DATA SHEET

(DOC No. HX8257-A01-DS)

HX8257-A01

480RGBX272 TFT LCD Single Chip Digital Driver

Version 01, November 2008

Himax 奇景光電股份有限公司
文 件 發 行 及 參 考 文 件
TO ： 光基 Date： 2008.12.25
DOCUMENT CONTROL CENTER

List of Figures

1. General Description

The HX8257-A is a single chip digital driver supporting 480RGBX272 or 480RGBX240 resolution. The single chip includes Source, Gate, TCON, and Power circuits. The driver receives 24-bit digital display data with single clock edge and generates corresponding 64 level gray scale voltage outputs with dithering function to realize 16M colors display. Positive and negative polarity voltages can be alternately output from each channel in line (row) inversion driving method.

The HX8257-A can be applied on dual gate TFT LCD panel. Source line is half with 720 channels and gate line is double with 544 or 480-channel outputs.

2. Features

- Support 480RGBx272 or 480RGBx240 graphics display TFT LCD panel
- 64-gray level with 2 bit dithering function to realize 16M colors
- Support 8-bit serial RGB data and 24-bit parallel RGB data input
- Power supply:
  - VDDIO: 1.8V ~ 3.6V
  - VCI: 3.0V ~ 3.6V
- Built in 1.8V LDO for internal logic circuit
- Maximum gate driving output range: 30Vp-p
- Source output range: 0.1 ~ VLCD - 0.1
- Source and gate scan direction control
- 720-channel source outputs and 544-channel gate outputs
- Programmable gamma correction curve
- Support contrast/brightness adjustment
- Support PAL decimation in 480RGBx240 resolution
- Non-Volatile Memory (OTP) for VCOM calibration
- On-chip DC-DC converter for gate driver VGH/VGL and panel AC VCOM signal
- PWM control function to generate power for backlight
- CABC function is embedded
- COG package

3. Block Diagram

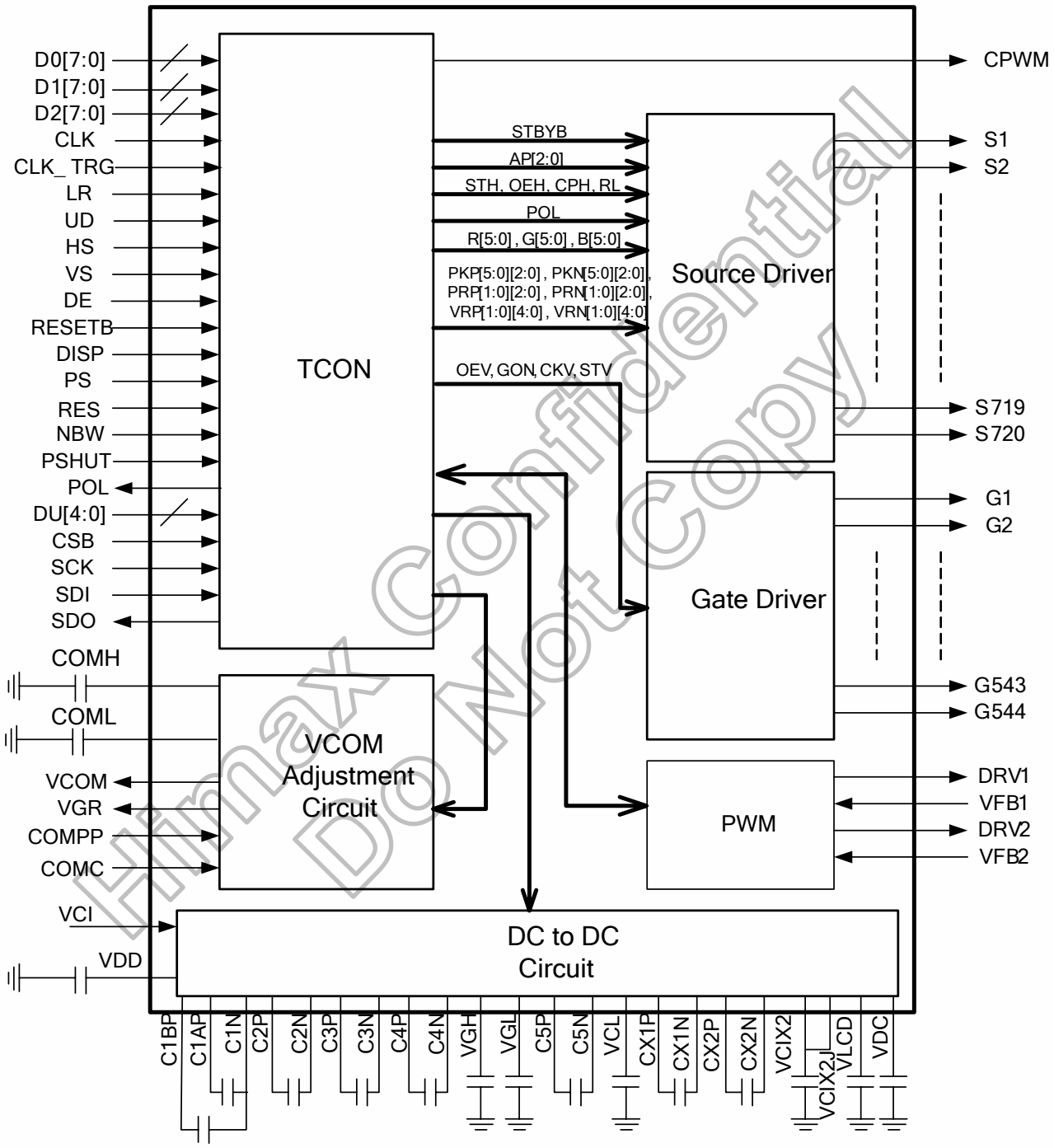
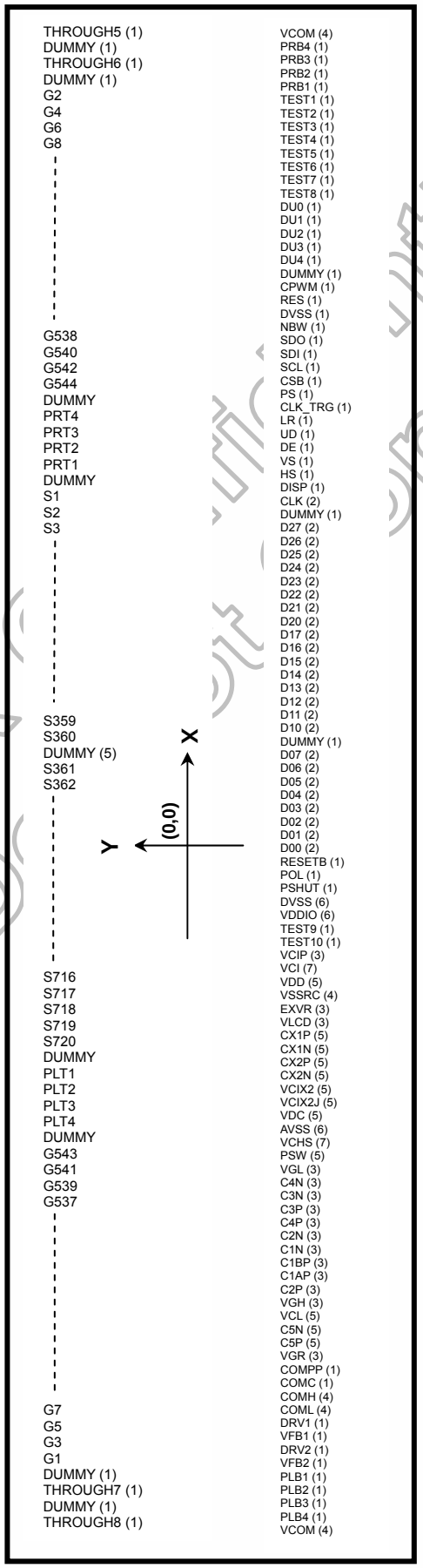
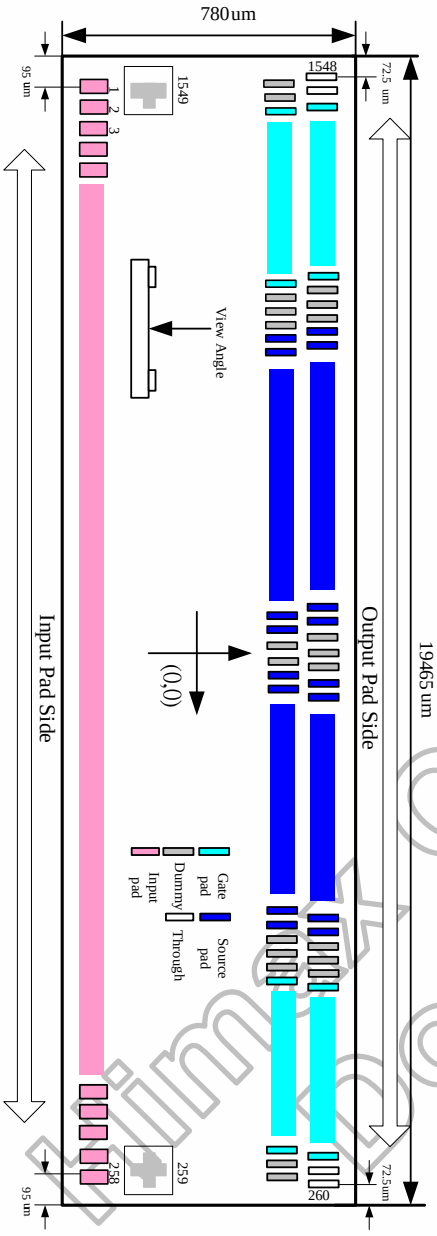
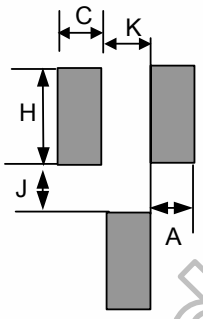


Figure 3.1 Block Diagram

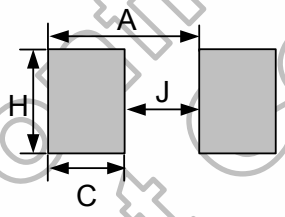
4. Pad Assignment(Gold Bump Face Up)





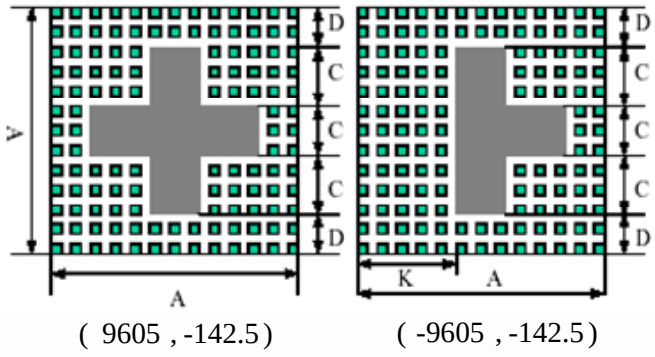


Output Pad	symbol	Size
Bump pitch	A	15um
Bump width	C	15um
Bump height	H	110um
Bump gap1 (Vertical)	J	30um
Bump gap2(Horizontal)	K	15um
Bump area	C x H	1650um^2



Input Pad	symbol	Size
Bump pitch	A	75um
Bump width	C	50um
Bump height	H	110um
Bump gap1 (Vertical)	J	25um
Bump area	C x H	5500um2

Die Size approximately: 19465 x 780 um^2
Bump Height: 15 um +/- 3um
Bump Hardness: 60 Hv +/- 15 Hv



Alignment Mark	symbol	Size
Alignment mark size	A	105um
Clearance gap1	D	15um
Clearance gap2	K	40um
Alignment mark width	C	25um
Alignment area	A x A	11025um^2

Figure 4.1 HX8257-A Die Floor Plan (Bump Face UP)

5. Pad Coordinates

No.	Name	X	Y	Bump Size
1	VCOM	-9637.5	-270	50x110
2	VCOM	-9562.5	-270	50x110
3	VCOM	-9487.5	-270	50x110
4	VCOM	-9412.5	-270	50x110
5	PLB4	-9337.5	-270	50x110
6	PLB3	-9262.5	-270	50x110
7	PLB2	-9187.5	-270	50x110
8	PLB1	-9112.5	-270	50x110
9	VFB2	-9037.5	-270	50x110
10	DRV2	-8962.5	-270	50x110
11	VFB1	-8887.5	-270	50x110
12	DRV1	-8812.5	-270	50x110
13	COML	-8737.5	-270	50x110
14	COML	-8662.5	-270	50x110
15	COML	-8587.5	-270	50x110
16	COML	-8512.5	-270	50x110
17	COMH	-8437.5	-270	50x110
18	COMH	-8362.5	-270	50x110
19	COMH	-8287.5	-270	50x110
20	COMH	-8212.5	-270	50x110
21	COMC	-8137.5	-270	50x110
22	COMPP	-8062.5	-270	50x110
23	VGR	-7987.5	-270	50x110
24	VGR	-7912.5	-270	50x110
25	VGR	-7837.5	-270	50x110
26	C5P	-7762.5	-270	50x110
27	C5P	-7687.5	-270	50x110
28	C5P	-7612.5	-270	50x110
29	C5P	-7537.5	-270	50x110
30	C5P	-7462.5	-270	50x110
31	C5N	-7387.5	-270	50x110
32	C5N	-7312.5	-270	50x110
33	C5N	-7237.5	-270	50x110
34	C5N	-7162.5	-270	50x110
35	C5N	-7087.5	-270	50x110
36	VCL	-7012.5	-270	50x110
37	VCL	-6937.5	-270	50x110
38	VCL	-6862.5	-270	50x110
39	VCL	-6787.5	-270	50x110
40	VCL	-6712.5	-270	50x110
41	VGH	-6637.5	-270	50x110
42	VGH	-6562.5	-270	50x110
43	VGH	-6487.5	-270	50x110
44	C2P	-6412.5	-270	50x110
45	C2P	-6337.5	-270	50x110
46	C2P	-6262.5	-270	50x110
47	C1AP	-6187.5	-270	50x110
48	C1AP	-6112.5	-270	50x110
49	C1AP	-6037.5	-270	50x110
50	C1BP	-5962.5	-270	50x110

No.	Name	X	Y	Bump Size
51	C1BP	-5887.5	-270	50x110
52	C1BP	-5812.5	-270	50x110
53	C1N	-5737.5	-270	50x110
54	C1N	-5662.5	-270	50x110
55	C1N	-5587.5	-270	50x110
56	C2N	-5512.5	-270	50x110
57	C2N	-5437.5	-270	50x110
58	C2N	-5362.5	-270	50x110
59	C4P	-5287.5	-270	50x110
60	C4P	-5212.5	-270	50x110
61	C4P	-5137.5	-270	50x110
62	C3P	-5062.5	-270	50x110
63	C3P	-4987.5	-270	50x110
64	C3P	-4912.5	-270	50x110
65	C3N	-4837.5	-270	50x110
66	C3N	-4762.5	-270	50x110
67	C3N	-4687.5	-270	50x110
68	C4N	-4612.5	-270	50x110
69	C4N	-4537.5	-270	50x110
70	C4N	-4462.5	-270	50x110
71	VGL	-4387.5	-270	50x110
72	VGL	-4312.5	-270	50x110
73	VGL	-4237.5	-270	50x110
74	PSW	-4162.5	-270	50x110
75	PSW	-4087.5	-270	50x110
76	PSW	-4012.5	-270	50x110
77	PSW	-3937.5	-270	50x110
78	PSW	-3862.5	-270	50x110
79	VCHS	-3787.5	-270	50x110
80	VCHS	-3712.5	-270	50x110
81	VCHS	-3637.5	-270	50x110
82	VCHS	-3562.5	-270	50x110
83	VCHS	-3487.5	-270	50x110
84	VCHS	-3412.5	-270	50x110
85	VCHS	-3337.5	-270	50x110
86	AVSS	-3262.5	-270	50x110
87	AVSS	-3187.5	-270	50x110
88	AVSS	-3112.5	-270	50x110
89	AVSS	-3037.5	-270	50x110
90	AVSS	-2962.5	-270	50x110
91	AVSS	-2887.5	-270	50x110
92	VDC	-2812.5	-270	50x110
93	VDC	-2737.5	-270	50x110
94	VDC	-2662.5	-270	50x110
95	VDC	-2587.5	-270	50x110
96	VDC	-2512.5	-270	50x110
97	VCIX2J	-2437.5	-270	50x110
98	VCIX2J	-2362.5	-270	50x110
99	VCIX2J	-2287.5	-270	50x110
100	VCIX2J	-2212.5	-270	50x110

No.	Name	X	Y	Bump Size
101	VCIX2J	-2137.5	-270	50x110
102	VCIX2	-2062.5	-270	50x110
103	VCIX2	-1987.5	-270	50x110
104	VCIX2	-1912.5	-270	50x110
105	VCIX2	-1837.5	-270	50x110
106	VCIX2	-1762.5	-270	50x110
107	CX2N	-1687.5	-270	50x110
108	CX2N	-1612.5	-270	50x110
109	CX2N	-1537.5	-270	50x110
110	CX2N	-1462.5	-270	50x110
111	CX2N	-1387.5	-270	50x110
112	CX2P	-1312.5	-270	50x110
113	CX2P	-1237.5	-270	50x110
114	CX2P	-1162.5	-270	50x110
115	CX2P	-1087.5	-270	50x110
116	CX2P	-1012.5	-270	50x110
117	CX1N	-937.5	-270	50x110
118	CX1N	-862.5	-270	50x110
119	CX1N	-787.5	-270	50x110
120	CX1N	-712.5	-270	50x110
121	CX1N	-637.5	-270	50x110
122	CX1P	-562.5	-270	50x110
123	CX1P	-487.5	-270	50x110
124	CX1P	-412.5	-270	50x110
125	CX1P	-337.5	-270	50x110
126	CX1P	-262.5	-270	50x110
127	VLCD	-187.5	-270	50x110
128	VLCD	-112.5	-270	50x110
129	VLCD	-37.5	-270	50x110
130	EXVR	37.5	-270	50x110
131	EXVR	112.5	-270	50x110
132	EXVR	187.5	-270	50x110
133	VSSRC	262.5	-270	50x110
134	VSSRC	337.5	-270	50x110
135	VSSRC	412.5	-270	50x110
136	VSSRC	487.5	-270	50x110
137	VDD	562.5	-270	50x110
138	VDD	637.5	-270	50x110
139	VDD	712.5	-270	50x110
140	VDD	787.5	-270	50x110
141	VDD	862.5	-270	50x110
142	VCI	937.5	-270	50x110
143	VCI	1012.5	-270	50x110
144	VCI	1087.5	-270	50x110
145	VCI	1162.5	-270	50x110
146	VCI	1237.5	-270	50x110
147	VCI	1312.5	-270	50x110
148	VCI	1387.5	-270	50x110
149	VCIP	1462.5	-270	50x110
150	VCIP	1537.5	-270	50x110

No.	Name	X	Y	Bump Size
151	VCIP	1612.5	-270	50x110
152	TEST10	1687.5	-270	50x110
153	TEST9	1762.5	-270	50x110
154	VDDIO	1837.5	-270	50x110
155	VDDIO	1912.5	-270	50x110
156	VDDIO	1987.5	-270	50x110
157	VDDIO	2062.5	-270	50x110
158	VDDIO	2137.5	-270	50x110
159	VDDIO	2212.5	-270	50x110
160	DVSS	2287.5	-270	50x110
161	DVSS	2362.5	-270	50x110
162	DVSS	2437.5	-270	50x110
163	DVSS	2512.5	-270	50x110
164	DVSS	2587.5	-270	50x110
165	DVSS	2662.5	-270	50x110
166	PSHUT	2737.5	-270	50x110
167	POL	2812.5	-270	50x110
168	RESETB	2887.5	-270	50x110
169	D00	2962.5	-270	50x110
170	D00	3037.5	-270	50x110
171	D01	3112.5	-270	50x110
172	D01	3187.5	-270	50x110
173	D02	3262.5	-270	50x110
174	D02	3337.5	-270	50x110
175	D03	3412.5	-270	50x110
176	D03	3487.5	-270	50x110
177	D04	3562.5	-270	50x110
178	D04	3637.5	-270	50x110
179	D05	3712.5	-270	50x110
180	D05	3787.5	-270	50x110
181	D06	3862.5	-270	50x110
182	D06	3937.5	-270	50x110
183	D07	4012.5	-270	50x110
184	D07	4087.5	-270	50x110
185	DUMMY	4162.5	-270	50x110
186	D10	4237.5	-270	50x110
187	D10	4312.5	-270	50x110
188	D11	4387.5	-270	50x110
189	D11	4462.5	-270	50x110
190	D12	4537.5	-270	50x110
191	D12	4612.5	-270	50x110
192	D13	4687.5	-270	50x110
193	D13	4762.5	-270	50x110
194	D14	4837.5	-270	50x110
195	D14	4912.5	-270	50x110
196	D15	4987.5	-270	50x110
197	D15	5062.5	-270	50x110
198	D16	5137.5	-270	50x110
199	D16	5212.5	-270	50x110
200	D17	5287.5	-270	50x110

