

SSD1303

Advance Information

**132 x 64 Dot Matrix
OLED/PLED Segment/Common Driver with Controller**

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

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1 GENERAL INFORMATION

The SSD1303 is a single-chip CMOS OLED/PLED driver with a controller for an organic or polymer light emitting diode dot-matrix graphic display system. It consists of 132 segments, 64 commons which support a maximum display resolution of 132x64. There are 4-color selections, supporting monochrome or area color OLED/PLED. This IC is designed for a Common Cathode type OLED panel.

The SSD1303 has contrast control, display RAM and an oscillator, reducing both the number of external components as well as power consumption. It is suitable for many compact, portable applications, including mobile phone sub-displays, calculators and MP3 players.

2 FEATURES

Supports maximum 132 x 64 dot matrix panel
Area color support with 4 Color Selection and 64 steps per color
Logic voltage supply: $V_{DD} = 2.4V - 3.5V$
High voltage supply: $V_{CC} = 7.0V - 16.0V$
Maximum segment output current: 320uA
Maximum common sink current: 45mA
Embedded with 132 x 64 bit SRAM display buffer
256-step Contrast Control on monochrome passive OLED panel
On-Chip Oscillator
Programmable Frame Frequency and Multiplexing Ratio
Pin selectable MCU interfaces:

- Serial Peripheral Interface
- 8-bit 6800-series Parallel Interface
- 8-bit 8080-series Parallel Interface
- I²C Interface

Row Re-mapping and Column Re-mapping
Vertical Scrolling
Automatic horizontal scrolling function
Low power consumption
Wide range of operating temperatures: -40 to 90 °C

3 ORDERING INFORMATION

Table 1 - Ordering Information

Ordering Part Number	SEG	COM	Package Form	Reference	Remark
SSD1303Z	132	64	Gold Bump Die	Page 7, 56	Die size: 9.22mm x 1.55mm Pad pitch: COM 51.8um SEG 52.2um
SSD1303T3R1	96	64	TAB	Page 44	• 35mm film • 4 sprocket hole • Folding TAB • 80 / 68 / SPI / I²C interface • Output lead pitch 0.12974mm
SSD1303T6R1	132	64	TAB	Page 48	• 35mm film • 4 sprocket hole • Folding TAB • 80 / 68 / SPI / I²C interface • Output lead pitch 0.11976
SSD1303T10R1	132	64	TAB	Page 52	• 48mm film • 5 sprocket hole • Folding TAB • 80 / 68 / SPI / I²C interface • Output lead pitch 0.139825mm

4 BLOCK DIAGRAM

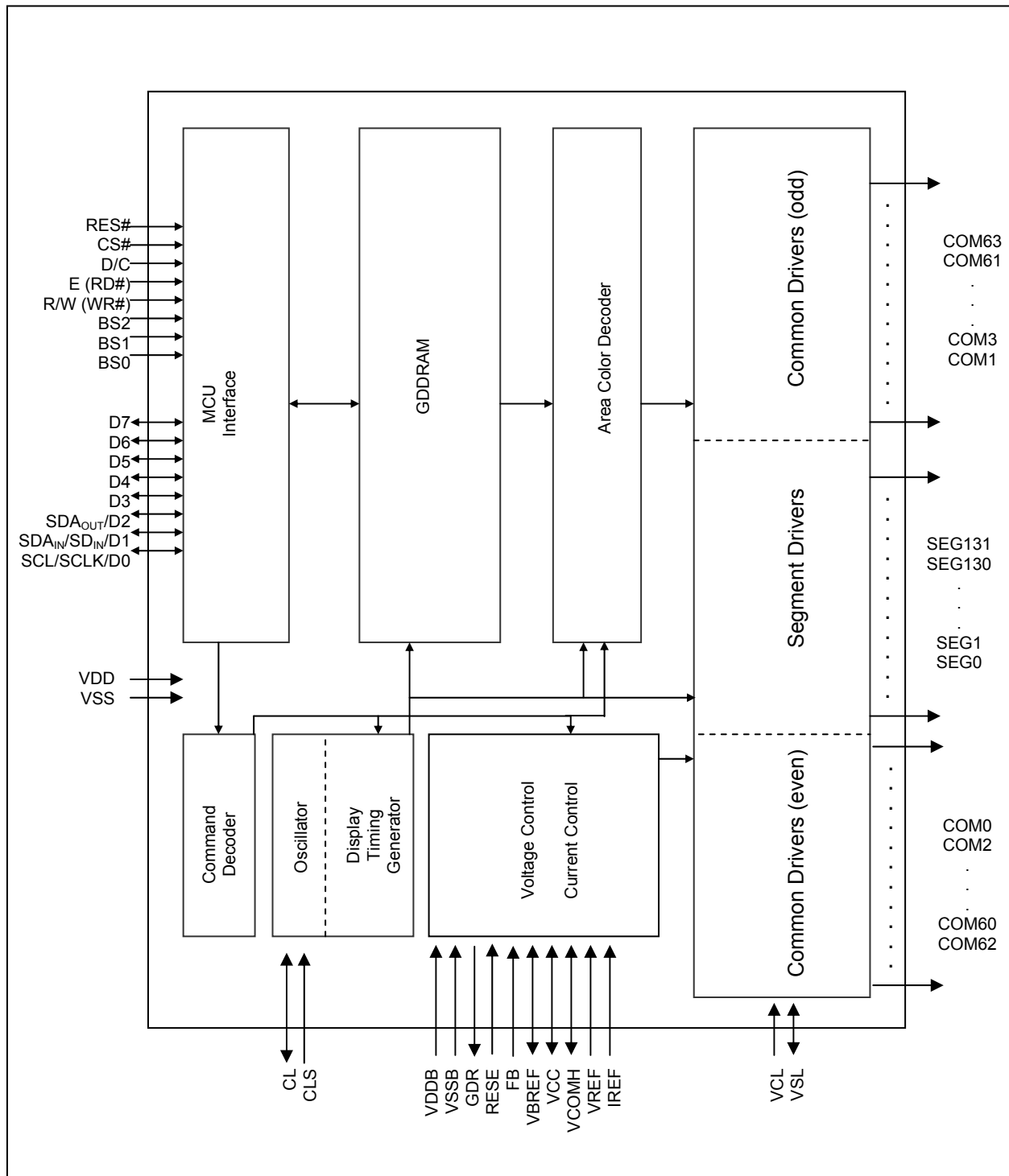
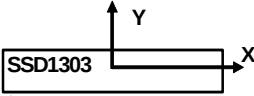
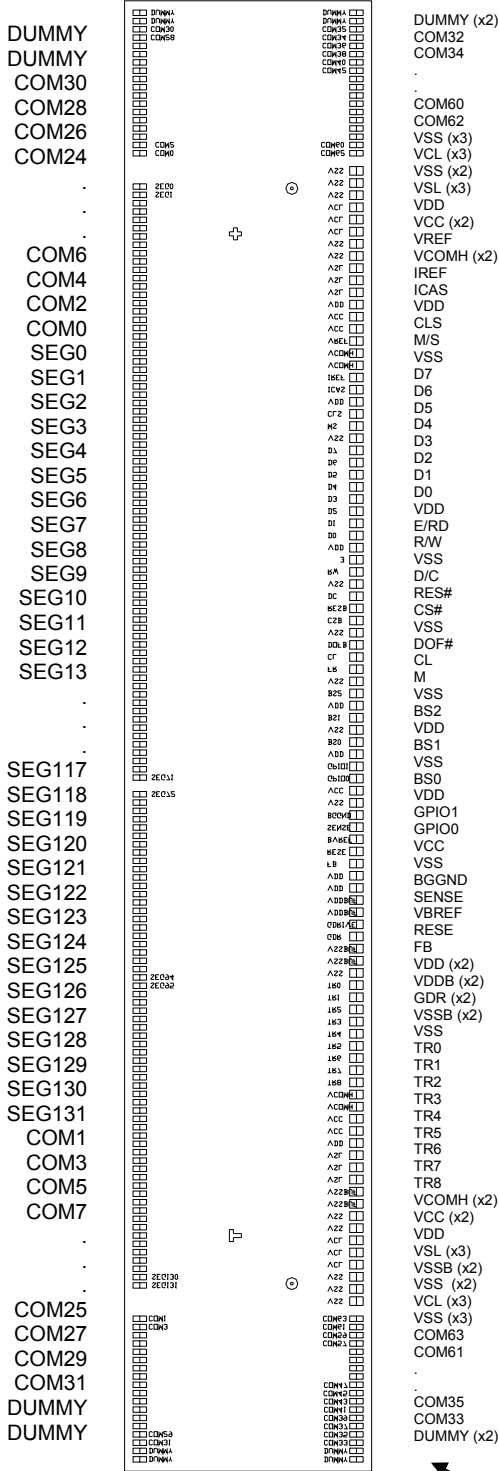


Figure 1 - Block Diagram

5 DIE PAD FLOOR PLAN

Figure 2 - SSD1303Z Pin Assignment



Pad 1,2,3,? >130
Gold Bumps face up

Die size	9.22mm x 1.55mm
Die height	457 +/- 25um

Bump height	Nominal 18um
Bump size	
Pad 1-18, 113-298	34um x 84um
Pad 19-112	54um x 84um

Alignment mark		
T shape	(-3132.9, 79.5)	75um x 75um
+ shape	(3148.9, 79.5)	75um x 75um
Circle	(3433.9, -274.6)	R37.5um, inner 18um
Circle	(-3433.9, -274.6)	R37.5um, inner 18um

PAD 1

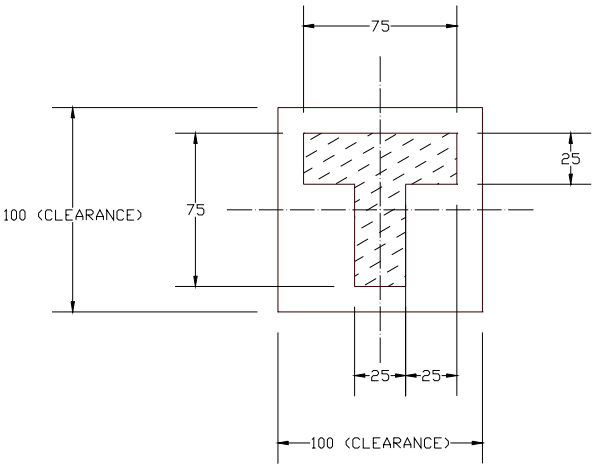
Table 2 - SSD1303Z Die Pad Coordinates

Pad no.	Pad Name	X-pos	Y-pos	Pad no.	Pad Name	X-pos	Y-pos	Pad no.	Pad Name	X-pos	Y-pos
1	NC	-4535.4	-679.6	61	VCC	-342.9	-679.6	121	COM46	4068.4	-679.6
2	NC	-4483.2	-679.6	62	GPIO0	-267.2	-679.6	122	COM44	4120.2	-679.6
3	COM33	-4431.0	-679.6	63	GPIO1	-190.5	-679.6	123	COM42	4172.0	-679.6
4	COM35	-4379.2	-679.6	64	VDD	-114.3	-679.6	124	COM40	4223.8	-679.6
5	COM37	-4327.4	-679.6	65	BS0	-38.1	-679.6	125	COM38	4275.6	-679.6
6	COM39	-4275.6	-679.6	66	VSS	38.1	-679.6	126	COM36	4327.4	-679.6
7	COM41	-4223.8	-679.6	67	BS1	114.3	-679.6	127	COM34	4379.2	-679.6
8	COM43	-4172.0	-679.6	68	VDD	190.5	-679.6	128	COM32	4431.0	-679.6
9	COM45	-4120.2	-679.6	69	BS2	266.7	-679.6	129	NC	4483.2	-679.6
10	COM47	-4068.4	-679.6	70	VSS	342.9	-679.6	130	NC	4535.4	-679.6
11	COM49	-4016.6	-679.6	71	M	419.1	-679.6	131	NC	4535.4	679.6
12	COM51	-3964.8	-679.6	72	CL	495.3	-679.6	132	NC	4483.2	679.6
13	COM53	-3913.0	-679.6	73	DOF#	571.5	-679.6	133	COM30	4431.0	679.6
14	COM55	-3861.2	-679.6	74	VSS	647.7	-679.6	134	COM28	4379.2	679.6
15	COM57	-3809.4	-679.6	75	CS#	723.9	-679.6	135	COM26	4327.4	679.6
16	COM59	-3757.6	-679.6	76	RES#	800.1	-679.6	136	COM24	4275.6	679.6
17	COM61	-3705.8	-679.6	77	D/C	876.3	-679.6	137	COM22	4223.8	679.6
18	COM63	-3654.0	-679.6	78	VSS	952.5	-679.6	138	COM20	4172.0	679.6
19	VSS	-3543.3	-679.6	79	R/W	1028.7	-679.6	139	COM18	4120.2	679.6
20	VSS	-3467.1	-679.6	80	E/RD	1104.9	-679.6	140	COM16	4068.4	679.6
21	VSS	-3390.9	-679.6	81	VDD	1181.1	-679.6	141	COM14	4016.6	679.6
22	VCL	-3314.7	-679.6	82	D0	1257.3	-679.6	142	COM12	3964.8	679.6
23	VCL	-3238.5	-679.6	83	D1	1333.5	-679.6	143	COM10	3913.0	679.6
24	VCL	-3162.3	-679.6	84	D2	1409.7	-679.6	144	COM8	3861.2	679.6
25	VSS	-3086.1	-679.6	85	D3	1485.9	-679.6	145	COM6	3809.4	679.6
26	VSS	-3009.9	-679.6	86	D4	1562.1	-679.6	146	COM4	3757.6	679.6
27	VSSB	-2933.7	-679.6	87	D5	1638.3	-679.6	147	COM2	3705.8	679.6
28	VSSB	-2857.5	-679.6	88	D6	1714.5	-679.6	148	COM0	3654.0	679.6
29	VSL	-2781.3	-679.6	89	D7	1790.7	-679.6	149	SEG0	3445.2	679.6
30	VSL	-2705.1	-679.6	90	VSS	1866.9	-679.6	150	SEG1	3393.0	679.6
31	VSL	-2628.9	-679.6	91	M/S	1943.1	-679.6	151	SEG2	3340.8	679.6
32	VDD	-2552.7	-679.6	92	CLS	2019.3	-679.6	152	SEG3	3288.6	679.6
33	VCC	-2476.5	-679.6	93	VDD	2095.5	-679.6	153	SEG4	3236.4	679.6
34	VCC	-2400.3	-679.6	94	ICAS	2171.7	-679.6	154	SEG5	3184.2	679.6
35	VCOMH	-2324.1	-679.6	95	IREF	2247.9	-679.6	155	SEG6	3132.0	679.6
36	VCOMH	-2247.9	-679.6	96	VCOMH	2324.1	-679.6	156	SEG7	3079.8	679.6
37	TR8	-2171.7	-679.6	97	VCOMH	2400.3	-679.6	157	SEG8	3027.6	679.6
38	TR7	-2095.5	-679.6	98	VREF	2476.5	-679.6	158	SEG9	2975.4	679.6
39	TR6	-2019.3	-679.6	99	VCC	2552.7	-679.6	159	SEG10	2923.2	679.6
40	TR5	-1943.1	-679.6	100	VCC	2628.9	-679.6	160	SEG11	2871.0	679.6
41	TR4	-1866.9	-679.6	101	VDD	2705.1	-679.6	161	SEG12	2818.8	679.6
42	TR3	-1790.7	-679.6	102	VSL	2781.3	-679.6	162	SEG13	2766.6	679.6
43	TR2	-1714.5	-679.6	103	VSL	2857.5	-679.6	163	SEG14	2714.4	679.6
44	TR1	-1638.3	-679.6	104	VSL	2933.7	-679.6	164	SEG15	2662.2	679.6
45	TR0	-1562.1	-679.6	105	VSS	3009.9	-679.6	165	SEG16	2610.0	679.6
46	VSS	-1485.9	-679.6	106	VSS	3086.1	-679.6	166	SEG17	2557.8	679.6
47	VSSB	-1409.7	-679.6	107	VCL	3162.3	-679.6	167	SEG18	2505.6	679.6
48	VSSB	-1333.5	-679.6	108	VCL	3238.5	-679.6	168	SEG19	2453.4	679.6
49	GDR	-1257.3	-679.6	109	VCL	3314.7	-679.6	169	SEG20	2401.2	679.6
50	GDR	-1181.1	-679.6	110	VSS	3390.9	-679.6	170	SEG21	2349.0	679.6
51	VDDB	-1104.9	-679.6	111	VSS	3467.1	-679.6	171	SEG22	2296.8	679.6
52	VDDB	-1028.7	-679.6	112	VSS	3543.3	-679.6	172	SEG23	2244.6	679.6
53	VDD	-952.5	-679.6	113	COM62	3654.0	-679.6	173	SEG24	2192.4	679.6
54	VDD	-876.3	-679.6	114	COM60	3705.8	-679.6	174	SEG25	2140.2	679.6
55	FB	-800.1	-679.6	115	COM58	3757.6	-679.6	175	SEG26	2088.0	679.6
56	RESE	-723.9	-679.6	116	COM56	3809.4	-679.6	176	SEG27	2035.8	679.6
57	VBREF	-647.7	-679.6	117	COM54	3861.2	-679.6	177	SEG28	1983.6	679.6
58	SENSE	-571.5	-679.6	118	COM52	3913.0	-679.6	178	SEG29	1931.4	679.6
59	BGGND	-495.3	-679.6	119	COM50	3964.8	-679.6	179	SEG30	1879.2	679.6
60	VSS	-419.1	-679.6	120	COM48	4016.6	-679.6	180	SEG31	1827.0	679.6

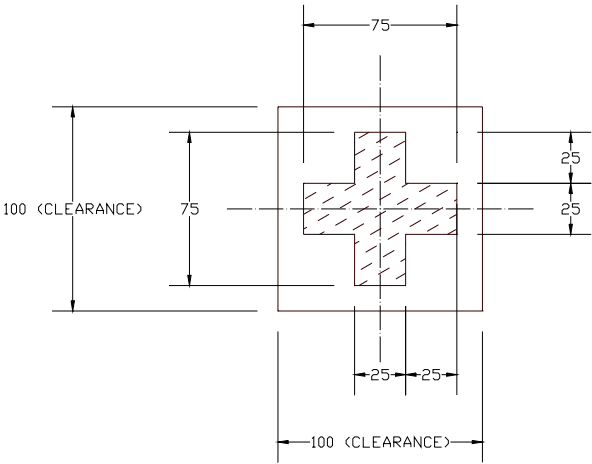
Pad no.	Pad Name	X-pos	Y-pos
181	SEG32	1774.8	679.6
182	SEG33	1722.6	679.6
183	SEG34	1670.4	679.6
184	SEG35	1618.2	679.6
185	SEG36	1566.0	679.6
186	SEG37	1513.8	679.6
187	SEG38	1461.6	679.6
188	SEG39	1409.4	679.6
189	SEG40	1357.2	679.6
190	SEG41	1305.0	679.6
191	SEG42	1252.8	679.6
192	SEG43	1200.6	679.6
193	SEG44	1148.4	679.6
194	SEG45	1096.2	679.6
195	SEG46	1044.0	679.6
196	SEG47	991.8	679.6
197	SEG48	939.6	679.6
198	SEG49	887.4	679.6
199	SEG50	835.2	679.6
200	SEG51	783.0	679.6
201	SEG52	730.8	679.6
202	SEG53	678.6	679.6
203	SEG54	626.4	679.6
204	SEG55	574.2	679.6
205	SEG56	522.0	679.6
206	SEG57	469.8	679.6
207	SEG58	417.6	679.6
208	SEG59	365.4	679.6
209	SEG60	313.2	679.6
210	SEG61	261.0	679.6
211	SEG62	208.8	679.6
212	SEG63	156.6	679.6
213	SEG64	104.4	679.6
214	SEG65	52.2	679.6
215	SEG66	0.0	679.6
216	SEG67	-52.2	679.6
217	SEG68	-104.4	679.6
218	SEG69	-156.6	679.6
219	SEG70	-208.8	679.6
220	SEG71	-261.0	679.6
221	SEG72	-365.4	679.6
222	SEG73	-417.6	679.6
223	SEG74	-469.8	679.6
224	SEG75	-522.0	679.6
225	SEG76	-574.2	679.6
226	SEG77	-626.4	679.6
227	SEG78	-678.6	679.6
228	SEG79	-730.8	679.6
229	SEG80	-783.0	679.6
230	SEG81	-835.2	679.6
231	SEG82	-887.4	679.6
232	SEG83	-939.6	679.6
233	SEG84	-991.8	679.6
234	SEG85	-1044.0	679.6
235	SEG86	-1096.2	679.6
236	SEG87	-1148.4	679.6
237	SEG88	-1200.6	679.6
238	SEG89	-1252.8	679.6
239	SEG90	-1305.0	679.6
240	SEG91	-1357.2	679.6

