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EM65568

130COM/ 128SEG 4096 Color STN LCD Driver

October 12, 2004

Version 1.2

EM65568 Specification Revision History		
Version	Content	Date
0.1	Initial version	February 11, 2003
0.2	1. Add Pad configuration 2. Add the shape of alignment mark	April 10,2003
0.3	1. Rectify 256 color mode Palette5 on Page 44 Initial value 10001 → 10101 2. Modify DC characteristics current consumption IDD1 & IDD2, and add IDD3, IDD4, IDD5 3. Remove EXCS	June 3, 2003
0.4	Modify Bias initial value 1/9 → 1/5 at page 57	June 24, 2003
0.5	Modify CK pin description	August 4, 2003
0.6	Modify initial duty ratio at page 58 Modify display off current IDD5	September 16, 2003
0.7	1. Modify RF ratio register 2. Remove application circuit of 3 wires type and 4 wires serial interface with one chip enable signals	March 22,2004
0.8	1. Modify VDD range: 2.2~3.3 V 2. Modify oscillation frequency of monochrome mode and variable mode on DC characteristics table	March 29,2004
0.9	Add tray information	April 1,2004
1.0	Add COF information	May 20,2004
1.1	Modify AC characteristics	June 2,2004
1.2	1.Modify ITO value 2.Modify using external power supply at page52	October 12,2004

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Contents

1. GENERAL DESCRIPTION	4
2. FEATURE	4
3. APPLICATIONS.....	4
4. PIN CONFIGURATIONS.....	5
5. FUNCTIONAL BLOCK DIAGRAM	15
6. PIN DESCRIPTION	17
7. FUNCTIONAL DESCRIPTION.....	21
8. CONTROL REGISTER.....	61
9. RELATIONSHIP BETWEEN SETTING AND COMMON/DISPLAY RAM	92
10. ABSOLUTE MAXIMUM RATINGS.....	93
11. DC CHARACTERISTICS.....	94
12. AC CHARACTERISTIC	98
13. APPLICATION CIRCUIT	106



1. General description

EM65568 is one of the industry's most advanced wide-screen STN-LCD drivers for 4096-color display. The industry's first sub-screen display function makes it possible to display different images and data in a sub-screen inside the main LCD screen. It also has a built-in display RAM, a power supply circuit for LCD drive, and an LCD controller circuit, therefore contributing to compact system design. Its partial display function realizes low power consumption.

*Partial display function: A function that utilizes only part of the screen, thus reducing power consumption.

2. Feature

- ▶ 4096-color display
- ▶ LCD outputs: Segment 128RGB(384 outputs); Common 130 outputs
- ▶ Display RAM capacity: 128x130x12=199680 bits
- ▶ Built-in display RAM and power supply circuit
- ▶ Partial display functions
- ▶ Switchable display in black and white mode
- ▶ Bus connection with 80-family/68-family MPU/ELAN MPU
- ▶ Logic power supply voltage: 2.2 to 3.3 V
- ▶ LCD driving voltage: 5.0 to 18 V
- ▶ Booster: 2 to 6 times
- ▶ Write system cycle: 200 ns
- ▶ Package:

Part Number	Package	Description	Package information
EM65568AGH	Gold bumped chip	NA	Page 5
EM65568AF	COF	Ver.A	Page 111
EM65568BF	COF	Ver.B	Page 112

Note: The EM65568 series has the following sub-codes depending on their shapes.

H: Bare chip (Aluminum pad without bumped); **GH:** Gold bumped chip;

F: COF package; **T:** TAB (TCP) package

Example EM65568AGH → EM65568: Elan number ; A: Package Version ; GH: Gold bumped chip

3. Applications

- ▶ Mobile phone
- ▶ Small PDA

4. Pin configurations

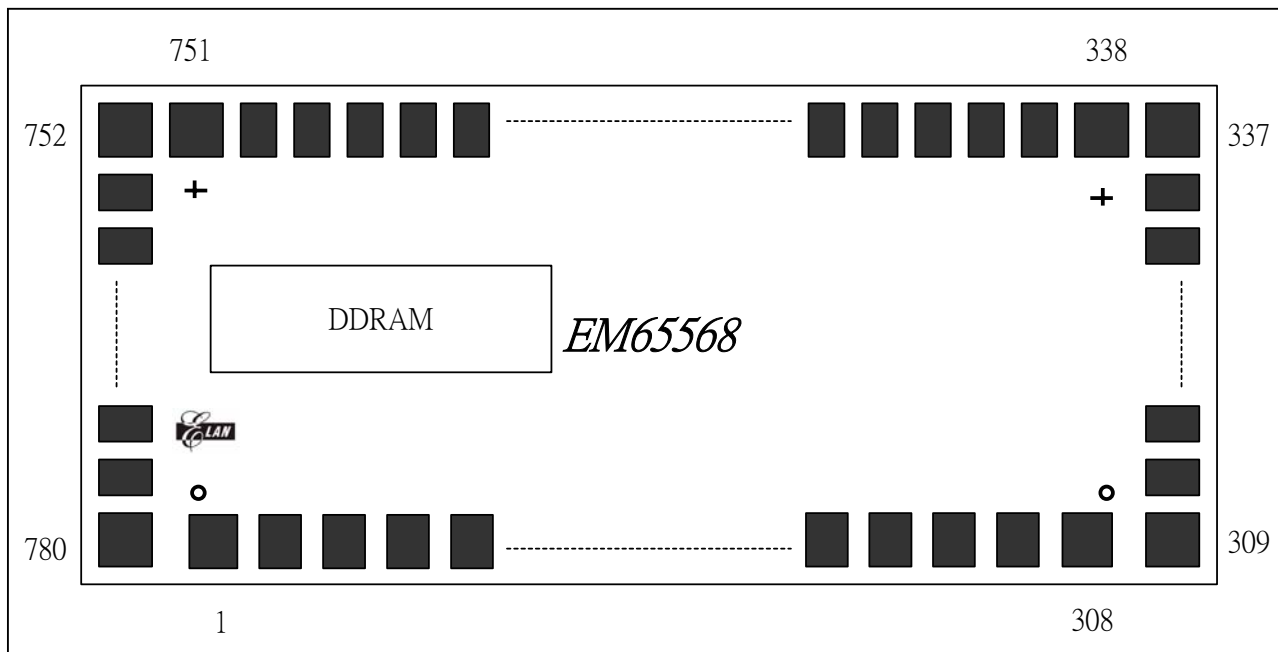
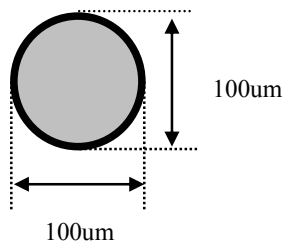


Figure 1. Pin configuration

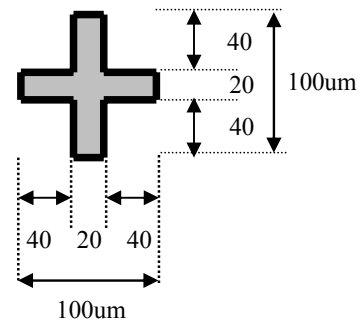
Note: With the Elan logo in the left corner (as shown figure) and DDRAM (black color) on the left side the pin 1 is in the down left corner.

Mark	Coordinate (X,Y)	Mark	Coordinate (X,Y)
U-Left	-10425.0 ,375.0	U-Right	10425.0 ,375.0
D-Left	-10425.0 ,-375.0	D-Right	10425.0 ,-375.0

D-Left and D-Right:



U-Left and U-Right:





PIN DIMENSIONS

Item	Pad No.	Size		Unit
		X	Y	
Chip size	-	21760	1730	μm
Bump Size	1~26,283~308,338~751	36	63	
	27~282	46	63	
	309~337,752~780	63	36	
Pad Pitch	50 (min.)			
Die thickness (excluding bumps)	508+/-25.4			
Bump Height	All Pad 17 +/- 3 (within die)			
Minimum Bump Gap	14			
Coordinate Origin	Chip center			

RECOMMENDED COG ITO TRACES RESISTOR

Interface	ITO Traces resistances
V0~V4 CAP1+, CAP1-, CAP2+, CAP2-, CAP3+, CAP3- CAP4+, CAP4-, CAP5+, CAP5-, Vout VDD, VEE VSSL, VSSH	Max=50Ω
WRB, RDB, CSB, ..., D0~D7	Max=3KΩ
RESB	Max=5~10KΩ



PAD Coordinates Table

Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
1	NC1	-10434.6 ,-734.5	51	V3	-7387.2 ,-734.5
2	COM81	-10384.6 ,-734.5	52	V4	-7324.2 ,-734.5
3	COM83	-10334.6 ,-734.5	53	V4	-7261.2 ,-734.5
4	COM85	-10284.6 ,-734.5	54	V4	-7198.2 ,-734.5
5	COM87	-10234.6 ,-734.5	55	V4	-7135.2 ,-734.5
6	COM89	-10184.6 ,-734.5	56	V4	-7072.2 ,-734.5
7	COM91	-10134.6 ,-734.5	57	V4	-7009.2 ,-734.5
8	COM93	-10084.6 ,-734.5	58	VSSH	-6946.2 ,-734.5
9	COM95	-10034.6 ,-734.5	59	VSSH	-6883.2 ,-734.5
10	COM97	-9984.6 ,-734.5	60	VSSH	-6820.2 ,-734.5
11	COM99	-9934.6 ,-734.5	61	VSSH	-6757.2 ,-734.5
12	COM101	-9884.6 ,-734.5	62	VSSH	-6694.2 ,-734.5
13	COM103	-9834.6 ,-734.5	63	VSSH	-6631.2 ,-734.5
14	COM105	-9784.6 ,-734.5	64	VSSH	-6568.2 ,-734.5
15	COM107	-9734.6 ,-734.5	65	VSSH	-6505.2 ,-734.5
16	COM109	-9684.6 ,-734.5	66	NC3	-6442.2 ,-734.5
17	COM111	-9634.6 ,-734.5	67	VSSL	-6330.3 ,-734.5
18	COM113	-9584.6 ,-734.5	68	VSSL	-6267.3 ,-734.5
19	COM115	-9534.6 ,-734.5	69	VSSL	-6204.3 ,-734.5
20	COM117	-9484.6 ,-734.5	70	VSSL	-6141.3 ,-734.5
21	COM119	-9434.6 ,-734.5	71	VSSL	-6078.3 ,-734.5
22	COM121	-9384.6 ,-734.5	72	VSSL	-6015.3 ,-734.5
23	COM123	-9334.6 ,-734.5	73	VSSL	-5952.3 ,-734.5
24	COM125	-9284.6 ,-734.5	74	VSSL	-5889.3 ,-734.5
25	COM127	-9234.6 ,-734.5	75	TEST	-5826.3 ,-734.5
26	COMB	-9184.6 ,-734.5	76	TEST	-5763.3 ,-734.5
27	NC2	-9121.6 ,-734.5	77	TEST	-5700.3 ,-734.5
28	V0	-9058.6 ,-734.5	78	RESB	-5637.3 ,-734.5
29	V0	-8995.6 ,-734.5	79	RESB	-5574.3 ,-734.5
30	V0	-8932.6 ,-734.5	80	RESB	-5511.3 ,-734.5
31	V0	-8869.6 ,-734.5	81	CSB	-5448.3 ,-734.5
32	V0	-8806.6 ,-734.5	82	CSB	-5385.3 ,-734.5
33	V0	-8743.6 ,-734.5	83	CSB	-5322.3 ,-734.5
34	V1	-8680.6 ,-734.5	84	RS	-5259.3 ,-734.5
35	V1	-8617.6 ,-734.5	85	RS	-5196.3 ,-734.5
36	V1	-8554.6 ,-734.5	86	RS	-5133.3 ,-734.5
37	V1	-8491.6 ,-734.5	87	VSSL	-4847.9 ,-734.5
38	V1	-8428.6 ,-734.5	88	VSSL	-4784.9 ,-734.5
39	V1	-8365.6 ,-734.5	89	MS	-4721.9 ,-734.5
40	V2	-8302.6 ,-734.5	90	MS	-4658.9 ,-734.5
41	V2	-8239.6 ,-734.5	91	MS	-4595.9 ,-734.5
42	V2	-8176.6 ,-734.5	92	VDD	-4532.9 ,-734.5
43	V2	-8113.6 ,-734.5	93	VDD	-4469.9 ,-734.5
44	V2	-8050.6 ,-734.5	94	PS	-4406.9 ,-734.5
45	V2	-7987.6 ,-734.5	95	PS	-4343.9 ,-734.5
46	V3	-7702.2 ,-734.5	96	PS	-4280.9 ,-734.5
47	V3	-7639.2 ,-734.5	97	M86	-4217.9 ,-734.5
48	V3	-7576.2 ,-734.5	98	M86	-4154.9 ,-734.5
49	V3	-7513.2 ,-734.5	99	M86	-4091.9 ,-734.5
50	V3	-7450.2 ,-734.5	100	VSSL	-4028.9 ,-734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
101	VSSL	-3965.9 ,-734.5	151	D13	-331.7 ,-734.5
102	WRB	-3902.9 ,-734.5	152	D14	-268.7 ,-734.5
103	WRB	-3839.9 ,-734.5	153	D14	-205.7 ,-734.5
104	WRB	-3776.9 ,-734.5	154	D14	-142.7 ,-734.5
105	RDB	-3713.9 ,-734.5	155	D15	-79.7 ,-734.5
106	RDB	-3650.9 ,-734.5	156	D15	-16.7 ,-734.5
107	RDB	-3587.9 ,-734.5	157	D15	46.3 ,-734.5
108	VDD	-3524.9 ,-734.5	158	LP	331.7 ,-734.5
109	VDD	-3461.9 ,-734.5	159	LP	394.7 ,-734.5
110	D0	-3137.1 ,-734.5	160	LP	457.7 ,-734.5
111	D0	-3074.1 ,-734.5	161	FLM	520.7 ,-734.5
112	D0	-3011.1 ,-734.5	162	FLM	583.7 ,-734.5
113	D1	-2948.1 ,-734.5	163	FLM	646.7 ,-734.5
114	D1	-2885.1 ,-734.5	164	M	709.7 ,-734.5
115	D1	-2822.1 ,-734.5	165	M	772.7 ,-734.5
116	D2	-2759.1 ,-734.5	166	M	835.7 ,-734.5
117	D2	-2696.1 ,-734.5	167	CLK	898.7 ,-734.5
118	D2	-2633.1 ,-734.5	168	CLK	961.7 ,-734.5
119	D3	-2570.1 ,-734.5	169	CLK	1024.7 ,-734.5
120	D3	-2507.1 ,-734.5	170	VSSL	1087.7 ,-734.5
121	D3	-2444.1 ,-734.5	171	VSSL	1150.7 ,-734.5
122	D4	-2158.7 ,-734.5	172	CK	1213.7 ,-734.5
123	D4	-2095.7 ,-734.5	173	CK	1276.7 ,-734.5
124	D4	-2032.7 ,-734.5	174	CK	1339.7 ,-734.5
125	D5	-1969.7 ,-734.5	175	CKS	1402.7 ,-734.5
126	D5	-1906.7 ,-734.5	176	CKS	1465.7 ,-734.5
127	D5	-1843.7 ,-734.5	177	CKS	1528.7 ,-734.5
128	D6	-1780.7 ,-734.5	178	VDD	1853.5 ,-734.5
129	D6	-1717.7 ,-734.5	179	VDD	1916.5 ,-734.5
130	D6	-1654.7 ,-734.5	180	VDD	1979.5 ,-734.5
131	D7	-1591.7 ,-734.5	181	VDD	2042.5 ,-734.5
132	D7	-1528.7 ,-734.5	182	VDD	2105.5 ,-734.5
133	D7	-1465.7 ,-734.5	183	VDD	2168.5 ,-734.5
134	D8	-1402.7 ,-734.5	184	VDD	2231.5 ,-734.5
135	D8	-1339.7 ,-734.5	185	VDD	2294.5 ,-734.5
136	D8	-1276.7 ,-734.5	186	VBA	2579.9 ,-734.5
137	D9	-1213.7 ,-734.5	187	VBA	2642.9 ,-734.5
138	D9	-1150.7 ,-734.5	188	VBA	2705.9 ,-734.5
139	D9	-1087.7 ,-734.5	189	VBA	2768.9 ,-734.5
140	D10	-1024.7 ,-734.5	190	VBA	2831.9 ,-734.5
141	D10	-961.7 ,-734.5	191	VBA	2894.9 ,-734.5
142	D10	-898.7 ,-734.5	192	VREF	2957.9 ,-734.5
143	D11	-835.7 ,-734.5	193	VREF	3020.9 ,-734.5
144	D11	-772.7 ,-734.5	194	VREF	3083.9 ,-734.5
145	D11	-709.7 ,-734.5	195	VREF	3146.9 ,-734.5
146	D12	-646.7 ,-734.5	196	VREF	3209.9 ,-734.5
147	D12	-583.7 ,-734.5	197	VREF	3272.9 ,-734.5
148	D12	-520.7 ,-734.5	198	VEE	3335.9 ,-734.5
149	D13	-457.7 ,-734.5	199	VEE	3398.9 ,-734.5
150	D13	-394.7 ,-734.5	200	VEE	3461.9 ,-734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
201	VEE	3524.9 ,-734.5	251	CAP3-	6897.3 ,-734.5
202	VEE	3587.9 ,-734.5	252	CAP3+	6960.3 ,-734.5
203	VEE	3650.9 ,-734.5	253	CAP3+	7023.3 ,-734.5
204	VREG	3713.9 ,-734.5	254	CAP3+	7086.3 ,-734.5
205	VREG	3776.9 ,-734.5	255	CAP3+	7149.3 ,-734.5
206	VREG	3839.9 ,-734.5	256	CAP3+	7212.3 ,-734.5
207	VREG	3902.9 ,-734.5	257	CAP3+	7275.3 ,-734.5
208	VREG	3965.9 ,-734.5	258	CAP4-	7338.3 ,-734.5
209	VREG	4028.9 ,-734.5	259	CAP4-	7401.3 ,-734.5
210	VSSH	4091.9 ,-734.5	260	CAP4-	7464.3 ,-734.5
211	VSSH	4154.9 ,-734.5	261	CAP4-	7527.3 ,-734.5
212	VSSH	4217.9 ,-734.5	262	CAP4-	7590.3 ,-734.5
213	VSSH	4280.9 ,-734.5	263	CAP4-	7653.3 ,-734.5
214	VSSH	4343.9 ,-734.5	264	CAP4+	7716.3 ,-734.5
215	VSSH	4406.9 ,-734.5	265	CAP4+	7779.3 ,-734.5
216	VOUT	4469.9 ,-734.5	266	CAP4+	7842.3 ,-734.5
217	VOUT	4532.9 ,-734.5	267	CAP4+	7905.3 ,-734.5
218	VOUT	4595.9 ,-734.5	268	CAP4+	7968.3 ,-734.5
219	VOUT	4658.9 ,-734.5	269	CAP4+	8031.3 ,-734.5
220	VOUT	4721.9 ,-734.5	270	CAP5-	8316.7 ,-734.5
221	VOUT	4784.9 ,-734.5	271	CAP5-	8379.7 ,-734.5
222	CAP1-	4847.9 ,-734.5	272	CAP5-	8442.7 ,-734.5
223	CAP1-	4910.9 ,-734.5	273	CAP5-	8505.7 ,-734.5
224	CAP1-	4973.9 ,-734.5	274	CAP5-	8568.7 ,-734.5
225	CAP1-	5036.9 ,-734.5	275	CAP5-	8631.7 ,-734.5
226	CAP1-	5099.9 ,-734.5	276	CAP5+	8694.7 ,-734.5
227	CAP1-	5162.9 ,-734.5	277	CAP5+	8757.7 ,-734.5
228	CAP1+	5448.3 ,-734.5	278	CAP5+	8820.7 ,-734.5
229	CAP1+	5511.3 ,-734.5	279	CAP5+	8883.7 ,-734.5
230	CAP1+	5574.3 ,-734.5	280	CAP5+	8946.7 ,-734.5
231	CAP1+	5637.3 ,-734.5	281	CAP5+	9009.7 ,-734.5
232	CAP1+	5700.3 ,-734.5	282	NC4	9121.6 ,-734.5
233	CAP1+	5763.3 ,-734.5	283	COM126	9184.6 ,-734.5
234	CAP2-	5826.3 ,-734.5	284	COM124	9234.6 ,-734.5
235	CAP2-	5889.3 ,-734.5	285	COM122	9284.6 ,-734.5
236	CAP2-	5952.3 ,-734.5	286	COM120	9334.6 ,-734.5
237	CAP2-	6015.3 ,-734.5	287	COM118	9384.6 ,-734.5
238	CAP2-	6078.3 ,-734.5	288	COM116	9434.6 ,-734.5
239	CAP2-	6141.3 ,-734.5	289	COM114	9484.6 ,-734.5
240	CAP2+	6204.3 ,-734.5	290	COM112	9534.6 ,-734.5
241	CAP2+	6267.3 ,-734.5	291	COM110	9584.6 ,-734.5
242	CAP2+	6330.3 ,-734.5	292	COM108	9634.6 ,-734.5
243	CAP2+	6393.3 ,-734.5	293	COM106	9684.6 ,-734.5
244	CAP2+	6456.3 ,-734.5	294	COM104	9734.6 ,-734.5
245	CAP2+	6519.3 ,-734.5	295	COM102	9784.6 ,-734.5
246	CAP3-	6582.3 ,-734.5	296	COM100	9834.6 ,-734.5
247	CAP3-	6645.3 ,-734.5	297	COM98	9884.6 ,-734.5
248	CAP3-	6708.3 ,-734.5	298	COM96	9934.6 ,-734.5
249	CAP3-	6771.3 ,-734.5	299	COM94	9984.6 ,-734.5
250	CAP3-	6834.3 ,-734.5	300	COM92	10034.6 ,-734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
301	COM90	10084.6 ,-734.5	351	COMA	9784.6 ,734.5
302	COM88	10134.6 ,-734.5	352	NC9	9734.6 ,734.5
303	COM86	10184.6 ,-734.5	353	SEGA0	9684.6 ,734.5
304	COM84	10234.6 ,-734.5	354	SEGB0	9634.6 ,734.5
305	COM82	10284.6 ,-734.5	355	SEGC0	9584.6 ,734.5
306	COM80	10334.6 ,-734.5	356	SEGA1	9534.6 ,734.5
307	COM78	10384.6 ,-734.5	357	SEGB1	9484.6 ,734.5
308	NC5	10434.6 ,-734.5	358	SEGC1	9434.6 ,734.5
309	NC6	10749.5 ,-700.0	359	SEGA2	9384.6 ,734.5
310	COM76	10749.5 ,-650.0	360	SEGB2	9334.6 ,734.5
311	COM74	10749.5 ,-600.0	361	SEGC2	9284.6 ,734.5
312	COM72	10749.5 ,-550.0	362	SEGA3	9234.6 ,734.5
313	COM70	10749.5 ,-500.0	363	SEGB3	9184.6 ,734.5
314	COM68	10749.5 ,-450.0	364	SEGC3	9134.6 ,734.5
315	COM66	10749.5 ,-400.0	365	SEGA4	9084.6 ,734.5
316	COM64	10749.5 ,-350.0	366	SEGB4	9034.6 ,734.5
317	COM62	10749.5 ,-300.0	367	SEGC4	8984.6 ,734.5
318	COM60	10749.5 ,-250.0	368	SEGA5	8934.6 ,734.5
319	COM58	10749.5 ,-200.0	369	SEGB5	8884.6 ,734.5
320	COM56	10749.5 ,-150.0	370	SEGC5	8834.6 ,734.5
321	COM54	10749.5 ,-100.0	371	SEGA6	8784.6 ,734.5
322	COM52	10749.5 ,-50.0	372	SEGB6	8734.6 ,734.5
323	COM50	10749.5 ,-0.0	373	SEGC6	8684.6 ,734.5
324	COM48	10749.5 ,50.0	374	SEGA7	8634.6 ,734.5
325	COM46	10749.5 ,100.0	375	SEGB7	8584.6 ,734.5
326	COM44	10749.5 ,150.0	376	SEGC7	8534.6 ,734.5
327	COM42	10749.5 ,200.0	377	SEGA8	8484.6 ,734.5
328	COM40	10749.5 ,250.0	378	SEGB8	8434.6 ,734.5
329	COM38	10749.5 ,300.0	379	SEGC8	8384.6 ,734.5
330	COM36	10749.5 ,350.0	380	SEGA9	8334.6 ,734.5
331	COM34	10749.5 ,400.0	381	SEGB9	8284.6 ,734.5
332	COM32	10749.5 ,450.0	382	SEGC9	8234.6 ,734.5
333	COM30	10749.5 ,500.0	383	SEGA10	8184.6 ,734.5
334	COM28	10749.5 ,550.0	384	SEGB10	8134.6 ,734.5
335	COM26	10749.5 ,600.0	385	SEGC10	8084.6 ,734.5
336	COM24	10749.5 ,650.0	386	SEGA11	8034.6 ,734.5
337	NC7	10749.5 ,700.0	387	SEGB11	7984.6 ,734.5
338	NC8	10434.6 ,734.5	388	SEGC11	7934.6 ,734.5
339	COM22	10384.6 ,734.5	389	SEGA12	7884.6 ,734.5
340	COM20	10334.6 ,734.5	390	SEGB12	7834.6 ,734.5
341	COM18	10284.6 ,734.5	391	SEGC12	7784.6 ,734.5
342	COM16	10234.6 ,734.5	392	SEGA13	7734.6 ,734.5
343	COM14	10184.6 ,734.5	393	SEGB13	7684.6 ,734.5
344	COM12	10134.6 ,734.5	394	SEGC13	7634.6 ,734.5
345	COM10	10084.6 ,734.5	395	SEGA14	7584.6 ,734.5
346	COM8	10034.6 ,734.5	396	SEGB14	7534.6 ,734.5
347	COM6	9984.6 ,734.5	397	SEGC14	7484.6 ,734.5
348	COM4	9934.6 ,734.5	398	SEGA15	7434.6 ,734.5
349	COM2	9884.6 ,734.5	399	SEGB15	7384.6 ,734.5
350	COM0	9834.6 ,734.5	400	SEGC15	7334.6 ,734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
401	SEGA16	7284.6 ,734.5	451	SEGC32	4784.6 ,734.5
402	SEGB16	7234.6 ,734.5	452	SEGA33	4734.6 ,734.5
403	SEGC16	7184.6 ,734.5	453	SEGB33	4684.6 ,734.5
404	SEGA17	7134.6 ,734.5	454	SEGC33	4634.6 ,734.5
405	SEGB17	7084.6 ,734.5	455	SEGA34	4584.6 ,734.5
406	SEGC17	7034.6 ,734.5	456	SEGB34	4534.6 ,734.5
407	SEGA18	6984.6 ,734.5	457	SEGC34	4484.6 ,734.5
408	SEGB18	6934.6 ,734.5	458	SEGA35	4434.6 ,734.5
409	SEGC18	6884.6 ,734.5	459	SEGB35	4384.6 ,734.5
410	SEGA19	6834.6 ,734.5	460	SEGC35	4334.6 ,734.5
411	SEGB19	6784.6 ,734.5	461	SEGA36	4284.6 ,734.5
412	SEGC19	6734.6 ,734.5	462	SEGB36	4234.6 ,734.5
413	SEGA20	6684.6 ,734.5	463	SEGC36	4184.6 ,734.5
414	SEGB20	6634.6 ,734.5	464	SEGA37	4134.6 ,734.5
415	SEGC20	6584.6 ,734.5	465	SEGB37	4084.6 ,734.5
416	SEGA21	6534.6 ,734.5	466	SEGC37	4034.6 ,734.5
417	SEGB21	6484.6 ,734.5	467	SEGA38	3984.6 ,734.5
418	SEGC21	6434.6 ,734.5	468	SEGB38	3934.6 ,734.5
419	SEGA22	6384.6 ,734.5	469	SEGC38	3884.6 ,734.5
420	SEGB22	6334.6 ,734.5	470	SEGA39	3834.6 ,734.5
421	SEGC22	6284.6 ,734.5	471	SEGB39	3784.6 ,734.5
422	SEGA23	6234.6 ,734.5	472	SEGC39	3734.6 ,734.5
423	SEGB23	6184.6 ,734.5	473	SEGA40	3684.6 ,734.5
424	SEGC23	6134.6 ,734.5	474	SEGB40	3634.6 ,734.5
425	SEGA24	6084.6 ,734.5	475	SEGC40	3584.6 ,734.5
426	SEGB24	6034.6 ,734.5	476	SEGA41	3534.6 ,734.5
427	SEGC24	5984.6 ,734.5	477	SEGB41	3484.6 ,734.5
428	SEGA25	5934.6 ,734.5	478	SEGC41	3434.6 ,734.5
429	SEGB25	5884.6 ,734.5	479	SEGA42	3384.6 ,734.5
430	SEGC25	5834.6 ,734.5	480	SEGB42	3334.6 ,734.5
431	SEGA26	5784.6 ,734.5	481	SEGC42	3284.6 ,734.5
432	SEGB26	5734.6 ,734.5	482	SEGA43	3234.6 ,734.5
433	SEGC26	5684.6 ,734.5	483	SEGB43	3184.6 ,734.5
434	SEGA27	5634.6 ,734.5	484	SEGC43	3134.6 ,734.5
435	SEGB27	5584.6 ,734.5	485	SEGA44	3084.6 ,734.5
436	SEGC27	5534.6 ,734.5	486	SEGB44	3034.6 ,734.5
437	SEGA28	5484.6 ,734.5	487	SEGC44	2984.6 ,734.5
438	SEGB28	5434.6 ,734.5	488	SEGA45	2934.6 ,734.5
439	SEGC28	5384.6 ,734.5	489	SEGB45	2884.6 ,734.5
440	SEGA29	5334.6 ,734.5	490	SEGC45	2834.6 ,734.5
441	SEGB29	5284.6 ,734.5	491	SEGA46	2784.6 ,734.5
442	SEGC29	5234.6 ,734.5	492	SEGB46	2734.6 ,734.5
443	SEGA30	5184.6 ,734.5	493	SEGC46	2684.6 ,734.5
444	SEGB30	5134.6 ,734.5	494	SEGA47	2634.6 ,734.5
445	SEGC30	5084.6 ,734.5	495	SEGB47	2584.6 ,734.5
446	SEGA31	5034.6 ,734.5	496	SEGC47	2534.6 ,734.5
447	SEGB31	4984.6 ,734.5	497	SEGA48	2484.6 ,734.5
448	SEGC31	4934.6 ,734.5	498	SEGB48	2434.6 ,734.5
449	SEGA32	4884.6 ,734.5	499	SEGC48	2384.6 ,734.5
450	SEGB32	4834.6 ,734.5	500	SEGA49	2334.6 ,734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
501	SEGB49	2284.6 ,734.5	551	SEGA66	-434.6 ,734.5
502	SEGC49	2234.6 ,734.5	552	SEGB66	-484.6 ,734.5
503	SEGA50	2184.6 ,734.5	553	SEGC66	-534.6 ,734.5
504	SEGB50	2134.6 ,734.5	554	SEGA67	-584.6 ,734.5
505	SEGC50	2084.6 ,734.5	555	SEGB67	-634.6 ,734.5
506	SEGA51	2034.6 ,734.5	556	SEGC67	-684.6 ,734.5
507	SEGB51	1984.6 ,734.5	557	SEGA68	-734.6 ,734.5
508	SEGC51	1934.6 ,734.5	558	SEGB68	-784.6 ,734.5
509	SEGA52	1884.6 ,734.5	559	SEGC68	-834.6 ,734.5
510	SEGB52	1834.6 ,734.5	560	SEGA69	-884.6 ,734.5
511	SEGC52	1784.6 ,734.5	561	SEGB69	-934.6 ,734.5
512	SEGA53	1734.6 ,734.5	562	SEGC69	-984.6 ,734.5
513	SEGB53	1684.6 ,734.5	563	SEGA70	-1034.6 ,734.5
514	SEGC53	1634.6 ,734.5	564	SEGB70	-1084.6 ,734.5
515	SEGA54	1584.6 ,734.5	565	SEGC70	-1134.6 ,734.5
516	SEGB54	1534.6 ,734.5	566	SEGA71	-1184.6 ,734.5
517	SEGC54	1484.6 ,734.5	567	SEGB71	-1234.6 ,734.5
518	SEGA55	1434.6 ,734.5	568	SEGC71	-1284.6 ,734.5
519	SEGB55	1384.6 ,734.5	569	SEGA72	-1334.6 ,734.5
520	SEGC55	1334.6 ,734.5	570	SEGB72	-1384.6 ,734.5
521	SEGA56	1284.6 ,734.5	571	SEGC72	-1434.6 ,734.5
522	SEGB56	1234.6 ,734.5	572	SEGA73	-1484.6 ,734.5
523	SEGC56	1184.6 ,734.5	573	SEGB73	-1534.6 ,734.5
524	SEGA57	1134.6 ,734.5	574	SEGC73	-1584.6 ,734.5
525	SEGB57	1084.6 ,734.5	575	SEGA74	-1634.6 ,734.5
526	SEGC57	1034.6 ,734.5	576	SEGB74	-1684.6 ,734.5
527	SEGA58	984.6 ,734.5	577	SEGC74	-1734.6 ,734.5
528	SEGB58	934.6 ,734.5	578	SEGA75	-1784.6 ,734.5
529	SEGC58	884.6 ,734.5	579	SEGB75	-1834.6 ,734.5
530	SEGA59	834.6 ,734.5	580	SEGC75	-1884.6 ,734.5
531	SEGB59	784.6 ,734.5	581	SEGA76	-1934.6 ,734.5
532	SEGC59	734.6 ,734.5	582	SEGB76	-1984.6 ,734.5
533	SEGA60	684.6 ,734.5	583	SEGC76	-2034.6 ,734.5
534	SEGB60	634.6 ,734.5	584	SEGA77	-2084.6 ,734.5
535	SEGC60	584.6 ,734.5	585	SEGB77	-2134.6 ,734.5
536	SEGA61	534.6 ,734.5	586	SEGC77	-2184.6 ,734.5
537	SEGB61	484.6 ,734.5	587	SEGA78	-2234.6 ,734.5
538	SEGC61	434.6 ,734.5	588	SEGB78	-2284.6 ,734.5
539	SEGA62	384.6 ,734.5	589	SEGC78	-2334.6 ,734.5
540	SEGB62	334.6 ,734.5	590	SEGA79	-2384.6 ,734.5
541	SEGC62	284.6 ,734.5	591	SEGB79	-2434.6 ,734.5
542	SEGA63	234.6 ,734.5	592	SEGC79	-2484.6 ,734.5
543	SEGB63	184.6 ,734.5	593	SEGA80	-2534.6 ,734.5
544	SEGC63	134.6 ,734.5	594	SEGB80	-2584.6 ,734.5
545	SEGA64	-134.6 ,734.5	595	SEGC80	-2634.6 ,734.5
546	SEGB64	-184.6 ,734.5	596	SEGA81	-2684.6 ,734.5
547	SEGC64	-234.6 ,734.5	597	SEGB81	-2734.6 ,734.5
548	SEGA65	-284.6 ,734.5	598	SEGC81	-2784.6 ,734.5
549	SEGB65	-334.6 ,734.5	599	SEGA82	-2834.6 ,734.5
550	SEGC65	-384.6 ,734.5	600	SEGB82	-2884.6 ,734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
601	SEGC82	-2934.6 ,734.5	651	SEGB99	-5434.6 ,734.5
602	SEGA83	-2984.6 ,734.5	652	SEGC99	-5484.6 ,734.5
603	SEGB83	-3034.6 ,734.5	653	SEGA100	-5534.6 ,734.5
604	SEGC83	-3084.6 ,734.5	654	SEGB100	-5584.6 ,734.5
605	SEGA84	-3134.6 ,734.5	655	SEGC100	-5634.6 ,734.5
606	SEGB84	-3184.6 ,734.5	656	SEGA101	-5684.6 ,734.5
607	SEGC84	-3234.6 ,734.5	657	SEGB101	-5734.6 ,734.5
608	SEGA85	-3284.6 ,734.5	658	SEGC101	-5784.6 ,734.5
609	SEGB85	-3334.6 ,734.5	659	SEGA102	-5834.6 ,734.5
610	SEGC85	-3384.6 ,734.5	660	SEGB102	-5884.6 ,734.5
611	SEGA86	-3434.6 ,734.5	661	SEGC102	-5934.6 ,734.5
612	SEGB86	-3484.6 ,734.5	662	SEGA103	-5984.6 ,734.5
613	SEGC86	-3534.6 ,734.5	663	SEGB103	-6034.6 ,734.5
614	SEGA87	-3584.6 ,734.5	664	SEGC103	-6084.6 ,734.5
615	SEGB87	-3634.6 ,734.5	665	SEGA104	-6134.6 ,734.5
616	SEGC87	-3684.6 ,734.5	666	SEGB104	-6184.6 ,734.5
617	SEGA88	-3734.6 ,734.5	667	SEGC104	-6234.6 ,734.5
618	SEGB88	-3784.6 ,734.5	668	SEGA105	-6284.6 ,734.5
619	SEGC88	-3834.6 ,734.5	669	SEGB105	-6334.6 ,734.5
620	SEGA89	-3884.6 ,734.5	670	SEGC105	-6384.6 ,734.5
621	SEGB89	-3934.6 ,734.5	671	SEGA106	-6434.6 ,734.5
622	SEGC89	-3984.6 ,734.5	672	SEGB106	-6484.6 ,734.5
623	SEGA90	-4034.6 ,734.5	673	SEGC106	-6534.6 ,734.5
624	SEGB90	-4084.6 ,734.5	674	SEGA107	-6584.6 ,734.5
625	SEGC90	-4134.6 ,734.5	675	SEGB107	-6634.6 ,734.5
626	SEGA91	-4184.6 ,734.5	676	SEGC107	-6684.6 ,734.5
627	SEGB91	-4234.6 ,734.5	677	SEGA108	-6734.6 ,734.5
628	SEGC91	-4284.6 ,734.5	678	SEGB108	-6784.6 ,734.5
629	SEGA92	-4334.6 ,734.5	679	SEGC108	-6834.6 ,734.5
630	SEGB92	-4384.6 ,734.5	680	SEGA109	-6884.6 ,734.5
631	SEGC92	-4434.6 ,734.5	681	SEGB109	-6934.6 ,734.5
632	SEGA93	-4484.6 ,734.5	682	SEGC109	-6984.6 ,734.5
633	SEGB93	-4534.6 ,734.5	683	SEGA110	-7034.6 ,734.5
634	SEGC93	-4584.6 ,734.5	684	SEGB110	-7084.6 ,734.5
635	SEGA94	-4634.6 ,734.5	685	SEGC110	-7134.6 ,734.5
636	SEGB94	-4684.6 ,734.5	686	SEGA111	-7184.6 ,734.5
637	SEGC94	-4734.6 ,734.5	687	SEGB111	-7234.6 ,734.5
638	SEGA95	-4784.6 ,734.5	688	SEGC111	-7284.6 ,734.5
639	SEGB95	-4834.6 ,734.5	689	SEGA112	-7334.6 ,734.5
640	SEGC95	-4884.6 ,734.5	690	SEGB112	-7384.6 ,734.5
641	SEGA96	-4934.6 ,734.5	691	SEGC112	-7434.6 ,734.5
642	SEGB96	-4984.6 ,734.5	692	SEGA113	-7484.6 ,734.5
643	SEGC96	-5034.6 ,734.5	693	SEGB113	-7534.6 ,734.5
644	SEGA97	-5084.6 ,734.5	694	SEGC113	-7584.6 ,734.5
645	SEGB97	-5134.6 ,734.5	695	SEGA114	-7634.6 ,734.5
646	SEGC97	-5184.6 ,734.5	696	SEGB114	-7684.6 ,734.5
647	SEGA98	-5234.6 ,734.5	697	SEGC114	-7734.6 ,734.5
648	SEGB98	-5284.6 ,734.5	698	SEGA115	-7784.6 ,734.5
649	SEGC98	-5334.6 ,734.5	699	SEGB115	-7834.6 ,734.5
650	SEGA99	-5384.6 ,734.5	700	SEGC115	-7884.6 ,734.5