No.	Name	X	Y	Bump Size
201	D17	5362.5	-270	50x110
202	D20	5437.5	-270	50x110
203	D20	5512.5	-270	50x110
204	D21	5587.5	-270	50x110
205	D21	5662.5	-270	50x110
206	D22	5737.5	-270	50x110
207	D22	5812.5	-270	50x110
208	D23	5887.5	-270	50x110
209	D23	5962.5	-270	50x110
210	D24	6037.5	-270	50x110
211	D24	6112.5	-270	50x110
212	D25	6187.5	-270	50x110
213	D25	6262.5	-270	50x110
214	D26	6337.5	-270	50x110
215	D26	6412.5	-270	50x110
216	D27	6487.5	-270	50x110
217	D27	6562.5	-270	50x110
218	DUMMY	6637.5	-270	50x110
219	CLK	6712.5	-270	50x110
220	CLK	6787.5	-270	50x110
221	DISP	6862.5	-270	50x110
222	HS	6937.5	-270	50x110
223	VS	7012.5	-270	50x110
224	DE	7087.5	-270	50x110
225	UD	7162.5	-270	50x110
226	LR	7237.5	-270	50x110
227	CLK_TRG	7312.5	-270	50x110
228	PS	7387.5	-270	50x110
229	CSB	7462.5	-270	50x110
230	SCL	7537.5	-270	50x110
231	SDI	7612.5	-270	50x110
232	SDO	7687.5	-270	50x110
233	NBW	7762.5	-270	50x110
234	DVSS	7837.5	-270	50x110
235	RES	7912.5	-270	50x110
236	CPWM	7987.5	-270	50x110
237	DUMMY	8062.5	-270	50x110
238	DU4	8137.5	-270	50x110
239	DU3	8212.5	-270	50x110
240	DU2	8287.5	-270	50x110
241	DU1	8362.5	-270	50x110
242	DU0	8437.5	-270	50x110
243	TEST8	8512.5	-270	50x110
244	TEST7	8587.5	-270	50x110
245	TEST6	8662.5	-270	50x110
246	TEST5	8737.5	-270	50x110
247	TEST4	8812.5	-270	50x110
248	TEST3	8887.5	-270	50x110
249	TEST2	8962.5	-270	50x110
250	TEST1	9037.5	-270	50x110

No.	Name	X	Y	Bump Size
251	PRB1	9112.5	-270	50x110
252	PRB2	9187.5	-270	50x110
253	PRB3	9262.5	-270	50x110
254	PRB4	9337.5	-270	50x110
255	VCOM	9412.5	-270	50x110
256	VCOM	9487.5	-270	50x110
257	VCOM	9562.5	-270	50x110
258	VCOM	9637.5	-270	50x110
259	R_MARK	9605	-142.5	NA
260	THROUGH5	9660	270	15x110
261	DUMMY	9645	130	15x110
262	THROUGH6	9630	270	15x110
263	DUMMY	9615	130	15x110
264	G2	9600	270	15x110
265	G4	9585	130	15x110
266	G6	9570	270	15x110
267	G8	9555	130	15x110
268	G10	9540	270	15x110
269	G12	9525	130	15x110
270	G14	9510	270	15x110
271	G16	9495	130	15x110
272	G18	9480	270	15x110
273	G20	9465	130	15x110
274	G22	9450	270	15x110
275	G24	9435	130	15x110
276	G26	9420	270	15x110
277	G28	9405	130	15x110
278	G30	9390	270	15x110
279	G32	9375	130	15x110
280	G34	9360	270	15x110
281	G36	9345	130	15x110
282	G38	9330	270	15x110
283	G40	9315	130	15x110
284	G42	9300	270	15x110
285	G44	9285	130	15x110
286	G46	9270	270	15x110
287	G48	9255	130	15x110
288	G50	9240	270	15x110
289	G52	9225	130	15x110
290	G54	9210	270	15x110
291	G56	9195	130	15x110
292	G58	9180	270	15x110
293	G60	9165	130	15x110
294	G62	9150	270	15x110
295	G64	9135	130	15x110
296	G66	9120	270	15x110
297	G68	9105	130	15x110
298	G70	9090	270	15x110
299	G72	9075	130	15x110
300	G74	9060	270	15x110

No.	Name	X	Y	Bump Size
301	G76	9045	130	15x110
302	G78	9030	270	15x110
303	G80	9015	130	15x110
304	G82	9000	270	15x110
305	G84	8985	130	15x110
306	G86	8970	270	15x110
307	G88	8955	130	15x110
308	G90	8940	270	15x110
309	G92	8925	130	15x110
310	G94	8910	270	15x110
311	G96	8895	130	15x110
312	G98	8880	270	15x110
313	G100	8865	130	15x110
314	G102	8850	270	15x110
315	G104	8835	130	15x110
316	G106	8820	270	15x110
317	G108	8805	130	15x110
318	G110	8790	270	15x110
319	G112	8775	130	15x110
320	G114	8760	270	15x110
321	G116	8745	130	15x110
322	G118	8730	270	15x110
323	G120	8715	130	15x110
324	G122	8700	270	15x110
325	G124	8685	130	15x110
326	G126	8670	270	15x110
327	G128	8655	130	15x110
328	G130	8640	270	15x110
329	G132	8625	130	15x110
330	G134	8610	270	15x110
331	G136	8595	130	15x110
332	G138	8580	270	15x110
333	G140	8565	130	15x110
334	G142	8550	270	15x110
335	G144	8535	130	15x110
336	G146	8520	270	15x110
337	G148	8505	130	15x110
338	G150	8490	270	15x110
339	G152	8475	130	15x110
340	G154	8460	270	15x110
341	G156	8445	130	15x110
342	G158	8430	270	15x110
343	G160	8415	130	15x110
344	G162	8400	270	15x110
345	G164	8385	130	15x110
346	G166	8370	270	15x110
347	G168	8355	130	15x110
348	G170	8340	270	15x110
349	G172	8325	130	15x110
350	G174	8310	270	15x110

No.	Name	X	Y	Bump Size
351	G176	8295	130	15x110
352	G178	8280	270	15x110
353	G180	8265	130	15x110
354	G182	8250	270	15x110
355	G184	8235	130	15x110
356	G186	8220	270	15x110
357	G188	8205	130	15x110
358	G190	8190	270	15x110
359	G192	8175	130	15x110
360	G194	8160	270	15x110
361	G196	8145	130	15x110
362	G198	8130	270	15x110
363	G200	8115	130	15x110
364	G202	8100	270	15x110
365	G204	8085	130	15x110
366	G206	8070	270	15x110
367	G208	8055	130	15x110
368	G210	8040	270	15x110
369	G212	8025	130	15x110
370	G214	8010	270	15x110
371	G216	7995	130	15x110
372	G218	7980	270	15x110
373	G220	7965	130	15x110
374	G222	7950	270	15x110
375	G224	7935	130	15x110
376	G226	7920	270	15x110
377	G228	7905	130	15x110
378	G230	7890	270	15x110
379	G232	7875	130	15x110
380	G234	7860	270	15x110
381	G236	7845	130	15x110
382	G238	7830	270	15x110
383	G240	7815	130	15x110
384	G242	7800	270	15x110
385	G244	7785	130	15x110
386	G246	7770	270	15x110
387	G248	7755	130	15x110
388	G250	7740	270	15x110
389	G252	7725	130	15x110
390	G254	7710	270	15x110
391	G256	7695	130	15x110
392	G258	7680	270	15x110
393	G260	7665	130	15x110
394	G262	7650	270	15x110
395	G264	7635	130	15x110
396	G266	7620	270	15x110
397	G268	7605	130	15x110
398	G270	7590	270	15x110
399	G272	7575	130	15x110
400	G274	7560	270	15x110

No.	Name	X	Y	Bump Size
401	G276	7545	130	15x110
402	G278	7530	270	15x110
403	G280	7515	130	15x110
404	G282	7500	270	15x110
405	G284	7485	130	15x110
406	G286	7470	270	15x110
407	G288	7455	130	15x110
408	G290	7440	270	15x110
409	G292	7425	130	15x110
410	G294	7410	270	15x110
411	G296	7395	130	15x110
412	G298	7380	270	15x110
413	G300	7365	130	15x110
414	G302	7350	270	15x110
415	G304	7335	130	15x110
416	G306	7320	270	15x110
417	G308	7305	130	15x110
418	G310	7290	270	15x110
419	G312	7275	130	15x110
420	G314	7260	270	15x110
421	G316	7245	130	15x110
422	G318	7230	270	15x110
423	G320	7215	130	15x110
424	G322	7200	270	15x110
425	G324	7185	130	15x110
426	G326	7170	270	15x110
427	G328	7155	130	15x110
428	G330	7140	270	15x110
429	G332	7125	130	15x110
430	G334	7110	270	15x110
431	G336	7095	130	15x110
432	G338	7080	270	15x110
433	G340	7065	130	15x110
434	G342	7050	270	15x110
435	G344	7035	130	15x110
436	G346	7020	270	15x110
437	G348	7005	130	15x110
438	G350	6990	270	15x110
439	G352	6975	130	15x110
440	G354	6960	270	15x110
441	G356	6945	130	15x110
442	G358	6930	270	15x110
443	G360	6915	130	15x110
444	G362	6900	270	15x110
445	G364	6885	130	15x110
446	G366	6870	270	15x110
447	G368	6855	130	15x110
448	G370	6840	270	15x110
449	G372	6825	130	15x110
450	G374	6810	270	15x110

No.	Name	X	Y	Bump Size
451	G376	6795	130	15x110
452	G378	6780	270	15x110
453	G380	6765	130	15x110
454	G382	6750	270	15x110
455	G384	6735	130	15x110
456	G386	6720	270	15x110
457	G388	6705	130	15x110
458	G390	6690	270	15x110
459	G392	6675	130	15x110
460	G394	6660	270	15x110
461	G396	6645	130	15x110
462	G398	6630	270	15x110
463	G400	6615	130	15x110
464	G402	6600	270	15x110
465	G404	6585	130	15x110
466	G406	6570	270	15x110
467	G408	6555	130	15x110
468	G410	6540	270	15x110
469	G412	6525	130	15x110
470	G414	6510	270	15x110
471	G416	6495	130	15x110
472	G418	6480	270	15x110
473	G420	6465	130	15x110
474	G422	6450	270	15x110
475	G424	6435	130	15x110
476	G426	6420	270	15x110
477	G428	6405	130	15x110
478	G430	6390	270	15x110
479	G432	6375	130	15x110
480	G434	6360	270	15x110
481	G436	6345	130	15x110
482	G438	6330	270	15x110
483	G440	6315	130	15x110
484	G442	6300	270	15x110
485	G444	6285	130	15x110
486	G446	6270	270	15x110
487	G448	6255	130	15x110
488	G450	6240	270	15x110
489	G452	6225	130	15x110
490	G454	6210	270	15x110
491	G456	6195	130	15x110
492	G458	6180	270	15x110
493	G460	6165	130	15x110
494	G462	6150	270	15x110
495	G464	6135	130	15x110
496	G466	6120	270	15x110
497	G468	6105	130	15x110
498	G470	6090	270	15x110
499	G472	6075	130	15x110
500	G474	6060	270	15x110

No.	Name	X	Y	Bump Size
501	G476	6045	130	15x110
502	G478	6030	270	15x110
503	G480	6015	130	15x110
504	G482	6000	270	15x110
505	G484	5985	130	15x110
506	G486	5970	270	15x110
507	G488	5955	130	15x110
508	G490	5940	270	15x110
509	G492	5925	130	15x110
510	G494	5910	270	15x110
511	G496	5895	130	15x110
512	G498	5880	270	15x110
513	G500	5865	130	15x110
514	G502	5850	270	15x110
515	G504	5835	130	15x110
516	G506	5820	270	15x110
517	G508	5805	130	15x110
518	G510	5790	270	15x110
519	G512	5775	130	15x110
520	G514	5760	270	15x110
521	G516	5745	130	15x110
522	G518	5730	270	15x110
523	G520	5715	130	15x110
524	G522	5700	270	15x110
525	G524	5685	130	15x110
526	G526	5670	270	15x110
527	G528	5655	130	15x110
528	G530	5640	270	15x110
529	G532	5625	130	15x110
530	G534	5610	270	15x110
531	G536	5595	130	15x110
532	G538	5580	270	15x110
533	G540	5565	130	15x110
534	G542	5550	270	15x110
535	G544	5535	130	15x110
536	DUMMY	5520	270	15x110
537	PRT4	5505	130	15x110
538	PRT3	5490	270	15x110
539	PRT2	5475	130	15x110
540	PRT1	5460	270	15x110
541	DUMMY	5445	130	15x110
542	S1	5430	270	15x110
543	S2	5415	130	15x110
544	S3	5400	270	15x110
545	S4	5385	130	15x110
546	S5	5370	270	15x110
547	S6	5355	130	15x110
548	S7	5340	270	15x110
549	S8	5325	130	15x110
550	S9	5310	270	15x110

No.	Name	X	Y	Bump Size
551	S10	5295	130	15x110
552	S11	5280	270	15x110
553	S12	5265	130	15x110
554	S13	5250	270	15x110
555	S14	5235	130	15x110
556	S15	5220	270	15x110
557	S16	5205	130	15x110
558	S17	5190	270	15x110
559	S18	5175	130	15x110
560	S19	5160	270	15x110
561	S20	5145	130	15x110
562	S21	5130	270	15x110
563	S22	5115	130	15x110
564	S23	5100	270	15x110
565	S24	5085	130	15x110
566	S25	5070	270	15x110
567	S26	5055	130	15x110
568	S27	5040	270	15x110
569	S28	5025	130	15x110
570	S29	5010	270	15x110
571	S30	4995	130	15x110
572	S31	4980	270	15x110
573	S32	4965	130	15x110
574	S33	4950	270	15x110
575	S34	4935	130	15x110
576	S35	4920	270	15x110
577	S36	4905	130	15x110
578	S37	4890	270	15x110
579	S38	4875	130	15x110
580	S39	4860	270	15x110
581	S40	4845	130	15x110
582	S41	4830	270	15x110
583	S42	4815	130	15x110
584	S43	4800	270	15x110
585	S44	4785	130	15x110
586	S45	4770	270	15x110
587	S46	4755	130	15x110
588	S47	4740	270	15x110
589	S48	4725	130	15x110
590	S49	4710	270	15x110
591	S50	4695	130	15x110
592	S51	4680	270	15x110
593	S52	4665	130	15x110
594	S53	4650	270	15x110
595	S54	4635	130	15x110
596	S55	4620	270	15x110
597	S56	4605	130	15x110
598	S57	4590	270	15x110
599	S58	4575	130	15x110
600	S59	4560	270	15x110

No.	Name	X	Y	Bump Size
601	S60	4545	130	15x110
602	S61	4530	270	15x110
603	S62	4515	130	15x110
604	S63	4500	270	15x110
605	S64	4485	130	15x110
606	S65	4470	270	15x110
607	S66	4455	130	15x110
608	S67	4440	270	15x110
609	S68	4425	130	15x110
610	S69	4410	270	15x110
611	S70	4395	130	15x110
612	S71	4380	270	15x110
613	S72	4365	130	15x110
614	S73	4350	270	15x110
615	S74	4335	130	15x110
616	S75	4320	270	15x110
617	S76	4305	130	15x110
618	S77	4290	270	15x110
619	S78	4275	130	15x110
620	S79	4260	270	15x110
621	S80	4245	130	15x110
622	S81	4230	270	15x110
623	S82	4215	130	15x110
624	S83	4200	270	15x110
625	S84	4185	130	15x110
626	S85	4170	270	15x110
627	S86	4155	130	15x110
628	S87	4140	270	15x110
629	S88	4125	130	15x110
630	S89	4110	270	15x110
631	S90	4095	130	15x110
632	S91	4080	270	15x110
633	S92	4065	130	15x110
634	S93	4050	270	15x110
635	S94	4035	130	15x110
636	S95	4020	270	15x110
637	S96	4005	130	15x110
638	S97	3990	270	15x110
639	S98	3975	130	15x110
640	S99	3960	270	15x110
641	S100	3945	130	15x110
642	S101	3930	270	15x110
643	S102	3915	130	15x110
644	S103	3900	270	15x110
645	S104	3885	130	15x110
646	S105	3870	270	15x110
647	S106	3855	130	15x110
648	S107	3840	270	15x110
649	S108	3825	130	15x110
650	S109	3810	270	15x110

No.	Name	X	Y	Bump Size
651	S110	3795	130	15x110
652	S111	3780	270	15x110
653	S112	3765	130	15x110
654	S113	3750	270	15x110
655	S114	3735	130	15x110
656	S115	3720	270	15x110
657	S116	3705	130	15x110
658	S117	3690	270	15x110
659	S118	3675	130	15x110
660	S119	3660	270	15x110
661	S120	3645	130	15x110
662	S121	3630	270	15x110
663	S122	3615	130	15x110
664	S123	3600	270	15x110
665	S124	3585	130	15x110
666	S125	3570	270	15x110
667	S126	3555	130	15x110
668	S127	3540	270	15x110
669	S128	3525	130	15x110
670	S129	3510	270	15x110
671	S130	3495	130	15x110
672	S131	3480	270	15x110
673	S132	3465	130	15x110
674	S133	3450	270	15x110
675	S134	3435	130	15x110
676	S135	3420	270	15x110
677	S136	3405	130	15x110
678	S137	3390	270	15x110
679	S138	3375	130	15x110
680	S139	3360	270	15x110
681	S140	3345	130	15x110
682	S141	3330	270	15x110
683	S142	3315	130	15x110
684	S143	3300	270	15x110
685	S144	3285	130	15x110
686	S145	3270	270	15x110
687	S146	3255	130	15x110
688	S147	3240	270	15x110
689	S148	3225	130	15x110
690	S149	3210	270	15x110
691	S150	3195	130	15x110
692	S151	3180	270	15x110
693	S152	3165	130	15x110
694	S153	3150	270	15x110
695	S154	3135	130	15x110
696	S155	3120	270	15x110
697	S156	3105	130	15x110
698	S157	3090	270	15x110
699	S158	3075	130	15x110
700	S159	3060	270	15x110

No.	Name	X	Y	Bump Size
701	S160	3045	130	15x110
702	S161	3030	270	15x110
703	S162	3015	130	15x110
704	S163	3000	270	15x110
705	S164	2985	130	15x110
706	S165	2970	270	15x110
707	S166	2955	130	15x110
708	S167	2940	270	15x110
709	S168	2925	130	15x110
710	S169	2910	270	15x110
711	S170	2895	130	15x110
712	S171	2880	270	15x110
713	S172	2865	130	15x110
714	S173	2850	270	15x110
715	S174	2835	130	15x110
716	S175	2820	270	15x110
717	S176	2805	130	15x110
718	S177	2790	270	15x110
719	S178	2775	130	15x110
720	S179	2760	270	15x110
721	S180	2745	130	15x110
722	S181	2730	270	15x110
723	S182	2715	130	15x110
724	S183	2700	270	15x110
725	S184	2685	130	15x110
726	S185	2670	270	15x110
727	S186	2655	130	15x110
728	S187	2640	270	15x110
729	S188	2625	130	15x110
730	S189	2610	270	15x110
731	S190	2595	130	15x110
732	S191	2580	270	15x110
733	S192	2565	130	15x110
734	S193	2550	270	15x110
735	S194	2535	130	15x110
736	S195	2520	270	15x110
737	S196	2505	130	15x110
738	S197	2490	270	15x110
739	S198	2475	130	15x110
740	S199	2460	270	15x110
741	S200	2445	130	15x110
742	S201	2430	270	15x110
743	S202	2415	130	15x110
744	S203	2400	270	15x110
745	S204	2385	130	15x110
746	S205	2370	270	15x110
747	S206	2355	130	15x110
748	S207	2340	270	15x110
749	S208	2325	130	15x110
750	S209	2310	270	15x110

No.	Name	X	Y	Bump Size
751	S210	2295	130	15x110
752	S211	2280	270	15x110
753	S212	2265	130	15x110
754	S213	2250	270	15x110
755	S214	2235	130	15x110
756	S215	2220	270	15x110
757	S216	2205	130	15x110
758	S217	2190	270	15x110
759	S218	2175	130	15x110
760	S219	2160	270	15x110
761	S220	2145	130	15x110
762	S221	2130	270	15x110
763	S222	2115	130	15x110
764	S223	2100	270	15x110
765	S224	2085	130	15x110
766	S225	2070	270	15x110
767	S226	2055	130	15x110
768	S227	2040	270	15x110
769	S228	2025	130	15x110
770	S229	2010	270	15x110
771	S230	1995	130	15x110
772	S231	1980	270	15x110
773	S232	1965	130	15x110
774	S233	1950	270	15x110
775	S234	1935	130	15x110
776	S235	1920	270	15x110
777	S236	1905	130	15x110
778	S237	1890	270	15x110
779	S238	1875	130	15x110
780	S239	1860	270	15x110
781	S240	1845	130	15x110
782	S241	1830	270	15x110
783	S242	1815	130	15x110
784	S243	1800	270	15x110
785	S244	1785	130	15x110
786	S245	1770	270	15x110
787	S246	1755	130	15x110
788	S247	1740	270	15x110
789	S248	1725	130	15x110
790	S249	1710	270	15x110
791	S250	1695	130	15x110
792	S251	1680	270	15x110
793	S252	1665	130	15x110
794	S253	1650	270	15x110
795	S254	1635	130	15x110
796	S255	1620	270	15x110
797	S256	1605	130	15x110
798	S257	1590	270	15x110
799	S258	1575	130	15x110
800	S259	1560	270	15x110