Pad no.	Pad Name	X-pos	Y-pos
241	SEG92	-1409.4	679.6
242	SEG93	-1461.6	679.6
243	SEG94	-1513.8	679.6
244	SEG95	-1566.0	679.6
245	SEG96	-1618.2	679.6
246	SEG97	-1670.4	679.6
247	SEG98	-1722.6	679.6
248	SEG99	-1774.8	679.6
249	SEG100	-1827.0	679.6
250	SEG101	-1879.2	679.6
251	SEG102	-1931.4	679.6
252	SEG103	-1983.6	679.6
253	SEG104	-2035.8	679.6
254	SEG105	-2088.0	679.6
255	SEG106	-2140.2	679.6
256	SEG107	-2192.4	679.6
257	SEG108	-2244.6	679.6
258	SEG109	-2296.8	679.6
259	SEG110	-2349.0	679.6
260	SEG111	-2401.2	679.6
261	SEG112	-2453.4	679.6
262	SEG113	-2505.6	679.6
263	SEG114	-2557.8	679.6
264	SEG115	-2610.0	679.6
265	SEG116	-2662.2	679.6
266	SEG117	-2714.4	679.6
267	SEG118	-2766.6	679.6
268	SEG119	-2818.8	679.6
269	SEG120	-2871.0	679.6
270	SEG121	-2923.2	679.6
271	SEG122	-2975.4	679.6
272	SEG123	-3027.6	679.6
273	SEG124	-3079.8	679.6
274	SEG125	-3132.0	679.6
275	SEG126	-3184.2	679.6
276	SEG127	-3236.4	679.6
277	SEG128	-3288.6	679.6
278	SEG129	-3340.8	679.6
279	SEG130	-3393.0	679.6
280	SEG131	-3445.2	679.6
281	COM1	-3654.0	679.6
282	COM3	-3705.8	679.6
283	COM5	-3757.6	679.6
284	COM7	-3809.4	679.6
285	COM9	-3861.2	679.6
286	COM11	-3913.0	679.6
287	COM13	-3964.8	679.6
288	COM15	-4016.6	679.6
289	COM17	-4068.4	679.6
290	COM19	-4120.2	679.6
291	COM21	-4172.0	679.6
292	COM23	-4223.8	679.6
293	COM25	-4275.6	679.6
294	COM27	-4327.4	679.6
295	COM29	-4379.2	679.6
296	COM31	-4431.0	679.6
297	NC	-4483.2	679.6
298	NC	-4535.4	679.6

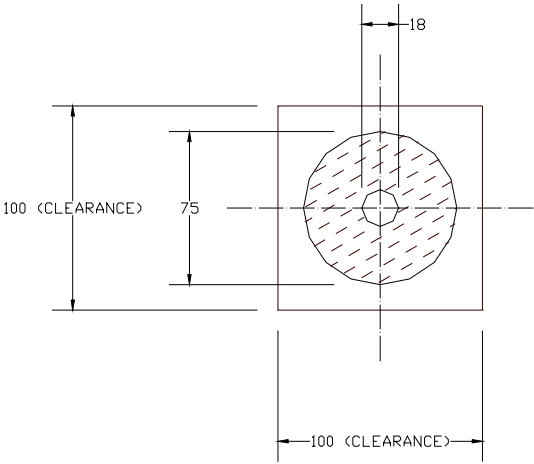
Figure 3 - SSD1303Z Alignment mark dimensions



T shape



+ shape



Circle

Unit in um

6 PIN DESCRIPTION

CL

This pin is the system clock input. When the internal clock is enabled this pin should be left open, as the internal clock is the output from this pin. When the internal oscillator is disabled this pin receives the display clock signal from the external clock source.

CLS

This is the internal clock enable pin. When it is pulled HIGH the internal clock is enabled. When it is pulled LOW the internal clock is disabled and an external clock source must be connected to the CL pin for normal operation.

BS0, BS1, BS2

These are the MCU interface input selection pins. See the table below for selecting different interfaces:

	6800-parallel interface	8080-parallel interface	Serial interface	I ² C interface
BS0	0	0	0	0
BS1	0	1	0	1
BS2	1	1	0	0

CS#

This pin is the chip select input. The chip is enabled for MCU communication only when the CS# is pulled low.

RES#

This is a reset signal input pin. When it is pulled LOW initialization of the chip is executed.

D/C

This is the Data/Command control pin. When it is pulled HIGH, the input at D₇-D₀ is treated as data. When it is pulled LOW, the input at D₇-D₀ is transferred to the command registers. For details of the relationship to MCU interface signals please refer to the Timing Characteristics Diagrams.

When the pin is pulled high and serial interface mode is selected, the data at SD_{IN} is treated as data. When the pin is pulled low, the data at SD_{IN} will be transferred to the command register. In I²C mode, this pin acts as SA0 for slave address selection.

R/W (WR#)

This is a MCU interface input pin. When the 6800-series Parallel Interface mode is selected, this pin is used as the Read/Write (R/W) selection input. Pull this pin to HIGH is for read mode and to LOW is for write mode.

When the 8080-series Parallel Interface mode is selected this pin is used as Write (WR#) selection input. Pull this pin to LOW is for write mode. Data write operation is initiated when this pin is pulled LOW and the CS# is also pulled LOW.

E (RD#)

This is a MCU interface input pin. When the 6800-series Parallel Interface is selected this pin is used as the Enable (E) signal. Read/Write operation is initiated when this pin is pulled HIGH and the CS# pin is pulled LOW. When the 8080-series Parallel Interface is selected this pin is used to receive the Read Data (RD#) signal. Data read operation is initiated when this pin is pulled LOW and the CS# pin is also pulled LOW.

D₇-D₀

These is 8-bit bi-directional data bus to be connected to the microprocessor's data bus. When serial interface mode is selected, D1 will be the serial data input, SD_{IN}, and D₀ will be the serial clock input, SCLK. When I²C mode is selected, D2, D1 should be tied together and serve as SDA_{out}, SDA_{in} in application and D0 is the serial clock input, SCL.

VDD

This is a voltage supply pin. It must be connected to an external source.

VSS

This is a ground pin. It also acts as a reference for the logic pins and the OLED driving voltages. It must be connected to an external ground.

BGGND

This is a ground pin for analog circuits. It must be connected to an external ground

VCC

This is the most positive voltage supply pin of the chip. It can be supplied externally.

VREF

This is a voltage reference pin for pre-charge voltage to drive the OLED device. The voltage should be set to match the OLED driving voltage in its current drive phase. It can either be supplied externally, or by connecting to the VCC.

IREF

This is a segment current reference pin. A resistor should be connected between this pin and the V_{SS} and the current set at 10uA.

VCOMH

This is an input pin for high-level voltage output for COM signals. A capacitor should be connected between this pin and the VSS.

VDDB This is a power supply pin for the internal buffer of the DC-DC voltage converter. It must be connected to the V_{DD} when the converter is used.

VSSB

This is a ground pin for the internal buffer of the DC-DC voltage converter. It must be connected to the V_{SS} when the converter is used.

GDR

This is an output pin which drives the gate of the external NMOS of the booster circuit.

RESE

This is a source current pin for the external NMOS of the booster circuit.

VB_{REF}

This is an internal voltage reference pin for the booster circuit. A stabilization capacitor, type 1uF, should be connected to the Vss.

FB

This is a feedback resistor input pin for the booster circuit. It is used to adjust the booster output voltage level for the Vcc.

COM0-COM63

These pins provide the Common switch signals to the OLED panel. They are in a state of high impedance when the display is OFF.

SEG0-SEG131

These pins provide the Segment switch signals to the OLED panel. They are in a state of high impedance when the display is OFF.

TR0-TR8, GPIO0, GPIO1, ICAS, M and DOF#

These are reserved pins. No connection is necessary and they should be left open individually.

VSL

This is a segment voltage reference pin. This pin should be connected to the VSS externally.

VCL

This is a common voltage reference pin. This pin should be connected to the VSS externally.

M/S

This pin must be connected to the VDD to enable the chip.

NC

Dummy pad. Do not group or short the NC pins together.

7 FUNCTIONAL BLOCK DESCRIPTIONS

7.1 Oscillator Circuit and Display Time Generator

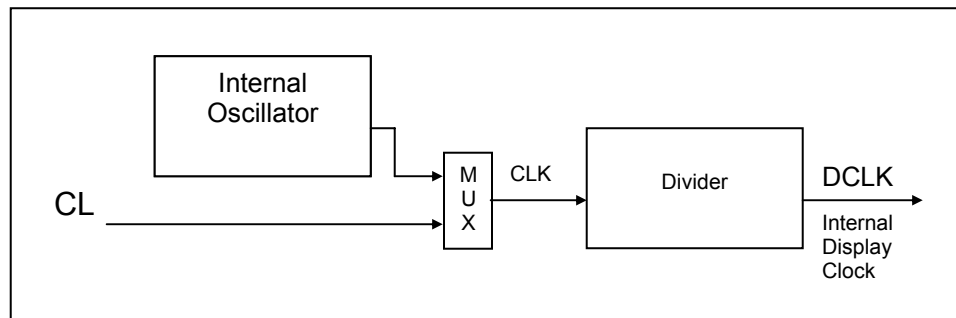


Figure 4 - Oscillator Circuit

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

7.2 Reset Circuit

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

1. Display is OFF
2. 132 x 64 Display Mode
3. Normal segment and display data column address and row address mapping (SEG0 is mapped to column address 00H and COM0 is mapped to row address 00H)
4. Shift register data clear in serial interface
5. Display start line is set at display RAM address 0
6. Column address counter is set at 0
7. Normal scan direction of the COM outputs
8. Contrast control register is set at 80H
9. DC/DC enabled

7.3 Command Decoder and Command Interface

This module determines if the input data is interpreted as data, or a command. When the D/C# pin is pulled HIGH the inputs at D₇-D₀ are interpreted as data and will be written to Graphic Display Data RAM (GDDRAM). When it is pulled LOW the inputs at D₇-D₀ are interpreted as a command and will be decoded and written to the corresponding command registers.

7.4 MPU I²C interface

The I²C communication interface consists of slave address bit SA0, I²C-bus data signal SDA (SDA_{OUT}/D₂ for output and SDA_{IN}/D₁ for input) and I²C-bus clock signal SCL (D₀). Both the data and clock signals must be connected to pull-up resistors. RES# is used for the initialization of device.

a) Slave address bit (SA0)

SSD1303 has to recognize the slave address before transmitting or receiving any information by the I²C-bus. The device will respond 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,

b₇ b₆ b₅ b₄ b₃ b₂ b₁ b₀
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 SSD1303. D/C pin acts as SA0 for slave address selection.

"R/W#" bit is used to determine the operation mode of the I²C-bus interface. R/W#=1, it is in read mode. R/W#=0, it is in write mode.

b) I²C-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.

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".

"SDA_{IN}" and "SDA_{OUT}" are tied together and serve as SDA. The "SDA_{IN}" pin must be connected to act as SDA. The "SDA_{OUT}" pin may be disconnected. When "SDA_{OUT}" pin is disconnected, the acknowledgement signal will be ignored in the I²C-bus.

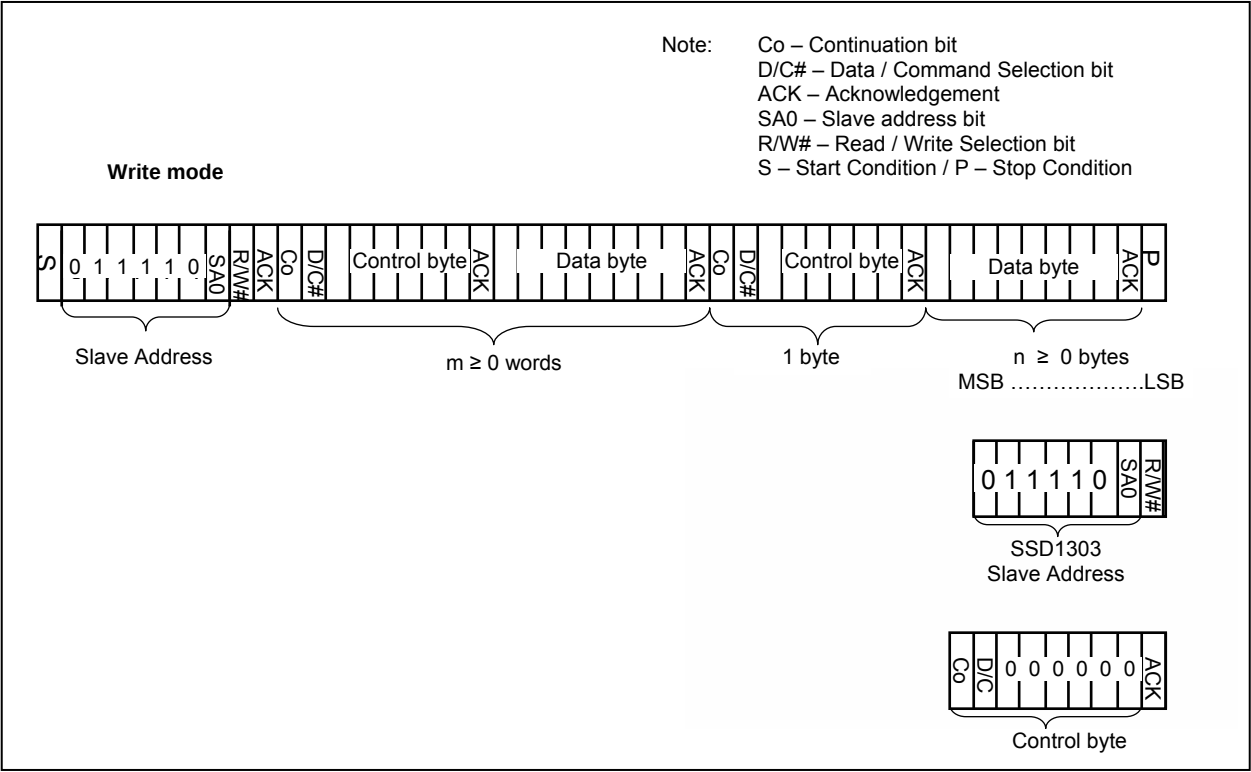
c) I²C-bus clock signal (SCL)

The transmission of information in the I²C-bus is following a clock signal, SCL. Each transmission of data bit is taken place during a single clock period of SCL.

I²C-bus Write data

The I²C-bus interface gives access to write data and command into the device. Please refer to Figure 5 for the write mode of I²C-bus in chronological order.

Figure 5 - I²C-bus data format



Write mode for I²C

- 1) The master device initiates the data communication by a start condition. The definition of the start condition is shown in Figure 6. 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 SSD1303, the slave address is either “b0111100” or “b0111101” by changing the SA0 to LOW or HIGH (D/C pin acts as SA0).
- 3) The write mode is established by setting the R/W# bit to logic “0”.
- 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 7 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.
- 5) After the transmission of the slave address, either the control byte or the data byte may be sent across the SDA. A control byte mainly consists of Co and D/C# bits following by six “0”’s.
 - a. If the Co bit is set as logic “0”, the transmission of the following information will contain data bytes only.
 - b. 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 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.
- 7) The write mode will be finished when a stop condition is applied. The stop condition is also defined in Figure 6. The stop condition is established by pulling the “SDA in” from LOW to HIGH while the “SCL” stays HIGH.

Figure 6 - Definition of the Start and Stop Condition

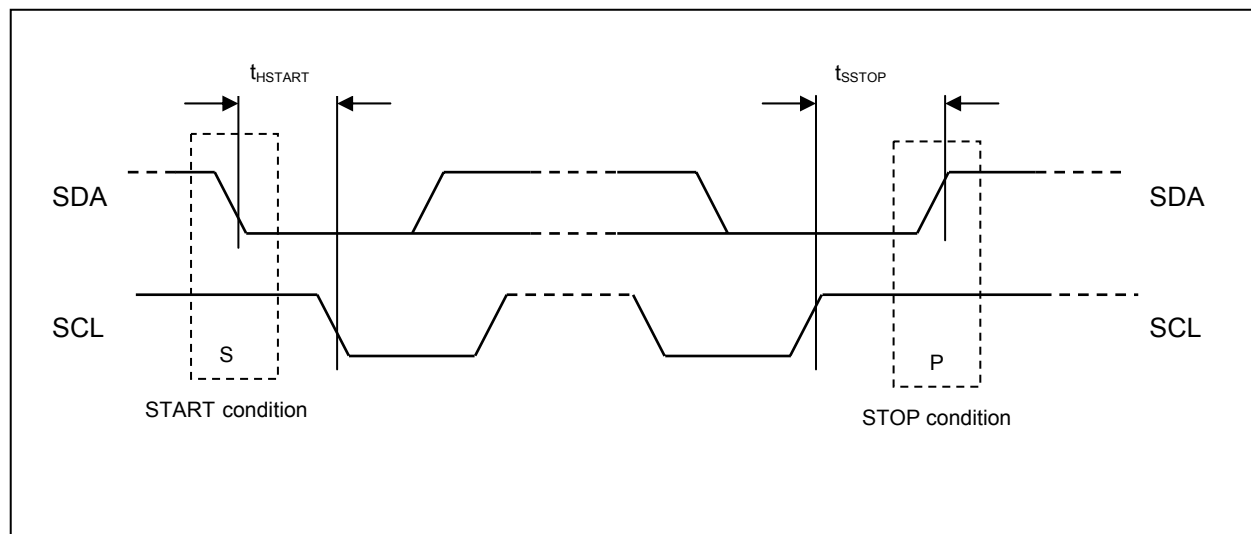
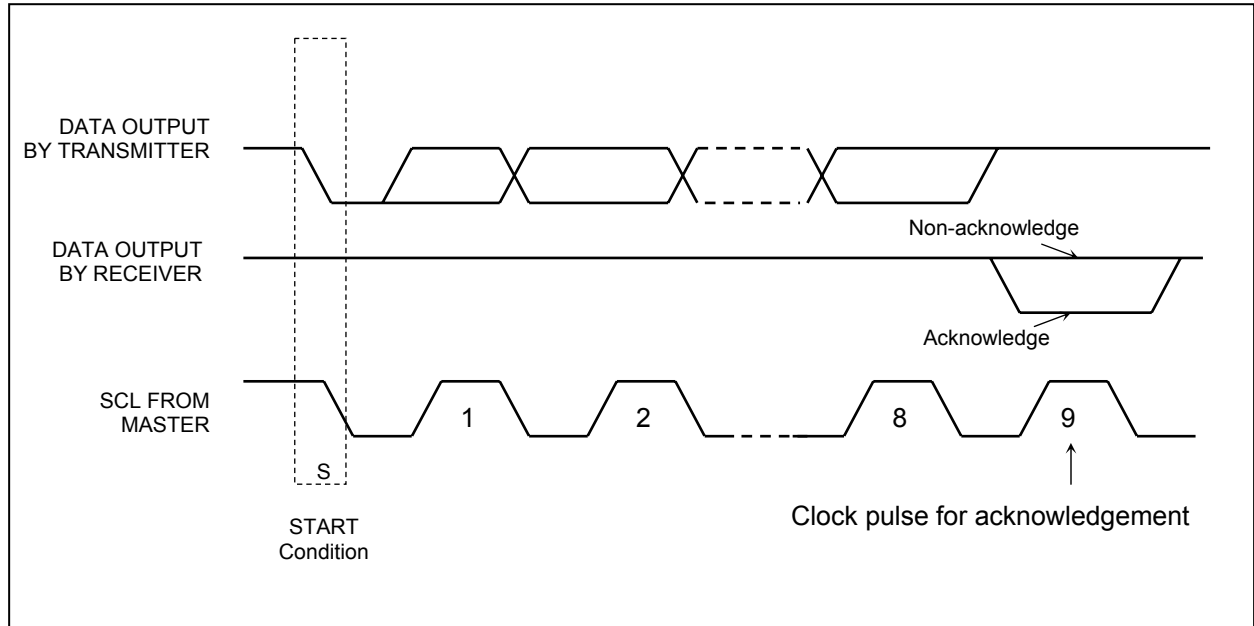


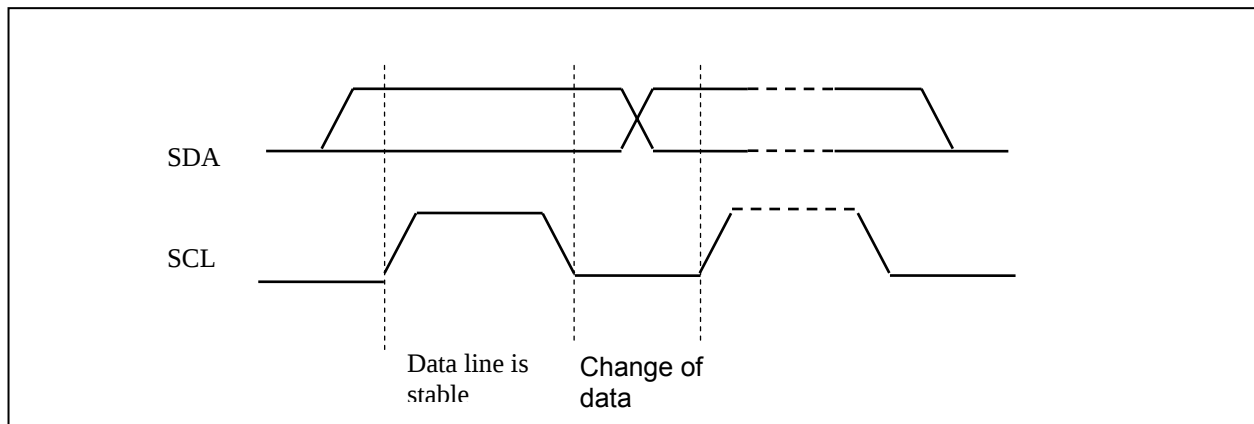
Figure 7 - Definition of the acknowledgement condition



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 8 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 8 - Definition of the data transfer condition



7.5 MPU Parallel 6800-series Interface

The parallel interface consists of 8 bi-directional data pins: (D₇-D₀), R/W (WR#), E (RD#), D/C, CS#. When the R/W (WR#) pin is pulled HIGH Read operation from the Graphic Display Data RAM (GDDRAM), or the status register, occurs. When the R/W (WR#) pin is pulled LOW Write operation to the Display Data RAM, or Internal Command Registers, occurs, depending on the status of the D/C input. The E (RD#) input serves as the data latch signal (clock) when on HIGH, provided the CS# is pulled LOW. Please refer to the Parallel Interface Timing Diagram of the 6800-series microprocessors.

