.

#### R/W#(WR#)

This pin is MCU interface input. When interfacing to an 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.

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.

#### E (RD#)

This pin is MCU interface input. 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.

When connecting to an 8080-microprocessor, this pin receives the Read (RD#) signal. Data read operation is initiated when this pin is pulled low and the chip is selected.

### D7-D0

These pins are 8-bit bi-directional data bus to be connected to the microprocessor's data bus. When serial mode is selected,  $D_7$  will be the serial data input SDA and  $D_6$  will be the serial clock input SCK.

When  $1^{\circ}$ C mode is selected,  $D_4$  will be the clock signal (SCL) and  $D_5$  will be the salve address (SA0). If read register status and write data are necessary,  $D_0$  should be connected with  $D_1$  as SDA bus. If only write data is necessary,  $D_1$  will be SDA bus and  $D_0$  should be left open.

### $V_{DD}$

Power Supply pin. This is also the reference for the OLED driving voltages. It must be connected to external source.

### $V_{DD1}$

Internally connected to V<sub>DD</sub> for pull high purpose.

### $V_{DD2}$

Internally connected to V<sub>DD</sub>.

### $V_{SS}$

Ground. It also acts as a reference for the logic pins. It must be connected to external ground.

# V<sub>SS1</sub>

Internally connected to V<sub>SS</sub> for pull low purpose.

#### $V_{EE}$

This is the most negative voltage supply pin of the chip. It is supplied externally.

#### M/S#

This pin is the selection input. This pin must be pulled high to enable the chip function.

#### CLS

This pin is internal clock enable. When this pin is pulled high, internal clock is enabled.

The internal clock will be disabled when it is pulled low, an external clock source must be connected to CL pin for normal operation.

#### C68/80#

This pin is MCU parallel interface selection input. When the pin is pulled high, 6800 series interface is selected and when the pin is pulled low, 8080 series interface is selected. If Serial Interface is selected (P/S# and SP# pulled low), the setting of this pin is ignored, but must be connected to a known

logic (either high or low).

#### P/S#

This pin is parallel interface selection input. When this pin is pulled high, parallel interface mode is selected. When this pin and SP# pins are pulled low, serial interface is selected.

Note: Read data operation is only available in parallel mode.

#### ROW0-ROW63

These pins provide the Common switch signals to the OLED panel.

#### SEG0-SEG131

These pins provide the OLED segment driving signals. The output voltage level of these pins is in high impedance stage when display is off.

#### ICONS

There are two ICONS pin on the chip. They are the common pin for the icon row. Both pins output exactly the same signal. The reason for duplicating the pin is to enhance the flexibility of the OLED layout.

### $V_{REF}$

This pin is the reference for OLED driving voltages. It is supplied externally.

#### REF

This pin is current reference pin. A resistor should be connected between this pin and  $V_{EE}$ .

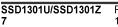
#### SP#

This pin is serial interface selection input. When this pin and P/S# pulled low, serial interface mode is selected.

#### TESTIN, TESTOUT

They are reserved pins. TESTIN must be connected to V<sub>SS</sub> and TESTOUT must be left open.

Note: Refer to Appendix 1 for the configuration of I<sup>2</sup>C Interface.



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### FUNCTIONAL BLOCK DESCRIPTIONS

#### **Command Decoder and Command Interface**

This module determines whether the input data is interpreted as data or command. Data is interpreted 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 input at D<sub>7</sub>-D<sub>0</sub> is interpreted as a Command and it will be decoded and be written to the corresponding command register.

#### **MPU Parallel 6800-series Interface**

The parallel interface consists of 8 bi-directional data pins ( $D_0$ - $D_7$ ), R/W#(WR#), D/C#, E (RD#), CS1# and CS2. R/W#(WR#) input High indicates a read operation from the Graphic Display Data RAM (GDDRAM) or the status register. RW#/ (WR#) input Low indicates a write operation to Display Data RAM or Internal Command Registers depending on the status of D/C# input. The E (RD#) input serves as data latch signal (clock) when high provided that CS1# and CS2 are low and high respectively. Refer to Figure 8 of parallel timing characteristics for Parallel Interface Timing Diagram of 6800-series microprocessors.

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 3 below.

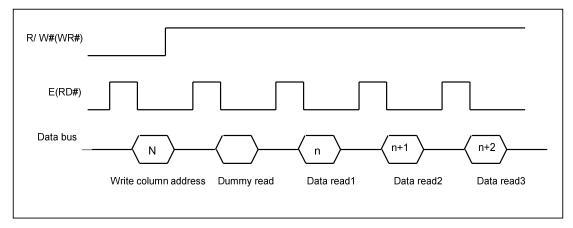


Figure 3 : Display Data Read Back Procedure - Insertion of Dummy Read

#### **MPU Parallel 8080-series Interface**

The parallel interface consists of 8 bi-directional data pins (D<sub>0</sub>-D<sub>7</sub>), E (RD#), R/W#(WR#), D/C#, CS1# and CS2. The E (RD#) input serves as data read latch signal (clock) when low, provided that CS1# and CS2 are low and high respectively. Display data or status register read is controlled by D/C#.

RW# (WR#) input serves as data write latch signal (clock) when high provided that CS1# and CS2 are low and high respectively. Display data or command register write is controlled by D/C#. Refer to Figure 8 of parallel timing characteristics for Parallel Interface Timing Diagram of 8080-series microprocessor. Similar to 6800-series interface, a dummy read is also required before the first actual display data read.

#### **MPU Serial Interface**

The serial interface consists of serial clock SCK, serial data SDA, D/C#, CS1# and CS2. SDA is shifted into an 8-bit shift register on every rising edge of SCL in the order of  $D_7$ ,  $D_6$ , ...  $D_0$ . D/C# is sampled on every eighth clock and the data byte in the shift register is written to the Display Data RAM or command register in the same clock.

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#### **Oscillator Circuit**

This module is an On-Chip low power RC oscillator circuitry (Figure 4). The oscillator generates the clock for the Display Timing Generator.

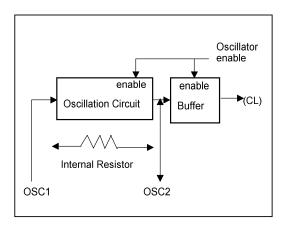


Figure 4 : Oscillator Circuit

#### **OLED Driving Current Control Block**

This block is used to divide the incoming power sources into the different levels of internal use voltage and current. VEE and V<sub>DD</sub> are external power supplies. V<sub>REF</sub> is reference voltage, which is used to deliver a reference voltage for Seg Cells. I<sub>REF</sub> is a reference current source for Seg Cells current drivers.

#### Graphic Display Data RAM (GDDRAM)

The GDDRAM is a bit mapped static RAM holding the bit pattern to be displayed. The size of the RAM is 132 x 65 = 8580 bits. Figure 5 on page 12 is a description of the GDDRAM address map.

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. Figure 5 on page 12 shows the case in which the display start line register is set to 38h.

For those GDDRAM out of the display common range, they could still be accessed, for either preparation of vertical scrolling data or even for the system usage.