No.	Name	X	Y	Bump Size	No.	Name	X	Y	Bump Size
801	S260	1545	130	15x110	851	S310	795	130	15x110
802	S261	1530	270	15x110	852	S311	780	270	15x110
803	S262	1515	130	15x110	853	S312	765	130	15x110
804	S263	1500	270	15x110	854	S313	750	270	15x110
805	S264	1485	130	15x110	855	S314	735	130	15x110
806	S265	1470	270	15x110	856	S315	720	270	15x110
807	S266	1455	130	15x110	857	S316	705	130	15x110
808	S267	1440	270	15x110	858	S317	690	270	15x110
809	S268	1425	130	15x110	859	S318	675	130	15x110
810	S269	1410	270	15x110	860	S319	660	270	15x110
811	S270	1395	130	15x110	861	S320	645	130	15x110
812	S271	1380	270	15x110	862	S321	630	270	15x110
813	S272	1365	130	15x110	863	S322	615	130	15x110
814	S273	1350	270	15x110	864	S323	600	270	15x110
815	S274	1335	130	15x110	865	S324	585	130	15x110
816	S275	1320	270	15x110	866	S325	570	270	15x110
817	S276	1305	130	15x110	867	S326	555	130	15x110
818	S277	1290	270	15x110	868	S327	540	270	15x110
819	S278	1275	130	15x110	869	S328	525	130	15x110
820	S279	1260	270	15x110	870	S329	510	270	15x110
821	S280	1245	130	15x110	871	S330	495	130	15x110
822	S281	1230	270	15x110	872	S331	480	270	15x110
823	S282	1215	130	15x110	873	S332	465	130	15x110
824	S283	1200	270	15x110	874	S333	450	270	15x110
825	S284	1185	130	15x110	875	S334	435	130	15x110
826	S285	1170	270	15x110	876	S335	420	270	15x110
827	S286	1155	130	15x110	877	S336	405	130	15x110
828	S287	1140	270	15x110	878	S337	390	270	15x110
829	S288	1125	130	15x110	879	S338	375	130	15x110
830	S289	1110	270	15x110	880	S339	360	270	15x110
831	S290	1095	130	15x110	881	S340	345	130	15x110
832	S291	1080	270	15x110	882	S341	330	270	15x110
833	S292	1065	130	15x110	883	S342	315	130	15x110
834	S293	1050	270	15x110	884	S343	300	270	15x110
835	S294	1035	130	15x110	885	S344	285	130	15x110
836	S295	1020	270	15x110	886	S345	270	270	15x110
837	S296	1005	130	15x110	887	S346	255	130	15x110
838	S297	990	270	15x110	888	S347	240	270	15x110
839	S298	975	130	15x110	889	S348	225	130	15x110
840	S299	960	270	15x110	890	S349	210	270	15x110
841	S300	945	130	15x110	891	S350	195	130	15x110
842	S301	930	270	15x110	892	S351	180	270	15x110
843	S302	915	130	15x110	893	S352	165	130	15x110
844	S303	900	270	15x110	894	S353	150	270	15x110
845	S304	885	130	15x110	895	S354	135	130	15x110
846	S305	870	270	15x110	896	S355	120	270	15x110
847	S306	855	130	15x110	897	S356	105	130	15x110
848	S307	840	270	15x110	898	S357	90	270	15x110
849	S308	825	130	15x110	899	S358	75	130	15x110
850	S309	810	270	15x110	900	S359	60	270	15x110

No.	Name	X	Y	Bump Size
901	S360	45	130	15x110
902	DUMMY	30	270	15x110
903	DUMMY	15	130	15x110
904	DUMMY	0	270	15x110
905	DUMMY	-15	130	15x110
906	DUMMY	-30	270	15x110
907	S361	-45	130	15x110
908	S362	-60	270	15x110
909	S363	-75	130	15x110
910	S364	-90	270	15x110
911	S365	-105	130	15x110
912	S366	-120	270	15x110
913	S367	-135	130	15x110
914	S368	-150	270	15x110
915	S369	-165	130	15x110
916	S370	-180	270	15x110
917	S371	-195	130	15x110
918	S372	-210	270	15x110
919	S373	-225	130	15x110
920	S374	-240	270	15x110
921	S375	-255	130	15x110
922	S376	-270	270	15x110
923	S377	-285	130	15x110
924	S378	-300	270	15x110
925	S379	-315	130	15x110
926	S380	-330	270	15x110
927	S381	-345	130	15x110
928	S382	-360	270	15x110
929	S383	-375	130	15x110
930	S384	-390	270	15x110
931	S385	-405	130	15x110
932	S386	-420	270	15x110
933	S387	-435	130	15x110
934	S388	-450	270	15x110
935	S389	-465	130	15x110
936	S390	-480	270	15x110
937	S391	-495	130	15x110
938	S392	-510	270	15x110
939	S393	-525	130	15x110
940	S394	-540	270	15x110
941	S395	-555	130	15x110
942	S396	-570	270	15x110
943	S397	-585	130	15x110
944	S398	-600	270	15x110
945	S399	-615	130	15x110
946	S400	-630	270	15x110
947	S401	-645	130	15x110
948	S402	-660	270	15x110
949	S403	-675	130	15x110
950	S404	-690	270	15x110

No.	Name	X	Y	Bump Size
951	S405	-705	130	15x110
952	S406	-720	270	15x110
953	S407	-735	130	15x110
954	S408	-750	270	15x110
955	S409	-765	130	15x110
956	S410	-780	270	15x110
957	S411	-795	130	15x110
958	S412	-810	270	15x110
959	S413	-825	130	15x110
960	S414	-840	270	15x110
961	S415	-855	130	15x110
962	S416	-870	270	15x110
963	S417	-885	130	15x110
964	S418	-900	270	15x110
965	S419	-915	130	15x110
966	S420	-930	270	15x110
967	S421	-945	130	15x110
968	S422	-960	270	15x110
969	S423	-975	130	15x110
970	S424	-990	270	15x110
971	S425	-1005	130	15x110
972	S426	-1020	270	15x110
973	S427	-1035	130	15x110
974	S428	-1050	270	15x110
975	S429	-1065	130	15x110
976	S430	-1080	270	15x110
977	S431	-1095	130	15x110
978	S432	-1110	270	15x110
979	S433	-1125	130	15x110
980	S434	-1140	270	15x110
981	S435	-1155	130	15x110
982	S436	-1170	270	15x110
983	S437	-1185	130	15x110
984	S438	-1200	270	15x110
985	S439	-1215	130	15x110
986	S440	-1230	270	15x110
987	S441	-1245	130	15x110
988	S442	-1260	270	15x110
989	S443	-1275	130	15x110
990	S444	-1290	270	15x110
991	S445	-1305	130	15x110
992	S446	-1320	270	15x110
993	S447	-1335	130	15x110
994	S448	-1350	270	15x110
995	S449	-1365	130	15x110
996	S450	-1380	270	15x110
997	S451	-1395	130	15x110
998	S452	-1410	270	15x110
999	S453	-1425	130	15x110
1000	S454	-1440	270	15x110

No.	Name	X	Y	Bump Size
1001	S455	-1455	130	15x110
1002	S456	-1470	270	15x110
1003	S457	-1485	130	15x110
1004	S458	-1500	270	15x110
1005	S459	-1515	130	15x110
1006	S460	-1530	270	15x110
1007	S461	-1545	130	15x110
1008	S462	-1560	270	15x110
1009	S463	-1575	130	15x110
1010	S464	-1590	270	15x110
1011	S465	-1605	130	15x110
1012	S466	-1620	270	15x110
1013	S467	-1635	130	15x110
1014	S468	-1650	270	15x110
1015	S469	-1665	130	15x110
1016	S470	-1680	270	15x110
1017	S471	-1695	130	15x110
1018	S472	-1710	270	15x110
1019	S473	-1725	130	15x110
1020	S474	-1740	270	15x110
1021	S475	-1755	130	15x110
1022	S476	-1770	270	15x110
1023	S477	-1785	130	15x110
1024	S478	-1800	270	15x110
1025	S479	-1815	130	15x110
1026	S480	-1830	270	15x110
1027	S481	-1845	130	15x110
1028	S482	-1860	270	15x110
1029	S483	-1875	130	15x110
1030	S484	-1890	270	15x110
1031	S485	-1905	130	15x110
1032	S486	-1920	270	15x110
1033	S487	-1935	130	15x110
1034	S488	-1950	270	15x110
1035	S489	-1965	130	15x110
1036	S490	-1980	270	15x110
1037	S491	-1995	130	15x110
1038	S492	-2010	270	15x110
1039	S493	-2025	130	15x110
1040	S494	-2040	270	15x110
1041	S495	-2055	130	15x110
1042	S496	-2070	270	15x110
1043	S497	-2085	130	15x110
1044	S498	-2100	270	15x110
1045	S499	-2115	130	15x110
1046	S500	-2130	270	15x110
1047	S501	-2145	130	15x110
1048	S502	-2160	270	15x110
1049	S503	-2175	130	15x110
1050	S504	-2190	270	15x110

No.	Name	X	Y	Bump Size
1051	S505	-2205	130	15x110
1052	S506	-2220	270	15x110
1053	S507	-2235	130	15x110
1054	S508	-2250	270	15x110
1055	S509	-2265	130	15x110
1056	S510	-2280	270	15x110
1057	S511	-2295	130	15x110
1058	S512	-2310	270	15x110
1059	S513	-2325	130	15x110
1060	S514	-2340	270	15x110
1061	S515	-2355	130	15x110
1062	S516	-2370	270	15x110
1063	S517	-2385	130	15x110
1064	S518	-2400	270	15x110
1065	S519	-2415	130	15x110
1066	S520	-2430	270	15x110
1067	S521	-2445	130	15x110
1068	S522	-2460	270	15x110
1069	S523	-2475	130	15x110
1070	S524	-2490	270	15x110
1071	S525	-2505	130	15x110
1072	S526	-2520	270	15x110
1073	S527	-2535	130	15x110
1074	S528	-2550	270	15x110
1075	S529	-2565	130	15x110
1076	S530	-2580	270	15x110
1077	S531	-2595	130	15x110
1078	S532	-2610	270	15x110
1079	S533	-2625	130	15x110
1080	S534	-2640	270	15x110
1081	S535	-2655	130	15x110
1082	S536	-2670	270	15x110
1083	S537	-2685	130	15x110
1084	S538	-2700	270	15x110
1085	S539	-2715	130	15x110
1086	S540	-2730	270	15x110
1087	S541	-2745	130	15x110
1088	S542	-2760	270	15x110
1089	S543	-2775	130	15x110
1090	S544	-2790	270	15x110
1091	S545	-2805	130	15x110
1092	S546	-2820	270	15x110
1093	S547	-2835	130	15x110
1094	S548	-2850	270	15x110
1095	S549	-2865	130	15x110
1096	S550	-2880	270	15x110
1097	S551	-2895	130	15x110
1098	S552	-2910	270	15x110
1099	S553	-2925	130	15x110
1100	S554	-2940	270	15x110

No.	Name	X	Y	Bump Size
1101	S555	-2955	130	15x110
1102	S556	-2970	270	15x110
1103	S557	-2985	130	15x110
1104	S558	-3000	270	15x110
1105	S559	-3015	130	15x110
1106	S560	-3030	270	15x110
1107	S561	-3045	130	15x110
1108	S562	-3060	270	15x110
1109	S563	-3075	130	15x110
1110	S564	-3090	270	15x110
1111	S565	-3105	130	15x110
1112	S566	-3120	270	15x110
1113	S567	-3135	130	15x110
1114	S568	-3150	270	15x110
1115	S569	-3165	130	15x110
1116	S570	-3180	270	15x110
1117	S571	-3195	130	15x110
1118	S572	-3210	270	15x110
1119	S573	-3225	130	15x110
1120	S574	-3240	270	15x110
1121	S575	-3255	130	15x110
1122	S576	-3270	270	15x110
1123	S577	-3285	130	15x110
1124	S578	-3300	270	15x110
1125	S579	-3315	130	15x110
1126	S580	-3330	270	15x110
1127	S581	-3345	130	15x110
1128	S582	-3360	270	15x110
1129	S583	-3375	130	15x110
1130	S584	-3390	270	15x110
1131	S585	-3405	130	15x110
1132	S586	-3420	270	15x110
1133	S587	-3435	130	15x110
1134	S588	-3450	270	15x110
1135	S589	-3465	130	15x110
1136	S590	-3480	270	15x110
1137	S591	-3495	130	15x110
1138	S592	-3510	270	15x110
1139	S593	-3525	130	15x110
1140	S594	-3540	270	15x110
1141	S595	-3555	130	15x110
1142	S596	-3570	270	15x110
1143	S597	-3585	130	15x110
1144	S598	-3600	270	15x110
1145	S599	-3615	130	15x110
1146	S600	-3630	270	15x110
1147	S601	-3645	130	15x110
1148	S602	-3660	270	15x110
1149	S603	-3675	130	15x110
1150	S604	-3690	270	15x110

No.	Name	X	Y	Bump Size
1151	S605	-3705	130	15x110
1152	S606	-3720	270	15x110
1153	S607	-3735	130	15x110
1154	S608	-3750	270	15x110
1155	S609	-3765	130	15x110
1156	S610	-3780	270	15x110
1157	S611	-3795	130	15x110
1158	S612	-3810	270	15x110
1159	S613	-3825	130	15x110
1160	S614	-3840	270	15x110
1161	S615	-3855	130	15x110
1162	S616	-3870	270	15x110
1163	S617	-3885	130	15x110
1164	S618	-3900	270	15x110
1165	S619	-3915	130	15x110
1166	S620	-3930	270	15x110
1167	S621	-3945	130	15x110
1168	S622	-3960	270	15x110
1169	S623	-3975	130	15x110
1170	S624	-3990	270	15x110
1171	S625	-4005	130	15x110
1172	S626	-4020	270	15x110
1173	S627	-4035	130	15x110
1174	S628	-4050	270	15x110
1175	S629	-4065	130	15x110
1176	S630	-4080	270	15x110
1177	S631	-4095	130	15x110
1178	S632	-4110	270	15x110
1179	S633	-4125	130	15x110
1180	S634	-4140	270	15x110
1181	S635	-4155	130	15x110
1182	S636	-4170	270	15x110
1183	S637	-4185	130	15x110
1184	S638	-4200	270	15x110
1185	S639	-4215	130	15x110
1186	S640	-4230	270	15x110
1187	S641	-4245	130	15x110
1188	S642	-4260	270	15x110
1189	S643	-4275	130	15x110
1190	S644	-4290	270	15x110
1191	S645	-4305	130	15x110
1192	S646	-4320	270	15x110
1193	S647	-4335	130	15x110
1194	S648	-4350	270	15x110
1195	S649	-4365	130	15x110
1196	S650	-4380	270	15x110
1197	S651	-4395	130	15x110
1198	S652	-4410	270	15x110
1199	S653	-4425	130	15x110
1200	S654	-4440	270	15x110

No.	Name	X	Y	Bump Size
1201	S655	-4455	130	15x110
1202	S656	-4470	270	15x110
1203	S657	-4485	130	15x110
1204	S658	-4500	270	15x110
1205	S659	-4515	130	15x110
1206	S660	-4530	270	15x110
1207	S661	-4545	130	15x110
1208	S662	-4560	270	15x110
1209	S663	-4575	130	15x110
1210	S664	-4590	270	15x110
1211	S665	-4605	130	15x110
1212	S666	-4620	270	15x110
1213	S667	-4635	130	15x110
1214	S668	-4650	270	15x110
1215	S669	-4665	130	15x110
1216	S670	-4680	270	15x110
1217	S671	-4695	130	15x110
1218	S672	-4710	270	15x110
1219	S673	-4725	130	15x110
1220	S674	-4740	270	15x110
1221	S675	-4755	130	15x110
1222	S676	-4770	270	15x110
1223	S677	-4785	130	15x110
1224	S678	-4800	270	15x110
1225	S679	-4815	130	15x110
1226	S680	-4830	270	15x110
1227	S681	-4845	130	15x110
1228	S682	-4860	270	15x110
1229	S683	-4875	130	15x110
1230	S684	-4890	270	15x110
1231	S685	-4905	130	15x110
1232	S686	-4920	270	15x110
1233	S687	-4935	130	15x110
1234	S688	-4950	270	15x110
1235	S689	-4965	130	15x110
1236	S690	-4980	270	15x110
1237	S691	-4995	130	15x110
1238	S692	-5010	270	15x110
1239	S693	-5025	130	15x110
1240	S694	-5040	270	15x110
1241	S695	-5055	130	15x110
1242	S696	-5070	270	15x110
1243	S697	-5085	130	15x110
1244	S698	-5100	270	15x110
1245	S699	-5115	130	15x110
1246	S700	-5130	270	15x110
1247	S701	-5145	130	15x110
1248	S702	-5160	270	15x110
1249	S703	-5175	130	15x110
1250	S704	-5190	270	15x110

No.	Name	X	Y	Bump Size
1251	S705	-5205	130	15x110
1252	S706	-5220	270	15x110
1253	S707	-5235	130	15x110
1254	S708	-5250	270	15x110
1255	S709	-5265	130	15x110
1256	S710	-5280	270	15x110
1257	S711	-5295	130	15x110
1258	S712	-5310	270	15x110
1259	S713	-5325	130	15x110
1260	S714	-5340	270	15x110
1261	S715	-5355	130	15x110
1262	S716	-5370	270	15x110
1263	S717	-5385	130	15x110
1264	S718	-5400	270	15x110
1265	S719	-5415	130	15x110
1266	S720	-5430	270	15x110
1267	DUMMY	-5445	130	15x110
1268	PLT1	-5460	270	15x110
1269	PLT2	-5475	130	15x110
1270	PLT3	-5490	270	15x110
1271	PLT4	-5505	130	15x110
1272	DUMMY	-5520	270	15x110
1273	G543	-5535	130	15x110
1274	G541	-5550	270	15x110
1275	G539	-5565	130	15x110
1276	G537	-5580	270	15x110
1277	G535	-5595	130	15x110
1278	G533	-5610	270	15x110
1279	G531	-5625	130	15x110
1280	G529	-5640	270	15x110
1281	G527	-5655	130	15x110
1282	G525	-5670	270	15x110
1283	G523	-5685	130	15x110
1284	G521	-5700	270	15x110
1285	G519	-5715	130	15x110
1286	G517	-5730	270	15x110
1287	G515	-5745	130	15x110
1288	G513	-5760	270	15x110
1289	G511	-5775	130	15x110
1290	G509	-5790	270	15x110
1291	G507	-5805	130	15x110
1292	G505	-5820	270	15x110
1293	G503	-5835	130	15x110
1294	G501	-5850	270	15x110
1295	G499	-5865	130	15x110
1296	G497	-5880	270	15x110
1297	G495	-5895	130	15x110
1298	G493	-5910	270	15x110
1299	G491	-5925	130	15x110
1300	G489	-5940	270	15x110

No.	Name	X	Y	Bump Size
1301	G487	-5955	130	15x110
1302	G485	-5970	270	15x110
1303	G483	-5985	130	15x110
1304	G481	-6000	270	15x110
1305	G479	-6015	130	15x110
1306	G477	-6030	270	15x110
1307	G475	-6045	130	15x110
1308	G473	-6060	270	15x110
1309	G471	-6075	130	15x110
1310	G469	-6090	270	15x110
1311	G467	-6105	130	15x110
1312	G465	-6120	270	15x110
1313	G463	-6135	130	15x110
1314	G461	-6150	270	15x110
1315	G459	-6165	130	15x110
1316	G457	-6180	270	15x110
1317	G455	-6195	130	15x110
1318	G453	-6210	270	15x110
1319	G451	-6225	130	15x110
1320	G449	-6240	270	15x110
1321	G447	-6255	130	15x110
1322	G445	-6270	270	15x110
1323	G443	-6285	130	15x110
1324	G441	-6300	270	15x110
1325	G439	-6315	130	15x110
1326	G437	-6330	270	15x110
1327	G435	-6345	130	15x110
1328	G433	-6360	270	15x110
1329	G431	-6375	130	15x110
1330	G429	-6390	270	15x110
1331	G427	-6405	130	15x110
1332	G425	-6420	270	15x110
1333	G423	-6435	130	15x110
1334	G421	-6450	270	15x110
1335	G419	-6465	130	15x110
1336	G417	-6480	270	15x110
1337	G415	-6495	130	15x110
1338	G413	-6510	270	15x110
1339	G411	-6525	130	15x110
1340	G409	-6540	270	15x110
1341	G407	-6555	130	15x110
1342	G405	-6570	270	15x110
1343	G403	-6585	130	15x110
1344	G401	-6600	270	15x110
1345	G399	-6615	130	15x110
1346	G397	-6630	270	15x110
1347	G395	-6645	130	15x110
1348	G393	-6660	270	15x110
1349	G391	-6675	130	15x110
1350	G389	-6690	270	15x110