In order to match the operating frequency of the display RAM with that of the microprocessor, some pipeline processing is performed internally, which requires the insertion of a dummy read before the first actual display data read. See Figure 5 below.

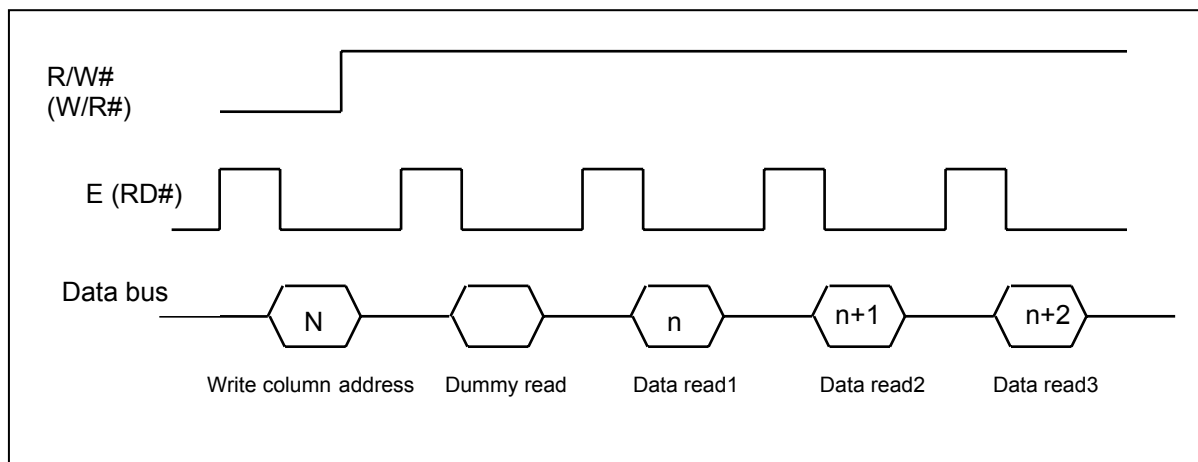


Figure 9 - Display data read back procedure - insertion of dummy read

7.6 MPU Parallel 8080-series Interface

The parallel interface consists of 8 bi-directional data pins (D₇-D₀), R/W (WR#), E (RD#), D/C, CS#. The E (RD#) input serves as the data read latch signal (clock) when on LOW, provided the CS# is also pulled LOW. Display data, or status register read, is controlled by the D/C signal.

R/W (WR#) input serves as the data write latch signal (clock) when on HIGH, provided the CS# is also pulled LOW. Display data, or command register write, is controlled by the D/C. Please refer to Parallel Interface Timing Diagram of the 8080-series microprocessors. Similar to the 6800-series interface, a dummy read is also required before the first, actual display data read.

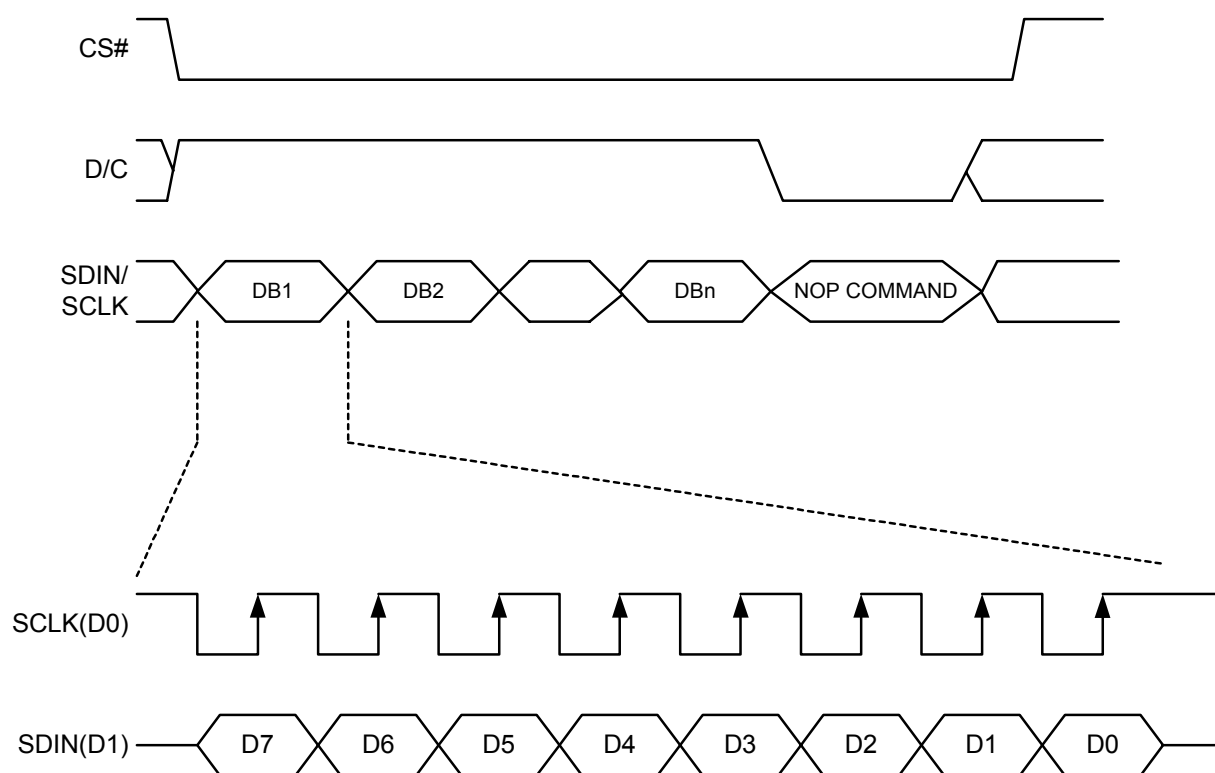
7.7 MPU Serial Interface

The serial interface consists of the serial clock SCLK and serial data SDIN, D/C#, CS#. In SPI mode, D0 acts as SCLK and D1 acts as SDIN. For the unused data pins, D2 should be left open. The pins from D3 to D7, E and R/W can be connected to an external ground.

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

During data writing an additional NOP command should be inserted before the CS# is pulled HIGH. See Figure 10 below.

Figure 10 – Display data write procedure in SPI mode



7.8 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 64 bits. 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 the display start line can be set to control the portion of the RAM data to be mapped to the display.

7.9 Current Control and Voltage Control

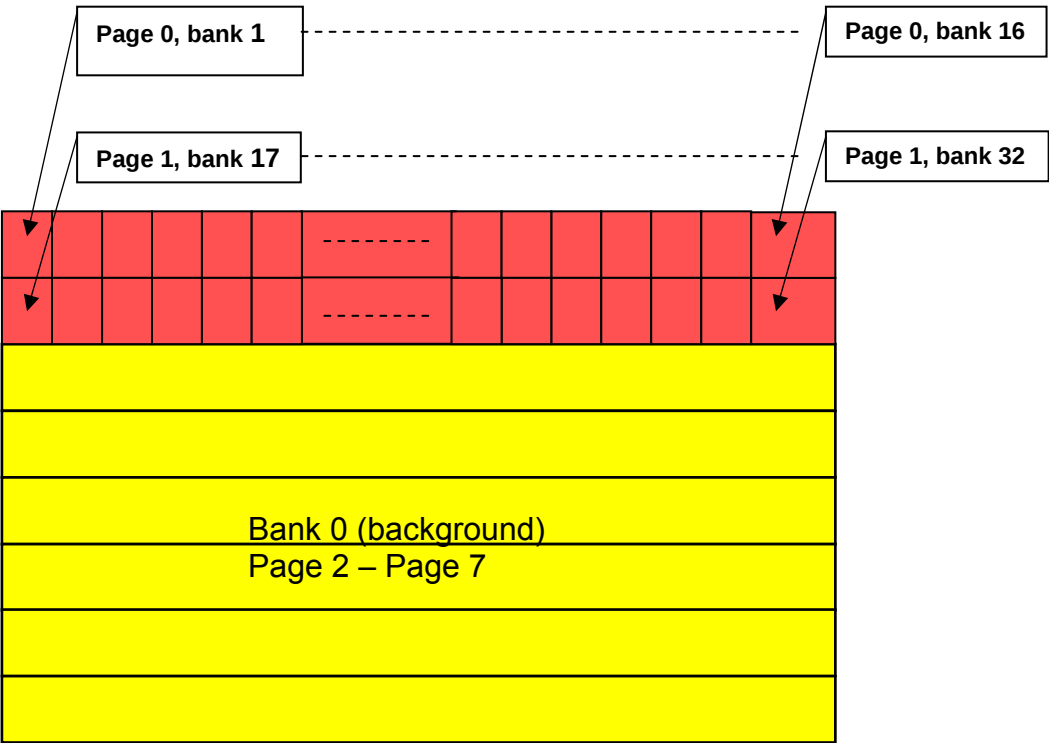
This block is used to divide the incoming power sources into different levels of internal use voltage and current. VCC and VDD are external power supplies. VREF is a reference voltage, used to derive the driving voltage for both segments and commons. IREF is a reference current source for the segment current drivers.

7.10 Segment Drivers / Common Drivers

Segment drivers deliver 132 current sources to drive the OLED panel. The driving current can be adjusted from 0 to 300uA with 256 steps. Common drivers generate voltage-scanning pulses.

7.11 Area Color Decoder

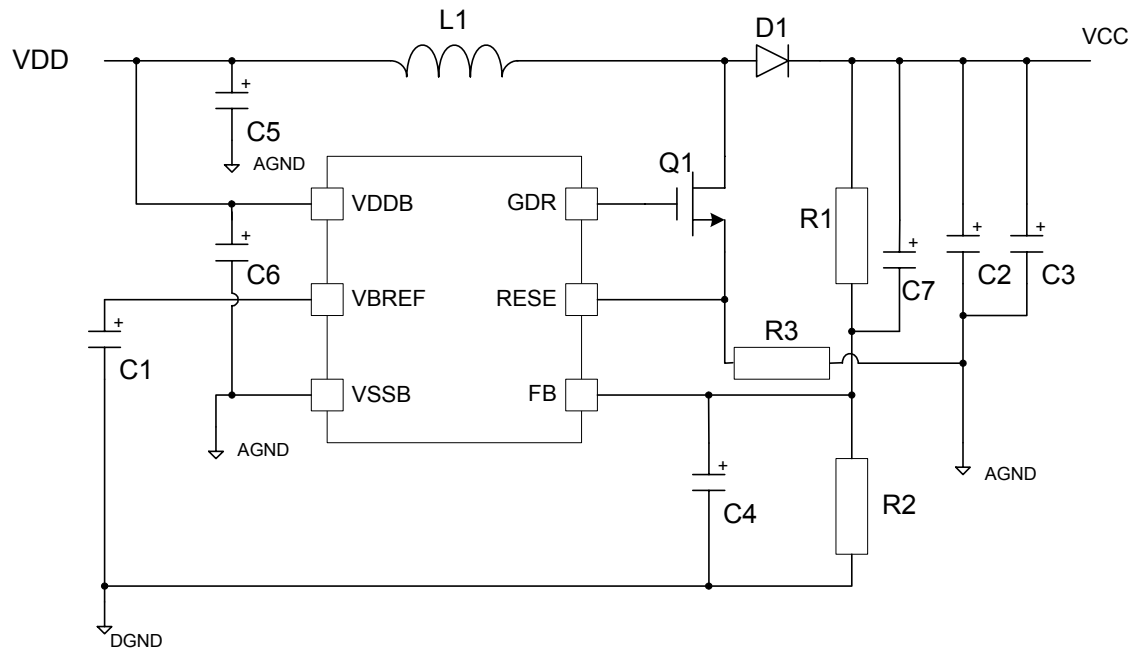
Page 0 and Page 1 of the display are divided into 32 banks. Bank16 and Bank32 consist of a display area of 12 x 8 pixels. Other banks (0~15 & 17~31) have matrices of 8 x 8 pixels. Each bank can be programmed to any one of the four colors (color A, B, C and D). Detailed operation can be referred to the Command Table.



7.12 DC-DC Voltage Converter

This is a switching voltage generator circuit, designed for handheld applications. In the SSD1303 an internal DC-DC voltage converter accompanying an external application circuit (See Figure 7 below) can generate a high voltage supply, V_{CC} , from a low voltage supply input, V_{DD} . The V_{CC} is the voltage supply to the OLED driver block. Below is an example application circuit for the input voltage of 3V V_{DD} to generate V_{CC} of 12V @0mA ~ 20mA application.

Figure 11 - DC-DC voltage converter circuit



Remark:

1. VSSB is tied to VSS in the SSD1303T3 package.
2. L1, D1, Q1, C5 should be grouped close together on PCB layout.
3. R1, R2, C1, C4 should be grouped close together on PCB layout.
4. The VCC output voltage level can be adjusted by R1 and R2, the reference formula is:
$$VCC = 1.2 \times (R1 + R2) / R2$$

The value of (R1+R2) should be between 500k to 1M Ohm.

Table 3 - Passive component selection:

Components	Typical Value	Remark
L1	Inductor, 22 μ H	LP04815-223KXB [Coilcraft] - Low DCR - Over 0.5A current rating
D1	Schottky diode	MBR0520 [On Semi] - 0.5A
Q1	MOSFET	NTA4153N [On Semi] - Low Rds - Over 0.5A current rating
R1	Resistor, 510k	1%
R2	Resistor, 56k	1%
R3	Resistor, 1.2 Ω	1%, 1/8W
C1	Capacitor, 1 μ F	6V
C2	Capacitor, 10 μ F	25V
C3	Capacitor, 1 μ F	25V
C4	Capacitor, 15nF	16V
C5	Capacitor, 10 μ F	6V
C6	Capacitor, 10 μ F	6V
C7	Capacitor, 15nF	6V

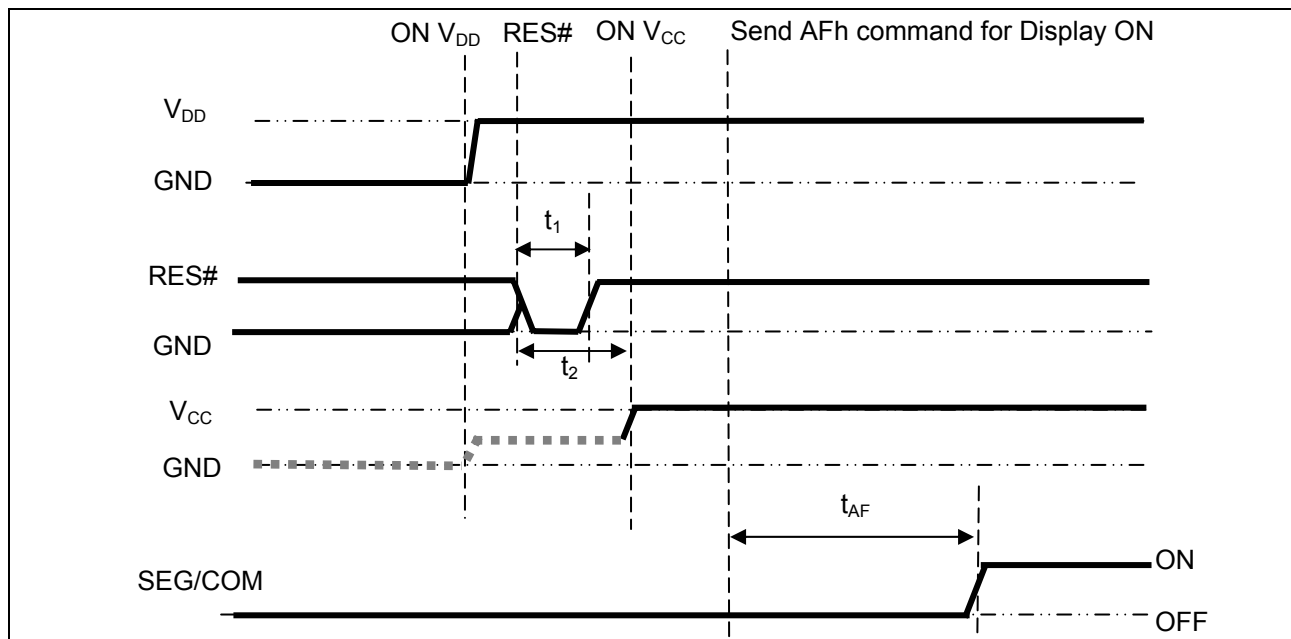
7.13 Power ON and OFF sequence

The following figures illustrate the recommended power ON and power OFF sequence of SSD1303.

Power ON sequence:

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

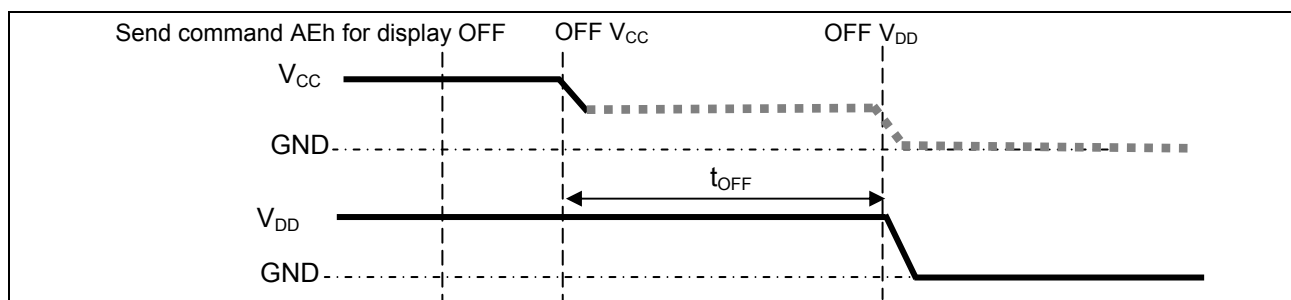
Figure 12 - The Power ON sequence



Power OFF sequence:

1. Send command AEh for display OFF.
2. Wait until panel discharges completely.
3. Power OFF V_{CC} .^{(1), (2)}
4. Wait for t_{OFF} . Power OFF V_{DD} . (where Minimum $t_{OFF}=0ms$, Typical $t_{OFF}=100ms$)

Figure 13 - The Power OFF sequence



Note:

⁽¹⁾ Since an ESD protection circuit is connected between V_{DD} and V_{CC} , V_{CC} becomes lower than V_{DD} whenever V_{DD} is ON and V_{CC} is OFF as shown in the dotted line of V_{CC} in Figure 12 and Figure 13.

⁽²⁾ V_{CC} should be kept float (disable) when it is OFF.