#### **Reset Circuit**

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

- Display is OFF 1
- 132x64 [Not included ICONS line] Display Mode 2.
- 3. Normal segment and display data column address mapping(SEG0 mapped to address 00H)
- Read-modify-write mode is OFF 4.
- 5.
- Shift register data clear in serial interface Display start line is set at display RAM address 0 6.
- Column address counter is set at 0 7.
- 8 Page address is set at 0
- Normal scan direction of the COM outputs 9.
- 10. Contrast control register is set at 20H
- Test mode is OFF 11.
- Current mode is set to half range current mode 12

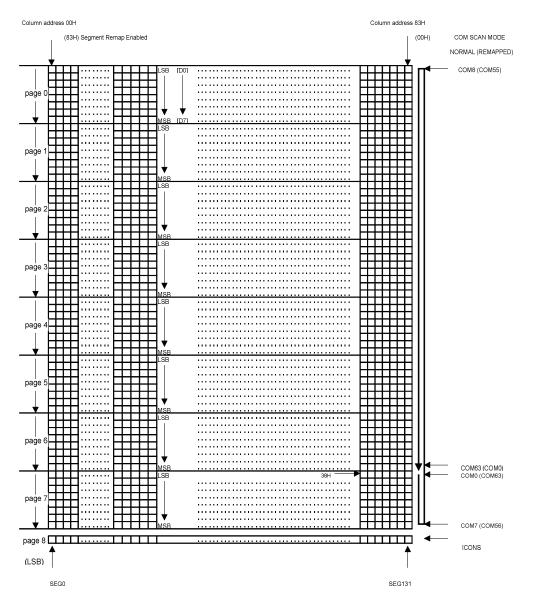
#### 197 Bit Latch

A register carries the display signal information. In 132x65 display mode, data will be fed to the Seg/Com Cell and output to the required voltage/current level respectively.

#### Seg/Com Cell

Seg current source drivers deliver 132 current sources to drive OLED panel. It uses current source to drive the SegCell where the driving current can be adjusted from 0 to 400 uA with 256 steps. Com cell is the voltage scanning pulse as shown in Figure 6.

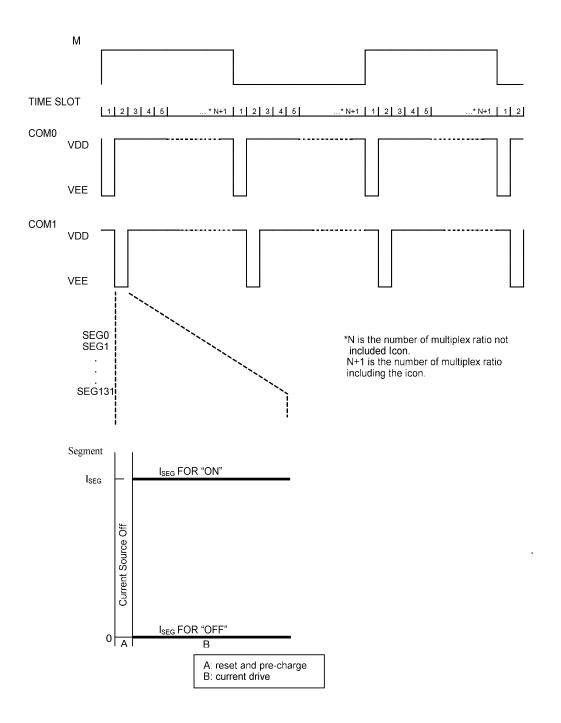
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Note: The configuration in parentheses represent the remapping of Rows and Columns

### Figure 5 : Graphic Display Data RAM (GDDRAM) Address Map with Display Start Line set to 38h.

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### COMMAND TABLE

| Bit Pattern   | Command                           | Description   |
|---|-----------------------------------|---|
| 0000X <sub>3</sub> X <sub>2</sub> X <sub>1</sub> X <sub>0</sub>     | Set Lower Column Address          | Set the lower nibble of the column address register using $X_3X_2X_1X_0$ as data bits. The initial display line register is reset to 0000b after POR.   |
| 0001X <sub>3</sub> X <sub>2</sub> X <sub>1</sub> X <sub>0</sub>     | Set Higher Column Address         | Set the higher nibble of the column address register using $X_2X_2X_1X_0$ as data bits. The initial display line register is reset to 0000b after POR.  |
| 01X5X4X3X2X1X0  | Set Display Start Line            | Set display RAM display start line register from 0-63 using $X_{c}X_{4}X_{3}X_{2}X_{1}X_{0}$ .<br>Display start line register is reset to 000000 during POR.  |
| 10000001<br>X <sub>7</sub> X <sub>6</sub> X <sub>5</sub> X₄X₃X₂X₁X₀ | Set Contrast Control Register     | Double byte command to select 1 out of 256 contrast steps. Contrast increases as $X_7X_8X_5X_4X_3X_2X_1X_0$ is increased from 00000000b to 11111111b. $X_7X_8X_5X_4X_3X_2X_1X_0$ =10000000b after POR   |
| 1010000X₀   | Set Segment Re-map                | $X_0$ =0: column address 00H is mapped to SEG0 (POR) $X_0$ =1: column address 83H is mapped to SEG0   |
| 1010010X₀   | Set Entire Display On/Off         | X₀=0: normal display (POR)<br>X₀=1: entire display on   |
| 1010011X₀   | Set Normal/Inverse Display        | X <sub>0</sub> =0: normal display (POR)<br>X <sub>0</sub> =1: inverse display   |
| 1010111X₀   | Set Display On/Off                | X <sub>0</sub> =0: turns off OLED panel (POR)<br>X <sub>0</sub> =1: turns on OLED panel   |
| 1011X₃X₂X₁X₀  | Set Page Address                  | Set GDDRAM Page Address (0~8) for read/write using $X_{\rm 3}X_{\rm 2}X_{\rm 1}X_{\rm 0}$   |
| 1100X <sub>3</sub> * * *  | Set COM Output Scan Direction     | X <sub>3</sub> =0: normal mode (POR)<br>X <sub>3</sub> =1: remapped mode. COM0 to COM[N-1] becomes COM[N-<br>1] to COM0 in Multiplex ratio is equal to N. See Fig.5 as<br>an example for N equal to 64. |
| 11100000  | Set Read-Modify-Write Mode        | Read-Modify-Write mode will be entered in which the column<br>address will not be increased during display data read. After<br>POR, Read-modify-write mode is turned OFF                                |
| 11100010  | Software Reset                    | Initialize internal status registers  |
| 11101110  | Set End of Read-Modify-Write Mode | Exit Read-Modify-Write mode. RAM Column address before<br>entering the mode will be restored. After POR, Read-modify-<br>write mode is OFF.   |
| 11100011  | NOP                               | Command for No Operation  |
| 1111 * * * *  | Set Test Mode                     | Reserved for IC testing. Do NOT use.  |
| * * * * * * *   | Set Power Save Mode               | Sleep mode will be entered with compound commands   |