Pin NO	Pad Name	Coordinate (X,Y)	Pin NO	Pad Name	Coordinate (X,Y)
701	SEGA116	-7934.6 ,734.5	751	NC11	-10434.6 ,734.5
702	SEGB116	-7984.6 ,734.5	752	NC12	-10749.5 ,700.0
703	SEGC116	-8034.6 ,734.5	753	COM27	-10749.5 ,650.0
704	SEGA117	-8084.6 ,734.5	754	COM29	-10749.5 ,600.0
705	SEGB117	-8134.6 ,734.5	755	COM31	-10749.5 ,550.0
706	SEGC117	-8184.6 ,734.5	756	COM33	-10749.5 ,500.0
707	SEGA118	-8234.6 ,734.5	757	COM35	-10749.5 ,450.0
708	SEGB118	-8284.6 ,734.5	758	COM37	-10749.5 ,400.0
709	SEGC118	-8334.6 ,734.5	759	COM39	-10749.5 ,350.0
710	SEGA119	-8384.6 ,734.5	760	COM41	-10749.5 ,300.0
711	SEGB119	-8434.6 ,734.5	761	COM43	-10749.5 ,250.0
712	SEGC119	-8484.6 ,734.5	762	COM45	-10749.5 ,200.0
713	SEGA120	-8534.6 ,734.5	763	COM47	-10749.5 ,150.0
714	SEGB120	-8584.6 ,734.5	764	COM49	-10749.5 ,100.0
715	SEGC120	-8634.6 ,734.5	765	COM51	-10749.5 ,50.0
716	SEGA121	-8684.6 ,734.5	766	COM53	-10749.5 ,-0.0
717	SEGB121	-8734.6 ,734.5	767	COM55	-10749.5 ,-50.0
718	SEGC121	-8784.6 ,734.5	768	COM57	-10749.5 ,-100.0
719	SEGA122	-8834.6 ,734.5	769	COM59	-10749.5 ,-150.0
720	SEGB122	-8884.6 ,734.5	770	COM61	-10749.5 ,-200.0
721	SEGC122	-8934.6 ,734.5	771	COM63	-10749.5 ,-250.0
722	SEGA123	-8984.6 ,734.5	772	COM65	-10749.5 ,-300.0
723	SEGB123	-9034.6 ,734.5	773	COM67	-10749.5 ,-350.0
724	SEGC123	-9084.6 ,734.5	774	COM69	-10749.5 ,-400.0
725	SEGA124	-9134.6 ,734.5	775	COM71	-10749.5 ,-450.0
726	SEGB124	-9184.6 ,734.5	776	COM73	-10749.5 ,-500.0
727	SEGC124	-9234.6 ,734.5	777	COM75	-10749.5 ,-550.0
728	SEGA125	-9284.6 ,734.5	778	COM77	-10749.5 ,-600.0
729	SEGB125	-9334.6 ,734.5	779	COM79	-10749.5 ,-650.0
730	SEGC125	-9384.6 ,734.5	780	NC13	-10749.5 ,-700.0
731	SEGA126	-9434.6 ,734.5			
732	SEGB126	-9484.6 ,734.5			
733	SEGC126	-9534.6 ,734.5			
734	SEGA127	-9584.6 ,734.5			
735	SEGB127	-9634.6 ,734.5			
736	SEGC127	-9684.6 ,734.5			
737	NC10	-9734.6 ,734.5			
738	COM1	-9784.6 ,734.5			
739	COM3	-9834.6 ,734.5			
740	COM5	-9884.6 ,734.5			
741	COM7	-9934.6 ,734.5			
742	COM9	-9984.6 ,734.5			
743	COM11	-10034.6 ,734.5			
744	COM13	-10084.6 ,734.5			
745	COM15	-10134.6 ,734.5			
746	COM17	-10184.6 ,734.5			
747	COM19	-10234.6 ,734.5			
748	COM21	-10284.6 ,734.5			
749	COM23	-10334.6 ,734.5			
750	COM25	-10384.6 ,734.5			

Note : For PCB layout, IC substrate must be floated or connected to VSS.

5. Functional block diagram

5.1 System Block Diagram

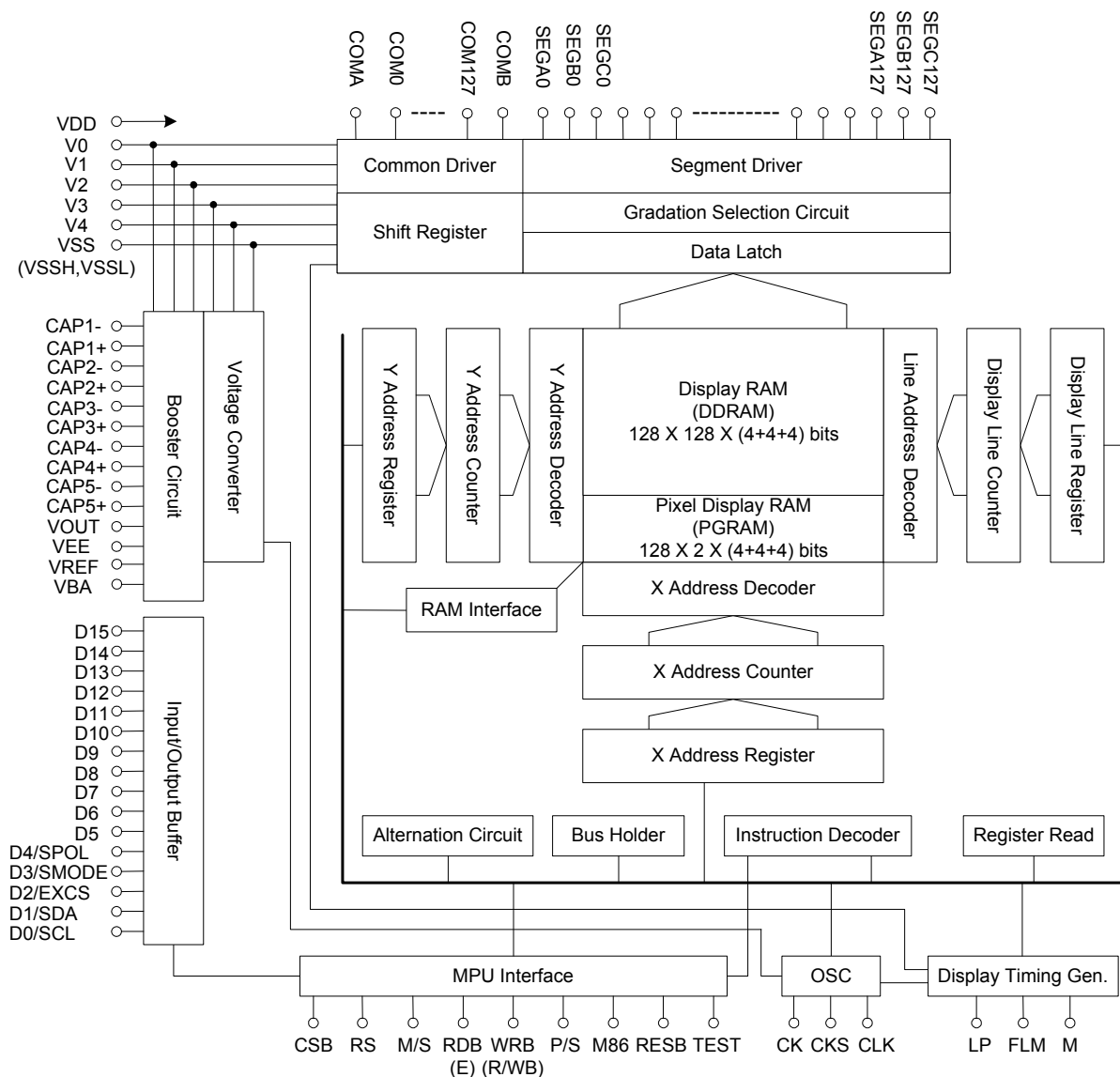


Figure 2. System Block Diagram

5.2 Power Circuit Block Diagram

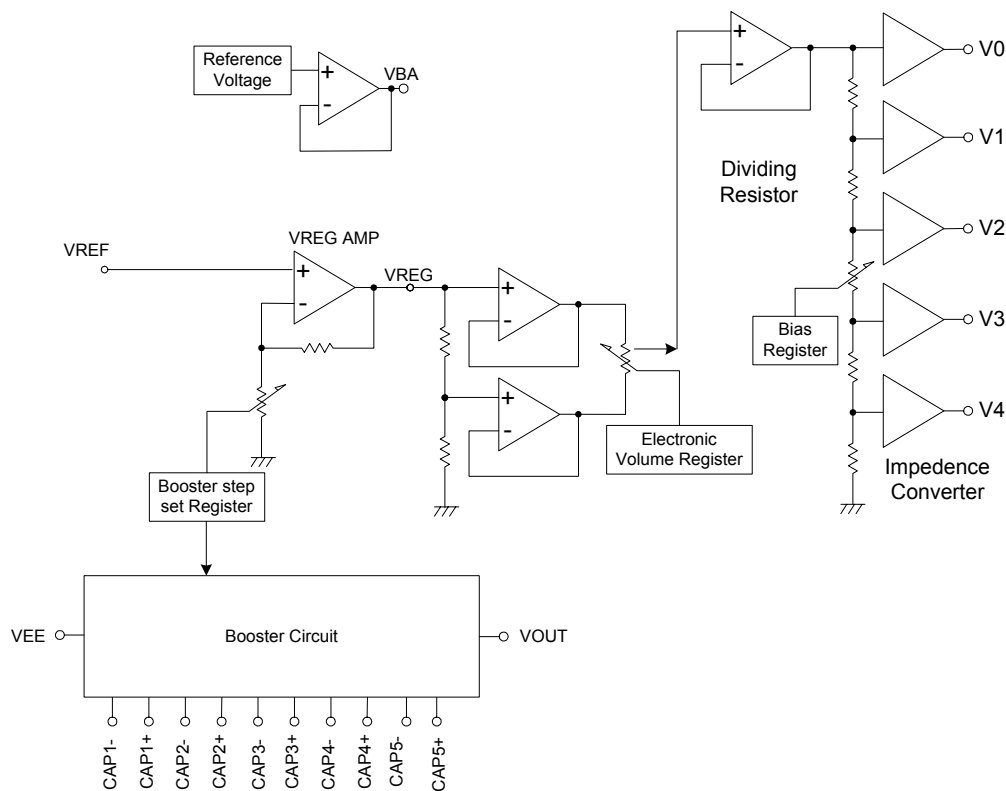


Figure 3. Power Circuit Block Diagram

6. Pin Description

6.1 Power Supply Pins

Symbol	I/O	Description
VDD	Power Supply	Power supply pin for logic circuit to +2.2 to 3.3V
VSSL	Power Supply	Ground pin for logic circuit, connect to 0V
VSSH	Power Supply	Ground pin for high voltage circuit, connected to 0V
V0 V1 V2 V3 V4	Power Supply	Bias power supply pin for LCD drive voltage When using an external power supply, convert impedance by using resistance-division of LCD drive power supply or operation amplifier before adding voltage to the pins. These voltages should have following relationship: $VSS < V4 < V3 < V2 < V1 < V0$ When the internal power supply circuit is active, these voltages are generated by the built-in booster and voltage converter. Then, must connect capacitor each to VSS.

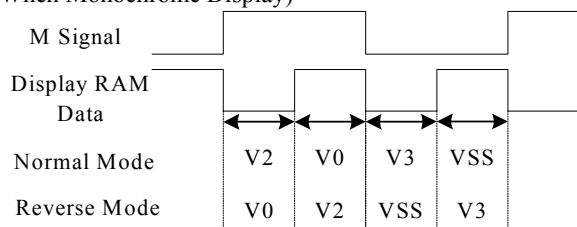
6.2 LCD Power Supply Circuit Pins

Symbol	I/O	Description
CAP1+	O	Connecting pin for the built in booster's capacitor + side. The capacitor is connected between CAP1- and CAP1+.
CAP1-	O	Connecting pin for the built in booster's capacitor - side. The capacitor is connected between CAP1- and CAP1+.
CAP2+	O	Connecting pin for the built in booster's capacitor + side. The capacitor is connected between CAP2- and CAP2+.
CAP2-	O	Connecting pin for the built in booster's capacitor - side. The capacitor is connected between CAP2- and CAP2+.
CAP3+	O	Connecting pin for the built in booster's capacitor + side. The capacitor is connected between CAP3- and CAP3+.
CAP3-	O	Connecting pin for the built in booster's capacitor - side. The capacitor is connected between CAP3- and CAP3+.
CAP4+	O	Connecting pin for the built in booster's capacitor + side. The capacitor is connected between CAP4- and CAP4+.
CAP4-	O	Connecting pin for the built in booster's capacitor - side. The capacitor is connected between CAP4- and CAP4+.
CAP5+	O	Connecting pin for the built in booster's capacitor + side. The capacitor is connected between CAP5- and CAP5+.
CAP5-	O	Connecting pin for the built in booster's capacitor - side. The capacitor is connected between CAP5- and CAP5+.
VBA	O	0.9 times VDD voltage output pin
VREF	I	Voltage input pin for generating reference power source
VEE	Power Supply	Voltage supply pin for booster circuit. Usually the same voltage level as VDD. In the case of TCP, draw it as a separate terminal.
VOUT	O	Output pin of boosted voltage in the built-in booster. The capacitor must be connected between this pin and VSS.
VREG	O	Output pin for regulated voltage of VREG AMP. The capacitor must be connected between this pin and VSS.

6.3 System Bus Pins

Symbol	I/O	Description																		
RESB	I	Reset input pin. When RESB is “L”, initialization is executed.																		
D0/SCL D1/SDA D2 D3/SMODE D4.SPOL D5-D7	I/O	Data bus / Signal interface related pins. When parallel interface is selected (P/S = “H”), The D7-D0 are 8-bits bi-directional data bus, connect to MPU data bus. When serial interface is selected (P/S = “L”), D0 and D1 (SCL, SDA) are used as serial interface pins. SCL: Input pin for data transfer clock SDA: Serial data input pin SMODE: Serial transfer mode select pin SPOL: RS pole select pin when 3-wires serial interface is selected. SDA data is latched at the rising edge of SCL. Internal serial/parallel conversion into 8-bit data occurs at the rising edge of 8 th clock of SCL. After completing data transferring, or when making no access, be sure to set SCL to “L”.																		
D8-D15	I/O	8-bit bi-directional bus. Connected to MPU data bus. Used as data bus for upper 8-pins in the 16-bits access mode.																		
CSB	I	Chip Select input pin. CSB = “L”: accepts access from MPU CSB = “H”: denies access from MPU																		
RS	I	RAM/Register select input pin. RS = “0”: D7-D0 are display RAM data RS = “1”: D7-D0 are control register data																		
RDB (E)	I	Read/Write control pin Select 80-family MPU type (M86 = “L”) The RDB is a data read signal. When RDB is “L”, D7-D0 are in an output status. Select 68-family MPU type (M86 = “H”) R/WB = “H”: When E is “H”, D7-D0 are in an output status. R/WB = “L”: The data on D7-D0 are latched at falling edge fo the E signal.																		
WRB (R/WB)	I	Read/Write control pin Select 80-family MPU type (M86 = “L”) The WRB is a data write signal. The data on D7-D0 are latched at rising edge of the WRB signal. Select 68-family MPU type (M86 = “H”) Read/Write control input pin. R/W = “H”: Read R/W = “L”: Write																		
M86	I	MPU interface type selecting input pin. M86 = “H”: 68-family interface M86 = “L”: 80-family interface Fixed at either “H” or “L”																		
P/S	I	Parallel/Serail interface select pin. <table border="1"><tr><th>P/S</th><th>Chip select</th><th>Data identification</th><th>Data</th><th>Read/Write</th><th>Serial clock</th></tr><tr><td>H</td><td>CSB</td><td>RS</td><td>D0-D7</td><td>RDB, WRB</td><td>-</td></tr><tr><td>L</td><td>CSB</td><td>RS</td><td>SDA</td><td>Write only</td><td>SCL</td></tr></table> P/S = “H”: For parallel interface. P/S = “L”: For serial interface. Fix D15-D5 pins are Hi-Z, RDB and WRB pins to either “H” or “L”.	P/S	Chip select	Data identification	Data	Read/Write	Serial clock	H	CSB	RS	D0-D7	RDB, WRB	-	L	CSB	RS	SDA	Write only	SCL
P/S	Chip select	Data identification	Data	Read/Write	Serial clock															
H	CSB	RS	D0-D7	RDB, WRB	-															
L	CSB	RS	SDA	Write only	SCL															
TEST	I	For testing only; usually fixed to “L”.																		

6.4 LCD Drive Circuit Signals

Symbol	I/O	Description																								
LP	I/O	The LP is latch clock I/O pin. At the rising edge, count the display line counter. At the falling edge output the LCD drive signal. This pin use in master/slave multi-chip system M/S = “H”: LP is output M/S = “L”: LP is input																								
FLM	I/O	I/O pin for LCD display synchronous signals (first line maker). When FLM pin is set to “H”, the display start-line address is preset. This pin use in master/slave multi-chip system. In the display line counter M/S = “H”: FLM is output M/S = “L”: FLM is input																								
M	I/O	I/O pin for alternated signals of LCD drive output. M/S = “H”: M is output M/S = “L”: M is input This pin use in master/slave multi-chip system.																								
M/S	I	Maser/Slave mode select input pin <table><tr><th>M/S</th><th>State</th><th>OSC</th><th>Power Supply Circuit</th><th>LP</th><th>FLM</th><th>M</th><th>CLK</th></tr><tr><td>H</td><td>Master</td><td>Enable</td><td>Enable</td><td>Output</td><td>Output</td><td>Output</td><td>Output</td></tr><tr><td>L</td><td>Slave</td><td>Disable</td><td>Disable</td><td>Input</td><td>Input</td><td>Input</td><td>Input</td></tr></table> Fix to “H” or “L” at this terminal.	M/S	State	OSC	Power Supply Circuit	LP	FLM	M	CLK	H	Master	Enable	Enable	Output	Output	Output	Output	L	Slave	Disable	Disable	Input	Input	Input	Input
M/S	State	OSC	Power Supply Circuit	LP	FLM	M	CLK																			
H	Master	Enable	Enable	Output	Output	Output	Output																			
L	Slave	Disable	Disable	Input	Input	Input	Input																			
SEGA0-A127 SEGB0-B127 SEGC0-C127	O	Segment output pins for LCD drives. According to the data of the Display RAM data, non-lighted at “0”, lighted at “1” (Normal Mode). non-lighted at “1”, lighted at “0” (Reverse Mode) and, by a combination of M signal and display data, one signal level among V0,V2,V3 and VSS signal levels are selected. (When Monochrome Display) 																								
COM0- COM127	O	Common output pins for LCD drivers. By a combination of the scanning data and M signal, one signal level among V0, V1, V4 and VSS signal level is selected. <table><tr><th>Data</th><th>M</th><th>Output level</th></tr><tr><td>H</td><td>H</td><td>VSS</td></tr><tr><td>L</td><td>H</td><td>V1</td></tr><tr><td>H</td><td>L</td><td>V0</td></tr><tr><td>L</td><td>L</td><td>V4</td></tr></table>	Data	M	Output level	H	H	VSS	L	H	V1	H	L	V0	L	L	V4									
Data	M	Output level																								
H	H	VSS																								
L	H	V1																								
H	L	V0																								
L	L	V4																								
COMA	O	Common output pin for LCD drive exclusively for icons.																								
COMB	O	Common output pin for LCD drive exclusively for icons.																								

6.5 Oscillating Circuit Pin

<i>Symbol</i>	<i>I/O</i>	<i>Description</i>
CKS	I	Display timing clock source select input pin. CKS = "H": Use external clock from CK pin. CKS = "L": Use internal oscillated clock. In the slave mode, fix this pin at "L". In the case of TCP, draw it as a separate terminal.
CK	I	External clock input pin for display timing (CKS=1). When using internal oscillated clock (CKS=0), CK must be connected to VSS.
CLK	I/O	I/O pin for display timing clock. To use this pin in the master/slave system. M/S = "H": Output display timing clock. M/S = "L": Input display timing clock from the master.

7. Functional Description

7.1 MPU Interface

7.1.1 Selection of Interface Type

The EM65568 transfers data through 8-bit parallel I/O (D7-D0), 16-bit parallel I/O (D15-D0) or serial data input (SDA, SCL).

The parallel interface or serial interface can select by state of P/S pin. When select serial interface, data reading cannot be performed, only data writing can operate.

P/S	I/F Type	CSB	RS	RDB	WRB	M86	SDA	SCL	Data
H	Parallel	CSB	RS	RDB	WRB	M86	-	-	D7~D0 (D15~D0)
L	Serial	CSB	RS	-	-	-	SDA	SCL	-

7.1.2 Parallel Input

When parallel interface is selected with the P/S pin, the EM65568 allows data to be transferred in parallel to an 8-bit/16-bit MPU through the data bus. For the 8-bit/16-bit MPU, either the 80-family MPU interface or the 68-family MPU interface can be selected with the m86 pin.

M86	MPU Type	CSB	RS	RDB	WRB	Data
H	68-family MPU	CSB	RS	E	R/WB	D7~D0 (D15~D0)
L	80-family MPU	CSB	RS	RDB	WRB	D0~D7 (D15~D0)

7.1.3 Read/Write functions of Register and display RAM

The EM65568 have four read/write functions at parallel interface mode. Each read/write function select by combinations of RS, RDB and WRB signals.

RS	68-family R/WB	80-family		Function
		RDB	WRB	
1	1	0	1	Read internal Register
1	0	1	0	Write internal Register
0	1	0	1	Read display data
0	0	1	0	Write display data

7.1.4 Serial Interface

EM65568 has two types serial interface. One is a 3-wires type serial interface; other one is a 4-wires type serial interface. The 3-wire or 4-wire is determined by SMODE pin.

SMODE = "L": 4-wires serial interface

SMODE = "H": 3-wires serial interface

7.1.5 4 Wires Serial Interface

When chip select is active (CSB = "L"), 4-wires type serial interface can work through the SDA and SCL input pins. When chip select is inactive (CSB = "H"), the internal shift register and counter are reset in the initial condition. Serial data SDA are input sequentially in order of D7 to D0 at the rising of serial clock (SCL) and are converted into 8-bit parallel data (by serial to parallel conversion) at the rising edge of the 8th serial clock, being processed in accordance with the data. The identification whether are serial data inputs (SDA) are display data or control register data is judged by input to RS pin.

RS = "L": display RAM data

RS = "H": control register data

After completing 8-bit data transferring, or when making no access, be sure to set serial clock input (SCL) to "L". Cares of SDA and SCL signals against external noise should be taken in board writing. To prevent transfer error due to external noise, release chip select (CSB = "H") every completion of 8-bit data transferring.

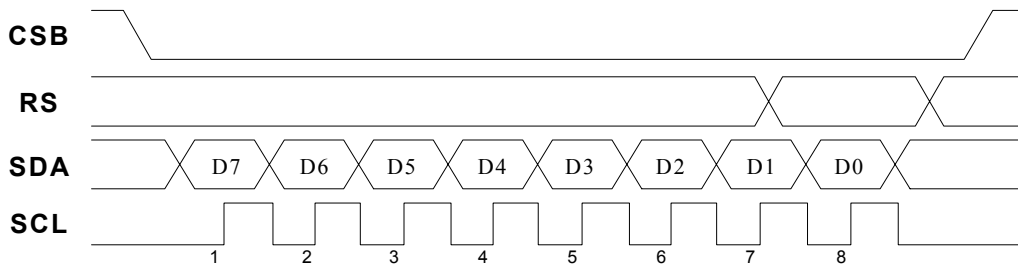


Figure 4. 4-Wires type Serial Interface

7.1.6 3 Wires Type Serial Interface

When chip select is active (CSB = "L"), 3-wires type serial interface can work through the SDA and SCL input pins. When chip select is inactive (CSB = "H"), the internal shift register and counter are reset in the initial condition. Serial data SDA are input sequentially in order of RS, D7 to D0 at the rising edge of serial clock (SCL) and are converted into 9-bit parallel data (by serial to parallel conversion) at the rising edge of the 9th serial clock. The identification whether the serial data inputs (SDA) are display data or control register data is determined by first serial input data (RS) and SPOL pin as followed.

SPOL = "0"		SPOL = "1"	
RS	Display RAM/Register	RS	Display RAM/Register
0	Display RAM Data	0	Control Register Data
1	Control Register Data	1	Display RAM Data

After completing 9-bits data transferring, or when making no access, be sure to set serial clock input (SCL) to "L". Cares of SDA and SCL signals against external noise should be taken in board wiring. To prevent transfer error due to external noise, release chip select (CSB = "H") every completion of 9-bit data transferring.

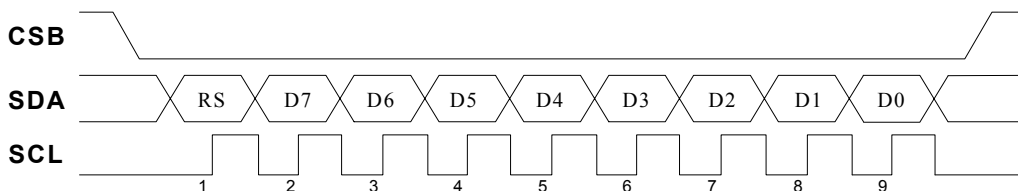


Figure 5. 3-Wires Type Serial Interface

7.1.7 Chip Select Connection in Serial Interface Mode

When serial interface use in 2 chips EM65568 system; one is a Master another is a slave, both EM65568 can control by only one chip select signal.

7.2 Data write to Display RAM and Control Register

The data write to display RAM and Control Register use almost same procedure, only different setting of RS that select access object.

RS = "L": Display RAM data

RS = "H": Control register data

In the case of the 80-family MPU, the data is written at the rising edge of WRB. In the case of the 68-family MPU, the data is written at the falling edge of signal E.

Data write operation

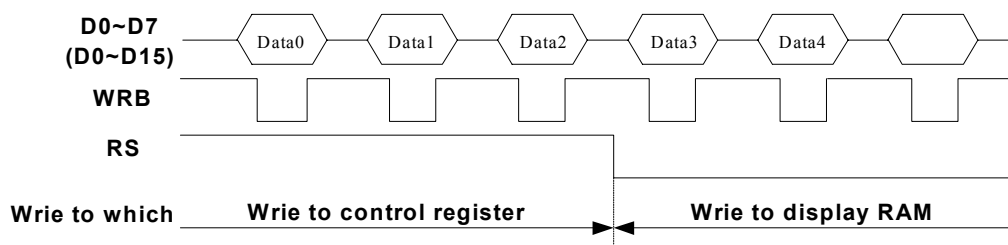


Figure 6. Data write operation

7.3 Internal Register Read

In the case of display RAM read operation, need dummy read one time. The designated address data are not output to read operation immediately after the address set to AX or AY register, but are output when the second data read. Dummy read is always required one time after address set and write cycle.