8 COMMAND TABLE

Table 4 - Command table

(D/C =0, R/W (WR#)=0, E (RD#)=1)

Note: commands marked with “***” are compatible with the SSD1301

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	00~0F	0	0	0	0	X ₃	X ₂	X ₁	X ₀	Set Lower Column Address **	Set the lower nibble of the column address register using X ₃ X ₂ X ₁ X ₀ as data bits. The initial display line register is reset to 0000b after RESET.
0	10~1F	0	0	0	1	X ₃	X ₂	X ₁	X ₀	Set Higher Column Address **	Set the higher nibble of the column address register using X ₃ X ₂ X ₁ X ₀ as data bits. The initial display line register is reset to 0000b after RESET.
0 0 0 0 0	26 A[2:0] B[2:0] C[1:0] D[2:0]	0 * * * *	0 * * * *	1 * * * *	0 * * * *	0 * * * *	1 A ₂ B ₂ * D ₂	1 A ₁ B ₁ C ₁ D ₁	0 A ₀ B ₀ C ₀ D ₀	Horizontal scroll setup	A[2:0] Set the number of column scroll per step Valid value: 001b, 010b, 011b, 100b B[2:0] Define start page address C[1:0] Set time interval between each scroll step in terms of frame frequency 00b – 12 frame 01b – 64 frames 10b – 128 frames 11b – 256 frames D[2:0] Define end page address Set the value of D[2:0] larger or equal to B[2:0]
0	2F	0	0	1	0	1	1	1	1	Activate horizontal scroll	Start horizontal scrolling
0	2E	0	0	1	0	1	1	1	0	Deactivate horizontal scroll	Stop horizontal scrolling
0	40~7F	0	1	X ₅	X ₄	X ₃	X ₂	X ₁	X ₀	Set Display Start Line	Set display RAM display start line register from 0-63 using X₅X₄X₃X₂X₁X₀. Display start line register is reset to 000000 during RESET
0 0	81 A[7:0]	1 A ₇	0 A ₆	0 A ₅	0 A ₄	0 A ₃	0 A ₂	0 A ₁	1 A ₀	Set Contrast Control Register **	Double byte command to select 1 out of 256 contrast steps. Contrast increases as the value increases. (RESET = 80h)
0 0	82 A[7:0]	1 A ₇	0 A ₆	0 A ₅	0 A ₄	0 A ₃	0 A ₂	1 A ₁	0 A ₀	Brightness for color banks	Double byte command to select 1 out of 256 brightness steps. Brightness increases as the value increases. (RESET = 80h)
0 0 0 0 0	91 X[5:0] A[5:0] B[5:0] C[5:0]	1 * * * *	0 * * * *	0 X ₅ A ₅ B ₅ C ₅	1 X ₄ A ₄ B ₄ C ₄	0 X ₃ A ₃ B ₃ C ₃	0 X ₂ A ₂ B ₂ C ₂	0 X ₁ A ₁ B ₁ C ₁	1 X ₀ A ₀ B ₀ C ₀	Set Look Up Table (LUT)	Set current drive pulse width of Bank 0, Color A, B and C. Bank 0: X[5:0] = 31... 63; for pulse width set to 32 ~ 64 clocks (RESET = 110001b) Color A: A[5:0] same as above (RESET = 111111b) Color B: B[5:0] same as above (RESET = 111111b) Color C: C[5:0] same as above (RESET = 111111b) Note: color D pulse width is fixed at 64 clocks pulse.

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0	92	1	0	0	1	0	0	1	0	Set bank color of for bank 1-16 (Page 0)	A[1:0] : 00, 01, 10, or 11 for Color = A, B, C or D of bank 1
0	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[3:2] : 00, 01, 10, or 11 for Color = A, B, C or D of bank 2
0	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		:
0	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		:
0	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		D[7:6]: 00, 01, 10, or 11 for Color = A, B, C or D of bank 16
0	93	1	0	0	1	0	0	1	1	Set bank color of for bank 17-32 (Page 1)	A[1:0] : 00, 01, 10, or 11 for Color = A, B, C or D of bank 17
0	A[7:0]	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		A[3:2] : 00, 01, 10, or 11 for Color = A, B, C or D of bank 18
0	B[7:0]	B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	B ₀		:
0	C[7:0]	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		:
0	D[7:0]	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		D[7:6]: 00, 01, 10, or 11 for Color = A, B, C or D of bank 32
0	A0~A1	1	0	1	0	0	0	0	X ₀	Set Segment Re-map **	X ₀ =0: column address 0 is mapped to SEG0 (RESET) X ₀ =1: column address 131 is mapped to SEG0
0	A4~A5	1	0	1	0	0	1	0	X ₀	Set Entire Display ON/OFF **	X ₀ =0: normal display (RESET) X ₀ =1: entire display ON
0	A6~A7	1	0	1	0	0	1	1	X ₀	Set Normal/Inverse Display **	X ₀ =0: normal display (RESET) X ₀ =1: inverse display
0	A8	1	0	1	0	1	0	0	0	Set Multiplex Ratio **	The next command, A[5:0] determines multiplex ratio N from 16MUX-64MUX, RESET= 64MUX
0	A[5:0]	*	*	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀		
0	AA	1	0	1	0	1	0	1	0	NOP	Reserved, do not use
0	AB	1	0	1	0	1	0	1	1	NOP	Reserved, do not use
0	AD	1	0	1	0	1	1	0	1	Set DC-DC on/off	X ₀ : 1 DC-DC will be turned on when display on (RESET) 0 DC-DC is disable
0	AE~AF	1	0	1	0	1	1	1	X ₀	Set Display ON/OFF **	X ₀ =0: turns OFF OLED panel (RESET) X ₀ =1: turns ON OLED panel
0	B0~BF	1	0	1	1	X ₃	X ₂	X ₁	X ₀	Set Page Address **	Set GDDRAM Page Address (0~7) for read/write using X ₃ X ₂ X ₁ X ₀
0	C0/C8	1	1	0	0	X ₃	*	*	*	Set COM Output Scan Direction **	X ₃ =0: normal mode (RESET) Scan from COM 0 to COM [N -1] X ₃ =1: remapped mode. Scan from COM [N-1] to COM0 Where N is the Multiplex ratio.
0	D0-D1	1	1	0	1	0	0	0	X ₀	Reserved	Reserved, do not use

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 0	D3 A[5:0]	1 *	1 *	0 A ₅	1 A ₄	0 A ₃	0 A ₂	1 A ₁	1 A ₀	Set Display Offset **	Set vertical scroll by COM from 0-63. The value is reset to 00H after RESET.
0 0	D5 A[7:0]	1 A ₇	1 A ₆	0 A ₅	1 A ₄	0 A ₃	1 A ₂	0 A ₁	1 A ₀	Set Display Clock Divide Ratio/Oscillator Frequency	A[3:0] Define the divide ratio of the display clocks (DCLK): Divide ratio= A[3:0] + 1, RESET is 0000b (divide ratio = 1) A[7:4] Set the Oscillator Frequency. Oscillator Frequency increases with the value of A[7:4] and vice versa. RESET is 0111b
0 0	D8 0	1 0	1 0	0 X ₅	1 X ₄	1 0	0 X ₂	0 0	0 X ₀	Set area color mode on/off & low power display mode	X ₅ X ₄ = 00 (RESET) : mono mode X ₅ X ₄ = 11 Area Color enable X ₂ =0 and X ₀ =0: Normal (RESET) power mode X ₂ =1 and X ₀ =1: Set low power save mode
0 0	D9 A[7:0]	1 A ₇	1 A ₆	0 A ₅	1 A ₄	1 A ₃	0 A ₂	0 A ₁	1 A ₀	Set Pre-charge period**	A[3:0] Phase 1 period of up to 15 dclk clocks [RESET=2h]; 0 is invalid entry A[7:4] Phase 2 period of up to 15 dclk clocks [RESET=2h]; 0 is invalid entry
0 0	DA 0	1 0	1 0	0 0	1 X ₄	1 0	0 0	1 1	0 0	Set COM pins hardware configuration	X ₄ =0, Sequential COM pin configuration (i.e. COM31, 30, 29....0 ; SEG0-132; COM31,32....62,63) X ₄ =1(RESET), Alternative COM pin configuration (i.e. COM62,60,58,...2,0; SEG0-132; COM1,3,5...61,63)
0 0	DB A[6:0]	1 0	1 0	0 A ₅	1 A ₄	1 A ₃	0 A ₂	1 A ₁	1 A ₀	Set VCOM Deselect Level	A[5:0] 000000 low VCOM deselect level (~ 0.43 Vref) 110101 normal VCOM deselect level (~ 0.77*Vref (RESET))
0	E2	1	1	1	0	0	0	1	0	Reserved	Reserved
0	E3	1	1	1	0	0	0	1	1	NOP **	Command for No Operation
0	F*	1	1	1	1	*	*	*	*	Reserved	Reserved, do not use

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

Table 5 - 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
D ₇ D ₆ D ₅ D ₄ D ₃ D ₂ D ₁ D ₀	Status Register Read *	D ₇ : Reserve D ₆ : "1" for display OFF / "0" for display ON D ₅ : Reserve D ₄ : Reserve D ₃ : Reserve D ₂ : Reserve D ₁ : Reserve D ₀ : Reserve

Note: Patterns other than those given in the Command Table are prohibited to enter the chip as a command; as unexpected results can occur.

8.1 Data Read / Write

To read data from the GDD RAM, select HIGH for both the R/W (WR#) pin and the D/C pin for 6800-series parallel mode and select LOW for the E (RD#) pin and HIGH for the D/C# pin for 8080-series parallel mode. No data read is provided in serial mode operation.

In normal data read mode the GDD RAM column address pointer will be increased automatically by one after each data read.

Also, a dummy read is required before the first data read. See Figure 5 in the Functional Block Description. To write data to the GDD RAM, select LOW for the R/W (WR#) pin and HIGH for the D/C pin for both 6800-series parallel mode and 8080-series parallel mode. The serial interface mode is always in write mode. The GDD RAM column address pointer will be increased automatically by one after each data write.

Table 6 - Address increment table (Automatic)

D/C	R/W (WR#)	Comment	Address Increment
0	0	Write Command	No
0	1	Read Status	No
1	0	Write Data	Yes
1	1	Read Data	Yes*1

9 COMMAND DESCRIPTIONS

Set Lower Column Address

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

Activate Horizontal Scroll

This command starts the motion of horizontal scrolling and should only be issued after the Horizontal scroll setup parameters have been defined.

The following actions are prohibited after the horizontal scroll is activated

1. RAM access (Data write or read)
2. Changing the horizontal scroll setup parameters

The SSD1303 horizontal scroll is designed for 128 columns scrolling only. The 4 remaining columns are reserved for computation and should be left open.

With column address 0 mapped to SEG0 (Segment remap setting = A0h), the 4 open columns will be SEG128, SEG129, SEG130 and SEG131.

With column address 0 mapped to SEG131 (Segment remap setting = A1h), the 4 open columns will be SEG0, SEG1, SEG2 and SEG3.

Figure 14 - Horizontal scroll direction

REMAP SETTING	SEG0	SEG1	SEG2	SEG3	SEG4	SEG5	...	...	...	SEG126	SEG127	SEG128	SEG129	SEG130	SEG131
A0	A	B	C	D	E	F	→	→	→	Y	Z	Invalid data			
A1	Invalid data				Z	Y	←	←	←	F	E	D	C	B	A

Scroll direction

Deactivate Horizontal Scroll

This command stops the motion of horizontal scrolling.

Horizontal Scroll Setup

This command consists of 5 consecutive bytes to set up the horizontal scroll parameters and determines the scrolling start page, end page and scrolling speed.

Before issuing this command the horizontal scroll must be deactivated (2Eh). Otherwise, RAM content may be corrupted.

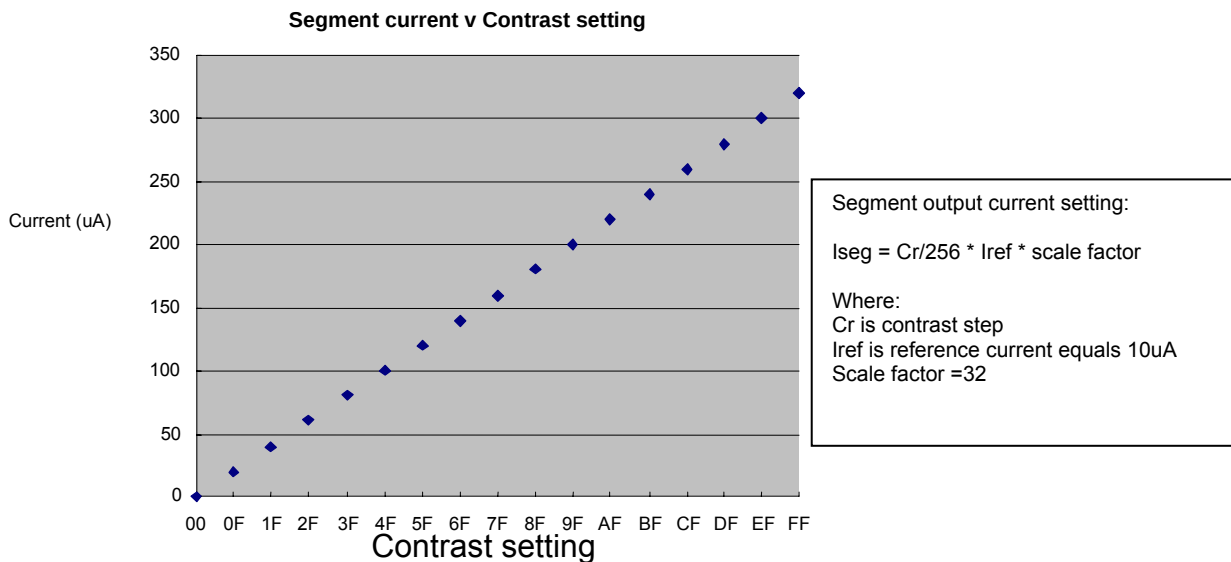
Set Display Start Line

This command sets the Display Start Line register to determine starting address of display RAM, by selecting a value from 0 to 63. With value equal to 0, D₀ of Page 0 is mapped to COM0. With value equal to 1, D₁ of Page0 is mapped to COM0. The display start line values of 0 to 63 are assigned to Page 0 to Page 7.

Set Contrast Control Register

This command sets the Contrast Setting of the display. The chip has 256 contrast steps from 00 to FF. The segment output current increases as the contrast step value increases. See Figure 15 below.

Figure 15 - Segment current v Contrast setting



Set Brightness for Color Banks

This command sets the Brightness Setting of the display for the area color banks (except bank 0). The chip has 256 brightness steps from 00 to FF. The segment output current increases as the brightness step value increases

Set Look Up Table (LUT)

The SSD1303 provides 4 color (pulse width) settings - Colors A, B, C and D. The color intensity (or grey scale) is defined by the current drive pulse width. The pulse width of colors A, B, C is programmable from 32 to 64 DCLK* duration. The color D is fixed at 64 DCLK pulse width. This color setting must be stored in the Look Up Table (LUT).

For the background color, the color intensity is defined by a variable X[5:0].

Set LUT command: 10010001
 X[5:0]
 A[5:0]
 B[5:0]
 C[5:0]

	Description	Number of DCLKs
Bank 0	Set background color	X[5:0]
Color A	Set Pulse Width A	A[5:0]
Color B	Set Pulse Width B	B[5:0]
Color C	Set Pulse Width C	C[5:0]
Color D	Pulse width D is fixed to 64 DCLK	64 (fixed)

DCLK: Internal Display Clock

Set bank color of bank 1-16 (Page 0) and bank color of bank 17-32 (Page 1)

The next step is to define the color of each display area. The 132x64 display matrix is divided into 8 pages of 8 commons per page. The first two pages, page 0 and page 1, are divided into 32 banks: Bank16 and Bank32 consists of a display area of 12x8 pixels. Other banks (0~15 & 17~31) have matrices of 8x8 pixels. Each bank can be programmable to any one of the 4 colors (A, B, C and D). The user can select 92h and 93h commands for the bank color setting but this is only applicable in area color mode.

Set Segment Re-map

This command changes the mapping between the display data column address and the segment driver. It allows flexibility in OLED module design. Please refer to the Command Table.

Set Entire Display ON/OFF

This command forces the entire display to be "ON", regardless of the contents of the display data RAM. This command has priority over normal/reverse display and can be used with "Set Display ON/OFF" command to form a combined command for engaging power save mode.

Set Normal/Inverse Display

This command sets the display to be either normal or inverse. In normal display a RAM data of 1 indicates an "ON" pixel while in inverse display a RAM data of 0 indicates an "ON" pixel.

Set Multiplex Ratio

This command switches the default 63 multiplex mode to any multiplex ratio, ranging from 2 to 63. The output pads COM0-COM63 will be switched to the corresponding COM signal.

Set DC-DC on/off

This command controls the DC-DC voltage converter, which will be turned on by issuing this command then the DISPLAY ON command. The panel display must be off while issuing this command. For RESET the DC-DC will be turned on.

Set Display ON/OFF

This command turns the display ON or OFF. When the display is OFF the segment and common output are in a state of high impedance.

Set Page Address

This command positions the page address from 0 to 7 in GDD RAM. Please refer to the Command Table.

Set COM Output Scan Direction

This command sets the scan direction of the COM output, allowing layout flexibility in the OLED module design. Additionally, the display will show once this command is issued. For example, if this command is sent during normal display then the graphic display will be vertically flipped.

Set Display Offset

This is a double byte command. The second command specifies the mapping of the display start line to one of COM0-63 (assuming that COM0 is the display start line then the display start line register is equal to 0). For example, to move the COM16 towards the COM0 direction by 16 lines the 6-bit data in the second byte should be given as 010000. To move in the opposite direction by 16 lines the 6-bit data should be given by $64 - 16$, so the second byte would be 100000.