No.	Name	X	Y	Bump Size
1351	G387	-6705	130	15x110
1352	G385	-6720	270	15x110
1353	G383	-6735	130	15x110
1354	G381	-6750	270	15x110
1355	G379	-6765	130	15x110
1356	G377	-6780	270	15x110
1357	G375	-6795	130	15x110
1358	G373	-6810	270	15x110
1359	G371	-6825	130	15x110
1360	G369	-6840	270	15x110
1361	G367	-6855	130	15x110
1362	G365	-6870	270	15x110
1363	G363	-6885	130	15x110
1364	G361	-6900	270	15x110
1365	G359	-6915	130	15x110
1366	G357	-6930	270	15x110
1367	G355	-6945	130	15x110
1368	G353	-6960	270	15x110
1369	G351	-6975	130	15x110
1370	G349	-6990	270	15x110
1371	G347	-7005	130	15x110
1372	G345	-7020	270	15x110
1373	G343	-7035	130	15x110
1374	G341	-7050	270	15x110
1375	G339	-7065	130	15x110
1376	G337	-7080	270	15x110
1377	G335	-7095	130	15x110
1378	G333	-7110	270	15x110
1379	G331	-7125	130	15x110
1380	G329	-7140	270	15x110
1381	G327	-7155	130	15x110
1382	G325	-7170	270	15x110
1383	G323	-7185	130	15x110
1384	G321	-7200	270	15x110
1385	G319	-7215	130	15x110
1386	G317	-7230	270	15x110
1387	G315	-7245	130	15x110
1388	G313	-7260	270	15x110
1389	G311	-7275	130	15x110
1390	G309	-7290	270	15x110
1391	G307	-7305	130	15x110
1392	G305	-7320	270	15x110
1393	G303	-7335	130	15x110
1394	G301	-7350	270	15x110
1395	G299	-7365	130	15x110
1396	G297	-7380	270	15x110
1397	G295	-7395	130	15x110
1398	G293	-7410	270	15x110
1399	G291	-7425	130	15x110
1400	G289	-7440	270	15x110

No.	Name	X	Y	Bump Size
1401	G287	-7455	130	15x110
1402	G285	-7470	270	15x110
1403	G283	-7485	130	15x110
1404	G281	-7500	270	15x110
1405	G279	-7515	130	15x110
1406	G277	-7530	270	15x110
1407	G275	-7545	130	15x110
1408	G273	-7560	270	15x110
1409	G271	-7575	130	15x110
1410	G269	-7590	270	15x110
1411	G267	-7605	130	15x110
1412	G265	-7620	270	15x110
1413	G263	-7635	130	15x110
1414	G261	-7650	270	15x110
1415	G259	-7665	130	15x110
1416	G257	-7680	270	15x110
1417	G255	-7695	130	15x110
1418	G253	-7710	270	15x110
1419	G251	-7725	130	15x110
1420	G249	-7740	270	15x110
1421	G247	-7755	130	15x110
1422	G245	-7770	270	15x110
1423	G243	-7785	130	15x110
1424	G241	-7800	270	15x110
1425	G239	-7815	130	15x110
1426	G237	-7830	270	15x110
1427	G235	-7845	130	15x110
1428	G233	-7860	270	15x110
1429	G231	-7875	130	15x110
1430	G229	-7890	270	15x110
1431	G227	-7905	130	15x110
1432	G225	-7920	270	15x110
1433	G223	-7935	130	15x110
1434	G221	-7950	270	15x110
1435	G219	-7965	130	15x110
1436	G217	-7980	270	15x110
1437	G215	-7995	130	15x110
1438	G213	-8010	270	15x110
1439	G211	-8025	130	15x110
1440	G209	-8040	270	15x110
1441	G207	-8055	130	15x110
1442	G205	-8070	270	15x110
1443	G203	-8085	130	15x110
1444	G201	-8100	270	15x110
1445	G199	-8115	130	15x110
1446	G197	-8130	270	15x110
1447	G195	-8145	130	15x110
1448	G193	-8160	270	15x110
1449	G191	-8175	130	15x110
1450	G189	-8190	270	15x110

No.	Name	X	Y	Bump Size
1451	G187	-8205	130	15x110
1452	G185	-8220	270	15x110
1453	G183	-8235	130	15x110
1454	G181	-8250	270	15x110
1455	G179	-8265	130	15x110
1456	G177	-8280	270	15x110
1457	G175	-8295	130	15x110
1458	G173	-8310	270	15x110
1459	G171	-8325	130	15x110
1460	G169	-8340	270	15x110
1461	G167	-8355	130	15x110
1462	G165	-8370	270	15x110
1463	G163	-8385	130	15x110
1464	G161	-8400	270	15x110
1465	G159	-8415	130	15x110
1466	G157	-8430	270	15x110
1467	G155	-8445	130	15x110
1468	G153	-8460	270	15x110
1469	G151	-8475	130	15x110
1470	G149	-8490	270	15x110
1471	G147	-8505	130	15x110
1472	G145	-8520	270	15x110
1473	G143	-8535	130	15x110
1474	G141	-8550	270	15x110
1475	G139	-8565	130	15x110
1476	G137	-8580	270	15x110
1477	G135	-8595	130	15x110
1478	G133	-8610	270	15x110
1479	G131	-8625	130	15x110
1480	G129	-8640	270	15x110
1481	G127	-8655	130	15x110
1482	G125	-8670	270	15x110
1483	G123	-8685	130	15x110
1484	G121	-8700	270	15x110
1485	G119	-8715	130	15x110
1486	G117	-8730	270	15x110
1487	G115	-8745	130	15x110
1488	G113	-8760	270	15x110
1489	G111	-8775	130	15x110
1490	G109	-8790	270	15x110
1491	G107	-8805	130	15x110
1492	G105	-8820	270	15x110
1493	G103	-8835	130	15x110
1494	G101	-8850	270	15x110
1495	G99	-8865	130	15x110
1496	G97	-8880	270	15x110
1497	G95	-8895	130	15x110
1498	G93	-8910	270	15x110
1499	G91	-8925	130	15x110
1500	G89	-8940	270	15x110

No.	Name	X	Y	Bump Size
1501	G87	-8955	130	15x110
1502	G85	-8970	270	15x110
1503	G83	-8985	130	15x110
1504	G81	-9000	270	15x110
1505	G79	-9015	130	15x110
1506	G77	-9030	270	15x110
1507	G75	-9045	130	15x110
1508	G73	-9060	270	15x110
1509	G71	-9075	130	15x110
1510	G69	-9090	270	15x110
1511	G67	-9105	130	15x110
1512	G65	-9120	270	15x110
1513	G63	-9135	130	15x110
1514	G61	-9150	270	15x110
1515	G59	-9165	130	15x110
1516	G57	-9180	270	15x110
1517	G55	-9195	130	15x110
1518	G53	-9210	270	15x110
1519	G51	-9225	130	15x110
1520	G49	-9240	270	15x110
1521	G47	-9255	130	15x110
1522	G45	-9270	270	15x110
1523	G43	-9285	130	15x110
1524	G41	-9300	270	15x110
1525	G39	-9315	130	15x110
1526	G37	-9330	270	15x110
1527	G35	-9345	130	15x110
1528	G33	-9360	270	15x110
1529	G31	-9375	130	15x110
1530	G29	-9390	270	15x110
1531	G27	-9405	130	15x110
1532	G25	-9420	270	15x110
1533	G23	-9435	130	15x110
1534	G21	-9450	270	15x110
1535	G19	-9465	130	15x110
1536	G17	-9480	270	15x110
1537	G15	-9495	130	15x110
1538	G13	-9510	270	15x110
1539	G11	-9525	130	15x110
1540	G9	-9540	270	15x110
1541	G7	-9555	130	15x110
1542	G5	-9570	270	15x110
1543	G3	-9585	130	15x110
1544	G1	-9600	270	15x110
1545	DUMMY	-9615	130	15x110
1546	THROUGH7	-9630	270	15x110
1547	DUMMY	-9645	130	15x110
1548	THROUGH8	-9660	270	15x110
1549	L_MARK	-9605	-142.5	NA

6. Pin Description

Pin name	I/O	Description
S[1:720]	O	Source driver output.
D27~D20 D17~D10 D07~D00	I	Digital data input. Internally pulled low. (a) PS=H (parallel RGB interface): Dx7~Dx0 are used. (b) PS=L (serial RGB interface): only D07~D00 are used.
G[1:544]	O	Gate driver output. If RES=L, G481 ~ G544 are disabled.
LR	I	Shift direction selection signal. Internally pulled high. Shift direction of the internal shift register is controlled by this pin as shown below: (a) LR=H: S1→S2 →• • •→S720 (b) LR=L: S720→S719→• • •→S1
UD	I	Scan direction selection signal. Internally pulled high. (a) UD=H: G1→G2 →• • •→G544 (b) UD=L: G544→G543 →• • •→G1
CLK	I	Clock signal for data latching and internal counter of the timing controller.
CLK_TRG	I	Clock edge selection signal for the data sampling. Internally pulled high. (a) CLK_TRG=H: Data sampling at the CLK falling edge. (b) CLK_TRG=L: Data sampling at the CLK rising edge.
HS	I	Horizontal sync input with negative polarity. Internally pull high.
VS	I	Vertical sync input with negative polarity. Internally pull high.
DE	I	Input data enable control. Internally pulled low.
DISP	I	Display on/off mode control. Internally pulled high. (a) DISP=L, standby mode. (b) DISP=H, normal display mode.
RESETB	I	Active low global reset signal input. Internally pulled high.
PS	I	Input data format select signal. Internally pulled high. (a) PS=H: Parallel RGB (b) PS=L: Serial RGB
RES	I	Resolution select signal. Internally pulled high. (a) RES=H: 480RGB x 272 (b) RES=L: 480RGB x 240
NBW	I	LC type selection. Internally pulled high. (a) NBW=H: Normally black LC. (b) NBW=L: Normally white LC.
POL	O	Polarity signal to monitor VCOM signal.
PSHUT	I	Input pin to enable internal charge pump circuit. Internal pull high. - Connect to VDDIO to enable internal charge pump VCL, VGH, VGL, VCIX2 and VCOM. - Connect to DVSS to disable internal charge pump VGH, VGL, VCIX2 and VCOM.
CSB	I	Chip select pin of serial interface. Internal pull high. - Leave it OPEN when not used (Refer to Serial Interface block)
SCL	I	Clock pin of serial interface. Internal pull high. - Leave it OPEN when not used (Refer to Serial Interface block)
SDI	I	Data input pin in serial mode. Internal pull high. - Leave it OPEN when not used (Refer to Serial Interface block)
SDO	O	Data output pin in serial mode. - Leave it OPEN when not used (Refer to Serial Interface block)

Pin name	I/O	Description
VGR	O	Output pin of internal regulator circuit.
COMH	O	Output pin of regulator for COMMON output high level.
COML	O	Output pin of regulator for COMMON output low level.
COMPP	I	Adjust the amplitude voltage level for COMMON output. If not used, please leave it open.
COMC	I	Adjust the DC voltage level for COMMON output. If not used, please leave it open.
VCOM	O	This is output pin for COMMON signal of a TFT panel.
VDDIO	VI	Voltage input pin for I/O logic.
VCI	VI	Booster input voltage pin.
VCIP	VI	Voltage supply pin for analog circuit. This pin requires a noise free path for providing accurate LCD driving voltages. Can be connected to VCI on system board or FPC.
VDD	V	Internal regulator output voltage for logic circuit. Connect a capacitor for stabilization.
VCIX2	V	Equal to 2 x VCI. Connect a capacitor for stabilization.
VCIX2J	V	This is the power supply used for analog blocks and VLCD/VDC regulation.
VLCD	V	Internal generated power for gamma circuit. Connect a capacitor for stabilization.
VDC	V	Power for reference voltage of VGH/VGL pumping.
VGH	V	Positive power pin for gate driver.
VGL	V	Negative power pin for gate driver.
VCL	V	Negative voltage of VCI. Connect a capacitor for stabilization.
C1AP/C1BP, C1N, C2P, C2N C3P, C3N C4P, C4N C5P, C5N CX1P, CX1N CX2P, CX2N	I	Connect 0.1uF capacitor between CnP and CnN pins.
DVSS	VI	Digital ground.
AVSS	VI	Analog ground.
VCHS	VI	Ground for booster circuit.
VSSRC	VI	Ground for analog circuit. This pin requires a noise free path for providing accurate LCD driving voltages.
EXVR	I	External reference of internal gamma resistor.
DRV1	O	Power transistor gate signal for the boost converter 1. 1st PWM can be used for LED backlight power.
VFB1	I	Main boost regulator feedback input 1. Connect feedback resistive divider to GND. If 1st PWM is not used, please connect VFB1 to GND. VFB1 default threshold is 1.0 V.

Pin name	I/O	Description
DRV2	O	Power transistor gate signal for the boost converter 2. 2nd PWM can be used for generate VCIX2J power if needed.
VFB2	I	Main boost regulator feedback input 2. Connect feedback resistive divider to GND. If 2nd PWM is not used, please connect VFB2 to GND. VFB2 default threshold is 1.0 V.
DU[4:0]	I	Set 1st PWM duty cycle for LED backlight. This setting is only effective when DUS bit = 1(R05h). If this function is not used, connect DU[4:0] to VDDIO or floating them. Internally pull high.
CPWM	O	Duty cycle control signal of CABC function output.
PSW	I	Internal switch input. This is used only for 2nd PWM (PWM B). If 2nd PWM is not used, please leave it open.
TEST1~10	O	Test pins. Floating it on panel.
PRT1	-	Dummy pads. These two pins are short circuited within the chip
PRB1		
PRT2	-	Dummy pads. These two pins are short circuited within the chip
PRB2		
PRT3	-	Dummy pads. These two pins are short circuited within the chip
PRB3		
PRT4	-	Dummy pads. These two pins are short circuited within the chip
PRB4		
PLT1	-	Dummy pads. These two pins are short circuited within the chip
PLB1		
PLT2	-	Dummy pads. These two pins are short circuited within the chip
PLB2		
PLT3	-	Dummy pads. These two pins are short circuited within the chip
PLB3		
PLT4	-	Dummy pads. These two pins are short circuited within the chip
PLB4		
THROUGH5	-	Dummy pads. Used to measure the COG contact resistance. These two pins are short circuited within the chip
THROUGH6		
THROUGH7	-	Dummy pads. Used to measure the COG contact resistance. These two pins are short circuited within the chip
THROUGH8		
DUMMY	-	Dummy pins. Floating it on panel.

7. Function Description

7.1 Power relationship

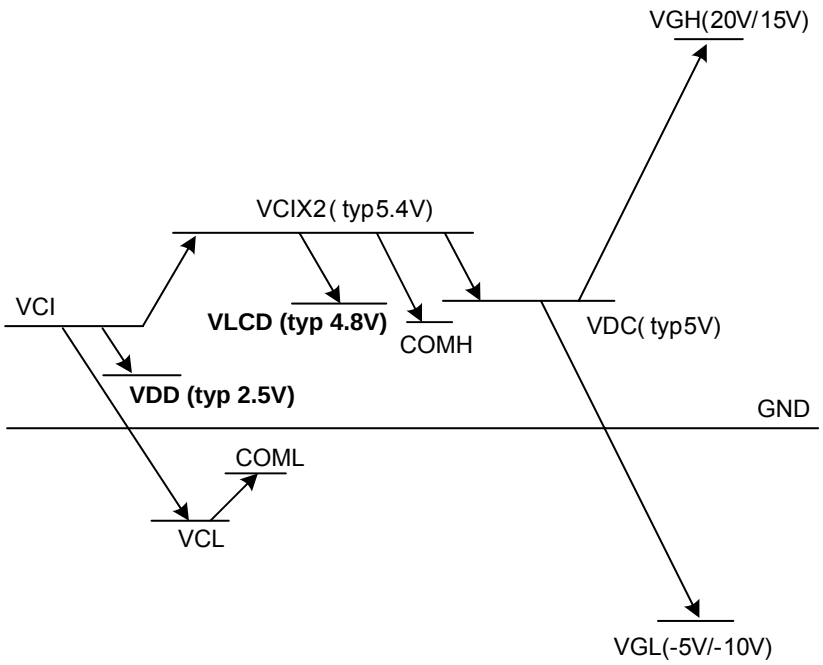


Figure 7.1 Power Block

You can get different VGH/VGL voltage by following different component configuration.

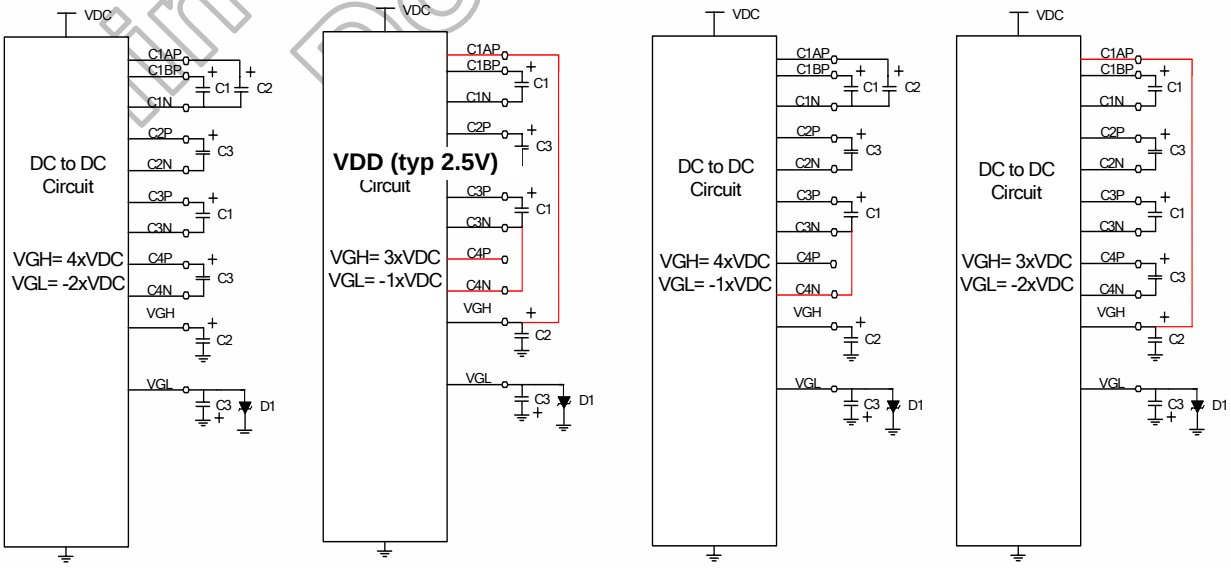


Figure 7.2 VGH/VGL External Setting

7.2 VCOM block

You can use internal circuit to generate COMPP and COMC voltage level. Register VDV[4:0] and VMC[4:0] are used to adjust COMPP and COMC voltage. If you want to set COMPP and COMC voltage level from external, just set VDV[4:0]=00000 and VMC[4:0]=00000. Then you can input COMPP and COMC from hardware pins. The HX8257-A has a regulator circuit for VGR output power level. Connect VGR with outside resistor strings. These resistor strings can generate COMPP and COMC voltage levels for internal VCOM generation circuit. VGR voltage level is 4.5V. (Typ.) If COMC/COMPP is generated internally, VGR circuit will be disabled.