Read display RAM operation

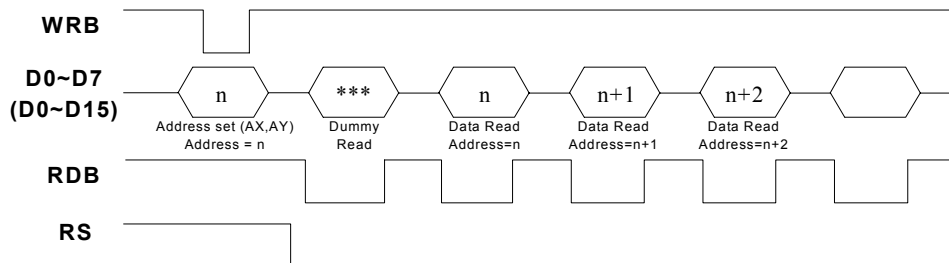


Figure 7. Read display RAM operation

The EM65568 can be read the control registers, in case of control register read operation, data bus upper nibble (D7~D4) use for register address (0 to FH). In maximum, 16 registers can access directly. But number of register is more than 16 registers. Therefore, EM65568 has register bank control. The RE register is set bank number to access. And the RE address is 0FH, in any bank can access RE register. It is need 4-steps to read the specific register in maximum case.

- (1) Write 04H to RE register for access to RA register.
- (2) Writes specific register address to RA register.
- (3) Write specific register bank to RE register.
- (4) Read specific register contents.

Register read operation

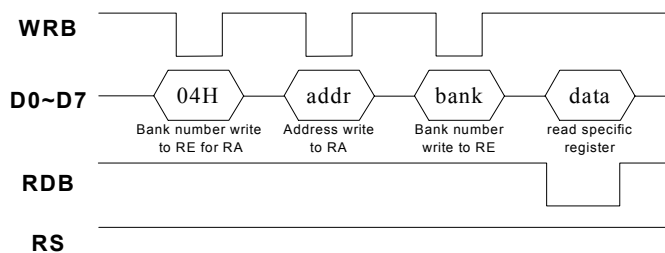


Figure 8. Register read operation

7.4 16-bit Data Access to Display RAM

The EM65568 correspond to 8-bits and 16-bits bus size access.

The data bus size can select by WLS register.

WLS = "0": 8-bits bus size

WLS = "1": 16-bits bus size

In the 16-bits access mode, access for control register use low-byte data bus (D7~D0). Then high byte data bus (D15~D8) are not used in internal circuit. When read control register using 16-bits bus. Register values output to D3~D0 and D15~D4 output "H".

7.5 Display Start Address Register

This register determines the Y-address of the display RAM corresponding to the display start line. The display RAM data that addressed Display Start Address register output to common driver start line. The actual common start line of LCD panel depend on Display Start Common register and SHIFT bit of Display Control register. The register are preset every timing of FLM signal variation in the display line counter. The line counter counts up being synchronized with LP input and generates line addresses which read out sequentially 384 bits data from display RAM to LCD drive circuit.

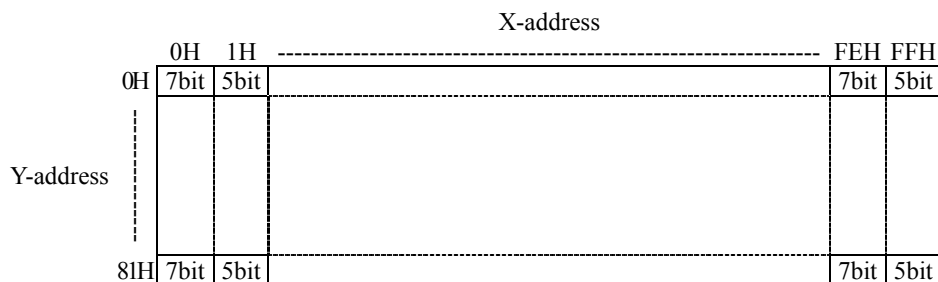
7.6 Addressing of Display RAM

The EM65568 has built-in bit mapped display RAM. The display RAM consists of 1536 bits (12 bits*128) in the X-direction and 130 bits in the Y-direction. In the gradation display mode, the EM65568 provides segment driver output for 16-gradation display using 4 bits. The three outputs of the segment driver can be used for one pixel of RGB. When connected to an STN color LCD panel, the EM65568 can display 128*130 pixels with 4096 colors (16 gradation * 16 gradation * 16 gradation). The address area in the X-direction depends on the access bus size. In the X-direction, X Address register use to access; and in the Y-direction, Y Address register use to access. Do not specify any address outside the effective address area in each access mode because it is not permitted.

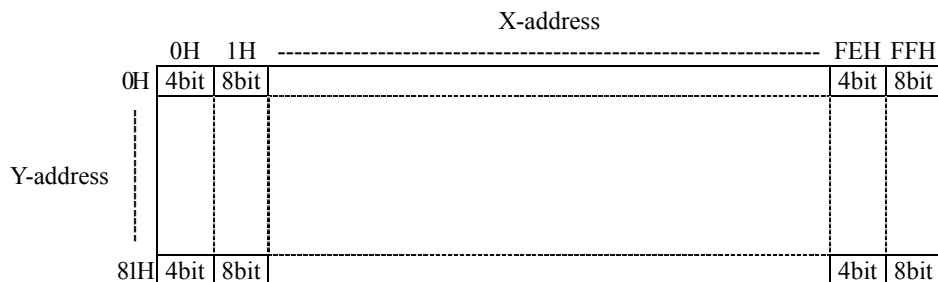
In Gradation Display Mode (MON="0")

8-bits bus size access

ABS=0



ABS=1



		X-address					
		0H	1H	-----		BEH	BFH
Y-address	0H	8bit	8bit			8bit	8bit
	81H	8bit	8bit			8bit	8bit

		X-address			
		0H	1H	7EH 7FH	
Y-address	0H	8bit	8bit		8bit 8bit
	8IH	8bit	8bit		8bit 8bit

Diagram illustrating a 2D array structure with X and Y addresses.

The X-axis (horizontal) is labeled "X-address" and ranges from 0H to 7FH. The Y-axis (vertical) is labeled "Y-address" and ranges from 0H to 81H.

The array is organized into rows and columns. The first row is labeled 0H on the left, and the first column is labeled 0H on the left. The last row is labeled 81H on the left, and the last column is labeled 7FH on the right.

Each cell in the array is labeled 12bit, indicating the data width of each element.

The diagram illustrates a 2D array structure. The horizontal axis is labeled "X-address" and has two marked points: "0H" and "3FH". The vertical axis is labeled "Y-address" and has two marked points: "0H" and "81H". The array is represented as a large rectangle divided into four quadrants by dashed lines. Each quadrant is labeled "16bit", indicating the size of the data stored in each quadrant.

The addresses, X Address and Y Address are possible to be set up so that they can increment automatically with the address control register. The increment is made every time display RAM is read or written from MPU. In the Y-direction, 384 bits of data are read out to the display data latch circuit by internal operation when the LP rises in a one-line cycle. They are output

from the display data latch circuit when the LP fails. When FLM signals being output in one frame cycle are at “H”, the values in the display starting line register are preset in the line counter and the line counter counts up at the falling of LP signals. The display line address counter is synchronized with each timing signal of the LCD system to operate and is independent of address counters X and Y.

7.7 Display RAM access using Windows Function

The EM65568 has window area setting command for specified display RAM area access. For use window function, need to set up two position's X and Y address. Also need set up auto increment mode (AXI="1", AYI="1"). Two position means window start position and window end position. The window start position's X and Y address set to normal X address(AX) and Y address(AY) registers. The window end position's X and Y address set to Window X End Address (EX) and Window Y Enc Address (EY) register. In window function access, can use modify write access with set to AIM="1". In case of using window function access, should be set following registers before access to RAM.

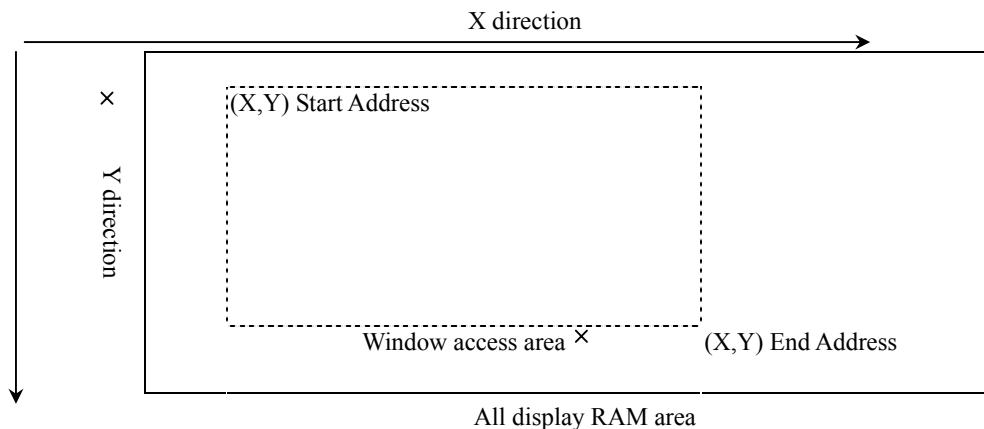
WIN = "1", AXI="1", AYI="1"

X Address, Y Address, Window X End Address, Window Y End Address

Moreover, should be keep following address condition.

Window end X address(EX) $\geq$ Window start X address (AX)

Window end Y address(EY) $\geq$ Window start X address (AY)



7.8 Display RAM Data and LCD (only monochrome mode)

One bit of display RAM data corresponds to one dot of LCD. Normal display and reverse display by REV register are set up as follows.

Normal display (REV=0): RAM data = "0" not lighted

RAM data = "1" lighted

Reverse display (REV=1): RAM data = "0" lighted

RAM data = "1" not lighted

7.9 Segment Display Output Order/Reverse Set up

The order of display output, SEGA0, SEGB0, SEGC0 to SEGA127, SEGB127, and SEGC127 can be reversed. If REF control bit set to “1”, display by reversing access to display RAM from MPU by using REF register, lessen the limitation in placing IC when assembling an LCD panel module.

7.10 Relationship between Display RAM and Address

The Display RAM block diagram shows in the figure below:

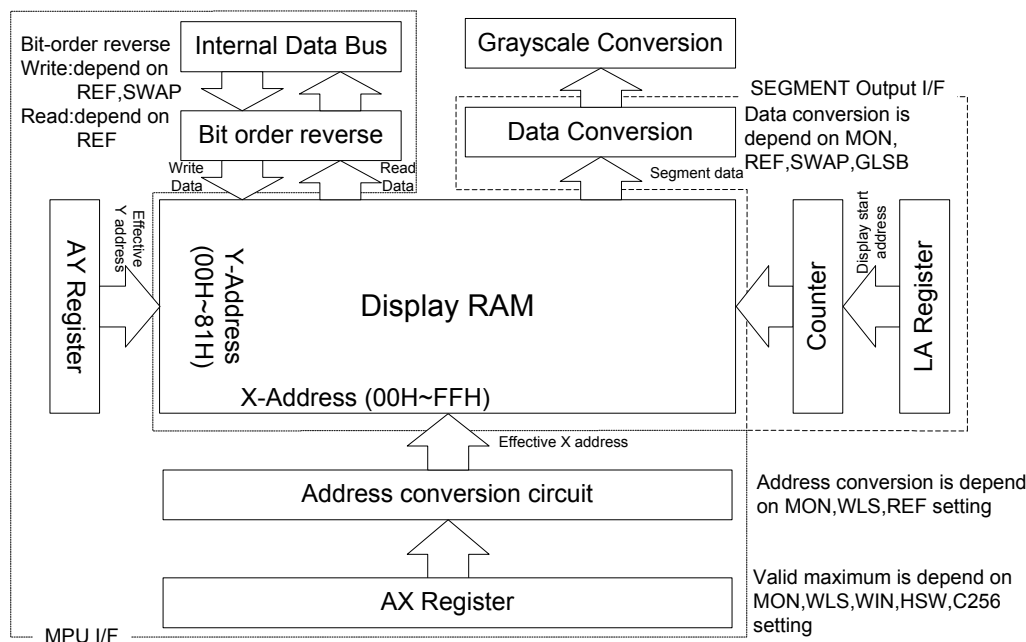


Figure 10. The Display RAM block diagram

The EM65568 execute address conversion that depends on control register setting. In case of auto increment mode, usually AX register is added one. For instance when REF and AXI are both “1”, AX register is added one, but effective X address seems decrement because of address conversion. The effective Y address use AY register values as it is.

- (1) Monochrome mode, 8-bits Access mode

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																											
0	0	0	0	X=00H							X=01H						X=FEH							X=FFH							
0	0	1	1	X=FEH							X=FFH						X=00H							X=01H							
				D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7		D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7			
							SEGA0					SEGB0					SEGC0									SEGB127					SEGC127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																											
0	0	0	1	X=00H							X=01H						X=FEH							X=FFH							
0	0	1	0	X=FEH							X=FFH						X=00H							X=01H							
				D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7		D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7			
							SEGC0					SEGB0					SEGA0					SEGC127				SEGB127					SEGA127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																																											
0	1	0	0	X=00H				X=01H									X=FEH				X=FFH																										
0	1	1	1	X=FEH				X=FFH									X=00H				X=01H																										
				D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7																			
				SEGA0								SEGB0								SEGC0								SEGA127								SEGB127								SEGC127			

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																																											
0	1	0	1	X=00H				X=01H					X=FEH				X=FFH																														
0	1	1	0	X=FEH				X=FFH					X=00H				X=01H																														
				D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7																			
				SEGC0								SEGB0								SEGA0								SEGC127								SEGB127								SEGA127			

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																																
1	*	0	0	X=00H							X=01H							X=BEH							X=BFH											
				D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7
							SEGA0				SEGB0				SEGC0				SEGA1					SEGC126				SEGA127				SEGB127				SEGC127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																																
1	*	0	1	X=00H							X=01H								X=BEH							X=BFH										
				D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7
							SEGC0				SEGB0				SEGA0				SEGC1					SEGA126				SEGC127				SEGB127				SEGA127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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				X=BEH								X=BFH								X=BDH								X=BEH								X=01H				X=02H								X=00H								X=01H																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
				D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign																																																			
1	*	1	1	X=BEH								X=BFH								X=BDH								X=BEH				X=01H				X=02H								X=00H								X=01H			
D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3								
			SEGA0				SEGB0				SEGC0				SEGA1				SEGB1				SEGC1				SEGA126				SEGB126				SEGC126				SEGA127				SEGB127				SEGC127								

(2) Monochrome mode, 16-bits Access mode, Display Start Address = "00H"

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign															
*	0	0	0	X=00H								X=7FH							
*	0	1	1	X=7FH								X=00H							
				D1	D2	D3	D4	D7	D8	D9	D10	D12	D13	D14	D15	D1	D2	D3	D4
							SEGA0				SEGB0				SEGC0			SEGA127	
																		SEGB127	
																			SEGC127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign															
*	0	0	1	X=00H								X=7FH							
*	0	1	0	X=7FH								X=00H							
				D1	D2	D3	D4	D7	D8	D9	D10	D12	D13	D14	D15	D1	D2	D3	D4
							SEGC0				SEGB0				SEGA0			SEGC127	
																		SEGB127	
																			SEGA127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign															
*	1	0	0	X=00H								X=7FH							
*	1	1	1	X=7FH								X=00H							
				D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D0	D1	D2	D3
							SEGA0				SEGB0				SEGC0			SEGA127	
																		SEGB127	
																			SEGC127

HSW	ABS	REF	SWAP	X address / Data bus / Segment assign															
*	1	0	1	X=00H								X=7FH							
*	1	1	0	X=7FH								X=00H							
				D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D0	D1	D2	D3
							SEGC0				SEGB0				SEGA0			SEGC127	
																		SEGB127	
																			SEGA127

(3) Gradation mode(4096 color), 8 bits access mode

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																								
0	0	0	0	X=00H							X=01H						X=FEH							X=FFH				
0	0	1	1	X=FEH							X=FFH						X=00H							X=01H				
				D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7		D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C			
				SEG A0				SEG B0				SEG C0					SEG A127				SEG B127				SEG C127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																											
0	0	0	1	X=00H							X=01H						X=FEH							X=FFH							
0	0	1	0	X=FEH							X=FFH						X=00H							X=01H							
				D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7		D0	D1	D2	D4	D5	D6	D7	D1	D2	D3	D4	D7			
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C						
				SEG C0				SEG B0				SEG A0					SEG C127				SEG B127				SEG A127 ₇						

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																								
0	1	0	0	X=00H				X=01H									X=FEH				X=FFH							
0	1	1	1	X=FEH				X=FFH									X=00H				X=01H							
				D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C			
				SEG A0				SEG B0				SEG C0					SEG A127				SEG B127				SEG C127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																											
0	1	0	1	X=00H				X=01H									X=FEH				X=FFH										
0	1	1	0	X=FEH				X=FFH									X=00H				X=01H										
				D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D0	D1	D2	D3	D4	D5	D6	D7			
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C						
				SEG C0				SEG B0				SEG A0					SEG C127				SEG B127				SEG A127						

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																																
1	*	0	0	X=00H								X=01H									X=BEH								X=BFH							
				D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7
				Palette A				Palette B				Palette C				Palette A					Palette C				Palette A				Palette B				Palette C			
				SEG A0				SEG B0				SEG C0				SEG A1					SEG C126				SEG A127				SEG B127				SEG C127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																																
1	*	0	1	X=00H							X=01H								X=BEH							X=BFH										
				D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7		D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7
				Palette A				Palette B				Palette C				Palette A					Palette C				Palette A				Palette B				Palette C			
				SEG C0				SEG B0				SEG A0				SEG C1					SEG A126				SEG C127				SEG B127				SEG A127			

HSW	ABS	REF	SWAP																																												
1	*	1	0	X address / Data bus / Palette / Segment assign																																											
X=BEH				X=BFH				X=BDH				X=BEH				X=01H				X=02H				X=00H				X=01H																			
D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3								
Palette A				Palette B				Palette C				Palette A				Palette B				Palette C				Palette A				Palette B				Palette C				Palette A				Palette B				Palette C			
SEG C0				SEG B0				SEG A0				SEG C1				SEG B1				SEG A1				SEG C126				SEG B126				SEG A126				SEG C127				SEG B127				SEG A127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																																																							
1	*	1	1																																																								
				X=BEH								X=BFH								X=BDH								X=BEH								X=01H				X=02H								X=00H								X=01H			
				D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3	D4	D5	D6	D7	D0	D1	D2	D3																
				Palette A				Palette B				Palette C				Palette A				Palette B				Palette C								Palette A				Palette B				Palette C				Palette A				Palette B				Palette C							
SEG A0				SEG B0				SEG C0				SEG A1				SEG B1				SEG C1								SEG A126				SEG B126				SEG C126				SEG A127				SEG B127				SEG C127											

(3) Gradation mode (4096 color), 16 bits access mode

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																								
*	0	0	0	X=00H											X=7FH													
*	0	1	1	X=7FH											X=00H													
				D1	D2	D3	D4	D7	D8	D9	D10	D12	D13	D14	D15		D1	D2	D3	D4	D7	D8	D9	D10	D12	D13	D14	D15
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C			
				SEG A0				SEG B0				SEG C0					SEG A127				SEG B127				SEG C127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																								
*	0	0	1	X=00H											X=7FH													
*	0	1	0	X=7FH											X=00H													
				D1	D2	D3	D4	D7	D8	D9	D10	D12	D13	D14	D15		D15	D14	D13	D12	D10	D9	D8	D7	D4	D3	D2	D1
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C			
				SEG C0				SEG B0				SEG A0					SEG C127				SEG B127				SEG A127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																								
*	1	0	0	X=00H												X=7FH												
*	1	1	1	X=7FH												X=00H												
				D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11		D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C			
				SEG A0				SEG B0				SEG C0					SEG A127				SEG B127				SEG C127			

HSW	ABS	REF	SWAP	X address / Data bus / Palette / Segment assign																								
*	1	0	1	X=00H												X=7FH												
*	1	1	0	X=7FH												X=00H												
				D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11		D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
				Palette A				Palette B				Palette C					Palette A				Palette B				Palette C			
				SEG C0				SEG B0				SEG A0					SEG C127				SEG B127				SEG A127			

(5) Gradation mode (256 Color) , (C256=1)

8-bit mode (WLS=0)

HSW	ABS	REF	SWAP	X address / Data bus / Palette / palette bit / Segment assign																							
*	*	0	0	X=00H																X=7FH							
*	*	1	1	X=7FH																X=00H							
				D0	D1	D2	D3	D4	D5	D6	D7									D0	D1	D2	D3	D4	D5	D6	D7
				Palette A		Palette B			Palette C											Palette A		Palette B			Palette C		
				A2	A3	B1	B2	B3	C1	C2	C3									A2	A3	B1	B2	B3	C1	C2	C3
				SEG A0		SEG B0			SEG C0											SEG A127		SEG B127			SEG C127		

HSW	ABS	REF	SWAP	X address / Data bus / Palette / palette bit / Segment assign																			
*	*	0	1	X=00H												X=7FH							
*	*	1	0	X=7FH												X=00H							
				D0	D1	D2	D3	D4	D5	D6	D7					D0	D1	D2	D3	D4	D5	D6	D7
				Palette A		Palette B			Palette C							Palette A		Palette B			Palette C		
				A2	A3	B1	B2	B3	C1	C2	C3					A2	A3	B1	B2	B3	C1	C2	C3
				SEG C0		SEG B0			SEG A0							SEG C127		SEG B127			SEG A127		



16-bit mode(WLS=1)

HSW	ABS	REF	SWAP	X address / Data bus / Palette / palette bit / Segment assign															
*	*	0	0	X=00H								X=3FH							
*	*	1	1	X=3FH								X=00H							
				D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
				Palette A				Palette B				Palette C				Palette A			
				A2	A3	B1	B2	B3	C1	C2	C3	A2	A3	B1	B2	B3	C1	C2	C3
				SEG A0		SEG B0			SEG C0			SEG A1		SEG B1			SEG C1		

HSW	ABS	REF	SWAP	X address / Data bus / Palette / palette bit / Segment assign															
*	*	0	1	X=00H								X=3FH							
*	*	1	0	X=3FH								X=00H							
				D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
				Palette A				Palette B				Palette C				Palette A			
				A2	A3	B1	B2	B3	C1	C2	C3	A2	A3	B1	B2	B3	C1	C2	C3
				SEG A1		SEG B1			SEG C1			SEG A0		SEG B0			SEG C0		

(6)Data read and write bit assignment

In 16-bit data bus mode

ABS=0	C256=0	Write	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
		Read	D15	D14	D13	D12	1	D10	D9	D8	D7	1	1	D4	D3	D2	D1	1

ABS=1	C256=0	Write	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
		Read	1	1	1	1	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

ABS=*	C256=1	Write	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
		Read	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

In 8-bit data bus mode

ABS=0	HSW=0	C256=0	Address	00,02,04.....FC,FEH								01,03,05.....FD,FFH							
			Write	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
			Read	D7	D6	D5	D4	1	D2	D1	D0	D7	1	1	D4	D3	D2	D1	1

ABS=1	HSW=0	C256=0	Address	00,02,04.....FC,FEH								01,03,05.....FD,FFH							
			Write	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
			Read	1	1	1	1	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0

ABS=0	HSW=1	C256=0	Address	00,01,02.....BD,BE,BFH							
			Write	D7	D6	D5	D4	D3	D2	D1	D0
			Read	D7	D6	D5	D4	D3	D2	D1	D0

ABS=0	HSW=0	C256=1	Address	00,01,02.....7D,7E,7FH							
			Write	D7	D6	D5	D4	D3	D2	D1	D0
			Read	D7	D6	D5	D4	D3	D2	D1	D0

7.11 Display Data Structure and Gradation Control

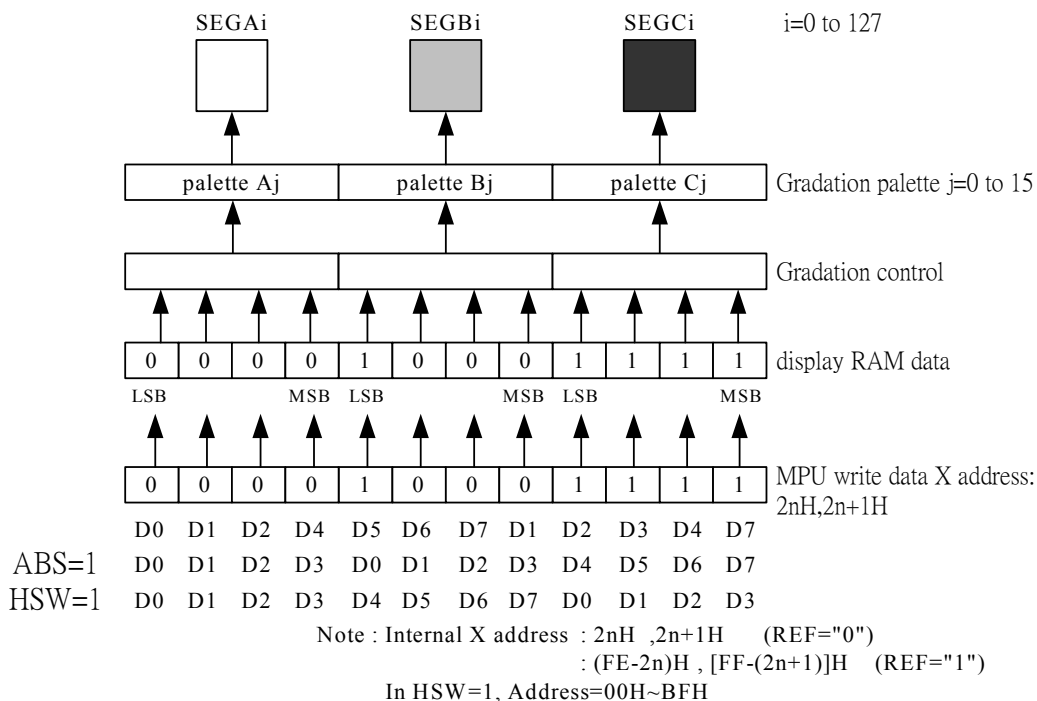
For the purpose of gradation control, one pixel requires multiple bits of display RAM. The EM65568 has 4-bit data per output to achieve the gradation display.

The three outputs of the segment driver are used for one pixel of RGB, and the EM65568 is connected to an STN color LCD panel. It can display 128*130 pixels with 4096 colors (4 bits * 4 bits * 4 bits). In this case, since the gradation display data is processed by a single access to the memory, the data can be rewritten fast and naturally.

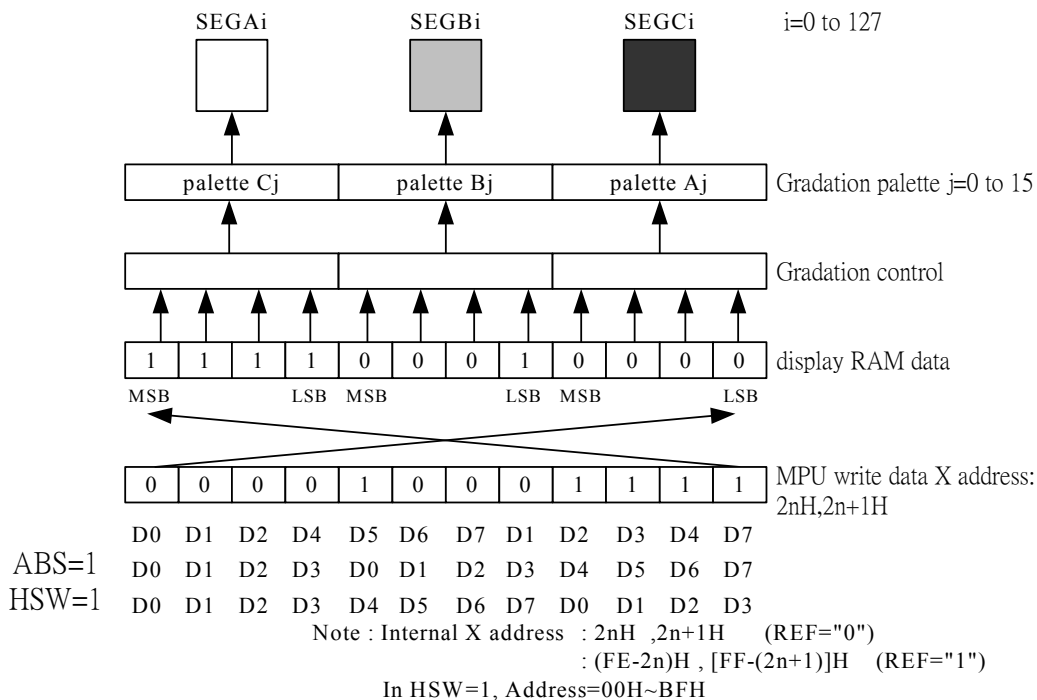
The weighting for each data bit is dependent on the status of the SWAP bit and the REF bit that is selected when data is written to the display RAM.

8-bit mode

- (REF, SWAP)=(0,0) or (1,1)



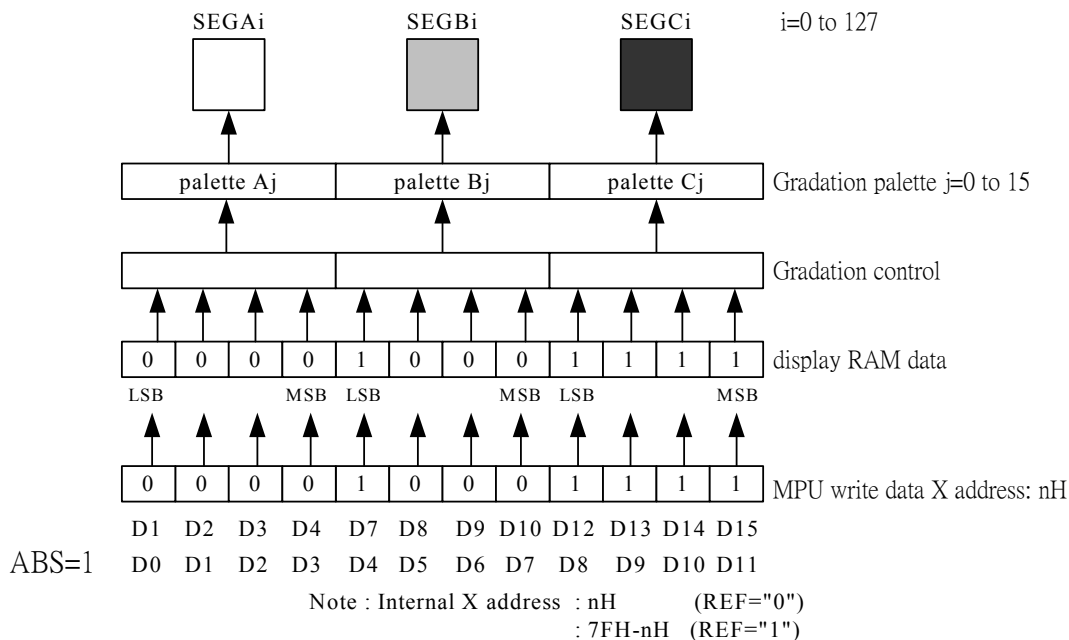
- (REF, SWAP)=(0,1) or (1,0)



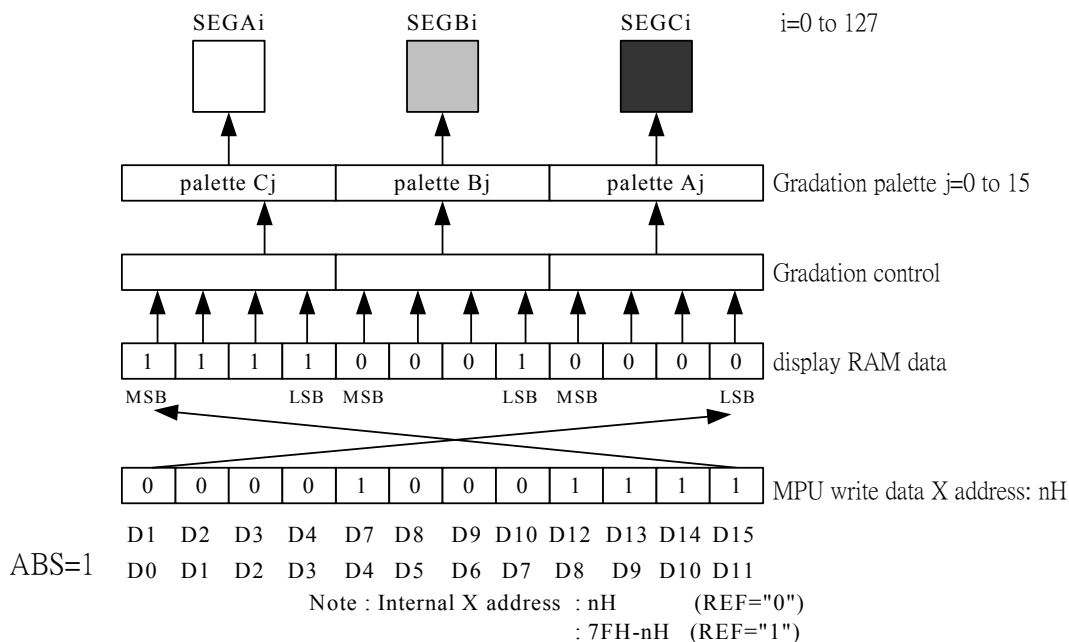
16-bit mode

In 16-bits access, the weighting for each data bit is dependent on the status of the SWAP bit and the REF bit that is selected when data is written to the display RAM, as in the case with 8-bits access.