Hardware pin name	Output												Set MUX ratio(A8) COM Normal / Remapped (C0 / C8) Display offset (D3) Display start line (40 - 7F)
	64		64		64		56		56		56		
	Normal		Normal		Normal		Normal		Normal		Normal		
	0		8		8		0		8		0		
COM0	Row0	RAM0	Row8	RAM8	Row0	RAM8	Row0	RAM0	Row8	RAM8	Row0	RAM8	
COM1	Row1	RAM1	Row9	RAM9	Row1	RAM9	Row1	RAM1	Row9	RAM9	Row1	RAM9	
COM2	Row2	RAM2	Row10	RAM10	Row2	RAM10	Row2	RAM2	Row10	RAM10	Row2	RAM10	
COM3	Row3	RAM3	Row11	RAM11	Row3	RAM11	Row3	RAM3	Row11	RAM11	Row3	RAM11	
COM4	Row4	RAM4	Row12	RAM12	Row4	RAM12	Row4	RAM4	Row12	RAM12	Row4	RAM12	
COM5	Row5	RAM5	Row13	RAM13	Row5	RAM13	Row5	RAM5	Row13	RAM13	Row5	RAM13	
COM6	Row6	RAM6	Row14	RAM14	Row6	RAM14	Row6	RAM6	Row14	RAM14	Row6	RAM14	
COM7	Row7	RAM7	Row15	RAM15	Row7	RAM15	Row7	RAM7	Row15	RAM15	Row7	RAM15	
COM8	Row8	RAM8	Row16	RAM16	Row8	RAM16	Row8	RAM8	Row16	RAM16	Row8	RAM16	
COM9	Row9	RAM9	Row17	RAM17	Row9	RAM17	Row9	RAM9	Row17	RAM17	Row9	RAM17	
COM10	Row10	RAM10	Row18	RAM18	Row10	RAM18	Row10	RAM10	Row18	RAM18	Row10	RAM18	
COM11	Row11	RAM11	Row19	RAM19	Row11	RAM19	Row11	RAM11	Row19	RAM19	Row11	RAM19	
COM12	Row12	RAM12	Row20	RAM20	Row12	RAM20	Row12	RAM12	Row20	RAM20	Row12	RAM20	
COM13	Row13	RAM13	Row21	RAM21	Row13	RAM21	Row13	RAM13	Row21	RAM21	Row13	RAM21	
COM14	Row14	RAM14	Row22	RAM22	Row14	RAM22	Row14	RAM14	Row22	RAM22	Row14	RAM22	
COM15	Row15	RAM15	Row23	RAM23	Row15	RAM23	Row15	RAM15	Row23	RAM23	Row15	RAM23	
COM16	Row16	RAM16	Row24	RAM24	Row16	RAM24	Row16	RAM16	Row24	RAM24	Row16	RAM24	
COM17	Row17	RAM17	Row25	RAM25	Row17	RAM25	Row17	RAM17	Row25	RAM25	Row17	RAM25	
COM18	Row18	RAM18	Row26	RAM26	Row18	RAM26	Row18	RAM18	Row26	RAM26	Row18	RAM26	
COM19	Row19	RAM19	Row27	RAM27	Row19	RAM27	Row19	RAM19	Row27	RAM27	Row19	RAM27	
COM20	Row20	RAM20	Row28	RAM28	Row20	RAM28	Row20	RAM20	Row28	RAM28	Row20	RAM28	
COM21	Row21	RAM21	Row29	RAM29	Row21	RAM29	Row21	RAM21	Row29	RAM29	Row21	RAM29	
COM22	Row22	RAM22	Row30	RAM30	Row22	RAM30	Row22	RAM22	Row30	RAM30	Row22	RAM30	
COM23	Row23	RAM23	Row31	RAM31	Row23	RAM31	Row23	RAM23	Row31	RAM31	Row23	RAM31	
COM24	Row24	RAM24	Row32	RAM32	Row24	RAM32	Row24	RAM24	Row32	RAM32	Row24	RAM32	
COM25	Row25	RAM25	Row33	RAM33	Row25	RAM33	Row25	RAM25	Row33	RAM33	Row25	RAM33	
COM26	Row26	RAM26	Row34	RAM34	Row26	RAM34	Row26	RAM26	Row34	RAM34	Row26	RAM34	
COM27	Row27	RAM27	Row35	RAM35	Row27	RAM35	Row27	RAM27	Row35	RAM35	Row27	RAM35	
COM28	Row28	RAM28	Row36	RAM36	Row28	RAM36	Row28	RAM28	Row36	RAM36	Row28	RAM36	
COM29	Row29	RAM29	Row37	RAM37	Row29	RAM37	Row29	RAM29	Row37	RAM37	Row29	RAM37	
COM30	Row30	RAM30	Row38	RAM38	Row30	RAM38	Row30	RAM30	Row38	RAM38	Row30	RAM38	
COM31	Row31	RAM31	Row39	RAM39	Row31	RAM39	Row31	RAM31	Row39	RAM39	Row31	RAM39	
COM32	Row32	RAM32	Row40	RAM40	Row32	RAM40	Row32	RAM32	Row40	RAM40	Row32	RAM40	
COM33	Row33	RAM33	Row41	RAM41	Row33	RAM41	Row33	RAM33	Row41	RAM41	Row33	RAM41	
COM34	Row34	RAM34	Row42	RAM42	Row34	RAM42	Row34	RAM34	Row42	RAM42	Row34	RAM42	
COM35	Row35	RAM35	Row43	RAM43	Row35	RAM43	Row35	RAM35	Row43	RAM43	Row35	RAM43	
COM36	Row36	RAM36	Row44	RAM44	Row36	RAM44	Row36	RAM36	Row44	RAM44	Row36	RAM44	
COM37	Row37	RAM37	Row45	RAM45	Row37	RAM45	Row37	RAM37	Row45	RAM45	Row37	RAM45	
COM38	Row38	RAM38	Row46	RAM46	Row38	RAM46	Row38	RAM38	Row46	RAM46	Row38	RAM46	
COM39	Row39	RAM39	Row47	RAM47	Row39	RAM47	Row39	RAM39	Row47	RAM47	Row39	RAM47	
COM40	Row40	RAM40	Row48	RAM48	Row40	RAM48	Row40	RAM40	Row48	RAM48	Row40	RAM48	
COM41	Row41	RAM41	Row49	RAM49	Row41	RAM49	Row41	RAM41	Row49	RAM49	Row41	RAM49	
COM42	Row42	RAM42	Row50	RAM50	Row42	RAM50	Row42	RAM42	Row50	RAM50	Row42	RAM50	
COM43	Row43	RAM43	Row51	RAM51	Row43	RAM51	Row43	RAM43	Row51	RAM51	Row43	RAM51	
COM44	Row44	RAM44	Row52	RAM52	Row44	RAM52	Row44	RAM44	Row52	RAM52	Row44	RAM52	
COM45	Row45	RAM45	Row53	RAM53	Row45	RAM53	Row45	RAM45	Row53	RAM53	Row45	RAM53	
COM46	Row46	RAM46	Row54	RAM54	Row46	RAM54	Row46	RAM46	Row54	RAM54	Row46	RAM54	
COM47	Row47	RAM47	Row55	RAM55	Row47	RAM55	Row47	RAM47	Row55	RAM55	Row47	RAM55	
COM48	Row48	RAM48	Row56	RAM56	Row48	RAM56	Row48	RAM48	-	-	Row48	RAM56	
COM49	Row49	RAM49	Row57	RAM57	Row49	RAM57	Row49	RAM49	-	-	Row49	RAM57	
COM50	Row50	RAM50	Row58	RAM58	Row50	RAM58	Row50	RAM50	-	-	Row50	RAM58	
COM51	Row51	RAM51	Row59	RAM59	Row51	RAM59	Row51	RAM51	-	-	Row51	RAM59	
COM52	Row52	RAM52	Row60	RAM60	Row52	RAM60	Row52	RAM52	-	-	Row52	RAM60	
COM53	Row53	RAM53	Row61	RAM61	Row53	RAM61	Row53	RAM53	-	-	Row53	RAM61	
COM54	Row54	RAM54	Row62	RAM62	Row54	RAM62	Row54	RAM54	-	-	Row54	RAM62	
COM55	Row55	RAM55	Row63	RAM63	Row55	RAM63	Row55	RAM55	-	-	Row55	RAM63	
COM56	Row56	RAM56	Row0	RAM0	Row56	RAM0	-	-	Row0	RAM0	-	-	
COM57	Row57	RAM57	Row1	RAM1	Row57	RAM1	-	-	Row1	RAM1	-	-	
COM58	Row58	RAM58	Row2	RAM2	Row58	RAM2	-	-	Row2	RAM2	-	-	
COM59	Row59	RAM59	Row3	RAM3	Row59	RAM3	-	-	Row3	RAM3	-	-	
COM60	Row60	RAM60	Row4	RAM4	Row60	RAM4	-	-	Row4	RAM4	-	-	
COM61	Row61	RAM61	Row5	RAM5	Row61	RAM5	-	-	Row5	RAM5	-	-	
COM62	Row62	RAM62	Row6	RAM6	Row62	RAM6	-	-	Row6	RAM6	-	-	
COM63	Row63	RAM63	Row7	RAM7	Row63	RAM7	-	-	Row7	RAM7	-	-	

Hardware pin name	Output																Set MUX ratio(A8) COM Normal / Remapped (C0 / C8) Display offset (D3) Display start line (40 - 7F)
	64		64		64		48		48		48		48				
	Remap		Remap		Remap		Remap		Remap		Remap		Remap				
	0		8		0		0		8		0		8				
	0		0		8		0		0		8		16				
COM0	Row63	RAM63	Row7	RAM7	Row63	RAM7	Row47	RAM47	-	-	Row47	RAM41	-	-			
COM1	Row62	RAM62	Row6	RAM6	Row62	RAM6	Row46	RAM46	-	-	Row46	RAM40	-	-			
COM2	Row61	RAM61	Row5	RAM5	Row61	RAM5	Row45	RAM45	-	-	Row45	RAM41	-	-			
COM3	Row60	RAM60	Row4	RAM4	Row60	RAM4	Row44	RAM44	-	-	Row44	RAM42	-	-			
COM4	Row59	RAM59	Row3	RAM3	Row59	RAM3	Row43	RAM43	-	-	Row43	RAM43	-	-			
COM5	Row58	RAM58	Row2	RAM2	Row58	RAM2	Row42	RAM42	-	-	Row42	RAM44	-	-			
COM6	Row57	RAM57	Row1	RAM1	Row57	RAM1	Row41	RAM41	-	-	Row41	RAM45	-	-			
COM7	Row56	RAM56	Row0	RAM0	Row56	RAM0	Row40	RAM40	-	-	Row40	RAM46	-	-			
COM8	Row55	RAM55	Row63	RAM63	Row55	RAM63	Row39	RAM39	Row47	RAM47	Row39	RAM47	Row47	RAM63			
COM9	Row54	RAM54	Row62	RAM62	Row54	RAM62	Row38	RAM38	Row46	RAM46	Row38	RAM46	Row46	RAM62			
COM10	Row53	RAM53	Row61	RAM61	Row53	RAM61	Row37	RAM37	Row45	RAM45	Row37	RAM45	Row45	RAM61			
COM11	Row52	RAM52	Row60	RAM60	Row52	RAM60	Row36	RAM36	Row44	RAM44	Row36	RAM44	Row44	RAM60			
COM12	Row51	RAM51	Row59	RAM59	Row51	RAM59	Row35	RAM35	Row43	RAM43	Row35	RAM43	Row43	RAM59			
COM13	Row50	RAM50	Row58	RAM58	Row50	RAM58	Row34	RAM34	Row42	RAM42	Row34	RAM42	Row42	RAM58			
COM14	Row49	RAM49	Row57	RAM57	Row49	RAM57	Row33	RAM33	Row41	RAM41	Row33	RAM41	Row41	RAM57			
COM15	Row48	RAM48	Row56	RAM56	Row48	RAM56	Row32	RAM32	Row40	RAM40	Row32	RAM40	Row40	RAM56			
COM16	Row47	RAM47	Row55	RAM55	Row47	RAM55	Row31	RAM31	Row39	RAM39	Row31	RAM39	Row39	RAM55			
COM17	Row46	RAM46	Row54	RAM54	Row46	RAM54	Row30	RAM30	Row38	RAM38	Row30	RAM38	Row38	RAM54			
COM18	Row45	RAM45	Row53	RAM53	Row45	RAM53	Row29	RAM29	Row37	RAM37	Row29	RAM37	Row37	RAM53			
COM19	Row44	RAM44	Row52	RAM52	Row44	RAM52	Row28	RAM28	Row36	RAM36	Row28	RAM36	Row36	RAM52			
COM20	Row43	RAM43	Row51	RAM51	Row43	RAM51	Row27	RAM27	Row35	RAM35	Row27	RAM35	Row35	RAM51			
COM21	Row42	RAM42	Row50	RAM50	Row42	RAM50	Row26	RAM26	Row34	RAM34	Row26	RAM34	Row34	RAM50			
COM22	Row41	RAM41	Row49	RAM49	Row41	RAM49	Row25	RAM25	Row33	RAM33	Row25	RAM33	Row33	RAM49			
COM23	Row40	RAM40	Row48	RAM48	Row40	RAM48	Row24	RAM24	Row32	RAM32	Row24	RAM32	Row32	RAM48			
COM24	Row39	RAM39	Row47	RAM47	Row39	RAM47	Row23	RAM23	Row31	RAM31	Row23	RAM31	Row31	RAM47			
COM25	Row38	RAM38	Row46	RAM46	Row38	RAM46	Row22	RAM22	Row30	RAM30	Row22	RAM30	Row30	RAM46			
COM26	Row37	RAM37	Row45	RAM45	Row37	RAM45	Row21	RAM21	Row29	RAM29	Row21	RAM29	Row29	RAM45			
COM27	Row36	RAM36	Row44	RAM44	Row36	RAM44	Row20	RAM20	Row28	RAM28	Row20	RAM28	Row28	RAM44			
COM28	Row35	RAM35	Row43	RAM43	Row35	RAM43	Row19	RAM19	Row27	RAM27	Row19	RAM27	Row27	RAM43			
COM29	Row34	RAM34	Row42	RAM42	Row34	RAM42	Row18	RAM18	Row26	RAM26	Row18	RAM26	Row26	RAM42			
COM30	Row33	RAM33	Row41	RAM41	Row33	RAM41	Row17	RAM17	Row25	RAM25	Row17	RAM25	Row25	RAM41			
COM31	Row32	RAM32	Row40	RAM40	Row32	RAM40	Row16	RAM16	Row24	RAM24	Row16	RAM24	Row24	RAM40			
COM32	Row31	RAM31	Row39	RAM39	Row31	RAM39	Row15	RAM15	Row23	RAM23	Row15	RAM23	Row23	RAM39			
COM33	Row30	RAM30	Row38	RAM38	Row30	RAM38	Row14	RAM14	Row22	RAM22	Row14	RAM22	Row22	RAM38			
COM34	Row29	RAM29	Row37	RAM37	Row29	RAM37	Row13	RAM13	Row21	RAM21	Row13	RAM21	Row21	RAM37			
COM35	Row28	RAM28	Row36	RAM36	Row28	RAM36	Row12	RAM12	Row20	RAM20	Row12	RAM20	Row20	RAM36			
COM36	Row27	RAM27	Row35	RAM35	Row27	RAM35	Row11	RAM11	Row19	RAM19	Row11	RAM19	Row19	RAM35			
COM37	Row26	RAM26	Row34	RAM34	Row26	RAM34	Row10	RAM10	Row18	RAM18	Row10	RAM18	Row18	RAM34			
COM38	Row25	RAM25	Row33	RAM33	Row25	RAM33	Row9	RAM9	Row17	RAM17	Row9	RAM17	Row17	RAM33			
COM39	Row24	RAM24	Row32	RAM32	Row24	RAM32	Row8	RAM8	Row16	RAM16	Row8	RAM16	Row16	RAM32			
COM40	Row23	RAM23	Row31	RAM31	Row23	RAM31	Row7	RAM7	Row15	RAM15	Row7	RAM15	Row15	RAM31			
COM41	Row22	RAM22	Row30	RAM30	Row22	RAM30	Row6	RAM6	Row14	RAM14	Row6	RAM14	Row14	RAM30			
COM42	Row21	RAM21	Row29	RAM29	Row21	RAM29	Row5	RAM5	Row13	RAM13	Row5	RAM13	Row13	RAM29			
COM43	Row20	RAM20	Row28	RAM28	Row20	RAM28	Row4	RAM4	Row12	RAM12	Row4	RAM12	Row12	RAM28			
COM44	Row19	RAM19	Row27	RAM27	Row19	RAM27	Row3	RAM3	Row11	RAM11	Row3	RAM11	Row11	RAM27			
COM45	Row18	RAM18	Row26	RAM26	Row18	RAM26	Row2	RAM2	Row10	RAM10	Row2	RAM10	Row10	RAM26			
COM46	Row17	RAM17	Row25	RAM25	Row17	RAM25	Row1	RAM1	Row9	RAM9	Row1	RAM9	Row9	RAM25			
COM47	Row16	RAM16	Row24	RAM24	Row16	RAM24	Row0	RAM0	Row8	RAM8	Row0	RAM8	Row8	RAM24			
COM48	Row15	RAM15	Row23	RAM23	Row15	RAM23	-	-	Row7	RAM7	-	-	Row7	RAM23			
COM49	Row14	RAM14	Row22	RAM22	Row14	RAM22	-	-	Row6	RAM6	-	-	Row6	RAM22			
COM50	Row13	RAM13	Row21	RAM21	Row13	RAM21	-	-	Row5	RAM5	-	-	Row5	RAM21			
COM51	Row12	RAM12	Row20	RAM20	Row12	RAM20	-	-	Row4	RAM4	-	-	Row4	RAM20			
COM52	Row11	RAM11	Row19	RAM19	Row11	RAM19	-	-	Row3	RAM3	-	-	Row3	RAM19			
COM53	Row10	RAM10	Row18	RAM18	Row10	RAM18	-	-	Row2	RAM2	-	-	Row2	RAM18			
COM54	Row9	RAM9	Row17	RAM17	Row9	RAM17	-	-	Row1	RAM1	-	-	Row1	RAM17			
COM55	Row8	RAM8	Row16	RAM16	Row8	RAM16	-	-	Row0	RAM0	-	-	Row0	RAM16			
COM56	Row7	RAM7	Row15	RAM15	Row7	RAM15	-	-	-	-	-	-	-	-			
COM57	Row6	RAM6	Row14	RAM14	Row6	RAM14	-	-	-	-	-	-	-	-			
COM58	Row5	RAM5	Row13	RAM13	Row5	RAM13	-	-	-	-	-	-	-	-			
COM59	Row4	RAM4	Row12	RAM12	Row4	RAM12	-	-	-	-	-	-	-	-			
COM60	Row3	RAM3	Row11	RAM11	Row3	RAM11	-	-	-	-	-	-	-	-			
COM61	Row2	RAM2	Row10	RAM10	Row2	RAM10	-	-	-	-	-	-	-	-			
COM62	Row1	RAM1	Row9	RAM9	Row1	RAM9	-	-	-	-	-	-	-	-			
COM63	Row0	RAM0	Row8	RAM8	Row0	RAM8	-	-	-	-	-	-	-	-			

Set Display Clock Divide Ratio/ Oscillator Frequency

This command sets the frequency of the internal display clocks -DCLKs. It is defined as the divide ratio (Value from 1 to 16) which is also used to divide the oscillator frequency. RESET is 1. Frame frequency is then determined by the divide ratio, the number of display clocks per row, the MUX ratio and oscillator frequency.

Set Area Color Mode ON/OFF

This command is used to enable area color mode. RESET is mono mode.

Set Low Power Display Mode

This is a double byte command and reduces power consumption during IC operation.

Set Pre-charge period

This command is used to set the duration of the pre-charge period. The interval is counted in number of DCLK, where RESET equals 2 DCLK.

Set COM pins hardware configuration

This command sets the COM signals pin configuration (sequential or alternative) to match the OLED panel hardware layout.

Sequential COM pin configuration:

COM31, 30, 29...0	9.1.1.1.1.1 131	SEG0, 1, 2...	COM32, 33, 34...63
-------------------	--------------------	---------------	--------------------

Alternative COM pin configuration (RESET):

COM62, 60, 58...0	9.1.1.1.1.2 131	SEG0, 1, 2...	COM1, 3, 5...63
-------------------	--------------------	---------------	-----------------

Set VCOM deselect level

This command sets the COM pin output voltage level at deselect stage.

NOP

No Operation Command

Status register Read

This command is issued by setting D/C# on LOW during a data read (See Figure 16 and Figure 17 for parallel interface waveform). It allows the MCU to monitor the internal status of the chip. No status read is provided for serial mode.

10 MAXIMUM RATINGS

Table 7 - Maximum Ratings

(Voltage Reference to V_{SS})

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage	-0.3 to +4.0	V
V_{CC}		0.0 to 18.0	V
V_{REF}		0.0 to 18.0	V
V_{COMH}	Supply Voltage/Output voltage	0.0 to 18.0	V
-	SEG/COM output voltage	0.0 to 18.0	V
V_{in}	Input voltage	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
T_A	Operating Temperature	-40 to +90	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

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

This device may be light sensitive. Caution should be taken to avoid exposure of this device to any light source during normal operation. This device is not radiation protected.

11 DC CHARACTERISTICS

Table 8 - DC Characteristics

(Unless otherwise specified, Voltage Referenced to V_{SS} , $V_{DD} = 2.4$ to $3.5V$, $T_A = 25^\circ C$)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V_{CC}	Operating Voltage	-	7	12	16	V
V_{DD}	Logic Supply Voltage	-	2.4	-	3.5	V
V_{DD}	Logic Supply Voltage (internal DC/DC enable)	-	3.0	-	3.5	V
V_{OH}	High Logic Output Level	$I_{OUT} = 100\mu A$, 3.3MHz	$0.9 \cdot V_{DD}$	-	V_{DD}	V
V_{OL}	Low Logic Output Level	$I_{OUT} = 100\mu A$, 3.3MHz	0	-	$0.1 \cdot V_{DD}$	V
V_{IH}	High Logic Input Level	-	$0.8 \cdot V_{DD}$	-	V_{DD}	V
V_{IL}	Low Logic Input Level	-	0	-	$0.2 \cdot V_{DD}$	V
I_{IL}/I_{IH}	Logic Input Current	-	-1	-	1	μA
$I_{CC, SLEEP}$	Sleep mode Current	$V_{DD} = 2.7V$, display OFF, No panel attached	-10	-	+10	μA
$I_{DD, SLEEP}$	Sleep mode Current	$V_{DD} = 2.7V$, display OFF, No panel attached	-10	-	+10	μA
I_{CC}	V_{CC} Supply Current $V_{DD} = 2.7V$, $V_{CC} = 12V$, $I_{REF} = 10\mu A$ No loading, Display ON, All ON	Contrast = FF	-	550	1000	μA
I_{DD}	V_{DD} Supply Current $V_{DD} = 2.7V$, $V_{CC} = 12V$, $I_{REF} = 10\mu A$ No loading, Display ON, All ON	Contrast = FF	-	190	300	μA
I_{SEG}	Segment Output Current $V_{DD} = 2.7V$, $V_{CC} = 12V$, $I_{REF} = 10\mu A$, Display ON, Segment pin under test is connected with a 20K resistive load to V_{SS}	Contrast=FF	285	320	355	μA
		Contrast=AF	-	220	-	
		Contrast=5F	-	120	-	
		Contrast=0F	-	20	-	
Dev	Segment output current uniformity	$Dev = (I_{SEG} - I_{MID})/I_{MID}$ $I_{MID} = (I_{MAX} + I_{MIN})/2$ $I_{SEG}[0:131] =$ Segment current at contrast = FF	-	-	± 3	%
Adj. Dev	Adjacent pin output current uniformity (contrast = FF)	$Adj\ Dev = (I[n] - I[n+1]) /$ $(I[n] + I[n+1])$	-	± 2.0	-	%
V_{CC}	DC-DC converter output voltage	V_{DD} input=3V, L=22 μH ; R1=450Kohm; R2=50Kohm; Icc = 20mA (loading)	11.0	12.0	13.0	V
		-	7	-	16	
Pwr	DC-DC converter output power	V_{DD} input=3V, L=22 μH ; $V_{CC} = 12V$	-	-	400	mW

12 AC CHARACTERISTICS

Table 9 - AC Characteristics

(Unless otherwise specified, Voltage Referenced to V_{SS} , $V_{DD} = 2.4$ to $3.5V$, $T_A = 25^\circ C$.)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
F_{OSC}	Oscillation Frequency of Display Timing Generator	$V_{DD} = 2.7V$	315	360	420	kHz
F_{FRM}	Frame Frequency for 64 MUX Mode	132x64 Graphic Display Mode, Display ON, Internal Oscillator Enabled	-	$F_{OSC} \times 1/(D \times K \times 64)$	-	Hz
RES#	Reset low pulse width	-	3	-	-	us
	Reset complete time	-	-	-	2	us

D: divide ratio (default value = 1)

K: number of display clocks (default value = 54)

Please refer to the command table (set display clock divide ratio/oscillator freq) for detailed description

F_{OSC} stands for the frequency value of the internal oscillator and the value is measured when command D5h A[7:4] is in default value.