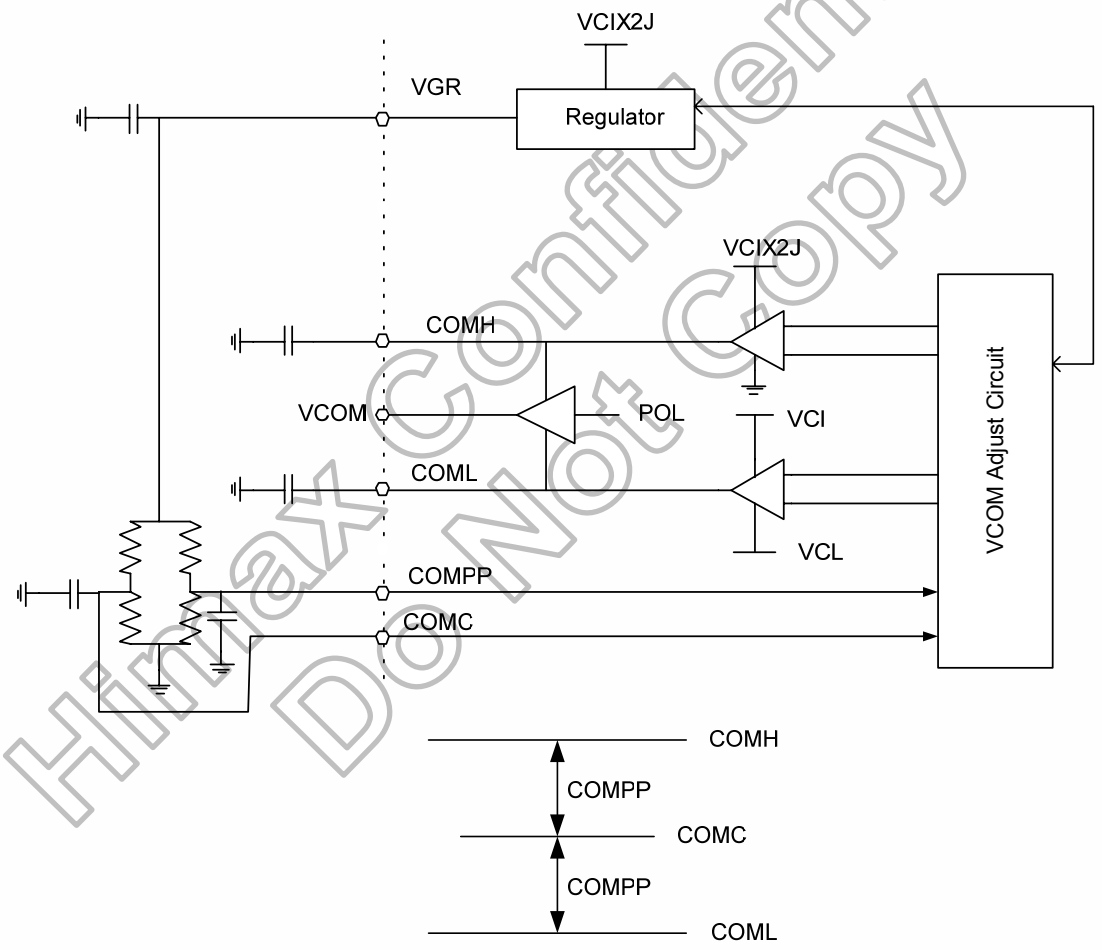


Figure 7.3 VCOM Block

7.3 Gate driver

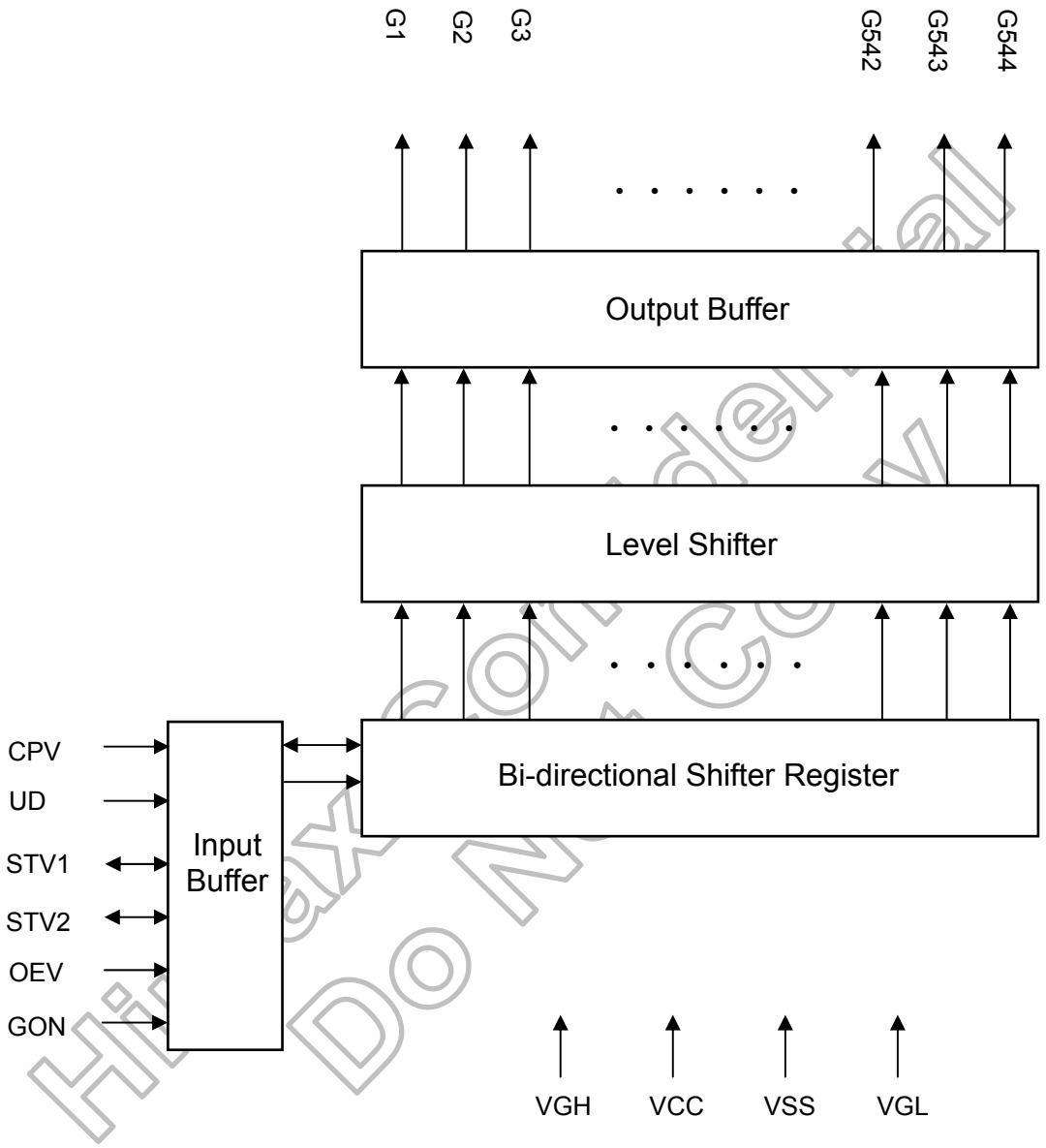


Figure 7.4 Gate Driver

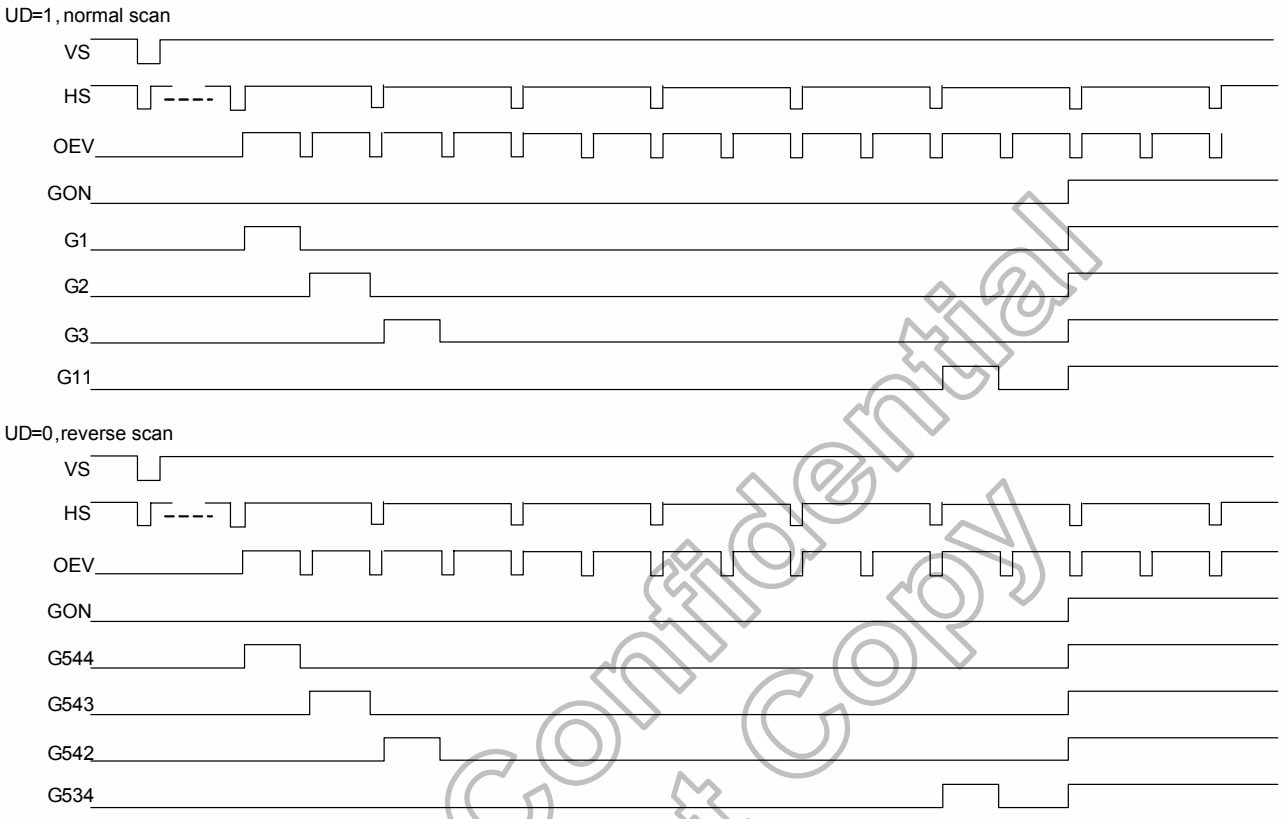


Figure 7.5 Gate Sequence

7.4 Source driver

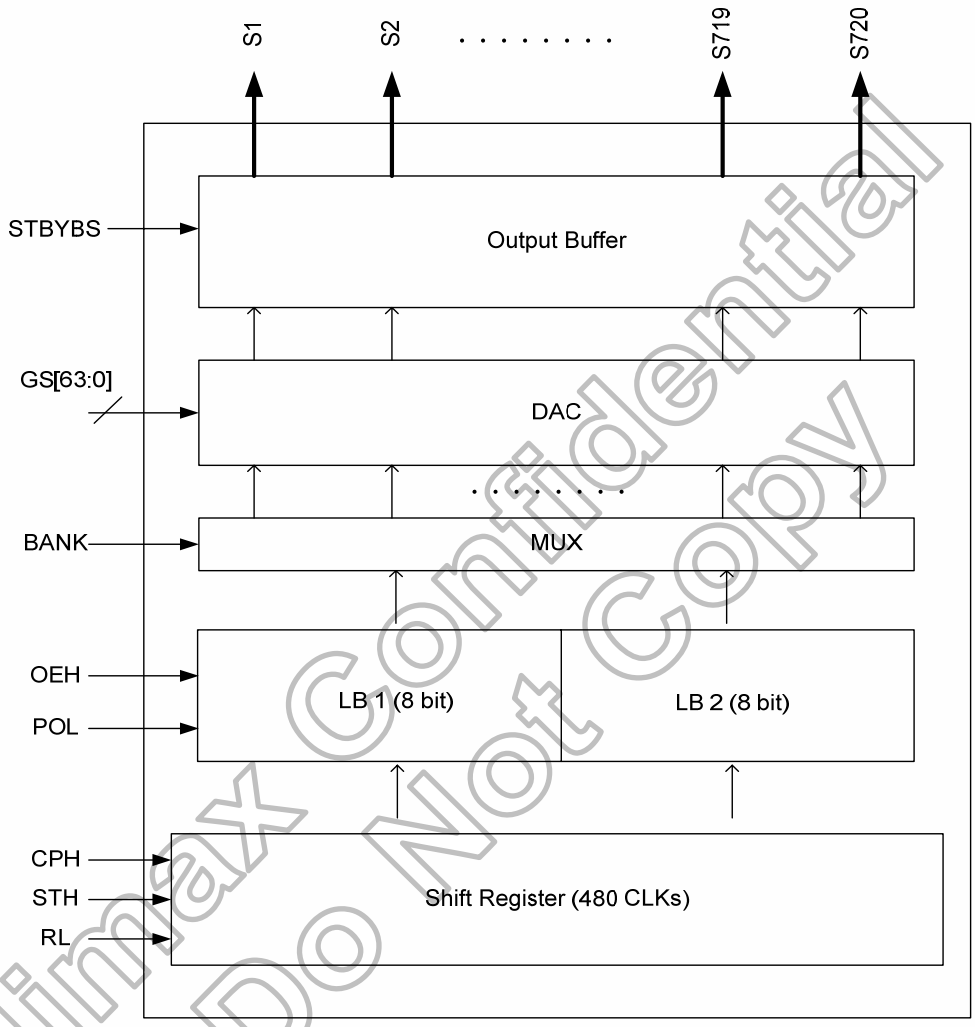


Figure 7.6 Source Block

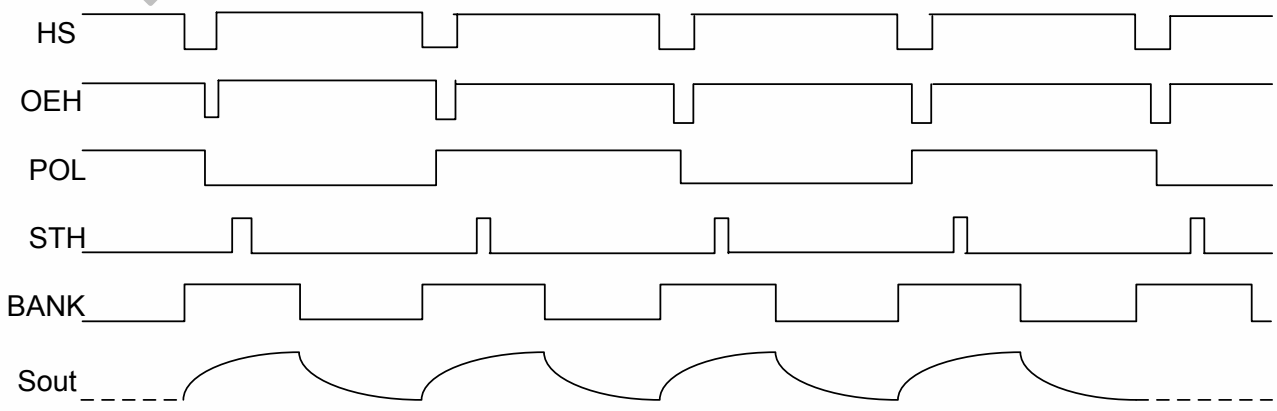


Figure 7.7 Source Sequence

7.5 Gamma adjustment

The HX8257-A incorporates gamma adjustment function for the 256-color display. Gamma adjustment is implemented by deciding the 6-grayscale levels with gradient adjustment and micro adjustment register. Also, gradient adjustment and micro adjustment is fixed for each of the internal positive and negative polarity. Set up by the liquid crystal panel's specification.

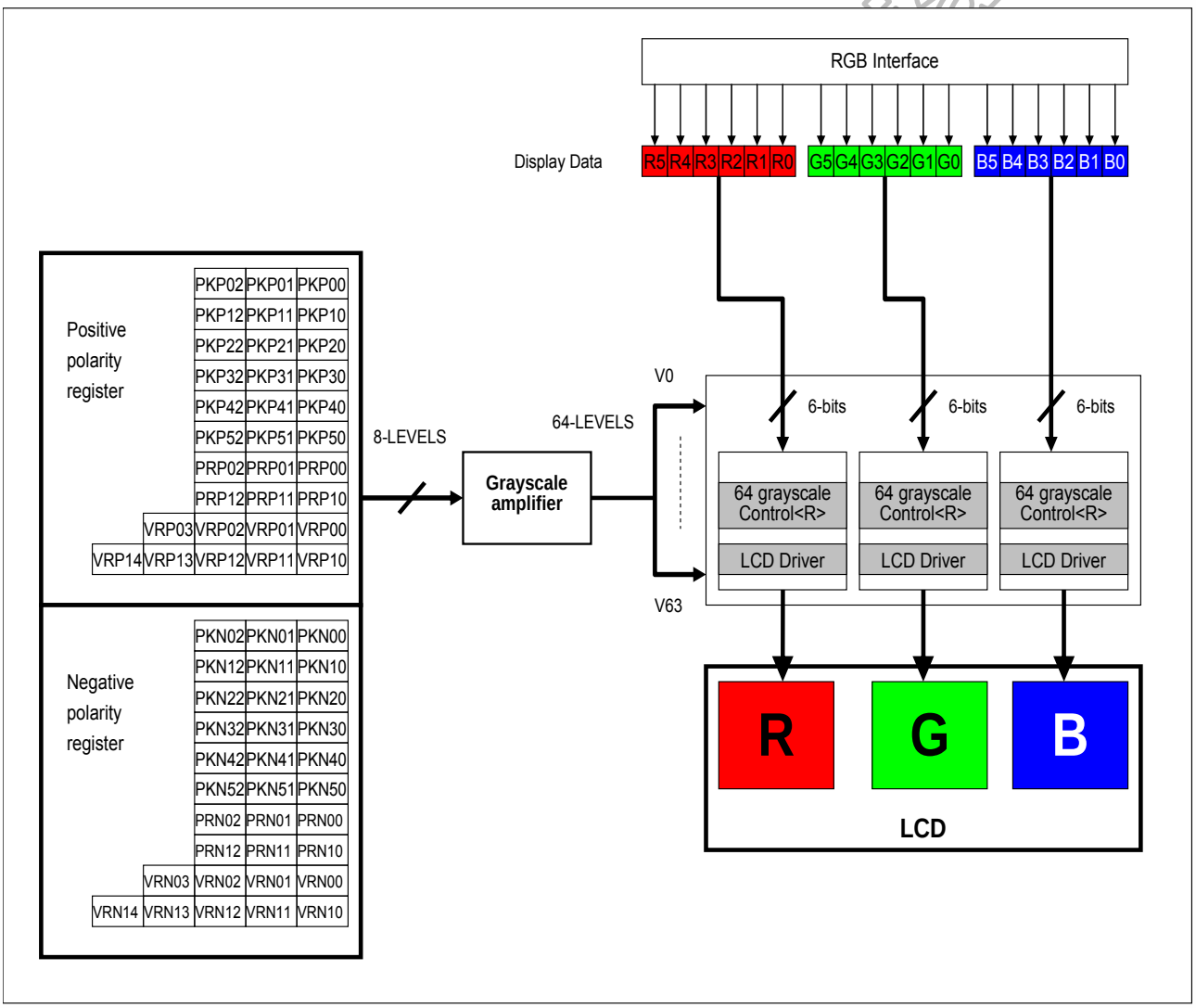


Figure 7.8 Grayscale Control Block

7.5.1 Structure of grayscale amplifier

Below figure indicates the structure of the grayscale amplifier (Positive Gray Scale). Different voltages are decided by the gradient adjustment register and the micro adjustment register, which are used for the Grayscale Amplifier. Then HX8257-A will generate 64 voltages（GS0 to GS63）by ladder resistors.