- (REF, SWAP)=(0,0) or (1,1)



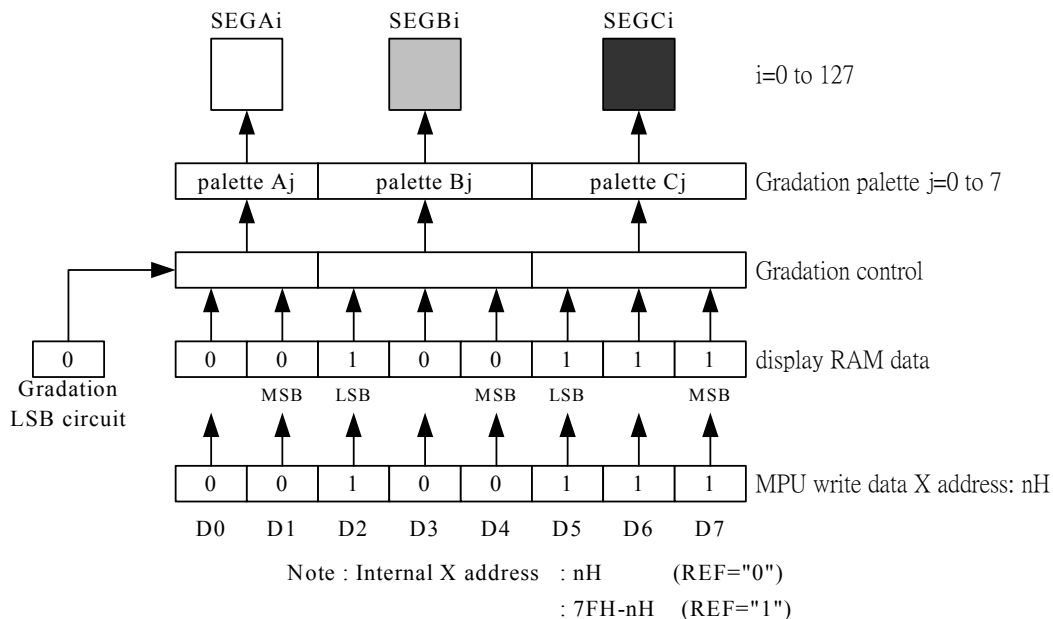
- (REF, SWAP)=(0,1) or (1,0)



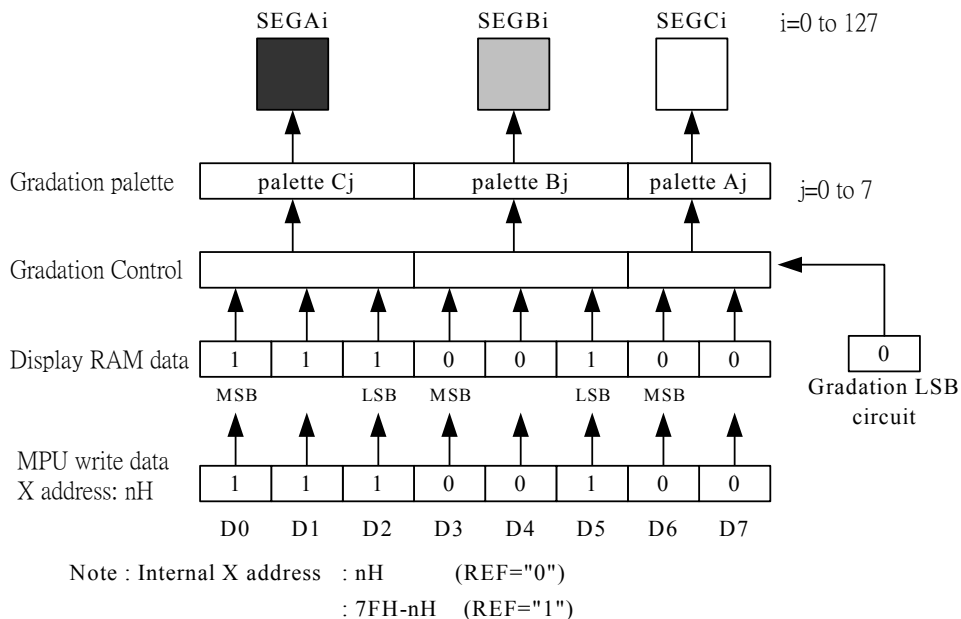
(2) Gradation mode (256 color), C256=1

8-bit mode(WLS=0)

(REF, SWAP)=(0,0) or (1,1)

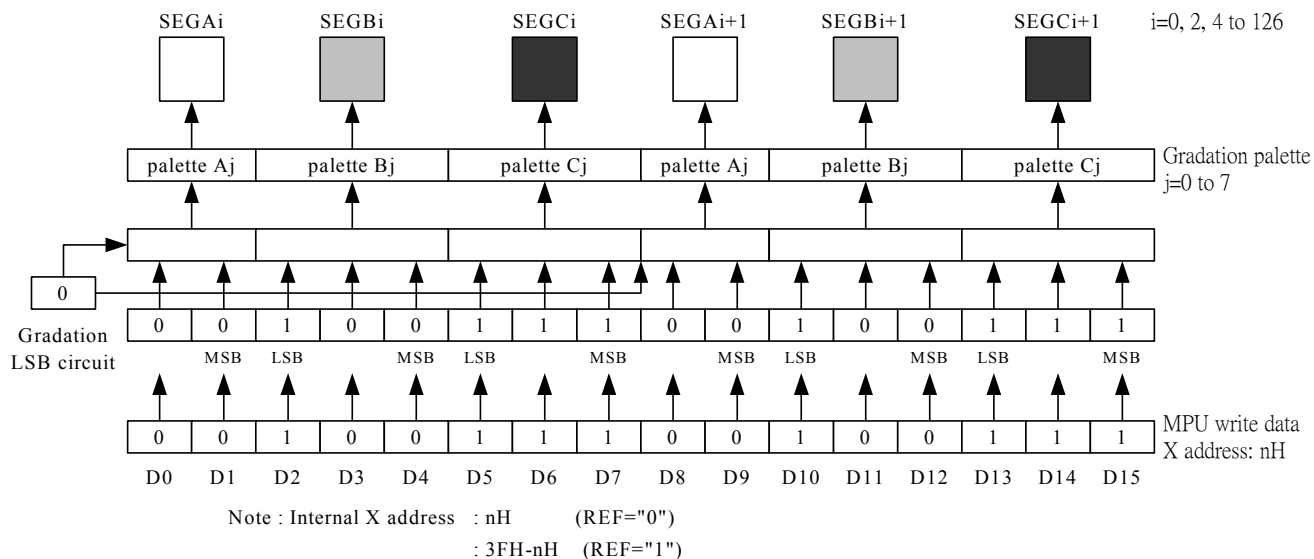


(REF, SWAP)=(0,1) or (1,0)

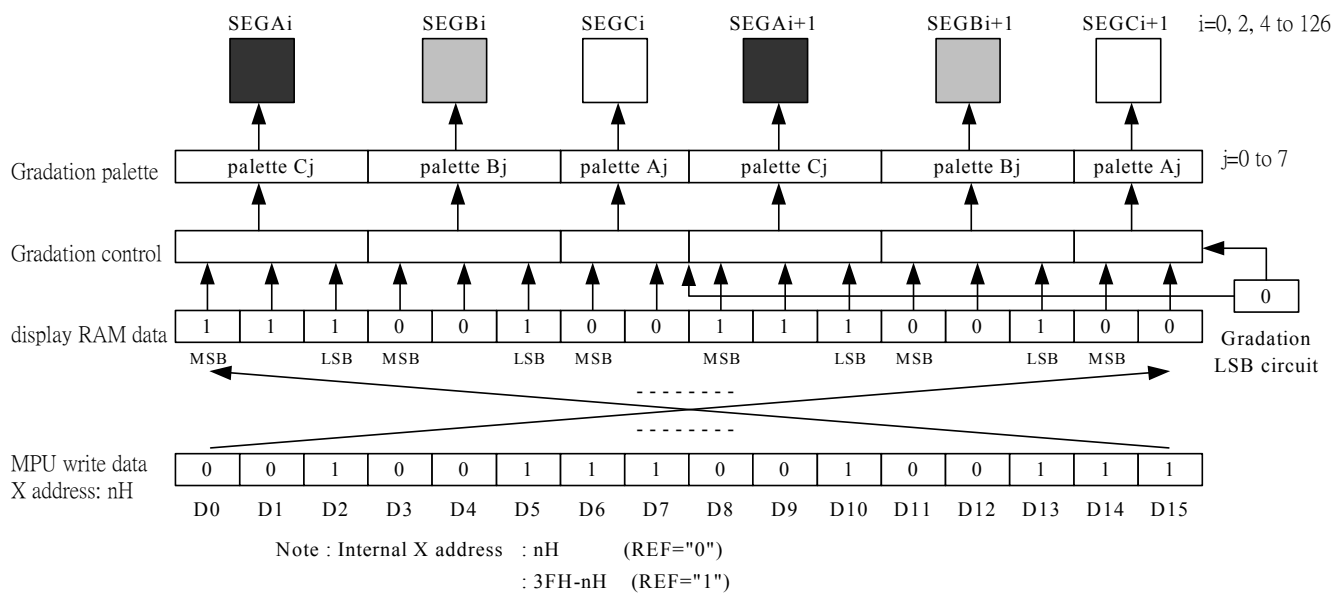


16-bit mode(WLS=1)

(REF, SWAP)=(0,0) or (1,1)



(REF, SWAP)=(0,1) or (1,0)



7.12 Gradation LSB Control

In 256 color mode (C256=1), the EM65568 provides segment driver output for 8-gradation display using 3-bits and that for 4-gradation display using 2-bits.

The segment driver output for the 4-gradation display uses 2-bits written to the corresponding RAM area and 1-bit supplemented by the gradation LSB circuit, and then selects 4-gradation from 8-gradation.

In 256 color mode (C256=1), the segment driver output for the 4-gradation display result in a gradation level of 0 regardless of the gradation LSB, when 2-bits of data on the display RAM are “00”. When 2-bits of data on the display RAM is “11”, a gradation level of 7/7 is selected regardless of the bit information of the gradation LSB. The other gradation levels are selected depending on 2-bits of data on the display RAM and the gradation LSB bits.

One bit of data is supplemented by setting the gradation LSB register (GLSB).

The Gradation LSB control bit applied to all 4-gradation segment drivers.

Gradation LSB = “0”: Selects 0 as the LSB information on the RAM for 4-gradation segment drivers.

Gradation LSB = “1”: Selects 1 as the LSB information on the RAM for 4-gradation segment drivers.

7.13 Gradation Palette

The EM65568 has two gradation display modes, the gradation fixed display mode and the gradation variable display mode. Select either of the two modes using the gradation display mode register.

Caution: Different gradation levels can't be set the same palette.

PWM = “0”: Selects the variable display mode using 16 gradation selected from 32 gradation. (C256=0)

 Selects the variable display mode using 8 gradation selected from 32 gradation. (C256=1)

PWM = “1”: Selects the fixed display mode using specific 16 gradation. (C256=0)

 Selects the fixed display mode using specific 8 gradation. (C256=1)

To select the best gradation level suited to the LCD panel, use the gradation palette register among the 32-level gradation palettes in the gradation variable display mode. The segment driver output is set up by the selected 16-levels of gradation palettes.

The gradation palette register provides three registers for the SEGAI (0-127) group, SEGBi (0-127) group, and SEGCi (0-127) group of segment driver outputs [palettes Aj, Bj, and Cj (j = 0-15)]. Each register consists of a 5-bit register, selecting 16-gradations from the pattern for 32-gradations.

Initial values on gradation palette register

Gradation mode (C256=0)

[Three groups of palettes Aj, Bj, and Cj (j = 0-15) are available]

<i>(MSB)RAM data(LSB)</i>				<i>Register Name</i>	<i>Initial value</i>
0	0	0	0	Palette0	00000
0	0	0	1	Palette1	00011
0	0	1	0	Palette2	00101
0	0	1	1	Palette3	00111
0	1	0	0	Palette4	01001
0	1	0	1	Palette5	01011
0	1	1	0	Palette6	01101
0	1	1	1	Palette7	01111
1	0	0	0	Palette8	10001
1	0	0	1	Palette9	10011
1	0	1	0	Palette10	10101
1	0	1	1	Palette11	10111
1	1	0	0	Palette12	11001
1	1	0	1	Palette13	11011
1	1	1	0	Palette14	11101
1	1	1	1	Palette15	11111

256 color mode (C256=1)

[Three groups of palettes Aj, Bj, and Cj (j = 0-7) are available]

<i>(MSB)RAM data(LSB)</i>			<i>Register Name</i>	<i>Initial value</i>
0	0	0	Palette0	00000
0	0	1	Palette1	00101
0	1	0	Palette2	01010
0	1	1	Palette3	01110
1	0	0	Palette4	10001
1	0	1	Palette5	10101
1	1	0	Palette6	11010
1	1	1	Palette7	11111



Gradation level table (PWM = "0", variable mode, MON= "0")

[Three groups of palettes Aj, Bj, and Cj (j = 0-15) are available

Palette	Gradation level	Remarks	Palette	Gradation level	Remarks
0 0 0 0 0	0	gradation palette0 initial value	1 0 0 0 0	16/31	
0 0 0 0 1	1/31		1 0 0 0 1	17/31	gradation palette8 initial value
0 0 0 1 0	2/31		1 0 0 1 0	18/31	
0 0 0 1 1	3/31	gradation palette1 initial value	1 0 0 1 1	19/31	gradation palette9 initial value
0 0 1 0 0	4/31		1 0 1 0 0	20/31	
0 0 1 0 1	5/31	gradation palette2 initial value	1 0 1 0 1	21/31	gradation palette10 initial value
0 0 1 1 0	6/31		1 0 1 1 0	22/31	
0 0 1 1 1	7//31	gradation palette3 initial value	1 0 1 1 1	23/31	gradation palette11 initial value
0 1 0 0 0	8/31		1 1 0 0 0	24/31	
0 1 0 0 1	9/31	gradation palette4 initial value	1 1 0 0 1	25/31	gradation palette12 initial value
0 1 0 1 0	10/31		1 1 0 1 0	26/31	
0 1 0 1 1	11/31	gradation palette5 initial value	1 1 0 1 1	27/31	gradation palette13 initial value
0 1 1 0 0	12/31		1 1 1 0 0	28/31	
0 1 1 0 1	13/31	gradation palette6 initial value	1 1 1 0 1	29/31	gradation palette14 initial value
0 1 1 1 0	14/31		1 1 1 1 0	30/31	
0 1 1 1 0	15/31	gradation palette7 initial value	1 1 1 1 1	31/31	gradation palette15 initial value

256 color mode (C256=1)

[Three groups of palettes Aj, Bj, and Cj (j = 0-7) are available

Palette	Gradation level	Remarks	Palette	Gradation level	Remarks
0 0 0 0 0	0	256 color palette0 initial value	1 0 0 0 0	16/31	
0 0 0 0 1	1/31		1 0 0 0 1	17/31	256 color palette4 initial value
0 0 0 1 0	2/31		1 0 0 1 0	18/31	
0 0 0 1 1	3/31		1 0 0 1 1	19/31	
0 0 1 0 0	4/31		1 0 1 0 0	20/31	
0 0 1 0 1	5/31	256 color palette1 initial value	1 0 1 0 1	21/31	256 color palette5 initial value
0 0 1 1 0	6/31		1 0 1 1 0	22/31	
0 0 1 1 1	7//31		1 0 1 1 1	23/31	
0 1 0 0 0	8/31		1 1 0 0 0	24/31	
0 1 0 0 1	9/31		1 1 0 0 1	25/31	
0 1 0 1 0	10/31	256 color palette2 initial value	1 1 0 1 0	26/31	256 color palette6 initial value
0 1 0 1 1	11/31		1 1 0 1 1	27/31	
0 1 1 0 0	12/31		1 1 1 0 0	28/31	
0 1 1 0 1	13/31		1 1 1 0 1	29/31	
0 1 1 1 0	14/31	256 color palette3 initial value	1 1 1 1 0	30/31	
0 1 1 1 0	15/31		1 1 1 1 1	31/31	256 color palette7 initial value



Gradation level table (PWM = "1", fixed mode , MON= "0", C256= "0")

(MSB)RAM data(LSB)				Gradation Level
0	0	0	0	0
0	0	0	1	1/15
0	0	1	0	2/15
0	0	1	1	3/15
0	1	0	0	4/15
0	1	0	1	5/15
0	1	1	0	6/15
0	1	1	1	7/15
1	0	0	0	8/15
1	0	0	1	9/15
1	0	1	0	10/15
1	0	1	1	11/15
1	1	0	0	12/15
1	1	0	1	13/15
1	1	1	0	14/15
1	1	1	1	15/15

Gradation level table (PWM = "1", fixed mode , MON= "0", C256= "1")

(MSB)RAM data(LSB)				Gradation Level
0	0	0	*	0
0	0	1	*	1/7
0	1	0	*	2/7
0	1	1	*	3/7
1	0	0	*	4/7
1	0	1	*	5/7
1	1	0	*	6/7
1	1	1	*	7/7

Monochrome mode , MON= "1"

(MSB)RAM data(LSB)				Gradation Level
0	*	*	*	0
1	*	*	*	1

*: don't care



7.14 Display Timing Circuit

The display timing circuit generates internal signals and timing pulses (LP, FLM, M and CLK) by clock. It can select external input (CK) or internal oscillation.

By setting up Master/Slave mode (M/S), the state of timing pulse pins and the timing generator changes.

M/S Pin	Mode	LP Pin	M Pin	FLM Pin	CLK Pin	State of timing generator
L	Slave	Input	Input	Input	Input	LP,FLM,M generation stop
H	Master	Output	Output	Output	Output	Operation state

Display timing pulse pins and Generator State

7.15 Signal Generation to Display Line Counter, and Display Data Latching Circuit

Both the clock to the line counter and clock to display data latching circuit from the display clock (LP) are generated. Synchronized with the display clock (LP), the line addresses of Display RAM are generated and 384-bits display data are latched to display data latching circuit to output to the LCD drive circuit (Segment outputs). Read-out of the display data to the LCD drive circuit is completely independent of MPU. Therefore, MPU that has no relationship the read-out operation of the display data can access.

7.16 Generation of the Alternated Signal (M) and the Synchronous Signal (FLM)

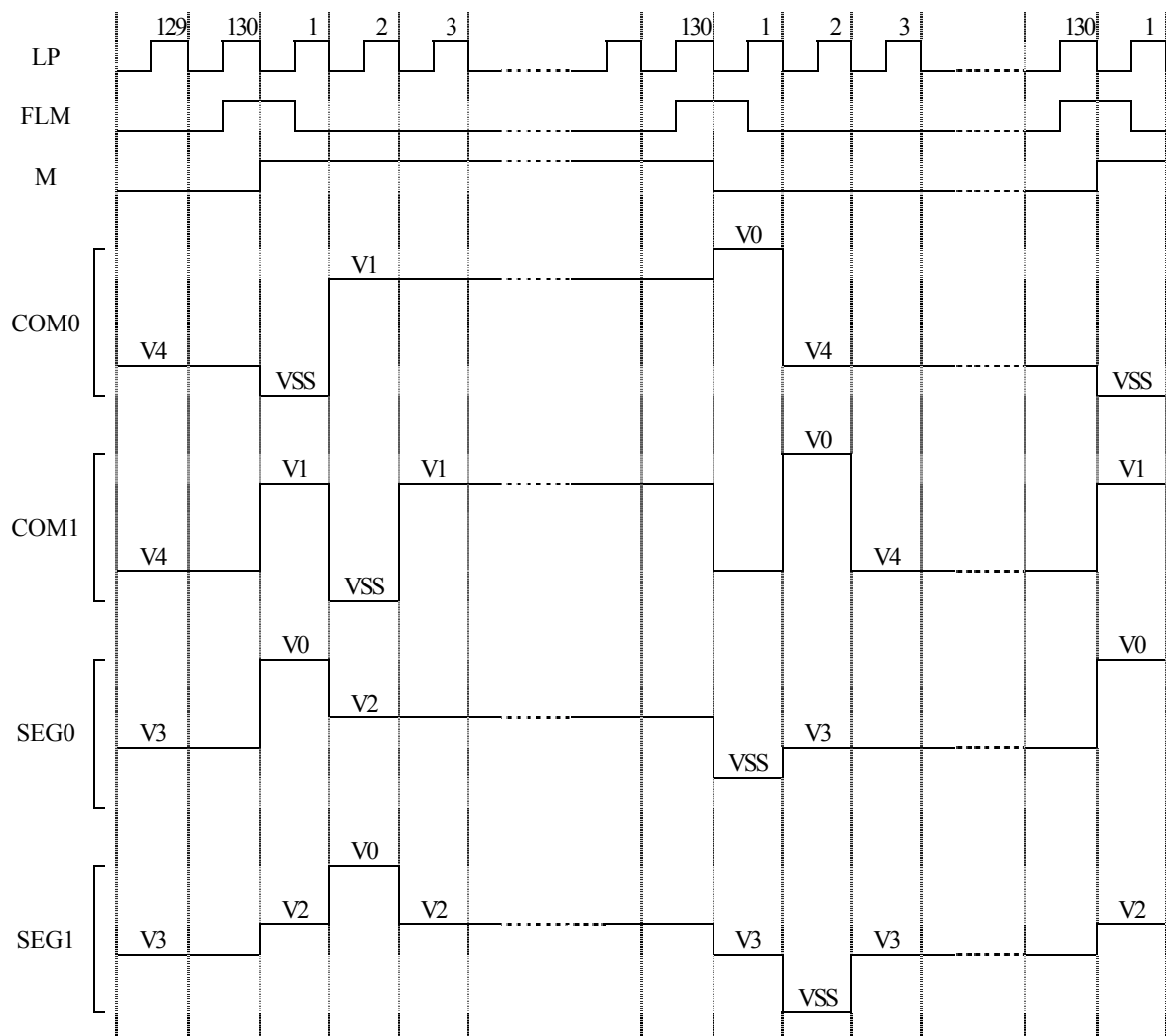
LCD alternated signal (M) and synchronous signal (FLM) are generated by the display clock (LP). The FLM generates alternated drive waveform to the LCD drive circuit. Normally, the FLM generates alternated drive waveform every frame (M-signal level is reversed every one frame). However, by setting up data (n-1) in an n-line reverse register and n-line alternated control bit (NLIN) at "1", n-line reverse waveform is generated. When the EM65568 is used in multi chip system, master chip must provide LP, FLM, and M signals for the slave chip.

7.17 Display Data Latching Circuit

Display data latching Circuit temporally latches display data that is output display data to LCD driver circuit from display RAM every one common period. Normal display/reverse display, display ON/OFF, and display all on functions are operated by controlling data in display data latch. Therefore, no data within display RAM changes.

7.18 Output Timing of LCD Driver

Display timing at Normal mode (not reverse mode), 1/130 DUTY, and on monochrome mode.



7.19 LCD Drive Circuit

This drive circuit generates four levels LCD drive voltage. The circuit has 384 segment outputs and 130 common outputs and outputs combined display data and M signal. Two of common outputs, COMA and COMB, are special outputs. The COMA and COMB outputs be not influenced by partial setting. Mainly use for display. The common drive circuit that has shift register sequentially outputs common scan signals.

7.20 Oscillating Circuit

The EM65568 has the CR oscillator. The output from this oscillator is used as the timing signal source of the display and the boosting clock to the booster.

This can use only in the master operation mode.

When in the master operation mode and external clock is used, feed the clock to CK pin.

The duty cycle of the external clock must be 50%.

The resistance ratio of CR oscillator is programmable. If change this ratio, also change frame frequency for display.

7.21 Power Supply Circuit

This circuit supplies voltages necessary to drive a LCD. The circuit consists of booster and voltage converter.

Boosted voltage from the booster is fed to the voltage converter that converts this input voltage into V0, V1, V2, V3 and V4 that are used to drive the LCD. This internal power supply should not be used to drive a large LCD panel containing many pixels. Otherwise, display quality will degrade considerably. Instead, use an external power supply. When using the external power supply, turn off the internal power supply (AMPON, DCON="00"), disconnect pins CAP1+, CAP2+, CAP2-, CAP3+, CAP3-, CAP4+, CAP4-, CAP5+, CAP5-, VOUT, VEE, VREF and VREG. Then, feed external LCD drive voltages to pins V0, V1, V2, V3 and V4. The power circuit can be control by power circuit related register. So partial function of built-in power circuit can use with external power supply.

DCON	AMPON	Booster circuit	Voltage conversion circuit	External voltage input	Note
0	0	DISABLE	DISABLE	V0,V1,V2,V3 and V4 are supplied	※1
0	1	DISABLE	ENABLE	VOUT is supplied	※2
1	1	ENABLE	ENABLE	-	-

※1 Because the booster and voltage converter not operating, disconnect pins

CAP1+, CAP1-, CAP2+, CAP2-, CAP3+, CAP3-, CAP4+, CAP4 -, CAP5+, CAP5-, VOUT, VREF, VREG and VEE.

Apply external LCD drive voltages to corresponding pin.

※2 Because the booster is not operating, disconnect pins

CAP1+, CAP1-, CAP2+, CPA2-, CAP3+, CAP3-, CAP4+, CAP4-, CAP5+, CAP5- and VEE.

Derive the voltage source to be supplied to the voltage converter from VOUT pin and then

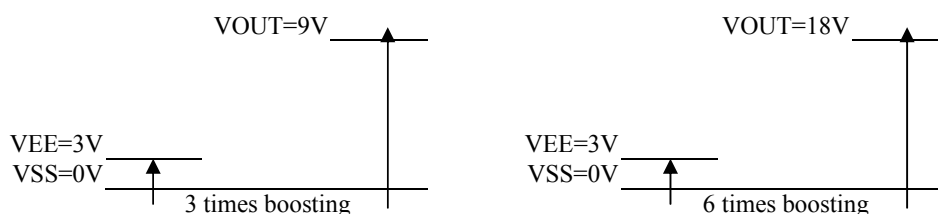
Input the reference voltage at VREF pin.

7.22 Booster Circuit

Placing capacitor C1 across CAP1+ and CAP1-, across CAP2+ and CAP2-, across CAP3+ and CAP3-, across CAP4+ and CAP4-, across CAP5+ and CAP5- and across VOUT and VSS boosts the voltage coming from VEE and VSS n-times and outputs the boosted voltage to VOUT pin. The twice, third, fourth or fifth boosted voltage output to the VOUT pin by the boost step register set. The boost step registers set by the command.

- (1) In case of using only twice boosted voltage, placing C1 only across CAP1+ and CAP1- and opening CAP2+, CAP2-, CAP3+, CAP3-, CAP4+, CAP4-, CAP5+ and CAP5-.
- (2) In case of using only third boosted voltage, placing C1 only across CAP1+ and CAP1-, across CAP2+ and CAP2- and opening CAP3+, CAP3-, CAP4+, CAP4-, CAP5+ and CAP5-.
- (3) In case of using only fourth boosted voltage, placing C1 only across CAP1+ and CAP1-, across CAP2+ and CAP2-, across CAP3+ and CAP3- and opening CAP4+, CAP4-, CAP5+ and CAP5-.
- (4) In case of using only fifth boosted voltage, placing C1 only across CAP1+ and CAP1-, across CAP2+ and CAP2-, across CAP3+ and CAP3- across CAP4+ and CAP4- and opening CAP5+ and CAP5-.
- (5) In case of using only sixth boosted voltage, placing C1 only across CAP1+ and CAP1-, across CAP2+ and CAP2-, across CAP3+ and CAP3- across CAP4+ and CAP4- across CAP5+ and CAP5-.

When use built-in booster circuit, output voltage (VOUT) must less than recommended operating voltage (18.0 Volt). If output voltage (VOUT) over recommended operating voltage, correct work of chip can not guarantee.



7.23 Electronic volume

The voltage conversion circuit has built-in an electronic volume, which allows the LCD drive voltage level V0 to be controlled with DV register setting and allows the tone of LCD to be controlled. The DV registers are 7-bits, so can select 128 voltage values for the LCD drive voltage V0.

7.24 Voltage Regulator

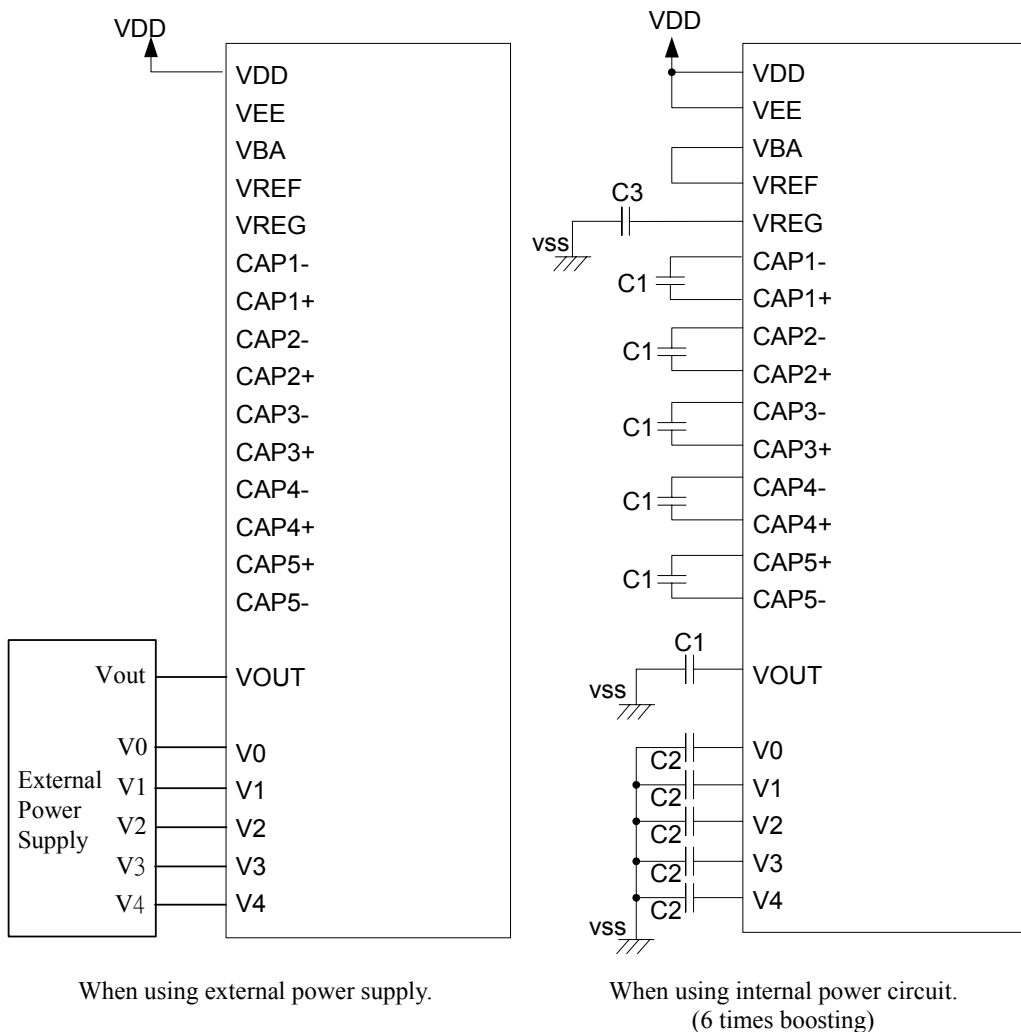
The EM65568 has built-in reference voltage regulator, which generate the voltage amplified by input voltage from VREF pin. The generated voltage is output at the VREG pin. Even if the boosted voltage level fluctuates, VREG remains stable so far as VOUT is higher than VREG. Stable power supply can be obtained using this constant voltage, even if the load fluctuates. The EM65568 uses the generated VREG level for the reference level of the electronic volume to generate LCD drive voltage. In order to stabilize the output voltage at the VREG pin, connect the capacitor C3 as appropriate by choosing its value.

7.25 0.9 times VDD Voltage Generation Circuit

The EM65568 has 0.9 times VDD voltage generation circuit. This circuit output 0.9 times VDD voltage from VBA pin. When VBA output connect to VREF input, LCD drive voltage can generate without external reference voltage.