Table 2 : Command Table (D/C# =0, R/W#(WR#)=0, E (RD#)=1)

| Bit Pattern                        | Command             | Description  |  |  |  |  |
|------------------------------------|---------------------|--|--|--|--|--|
| 10101000                           | Set Multiplex Ratio | To select multiplex ratio N from 2 to the maximum multiplex ratio (POR value) (including icon line).                 |  |  |  |  |
| **X5X4X3X2X1X0                     |                     | Max. mux ratio: 65   |  |  |  |  |
|                                    |                     | N= X <sub>5</sub> X <sub>4</sub> X <sub>3</sub> X <sub>2</sub> X <sub>1</sub> X <sub>0</sub> +2, e.g. N=001111b+2=17 |  |  |  |  |
|                                    |                     | $\frac{F_{OSC}}{X_4 X_3 X_2 X_1 X_0} = 00001: \frac{F_{OSC}}{4 \times 65}$   |  |  |  |  |
| 10101010<br>*10X₄X₃X₂X₁X₀          | Set Frame Frequency | $X_4X_3X_2X_1X_0 = 111111: \frac{F_{OSC}}{6x65}$ (POR)   |  |  |  |  |
|                                    |                     | $X_4X_3X_2X_1X_0 = 00011: \frac{F_{OSC}}{8x65}$  |  |  |  |  |
| 1101000X₀                          | Set Icon Mode       | $X_0=0$ : icon mode off (POR)<br>$X_0=1$ : icon mode on  |  |  |  |  |
| 11011010<br>***1**X <sub>1</sub> 0 | Set Current Mode    | $X_1=0$ : Select half range current mode (POR)<br>$X_1=1$ : Select full range current mode                           |  |  |  |  |

Note: Remark "\*" stands for "Don't Care"

#### Table 3 : Read Command Table (D/C#=0, R/W#(WR#)=1, E(RD#)=1 for 6800 or E(RD#)=0 for 8080)

| Bit Pattern      | Command              | Description  |
|------------------|----------------------|--|
| D7D6D3D4D3D2D1D0 | Status Register Read | $D_7=0$ : indicates the driver is ready for command.<br>$D_7=1$ : indicates the driver is Busy.<br>$D_6=0$ : indicates reverse segment mapping with column address<br>$D_6=1$ : indicates normal segment mapping with column address<br>$D_5=0$ : indicates the display is ON<br>$D_5=1$ : indicates the display is OFF<br>$D_4=0$ : initialization is not in progress<br>$D_4=1$ : initialization is in progress after RES# or software reset |

Note: Patterns other than that given in Command Table are prohibited to enter to the chip as a command; otherwise, unexpected result will occur.

#### Data Read / Write

To read data from the GDDRAM, input High to R/W#(WR#) pin and D/C# pin for 6800-series parallel mode, Low to E (RD#)

pin and High to D/ C# pin for 8080-series parallel mode. No data read is provided for serial mode. In normal data read mode, GDDRAM column address pointer will be increased by one automatically after each data read. However, no automatic increase will be performed in read-modify-write mode.

Also, a dummy read is required before the first data read. See Figure 3 in Functional Description.

To write data to the GDDRAM, input Low to R/W#(WR#) pin and High to D/C# pin for 6800-series parallel mode AND 8080-series parallel mode. For serial interface mode, it is always in write mode. GDDRAM column address pointer will be increased by one automatically after each data write.

It should be noted that, after the automatic column address increment, the pointer will NOT wrap round to 0 when overflow (>131). The increment of the pointer will stop at 131. Therefore, there is a need to re-initialize the pointer when progresses to another page address.

#### Address Increment Table (Automatic)

| D/C# | R/W#(WR#) | Comment       | Address<br>Increment |
|------|-----------|---------------|----------------------|
| 0    | 0         | Write Command | No                   |
| 0    | 1         | Read Status   | No                   |
| 1    | Ö         | Write Data    | Yes                  |
| 1    | 1         | Read Data     | Yes*1                |

\*1. If read-data command is issued in read-modify-write mode, address increase is not applied.

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### **COMMAND DESCRIPTIONS**

#### Set Lower Column Address

This command specifies the lower nibble of the 8-bit column address of the display data RAM. The column address will be incremented by each data access after it is pre-set by the MCU.

#### Set Higher Column Address

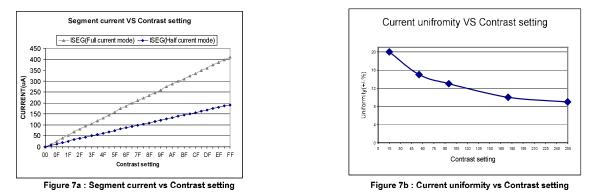
This command specifies the higher nibble of the 8-bit column address of the display data RAM. The column address will be incremented by each data access after it is pre-set by the MCU.

#### Set Display Start Line

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 63. With value equals to 0,  $D_0$  of Page 0 is mapped to COM0. With value equals to 1,  $D_1$  of Page0 is mapped to COM0. The display start line values of 0 to 63 are assigned to Page 0 to 7.

#### Set Contrast Control Register

This command is to set Contrast Setting of the display. The chip has 256 contrast steps from 00 to FF. The segment output current increase with the increase of contrast step. See Fig 7a below. From Fig 7b, it shows that the output uniformity is better at highest contrast setting. Therefore, for both full range current mode and half range current mode, it is recommended choosing a higher contrast setting if possible.



Set Segment Re-map

This command changes the mapping between the display data column address and segment driver. It allows flexibility in layout during OLED module assembly. Refer to Table 2.

#### Set Entire Display On/Off

This command forces the entire display, including the icon row, to be "ON" regardless of the contents of the display data RAM. This command has priority over normal/reverse display. This command will be used with "Set Display ON/OFF" command to form a compound command for entering power save mode. See "Set Power Save Mode".

#### Set Normal/Reverse Display

This command sets the display to be either normal/reverse. In normal display, a RAM data of 1 indicates an "ON" pixel while in reverse display, a RAM data of 0 indicates an "ON" pixel. In icon mode, the icon line is not reversed by this command.

#### Set Display On/Off

This command alternatively turns the display on and off. When display off is issued with entire display on, power save mode will be entered. See "Set Power Save Mode" for details.

#### Set Page Address

This command positions the page address to 0 to 8 possible positions in GDDRAM. Refer to Table 2.

#### Set COM Output Scan Direction

This command sets the scan direction of the COM output allowing layout flexibility in OLED module assembly. See Figure 5 on Page 12 for the relationship between turning on or off of this feature.

In addition, the display will have immediate effect once this command is issued. That is, if this command is sent during normal display, the graphic display will have vertical flipping effect.

#### Set Read-Modify-Write Mode

- This command puts the chip in read-modify-write mode in which:
- 1. The column address is saved before entering the mode
- 2. The column address is incremented by display data write but not by display data read