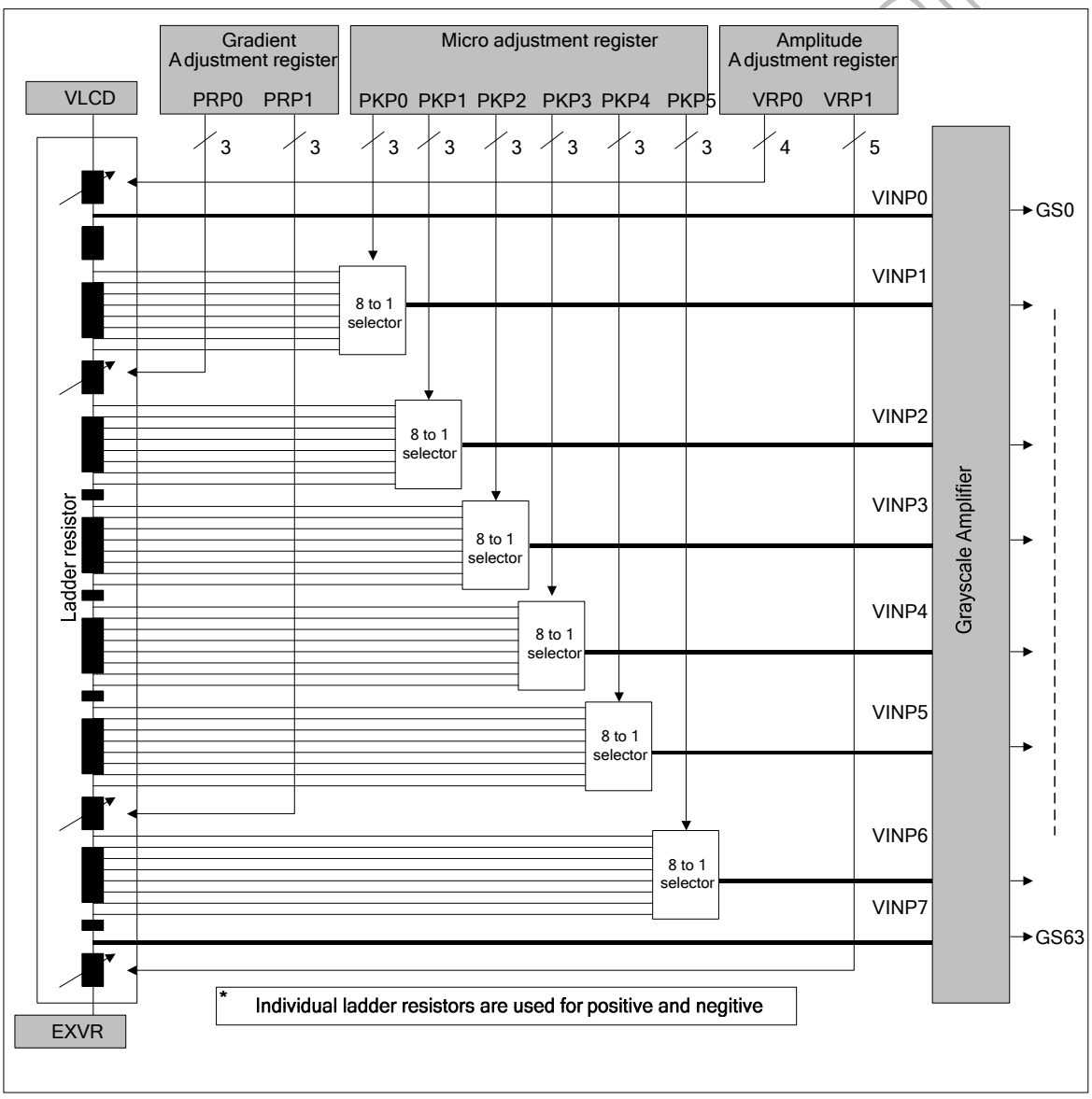


Figure 7.9 Grayscale Amplifier

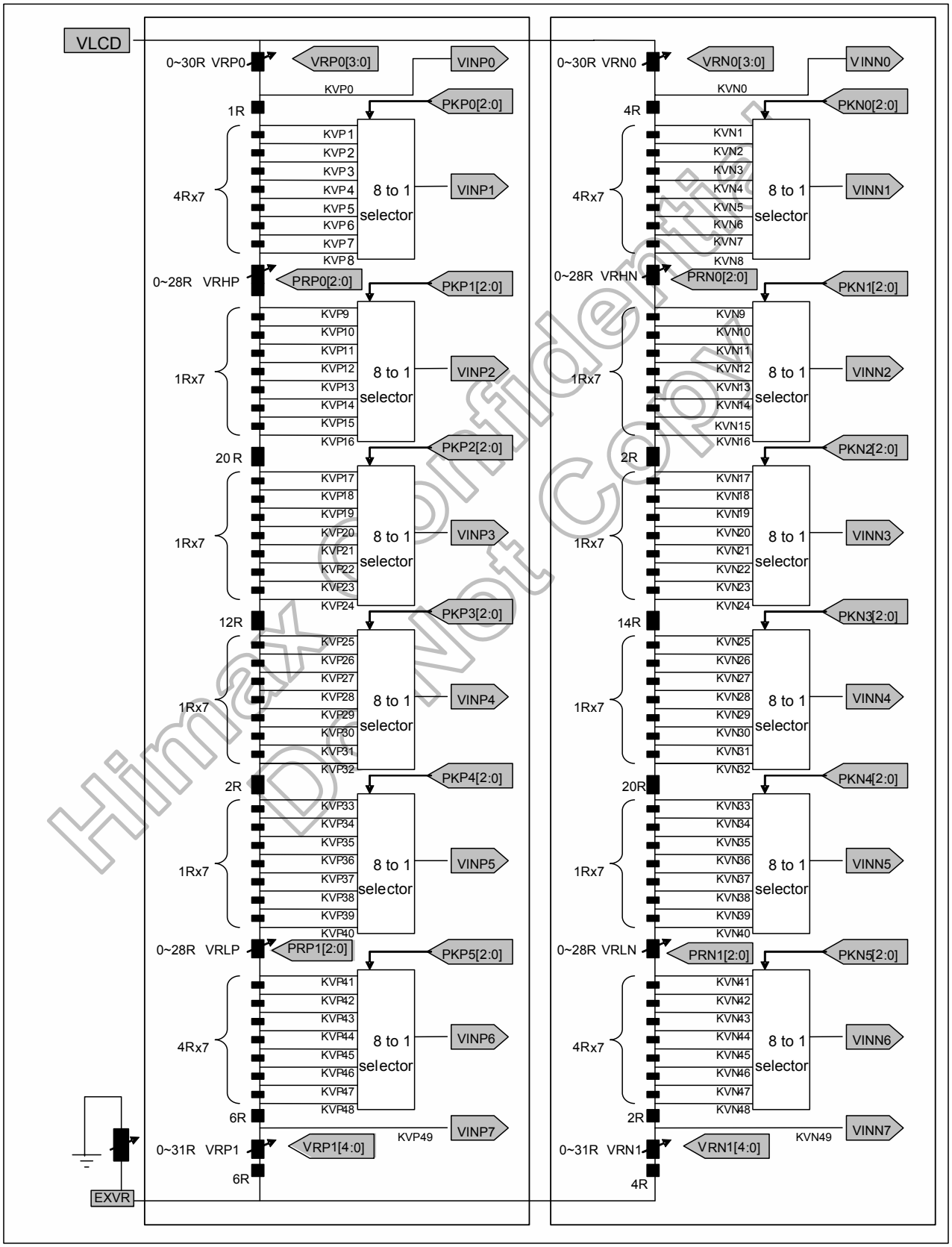


Figure 7.10 Resistor Ladder for Gamma Voltages Generation

7.5.2 Gamma adjustment register

This block is the register to set up the grayscale voltage adjusting to the gamma specification of the LCD panel. This register can independent set up to positive/negative polarities and there are three types of register groups to adjust gradient, amplitude, and micro-adjustment on number of the grayscale, characteristics of the grayscale voltage. (Use the same setting for Reference-value and R.G.B.) Following graphics indicates the operation of each adjusting register.

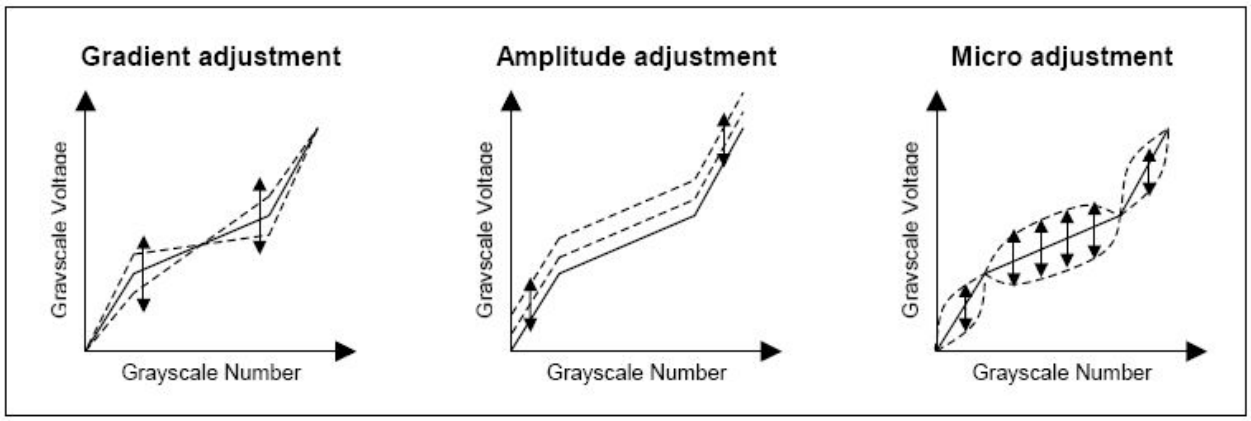


Figure 7.11 Gamma Adjustment Function

7.5.2.1 Gradient adjusting register

The gradient-adjusting resistor is to adjust around middle gradient, specification of the grayscale number and the grayscale voltage without changing the dynamic range. To accomplish the adjustment, it controls the variable resistors in the middle of the ladder resistor by registers (PRP(N)0 / PRP(N)1) for the grayscale voltage generator. Also, there is an independent resistor on the positive/negative polarities in order for corresponding to asymmetry drive.

7.5.2.2 Amplitude adjusting register

The amplitude-adjusting resistor is to adjust amplitude of the grayscale voltage. To accomplish the adjustment, it controls the variable resistors in the boundary of the ladder resistor by registers (VRP(N)0 / VRP(N)1) for the grayscale voltage generator. Also, there is an independent resistor on the positive/negative polarities as well as the gradient-adjusting resistor.

7.5.2.3 Micro adjusting register

The micro-adjusting register is to make subtle adjustment of the grayscale voltage level. To accomplish the adjustment, it controls each reference voltage level by the 8 to 1 selector towards the 8-level reference voltage generated from the ladder resistor. Also, there is an independent resistor on the positive/negative polarities as well as other adjusting resistors.

7.5.3 Ladder resistor / 8 to 1 selector

This block outputs the reference voltage of the grayscale voltage. There are two ladder resistors including the variable resistor and the 8 to 1 selector selecting voltage generated by the ladder resistor. The gamma registers control the variable resistors and 8 to 1 selector resistors. Also, there has pin (EXVR) that can be connected to VSS or an external variable resistor for compensating the dispersion of length according to different panels.

Variable resistor

There are 3 types of the variable resistors that are for the gradient and amplitude adjustment. The resistance is set by the resistor (PRP(N)0 / PRP(N)1) and (VRP(N)0 / VRP(N)1) as below.

PRP(N)[0:1]	Resistance
000	0R
001	4R
010	8R
011	12R
100	16R
101	20R
110	24R
111	28R

PRP(N)

VRP(N)0	Resistance
0000	0R
0001	2R
0010	4R
:	
Step = 2R	
:	
1110	28R
1111	30R

VRP(N)0

VRP(N)1	Resistance
00000	0R
00001	1R
00010	2R
:	
Step = 1R	
:	
11110	30R
11111	31R

VRP(N)1

Table 7.1 Variable Resistor

8 to 1 selector

In the 8 to 1 selector, a reference voltage VIN can be selected from the levels which are generated by the ladder resistors. There are six types of reference voltage (VIN1 to VIN6) and totally 48 divided voltages can be selected in one ladder resistor. Following figure explains the relationship between the micro adjusting register and the selecting voltage.

Positive polarity							Negative polarity						
Register	Selected voltage						Register	Selected voltage					
PKP[2:0]	VINP1	VINP2	VINP3	VINP4	VINP5	VINP6	PKN[2:0]	VINN1	VINN2	VINN3	VINN4	VINN5	VINN6
000	KVP1	KVP9	KVP17	KVP25	KVP33	KVP41	000	KVN1	KVN9	KVN17	KVN25	KVN33	KVN41
001	KVP2	KVP10	KVP18	KVP26	KVP34	KVP42	001	KVN2	KVN10	KVN18	KVN26	KVN34	KVN42
010	KVP3	KVP11	KVP19	KVP27	KVP35	KVP43	010	KVN3	KVN11	KVN19	KVN27	KVN35	KVN43
011	KVP4	KVP12	KVP20	KVP28	KVP36	KVP44	011	KVN4	KVN12	KVN20	KVN28	KVN36	KVN44
100	KVP5	KVP13	KVP21	KVP29	KVP37	KVP45	100	KVN5	KVN13	KVN21	KVN29	KVN37	KVN45
101	KVP6	KVP14	KVP22	KVP30	KVP38	KVP46	101	KVN6	KVN14	KVN22	KVN30	KVN38	KVN46
110	KVP7	KVP15	KVP23	KVP31	KVP39	KVP47	110	KVN7	KVN15	KVN23	KVN31	KVN39	KVN47
111	KVP8	KVP16	KVP24	KVP32	KVP40	KVP48	111	KVN8	KVN16	KVN24	KVN32	KVN40	KVN48

Table 7.2 PKP and PKN

Grayscale voltage	Positive Polarity	Negative Polarity
V0	VINP0	VINN7
V1	VINP1	VINN6
V2	V8+(V1-V8)*(167/222)	V1+(V8-V1)*(55/222)
V3	V8+(V1-V8)*(124/222)	V1+(V8-V1)*(98/222)
V4	V8+(V1-V8)*(90/222)	V1+(V8-V1)*(132/222)
V5	V8+(V1-V8)*(61/222)	V1+(V8-V1)*(161/222)
V6	V8+(V1-V8)*(37/222)	V1+(V8-V1)*(185/222)
V7	V8+(V1-V8)*(17/222)	V1+(V8-V1)*(205/222)
V8	VINP2	VINN5
V9	V20+(V8-V20)*(108/124)	V8+(V20-V8)*(16/124)
V10	V20+(V8-V20)*(94/124)	V8+(V20-V8)*(30/124)
V11	V20+(V8-V20)*(81/124)	V8+(V20-V8)*(43/124)
V12	V20+(V8-V20)*(70/124)	V8+(V20-V8)*(54/124)
V13	V20+(V8-V20)*(59/124)	V8+(V20-V8)*(65/124)
V14	V20+(V8-V20)*(49/124)	V8+(V20-V8)*(75/124)
V15	V20+(V8-V20)*(39/124)	V8+(V20-V8)*(85/124)
V16	V20+(V8-V20)*(31/124)	V8+(V20-V8)*(93/124)
V17	V20+(V8-V20)*(22/124)	V8+(V20-V8)*(102/124)
V18	V20+(V8-V20)*(15/124)	V8+(V20-V8)*(109/124)
V19	V20+(V8-V20)*(7/124)	V8+(V20-V8)*(117/124)
V20	VINP3	VINN4
V21	V43+(V20-V43)*(115/122)	V20+(V43-V20)*(7/122)
V22	V43+(V20-V43)*(108/122)	V20+(V43-V20)*(14/122)
V23	V43+(V20-V43)*(102/122)	V20+(V43-V20)*(20/122)
V24	V43+(V20-V43)*(96/122)	V20+(V43-V20)*(26/122)
V25	V43+(V20-V43)*(90/122)	V20+(V43-V20)*(32/122)
V26	V43+(V20-V43)*(84/122)	V20+(V43-V20)*(38/122)
V27	V43+(V20-V43)*(78/122)	V20+(V43-V20)*(44/122)
V28	V43+(V20-V43)*(73/122)	V20+(V43-V20)*(49/122)
V29	V43+(V20-V43)*(68/122)	V20+(V43-V20)*(54/122)
V30	V43+(V20-V43)*(63/122)	V20+(V43-V20)*(59/122)
V31	V43+(V20-V43)*(58/122)	V20+(V43-V20)*(64/122)
V32	V43+(V20-V43)*(53/122)	V20+(V43-V20)*(69/122)
V33	V43+(V20-V43)*(48/122)	V20+(V43-V20)*(74/122)
V34	V43+(V20-V43)*(43/122)	V20+(V43-V20)*(79/122)
V35	V43+(V20-V43)*(38/122)	V20+(V43-V20)*(84/122)
V36	V43+(V20-V43)*(33/122)	V20+(V43-V20)*(89/122)
V37	V43+(V20-V43)*(28/122)	V20+(V43-V20)*(94/122)
V38	V43+(V20-V43)*(24/122)	V20+(V43-V20)*(98/122)
V39	V43+(V20-V43)*(19/122)	V20+(V43-V20)*(103/122)
V40	V43+(V20-V43)*(14/122)	V20+(V43-V20)*(108/122)
V41	V43+(V20-V43)*(9/122)	V20+(V43-V20)*(113/122)
V42	V43+(V20-V43)*(5/122)	V20+(V43-V20)*(117/122)
V43	VINP4	VINN3
V44	V55+(V43-V55)*(61/65)	V43+(V55-V43)*(4/65)
V45	V55+(V43-V55)*(56/65)	V43+(V55-V43)*(9/65)
V46	V55+(V43-V55)*(51/65)	V43+(V55-V43)*(14/65)
V47	V55+(V43-V55)*(46/65)	V43+(V55-V43)*(19/65)
V48	V55+(V43-V55)*(41/65)	V43+(V55-V43)*(24/65)
V49	V55+(V43-V55)*(35/65)	V43+(V55-V43)*(30/65)
V50	V55+(V43-V55)*(30/65)	V43+(V55-V43)*(35/65)
V51	V55+(V43-V55)*(24/65)	V43+(V55-V43)*(41/65)
V52	V55+(V43-V55)*(19/65)	V43+(V55-V43)*(46/65)
V53	V55+(V43-V55)*(13/65)	V43+(V55-V43)*(52/65)
V54	V55+(V43-V55)*(7/65)	V43+(V55-V43)*(58/65)
V55	VINP5	VINN2
V56	V62+(V55-V62)*(70/77)	V55+(V62-V55)*(7/77)
V57	V62+(V55-V62)*(62/77)	V55+(V62-V55)*(15/77)
V58	V62+(V55-V62)*(54/77)	V55+(V62-V55)*(23/77)
V59	V62+(V55-V62)*(45/77)	V55+(V62-V55)*(32/77)
V60	V62+(V55-V62)*(33/77)	V55+(V62-V55)*(44/77)
V61	V62+(V55-V62)*(20/77)	V55+(V62-V55)*(57/77)
V62	VINP6	VINN1
V63	VINP7	VINN0

Table 7.3 Grayscale Voltages Formulas

Reference	Formula	Micro-adjusting register	Reference voltage
KVP0	VLCD63 - ΔV x VRP0 / SUMRP	-	VINP0
KVP1	VLCD63 - ΔV x (VRP0 + 1R) / SUMRP	PKP0[2:0] = ”000”	VINP1
KVP2	VLCD63 - ΔV x (VRP0 + 5R) / SUMRP	PKP0[2:0] = ”001”	
KVP3	VLCD63 - ΔV x (VRP0 + 9R) / SUMRP	PKP0[2:0] = ”010”	
KVP4	VLCD63 - ΔV x (VRP0 + 13R) / SUMRP	PKP0[2:0] = ”011”	
KVP5	VLCD63 - ΔV x (VRP0 + 17R) / SUMRP	PKP0[2:0] = ”100”	
KVP6	VLCD63 - ΔV x (VRP0 + 21R) / SUMRP	PKP0[2:0] = ”101”	
KVP7	VLCD63 - ΔV x (VRP0 + 25R) / SUMRP	PKP0[2:0] = ”110”	
KVP8	VLCD63 - ΔV x (VRP0 + 29R) / SUMRP	PKP0[2:0] = ”111”	
KVP9	VLCD63 - ΔV x (VRP0 + 29R + VRHP) / SUMRP	PKP1[2:0] = ”000”	VINP2
KVP10	VLCD63 - ΔV x (VRP0 + 30R + VRHP) / SUMRP	PKP1[2:0] = ”001”	
KVP11	VLCD63 - ΔV x (VRP0 + 31R + VRHP) / SUMRP	PKP1[2:0] = ”010”	
KVP12	VLCD63 - ΔV x (VRP0 + 32R + VRHP) / SUMRP	PKP1[2:0] = ”011”	
KVP13	VLCD63 - ΔV x (VRP0 + 33R + VRHP) / SUMRP	PKP1[2:0] = ”100”	
KVP14	VLCD63 - ΔV x (VRP0 + 34R + VRHP) / SUMRP	PKP1[2:0] = ”101”	
KVP15	VLCD63 - ΔV x (VRP0 + 35R + VRHP) / SUMRP	PKP1[2:0] = ”110”	
KVP16	VLCD63 - ΔV x (VRP0 + 36R + VRHP) / SUMRP	PKP1[2:0] = ”111”	
KVP17	VLCD63 - ΔV x (VRP0 + 56R + VRHP) / SUMRP	PKP2[2:0] = ”000”	VINP3
KVP18	VLCD63 - ΔV x (VRP0 + 57R + VRHP) / SUMRP	PKP2[2:0] = ”001”	
KVP19	VLCD63 - ΔV x (VRP0 + 58R + VRHP) / SUMRP	PKP2[2:0] = ”010”	
KVP20	VLCD63 - ΔV x (VRP0 + 59R + VRHP) / SUMRP	PKP2[2:0] = ”011”	
KVP21	VLCD63 - ΔV x (VRP0 + 60R + VRHP) / SUMRP	PKP2[2:0] = ”100”	
KVP22	VLCD63 - ΔV x (VRP0 + 61R + VRHP) / SUMRP	PKP2[2:0] = ”101”	
KVP23	VLCD63 - ΔV x (VRP0 + 62R + VRHP) / SUMRP	PKP2[2:0] = ”110”	
KVP24	VLCD63 - ΔV x (VRP0 + 63R + VRHP) / SUMRP	PKP2[2:0] = ”111”	
KVP25	VLCD63 - ΔV x (VRP0 + 75R + VRHP) / SUMRP	PKP3[2:0] = ”000”	VINP4
KVP26	VLCD63 - ΔV x (VRP0 + 76R + VRHP) / SUMRP	PKP3[2:0] = ”001”	
KVP27	VLCD63 - ΔV x (VRP0 + 77R + VRHP) / SUMRP	PKP3[2:0] = ”010”	
KVP28	VLCD63 - ΔV x (VRP0 + 78R + VRHP) / SUMRP	PKP3[2:0] = ”011”	
KVP29	VLCD63 - ΔV x (VRP0 + 79R + VRHP) / SUMRP	PKP3[2:0] = ”100”	
KVP30	VLCD63 - ΔV x (VRP0 + 80R + VRHP) / SUMRP	PKP3[2:0] = ”101”	
KVP31	VLCD63 - ΔV x (VRP0 + 81R + VRHP) / SUMRP	PKP3[2:0] = ”110”	
KVP32	VLCD63 - ΔV x (VRP0 + 82R + VRHP) / SUMRP	PKP3[2:0] = ”111”	
KVP33	VLCD63 - ΔV x (VRP0 + 84R + VRHP) / SUMRP	PKP4[2:0] = ”000”	VINP5
KVP34	VLCD63 - ΔV x (VRP0 + 85R + VRHP) / SUMRP	PKP4[2:0] = ”001”	
KVP35	VLCD63 - ΔV x (VRP0 + 86R + VRHP) / SUMRP	PKP4[2:0] = ”010”	
KVP36	VLCD63 - ΔV x (VRP0 + 87R + VRHP) / SUMRP	PKP4[2:0] = ”011”	
KVP37	VLCD63 - ΔV x (VRP0 + 88R + VRHP) / SUMRP	PKP4[2:0] = ”100”	
KVP38	VLCD63 - ΔV x (VRP0 + 89R + VRHP) / SUMRP	PKP4[2:0] = ”101”	
KVP39	VLCD63 - ΔV x (VRP0 + 90R + VRHP) / SUMRP	PKP4[2:0] = ”110”	
KVP40	VLCD63 - ΔV x (VRP0 + 91R + VRHP) / SUMRP	PKP4[2:0] = ”111”	
KVP41	VLCD63 - ΔV x (VRP0 + 91R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”000”	VINP6
KVP42	VLCD63 - ΔV x (VRP0 + 95R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”001”	
KVP43	VLCD63 - ΔV x (VRP0 + 99R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”010”	
KVP44	VLCD63 - ΔV x (VRP0 + 103R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”011”	
KVP45	VLCD63 - ΔV x (VRP0 + 107R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”100”	
KVP46	VLCD63 - ΔV x (VRP0 + 111R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”101”	
KVP47	VLCD63 - ΔV x (VRP0 + 115R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”110”	
KVP48	VLCD63 - ΔV x (VRP0 + 119R + VRHP + VRLP) / SUMRP	PKP5[2:0] = ”111”	
KVP49	VLCD63 - ΔV x (VRP0 + 125R + VRHP + VRLP) / SUMRP	-	VINP7

SUMRP: Total of the positive polarity ladder resistance = 131R + VRHP + VRLP + VRP0 + VRP1
ΔV: Voltage difference between VLCD and EXVR.