7.26 LCD Drive Voltage Generation Circuit

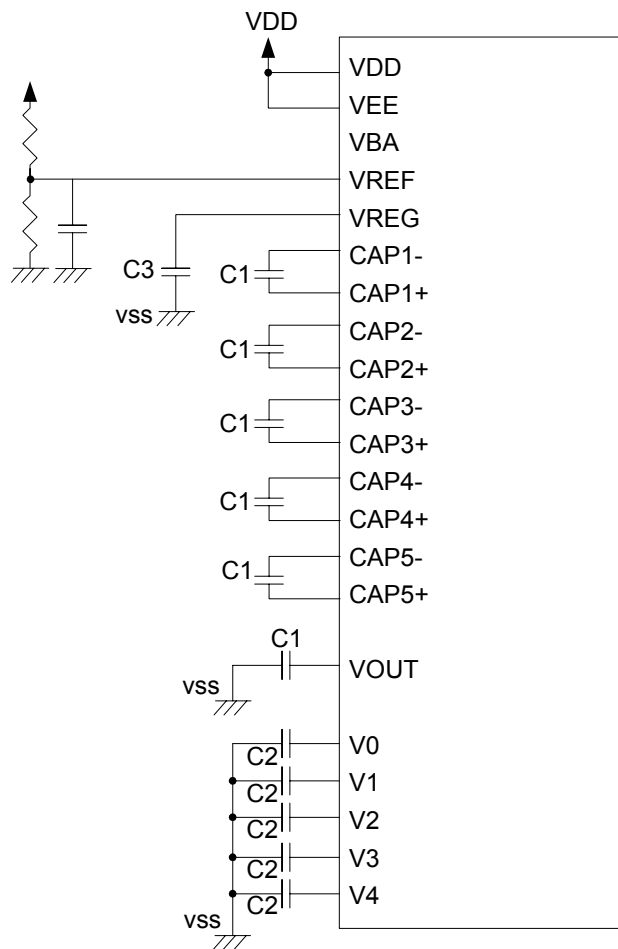
The voltage converter contains the voltage generation circuit. The LCD drive voltages other than V0, that is, V1, V2, V3 and V4 are obtained by dividing V0 through a resistor network. The LCD drive voltage from EM65568 is biased at 1/5, 1/6, 1/7, 1/8, 1/9, 1/10, 1/11 or 1/12. When using the internal power supply, connect a stabilizing capacitor C2 to each of pins V0 to V4. The capacitance of C2 should be determined while observing the LCD panel to be used. When using the external power supply, apply external LCD drive voltages to V0, V1, V2, V3, V4, disconnect pins CAP1+, CAP-, CAP2+, CAP2-, CAP3+, CAP3-, CAP4+, CAP4-, CAP5+, CAP5-, VOUT, VEE, VREF and VREG. When using only the voltage conversion circuit, turn off the internal booster circuit, disconnect pins CAP1+, CAP1-, CAP2+, CAP2-, CAP3+, CAP3-, CAP4+, CAP4-, CAP5+, CAP5- and VEE. Derive the voltage source to be supplied to the voltage converter from VOUT pin and then input the reference voltage to VREF pin.



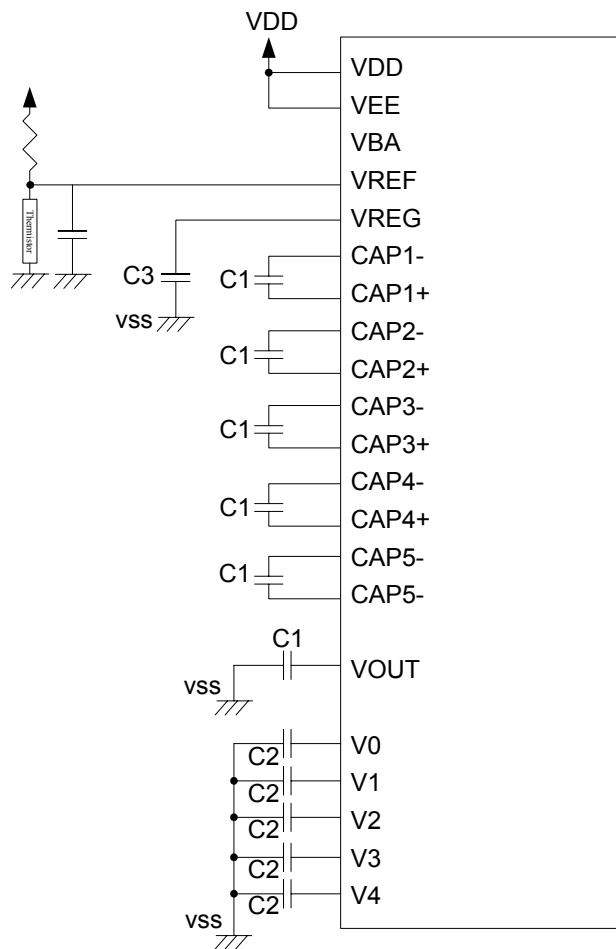
Recommended value.

C1	1.0 to 4.7 Uf
C2	1.0 to 2.2 Uf
C3	0.1 Uf

Note: External Capacitance must be use B characteristic.



When using internal power circuit with external reference voltage input.
(6 times boosting)

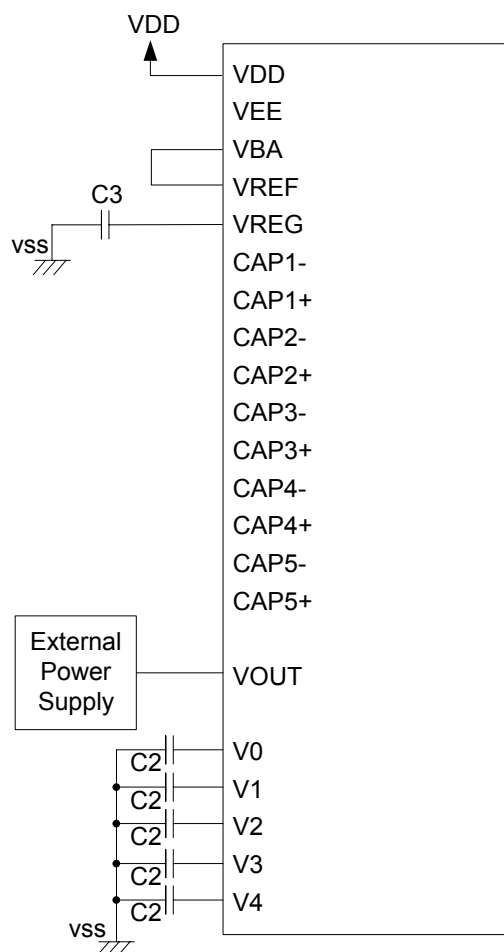


When using internal power circuit with thermistor for temperature independent.
(6 times boosting)

Recommended value.

C1	1.0 to 4.7 Uf
C2	1.0 to 2.2 Uf
C3	0.1 Uf

Note: External Capacitance must be use B characteristic.



When using internal power circuit.

(VOUT supplied from external, no use boosting circuit)

Recommended value.

C2	1.0 to 2.2 Uf
C3	0.1 Uf

Note: External Capacitance must be use B characteristic.

7.27 Partial Display Function

The EM65568 has the partial display function, which can display a part of graphic display area. This function is used be set lower bias ratio, lower boost step, and lower LCD drive voltage. Since setting partial display function, EM65568 provides low power consumption. Partial display function is the most suitable for clock indication or calendar indication when a portable equipment stand-by.

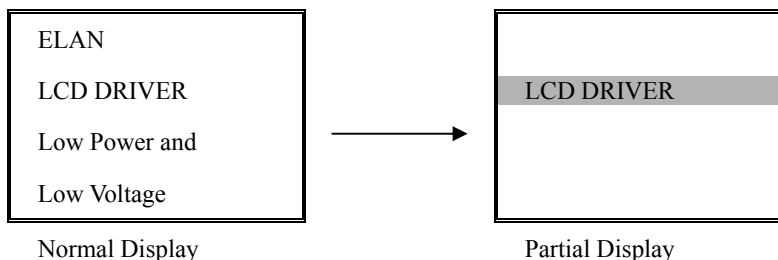
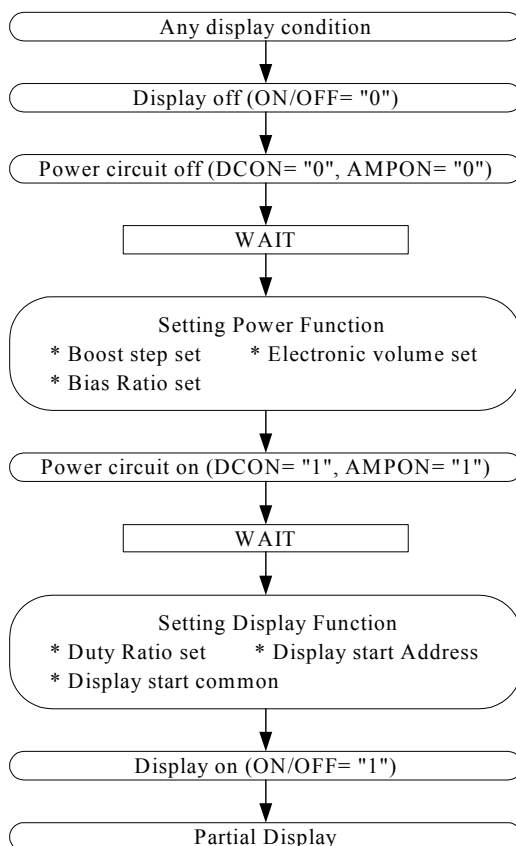


Image of partial Display

When using the partial display function, it is necessary to keep following sequence.



Select a display duty ratio for the partial display from 1/10 to 1/130 using the DS(Lcd duty ratio) register.

Set the most suitable values for LCD drive bias ratio, LCD drive voltage, electronic volume, the number of boosting steps, and others according to the actually used LCD panel and the selected duty ratio.

7.28 Discharge circuit

The EM65568 has built-in the discharge circuit, which discharges electricity from capacitors for a stability of power sources (V0~V4).

The discharge circuit is valid, while the DIS register is set to "1". When the built-in power supply is used, should be set DIS="1" after the power source is turned off (DCON, AMPON)=(0, 0). And don't turn on both the built-in power source and the external power source (V0~V4, VOUT) while DIS="1".

7.29 Initialization

The EM65568 is initialized by setting RESB pin to “L”. Normally, RESB pin is initialized together with MPU by connecting to the reset pin of MPU. When power ON, be sure to make RESB=“L”.

4096 color mode

ITEM	Initial value
Display RAM	Not fixed
X Address	00H set
Y Address	00H set
Display starting line	Set at the first line(0H)
Display ON/OFF	Display OFF
Display Normal/Reverse	Normal
Display duty	1/10
n-line alternated	every frame unit
(BF1,BF0)	(0,0)
Common shift direction	COM0 → COM127, COMA, COMB
Increment mode	Increment OFF
REF mode	Normal
Data SWAP Mode	OFF
Register in electronic volume	(0,0,0,0,0,0)
Power Supply	OFF
Display mode	Gradation display mode
Bias ratio	1/5 bias
Gradation palette 0	(0, 0, 0, 0, 0)
Gradation palette 1	(0, 0, 0, 1, 1)
Gradation palette 2	(0, 0, 1, 0, 1)
Gradation palette 3	(0, 0, 1, 1, 1)
Gradation palette 4	(0, 1, 0, 0, 1)
Gradation palette 5	(0, 1, 0, 1, 1)
Gradation palette 6	(0, 1, 1, 0, 1)
Gradation palette 7	(0, 1, 1, 1, 0)
Gradation palette 8	(1, 0, 0, 0, 1)
Gradation palette 9	(1, 0, 0, 1, 1)
Gradation palette 10	(1, 0, 1, 0, 1)
Gradation palette 11	(1, 0, 1, 1, 1)
Gradation palette 12	(1, 1, 0, 0, 1)
Gradation palette 13	(1, 1, 0, 1, 1)
Gradation palette 14	(1, 1, 1, 0, 1)
Gradation palette 15	(1, 1, 1, 1, 1)
Gradation display mode	Variable mode
Gradation LSB	0
RAM access data length	8-bits mode
Discharge Register	0

7.30 Precaution when Power ON and Power OFF

This LSI may be permanently damaged by high current that may flow if a voltage is supplied to the LCD driver power supply while the system power supply is floating. The detail is as follows.

(i)When using as external power supply

- Procedure for Power ON

- (1) Logic system (VDD) power ON, make reset operation.
- (2) Supply external LCD drive voltage to corresponding pins (V0, V1, V2, V3 and V4)

- Procedure for Power OFF

- (1) Set HALT register to “1” or make reset operation.
- (2) Cut off external LCD drive voltage.
- (3) Logic system(VDD) power OFF.

Note: connect the serial resistor (50 to 100 Ω) or fuse to the LCD drive power V0 or VOUT(when only use internal voltage conversion circuit) of the system as a current limiter. Moreover, set up the suitable value of the resistor in consideration of LCD display grade.

(ii)When using the built-in power supply

- Procedure for Power ON

- (1) Logic system(VDD) power ON
- (2) Booster circuit system(VEE) power ON
- (3) Make reset operation, booster and voltage conversion circuit enable.

If VDD and VEE voltages aren't same potential, power on logic system (VDD) first.

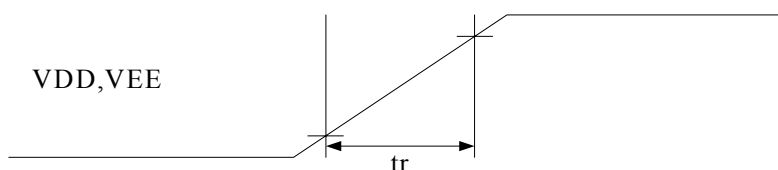
- Procedure for Power OFF

- (1) Set HALT register to “1” or make reset operation.
- (2) Booster circuit system(VEE) power OFF.
- (3) Logic system(VDD) power OFF.

If VDD and VEE are not same potential, cut off VEE first. After VEE, VOUT, V0, V1, V2, V3 and V4 voltages are below LCD ON voltage (threshold voltage for Liquid crystal turn on), power off logic system (VDD).

(iii)Power supply rising time

Though especially there is no constraint on the rising time of the power supply, the t_r (rising time) of the following is recommended in the practical use.

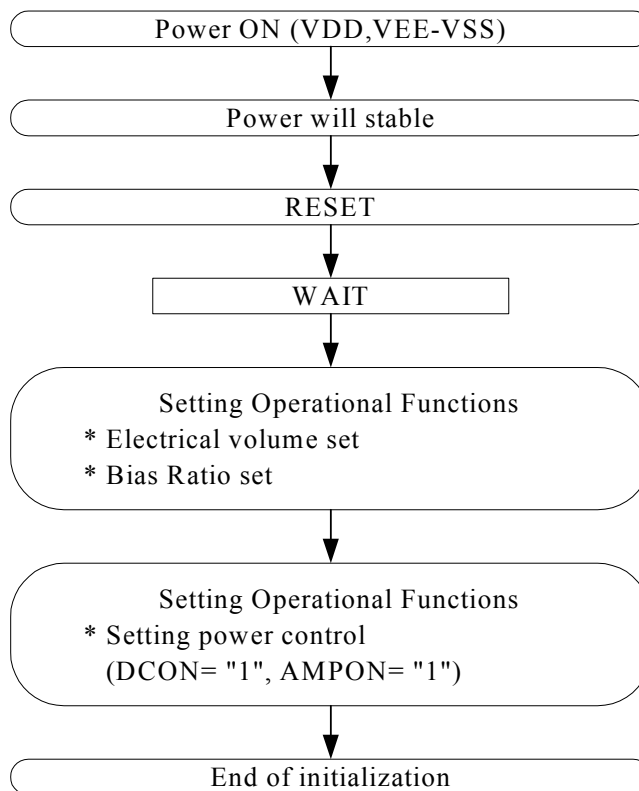


Item	Recommended rising time	Applicable Power
t_r	30us ~ 10ms	VDD, VEE

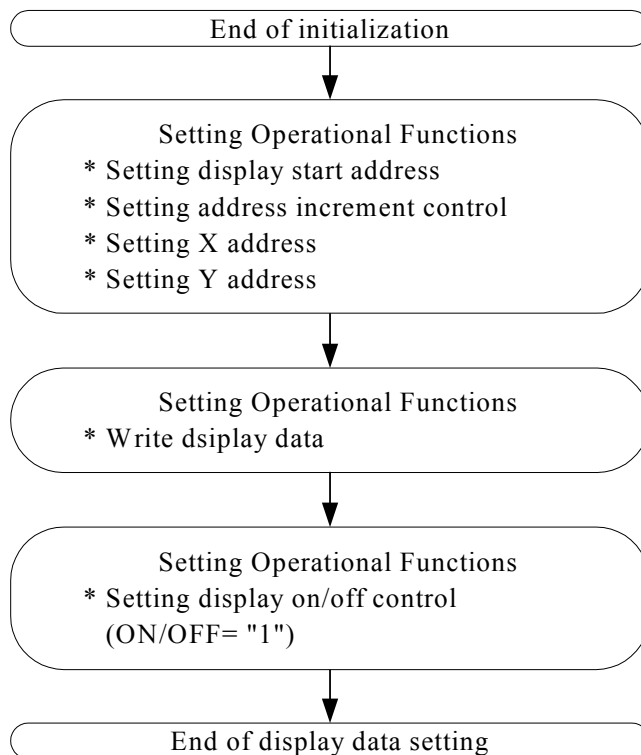
Note: The rising time is the time from 10% of VDD,VEE to 90%.

7.31 Example of Setting Registers

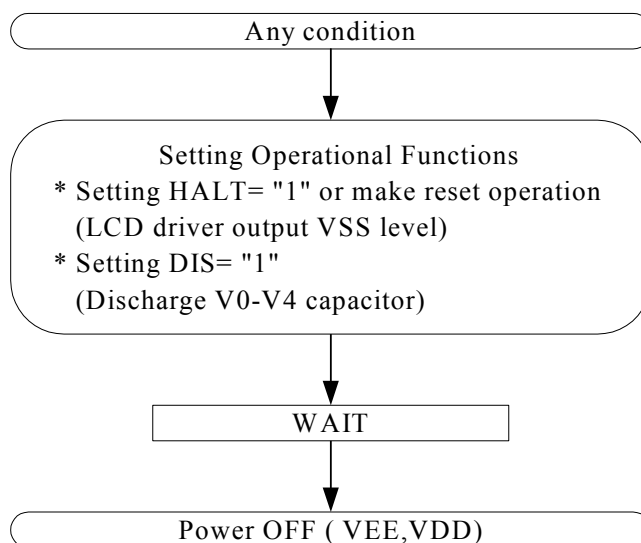
(1) Initialization



(2) Display data



(3) Power OFF



8. Control Register

8.1 control register

Control Register Table (Bank 0)

Control Register	Pins (for 80-family) & Bank							Address & Code								Function
	CSB	RS	WRB	RDB	RE2	RE1	RE0	D7	D6	D5	D4	D3	D2	D1	D0	
X Address (Lower nibble) [0H]	0	1	0	1	0	0	0	0	0	0	0	AX3	AX2	AX1	AX0	Set of X direction Address in display RAM
X Address (Upper nibble) [1H]	0	1	0	1	0	0	0	0	0	0	1	AX7	AX6	AX5	AX4	Set of X direction Address in display RAM
Y Address (Lower nibble) [2H]	0	1	0	1	0	0	0	0	0	1	0	AY3	AY2	AY1	AY0	Set of Y direction Address in display RAM
Y Address (Upper nibble) [3H]	0	1	0	1	0	0	0	0	0	1	1	AY7	AY6	AY5	AY4	Set of Y direction Address in display RAM
Display start address (Lower nibble) [4H]	0	1	0	1	0	0	0	0	1	0	0	LA3	LA2	LA1	LA0	Set address of display RAM making common starting line display
Display start address (Upper nibble) [5H]	0	1	0	1	0	0	0	0	1	0	1	*	LA6	LA5	LA4	Set address of display RAM making common starting line display
n-line alternation (Lower nibble) [6H]	0	1	0	1	0	0	0	0	1	1	0	N3	N2	N1	N0	Set the number of alternated reverse line
n-line alternation (Upper nibble) [7H]	0	1	0	1	0	0	0	0	1	1	1	N7	N6	N5	N4	Set the number of alternated reverse line
Display control (1) [8H]	0	1	0	1	0	0	0	1	0	0		SHI FT	MON	ALL ON	ON/ OFF	SHIFT: Select common shift direction MON: Select Monochrome/gradation ALLON: All display ON ON/OFF: Display ON/OFF control
Display control (2) [9H]	0	1	0	1	0	0	0	1	0	0	1	REV	NLIN	SW AP	REF	REV: Display normal/reverse NLIN: n line reverse control SWAP: Display data swapping REF: Segment normal/reverse
Increment control [AH]	0	1	0	1	0	0	0	1	0	1	0	WIN	AIM	AYI	AXI	WIN: Select window. AIM: Select increment mode AYI: Y increment, AXI: X increment
Power control [BH]	0	1	0	1	0	0	0	1	0	1	1	AMP ON	HA LT	DC ON	ACL	AMPON: Internal AMP. ON HALT: Power saving DCON: Boosting circuit ON ACL: Resetting
LCD Duty Ratio [CH]	0	1	0	1	0	0	0	1	1	0	0	DS3	DS2	DS1	DS0	Set LCD drive duty ratio
Booster [DH]	0	1	0	1	0	0	0	1	1	0	1	*	VU2	VU1	VU0	Set number of boosting step for booster circuit
Bias ratio control [EH]	0	1	0	1	0	0	0	1	1	1	0	*	B2	B1	B0	Set bias ratio for LCD driving voltage
Register Access Control [FH]	0	1	0	1	0/1	0/1	0/1	1	1	1	1	TS T0	RE2	RE1	RE0	TST0: for LS1 test, must set to "0" RE: set register bank number

Note: The "※" mark means "don't care"

Parentheses [] shows address for control register.



Control Register Table (Bank 1)

Control Register	Pins (for 80-family) & Bank							Address & Code								Function
	CSB	RS	WRB	RDB	RE2	RE1	RE0	D7	D6	D5	D4	D3	D2	D1	D0	
Gradation palette A0 (Lower nibble) [0H]	0	1	0	1	0	0	1	0	0	0	0	PA03 /PA83	PA02 /PA82	PA01 /PA81	PA00 /PA80	Set the umber of Gradation Palette A0
Gradation palette A0 (Upper nibble) [1H]	0	1	0	1	0	0	1	0	0	0	1	*	*	*	PA04 /PA84	Set the umber of Gradation Palette A0
Gradation palette A1 (Lower nibble) [2H]	0	1	0	1	0	0	1	0	0	1	0	PA13 /PA93	PA12 /PA92	PA11 /PA91	PA10 /PA90	Set the umber of Gradation Palette A1
Gradation palette A1 (Upper nibble) [3H]	0	1	0	1	0	0	1	0	0	1	1	*	*	*	PA14 /PA94	Set the umber of Gradation Palette A1
Gradation palette A2 (Lower nibble) [4H]	0	1	0	1	0	0	1	0	1	0	0	PA23 /PA103	PA22 /PA102	PA21 /PA101	PA20 /PA100	Set the umber of Gradation Palette A2
Gradation palette A2 (Upper nibble) [5H]	0	1	0	1	0	0	1	0	1	0	1	*	*	*	PA24 /PA104	Set the umber of Gradation Palette A2
Gradation palette A3 (Lower nibble) [6H]	0	1	0	1	0	0	1	0	1	1	0	PA33 /PA113	PA32 /PA112	PA31 /PA111	PA30 /PA110	Set the umber of Gradation Palette A3
Gradation palette A3 (Upper nibble) [7H]	0	1	0	1	0	0	1	0	1	1	1	*	*	*	PA34 /PA114	Set the umber of Gradation Palette A3
Gradation palette A4 (Lower nibble) [8H]	0	1	0	1	0	0	1	1	0	0	0	PA43 /PA123	PA42 /PA122	PA41 /PA121	PA40 /PA120	Set the umber of Gradation Palette A4
Gradation palette A4 (Upper nibble) [9H]	0	1	0	1	0	0	1	1	0	0	1	*	*	*	PA44 /PA124	Set the umber of Gradation Palette A4
Gradation palette A5 (Lower nibble) [AH]	0	1	0	1	0	0	1	1	0	1	0	PA53 /PA133	PA52 /PA132	PA51 /PA131	PA50 /PA130	Set the umber of Gradation Palette A5
Gradation palette A5 (Upper nibble) [BH]	0	1	0	1	0	0	1	1	0	1	1	*	*	*	PA54 /PA134	Set the umber of Gradation Palette A5
Gradation palette A6 (Lower nibble) [CH]	0	1	0	1	0	0	1	1	1	0	0	PA63 /PA143	PA62 /PA142	PA61 /PA141	PA60 /PA140	Set the umber of Gradation Palette A6
Gradation palette A6 (Upper nibble) [DH]	0	1	0	1	0	0	1	1	1	0	1	*	*	*	PA64 /PA144	Set the umber of Gradation Palette A6
Register Access Control [FH]	0	1	0	1	0/1	0/1	0/1	1	1	1	1	TS T0	RE2	RE1	RE0	TST0: for LS1 test,must set to "1" RE: set register bank number

Note: The “※” mark means “don’t care”

Parentheses [] shows address for control register.



Control Register Table (Bank 2)

Control Register	Pins (for 80-family) & Bank							Address & Code								Function
	CSB	RS	WRB	RDB	RE2	RE1	RE0	D7	D6	D5	D4	D3	D2	D1	D0	
Gradation palette A7 (Lower nibble) [0H]	0	1	0	1	0	1	0	0	0	0	0	PA73 /PA153	PA72 /PA152	PA71 /PA151	PA70 /PA150	Set the umber of Gradation Palette A7
Gradation palette A7 (Upper nibble) [1H]	0	1	0	1	0	1	0	0	0	0	1	*	*	*	PA74 /PA154	Set the umber of Gradation Palette A7
Gradation palette B0 (Lower nibble) [2H]	0	1	0	1	0	1	0	0	0	1	0	PB03 /PB83	PB02 /PB82	PB01 /PB81	PB00 /PB80	Set the umber of Gradation Palette B0
Gradation palette B0 (Upper nibble) [3H]	0	1	0	1	0	1	0	0	0	1	1	*	*	*	PB04 /PB84	Set the umber of Gradation Palette B0
Gradation palette B1 (Lower nibble) [4H]	0	1	0	1	0	1	0	0	1	0	0	PB13 PB93	PB12 PB92	PB11 PB91	PB10 PB90	Set the umber of Gradation Palette B1
Gradation palette B1 (Upper nibble) [5H]	0	1	0	1	0	1	0	0	1	0	1	*	*	*	PB14 PB94	Set the umber of Gradation Palette B1
Gradation palette B2 (Lower nibble) [6H]	0	1	0	1	0	1	0	0	1	1	0	PB23 PB103	PB22 PB102	PB21 PB101	PB20 PB100	Set the umber of Gradation Palette B2
Gradation palette B2 (Upper nibble) [7H]	0	1	0	1	0	1	0	0	1	1	1	*	*	*	PB24 PB104	Set the umber of Gradation Palette B2
Gradation palette B3 (Lower nibble) [8H]	0	1	0	1	0	1	0	1	0	0	0	PB33 PB113	PB32 PB112	PB31 PB111	PB30 PB110	Set the umber of Gradation Palette B3
Gradation palette B3 (Upper nibble) [9H]	0	1	0	1	0	1	0	1	0	0	1	*	*	*	PB34 PB114	Set the umber of Gradation Palette B3
Gradation palette B4 (Lower nibble) [AH]	0	1	0	1	0	1	0	1	0	1	0	PB43 PB123	PB42 PB122	PB41 PB121	PB40 PB120	Set the umber of Gradation Palette B4
Gradation palette B4 (Upper nibble) [BH]	0	1	0	1	0	1	0	1	0	1	1	*	*	*	PB44 PB124	Set the umber of Gradation Palette B4
Gradation palette B5 (Lower nibble) [CH]	0	1	0	1	0	1	0	1	1	0	0	PB53 PB133	PB52 PB132	PB51 PB131	PB50 PB130	Set the umber of Gradation Palette B5
Gradation palette B5 (Upper nibble) [DH]	0	1	0	1	0	1	0	1	1	0	1	*	*	*	PB54 PB134	Set the umber of Gradation Palette B5
Register Access Control [FH]	0	1	0	1	0/1	0/1	0/1	1	1	1	1	TS T0	RE2	RE1	RE0	TST0: for LS1 test,must set to "0" RE: set register bank number

Note: The “※” mark means “don’t care”

Parentheses [] shows address for control register.



Control Register Table (Bank 3)

Control Register	Pins (for 80-family) & Bank							Address & Code								Function
	CSB	RS	WRB	RDB	RE2	RE1	RE0	D7	D6	D5	D4	D3	D2	D1	D0	
Gradation palette B6 (Lower nibble) [0H]	0	1	0	1	0	1	1	0	0	0	0	PB63 /PB143	PB62 /PB142	PB61 /PB141	PB60 /PB140	Set the umber of Gradation Palette B6
Gradation palette B6 (Upper nibble) [1H]	0	1	0	1	0	1	1	0	0	0	1	*	*	*	PB64 /PB144	Set the umber of Gradation Palette B6
Gradation palette B7 (Lower nibble) [2H]	0	1	0	1	0	1	1	0	0	1	0	PB73 /PB153	PB72 /PB152	PB71 /PB151	PB70 /PB150	Set the umber of Gradation Palette B7
Gradation palette B7 (Upper nibble) [3H]	0	1	0	1	0	1	1	0	0	1	1	*	*	*	PB74 /PB154	Set the umber of Gradation Palette B7
Gradation palette C0 (Lower nibble) [4H]	0	1	0	1	0	1	1	0	1	0	0	PC03 /PC83	PC02 /PC82	PC01 /PC81	PC00 /PC80	Set the umber of Gradation Palette C0
Gradation palette C0 (Upper nibble) [5H]	0	1	0	1	0	1	1	0	1	0	1	*	*	*	PC04 /PC84	Set the umber of Gradation Palette C0
Gradation palette C1 (Lower nibble) [6H]	0	1	0	1	0	1	1	0	1	1	0	PC13 /PC93	PC12 /PC92	PC11 /PC91	PC10 /PC90	Set the umber of Gradation Palette C1
Gradation palette C1 (Upper nibble) [7H]	0	1	0	1	0	1	1	0	1	1	1	*	*	*	PB14 /PC94	Set the umber of Gradation Palette C1
Gradation palette C2 (Lower nibble) [8H]	0	1	0	1	0	1	1	1	0	0	0	PC23 /PC103	PC22 /PC102	PC21 /PC101	PC20 /PC100	Set the umber of Gradation Palette C2
Gradation palette C2 (Upper nibble) [9H]	0	1	0	1	0	1	1	1	0	0	1	*	*	*	PB24 /PC104	Set the umber of Gradation Palette C2
Gradation palette C3 (Lower nibble) [AH]	0	1	0	1	0	1	1	1	0	1	0	PC33 /PC113	PC32 /PC112	PC31 /PC111	PC30 /PC110	Set the umber of Gradation Palette C3
Gradation palette C3 (Upper nibble) [BH]	0	1	0	1	0	1	1	1	0	1	1	*	*	*	PB34 /PC114	Set the umber of Gradation Palette C3
Gradation palette C4 (Lower nibble) [CH]	0	1	0	1	0	1	1	1	1	0	0	PC43 /PC123	PC42 /PC122	PC41 /PC121	PC40 /PC120	Set the umber of Gradation Palette C4
Gradation palette C4 (Upper nibble) [DH]	0	1	0	1	0	1	1	1	1	0	1	*	*	*	PB44 /PC124	Set the umber of Gradation Palette C4
Register Access Control [FH]	0	1	0	1	0/1	0/1	0/1	1	1	1	1	TS T0	RE2	RE1	RE0	TST0: for LS1 test,must set to "0" RE: set register bank number

Note: The “※” mark means “don’t care”

Parentheses [] shows address for control register.



Control Register Table (Bank 4)

Control Register	Pins (for 80-family) & Bank							Address & Code								Function
	CSB	RS	WRB	RDB	RE2	RE1	RE0	D7	D6	D5	D4	D3	D2	D1	D0	
Gradation palette C5 (Lower nibble) [0H]	0	1	0	1		1	0	0	0	0	0	PC53 /PC133	PC52 /PC132	C51 /PC131	PC50 /PC130	Set the umber of Gradation Palette C5
Gradation palette C5 (Upper nibble) [1H]	0	1	0	1		1	0	0	0	0	0	1 *	*	*	PC54 /PC134	Set the umber of Gradation Palette C5
Gradation palette C6 (Lower nibble) [2H]	0	1	0	1		1	0	0	0	0	1	PC63 /PC143	PC62 /PC142	PC61 /PC141	PC60 /PC140	Set the umber of Gradation Palette C6
Gradation palette C6 (Upper nibble) [3H]	0	1	0	1		1	0	0	0	0	1	1 *	*	*	PC64 /PC144	Set the umber of Gradation Palette C6
Gradation palette C7 (Lower nibble) [4H]	0	1	0	1		1	0	0	0	1	0	PC73 /PC153	PC72 /PC152	PC71 /PC151	PC70 /PC150	Set the umber of Gradation Palette C7
Gradation palette C7 (Upper nibble) [5H]	0	1	0	1		1	0	0	0	1	0	1 *	*	*	PC74 /PC154	Set the umber of Gradation Palette C7
Display start common [6H]	0	1	0	1		1	0	0	0	1	1	0 SC3	SC2	SC1	SC0	Set Common Driver Start Line
Display Select Control [8H]	0	1	0	1		1	0	0	1	0	0	0 PWM	GL SB		PS	Select Plane(access/display) Set GLSB Bit. Select PWM Mode
RAM Data length Set [9H]	0	1	0	1		1	0	0	1	0	0	1 C256	HSW	ABS	WLS	Set Data length on RAM Access 8-bit access or 16-bit access
Electronic Volume (Lower nibble) [AH]	0	1	0	1		1	0	0	1	0	1	0 DV3	DV2	DV1	DV0	Set Electronic Vllume Register (lower code)
Electronic Volume (Upper nibble) [BH]	0	1	0	1		1	0	0	1	0	1	1 *	DV6	DV5	DV4	Set Electronic Vllume Register (upper code)
Register read Control [CH]	0	1	0	1		1	0	0	1	1	0	0 RA3	RA2	RA1	RA0	Set Register Address for read
Select Rf [DH]	0	1	0	1		1	0	0	1	1	0	1 *	RF2	RF1	RF0	Select Rf ratio of OSC circuit
Extended Power Control [EH]	0	1	0	1		1	0	0	1	1	1	0 BF1	BF0	HPM	DIS	Discharge capacitance of V0,V1,V2,V3,V4 Pins
Register Access Control [FH]	0	1	0	1	0/1	0/1	0/1		1	1	1	1 TS T0	RE2	RE1	RE0	TST0: for LS1 test,must set to "0" RE: set register bank number

Note: The “※” mark means “don’t care”

Parentheses [] shows address for control register.