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| Table 4 : ROW | pins assignment for | COM signals in Prog | grammable Multiplex Ratio |
|---------------|---------------------|---------------------|---------------------------|
|---------------|---------------------|---------------------|---------------------------|

| Die Deel Marrie | CA Marc Com    | L 54 Mars Oren | 50 Mars Oran  | 40 Mars Com                |                            | 00 14                      | 00 Mars 0 area             | 40.14                      |
|-----------------|----------------|----------------|---------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Die Pad Name    | 64 Mux Com     | 54 Mux Com     | 53 Mux Com    | 49 Mux Com                 | 48 Mux Com                 | 33 Mux Com                 | 32 Mux Com                 | 16 Mux Com                 |
|                 | Signal Output  | Signal Output  | Signal Output | Signal Output              | Signal Output              | Signal Output              | Signal Output              | Signal Output              |
| RQW0            | COM0           | COMO           | COM0          | COM0                       | COM0                       | COMO                       | COM0                       | COM0                       |
| ROW1            | COM1           | COM1           | COM1          | COM1                       | COM1                       | COM1                       | COM1                       | COM1                       |
| DOWO            | COM2           | COM2           | COM2          | COM2                       | COM2                       |                            | COM2                       | COM2                       |
| ROW2            |                | COMZ           |               |                            |                            | COM2                       | COMZ                       | COMZ                       |
| ROW3            | COM3           | COM3           | COM3          | COM3                       | COM3                       | COM3                       | COM3                       | COM3                       |
| ROW4            | COM4           | COM4           | COM4          | COM4                       | COM4                       | COM4                       | COM4                       | COM4                       |
| ROW5            | COM5           | COM5           | COM5          | COM5                       | COM5                       | COM5                       | COM5                       | COM5                       |
| ROW6            | COM6           | COM6           | COM6          | COM6                       | COM6                       | COM6                       | COM6                       | COM6                       |
|                 |                |                |               |                            |                            |                            |                            |                            |
| ROW7            | COM7           | COM7           | COM7          | COM7                       | COM7                       | COM7                       | COM7                       | COM7                       |
| ROW8            | COM8           | COM8           | COM8          | COM8                       | COM8                       | COM8                       | COM8                       | COM8                       |
| ROW9            | COM9           | COM9           | COM9          | COM9                       | COM9                       | COM9                       | COM9                       | COM9                       |
| ROW10           | COM10          | COM10          | COM10         | COM10                      | COM10<br>COM11             | COM10                      | COM10                      | COM10                      |
| ROW11           | COM11          | COM11          | COM11         | COM11                      | COM11                      | COM11                      | COM11                      | COM11                      |
| ROW12           | COM12          | COM12          | COM12         | COM12                      | COM12                      | 00111                      | COM12                      | COM12                      |
| ROWIZ           |                |                |               | COMIZ                      | COMIZ                      | COM12                      |                            |                            |
| ROW13           | COM13          | COM13          | COM13         | COM13                      | COM13                      | COM13                      | COM13                      | COM13                      |
| ROW14           | COM14          | COM14          | COM14         | COM14                      | COM14                      | COM14                      | COM14                      | COM14                      |
| ROW15           | COM15          | COM15          | COM15         | COM15                      | COM15                      | COM15                      | COM15                      | COM15                      |
| ROW16           | COM16          | COM16          | COM16         | COM16                      | COM16                      | COM16                      | COM16                      | NON-SELECT*                |
| ROW10           | COM10<br>COM17 | COM10<br>COM17 | COM17         | COM10<br>COM17             | COM10<br>COM17             | COM10<br>COM17             | COM10<br>COM17             | NON-SELECT*                |
|                 |                |                |               |                            |                            |                            |                            |                            |
| ROW18           | COM18          | COM18          | COM18         | COM18                      | COM18                      | COM18                      | COM18                      | NON-SELECT*                |
| ROW19           | COM19          | COM19          | COM19         | COM19                      | COM19                      | COM19                      | COM19                      | NON-SELECT*                |
| ROW20           | COM20          | COM20          | COM20         | COM20                      | COM20                      | COM20                      | COM20                      | NON-SELECT*                |
| ROW21           | COM21          | COM21          | COM21         | COM21                      | COM21                      | COM21                      | COM21                      | NON-SELECT*                |
| ROW22           | COM22          | COM22          | COM22         | COM22                      | COM21<br>COM22             | COM21<br>COM22             | COM21<br>COM22             | NON-SELECT*                |
| DOW/22          |                |                |               | 0011/22                    | 0011/22                    | 001022                     | 0011/22                    |                            |
| ROW23           | COM23          | COM23          | COM23         | COM23                      | COM23<br>COM24             | COM23                      | COM23                      | NON-SELECT*                |
| ROW24           | COM24          | COM24          | COM24         | COM24                      | COM24                      | COM24                      | COM24                      | NON-SELECT*                |
| ROW25           | COM25          | COM25          | COM25         | COM25                      | COM25                      | COM25                      | COM25                      | NON-SELECT*                |
| ROW26           | COM26          | COM26          | COM26         | COM26                      | COM26                      | COM26                      | COM26                      | NON-SELECT*                |
| ROW27           | COM27          | COM27          | COM27         | COM27                      | COM27                      | COM27                      | COM27                      | NON-SELECT*                |
|                 |                |                |               |                            | COM27<br>COM28             | 001/127                    | COM27<br>COM28             |                            |
| ROW28           | COM28          | COM28          | COM28         | COM28                      | COM28                      | COM28                      | COM28                      | NON-SELECT*                |
| ROW29<br>ROW30  | COM29          | COM29          | COM29         | COM29                      | COM29<br>COM30             | COM29<br>COM30             | COM29<br>COM30             | NON-SELECT*<br>NON-SELECT* |
| ROW30           | COM30          | COM30          | COM30         | COM30                      | COM30                      | COM30                      | COM30                      | NON-SELECT*                |
| ROW31           | COM31          | COM31          | COM31         | COM31                      | COM31                      | COM31                      | COM31                      | NON-SELECT*                |
| ROW32           | COM32          | COM32          | COM32         | COM32                      | COM32                      | COM32                      | NON-SELECT*                | NON-SELECT*                |
| ROW33           | COM33          | COM33          | COM33         | COM33                      | COM33                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW34           | COM34          | COM34          | COM34         | COM34                      | COM33<br>COM34             | NON-SELECT*<br>NON-SELECT* | NON-SELECT*                | NON-SELECT*                |
| ROW34           | 001/054        |                |               | 001/034                    | 001/134                    | NON-SELECT                 | NON-SELECT                 | NON-SELECT                 |
| ROW35           | COM35          | COM35          | COM35         | COM35                      | COM35<br>COM36             | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW36           | COM36          | COM36          | COM36         | COM36                      | COM36                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW37           | COM37          | COM37          | COM37         | COM37                      | COM37                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW38           | COM38          | COM38          | COM38         | COM38                      | COM38                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW39           | COM39          | COM39          | COM39         | COM39                      | COM39                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW40           |                | COM40          | COM40         | COM40                      | COM40                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
|                 | COM40          |                |               | 001140                     |                            | NON-SELECT                 | NON-SELECT                 | NON-SELECT                 |
| ROW41           | COM41          | COM41          | COM41         | COM41                      | COM41                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW42           | COM42          | COM42          | COM42         | COM42                      | COM42                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW43           | COM43          | COM43          | COM43         | COM43                      | COM43                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW44           | COM44          | COM44          | COM44         | COM44                      | COM44                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW45           | COM45          | COM45          | COM45         | COM45                      | COM45                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW46           | COM46          | COM46          | COM46         | COM46                      | COM46                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
|                 |                |                |               |                            |                            | NON-SELECT                 | NON-SELECT                 |                            |
| ROW47           | COM47          | COM47          | COM47         | COM47                      | COM47                      | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW48           | COM48          | COM48          | COM48         | COM48                      | NON-SELECT*<br>NON-SELECT* | NON-SELECT*                | NON-SELECT*<br>NON-SELECT* | NON-SELECT*                |
| ROW49           | COM49          | COM49          | COM49         | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW50           | COM50          | COM50          | COM50         | NON-SELECT*<br>NON-SELECT* | NON-SELECT*<br>NON-SELECT* | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW51           | COM51          | COM51          | COM51         | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
|                 |                |                |               | NON-GELECT                 | NON-OLLEOT                 |                            |                            |                            |
| ROW52           | COM52          | COM52          | COM52         | NON-SELECT*<br>NON-SELECT* | NON-SELECT*<br>NON-SELECT* | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW53           | COM53          | COM53          | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW54           | COM54          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW55           | COM55          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW56           | COM56          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*<br>NON-SELECT* | NON-SELECT*<br>NON-SELECT* | NON-SELECT*                | NON-SELECT*                |
| ROW57           | COM57          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
|                 |                | NON-BELEUT     | NON-BELEUT    | NON-BELEUT                 | NON-BELEUT                 | NON OF FOT                 | NON-BELEUT                 | NON-BELEUT                 |
| ROW58           | COM58          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW59           | COM59          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW60           | COM60          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW61           | COM61          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW62           | COM62          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| ROW63           | COM63          | NON-SELECT*    | NON-SELECT*   | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                | NON-SELECT*                |
| 1.07003         | 00000          | NON-OLLEGI"    | INDIN-OLLEGI" | NON-OLLEGI"                | NON-GELECT                 | INUN-GELEUT"               | NUN-GELEUT"                | NUN-GELEUT                 |