Table 7.4 Reference Voltages of Positive Polarity

Reference	Formula	Micro-adjusting register	Reference voltage
KVN0	VLCD63 - ΔV x VRN0 / SUMRN	-	VINN0
KVN1	VLCD63 - ΔV x (VRN0 + 4R) / SUMRN	PKN0[2:0] = ”000”	VINN1
KVN2	VLCD63 - ΔV x (VRN0 + 8R) / SUMRN	PKN0[2:0] = ”001”	
KVN3	VLCD63 - ΔV x (VRN0 + 12R) / SUMRN	PKN0[2:0] = ”010”	
KVN4	VLCD63 - ΔV x (VRN0 + 16R) / SUMRN	PKN0[2:0] = ”011”	
KVN5	VLCD63 - ΔV x (VRN0 + 20R) / SUMRN	PKN0[2:0] = ”100”	
KVN6	VLCD63 - ΔV x (VRN0 + 24R) / SUMRN	PKN0[2:0] = ”101”	
KVN7	VLCD63 - ΔV x (VRN0 + 28R) / SUMRN	PKN0[2:0] = ”110”	
KVN8	VLCD63 - ΔV x (VRN0 + 32R) / SUMRN	PKN0[2:0] = ”111”	
KVN9	VLCD63 - ΔV x (VRN0 + 32R + VRHN) / SUMRN	PKN1[2:0] = ”000”	VINN2
KVN10	VLCD63 - ΔV x (VRN0 + 33R + VRHN) / SUMRN	PKN1[2:0] = ”001”	
KVN11	VLCD63 - ΔV x (VRN0 + 34R + VRHN) / SUMRN	PKN1[2:0] = ”010”	
KVN12	VLCD63 - ΔV x (VRN0 + 35R + VRHN) / SUMRN	PKN1[2:0] = ”011”	
KVN13	VLCD63 - ΔV x (VRN0 + 36R + VRHN) / SUMRN	PKN1[2:0] = ”100”	
KVN14	VLCD63 - ΔV x (VRN0 + 37R + VRHN) / SUMRN	PKN1[2:0] = ”101”	
KVN15	VLCD63 - ΔV x (VRN0 + 38R + VRHN) / SUMRN	PKN1[2:0] = ”110”	
KVN16	VLCD63 - ΔV x (VRN0 + 39R + VRHN) / SUMRN	PKN1[2:0] = ”111”	
KVN17	VLCD63 - ΔV x (VRN0 + 41R + VRHN) / SUMRN	PKN2[2:0] = ”000”	VINN3
KVN18	VLCD63 - ΔV x (VRN0 + 42R + VRHN) / SUMRN	PKN2[2:0] = ”001”	
KVN19	VLCD63 - ΔV x (VRN0 + 43R + VRHN) / SUMRN	PKN2[2:0] = ”010”	
KVN20	VLCD63 - ΔV x (VRN0 + 44R + VRHN) / SUMRN	PKN2[2:0] = ”011”	
KVN21	VLCD63 - ΔV x (VRN0 + 45R + VRHN) / SUMRN	PKN2[2:0] = ”100”	
KVN22	VLCD63 - ΔV x (VRN0 + 46R + VRHN) / SUMRN	PKN2[2:0] = ”101”	
KVN23	VLCD63 - ΔV x (VRN0 + 47R + VRHN) / SUMRN	PKN2[2:0] = ”110”	
KVN24	VLCD63 - ΔV x (VRN0 + 48R + VRHN) / SUMRN	PKN2[2:0] = ”111”	
KVN25	VLCD63 - ΔV x (VRN0 + 62R + VRHN) / SUMRN	PKN3[2:0] = ”000”	VINN4
KVN26	VLCD63 - ΔV x (VRN0 + 63R + VRHN) / SUMRN	PKN3[2:0] = ”001”	
KVN27	VLCD63 - ΔV x (VRN0 + 64R + VRHN) / SUMRN	PKN3[2:0] = ”010”	
KVN28	VLCD63 - ΔV x (VRN0 + 65R + VRHN) / SUMRN	PKN3[2:0] = ”011”	
KVN29	VLCD63 - ΔV x (VRN0 + 66R + VRHN) / SUMRN	PKN3[2:0] = ”100”	
KVN30	VLCD63 - ΔV x (VRN0 + 67R + VRHN) / SUMRN	PKN3[2:0] = ”101”	
KVN31	VLCD63 - ΔV x (VRN0 + 68R + VRHN) / SUMRN	PKN3[2:0] = ”110”	
KVN32	VLCD63 - ΔV x (VRN0 + 69R + VRHN) / SUMRN	PKN3[2:0] = ”111”	
KVN33	VLCD63 - ΔV x (VRN0 + 89R + VRHN) / SUMRN	PKN4[2:0] = ”000”	VINN5
KVN34	VLCD63 - ΔV x (VRN0 + 90R + VRHN) / SUMRN	PKN4[2:0] = ”001”	
KVN35	VLCD63 - ΔV x (VRN0 + 91R + VRHN) / SUMRN	PKN4[2:0] = ”010”	
KVN36	VLCD63 - ΔV x (VRN0 + 92R + VRHN) / SUMRN	PKN4[2:0] = ”011”	
KVN37	VLCD63 - ΔV x (VRN0 + 93R + VRHN) / SUMRN	PKN4[2:0] = ”100”	
KVN38	VLCD63 - ΔV x (VRN0 + 94R + VRHN) / SUMRN	PKN4[2:0] = ”101”	
KVN39	VLCD63 - ΔV x (VRN0 + 95R + VRHN) / SUMRN	PKN4[2:0] = ”110”	
KVN40	VLCD63 - ΔV x (VRN0 + 96R + VRHN) / SUMRN	PKN4[2:0] = ”111”	
KVN41	VLCD63 - ΔV x (VRN0 + 96R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”000”	VINN6
KVN42	VLCD63 - ΔV x (VRN0 + 100R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”001”	
KVN43	VLCD63 - ΔV x (VRN0 + 104R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”010”	
KVN44	VLCD63 - ΔV x (VRN0 + 108R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”011”	
KVN45	VLCD63 - ΔV x (VRN0 + 112R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”100”	
KVN46	VLCD63 - ΔV x (VRN0 + 116R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”101”	
KVN47	VLCD63 - ΔV x (VRN0 + 120R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”110”	
KVN48	VLCD63 - ΔV x (VRN0 + 124R + VRHN + VRLN) / SUMRN	PKN5[2:0] = ”111”	
KVN49	VLCD63 - ΔV x (VRN0 + 126R + VRHN + VRLN) / SUMRN	-	VINN7

SUMRN: Total of the negative polarity ladder resistance = 130R + VRHN + VRLN + VRN0 + VRN1
ΔV: Voltage difference between VLCD and EXVR.

Table 7.5 Reference Voltages of Negative Polarity

7.6 PWM

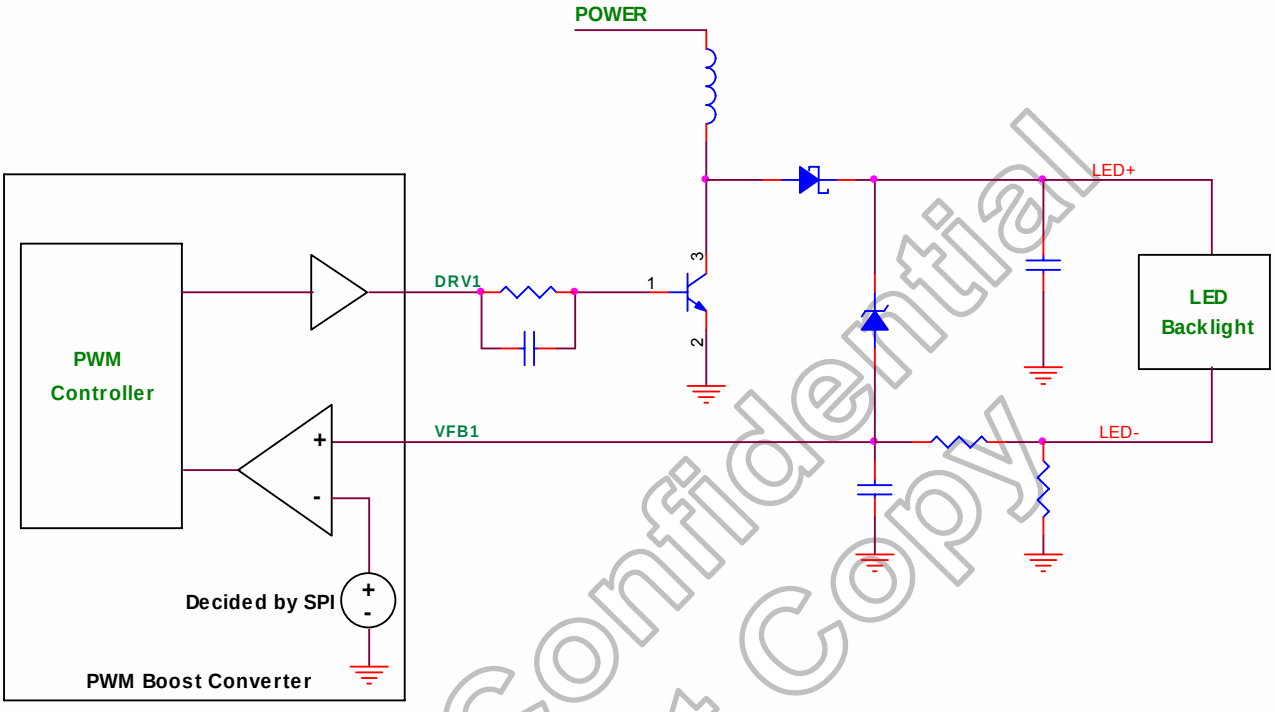


Figure 7.12 PWM Block

The HX8257-A is built in 2 independent PWM control circuits. The internal reference voltage is adjustable by FBA[2:0] and FBB[2:0] in R05h. By adjusting the voltage, you can get different VO to meet your system application. For 1st PWM, the VO also can be adjusted by DU[4:0] setting. (Input pins or register setting) This setting is combined with CABC function to provide power for LED backlight. 2nd PWM is designed to generate VCIX2J if charge pump circuit is not used.

7.7 TCON

The HX8257-A has 2 modes for input interface, parallel and serial interface. In parallel interface (PS="H"), 24-bit data are transferred into the HX8257-A each cycle when DE is activated. D07 to D00 is displayed for R dot on panel, D17 to D10 are displayed for G data, and D27 to D20 are displayed for B data. The relationship between display data and source output is shown in the following figure.

Input data format	24-bit RGB, 3 dots (sub-pixels) per clock
Input data width	24 bits with Dx7 is MSB and Dx0 is LSB, x = 1 ~ 3

LR	First			→	Last		
	D00~ D07	D10~ D17	D20~ D27	...	D00~ D07	D10~ D17	D20~ D27
H	R1	G1	B1	...	R480	G480	B480

LR	Last			←	First		
	D00~ D07	D10~ D17	D20~ D27	...	D00~ D07	D10~ D17	D20~ D27
L	R1	G1	B1	...	R480	G480	B480

In serial interface (PS="L"), 8-bit data are transferred into the HX8257-A through D07~D00 pins. The data are latched sequentially for display R_n, G_n, B_n, n=1, 2 … 480 when LR="H", and for B_n, G_n, R_n, n=480, 479, 478 … to 1 when LR="L".

Input data format	8-bit RGB, 1 dot (sub-pixel) per clock
Input data width	8 bits with D07 is MSB and D00 is LSB

LR	First			→			Last
	D00~ D07	D00~ D07	D00~ D07	...	D00~ D07	D00~ D07	D00~ D07
H	R1	G1	B1	...	R480	G480	B480

LR	Last			←			First
	D00~ D07	D00~ D07	D00~ D07	...	D00~ D07	D00~ D07	D00~ D07
L	R1	G1	B1	...	R480	G480	B480

7.7.1 LR/UD function

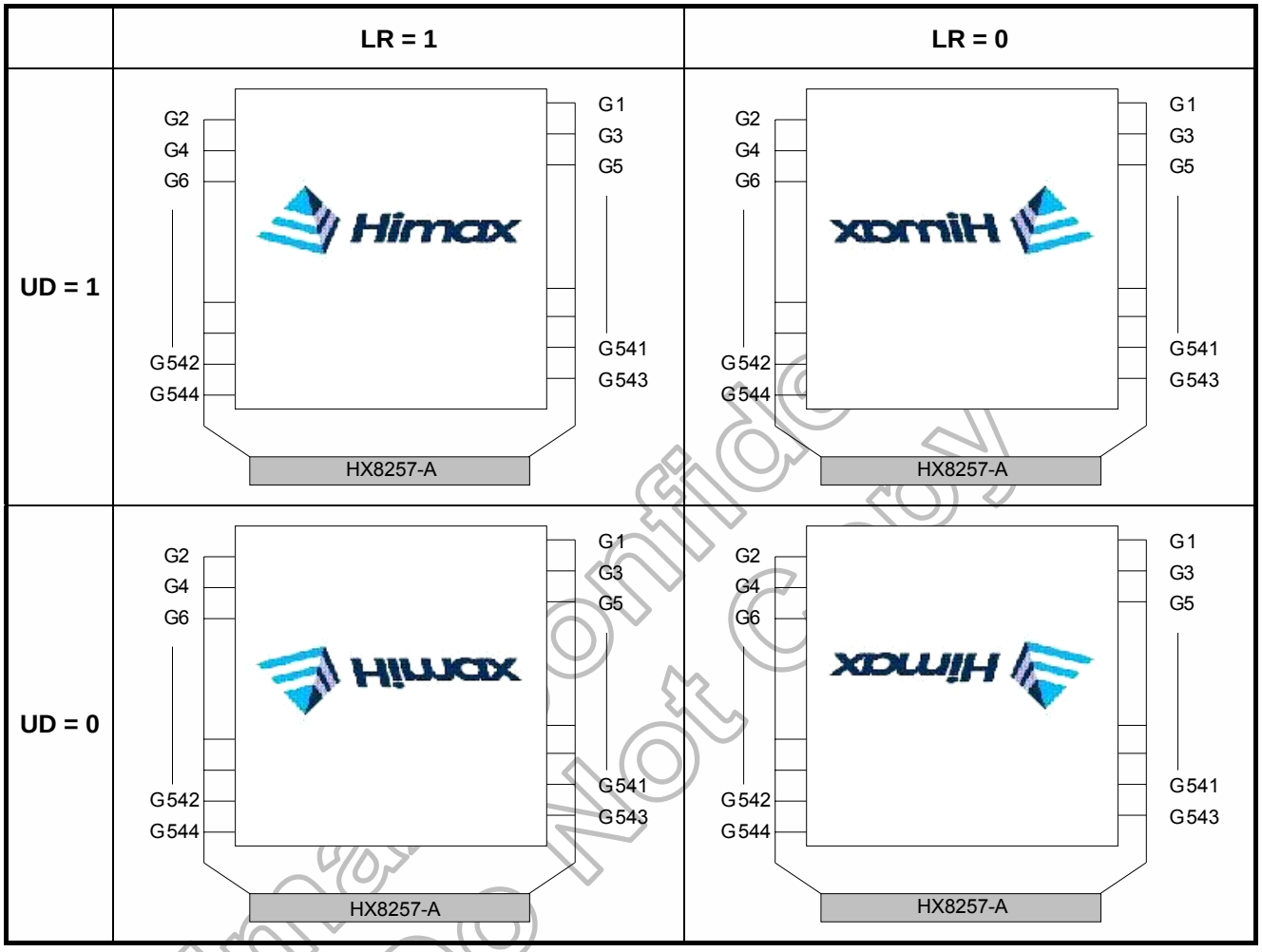


Figure 7.13 LR/UD Function

7.7.2 Aging mode

If only CLK is sent into driver IC without VS, HS, and DE signals, the HX8257-A will enter Aging Mode after power on. In Aging mode, the display picture can change automatically or be controlled manually by access register R04h.

7.7.3 TCON power on/off control

The HX8257-A has a power ON/OFF sequence control function. When DISP pin is pulled “H”, blank data is outputted for 10-frames first, from the falling edge of the following VSYNC signal. Similarly, when DISP is pulled “L”, 10-frames of blank data will be outputted from the falling edge of the following VSYNC, too. The blank data would be gray level 0 for normally black LC (NBW=”H”), and be gray level 255 for normally white LC (NBW=”L”).