Control Register Table (Bank 5)

Control Register		Pins (for 80-family) & Bank								Address & Code								Function
		CSB	RS	WRB	RDB	RE2	RE1	RE0	D7	D6	D5	D4	D3	D2	D1	D0		
Window X End Address (Lower nibble)	[0H]	0	1	0	1	1	0	1	0	0	0	0	EX3	EX2	EX1	EX0	Set X end address for window function access	
Window X End Address (Upper nibble)	[1H]	0	1	0	1	1	0	1	0	0	0	1	EX7	EX6	EX5	EX4	Set X end address for window function access	
Window Y End Address (Lower nibble)	[2H]	0	1	0	1	1	0	1	0	0	1	0	EY3	EY2	EY1	EY0	Set Y end address for window function access	
Window Y End Address (Upper nibble)	[3H]	0	1	0	1	1	0	1	0	0	1	1	EY7	EY6	EY5	EY4	Set Y end address for window function access	
Start Address for line reverse (Lower nibble)	[4H]	0	1	0	1	1	0	1	0	1	0	0	LS3	LS2	LS1	LS0	Set start line for line reverse display	
Start Address for line reverse (Upper nibble)	[5H]	0	1	0	1	1	0	1	0	1	0	1	LS7	LS6	LS5	LS4	Set start line for line reverse display	
End Address for line reverse (Lower nibble)	[6H]	0	1	0	1	1	0	1	0	1	1	0	LE3	LE2	LE1	LE0	Set end line for line reverse display	
End Address for line reverse (Upper nibble)	[7H]	0	1	0	1	1	0	1	0	1	1	1	LE7	LE6	LE5	LE4	Set end line for line reverse display	
Line reverse control	[8H]	0	1	0	1	1	0	1	1	0	0	0	*	*	BT	EV	LREV: Line reverse control BT: Reverse type select	
Register Access Control	[FH]	0	1	0	1	0/1	0/1	0/1	1	1	1	1	T0	RE2	RE1	RE0	TST0: for LS1 test,must set to "0" RE: set register bank number	

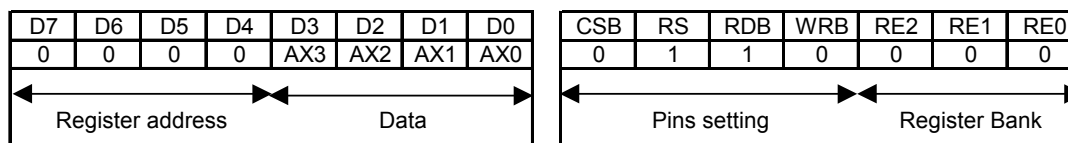
Note: The “※” mark means “don’t care”

Parentheses [] shows address for control register.

8.2 Functions of Control Registers

The EM65568 has many control registers as shown in “7 Control Register”. In case of control register access, upper nibble of data bus(D7~D4) represent register address, lower nibble of data bus(D3~D0) represent data. The access example is shown in the following. The Pins (CSB, RS, RDB, WRB) setting are for 80-family MPU interface. Only the setting of terminal (RDB,WRB) is different, when it is accessed by the 68-family MPU.

(Example) X Address



In the writing to the control register, it is used directly as addressing D7~D4 of the data bus. In case of register read, first set RA register for specific register address, next can read specific register. Therefore, it is need 2-step for register read. Then, specific register output to D3~D0 of data bus. Except D3~D0 of data bus are all “H”. Prohibit access to undefined register address area. When RS is “L”, all read/write operations are accessed to display RAM. Then data bus doesn’t include register address. In case of write, D3~D0 data is written to the register designated at D7~D4 in rising edge of the WRB signal. In case of read, register can output to data bus is RDB active period. Control register and display RAM are the equal access timing.

8.2.1 X Address Register (AX)

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
0	0	0	0	AX3	AX2	AX1	AX0	0	1	1	0	0	0	0

(At the time of reset: {AX3, AX2, AX1, AX0}=0H, read address: 0H)

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
0	0	0	1	AX7	AX6	AX5	AX4	0	1	1	0	0	0	0

(At the time of reset: {AX7, AX6, AX5, AX4}=0H, read address: 1H)

The AX register set to X-direction address of display RAM. In data setting, lower place and upper place are divided with 4-bit and 4-bit respectively.

8.2.2 Y Address Register

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
0	0	1	0	AY3	AY2	AY1	AY0	0	1	1	0	0	0	0

(At the time of reset: {AY3, AY2, AY1, AY0}=0H, read address: 2H)

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
0	0	1	1	AY7	AY6	AY5	AY4	0	1	1	0	0	0	0

(At the time of reset: {AY7, AY6, AY5, AY4}=0H, read address: 3H)

※ **Mark shows “Don’t care”**

The AY register set to Y-direction address of display RAM. In data setting, lower place and upper place are divided with 4-bit and 4-bit respectively. 00H to 81H are applicable to the values for AY7 to AY0, and 82H to FFH are not permitted. The address for (AY7 to AY0) = 70H, 81H are in the display RAM area for icon display.

8.2.3 Display Start Address Register (LA)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	LA3	LA2	LA1	LA0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	0

(At the time of reset: {LA3, LA2, LA1, LA0}=0H, read address: 4H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	※	LA6	LA5	LA4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	0

(At the time of reset: { LA6, LA5, LA4}=0H, read address: 5H)

※ **Mark shows “Don’t care”**

The LA register indicated first output segment data in display RAM. This segment data output to common line indicated by SC register. After that output common line shift to the increment direction.

LA6	LA5	LA4	LA3	LA2	LA1	LA0	Line Address
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
⋮							
1	1	1	1	1	1	1	127

8.2.4 n Line Alternated Register (N)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	0	N3	N2	N1	N0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	0

(At the time of reset: {N3, N2, N1, N0}=0H, read address: 6H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	1	N7	N6	N5	N4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	0

(At the time of reset: {N7,N6, N5, N4}=0H, read address: 7H)

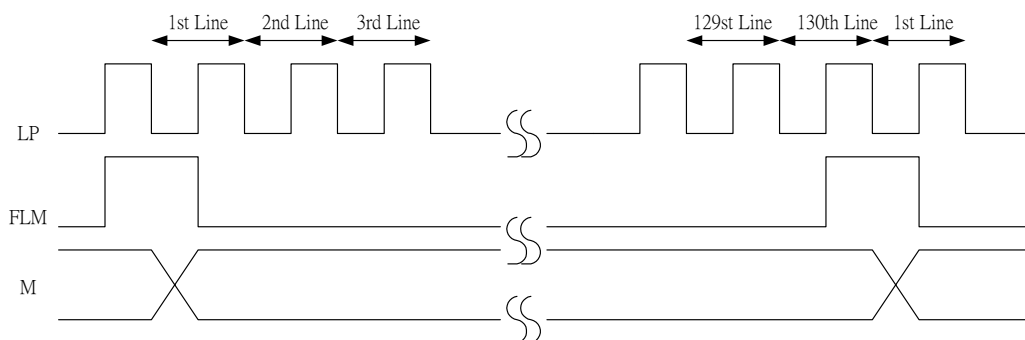
※ **Mark shows “Don’t care”**

The reverse line number of LCD alternated drive is required to set in the register. The line number has a limit, must keeps between from 2 to 80 lines. The values set up by the alternated register become enable when NLIN control bit is “1”. When NLIN control bit is “0”, alternated drive waveform reverses by each frame is generated.

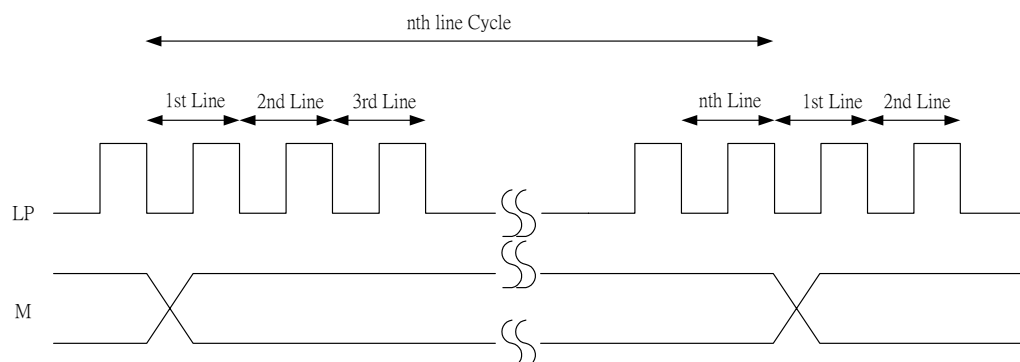
N7	N6	N5	N4	N3	N2	N1	N0	Line Address
0	0	0	0	0	0	0	0	-
0	0	0	0	0	0	0	1	2
				⋮				
				⋮				
1	0	0	0	0	0	0	0	129

Alternated Timing

(i) NLIN="0" (in case of 1/130 DUTY Display)



(ii) NLIN="1"



8.2.5 Display Control (1) Register

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	0	SHIFT	MON	ALL ON	ON/OFF

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	0

(At the time of reset: {SHIFT, MON, ALLON, ON/OFF}=0H, read address: 8H)

Various control of display is set up.

ON/OFF

To control ON/OFF of display

ON/OFF = "0": Display OFF

ON/OFF = “1”: Display ON

ALLON

Regardless of the data for display, all is on.

This control has priority over display normal/reverse commands.

ALLON = “0”: Normal display

ALLON = “1”: All display lighted

MON

Select Monochrome or Gradation display

MON = “0”: Gradation display mode

MON = “1”: Monochrome display mode

SHIFT

The shift direction of display scanning data in the common driver output is selected.

SHIFT = “0”: COM0→COM127 shift-scan

SHIFT = “1”: COM127→COM0 shift-scan

8.2.6 Display Control (2) Register

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	0	0	1	REV	NLIN	SWAP	REF	0	1	1	0	0	0	0

(At the time of reset: {REV,NLIN,SWAP,REF}=0H, read address: 9H)

Various control of display is set up.

REF

When MPU accesses to display RAM, the X address and data can reverse. The REF function shows in the table below:

REF	Access from MPU		Internal Access		Corresponding Segment Output
	X Address	D7-D0	X Address	D7-D0	
0	NH	D0(LSB)	NH	(LSB)	SEG(8*NH)Output
		⋮		⋮	⋮
1	NH	D7(MSB)	MaxH-NH	(MSB)	SEG(8*NH+7)Output
		⋮		⋮	⋮
1	NH	D0(LSB)	MaxH-NH	(MSB)	SEG(8*(maxH-NH)+7)Output
		⋮		⋮	⋮
1	NH	D7(MSB)	MaxH-NH	(LSB)	SEG(8*(maxH-NH))Output
		⋮		⋮	⋮

Note: maxH: The maximum X-address in each access mode.

The order of segment driver output can be reversed by register by register setting, lessening the limitation in placing IC when assembling a LCD module.

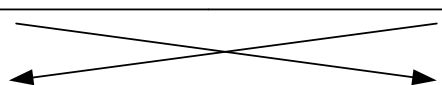
SWAP

When data to display RAM are written, the write data exchange bit order.

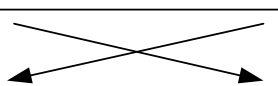
SWAP = "0": Normal mode.

SWAP = "1": in data writing, exchange bit order.

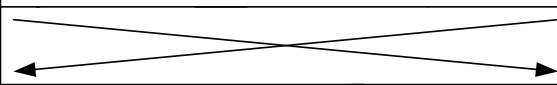
Example of exchange bit order

Write Data	SWAP=0	SWAP=1
	D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11	D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11
	↓ ————— ↓	
Internal Data	d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 d10 d11	d11 d10 d9 d8 d7 d6 d5 d4 d3 d2 d1 d0

8 bit access (HSW=1)

Write Data	SWAP=0	SWAP=1
	D0 D1 D2 D3 D4 D5 D6 D7	D0 D1 D2 D3 D4 D5 D6 D7
	↓ ————— ↓	
Internal Data	d0 d1 d2 d3 d4 d5 d6 d7	d7 d6 d5 d4 d3 d2 d1 d0

16 bit access (HSW=1)

Write Data	SWAP=0	SWAP=1
	D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15	D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15
	↓ ————— ↓	
Internal Data	d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 d10 d11 d12 d13 d14 d15	d15 d14 d13 d12 d11 d10 d9 d8 d7 d6 d5 d4 d3 d2 d1 d0

CAUTION: REF and SWAP both set to "1"

When data write to display RAM, the write data is normal bit order.

When data read from display RAM, the read data is exchanged bit order.

NLIN

The NLIN control n-line alternated drive.

NLIN = "0": n-line alternated drive OFF. In each frame, the alternated signals (M) are reversed.

NLIN = "1": n-line alternated drive ON. According to data set up in n-line alternated register, the alternation is made.

REV

Corresponding to the data of display RAM, the lighting or not-lighting of the display is set up.

REV="0": When RAM data at "H", LCD at ON voltage (normal)

REV="1": When RAM data at "L", LCD at ON voltage (reverse)

8.2.7 Increment Control Register Set

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	0	1	0	WIN	AIM	AYI	AXI	0	1	1	0	0	0	0

(At the time of reset: {WIN,AIM,AYI,AXI}=0H, read address: AH)

This register control the increment mode and window function when accessing to display RAM. The increment operation of AX and AY register can control by AIM,AYI and AXI registers setting and every write access or every read access to display RAM. The AY register directly connect to display RAM as Y address. The AX register connect to address converter, and that output to display RAM as X address in the auto increment mode, AX and AY register are increment, not directly increment X and Y address.

In setting to this control register, the increment operation of address can be made without setting successive addresses for writing data or for reading data to display RAM from MPU.

The WIN register use for window function control.

WIN="0": Normal RAM access

WIN="1": Window function access

In case of using window function access, should be set following register before access to RAM.

WIN="1", AXI="1", AYI="1"

X Address, Y Address, Window X End Address, Window Y End Address

Moreover, should be keep following address condition.

Window end X address $\geq$ Window start X address

Window end Y address $\geq$ Window start Y address

Detail of window function see "6-7 Display RAM access using Window Function".

The increment control of X and Y addresses by AIM, AYI and AXI registers are as follows.

AIM	Address Increment Timing
0	When writing to Display RAM or reading from Display RAM This is effective when access to successive address area
1	Only when writing to Display RAM This is effective the case of "Read Modify Write"

AYI	AXI	Select Address Increment Operation	Remark
0	0	Address is not increment	(1)
0	1	X-Address is increment	(2)
1	0	Y-Address is increment	(3)
1	1	X and Y both are increment	(4)

(1) Regardless of AIM, no increment for AX and AY register.

(2) According to the setting-up of AIM, automatically change X address.

In accordance with the REF register, AX register and X address becomes as follows.

REF	Transition of AX Register	Transition of X Address
0		Same as AX register
1	→ 00H → 01H → → max →	→ max → maxH → → 00H →

Note: maxH: The internal maximum X-address in each access mode.

(3) According to the setting-up of AIM, automatically change Y address. Regardless of REF, increment by loop of

Transition of AY Register	Transition of Y Address
→ 00H → 01H → → 51H →	Same as AY register

(4) According to the setting-up of AIM, cooperative change X and Y address. When the X address exceed maxH, Y address increment occurs.

REF	Transition of AX and AY Register	Transition of X and Y Address
0	AX: → 00H → 00H → --- → max →	Same as AX and AY register
1	AY: When each AX exceed maxH, increment AY → 00H → 00H → --- → 51H →	AX: → max → maxH → --- → 00H → AY: Same as AY register

Note: maxH: The internal maximum X-address in each access mode.

Following shows address increment in window function access.

REF	Transition of AX and AY Register	Transition of X and Y Address
0	AX: → START Address → START Address+1 → --- → END Address →	Same as AX and AY register
1	AY: When each AX exceed AE, increment AY → START Address → START Address+1 → --- → END Address →	AX: → maxH- (START Address) → maxH- (START Address+1) → --- → maxH- (END Address) → AY: Same as AY register

Note: maxH: The internal maximum X-address in each access mode.

In each operation mode, the following increment operation is performed:

- (i) When gradation display mode and 8-bit access are selected
Address are incremented as described above.
- (ii) When gradation display mode and 16-bit access are selected:
Two bytes are accessed by accessing the RAM once.
The X-addresses increment in the order of 00H,01H,...3EH,and 3FH.

8.2.8 Power Control Register

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	0	1	1	AMPON	HALT	DCON	ACL	0	1	1	0	0	0	0

(At the time of reset: {AMPON, HALT,DCON,ACL}=0H, read address: BH)

ACL

The internal circuit can be initialized. This register is effective only at Master operation mode.

ACL = "0": Normal operation

ACL = "1": Initialization ON

When the reset operation begins internally after ACL register sets to "1", the ACL register is automatically cleared to "0". The internal reset signal has been generated with a clock (built-in oscillation circuit or CK input) for the display. Therefore, install the WAIT period for the display clock two cycles at least. After WAIT period, next operation can handle. Since built-in oscillation circuit and external CK input can not be used in the slave mode, the setting of the ACL register becomes the invalidity. Certainly use the RESB terminal, when the reset is applied on the slave chip.

DCON

The internal booster circuit is set ON/OFF

DCON = "0": Booster circuit OFF

DCON="1": Booster circuit ON

HALT

The conditions of power saving are set ON/OFF by this command.

HALT = "0": Normal operation

HALT="1": Power-saving operation

When setting in the power-saving state, the consumed current can be reduced to a value near to the standby current.

The internal condition at power saving are as follows.

- (a) The oscillating circuit and power supply circuit are stopped.
- (b) The LCD drive is stopped, and output of the segment driver and common driver are VSS level.
- (c) The clock input from CK pin is inhibited.

- (d) The contents of Display RAM data are maintained.
- (e) The operational mode maintains the state of command execution before executing power saving command.

AMPON Command

The internal OP-AMP circuit block (voltage regulator, electronic volume, and voltage conversion circuit) is set ON/OFF by this command.

AMPON = "0": The internal OP-AMP circuit OFF

AMPON = "1": The internal OP-AMP circuit ON

8.2.9 LCD Duty (DS)

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	1	0	0	DS3	DS2	DS1	DS0	0	1	1	0	0	0	0

(At the time of reset: {DS3, DS2, DS1, DS0}=0H, read address: CH)

※ Mark shows "Don't care"

The DS register set to LCD display duty.

DS3	DS2	DS1	DS0	Display width and Duty
0	0	0	0	8-dot width display in Y-direction, 1/10 duty
0	0	0	1	16-dot width display in Y-direction, 1/18 duty
0	0	1	0	24-dot width display in Y-direction, 1/26 duty
0	0	1	1	32-dot width display in Y-direction, 1/34 duty
0	1	0	0	40-dot width display in Y-direction, 1/42 duty
0	1	0	1	48-dot width display in Y-direction, 1/50 duty
0	1	1	0	56-dot width display in Y-direction, 1/58 duty
0	1	1	1	64-dot width display in Y-direction, 1/66 duty
1	0	0	0	72-dot width display in Y-direction, 1/74 duty
1	0	0	1	80-dot width display in Y-direction, 1/82 duty
1	0	1	0	88-dot width display in Y-direction, 1/90 duty
1	0	1	1	96-dot width display in Y-direction, 1/98 duty
1	1	0	0	104-dot width display in Y-direction, 1/106 duty
1	1	0	1	112-dot width display in Y-direction, 1/114 duty
1	1	1	0	120-dot width display in Y-direction, 1/122 duty
1	1	1	1	128-dot width display in Y-direction, 1/130 duty

Partial display can be made possible by setting an arbitrary duty ratio.

8.2.10 Booster Setup (VU)

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	1	0	0	※	VU2	VU1	VU0	0	1	1	0	0	0	0

(At the time of reset: {VU2, VU1, VU0}=0H, read address: DH)

※ Mark shows "Don't care"

The booster steps set to VU register

VU2	VU1	VU0	Booster Operation
0	0	0	Booster disable (No operation)
0	0	1	2 times voltage output
0	1	0	3 times voltage output
0	1	1	4 times voltage output
1	0	0	5 times voltage output
1	0	1	6 times voltage output
1	1	0	Prohibit code
1	1	1	Prohibit code

8.2.11 Bias Setting Register (B)

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	0	※	B2	B1	B0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	0

(At the time of reset: {B2,B1,B0}=0H, read address: EH)

※ Mark shows “Don’t care”

This register is used to set a bias ratio. A bias ratio can be selected from 1/5 to 1/12 by setting B2, B1, and B0.

B2	B1	B0	Bias
0	0	0	1/5 Bias
0	0	1	1/6 Bias
0	1	0	1/7 Bias
0	1	1	1/8 Bias
1	0	0	1/9 Bias
1	0	1	1/10 Bias
1	1	0	1/11 Bias
1	1	1	1/12 Bias

8.2.12 Register Access Control

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	0	TST0	RE2	RE1	RE0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0/1	0/1	0/1

(At the time of reset: {TST0,RE2,RE1,RE0}=0H, read address: FH)

※ Mark shows “Don’t care”

The RE register set to number of register bank. Access to each control register, set RE register at first.

The TST0 register use for test of LSI, Therefore this register must be set to “0”

8-13 Gradation Palette Register (PA0~PA7, PB0~PB7, PC0~PC7)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	PA03 /PA83	PA02 /PA82	PA01 /PA81	PA00 /PA80

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 0H)



D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	※	※	※	PA04 /PA84

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 1H)

(At the time of reset: PA04~PA00 = “00000”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	PA13 /PA93	PA12 /PA92	PA11 /PA91	PA10 /PA90

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 2H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	※	※	※	PA14 /PA94

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 3H)

(At the time of reset: PA14~PA10 = “00101”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	PA23 /PA103	PA22 /PA102	PA21 /PA101	PA20 /PA100

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 4H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	※	※	※	PA24 /PA104

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 5H)

(At the time of reset: PA24~PA20 = “01010”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	0	PA33 /PA113	PA32 /PA112	PA31 /PA111	PA30 /PA110

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 6H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	1	※	※	※	PA34 /PA114

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 7H)

(At the time of reset: PA34~PA30 = “01110”)

※ Mark shows “Don’t care”



D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	0	PA43 /PA123	PA42 /PA122	PA41 /PA121	PA40 /PA120

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 8H)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	1	※	※	※	PA44 /PA124

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: 9H)

(At the time of reset: PA44~PA40 = “10001”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	0	PA53 /PA133	PA52 /PA132	PA51 /PA131	PA50 /PA130

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: AH)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	1	※	※	※	PA54 /PA134

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: BH)

(At the time of reset: PA54~PA50 = “10101”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	0	PA63 /PA143	PA62 /PA142	PA61 /PA141	PA60 /PA140

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: CH)

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	1	※	※	※	PA64 /PA144

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	0	1

(Read address: DH)

(At the time of reset: PA64~PA60 = “11010”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	PA73 /PA153	PA72 /PA152	PA71 /PA151	PA70 /PA150

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 0H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	※	※	※	PA74 /PA154

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 1H)



(At the time of reset: PA74~PA70 = “11111”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	PB03 /PB83	PB02 /PB82	PB01 /PB81	PB00 /PB80

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 2H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	※	※	※	PB04 /PB84

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 3H)

(At the time of reset: PB04~PB00 = “00000”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	PB13 /PB93	PB12 /PB92	PB11 /PB91	PB10 /PB90

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 4H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	※	※	※	PB14 /PB94

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 5H)

(At the time of reset: PB14~PB10 = “00101”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	0	PB23 /PB103	PB22 /PB102	PB21 /PB101	PB20 /PB100

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 6H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	1	※	※	※	PB24 /PB104

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 7H)

(At the time of reset: PB24~PB20 = “01010”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	0	PB33 /PB113	PB32 /PB112	PB31 /PB111	PB30 /PB110

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 8H)



D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	1	※	※	※	PB34 /PB114

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: 9H)

(At the time of reset: PB34~PB30 = “01110”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	0	PB43 /PB123	PB42 /PB122	PB41 /PB121	PB40 /PB120

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: AH)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	1	※	※	※	PB44 /PB124

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: BH)

(At the time of reset: PB44~PB40 = “10001”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	0	PB53 /PB133	PB52 /PB132	PB51 /PB131	PB50 /PB130

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: CH)

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	1	※	※	※	PB54 /PB134

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	0

(Read address: DH)

(At the time of reset: PB54~PB50 = “00101”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	PB63 /PB143	PB62 /PB142	PB61 /PB141	PB60 /PB140

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 0H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	※	※	※	PB64 /PB144

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 1H)

(At the time of reset: PB64~PB60 = “11010”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	PB73 /PB153	PB72 /PB152	PB71 /PB151	PB70 /PB150

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 2H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	※	※	※	PB74 /PB154

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 3H)

(At the time of reset: PB74~PB70 = “11111”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	PC03 /PC83	PC02 /PC82	PC01 /PC81	PC00 /PC80

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 4H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	※	※	※	PC04 /PC84

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 5H)

(At the time of reset: PC04~PC00 = “00000”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	0	PC13 /PC93	PC12 /PC92	PC11 /PC91	PC10 /PC90

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 6H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	1	※	※	※	PC14 /PC94

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 7H)

(At the time of reset: PC14~PC10 = “00101”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	0	PC23 /PC103	PC22 /PC102	PC21 /PC101	PC20 /PC100

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 8H)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	1	※	※	※	PC24 /PC104

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: 9H)

(At the time of reset: PC24~PC20 = “01010”)



※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	0	PC33 /PC113	PC32 /PC112	PC31 /PC111	PC30 /PC110

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: AH)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	1	※	※	※	PC34 /PC114

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: BH)

(At the time of reset: PC34~PC30 = “01110”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	0	PC43 /PC123	PC42 /PC122	PC41 /PC121	PC40 /PC120

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: CH)

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	1	※	※	※	PC44 /PC124

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	0	1	1

(Read address: DH)

(At the time of reset: PC44~PC40 = “10001”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	PC53 /PC133	PC52 /PC132	PC51 /PC131	PC50 /PC130

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: 0H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	※	※	※	PC54 /PC134

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: 1H)

(At the time of reset: PC54~PC50 = “10101”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	PC63 /PC143	PC62 /PC142	PC61 /PC141	PC60 /PC140

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: 2H)



D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	※	※	※	PC64 /PC144

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: 3H)

(At the time of reset: PC64~PC60 = “11010”)

※ Mark shows “Don’t care”

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	PC73 /PC153	PC72 /PC152	PC71 /PC151	PC70 /PC150

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: 4H)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	※	※	※	PC74 /PC154

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: 5H)

(At the time of reset: PC74~PC70 = “11111”)

※ Mark shows “Don’t care”

These gradation palette register set up gradation level. The EM65568 has 32 gradation levels. Gradation level table

4096 color mode

[Three groups of palettes Aj, Bj, and Cj (j=0-15) are available]

Palette	Gradation level	Remarks	Palette	Gradation level	Remarks
0 0 0 0 0	0	gradation palette0 initial value	1 0 0 0 0	16/31	
0 0 0 0 1	1/31		1 0 0 0 1	17/31	gradation palette8 initial value
0 0 0 1 0	2/31		1 0 0 1 0	18/31	
0 0 0 1 1	3/31	gradation palette1 initial value	1 0 0 1 1	19/31	gradation palette9 initial value
0 0 1 0 0	4/31		1 0 1 0 0	20/31	
0 0 1 0 1	5/31	gradation palette2 initial value	1 0 1 0 1	21/31	gradation palette10 initial value
0 0 1 1 0	6/31		1 0 1 1 0	22/31	
0 0 1 1 1	7//31	gradation palette3 initial value	1 0 1 1 1	23/31	gradation palette11 initial value
0 1 0 0 0	8/31		1 1 0 0 0	24/31	
0 1 0 0 1	9/31	gradation palette4 initial value	1 1 0 0 1	25/31	gradation palette12 initial value
0 1 0 1 0	10/31		1 1 0 1 0	26/31	
0 1 0 1 1	11/31	gradation palette5 initial value	1 1 0 1 1	27/31	gradation palette13 initial value
0 1 1 0 0	12/31		1 1 1 0 0	28/31	
0 1 1 0 1	13/31	gradation palette6 initial value	1 1 1 0 1	29/31	gradation palette14 initial value
0 1 1 1 0	14/31		1 1 1 1 0	30/31	
0 1 1 1 0	15/31	gradation palette7 initial value	1 1 1 1 1	31/31	gradation palette15 initial value

256 color mode

[Three groups of palettes Aj,Bj, and Cj (j=0-7) are available]

Palette	Gradation level	Remarks	Palette	Gradation level	Remarks
0 0 0 0 0	0	256 color palette0 initial value	1 0 0 0 0	16/31	
0 0 0 0 1	1/31		1 0 0 0 1	17/31	256 color palette4 initial value
0 0 0 1 0	2/31		1 0 0 1 0	18/31	
0 0 0 1 1	3/31		1 0 0 1 1	19/31	
0 0 1 0 0	4/31		1 0 1 0 0	20/31	
0 0 1 0 1	5/31	256 color palette1 initial value	1 0 1 0 1	21/31	256 color palette5 initial value
0 0 1 1 0	6/31		1 0 1 1 0	22/31	
0 0 1 1 1	7/31		1 0 1 1 1	23/31	
0 1 0 0 0	8/31		1 1 0 0 0	24/31	
0 1 0 0 1	9/31		1 1 0 0 1	25/31	
0 1 0 1 0	10/31	256 color palette2 initial value	1 1 0 1 0	26/31	256 color palette6 initial value
0 1 0 1 1	11/31		1 1 0 1 1	27/31	
0 1 1 0 0	12/31		1 1 1 0 0	28/31	
0 1 1 0 1	13/31		1 1 1 0 1	29/31	
0 1 1 1 0	14/31	256 color palette3 initial value	1 1 1 1 0	30/31	
0 1 1 1 1	15/31		1 1 1 1 1	31/31	256 color palette7 initial value

8.2.14 Display Start Common

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	0	SC3	SC2	SC1	SC0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(At the time of reset: { SC2,SC1,SC0}=0H, read address: 6H)

※ Mark shows “Don’t care”

The SC register set up the scanning start output of the common driver.

SC3	SC2	SC1	SC0	Display starting common when SHIFT=0	Display starting common when SHIFT=1
0	0	0	0	COM0~	COM127~
0	0	0	1	COM8~	COM119~
0	0	1	0	COM16~	COM111~
0	0	1	1	COM24~	COM103~
0	1	0	0	COM32~	COM95~
0	1	0	1	COM40~	COM87~
0	1	1	0	COM48~	COM79~
0	1	1	1	COM56~	COM71~
1	0	0	0	COM64~	COM63~
1	0	0	1	COM72~	COM55~
1	0	1	0	COM80~	COM47~
1	0	1	1	COM88~	COM39~
1	1	0	0	COM96~	COM31~
1	1	0	1	COM104~	COM23~
1	1	1	0	COM112~	COM15~
1	1	1	1	COM120~	COM7~
				Prohibit code	
				Prohibit code	

SHIFT=“0”: COM0 to COM127 shift-scan

SHIFT=“1”: COM127 down to COM0 shift-scan



8.2.15 Display Select Control

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	0	0	0	PWM	GLSB		PS	0	1	1	0	1	0	0

(At the time of reset: {PWM, GLSB, PS} = 0H, read address: 8H)

PS

In 4096 color mode, select 16 gradation level from 32 gradation palette. In 256 color mode, just setting lower 8 gradation.

PS= "0": Lower 8 gradation setting

PS= "1": Upper 8 gradation setting

GLSB

In 256 color mode, for the segment driver of 4-gradation display, select 4 gradations from 8 gradations using the 2 bits written to the corresponding RAM area and the 1 bit supplemented by the gradation LSB circuit. Supplement the 1 bit of data by setting the gradation LSB register (GLSB).

Gradation LSB = "0": Selects 0 as the LSB information on the RAM for 4-gradation segment driver.

Gradation LSB = "1": Selects 1 as the LSB information on the RAM for 4-gradation segment driver.

PWM

The PWM register select the gradation display mode.