Table 10 - 6800-Series MPU Parallel Interface Timing Characteristics

($V_{DD} - V_{SS} = 2.4$ to $3.5V$, $T_A = 25^\circ C$)

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

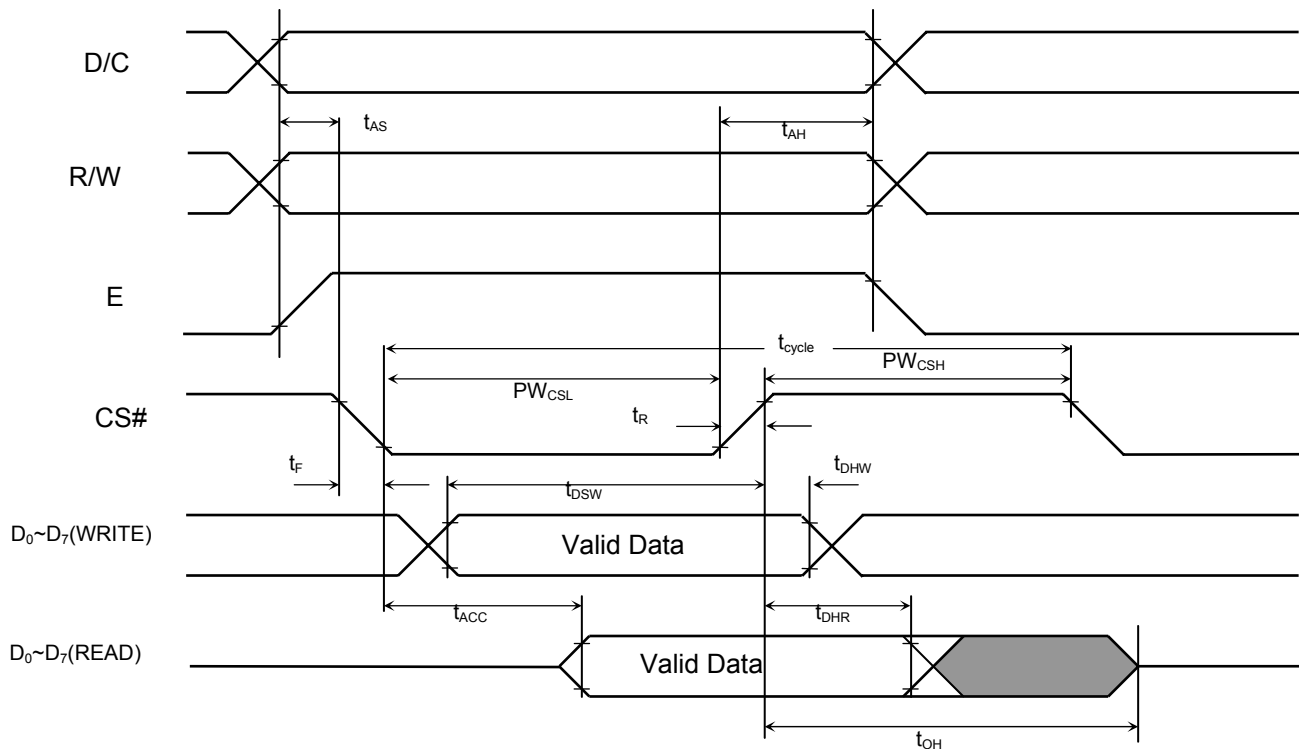


Figure 16 - 6800-series MPU parallel interface characteristics

Table 11 - 8080-Series MPU Parallel Interface Timing Characteristics

($V_{DD} - V_{SS} = 2.4$ to $3.5V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	0	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	40	-	-	ns
t_{DHW}	Write Data Hold Time	7	-	-	ns
t_{DHR}	Read Data Hold Time	20	-	-	ns
t_{OH}	Output Disable Time	-	-	70	ns
t_{ACC}	Access Time	-	-	140	ns
PW_{CSL}	Chip Select Low Pulse Width (read)	150	-	-	ns
	Chip Select Low Pulse Width (write)	60	-	-	ns
PW_{CSH}	Chip Select High Pulse Width (read)	60	-	-	ns
	Chip Select High Pulse Width (write)	60	-	-	ns
t_R	Rise Time	-	-	40	ns
t_F	Fall Time	-	-	40	ns

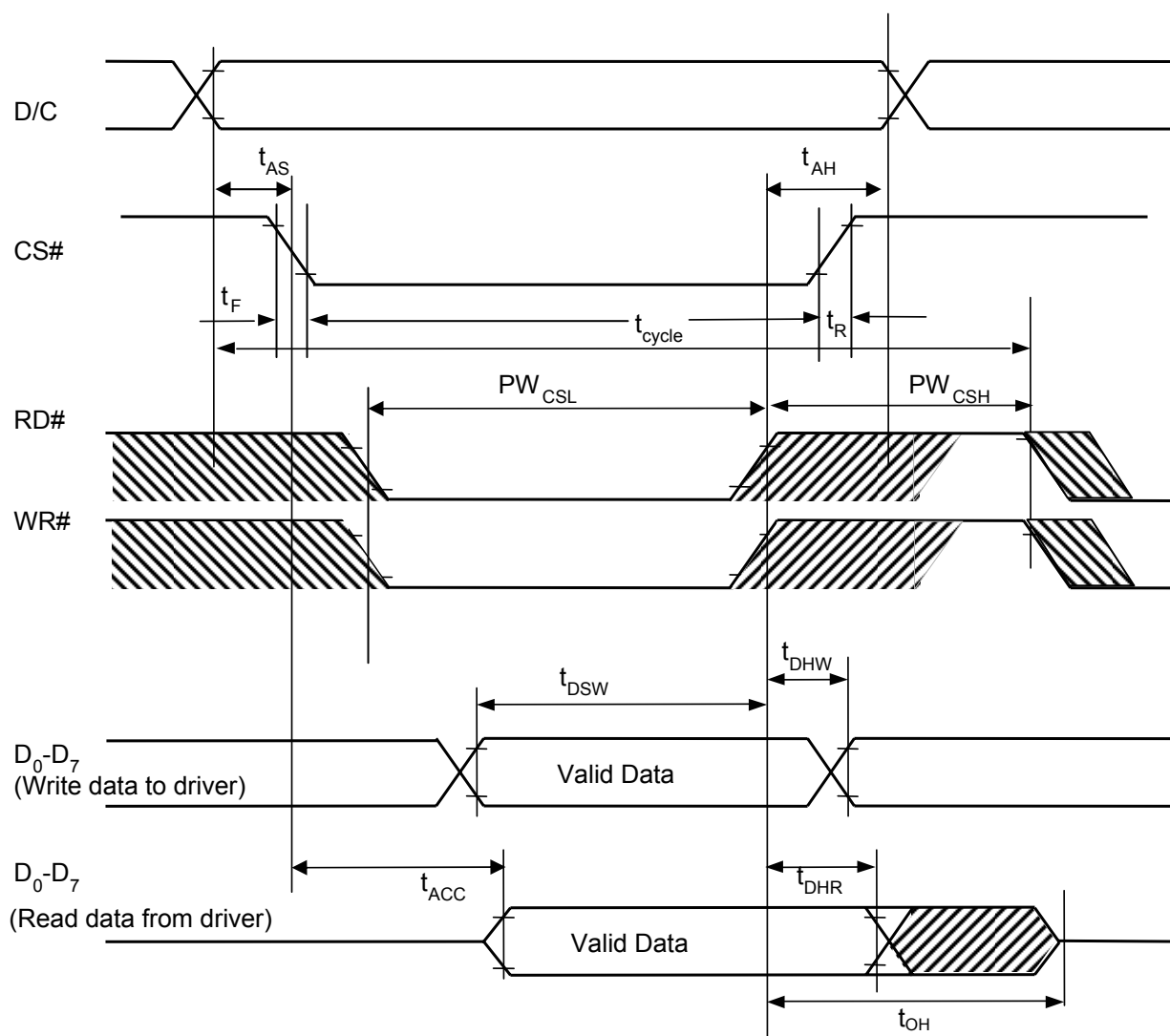


Figure 17 - 8080-series MPU parallel interface characteristics

Table 12 - Serial Interface Timing Characteristics

($V_{DD} - V_{SS} = 2.4$ to $3.5V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	250	-	-	ns
t_{AS}	Address Setup Time	150	-	-	ns
t_{AH}	Address Hold Time	150	-	-	ns
t_{CSS}	Chip Select Setup Time	120	-	-	ns
t_{CSH}	Chip Select Hold Time	60	-	-	ns
t_{DSW}	Write Data Setup Time	100	-	-	ns
t_{DHW}	Write Data Hold Time	100	-	-	ns
t_{CLKL}	Clock Low Time	100	-	-	ns
t_{CLKH}	Clock High Time	100	-	-	ns
t_R	Rise Time	-	-	40	ns
t_F	Fall Time	-	-	40	ns

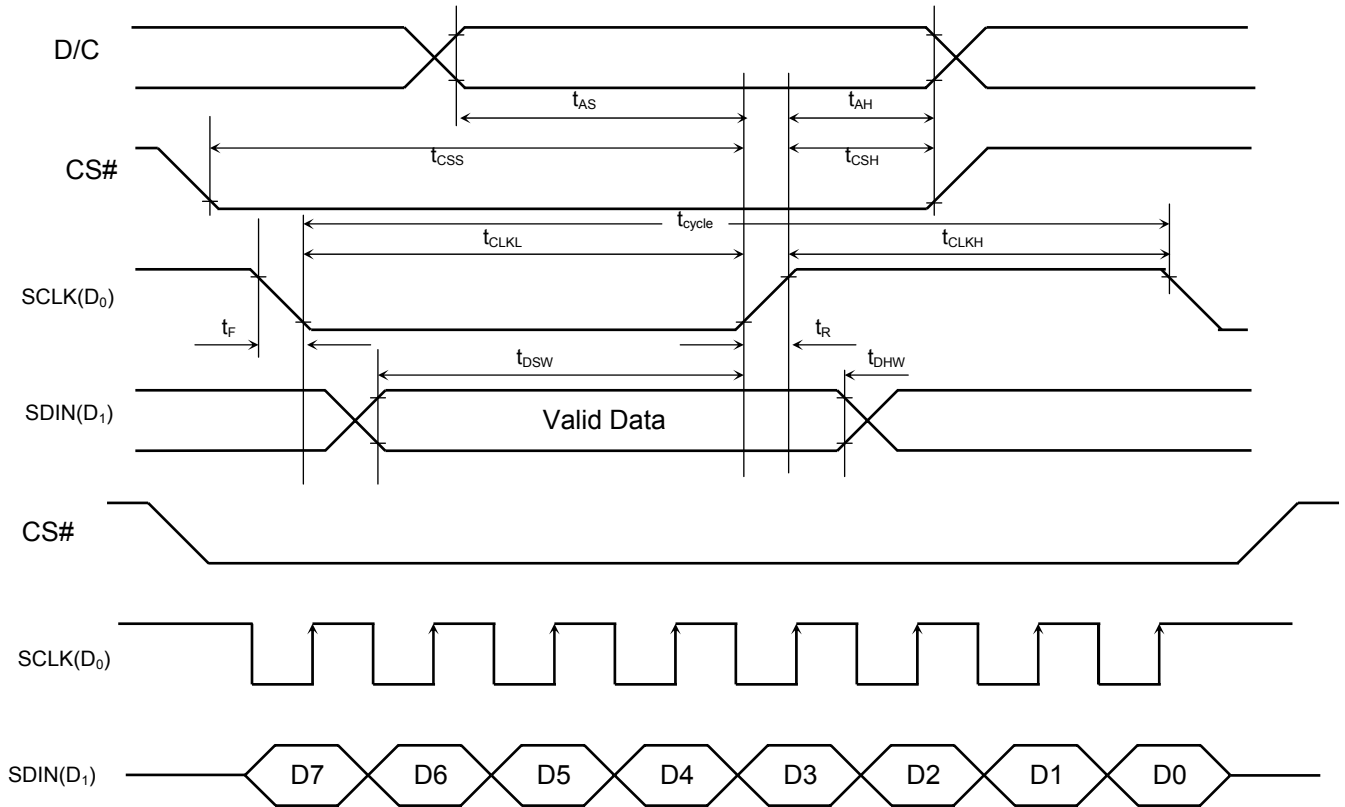
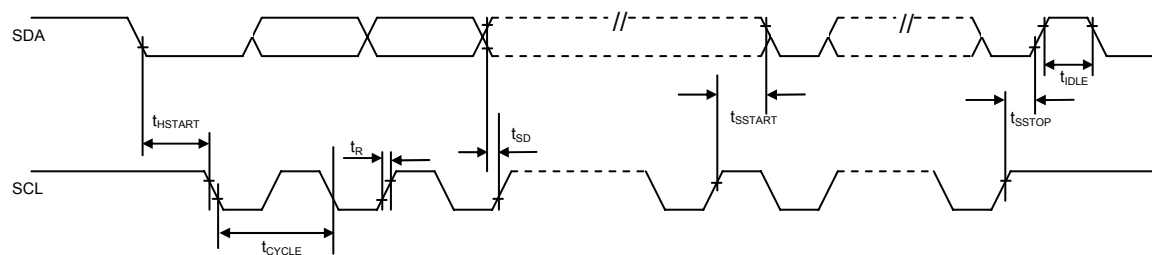


Figure 18 - Serial interface characteristics

Table 13 - I²C Interface Timing Characteristics

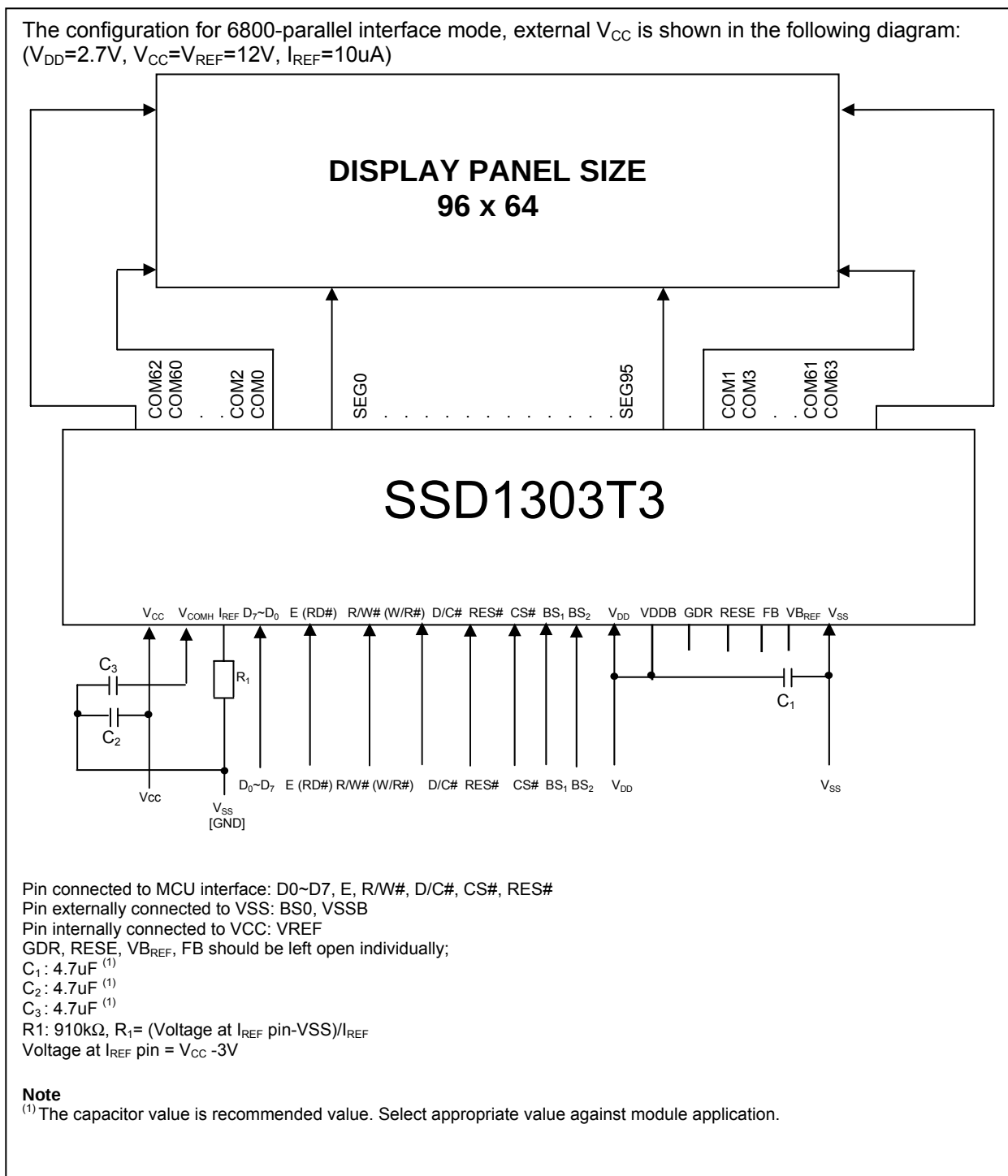
($V_{DD} - V_{SS} = 2.4$ to $3.5V$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	2.5	-	-	us
t_{HSTART}	Start condition Hold Time	0.6	-	-	us
t_{SD}	Data Setup Time	100	-	-	ns
t_{SSTART}	Start condition Setup Time (Only relevant for a repeated Start condition)	0.6	-	-	us
t_{SSTOP}	Stop condition Setup Time	0.6	-	-	us
t_R	Rise Time for data and clock pin	-	-	300	ns
t_{IDLE}	Idle Time before a new transmission can start	1.3	-	-	us

Figure 19 - I²C Interface Timing Characteristics

13 APPLICATION EXAMPLE

Figure 20 - Application Example (Block Diagram of SSD1303T3)



14 SSD1303T3R1 PACKAGE DETAILS

SSD1303T3R1 Pin Assignment

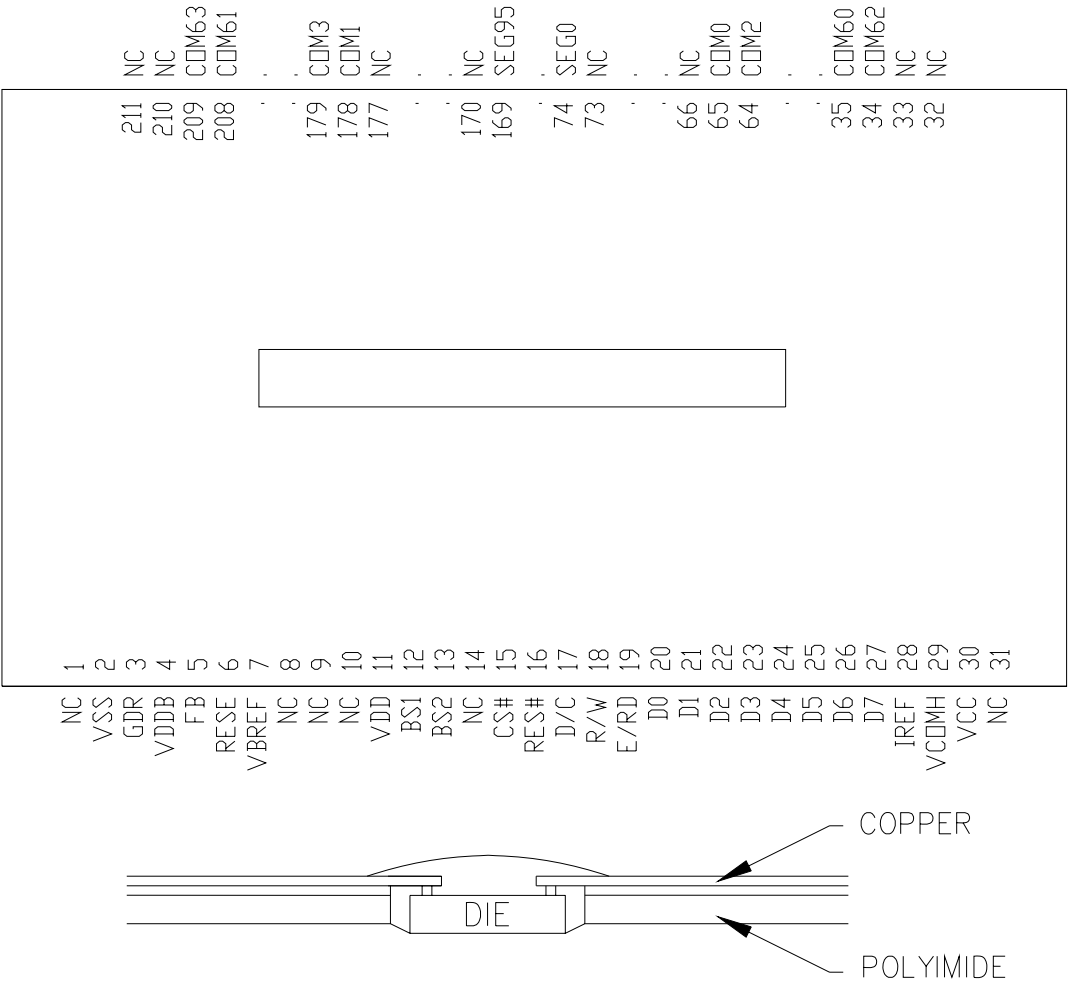


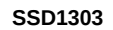
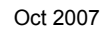
Figure 21 - SSD1303T3R1 pin assignment (Copper view, Normal TAB design)