Remark: \*The ROW will output a Non-Select COM signal.

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#### Software Reset

This command causes some of the internal status of the chip to be initialized:

- 1. Read-Modify-Write mode is off
- 2. Display start line register is set to 0
- 3. Column address counter is set to 0
- 4. Page address is set to 0
- 5. Normal scan direction of the COM outputs

#### Set End of Read-Modify-Write Mode

This command relieves the chip from read-modify-write mode. The column address saved before entering read-modify-write mode will be restored.

#### NOP

No Operation Command

#### Set Test Mode

This command forces the driver chip into its test mode for internal testing of the chip. Under normal operation, user should NOT use this command.

#### Set Power Save Mode

To enter Sleep Mode, it should be done by using a double byte command composed of "Set Display ON/OFF" and "Set Entire Display ON/OFF" commands. When "Set Entire Display ON" is issued during display is OFF, Sleep Mode will be entered. For Sleep mode:

- Internal oscillator and OLED power supply circuits are stopped
- Segment and Common drivers output high impedance level
- 3. The display data and operation mode before sleep are held
- 4. Internal display RAM can still be accessed
- 5. Sleep Mode can be exited by the issue of a new software command or by pulling Low at hardware pin RES#.

#### Status register Read

This command is issued by setting D/C# Low during a data read (refer to Figure 8 and Figure 9 parallel interface waveform). It allows the MCU to monitor the internal status of the chip. No status read is provided for serial mode.

#### Set Multiplex Ratio

This command switches default 65 multiplex mode to any multiplex mode from 2 to 65. The output pads ROW0-ROW63 will be switched to corresponding COM signal. (See Table 4)

#### Set Frame Frequency

This command is used to select Frame Frequency. In SSD1301, there are three choices for frame frequency.

#### Set Icon Mode

This command enables or disables the icon mode. The default setting (POR) disables the icon mode.

#### Set Current Mode

This command is used to select half range current mode or full range current mode. In POR, half range current mode is default.

### **MAXIMUM RATINGS**

Table 5 : Maximum Ratings (Voltage Reference to Vss)

| Symbol           | Parameter                 | Value                      | Unit |
|------------------|---------------------------|----------------------------|------|
| V <sub>DD</sub>  | Supply Voltago            | -0.3 to +4                 | V    |
| V <sub>EE</sub>  | Supply Voltage            | 0 to V <sub>DD</sub> -16.5 | V    |
| Vin              | Input voltage             | Vss-0.3 to Vdd+0.3         | V    |
| T <sub>A</sub>   | Operating Temperature     | -30 to +85                 | °C   |
| T <sub>stg</sub> | 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.

# DC CHARACTERISTICS

| Table 6 : DC Characteristics (Unless otherwise specified, Voltage Referenced to $V_{SS}$ , $V_{DD}$ = 2.4 to 3.5V, | T <sub>A</sub> = 25°C) |
|--|------------------------|
|--|------------------------|

| Symbol             | Parameter  | Test Condition   | Min                 | Тур   | Max                 | Unit |
|--------------------|--|--|---------------------|-------|---------------------|------|
| $V_{EE}$           | Operating Voltage  |  | -13.0               | -9    | -4.6                | V    |
| V <sub>DD</sub>    | Logic Supply Voltage   |  | 2.4                 | 2.7   | 3.5                 | V    |
| Vон                | High Logic Output Level  | lout =100uA, 3.3MHz  | 0.9*V <sub>DD</sub> | -     | V <sub>DD</sub>     | V    |
| Vol                | Low Logic Output Level   | lout =100uA, 3.3MHz  | 0                   | -     | 0.1*V <sub>DD</sub> | V    |
| VIH                | High Logic Input Level   | lout =100uA, 3.3MHz  | 0.8*V <sub>DD</sub> | -     | V <sub>DD</sub>     | V    |
| VIL                | Low Logic Input Level  | lout =100uA, 3.3MHz  | 0                   | -     | 0.2*V <sub>DD</sub> | V    |
| I <sub>SLEEP</sub> | Sleep mode Current   | VDD=2.7V, IREF=8uA,<br>Display On, no panel<br>attached        | -                   | 0.2   | 5                   | uA   |
| I                  | V <sub>EE</sub> Supply Current   | Contrast = FF  | -680                | -580  |                     | uA   |
| I <sub>EE</sub>    | VDD=2.7V, VEE=-9V, IREF=8uA, Frame rate =<br>85Hz, Contrast = FF, All one pattern, Display on, no<br>loading                                   | Contrast = AF  |                     | -480  |                     | UA   |
| I <sub>DD</sub>    | V <sub>DD</sub> Supply Current<br>VDD=2.7V, VEE=-9V, IREF=8uA, Frame rate =<br>85Hz, Contrast = FF, All one pattern, Display on, no<br>loading | Contrast = FF  | -                   | 600   | 700                 | uA   |
|                    | Power Consumption = $(I_{DD} + I_{EE}) V_{DD} - (V_{DD} - V_{EE}) I_{EE}$  | Contrast = AF  |                     | 500   |                     |      |
|                    | Full Range Current Mode  | Contrast = FF  | 350                 | 400   | 450                 |      |
|                    | VDD=2.7V, VEE=-9V, IREF=8uA,   | Contrast = AF  | 220                 | 270   | 320                 |      |
|                    | All one pattern, Display on,<br>Segment pin under test is connected with a $20K\Omega$   | Contrast = 5F  | 110                 | 145   | 180                 | uA   |
|                    | resistive load to VEE.   | Contrast = 0F  | 0                   | 25    | 50                  |      |
| SEG                | Lielf Dense Current Mede   | Contrast = FF  | 157.5               | 180   | 202.5               |      |
|                    | Half Range Current Mode  | Contrast = AF  | 99                  | 121.5 | 144                 |      |
|                    | VDD=2.7V, VEE=-9V, IREF=8uA,<br>All one pattern, Display on,   |  |                     |       |                     | uA   |
|                    | Segment pin under test is connected with a 20 $\!K\!\Omega$  | Contrast = 5F  | 49.5                | 65.25 | 81                  |      |
|                    | resistive load to VEE.   | Contrast = 0F  | 0                   | 11.25 | 22.5                |      |
|                    |  | Dev = (Iseg – Imid)/Imid                                       |                     |       |                     |      |
| Dev                | Segment output current uniformity  | I <sub>MID</sub> = (I <sub>MAX</sub> + I <sub>MIN</sub> )/2    | -                   | -     | ±9                  | %    |
|                    |  | I <sub>SEG</sub> [0:131] = Segment<br>current at contrast = FF |                     |       |                     |      |
|                    |  | Contrast = 5F  | -                   | -     | ±13                 |      |
| R <sub>ON_C</sub>  | Common Output On Resistance  | VDD - VEE=11.7V,<br>lout=30mA;                                 | -                   | 23    | 33                  | Ω    |