PWM = "0": Variable display mode using 16 gradations selected from 32 gradations in 4096 color mode

Variable display mode using 8 gradations selected from 32 gradations in 256 color mode (C256=1)

PWM = "1": 16-gradation fixed display mode

8.2.16 Data Bus Size Select

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	0	0	1	C256	HSW	ABS	WLS	0	1	1	0	1	0	0

(At the time of reset: {C256, HSW, ABS, WLS} = 0H, read address: 9H)

※ Mark shows "Don't care"

The WLS register select data bus size for access from MPU

WLS = "0": The data bus size is 8-bits width

WLS = "1": The data bus size is 16-bits width

When MPU access to control register using 16-bits bus size, high byte data is ignored.

ABS

ABS= "0": normal mode

ABS= "1": change corresponding bit from input data bus

HSW

HSW="0": High speed writing mode off

HSW="1": High speed writing mode on accessing the 8-bit data RAM

C256

C256="0": 4096 color mode

C256="1": 256 color mode

8.2.17 Electronic Volume Register

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	0	DV3	DV2	DV1	DV0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: AH)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	1	※	DV6	DV5	DV4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(Read address: BH)

(At the time of reset: {DV6~DV0} = 00H)

※ **Mark shows "Don't care"**

The DV register can control V0 voltage.

The DV register has 7-bits, so can select 128 level voltage.

DV6	DV5	DV4	DV3	DV2	DV1	DV0	Output voltage
0	0	0	0	0	0	0	Smaller
0	0	0	0	0	0	1	:
			:				:
			:				:
1	1	1	1	1	1	0	:
1	1	1	1	1	1	1	Larger

The output voltage at VREG is specified by equation (1).

$$VREG = VREF * N \text{ -----(1)}$$

(N: Number of boosting steps)

The LCD drive voltage V0 is determined by VREG level and electronic volume code equation (2).

$$V0 = 0.5 * VREG + M * (VREG - 0.5VREG) / 127 \text{ -----(2)}$$

(M: DV6 to DV0 register values)

In order to prevent transient voltage from generating when an electronic volume code is set, the circuit design is such that the set value is not reflected as a level immediately after only the upper bits(DV6-DV4) of the electronic code have been set. The set value becomes valid when the lower bits (DV3-DV0) of the electronic control volume code have also been set.

8.2.18 Resistance Ratio of CR Oscillator

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	1	※	RF2	RF1	RF0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	0

(At the time of reset: {RF2, RF1, RF0} = 0H, read address: DH)

※ Mark shows “Don’t care”

The RF registers can control resistance ratio of CR oscillator. Therefore frame frequency can change RF registers setting.

When change RF registers value, should be need to check LCD display quality.

RF2	RF1	RF0	Operation
0	0	0	Initial Resistance Ratio
0	0	1	0.7 times of initial Resistance Ratio
0	1	0	0.85 times of initial Resistance Ratio
0	1	1	1.15 times of initial Resistance Ratio
1	0	0	1.3 times of initial Resistance Ratio
1	0	1	Prohibit Code
1	1	0	Prohibit Code
1	1	1	Prohibit Code

8.2.19 Extended power control

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	1	1	0	BF1	BF0	HPM	DIS	0	1	1	0	1	0	0

(At the time of reset: {HPM, DIS} = 0H, {BF1,BF0}=0H;read address: EH)

The DIS register can control capacitors discharged that connected between the power supply V0-V4 for LCD drive voltage and VSS.

When using this register, refer to 6-30 (Discharge circuit).

DIS = “0”: Discharge OFF

DIS = “1”: Discharge start

The HPM register is the power control for the power supply circuit for liquid crystal drive.

HPM= “H”: High power mode

HPM= “L”: Normal mode

BF1~BF0: The operating frequency in the booster is selected. When the boosting frequency is high, the driving ability of booster become high, but the current consumption is increased. Adjust the boosting frequency considering the external capacitors and the current consumption.

BF1	BF0	Operating clock frequency in the booster
0	0	1.5K Hz * 8
0	1	1.5K Hz * 4
1	0	1.5K Hz * 2
1	1	1.5 K Hz

8.2.20 Internal Register Read Address

D7	D6	D5	D4	D3	D2	D1	D0	CSB	RS	RDB	WRB	RE2	RE1	RE0
1	1	0	1	RA3	RA2	RA1	RA0	0	1	1	0	1	0	0

(At the time of reset: {RA3,RA2,RA1,RA0} = BH)

The RA register set to specify the address for register read operation. The EM65568 has many registers and has register bank. Therefore, it is need 4-steps to read to read the specific register in maximum case.

- (1) Write 04H to RE register for access to RA register.
- (2) Writes specific register address to RA register.
- (3) Write specific register bank to RE register.
- (4) Read specific contents.

8.2.21 Internal Register Data Read

D7	D6	D5	D4	D3	D2	D1	D0
※	※	※	※	Internal Register read data			

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	0	1	0/1	0/1	0/1

※ Mark shows “Don’t care”

This command is used to read data from an internal register. Before executing the command, you need to set the address and RE flag for reading data from the internal register.

8.2.22 Windows End X Address

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	EX3	EX2	EX1	EX0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {EX3,EX2,EX1,EX0} = 0H, read address: 0H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	EX7	EX6	EX5	EX4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {EX7, EX6,EX5,EX4} = 0H, read address: 1H)

※ Mark shows “Don’t care”

The EX registers set to X direction end address for window function.

8.2.23 Windows End Y Address

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	EY3	EY2	EY1	EY0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {EY3, EY2, EY1, EY0} = 0H, read address: 2H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	EY7	EY6	EY5	EY4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {EY7, EY6, EY5, EY4} = 0H, read address: 3H)

※ Mark shows “Don’t care”

The EY registers set to Y direction end address for window function.

8.2.24 Line Reverse Start Address

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	LS3	LS2	LS1	LS0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {LS3,LS2,LS1,LS0} = 0H, read address: 4H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	※	LS6	LS5	LS4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {LS6, LS5, LS4} = 0H, read address: 5H)

※ Mark shows “Don’t care”

The LS registers set to line reverse start address. Moreover, must keep following two conditions.

- (1) $00H \leq LS \leq 7FH$
- (2) $LS \leq LE$ LE: Line reverse end address

8.2.25 Line Reverse End Address

D7	D6	D5	D4	D3	D2	D1	D0
0	1	1	0	LE3	LE2	LE1	LE0

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {LE3, LE2, LE1, LE0} = 0H, read address: 6H)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	※	LE6	LE5	LE4

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {LE6, LE5, LE4} = 0H, read address: 7H)

※ Mark shows “Don’t care”

The LE registers set to line reverse end address. Moreover, must keep following two conditions.

- (3) $00H \leq LS \leq 7FH$
- (4) $LS \leq LE$ LS: Line reverse start address

8.2.26 Line Reverse Control

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	0	※	※	BT	LREV

CSB	RS	RDB	WRB	RE2	RE1	RE0
0	1	1	0	1	0	1

(At the time of reset: {BT,LREV} = 0H, read address: 8H)

※ Mark shows “Don’t care”

The LREV registers control line reverse display function.

LREV = “0”: Normal display (Not reverse).

LREV = “1”: Line reverse display enable.

The area specified by Line Reverse Start/End Register reverse display.

The reverse type is selectable by BT register.

When use Line Reverse Display function, LS and LE registers must keep following relation.

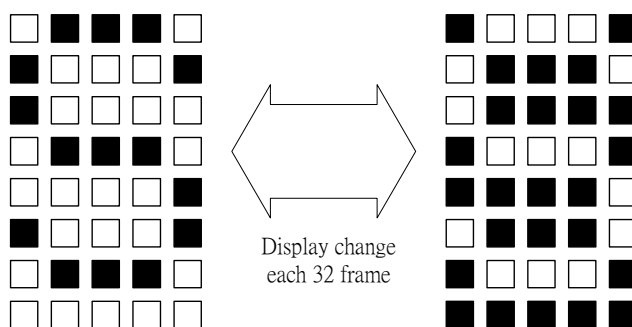
$$LS \leq LE$$

The BT register control line reverse type. This is an option of line reverse display function.

This BTs setting is only available in case of LREV="1"

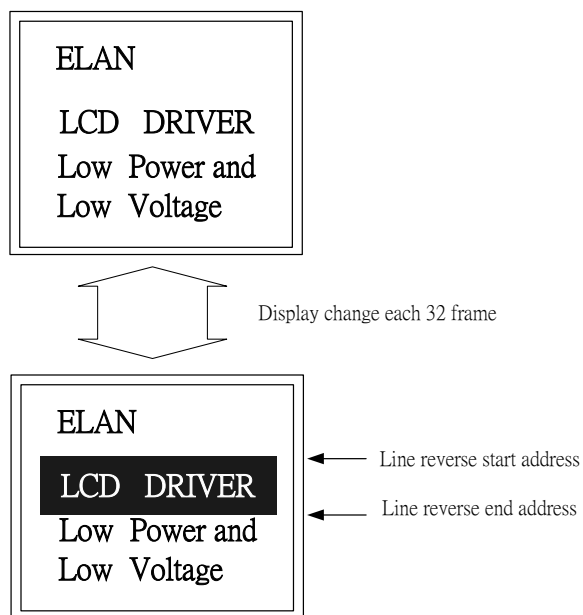
BT = "0": Reverse display

BT = "1": Reverse display at each 32 frame.



Blink example(LREV="1", BT="1")

The special segment outputs aren't influenced by LREV and BT setting. The display area by selected COMA and COMB common outputs aren't also influenced.



Blink example (LREV="1", BT="1")



9. Relationship between Setting and Common/Display RAM

The relationship between the COM pin numbers and the addresses in the Y-direction on the display RAM changes according to the SHIFT command. LCD Duty Set command. Display Starting Common Position Set command, and Display Starting Line Set command.

When “0” is selected for the display starting line:

The relationship between the COM pin and the addresses in the vertical direction of the display RAM (hereafter called MY) changes on an 15 dots basis according to the LCD Duty Set command and the Display Starting Common Position Set command. When the SHIFT bit is “0”, the common position change in the forward direction. When “1” they change reverse direction. When “0” is selected as the values for LA7 to LA0 in the Display Starting Line Set command, the MY number corresponding to the display starting position is “0”. The MY numbers are sequentially shifted backward when display occurs. In any case, the relations of COMA = MY128 and COMB = MY129 do not change.

When non-zero is selected for the display starting line:

The relationship between the COM pins and the addresses in the vertical direction on the display RAM, MY changes on an 15 dots basis according to the information in the LCD Duty Set command and Display Starting Common Position Set command. The common positions change in the forward when the SHIFT bit is “0”, and change in the reverse direction when the SHIFT bit is “1”. If non-zero is selected for the values for LA7 to LA0 by the Display Starting Line set command. the MY number corresponding to the display starting position shifts by the set value. The MY number shifts backward when display occurs. If it exceeds 128, it returns to 0, and the shifts sequentially. In any case, the relations of COMA = MY129 and COMB = MY129 do not change.

10. Absolute maximum ratings

10.1 Absolute maximum ratings

Item	Symbol	Condition	Pin use	Rating	Unit
Supply voltage (1)	VDD	Ta=25℃	VDD	-0.3 ~ + 4.0	V
Supply voltage (2)	VEE		VEE	-0.3 ~ + 4.0	V
Supply voltage (3)	VOUT		VOUT	-0.3 ~ + 16.0	V
Supply voltage (4)	VREG		VREG	-0.3 ~ + 16.0	V
Supply voltage (5)	V0		V0	-0.3 ~ + 16.0	V
Supply voltage (6)	V1,V2,V3,V4		V1,V2,V3,V4	-0.3 ~ V0+ 0.3	V
Input voltage	VI		*1	-0.3 ~ VDD+ 0.3	V
Storage temperature	Tstg			-45 ~ +125	℃

10.2 Recommended operating conditions

Item	Symbol	Pin	Min.	Typ.	Max.	Unit	Note
Supply voltage	VDD1	VDD	2.2		3.3	V	*1
	VDD2		2.4		3.3	V	*2
	VEE	VEE	2.4		3.3	V	*3
Operating voltage	V0	V0	5		15	V	*4
	VOUT	VOUT			15	V	
	VREG	VREG			VOUT*0.9	V	
	VREF	VREF	2.1		3.3	V	*5
Operating temperature	Topr		-30		85	℃	

*1 In case of VBA output doesn't use.

*2 In case of VBA output use.

*3 Power supply for internal boosting circuit. If applied voltage same as VDD, connect to VDD.

*4 Voltage V0>V1>V2>V3>V4>VSS must always satisfied.

*5 Voltage VEE > VREF must always satisfied.



11. DC characteristics

VSS=0V , VDD = 2.2 ~3.3V , Ta = -30 ~85 °C

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Pin used
High level input voltage	VIH			0.8VDD	0.9VDD	VDD	V	※ 1
Low level input voltage	VIL			0	0.1VDD	0.2VDD	V	※ 1
High level output current	IOH1	VOH = VDD-0.4V		-2.4	-3.2	-4.5	mA	※ 2
Low level output current	IOL1	VOL= 0.4V		2.4	3.2	4.5	mA	※ 2
High level output current	IOH2	VOH = VDD-0.4V		-0.8	-1.0	-1.2	mA	※ 3
Low level output current	IOL2	VOL= 0.4V		0.8	1.0	1.2	mA	※ 3
Input leakage current	ILI1	VI = VSS or VDD		-2	0	2	μA	※ 4
	ILI2	VI = VSS or VEE		-0.3	0	0.3	μA	※ 5
Output leakage current	ILO	VI = VSS or VDD		-2	0	2	μA	※ 6
LCD driver output resistance	RON	Δ Von = 0.5V	V0=10V	1.0	1.3	1.6	KΩ	※ 7
			V0=6V	1.2	1.7	2.2		
Standby current through VDD pin	ISTB	CK=0, CSB=VDD, Ta=25 ℃ , VDD=3V			5	15	μA	※ 8
Oscillator frequency (variable gradation mode, 4096 or 256 color mode)	Fosc1	VDD=3V , Ta=25℃ , Rf setting = (Rf2,Rf1,Rf0)=(000)		450	530	610	KHz	※ 9
Oscillator frequency (16 gradation mode)	Fosc2	VDD=3V, Ta=25 ℃ , Rf setting = (Rf2,Rf1,Rf0)=(000)		255	300	345	KHz	※10
Oscillator frequency (8 gradation mode)	Fosc3	VDD=3V, Ta=25 ℃ , Rf setting = (Rf2,Rf1,Rf0)=(000)		115	135	155	KHz	※11
Oscillator frequency (monochrome mode)	Fosc4	VDD=3V , Ta=25℃ , Rf setting = (Rf2,Rf1,Rf0)=(000)		18	21	24	KHz	※12
Booster output voltage on VOUT pin	VOUT1	Six times boosting RL = 500KΩ (VOUT-VSS)		6*VEE *0.95			V	※13
	VOUT1	Five times boosting RL = 500KΩ (VOUT-VSS)		5*VEE *0.95			V	※14
	VOUT2	Four times boosting RL = 500KΩ (VOUT-VSS)		4*VEE *0.95			V	※15
	VOUT3	Three times boosting RL = 500KΩ (VOUT-VSS)		3*VEE *0.95			V	※16
	VOUT4	Two times boosting RL = 500KΩ(VOUT-VSS)		2*VEE *0.95			V	※17
Current consumption	IDD1	VDD = 3V, 6 times booster, All ON pattern (color), display on			320	420	μA	※18
	IDD2	VDD = 3V, 6 times booster, Checker pattern (color)			370	480	μA	※19
	IDD3	VDD = 3V, 5 times booster, All ON pattern (color), display on			220	290	μA	※20
	IDD4	VDD = 3V, 5 times booster, Checker pattern (color)			260	340	μA	※21
	IDD5	VDD = 3V, 6 times booster, ALL ON pattern (mono), display off		150	200	300	uA	※22
VBA output voltage	VBA	VDD =2.4V~3.3V		0.9VDD*0.97	0.9VDD	0.9VDD*1.03	V	VBA
VREG output voltage	VREG	VEE =2.4~3.3V,VREF=0.9VEE, N times boosting (N=2 to 6)		(VREF*N) *0.95	VREF*N *1	(VREF*N) *1.03	V	※23



Relationship of oscillating frequency (fosc) and external clock frequency (fCK) to LCD frame frequency (fFLM) is each display mode

Original oscillating clock	Display mode	Ratio of display duty cycle (1/D)				Pin used
		1/130 to 1/82	1/74 to 1/42	1/34 to 1/26	1/18 to 1/10	
When use built-in oscillating circuit (fosc)	Variable gradation	$fosc / (2 \cdot 31 \cdot D)$	$fosc / (4 \cdot 31 \cdot D)$	$fosc / (8 \cdot 31 \cdot D)$	$fosc / (16 \cdot 31 \cdot D)$	FLM
	Simple gradation (4096 color)	$fosc / (2 \cdot 15 \cdot D)$	$fosc / (4 \cdot 15 \cdot D)$	$fosc / (8 \cdot 15 \cdot D)$	$fosc / (16 \cdot 15 \cdot D)$	
	Simple gradation (256 color)	$fosc / (2 \cdot 7 \cdot D)$	$fosc / (4 \cdot 7 \cdot D)$	$fosc / (8 \cdot 7 \cdot D)$	$fosc / (16 \cdot 7 \cdot D)$	
	Monochrome	$fosc / (2 \cdot 1 \cdot D)$	$fosc / (4 \cdot 1 \cdot D)$	$fosc / (8 \cdot 1 \cdot D)$	$fosc / (16 \cdot 1 \cdot D)$	
When use external clock from CK pin. (fCK)	Variable gradation	$fCK / (2 \cdot 31 \cdot D)$	$fCK / (4 \cdot 31 \cdot D)$	$fCK / (8 \cdot 31 \cdot D)$	$fCK / (16 \cdot 31 \cdot D)$	
	Simple gradation (4096 color)	$fCK / (2 \cdot 15 \cdot D)$	$fCK / (4 \cdot 15 \cdot D)$	$fCK / (8 \cdot 15 \cdot D)$	$fCK / (16 \cdot 15 \cdot D)$	
	Simple gradation (256 color)	$fCK / (2 \cdot 7 \cdot D)$	$fCK / (4 \cdot 7 \cdot D)$	$fCK / (8 \cdot 7 \cdot D)$	$fCK / (16 \cdot 7 \cdot D)$	
	Monochrome	$fCK / (2 \cdot 1 \cdot D)$	$fCK / (4 \cdot 1 \cdot D)$	$fCK / (8 \cdot 1 \cdot D)$	$fCK / (16 \cdot 1 \cdot D)$	

Pin used:

- ※ 1 D0-D15, CSB, RS, M/S, M86, RDB, WRB, CK, CKS, CLK, LP, FLM, M, P/S, RESB, TEST pins.
- ※ 2 D0~D15 pins
- ※ 3 LP, FLM, M, CLK pins
- ※ 4 CSB, RS, M/S, M86, RDB, WRB, CK, CKS, P/S, RESB, TEST pins
- ※ 5 VREF pin
- ※ 6 Applied when D0~D15, CLK, LP, FLM, and M are in the state of high impedance.
- ※ 7 SEGA0~SEGA127, SEGB0~SEGB127, SEGC0~SEGC127. DSEGA0~DSEGA1, DSEGB0~DSEGB0 , DSEGC0~DSEGC1 , COM0~COM79, COMA, COMB pins Resistance when being applied 0.5V between each output pin and each power supply (V0, V1, V2, V3, V4) and when being applied 1/9 bias.
- ※ 8 VDD pin, VDD pin current without load at the stoppage of original oscillating clock and at non-select (CSB=VDD)
- ※ 9 Oscillating frequency, when using the built-in oscillating circuit (variable gradation display mode, 4096 or 256 color mode)
- ※ 10 Oscillating frequency, when using the built-in oscillating circuit (16 gradation fixed display mode)
- ※ 11 Oscillating frequency, when using the built-in oscillating circuit (8 gradation fixed display mode)
- ※ 12 Oscillating frequency, when using the built-in oscillating circuit (monochrome display mode)
- ※ 13 VOUT pin. When using the built-in oscillating circuit, the built-in power supply is used, and boosting 6 times is used, this pin is applied. VEE=2.4~3.3 V, The electronic control is preset (The code is ("1 1 1 1 1 1")). Measuring conditions: bias=1/5~1/9, 1/130 duty, without load. RL=500 KΩ (between VOUT and VSS), C1=C2=1.0μF, C3=0.1μF, DCON=AMPON="1", BF="11"
- ※ 14 VOUT pin. When using the built-in oscillating circuit, the built-in power supply is used, and boosting 5 times is used, this pin is applied. VEE=2.4~3.3 V, The electronic control is preset (The code is ("1 1 1 1 1 1")). Measuring conditions: bias=1/5~1/12, 1/130 duty, without load. RL=500 KΩ (between VOUT and VSS), C1=C2=1.0μF, C3=0.1μF, DCON=AMPON="1", BF="11"

- ※ **15** VOUT pin. When using the built-in oscillating circuit, the built-in power supply is used, and boosting 4 times is used, this pin is applied. VEE=2.4~3.3 V, The electronic control is preset (The code is ("1 1 1 1 1 1")). Measuring conditions: bias=1/5~1/12, 1/130 duty, without load. RL=500 K Ω (between VOUT and VSS), C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", BF="11"
- ※ **16** VOUT pin. When using the built-in oscillating circuit, the built-in power supply is used, and boosting 3 times is used, this pin is applied. VEE=2.4~3.3 V, The electronic control is preset (The code is ("1 1 1 1 1 1")). Measuring conditions: bias=1/5~1/12, 1/130 duty, without load. RL=500 K Ω (between VOUT and VSS), C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", BF="11"
- ※ **17** VOUT pin. When using the built-in oscillating circuit, the built-in power supply is used, and boosting 2 times is used, this pin is applied. VEE=2.4~3.3 V, The electronic control is preset (The code is ("1 1 1 1 1 1")). Measuring conditions: bias=1/5~1/12, 1/130 duty, without load. RL=500 K Ω (between VOUT and VSS), C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", BF="11"
- ※ **18** VDD, VEE pin. When the built-in oscillating circuit and built-in power supply are used and there is no access from MPU. This pin is applied. Boosting 6 times is used the electronic control is preset (The code is ("1 1 1 1 1 1")). Display ALL ON pattern {Rf2, Rf1, Rf0 = ("0 0 0")} (on 4096 color display mode) and LCD driver pin with no load. Measuring conditions: VDD=VEE, VBA=VREF, C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", NLIN="0", (BF1,BF0)=(1,1), 1/130 duty, 1/9 bias, BF="11"
- ※ **19** VDD, VEE pin. When the built-in oscillating circuit and built-in power supply are used and there is no access from MPU. This pin is applied. Boosting 6 times is used the electronic control is preset (The code is ("1 1 1 1 1 1")). Display a checkered pattern, {Rf2, Rf1, Rf0 = ("0 0 0")} (on 4096 color display mode) and LCD driver pin with no load. Measuring conditions: VDD=VEE, VBA=VREF, C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", NLIN="0", (BF1,BF0)=(1,1), 1/130 duty, 1/9 bias, BF="11"
- ※ **20** VDD, VEE pin. When the built-in oscillating circuit and built-in power supply are used and there is no access from MPU. This pin is applied. Boosting 5 times is used the electronic control is preset (The code is ("1 1 1 1 1 1")). Display ALL ON pattern, {Rf2, Rf1, Rf0 = ("0 0 0")} (on 4096 color display mode) and LCD driver pin with no load. Measuring conditions: VDD=VEE, VBA=VREF, C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", NLIN="0", (BF1,BF0)=(1,1), 1/130 duty, 1/9 bias, BF="11"
- ※ **21** VDD, VEE pin. When the built-in oscillating circuit and built-in power supply are used and there is no access from MPU. This pin is applied. Boosting 5 times is used the electronic control is preset (The code is ("1 1 1 1 1 1")). Display a checkered pattern, {Rf2, Rf1, Rf0 = ("0 0 0")} (on 4096 color display mode) and LCD driver pin with no load. Measuring conditions: VDD=VEE, VBA=VREF, C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", NLIN="0", (BF1,BF0)=(1,1), 1/130 duty, 1/9 bias, BF="11"
- ※ **22** VDD, VEE pin. When the built-in oscillating circuit and built-in power supply are used and there is no access from MPU. This pin is applied. Boosting 6 times is used the electronic control is preset (The code is ("1 1 1 1 1 1")). Display OFF, {Rf2, Rf1, Rf0 = ("0 0 0")} (on mono color display mode) and LCD driver pin with no load. Measuring conditions: VDD=VEE, VBA=VREF, C1=C2=1.0 μ F, C3=0.1 μ F, DCON=AMPON="1", NLIN="0", (BF1,BF0)=(1,1), 1/130 duty, 1/9 bias, BF="11"



- ※ **23** VREG pin. Measuring conditions: N times boosting(N=2~5), electronic control = “1 1 1 1 1 1”, Display a checkered pattern , DCON=AMPON=’1’, NLIN=’0’, 1/130 duty , VDD=VEE , VBA=VREF , C1=C2=1.0μF, C3=0.1μF , no load

Note: The capacitor C1 is use for booster related pin.

CAP1+ , CAP1- , CAP2+ , CAP2- , CAP3+ , CAP3- , CAP4+ , CAP4- , CAP5+ , CAP5- VOUT

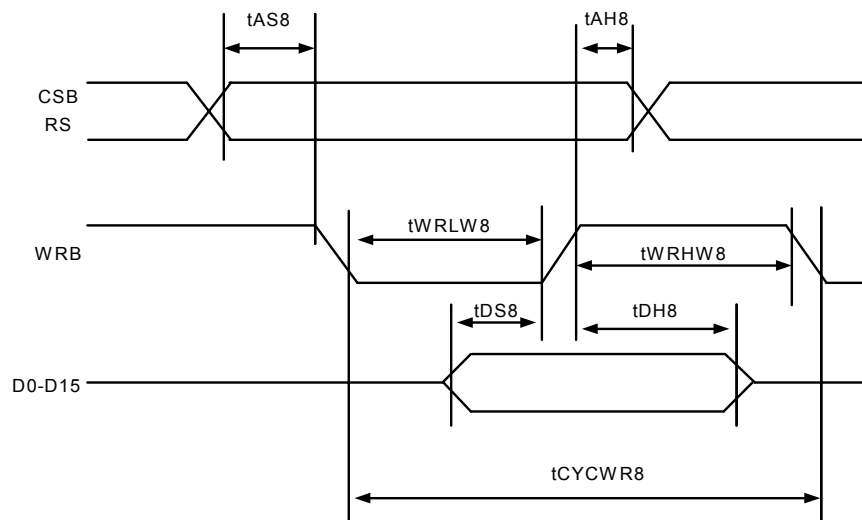
The capacitor C2 is use for bias related pin.

V0 , V1 , V2 , V3 , V4

The capacitor C3 is use for VREG pin.

12. AC characteristic

(1) 80-family MCU write timing



VSS=0V, VDD = 2.7~3.3V, Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH8		20			ns	CSB
Address setup time	tAS8		0			ns	RS
System cycle time in write	tCYCWR8		200			ns	WRB (R/WB)
Write pulse "L" width	tWRLW8		30			ns	
Write pulse "H" width	tWRHW8		160			ns	
Data setup time	tDS8		20			ns	D0~D15
Data hold time	tDH8		5			ns	

VSS=0V, VDD = 2.4~2.7V, Ta = -30~+85°C

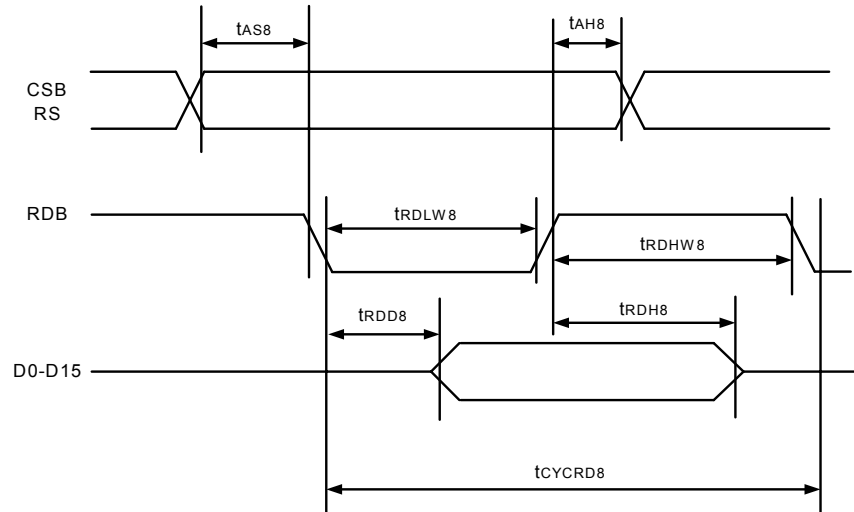
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH8		30			ns	CSB
Address setup time	tAS8		0			ns	RS
System cycle time in write	tCYCWR8		300			ns	WRB (R/WB)
Write pulse "L" width	tWRLW8		40			ns	
Write pulse "H" width	tWRHW8		250			ns	
Data setup time	tDS8		30			ns	D0~D15
Data hold time	tDH8		10			ns	

VSS=0V, VDD = 2.2~2.4V, Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH8		40			ns	CSB
Address setup time	tAS8		0			ns	RS
System cycle time in write	tCYCWR8		500			ns	WRB (R/WB)
Write pulse "L" width	tWRLW8		50			ns	
Write pulse "H" width	tWRHW8		440			ns	
Data setup time	tDS8		40			ns	D0~D15
Data hold time	tDH8		20			ns	

Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

(2) 80-family MCU read timing



VSS=0V , VDD = 2.7~3.3V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH8		0			ns	CSB
Address setup time	tAS8		0			ns	RS
System cycle time in read	tCYCRD8		380			ns	
Read pulse "L" width	tRDLW8		200			ns	RDB(E)
Read pulse "H" width	tRDHW8		170			ns	
Data setup time	tRDD8	CL = 80 pF			210	ns	D0~D15
Data hold time	tRDH8		10			ns	

VSS=0V , VDD = 2.4~2.7V , Ta = -30~+85°C

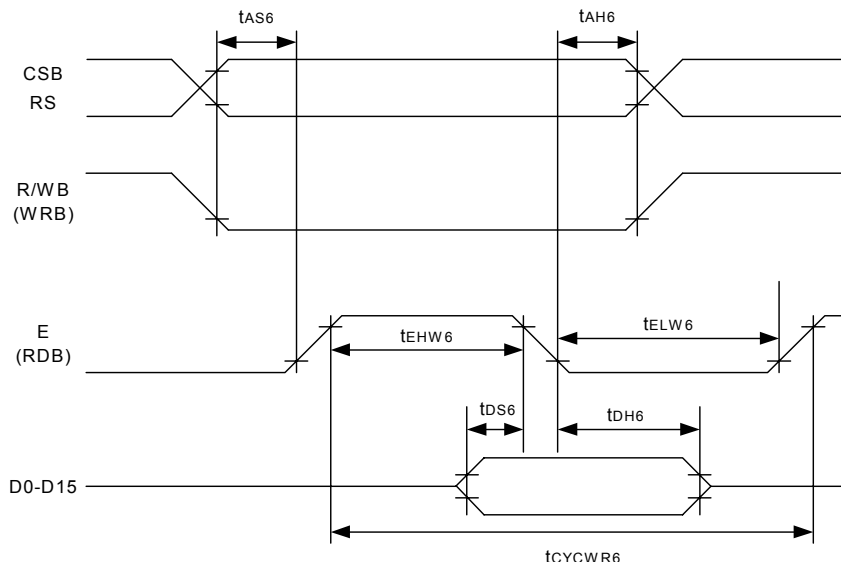
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH8		0			ns	CSB
Address setup time	tAS8		0			ns	RS
System cycle time in read	tCYCRD8		540			ns	
Read pulse "L" width	tRDLW8		290			ns	RDB(E)
Read pulse "H" width	tRDHW8		230			ns	
Data setup time	tRDD8	CL = 80 pF			300	ns	D0~D15
Data hold time	tRDH8		10			ns	

VSS=0V , VDD = 2.2~2.4V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH8		0			ns	CSB
Address setup time	tAS8		0			ns	RS
System cycle time in read	tCYCRD8		840			ns	
Read pulse "L" width	tRDLW8		440			ns	RDB(E)
Read pulse "H" width	tRDHW8		380			ns	
Data setup time	tRDD8	CL = 80 pF			450	ns	D0~D15
Data hold time	tRDH8		10			ns	

Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

(3) 68-family MCU write timing



VSS=0V , VDD = 2.7 ~3.3V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH6		20			ns	CSB RS
Address setup time	tAS6		0			ns	
System cycle time in write	tCYCWR6		200			ns	RDB(E)
Write pulse "L" width	tELW6		160			ns	
Write pulse "H" width	tEHW6		30			ns	
Data setup time	tDS6		20			ns	D0~D15
Data hold time	tDH6		5			ns	