Remark:
Use internal clock
VREF is connected to VCC
Support MCU interface: 8-bit 6800/8080 parallel interface and SPI
VSSB, BGGND are connected to VSS
BS0 is connected to VSS

Table 14 - SSD1303T3R1 pin assignment

Pin no.	Pin name	Pin no.	Pin name	Pin no.	Pin name	Pin no.	Pin name
1	NC	61	COM8	121	SEG47	181	COM7
2	VSS	62	COM6	122	SEG48	182	COM9
3	GDR	63	COM4	123	SEG49	183	COM11
4	VDDDB	64	COM2	124	SEG50	184	COM13
5	FB	65	COM0	125	SEG51	185	COM15
6	RESE	66	NC	126	SEG52	186	COM17
7	VBREF	67	NC	127	SEG53	187	COM19
8	GP0	68	NC	128	SEG54	188	COM21
9	GP1	69	NC	129	SEG55	189	COM23
10	NC	70	NC	130	SEG56	190	COM25
11	VDD1	71	NC	131	SEG57	191	COM27
12	BS1	72	NC	132	SEG58	192	COM29
13	BS2	73	NC	133	SEG59	193	COM31
14	NC	74	SEG0	134	SEG60	194	COM33
15	CS#	75	SEG1	135	SEG61	195	COM35
16	RES#	76	SEG2	136	SEG62	196	COM37
17	D/C	77	SEG3	137	SEG63	197	COM39
18	R/W	78	SEG4	138	SEG64	198	COM41
19	E/RD	79	SEG5	139	SEG65	199	COM43
20	D0	80	SEG6	140	SEG66	200	COM45
21	D1	81	SEG7	141	SEG67	201	COM47
22	D2	82	SEG8	142	SEG68	202	COM49
23	D3	83	SEG9	143	SEG69	203	COM51
24	D4	84	SEG10	144	SEG70	204	COM53
25	D5	85	SEG11	145	SEG71	205	COM55
26	D6	86	SEG12	146	SEG72	206	COM57
27	D7	87	SEG13	147	SEG73	207	COM59
28	IREF	88	SEG14	148	SEG74	208	COM61
29	VCOMH	89	SEG15	149	SEG75	209	COM63
30	VCC	90	SEG16	150	SEG76	210	NC
31	NC	91	SEG17	151	SEG77	211	NC
32	NC	92	SEG18	152	SEG78		
33	NC	93	SEG19	153	SEG79		
34	COM62	94	SEG20	154	SEG80		
35	COM60	95	SEG21	155	SEG81		
36	COM58	96	SEG22	156	SEG82		
37	COM56	97	SEG23	157	SEG83		
38	COM54	98	SEG24	158	SEG84		
39	COM52	99	SEG25	159	SEG85		
40	COM50	100	SEG26	160	SEG86		
41	COM48	101	SEG27	161	SEG87		
42	COM46	102	SEG28	162	SEG88		
43	COM44	103	SEG29	163	SEG89		
44	COM42	104	SEG30	164	SEG90		
45	COM40	105	SEG31	165	SEG91		
46	COM38	106	SEG32	166	SEG92		
47	COM36	107	SEG33	167	SEG93		
48	COM34	108	SEG34	168	SEG94		
49	COM32	109	SEG35	169	SEG95		
50	COM30	110	SEG36	170	NC		
51	COM28	111	SEG37	171	NC		
52	COM26	112	SEG38	172	NC		
53	COM24	113	SEG39	173	NC		
54	COM22	114	SEG40	174	NC		
55	COM20	115	SEG41	175	NC		
56	COM18	116	SEG42	176	NC		
57	COM16	117	SEG43	177	NC		
58	COM14	118	SEG44	178	COM1		
59	COM12	119	SEG45	179	COM3		
60	COM10	120	SEG46	180	COM5		

Solomon Systech



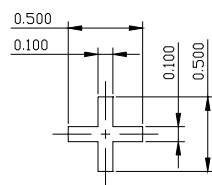
1. GENERAL TOLERANCE: $\pm 0.05\text{MM}$

PI: $75 \pm 6 \mu\text{m}$

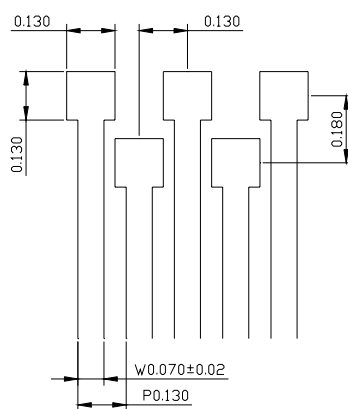
SR: $26 \pm 14 \mu\text{m}$

3. SN PLATING: $0.200 \pm 0.05 \mu\text{m}$

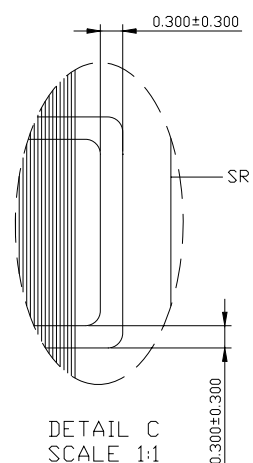
4. TAPESITE: 4 SPH,19mm



DETAIL A
SCALE 2:1



DETAIL B
SCALE 5:1

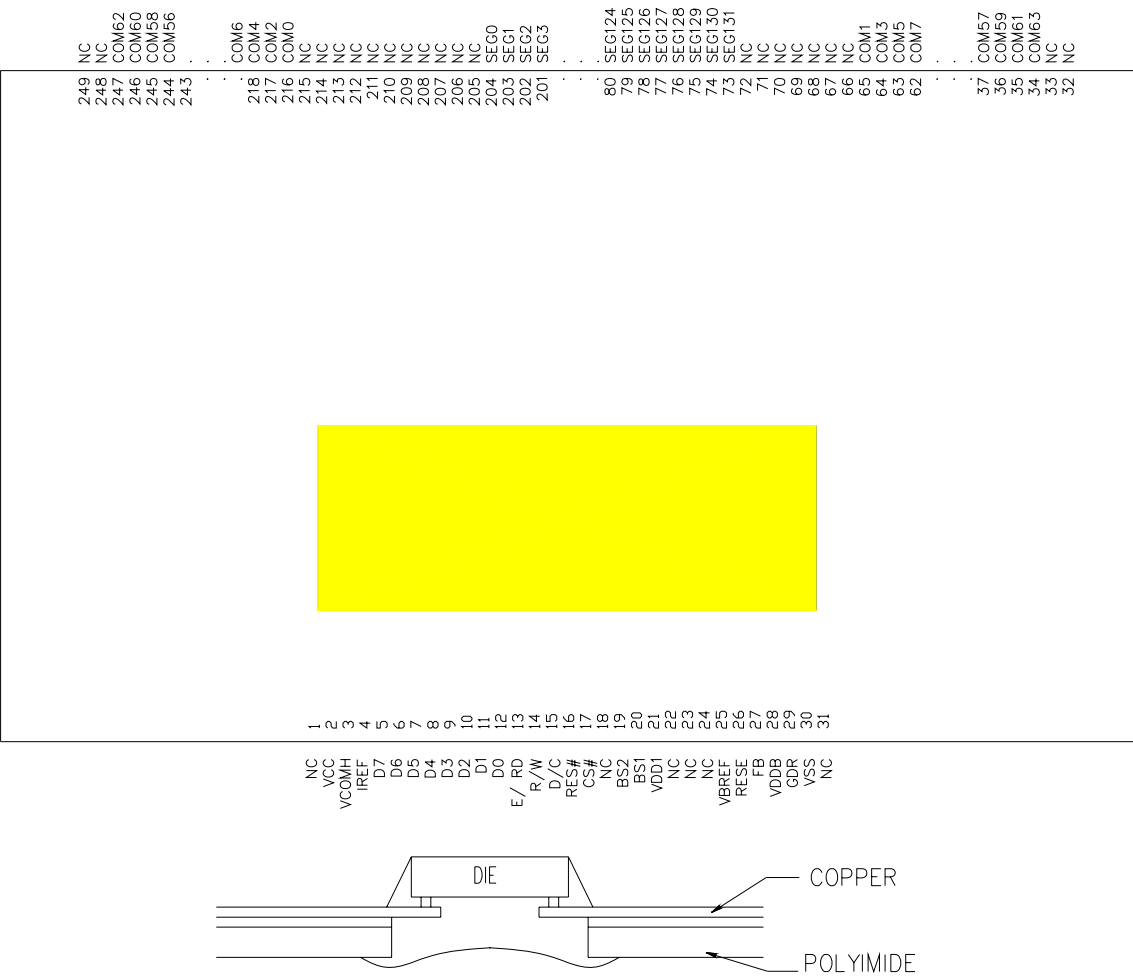


DETAIL C
SCALE 1:1

15 SSD1303T6R1 PACKAGE DETAILS

SSD1303T6R1 Pin Assignment

Figure 22 - SSD1303T6R1 pin assignment (Copper view)



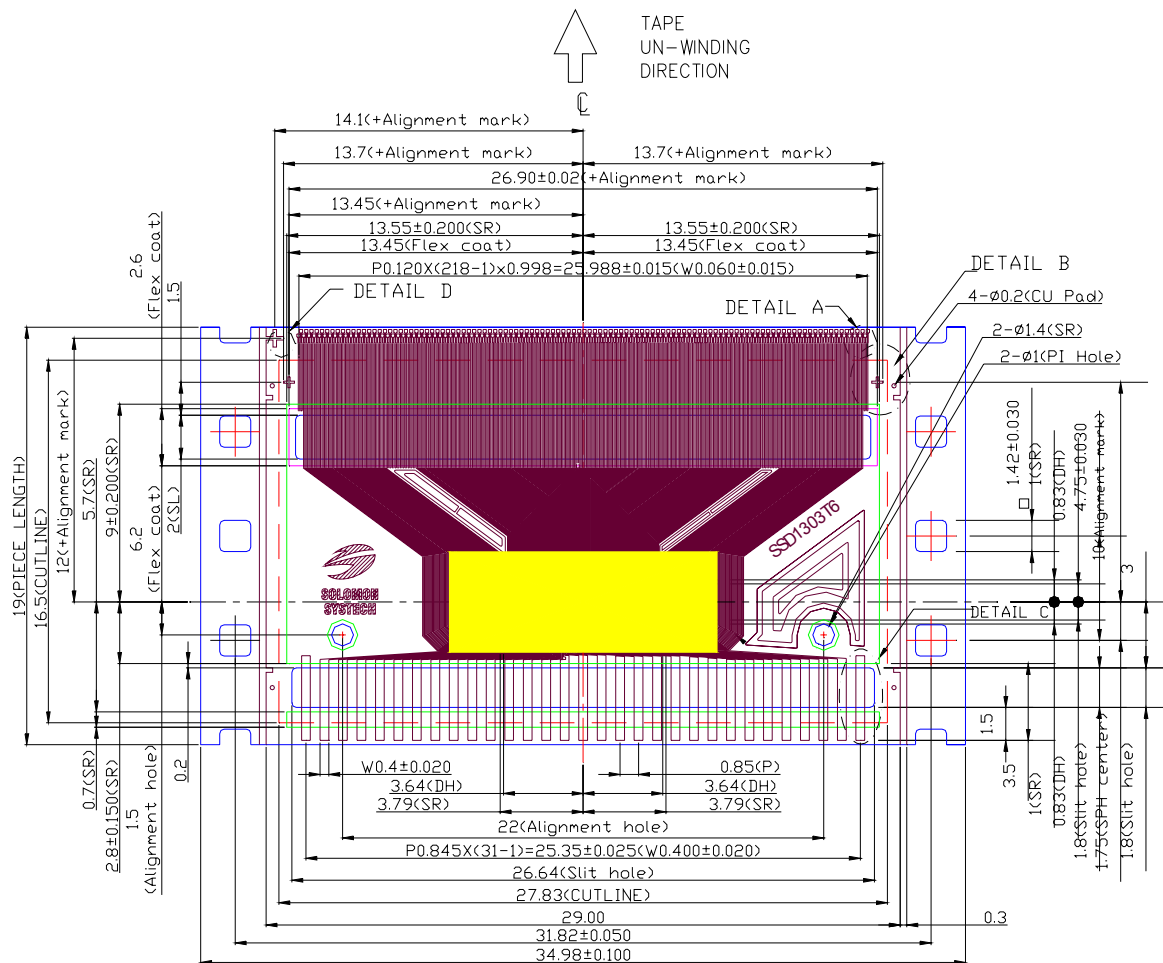
Remark:

Use internal clock
VREF is connected to VCC
Support MCU interface: 8-bit 6800/8080 parallel interface and SPI
VSSB, BGGND are connected to VSS
BS0 is connected to VSS

Table 15 - SSD1303T6R1 pin assignment

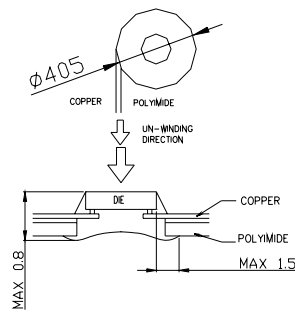
Pin no.	Pin name	Pin no.	Pin name	Pin no.	Pin name	Pin no.	Pin name	Pin no.	Pin name
1	NC	61	COM9	121	SEG83	181	SEG23	241	COM50
2	VCC	62	COM7	122	SEG82	182	SEG22	242	COM52
3	VCOMH	63	COM5	123	SEG81	183	SEG21	243	COM54
4	IREF	64	COM3	124	SEG80	184	SEG20	244	COM56
5	D7	65	COM1	125	SEG79	185	SEG19	245	COM58
6	D6	66	NC	126	SEG78	186	SEG18	246	COM60
7	D5	67	NC	127	SEG77	187	SEG17	247	COM62
8	D4	68	NC	128	SEG76	188	SEG16	248	NC
9	D3	69	NC	129	SEG75	189	SEG15	249	NC
10	D2	70	NC	130	SEG74	190	SEG14		
11	D1	71	NC	131	SEG73	191	SEG13		
12	D0	72	NC	132	SEG72	192	SEG12		
13	E/RD	73	SEG131	133	SEG71	193	SEG11		
14	R/W	74	SEG130	134	SEG70	194	SEG10		
15	D/C	75	SEG129	135	SEG69	195	SEG9		
16	RES#	76	SEG128	136	SEG68	196	SEG8		
17	CS#	77	SEG127	137	SEG67	197	SEG7		
18	NC	78	SEG126	138	SEG66	198	SEG6		
19	BS2	79	SEG125	139	SEG65	199	SEG5		
20	BS1	80	SEG124	140	SEG64	200	SEG4		
21	VDD	81	SEG123	141	SEG63	201	SEG3		
22	NC	82	SEG122	142	SEG62	202	SEG2		
23	NC	83	SEG121	143	SEG61	203	SEG1		
24	NC	84	SEG120	144	SEG60	204	SEG0		
25	VBREF	85	SEG119	145	SEG59	205	NC		
26	RESE	86	SEG118	146	SEG58	206	NC		
27	FB	87	SEG117	147	SEG57	207	NC		
28	VDDb	88	SEG116	148	SEG56	208	NC		
29	GDR	89	SEG115	149	SEG55	209	NC		
30	VSS	90	SEG114	150	SEG54	210	NC		
31	NC	91	SEG113	151	SEG53	211	NC		
32	NC	92	SEG112	152	SEG52	212	NC		
33	NC	93	SEG111	153	SEG51	213	NC		
34	COM63	94	SEG110	154	SEG50	214	NC		
35	COM61	95	SEG109	155	SEG49	215	NC		
36	COM59	96	SEG108	156	SEG48	216	COM0		
37	COM57	97	SEG107	157	SEG47	217	COM2		
38	COM55	98	SEG106	158	SEG46	218	COM4		
39	COM53	99	SEG105	159	SEG45	219	COM6		
40	COM51	100	SEG104	160	SEG44	220	COM8		
41	COM49	101	SEG103	161	SEG43	221	COM10		
42	COM47	102	SEG102	162	SEG42	222	COM12		
43	COM45	103	SEG101	163	SEG41	223	COM14		
44	COM43	104	SEG100	164	SEG40	224	COM16		
45	COM41	105	SEG99	165	SEG39	225	COM18		
46	COM39	106	SEG98	166	SEG38	226	COM20		
47	COM37	107	SEG97	167	SEG37	227	COM22		
48	COM35	108	SEG96	168	SEG36	228	COM24		
49	COM33	109	SEG95	169	SEG35	229	COM26		
50	COM31	110	SEG94	170	SEG34	230	COM28		
51	COM29	111	SEG93	171	SEG33	231	COM30		
52	COM27	112	SEG92	172	SEG32	232	COM32		
53	COM25	113	SEG91	173	SEG31	233	COM34		
54	COM23	114	SEG90	174	SEG30	234	COM36		
55	COM21	115	SEG89	175	SEG29	235	COM38		
56	COM19	116	SEG88	176	SEG28	236	COM40		
57	COM17	117	SEG87	177	SEG27	237	COM42		
58	COM15	118	SEG86	178	SEG26	238	COM44		
59	COM13	119	SEG85	179	SEG25	239	COM46		
60	COM11	120	SEG84	180	SEG24	240	COM48		

SSD1303T6R1 TAB Package Dimensions

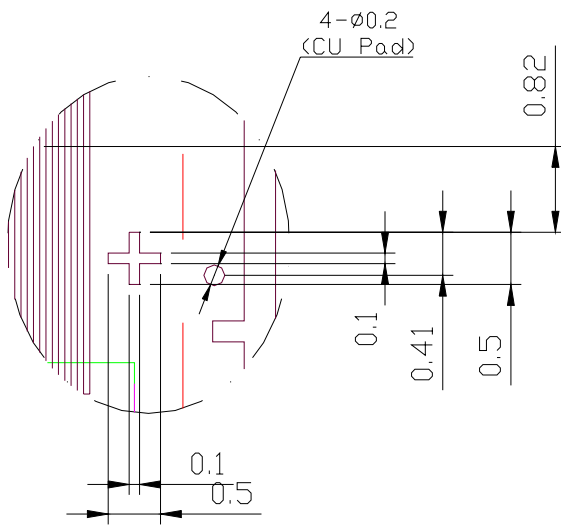
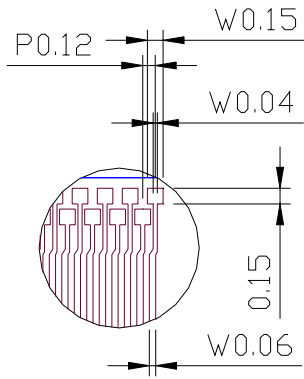


NOTE:

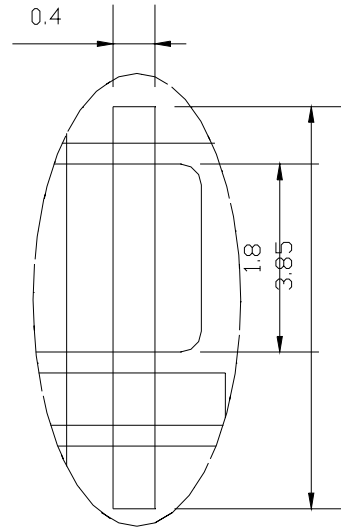
1. GENERAL TOLERANCE: ±0.05MM
2. MATERIAL
PI: UPILEX-S 75±6um
ADHESIVE: 12±2um
CU: 18um
SR: 26±14um
TOLERANCE±0.200
3. SN PLATING: 0.200±0.05um
4. TAPESITE: 4 SPH, 19mm