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# AC CHARACTERISTICS

| Symbol           | Parameter  | Test Condition   | Min | Тур   | Max | Unit     |
|------------------|--|--|-----|---|-----|----------|
| Fosc             | Oscillation Frequency of<br>Display Timing Generator | Vdd = 2.7V, IREF = 8uA   | 35  | 40  | 42  | kHz      |
| F <sub>FRM</sub> | Frame Frequency for<br>65 MUX Mode                   | 132x64 Graphic Display Mode, Display ON,<br>Internal Oscillator Enabled<br>132x64 Graphic Display Mode, Display ON,<br>Internal Oscillator Disabled, External clock with<br>freq., F <sub>ext</sub> , feeding to CL pin. |     | $\frac{F_{\rm osc}}{6x65}$ $\frac{F_{\rm ext}}{6x65}$ |     | Hz<br>Hz |

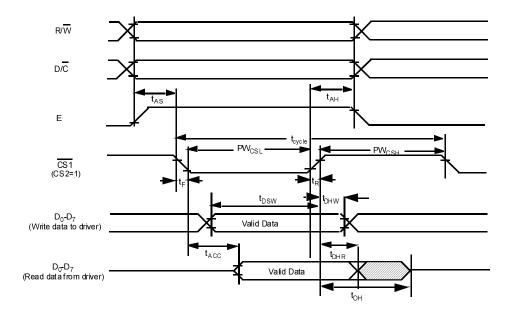
Table 7 : AC Characteristics (Unless otherwise specified, Voltage Referenced to  $V_{SS}$ ,  $V_{DD}$  = 2.4 to 3.5V,  $T_A$  = 25°C.)

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| Symbol             | Parameter   | Min       | Тур | Max | Unit |
|--------------------|---|-----------|-----|-----|------|
| t <sub>cycle</sub> | Clock Cycle Time  | 300       | -   | -   | ns   |
| t <sub>AS</sub>    | Address Setup Time  | 0         | -   | -   | ns   |
| t <sub>AH</sub>    | Address Hold Time   | 0         | -   | -   | ns   |
| t <sub>DSW</sub>   | Write Data Setup Time   | 40        | -   | -   | ns   |
| t <sub>ohw</sub>   | Write Data Hold Time  | 15        | -   | -   | ns   |
| t <sub>DHR</sub>   | Read Data Hold Time   | 20        | -   | -   | ns   |
| t <sub>он</sub>    | Output Disable Time   | -         | -   | 70  | ns   |
| t <sub>ACC</sub>   | Access Time   | -         | -   | 140 | ns   |
| PW <sub>CSL</sub>  | Chip Select Low Pulse Width (read)<br>Chip Select Low Pulse Width (write)   | 120<br>60 | -   | -   | ns   |
| PW <sub>CSH</sub>  | Chip Select High Pulse Width (read)<br>Chip Select High Pulse Width (write) | 60<br>60  | -   | -   | ns   |
| t <sub>R</sub>     | Rise Time   | -         | -   | 15  | ns   |
| ŧ                  | Fall Time   | -         | -   | 15  | ns   |

Table 8 : 6800-Series MPU Parallel Interface Timing Characteristics (V<sub>DD</sub> - V<sub>SS</sub> = 2.4 to 3.5V, T<sub>A</sub> = -30 to 85°C)







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| Symbol             | Parameter   | Min       | Тур | Max | Unit |
|--------------------|---|-----------|-----|-----|------|
| t <sub>cycle</sub> | Clock Cycle Time  | 300       | -   | -   | ns   |
| t <sub>AS</sub>    | Address Setup ⊺ime  | 0         | -   | -   | ns   |
| t <sub>АН</sub>    | Address Hold Time   | 0         | -   | -   | ns   |
| t <sub>DSW</sub>   | Write Data Setup Time   | 40        | -   | -   | ns   |
| t <sub>онw</sub>   | Write Data Hold Time  | 15        | -   | -   | ns   |
| t <sub>DHR</sub>   | Read Data Hold Time   | 20        | -   | -   | ns   |
| t <sub>OH</sub>    | Output Disable Time   | -         | -   | 70  | ns   |
| tacc               | Access Time   | -         | -   | 140 | ns   |
| PW <sub>CSL</sub>  | Chip Select Low Pulse Width (read)<br>Chip Select Low Pulse Width (write)   | 120<br>60 | -   | -   | ns   |
| PW <sub>CSH</sub>  | Chip Select High Pulse Width (read)<br>Chip Select High Pulse Width (write) | 60<br>60  | -   | -   | ns   |
| t <sub>R</sub>     | Rise Time   | -         | -   | 15  | ns   |
| t⊨                 | Fall Time   | -         | -   | 15  | ns   |

Table 9 : 8080-Series MPU Parallel Interface Timing Characteristics ( $V_{DD}$  -  $V_{SS}$  = 2.4 to 3.5V,  $T_A$  = -30 to 85°C)

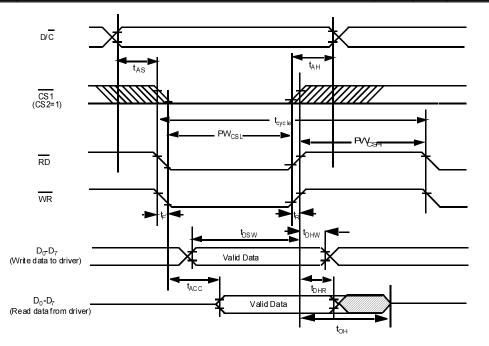


Figure 9 : 8080-series MPU Parallel Interface Characteristics

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|         |

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| Symbol             | Parameter              | Min | Тур | Max | Unit |
|--------------------|------------------------|-----|-----|-----|------|
| t <sub>cycle</sub> | Clock Cycle Time       | 250 | -   | -   | ns   |
| t <sub>AS</sub>    | Address Setup ⊺ime     | 150 | -   | -   | ns   |
| t <sub>AH</sub>    | Address Hold Time      | 150 | -   | -   | ns   |
| t <sub>css</sub>   | Chip Select Setup Time | 120 | -   | -   | ns   |
| t <sub>CSH</sub>   | Chip Select Hold Time  | 60  | -   | -   | ns   |
| t <sub>DSW</sub>   | Write Data Setup Time  | 100 | -   | -   | ns   |
| t <sub>onw</sub>   | Write Data Hold Time   | 100 | -   | -   | ns   |
| t <sub>CLKL</sub>  | Clock Low Time         | 100 | -   | -   | ns   |
| t <sub>cLKH</sub>  | Clock High Time        | 100 | -   | -   | ns   |
| t <sub>R</sub>     | Rise Time              | -   | -   | 15  | ns   |
| t⊨                 | Fall Time              | -   | -   | 15  | ns   |