VSS=0V , VDD = 2.4 ~2.7V , Ta = -30~+85°C

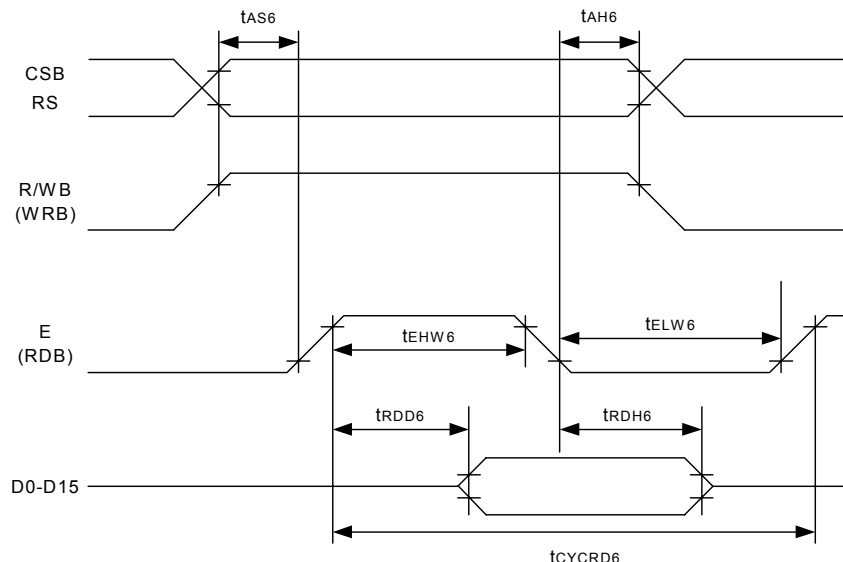
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH6		30			ns	CSB RS
Address setup time	tAS6		0			ns	
System cycle time in write	tCYCWR6		300			ns	RDB(E)
Write pulse "L" width	tELW6		250			ns	
Write pulse "H" width	tEHW6		40			ns	
Data setup time	tDS6		30			ns	D0~D15
Data hold time	tDH6		10			ns	

VSS=0V , VDD = 2.2 ~2.4V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH6		40			ns	CSB RS
Address setup time	tAS6		0			ns	
System cycle time in write	tCYCWR6		500			ns	RDB(E)
Write pulse "L" width	tELW6		440			ns	
Write pulse "H" width	tEHW6		50			ns	
Data setup time	tDS6		40			ns	D0~D15
Data hold time	tDH6		20			ns	

Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

(4) 68-family MCU read timing



VSS=0V , VDD = 2.7~3.3V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH6		0			ns	CSB
Address setup time	tAS6		0			ns	RS
System cycle time in read	tCYCRD6		380			ns	
Write pulse "L" width	tELW6		200			ns	RDB(E)
Write pulse "H" width	tEHW6		170			ns	
Data setup time	tRDD6	CL=50pF			210	ns	D0~D15
Data hold time	tRDH6		10			ns	

VSS=0V , VDD = 2.4~2.7V , Ta = -30~+85°C

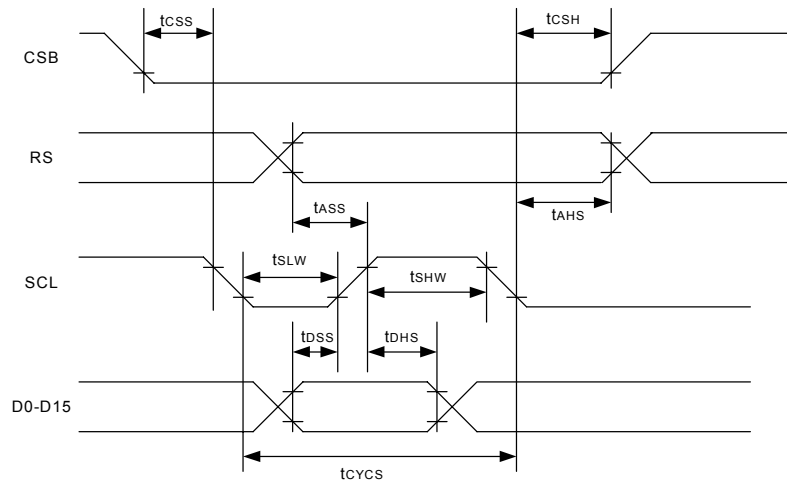
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH6		0			ns	CSB
Address setup time	tAS6		0			ns	RS
System cycle time in read	tCYCRD6		540			ns	
Write pulse "L" width	tELW6		290			ns	RDB(E)
Write pulse "H" width	tEHW6		230			ns	
Data setup time	tRDD6	CL=50pF			300	ns	D0~D15
Data hold time	tRDH6		10			ns	

VSS=0V , VDD = 2.2~2.4V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Address hold time	tAH6		0			ns	CSB
Address setup time	tAS6		0			ns	RS
System cycle time in read	tCYCRD6		1000			ns	
Write pulse "L" width	tELW6		450			ns	RDB(E)
Write pulse "H" width	tEHW6		500			ns	
Data setup time	tRDD6	CL=50pF			650	ns	D0~D15
Data hold time	tRDH6		10			ns	

Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

(5) Serial interface timing diagram



VSS=0V , VDD = 2.7~3.3V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Serial clock period	tCYCS		200			ns	SCL
SCL pulse "H" width	tSHW		80			ns	
SCL pulse "L" width	tSLW		80			ns	
Address setup time	tASS		40			ns	RS
Address hold time	tAHS		40			ns	
Data setup time	tDSS		80			ns	SDA
Data hold time	tDHS		80			ns	
CSB-SCL time	tCSS		40			ns	CSB
CSB hold time	tCSH		40			ns	

VSS=0V , VDD = 2.4~2.7V , Ta = -30~+85°C

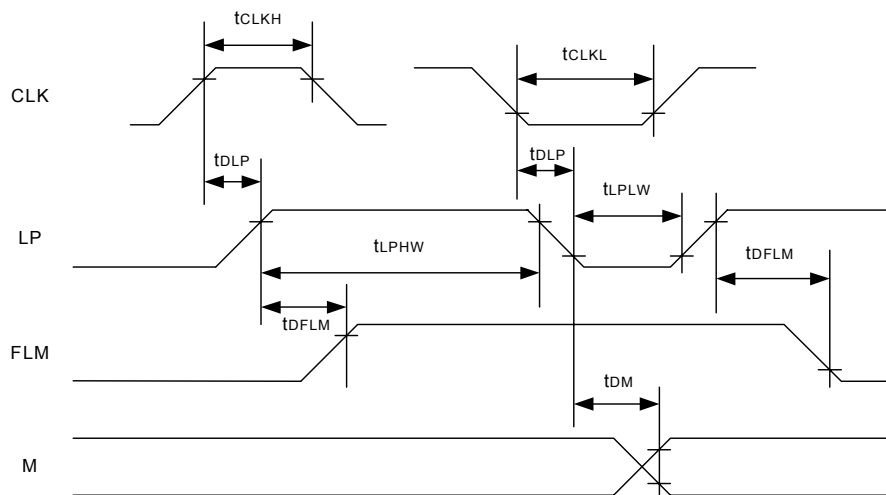
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Serial clock period	tCYCS		200			ns	SCL
SCL pulse "H" width	tSHW		80			ns	
SCL pulse "L" width	tSLW		80			ns	
Address setup time	tASS		50			ns	RS
Address hold time	tAHS		50			ns	
Data setup time	tDSS		80			ns	SDA
Data hold time	tDHS		80			ns	
CSB-SCL time	tCSS		50			ns	CSB
CSB hold time	tCSH		60			ns	

VSS=0V , VDD = 2.2~2.4V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Serial clock period	tCYCS		230			ns	SCL
SCL pulse "H" width	tSHW		100			ns	
SCL pulse "L" width	tSLW		100			ns	
Address setup time	tASS		80			ns	RS
Address hold time	tAHS		80			ns	
Data setup time	tDSS		100			ns	SDA
Data hold time	tDHS		100			ns	
CSB-SCL time	tCSS		80			ns	CSB
CSB hold time	tCSH		100			ns	

Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

(6) Display control timing



Input timing (Slave mode) VSS=0V , VDD = 2.4~3.3V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
CLK pulse "H" width	tCLKH		1.6			μs	CLK
CLK pulse "L" width	tCLKL		1.6			μs	
LP pulse "H" width	tLPHW		50			μs	LP
LP pulse "L" width	tLPLW		50			μs	
LP delay time	tDLP		-1		1	μs	
FLM delay time	tDFLM		-1		1	μs	FLM
M delay time	tDM		-1		1	μs	M

Input timing (Slave mode) VSS=0V , VDD = 2.2~2.4V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
CLK pulse "H" width	tCLKH		1.6			μs	CLK
CLK pulse "L" width	tCLKL		1.6			μs	
LP pulse "H" width	tLPHW		50			μs	LP
LP pulse "L" width	tLPLW		50			μs	
LP delay time	tDLP		-1		1	μs	
FLM delay time	tDFLM		-1		1	μs	FLM
M delay time	tDM		-1		1	μs	M

output timing (Master mode) VSS=0V , VDD = 2.4~3.3V , Ta = -30~+85°C

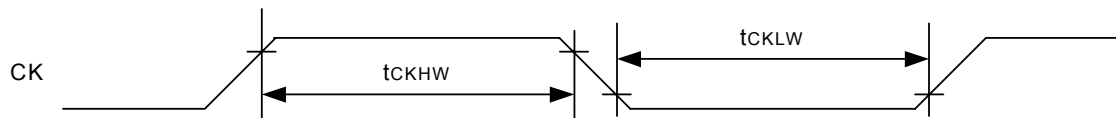
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
LP delay time	tDLP	CL = 15 pF	-500		500	ns	LP
FLM delay time	tDFLM		-500		500	ns	FLM
M delay time	tDM		-500		500	ns	M

output timing (Master mode) VSS=0V , VDD = 2.2~2.4V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
LP delay time	tDLP	CL = 15 pF	-1000		1000	μs	LP
FLM delay time	tDFLM		-1000		1000	μs	FLM
M delay time	tDM		-1000		1000	μs	M

Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

(7) Master clock input timing



VSS=0V , VDD = 2.4~3.3V , Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
CK pulse "H" width (1)	tCKHW1		1.2		1.4	μs	CK
CK pulse "L" width (1)	tCKLW1		1.2		1.4	μs	※ 1
CK pulse "H" width (2)	tCKHW2		5.4		6.5	μs	CK
CK pulse "L" width (2)	tCKLW2		5.4		6.5	μs	※ 2
CK pulse "H" width (3)	tCKHW3		3.8		4.5	μs	CK
CK pulse "L" width (3)	tCKLW3		3.8		4.5	μs	※ 3

VSS=0V , VDD = 2.2~2.4V , Ta = -30~+85°C

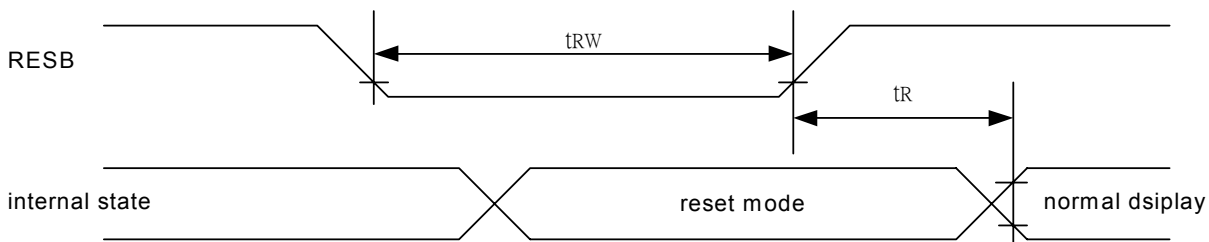
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
CK pulse "H" width (1)	tCKHW1	Note1	1.2		1.4	μs	CK
CK pulse "L" width (1)	tCKLW1	Note1	1.2		1.4	μs	※ 1
CK pulse "H" width (2)	tCKHW2	Note2	5.4		6.5	μs	CK
CK pulse "L" width (2)	tCKLW2	Note2	5.4		6.5	μs	※ 2
CK pulse "H" width (3)	tCKHW3	Note3	3.8		4.5	μs	CK
CK pulse "L" width (3)	tCKLW3	Note3	3.8		4.5	μs	※ 3

※ 1 Applied when the gradation display mode. MON="0" , PWM="0"

※ 2 Applied when the simple gradation mode. MON="0" , PWM="1"

※ 3 Applied when the monochrome mode. MON="1"

(8) Reset timing



VSS=0V, VDD = 2.4~3.3V, Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Reset time	tR				1	μs	
Reset pulse "L" width	tRW		10			μs	RESB

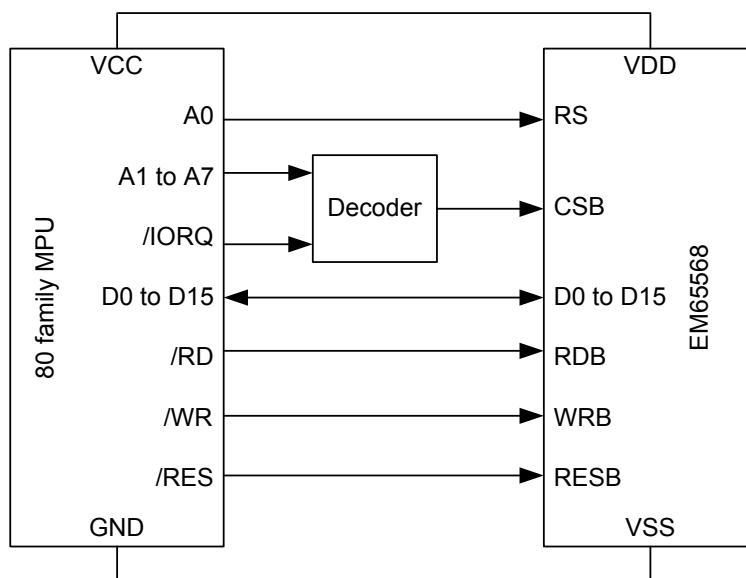
VSS=0V, VDD = 2.2~2.4V, Ta = -30~+85°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Reset time	tR				1.5	μs	
Reset pulse "L" width	tRW		10			μs	RESB

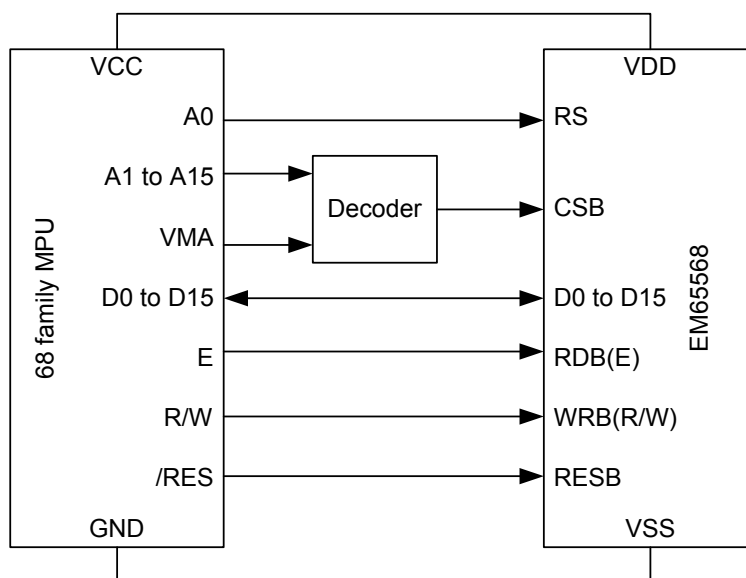
Note: All the timings must be specified relative to 20% and 80% of VDD voltage.

13. Application circuit

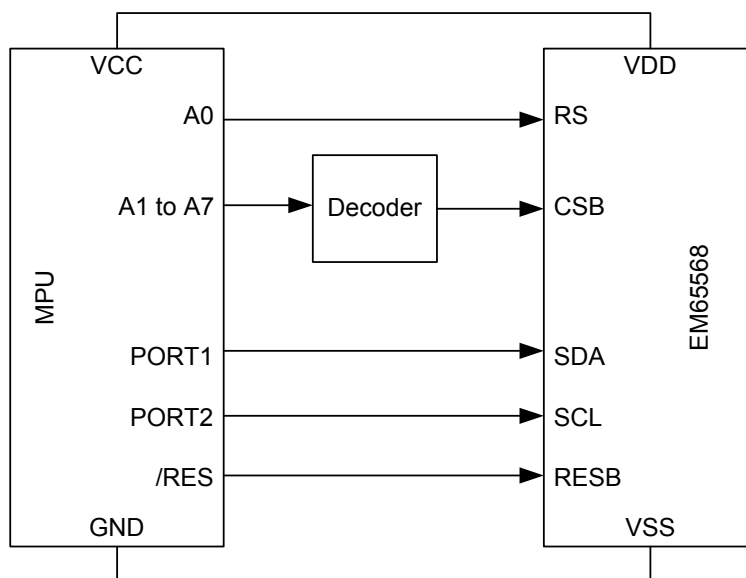
(1) Connection to 80-family MCU



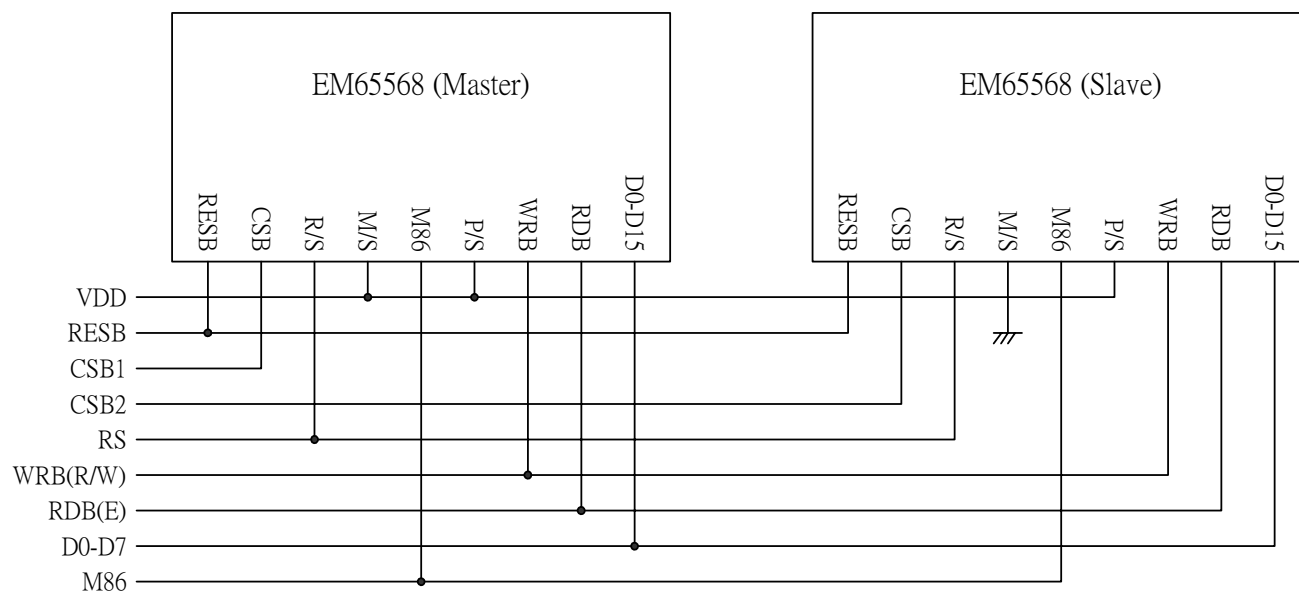
(2) Connection to 68-family MCU



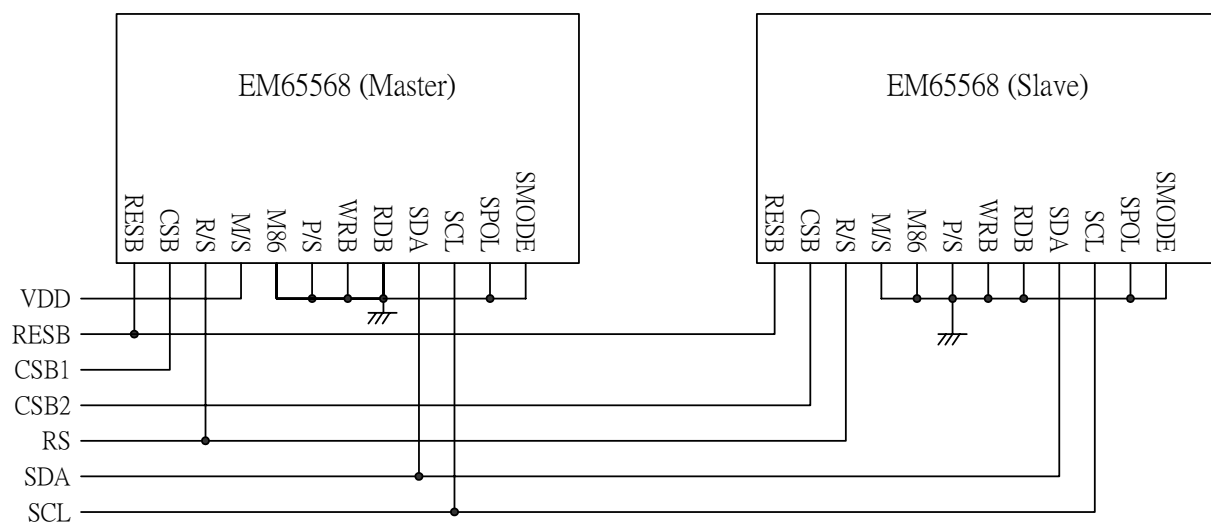
(3) Connection to the MCU with serial interface



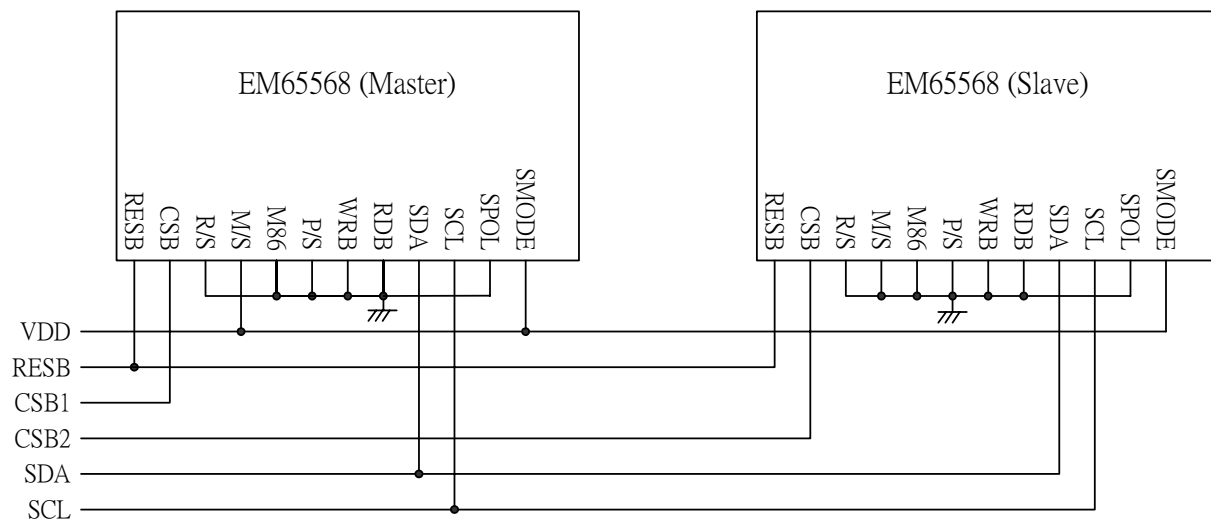
(4) Connection to Master / Slave about interface (parallel interface)



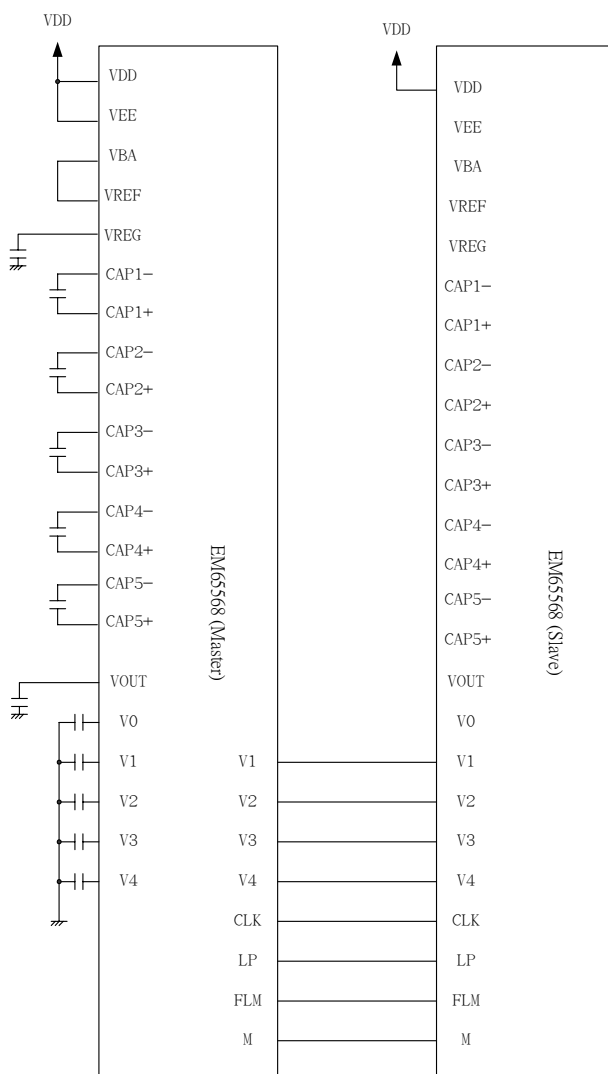
(5) 4 wires type serial interface with two chip enable signals



(6) 3 wires type serial interface with two chip enable signals



(7) Connection to master / slave about power block



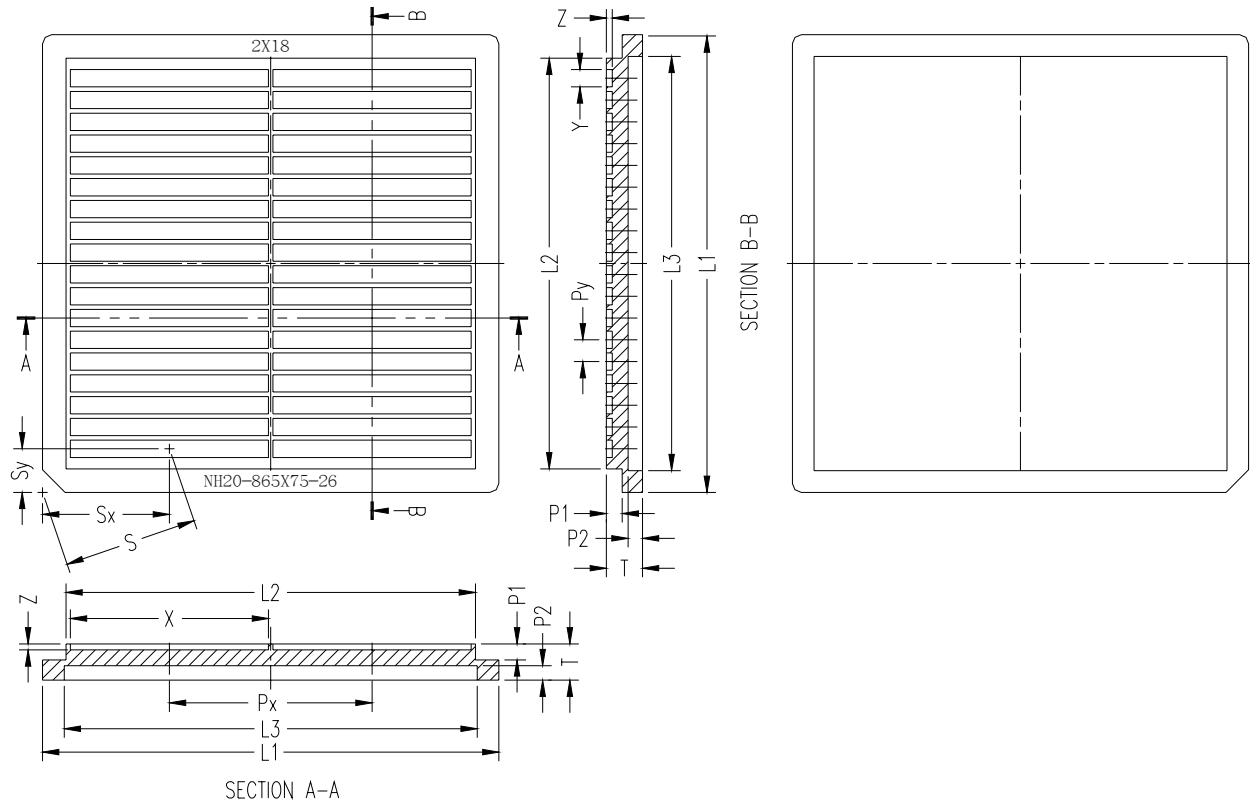
Caution of application about master / slave

* The master chip control display timing (CLK,LP,FLM, and M). When making display OFF on the master chip, the master chip can not output the display timing. When making display OFF , beforehand set display OFF to the slave chip and set display OFF to the master chip.

* When setting halt command, turn off the internal power supply, and output VSS level from LCD drive output pins , is set display OFF state. Because the master chip can not supply output voltage to the slave chip , beforehand set display OFF to the slave chip.

*In above connection example, the master chip is only available the electronic volume control.

Tray Information



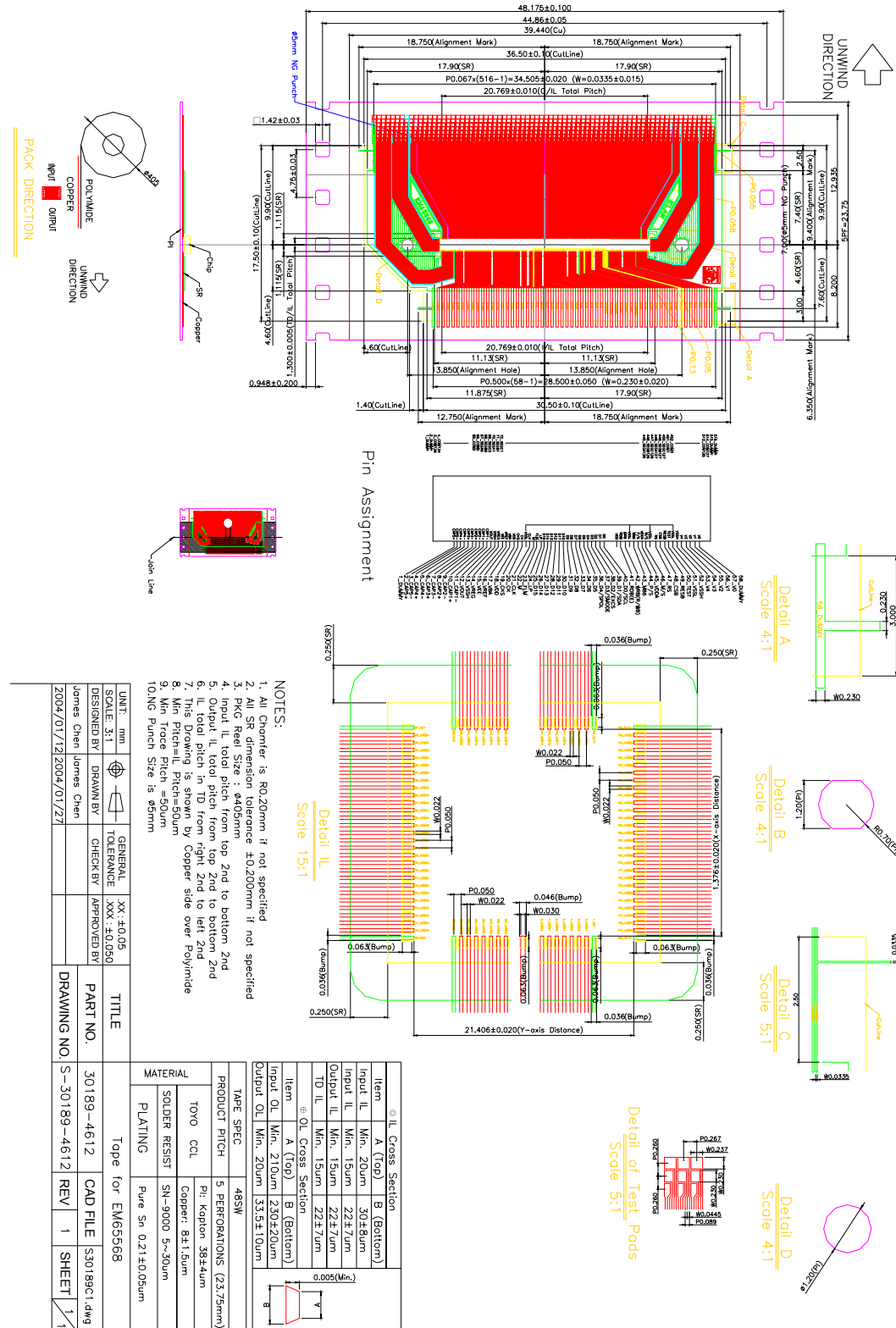
Tray Outline Dimensions

Symbol	Dimensions in mm	Symbol	Dimensions in mm
L1	50.60	Z	0.66
L2	45.40	Px	22.47
L3	45.80	Py	2.41
T	4.00	Nx	2
Sx	14.07	Ny	18
Sy	4.82	N	36
S	14.87	P1	1.76
X	21.97	P2	1.60
Y	1.91		

Unit:mm

14. COF information

EM65568AF package



EM65568BF package