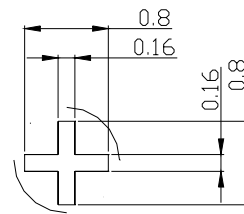
MIRROR DESIGN



DETAIL B



DETAIL C



DETAIL D

16 SSD1303T10R1 PACKAGE DETAILS

SSD1303T10R1 Pin Assignment

Figure 23 - SSD1303T10R1 pin assignment

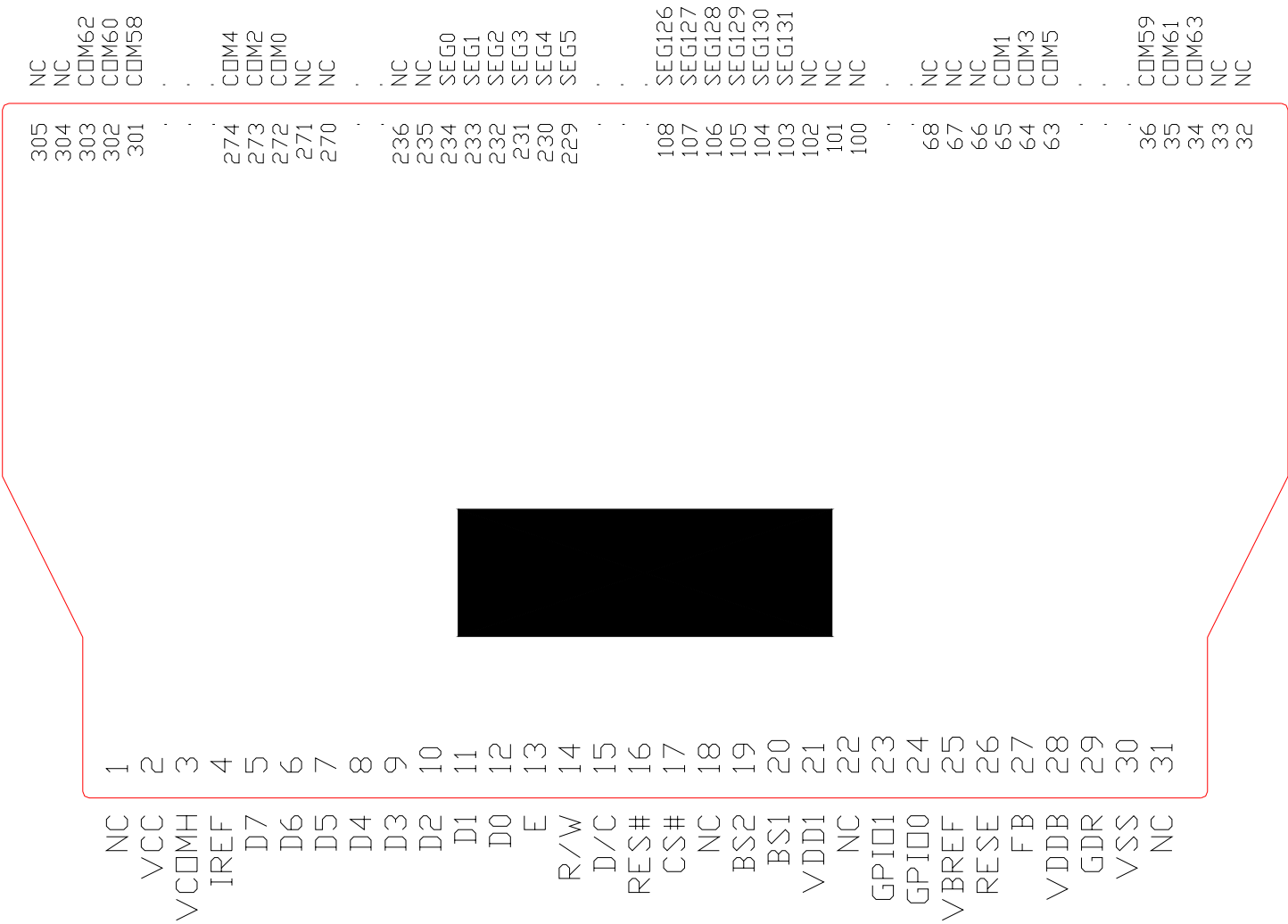
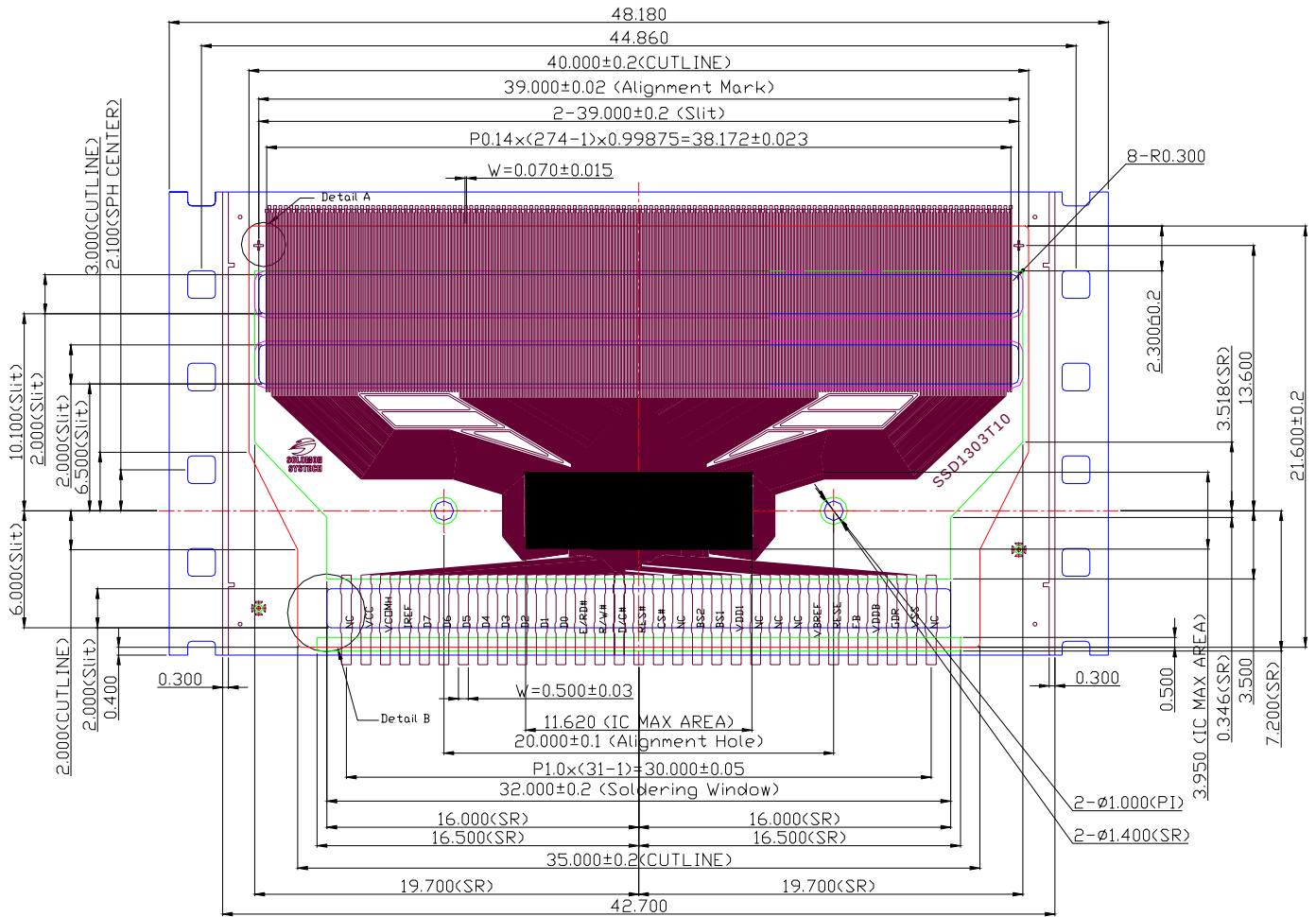


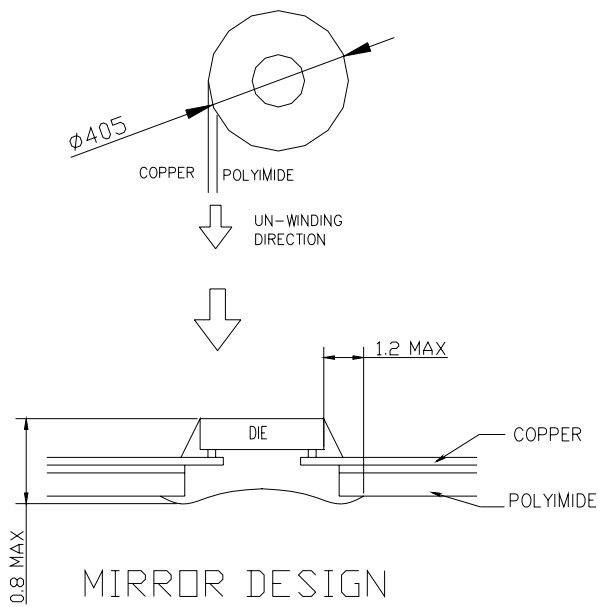
Table 16 : SSD1303T10R1 pin assignment

Pin no	Pin name	Pin no	Pin name	Pin no	Pin name	Pin no	Pin name
1	NC	81	NC	161	SEG73	241	NC
2	VCC	82	NC	162	SEG72	242	NC
3	VCOMH	83	NC	163	SEG71	243	NC
4	IREF	84	NC	164	SEG70	244	NC
5	D7	85	NC	165	SEG69	245	NC
6	D6	86	NC	166	SEG68	246	NC
7	D5	87	NC	167	SEG67	247	NC
8	D4	88	NC	168	SEG66	248	NC
9	D3	89	NC	169	SEG65	249	NC
10	D2	90	NC	170	SEG64	250	NC
11	D1	91	NC	171	SEG63	251	NC
12	D0	92	NC	172	SEG62	252	NC
13	E/RD	93	NC	173	SEG61	253	NC
14	R/W	94	NC	174	SEG60	254	NC
15	D/C	95	NC	175	SEG59	255	NC
16	RES#	96	NC	176	SEG58	256	NC
17	CS#	97	NC	177	SEG57	257	NC
18	NC	98	NC	178	SEG56	258	NC
19	BS2	99	NC	179	SEG55	259	NC
20	BS1	100	NC	180	SEG54	260	NC
21	VDD	101	NC	181	SEG53	261	NC
22	NC	102	NC	182	SEG52	262	NC
23	NC	103	SEG131	183	SEG51	263	NC
24	NC	104	SEG130	184	SEG50	264	NC
25	VBREF	105	SEG129	185	SEG49	265	NC
26	RESE	106	SEG128	186	SEG48	266	NC
27	FB	107	SEG127	187	SEG47	267	NC
28	VDDb	108	SEG126	188	SEG46	268	NC
29	GDR	109	SEG125	189	SEG45	269	NC
30	VSS	110	SEG124	190	SEG44	270	NC
31	NC	111	SEG123	191	SEG43	271	NC
32	GPIO1	112	SEG122	192	SEG42	272	COM0
33	GPIO0	113	SEG121	193	SEG41	273	COM2
34	COM63	114	SEG120	194	SEG40	274	COM4
35	COM61	115	SEG119	195	SEG39	275	COM6
36	COM59	116	SEG118	196	SEG38	276	COM8
37	COM57	117	SEG117	197	SEG37	277	COM10
38	COM55	118	SEG116	198	SEG36	278	COM12
39	COM53	119	SEG115	199	SEG35	279	COM14
40	COM51	120	SEG114	200	SEG34	280	COM16
41	COM49	121	SEG113	201	SEG33	281	COM18
42	COM47	122	SEG112	202	SEG32	282	COM20
43	COM45	123	SEG111	203	SEG31	283	COM22
44	COM43	124	SEG110	204	SEG30	284	COM24
45	COM41	125	SEG109	205	SEG29	285	COM26
46	COM39	126	SEG108	206	SEG28	286	COM28
47	COM37	127	SEG107	207	SEG27	287	COM30
48	COM35	128	SEG106	208	SEG26	288	COM32
49	COM33	129	SEG105	209	SEG25	289	COM34
50	COM31	130	SEG104	210	SEG24	290	COM36
51	COM29	131	SEG103	211	SEG23	291	COM38
52	COM27	132	SEG102	212	SEG22	292	COM40
53	COM25	133	SEG101	213	SEG21	293	COM42
54	COM23	134	SEG100	214	SEG20	294	COM44
55	COM21	135	SEG99	215	SEG19	295	COM46
56	COM19	136	SEG98	216	SEG18	296	COM48
57	COM17	137	SEG97	217	SEG17	297	COM50
58	COM15	138	SEG96	218	SEG16	298	COM52
59	COM13	139	SEG95	219	SEG15	299	COM54
60	COM11	140	SEG94	220	SEG14	300	COM56
61	COM9	141	SEG93	221	SEG13	301	COM58
62	COM7	142	SEG92	222	SEG12	302	COM60
63	COM5	143	SEG91	223	SEG11	303	COM62
64	COM3	144	SEG90	224	SEG10	304	NC
65	COM1	145	SEG89	225	SEG9	305	NC
66	NC	146	SEG88	226	SEG8		
67	NC	147	SEG87	227	SEG7		
68	NC	148	SEG86	228	SEG6		
69	NC	149	SEG85	229	SEG5		
70	NC	150	SEG84	230	SEG4		
71	NC	151	SEG83	231	SEG3		
72	NC	152	SEG82	232	SEG2		
73	NC	153	SEG81	233	SEG1		
74	NC	154	SEG80	234	SEG0		
75	NC	155	SEG79	235	NC		
76	NC	156	SEG78	236	NC		
77	NC	157	SEG77	237	NC		
78	NC	158	SEG76	238	NC		
79	NC	159	SEG75	239	NC		
80	NC	160	SEG74	240	NC		

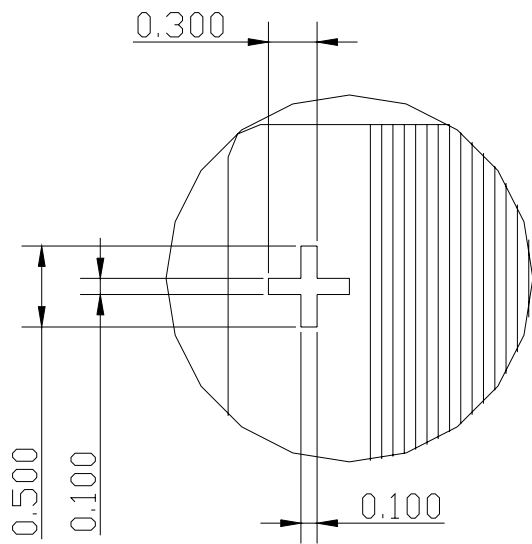
SSD1303T10R1 TAB Package Dimensions

TAPE
UN-WINDING
DIRECTION
↑

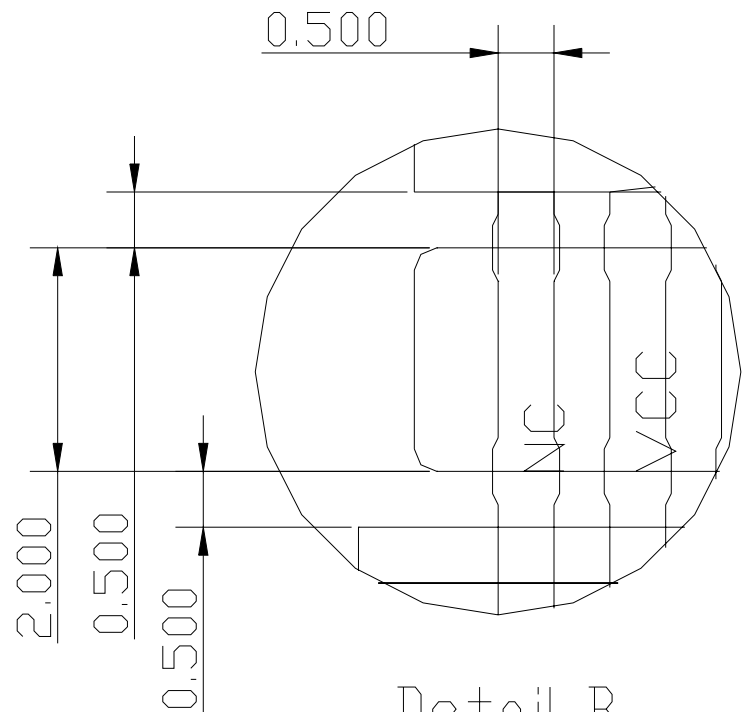




1. GENERAL TOLERANCE: $\pm 0.05\text{MM}$
2. MATERIAL
 - PI: $75 \pm 6\mu\text{m}$
 - CU: $18 \pm 5\mu\text{m}$
 - SR: $26 \pm 14\mu\text{m}$
 - TOLERANCE ± 0.200
 - FC: MIN $10\mu\text{m}$
 - ADHESIVE: $12 \pm 2\mu\text{m}$
3. SN PLATING: $0.200 \pm 0.05\mu\text{m}$



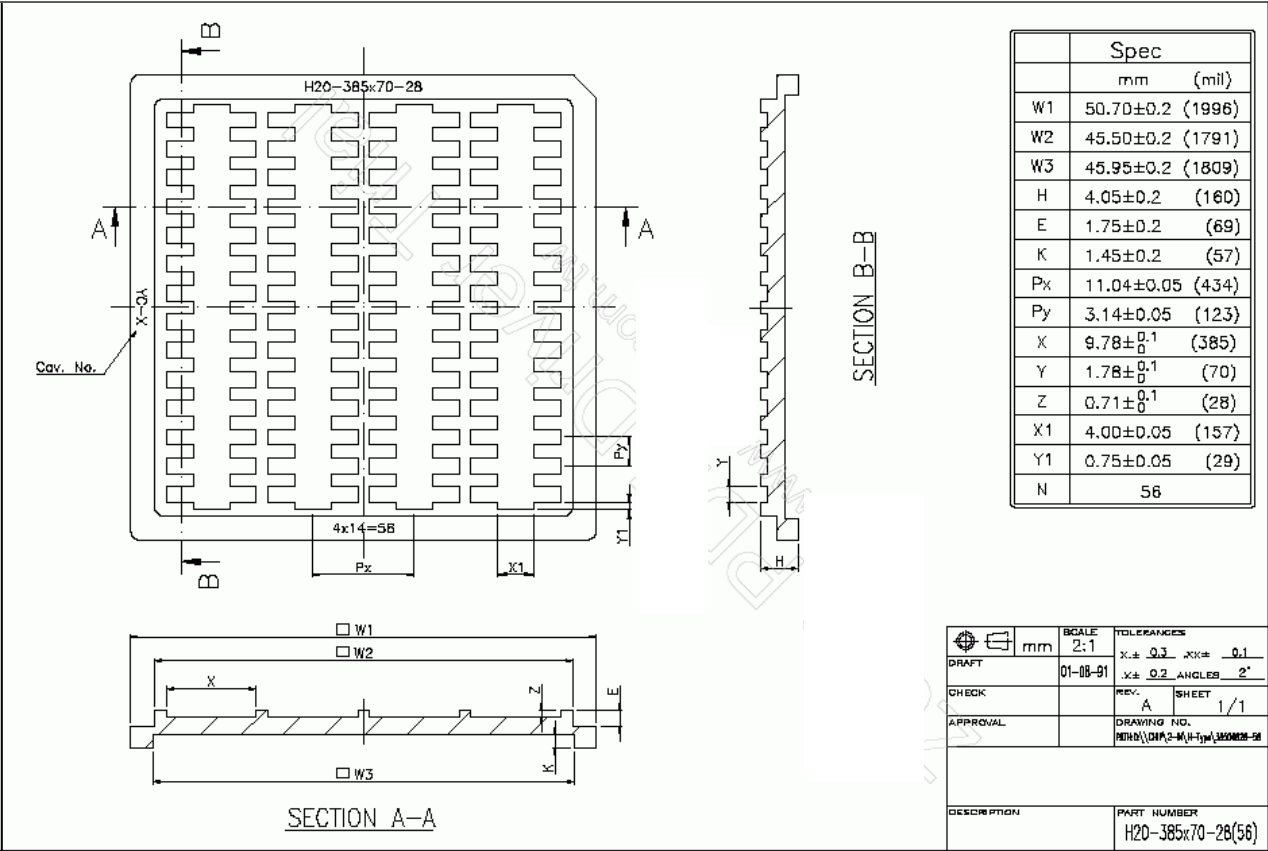
Detail A
Tolerance : $\pm 0.02\text{mm}$



Detail B

17 SSD1303Z PACKAGE DETAILS

DIE TRAY DIMENSIONS



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