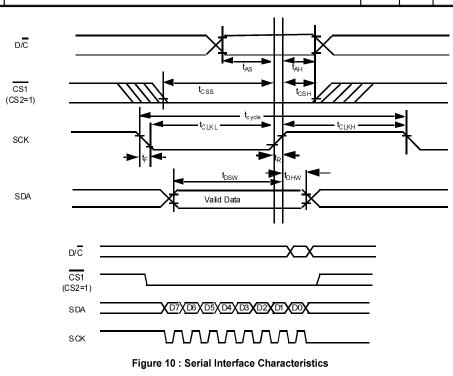


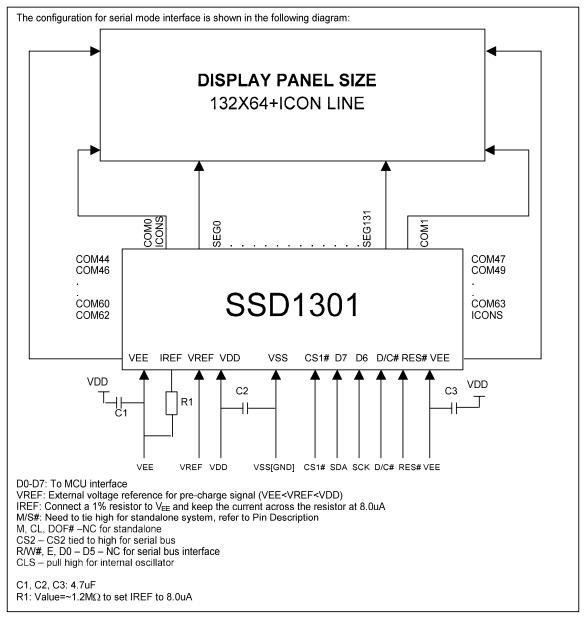
Table 10 : Serial Interface Timing Characteristics ( $V_{DD} - V_{SS} = 2.4$  to 3.5V,  $T_A = -30$  to 85°C)

\* When SP# is high, please refer to APPENDIX I for timing characteristics for Solomon Systech Limited internal use only.



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### **Application Example**



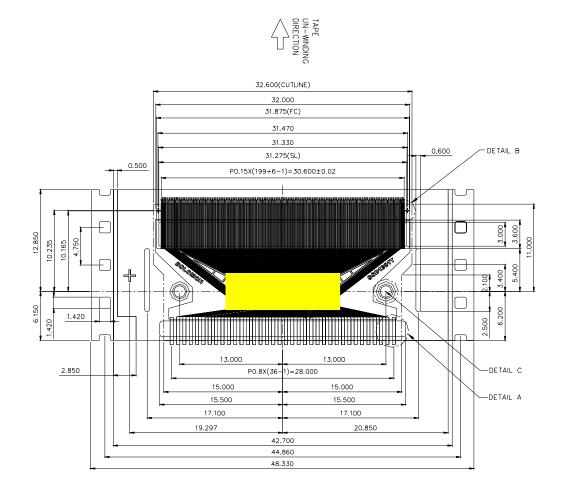
|                            | C68/80#              | P/S# | SP# |  |
|----------------------------|----------------------|------|-----|--|
| 6800 parallel interface    | 1                    | 1    | Х   |  |
| 8080 parallel interface    | 0                    | 1    | Х   |  |
| Serial interface           | Х                    | 0    | 0   |  |
| I <sup>2</sup> C interface | *Refer to Appendix I |      |     |  |

Note: X stands for don't care.

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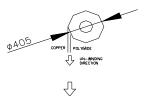
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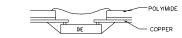
### SSD1301TR1 TAB PACKAGE DIMENSION



### Note:

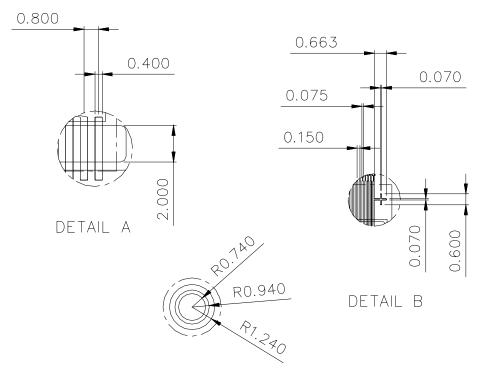
- 1. All dimensions are in mm unless specific
- 2. General Tolerance : +/-0.05mm
- 3. Cu Thickness : 25um
- 4. SN Plating: 0.35um







MIRROR DESIGN



DETAIL C



### APPENDIX I IIC TIMING DIAGRAM AND PIN CONNECTION

#### PIN DESCRIPTION

#### SP#

This pin is serial interface selection input. When this pin and P/S# are pulled low, serial interface mode is selected. When it is pulled high and P/S# pin is pulled low, PC interface mode is selected.

### FUNCTIONAL BLOCK DESCRIPTION

### MPU I<sup>2</sup>C Interface

The I<sup>2</sup>C communication interface consists of slave address bit SA0 (D<sub>5</sub>), I<sup>2</sup>C-bus data signal SDA (D<sub>0</sub> for output and D<sub>1</sub> for input) and I<sup>2</sup>C-bus clock signal SCL (D<sub>4</sub>). Both the data and clock signals must be connected to pull-up resistors. There are also five input signals including, RES#, CS1#, P/S#, CS2, SP#, which is used for the initialization of device.

a) Slave address bit (SA0)

SSD1301 have to recognize the slave address before transmitting or receiving any information by the l<sup>2</sup>C-bus. The device will responds to the slave address following by the slave address bit ("SA0" bit) and the read/write select bit ("R/W#" bit) with the following byte format,

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> 0 1 1 1 1 0 SA0 R/W#

0 1 1 1 1 0 SA0 R/W#

"SA0" bit provides an extension bit for the slave address. Either "0111100" or "0111101", can be selected as the slave address of SSD1301.

- "R/W#" bit determines the I<sup>2</sup>C-bus interface is operating at either write mode or read status mode.
- b) I<sup>2</sup>C-bus data signal (SDA)

SDA acts as a communication channel between the transmitter and the receiver. The data and the acknowledgement are sent through the SDA. If SDA in is connected to the "SDA out", the device becomes fully IIC bus compatible. It should be noticed that the ITO track resistance and the pulled-up resistance at "SDA" pin becomes a voltage potential divider. As a result, the acknowledgement would not be possible to attain a valid logic 0 level in "SDA". The "SDA out" pin may be disconnected from the "SDA in" pin. With such arrangement, the acknowledgement signal will be ignored in the I<sup>2</sup>C-bus.

c) I<sup>2</sup>C-bus clock signal (SCL)

The transmission of information in the I<sup>2</sup>C-bus is following a clock signal, SCL. Each transmission of data bit is taken place during a single clock period of SCL.

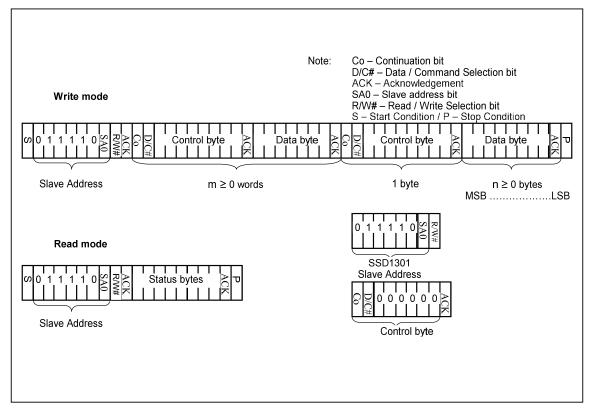
### **Command Decoder**

Input is directed to the command decoder based on the input of control byte which consists of a D/C# bit and a R/W# bit. For further information about the control byte, please refer to the section "I<sup>2</sup>C-bus Write data and read register status". If both the D/C# bit and the R/W# bit are low, the input signal is interpreted as a Command. It will be decoded and written to the corresponding command register. If the D/C# bit is high and the R/W# bit is low, input signal is written to Graphic Display Data RAM (GDDRAM).

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### I<sup>2</sup>C-bus Write data and read register status

The I<sup>2</sup>C-bus interface gives access to write data and command into the device. Please refer to Figure 11 for the write mode of I<sup>2</sup>Cbus in chronological order.



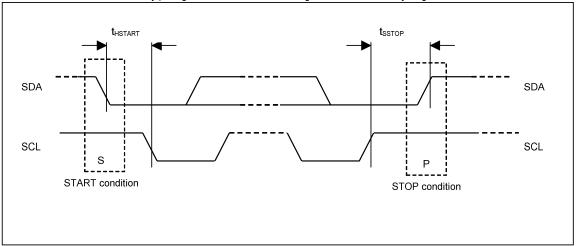
#### Figure 11 : I<sup>2</sup>C-bus data format

Write mode

- The master device initiates the data communication by a start condition. The definition of the start condition is shown in 1) Figure 12. The start condition is established by pulling the SDA from high to low while the SCL stays high.
- 2) The slave address is following the start condition for recognition use. For the SSD1301, the slave address is either
- "b0111100" or "b0111101" by changing the SA0 to high or low. The write mode is established by setting the R/W# bit to logic "0".
- 3)
- 4) An acknowledgement signal will be generated after receiving one byte of data, including the slave address and the R/W# bit. Please refer to the Figure 13 for the graphical representation of the acknowledge signal. The acknowledge bit is defined as the SDA line is pulled down during the high period of the acknowledgement related clock pulse.
- After the transmission of the slave address, either the control byte or the data byte may be sent across the SDA. A control 5) byte mainly consists of Co and D/C# bits following by six "0" 's.
  - а. If the Co bit is set as logic "0", the transmission of the following information will contain data bytes only.
  - The D/C# bit determines the next data byte is acted as a command or a data. If the D/C# bit is set to logic "0", it b. defines the following data byte as a command. If the D/C# bit is set to logic "1", it defines the following data byte as a data which will be stored at the GDDRAM. The GDDRAM column address pointer will be increased by one automatically after each data write.
- 6) Acknowledge bit will be generated after receiving each control byte or data byte.

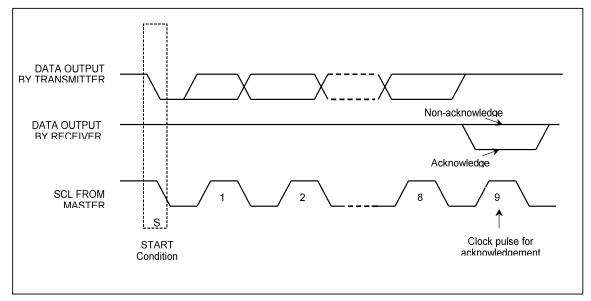
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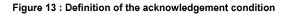
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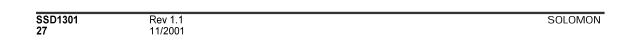


7) The write mode will be finished when a stop condition is applied. The stop condition is also defined in Figure 12. The stop condition is established by pulling the "SDA in" from low to high while the "SCL" stays high.

Figure 12 : Definition of the start and stop condition

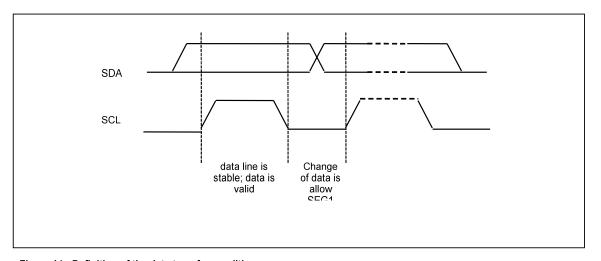






Please be noted that the transmission of the data bit has some limitations.

1. The data bit, which is transmitted during each SCL pulse, must keep at a stable state within the "high" period of the clock pulse. Please refer to the Figure 14 for graphical representations. Except in start or stop conditions, the data line can be switched only when the SCL is low.



2. Both the data line (SDA) and the clock line (SCL) should be pulled up by external resistors.

#### Figure 14 : Definition of the data transfer condition

Read mode (Read status register)

- 1) The master device firstly initiates the data communication by a start condition. The definition of the start condition is shown in Figure 12.
- The slave address is following the start condition for recognition use. For the SSD1301, the slave address is either "b0111100" or "b0111101".
- The read mode is established by setting R/W# bit to logic "1". The read mode allows the MCU to monitor the internal status of the chip.
- An acknowledgement signal will be generated after sending one byte of data, including the slave address and the R/W#
  bit. Please refer to the Figure 13 for the graphical representation of the acknowledge signal.
- 5) The status of the register will be read at the next status byte. Please refer to the Read Command Table on page 15 for the explanation of the status byte.
- 6) The read mode will be finished when a stop condition is applied. The stop condition is also defined in Figure 12.

| Symb<br>ol         | Parameter   | Min | Тур | Мах | Unit |
|--------------------|---|-----|-----|-----|------|
| t <sub>cycle</sub> | Clock Cycle Time  | 2.5 | -   | -   | us   |
| <b>t</b> HSTART    | Start condition Hold Time   | 0.6 | -   | -   | us   |
| t <sub>HD</sub>    | Data Hold Time  | 300 | -   | -   | ns   |
| t <sub>so</sub>    | Data Setup Time   | 100 | -   | -   | ns   |
| tsstart            | Start condition Setup Time (Only relevant for a repeated Start condition) | 0.6 | -   | -   | us   |
| <b>t</b> sstop     | Stop condition Setup Time   | 0.6 | -   | -   | us   |
| t <sub>R</sub>     | Rise Time for data and clock pin  | -   | -   | 300 | ns   |
| t⊨                 | Fall Time for data and clock pin  | -   | -   | 300 | ns   |
| <b>t</b> idle      | Idle Time before a new transmission can start                             | 1.3 | -   | -   | us   |

Table 11 : I<sup>2</sup>C Interface Timing Characteristics (V<sub>DD</sub>-V<sub>SS</sub>=2.4 to 3.5V, T<sub>A</sub>=-30 to 85° C)

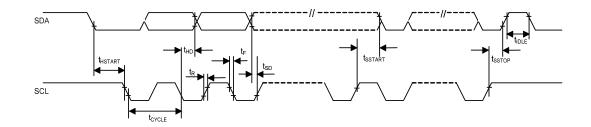


Figure 15 : I<sup>2</sup>C Interface Timing Characteristics

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