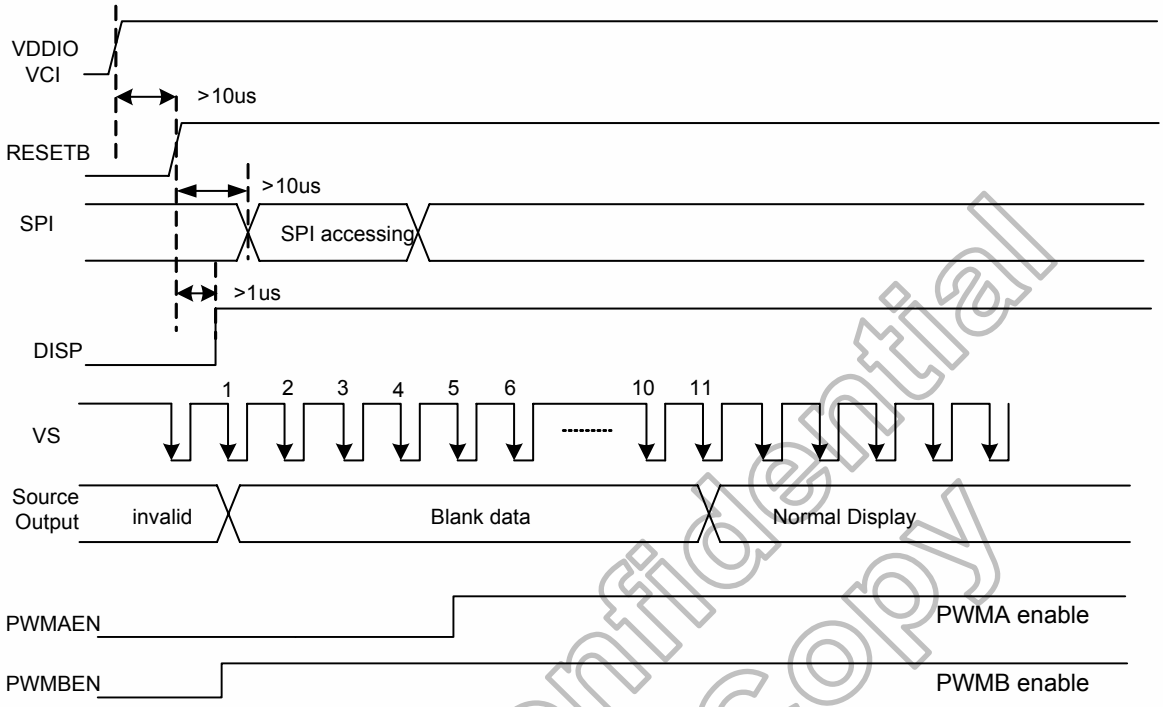


Figure 7.14 Power On Sequence

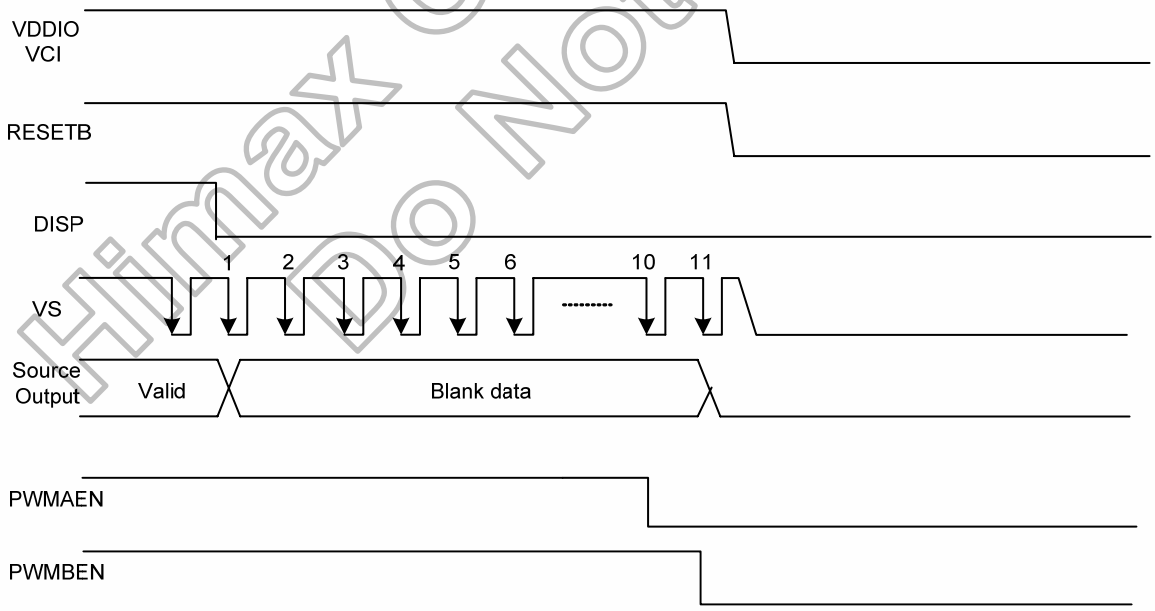


Figure 7.15 Power Off Sequence

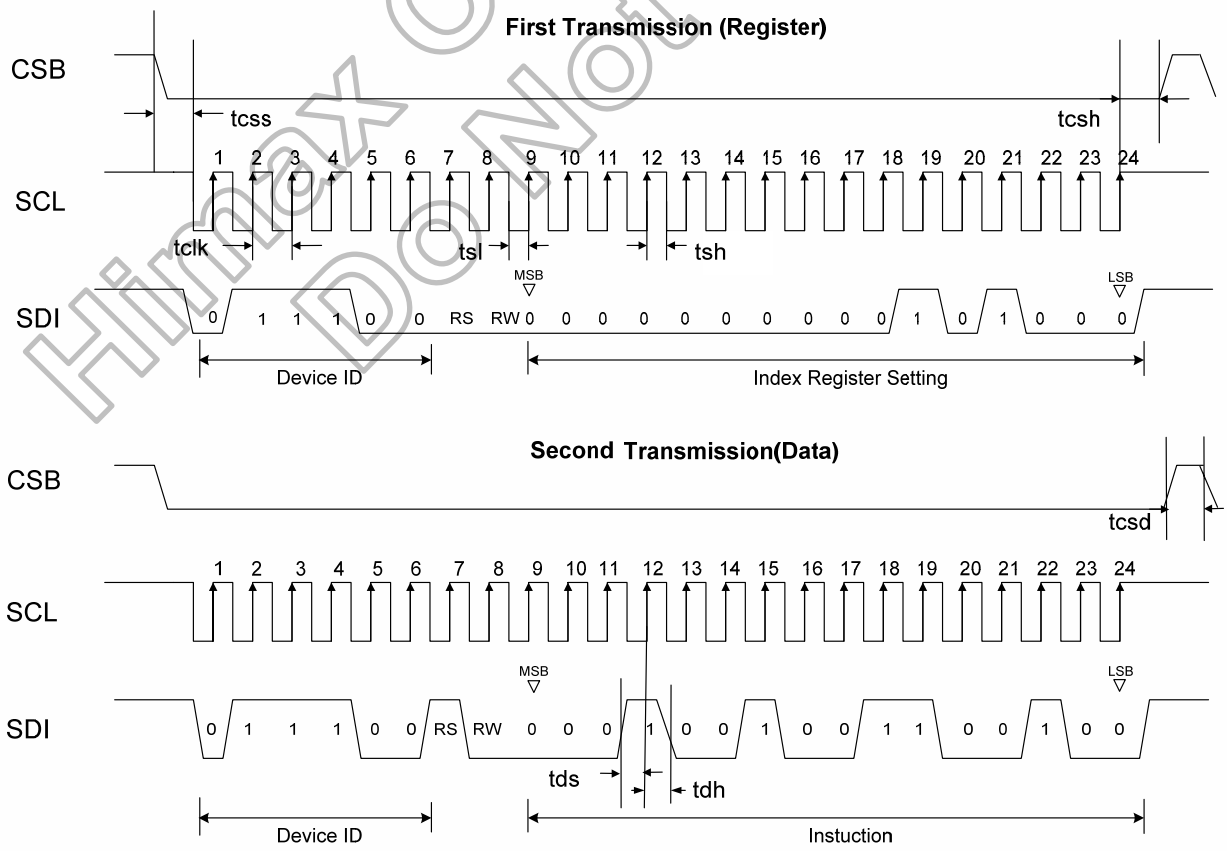
8. SPI Register

The HX8257-A is internally initialized by the global reset signal, RESETB. The reset input must be held for at least 1ms after power is stable.

HX8257-A supports 24-bit serial bus interface. 24-bit data are latched by SCL's rising edge step-by-step. Serial bus interface is active while CSB=L (from CSB's falling to CSB's rising). After CSB has transmitted twenty-four units of CLK, it has to change into High.

Under the standard condition, the number of SCL is twenty-four units. While CSB=L, if SCL < 24 cycles is input, then the input data won't be latched and will become invalid data. While CSB=L, if SCL >24 cycles is input, the 24-bit data in front of CSB's rising edge will become valid.

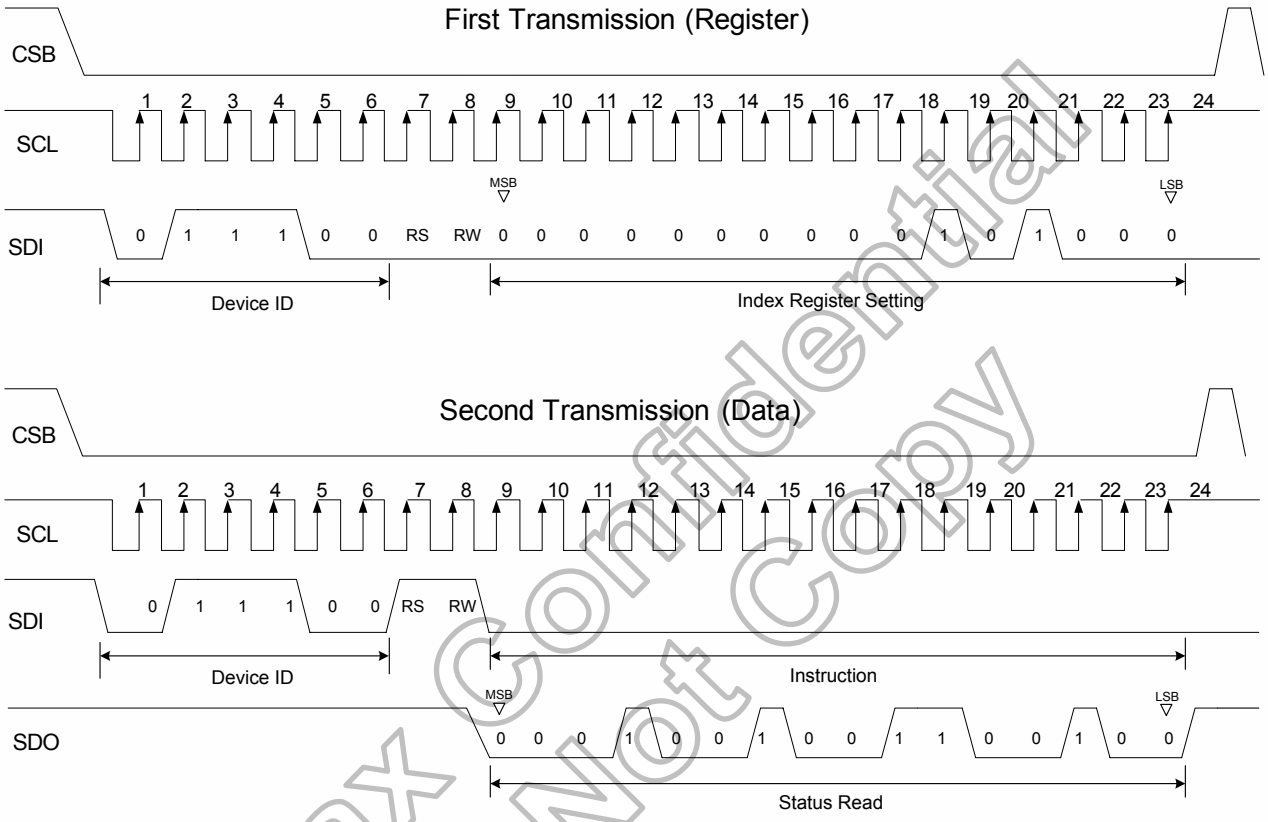
- Write SPI



Note: The example writes "0x1264h" to register R28h.

Figure 8.1 Write SPI Timing

- Read SPI



Note: The example reads "0x1264h" from register R28h.

Figure 8.2 Read SPI Timing

RS	RW	Status
0	0	Write SPI Address
0	1	NA
1	0	Write SPI Data
1	1	Read SPI Data

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Serial Clock Frequency	fclk	-	-	20	MHz
Serial Clock Cycle Time	tclk	50	-	-	ns
Clock Low Width	tsl	25	-	-	ns
Clock High Width	tsh	25	-	-	ns
Chip Select Setup Time	tcss	0	-	-	ns
Chip Select Hold Time	tcsh	10	-	-	ns
Chip Select High Delay Time	tcsd	20	-	-	ns
Data Setup Time	tds	5	-	-	ns
Data Hold Time	tdh	10	-	-	ns

Reg#	Register	R/W	R/S	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
R01h	Driver data control	0	1	OEA1	OEA0	PALM	DEO	DEP	HSP	VSP	CLK_TRG	GON	DIT	PINV	BGR	0	UD	LR	NBW
R02h	Power control (1)	0	1	0	0	VDS1	VDS0	0	EQ2	EQ1	EQ0	DC3	DC2	DC1	DC0	0	AP2	AP1	AP0
R03h	Power control (2)	0	1	X2EN	XDK	VRC1	VRC0	VDC3	VDC2	VDC1	VDC0	0	0	VRH5	VRH4	VRH3	VRH2	VRH1	VRH0
R04h	Function control	0	1	0	0	0	0	REV	PA2	PA1	PA0	AGM	SEQ	PS	0	REG	PSHUT	GDIS	COMG
R05h	PWM control			0	PSWE	DUS	DU4	DU3	DU2	DU1	DU0	PWMA	FBA2	FBA1	FBA0	PWMB	FBB2	FBB1	FBB0
R06h	VCOM control	0	1	0	0	nOTP	VMC4	VMC3	VMC2	VMC1	VMC0	0	0	eOTP	VDV4	VDV3	VDV2	VDV1	VDV0
R07h	Vertical Porch	0	1	0	0	0	0	0	0	0	0	0	VBP6	VBP5	VBP4	VBP3	VBP2	VBP1	VBP0
R08h	Horizontal Porch	0	1	0	0	0	0	0	0	STH1	STH0	HBP7	HBP6	HBP5	HBP4	HBP3	HBP2	HBP1	HBP0
R09h	Contrast/ Brightness control	0	1	0	BR6	BR5	BR4	BR3	BR2	BR1	BR0	0	0	0	CON4	CON3	CON2	CON1	CON0
R0Fh	CABC function control	0	1	0	0	0	1	0	0	Dout	1	0	1	0	0	0	0	0	DBEN
R10h	γ control (1)	0	1	0	0	0	0	0	PKP 12	PKP 11	PKP 10	0	0	0	0	0	PKP 02	PKP 01	PKP 00
R11h	γ control (2)	0	1	0	0	0	0	0	PKP 32	PKP 31	PKP 30	0	0	0	0	0	PKP 22	PKP 21	PKP 20
R12h	γ control (3)	0	1	0	0	0	0	0	PKP 52	PKP 51	PKP 50	0	0	0	0	0	PKP 42	PKP 41	PKP 40
R13h	γ control (4)	0	1	0	0	0	0	0	PRP 12	PRP 11	PRP 10	0	0	0	0	0	PRP 02	PRP 01	PRP 00
R14h	γ control (5)	0	1	0	0	0	0	0	PKN 12	PKN 11	PKN 10	0	0	0	0	0	PKN 02	PKN 01	PKN 00
R15h	γ control (6)	0	1	0	0	0	0	0	PKN 32	PKN 31	PKN 30	0	0	0	0	0	PKN 22	PKN 21	PKN 20
R16h	γ control (7)	0	1	0	0	0	0	0	PKN 52	PKN 51	PKN 50	0	0	0	0	0	PKN 42	PKN 41	PKN 40
R17h	γ control (8)	0	1	0	0	0	0	0	PRN 12	PRN 11	PRN 10	0	0	0	0	0	PRN 02	PRN 01	PRN 00
R18h	γ control (9)	0	1	0	0	0	VRP 14	VRP 13	VRP 12	VRP 11	VRP 10	0	0	0	0	VRP 03	VRP 02	VRP 01	VRP 00
R19h	γ control (10)	0	1	0	0	0	VRN 14	VRN 13	VRN 12	VRN 11	VRN 10	0	0	0	0	VRN 03	VRN 02	VRN 01	VRN 00

Note: Software settings will override hardware pin (Example： UD bits override UD pin definition)

Driver Data Control (R01h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	OEA1	OEA0	PALM	DEO	DEP	HSP	VSP	CLK_TRG	GON	DIT	PINV	BGR	0	UD	LR	NBW
Default		0	1	1	1	1	0	0	x	0	1	0	0	0	x	x	x

Table 8.1 Driver Output Control (“x” means default value is set by hardware pin)

NBW: Define LC type of panel. NBW=1, normally black panel. (TCON send POLB to VCOM circuit) NBW=0, normally white panel. (TCON send POL to VCOM circuit)

LR: Set display shift direction. LR=1, S1 → S720. LR=0, S720 → S1.

UD: Set display scan direction. UD=1, G1 → G544. UD=0, G544 → G1.

BGR: Selects the <R><G><B> arrangement. When BGR = “0”, <R><G><B> color is assigned from S1. When BGR = “1”, <B><G><R> color is assigned from S1.

PINV: When PINV=0, POL output is normal. When PINV=1, POL output phase is reversed with internal POL signal.

DIT: When DIT=0, dithering function is turned off. When DIT=1, dithering function is enabled.

GON: When GON=0, gate driver is normal operation. When GON=1, gate driver output keep high voltage.

CLK_TRG: Clock edge selection signal for the data sampling.

CLK_TRG=1: Data sampling at the CLK falling edge.

CLK_TRG=0: Data sampling at the CLK rising edge.

VSP: When VSP=0, VSYNC is negative polarity. When VSP=1, VSYNC is positive polarity.

HSP: When HSP=0, HSYNC is negative polarity. When HSP=1, HSYNC is positive polarity.

DEP: When DEP=0, DEN is negative polarity active. When DEP=1, DEN is positive polarity active.

DEO: When DEO=0, VSYNC/HSYNC are also needed in DE mode. Under this condition, vertical back porch is defined by VBP[6:0] and the horizontal first valid data is defined by DE signal. When DEO=1, only DEN signal is needed in DE mode.

PALM: Set the input data line number in PAL mode. **Only effective in 480RGBx240 resolution**. Our driver IC will auto detect NTSC/PAL mode under 480RGBx240 resolution)
0: 280 lines
1: 288 lines

OEA1-0: Odd/Even field advanced function. **Only effective in SYNC mode.**

OEA1	OEA0	Description
0	0	Start pulse start @ VBP delay for Odd field and @ ***VBP-1*** for Even field.
0	1	Start pulse start @ VBP delay for Odd field and @ ***VBP*** for Even field.
1	0	Start pulse start @ VBP delay for Odd field and @ ***VBP+1*** for Even field.
1	1	No use

Power Control 1 (R02h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	VDS1	VDS0	0	EQ2	EQ1	EQ0	DC3	DC2	DC1	DC0	0	AP2	AP1	AP0
Default		0	0	0	1	0	1	1	0	0	1	1	0	0	0	1	0

AP2-0: Adjust the amount of current from the stable-current source in the internal operational amplifier circuit. When the amount of current becomes large, the driving ability of the operational-amplifier circuits increase. Adjust the current taking into account the power consumption. During times when there is no display, such as when the system is in a sleep mode, set AP2-0 = “000” to halt the operational amplifier circuit and the step-up circuits to reduce current consumption.

AP2	AP1	AP0	Op-amp power
0	0	0	Least
0	0	1	Small
0	1	0	Small to medium
0	1	1	Medium
1	0	0	Medium to large
1	0	1	Large
1	1	0	Large to Maximum
1	1	1	Maximum

DC3-0: Set the step-up cycle of the step-up circuit. When the cycle is accelerated, the VCL and VCIX2 driving ability of the step-up circuit increase, but their current consumption increase, too. Adjust the cycle taking into account the display quality and power consumption.

DC3	DC2	DC1	DC0	Step-up cycle
0	0	0	0	Fline x 14
0	0	0	1	Fline x 12
0	0	1	0	Fline x 10
0	0	1	1	Fline x 8
0	1	0	0	Fline x 7
0	1	0	1	Fline x 6
0	1	1	0	Fline x 5
0	1	1	1	Fline x 4
1	0	0	0	Fline x 3
1	0	0	1	Fline x 2
1	0	1	0	Fline x 1
1	0	1	1	Fline x 0.5
1	1	0	0	Fline x 0.25
1	1	0	1	Reserved
1	1	1	0	Reserved
1	1	1	1	Reserved

Note: Fline = horizontal frequency (Fline Typ. 17 KHz)

EQ2-0: Sets the equalizing period.

EQ2	EQ1	EQ0	EQ period
0	0	0	No EQ
0	0	1	1 us
0	1	0	2 us
0	1	1	3 us
1	0	0	4 us
1	0	1	5 us
1	1	0	6 us
1	1	1	7 us

VDS1-0: Set the VDD regulator voltage.

VDS[1:0]=00, 1.8V
VDS[1:0]=11, 2.0V
VDS[1:0]=10, 2.2V
VDS[1:0]=01, 2.5V

Power Control 2 (R03h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	X2EN	XDK	VRC1	VRC0	VDC3	VDC2	VDC1	VDC0	0	0	VRH5	VRH4	VRH3	VRH2	VRH1	VRH0
Default		1	1	0	1	1	0	1	1	0	0	1	0	1	1	0	0

VRH5-0: Set amplitude magnification of VLCD. These bits amplify the VLCD voltage 2.464 to 4.456 times the Vref voltage set by VRH5-0.

VRH5	VRH4	VRH3	VRH2	VRH1	VRH0	VLCD Voltage
0	0	0	0	0	0	Vref x 2.456
0	0	0	0	0	1	Vref x 2.488
0	0	0	0	1	0	Vref x 2.520
0	0	0	0	1	1	Vref x 2.552
0	0	0	1	0	0	Vref x 2.584
0	0	0	1	0	1	Vref x 2.616
0	0	0	1	1	0	Vref x 2.648
0	0	0	1	1	1	Vref x 2.680
0	0	1	0	0	0	Vref x 2.712
0	0	1	0	0	1	Vref x 2.744
0	0	1	0	1	0	Vref x 2.776
0	0	1	0	1	1	Vref x 2.808
0	0	1	1	0	0	Vref x 2.840
0	0	1	1	0	1	Vref x 2.872
0	0	1	1	1	0	Vref x 2.904
0	0	1	1	1	1	Vref x 2.936
0	1	0	0	0	0	Vref x 2.968
0	1	0	0	0	1	Vref x 3.000
0	1	0	0	1	0	Vref x 3.032
0	1	0	0	1	1	Vref x 3.064
0	1	0	1	0	0	Vref x 3.096
0	1	0	1	0	1	Vref x 3.128
0	1	0	1	1	0	Vref x 3.160
0	1	0	1	1	1	Vref x 3.192
0	1	1	0	0	0	Vref x 3.224
0	1	1	0	0	1	Vref x 3.256
0	1	1	0	1	0	Vref x 3.288
0	1	1	0	1	1	Vref x 3.320
0	1	1	1	0	0	Vref x 3.352
0	1	1	1	0	1	Vref x 3.384
0	1	1	1	1	0	Vref x 3.416
0	1	1	1	1	1	Vref x 3.448

VRH5	VRH4	VRH3	VRH2	VRH1	VRH0	VLCD Voltage
1	0	0	0	0	0	Vref x 3.480
1	0	0	0	0	1	Vref x 3.512
1	0	0	0	1	0	Vref x 3.544
1	0	0	0	1	1	Vref x 3.576
1	0	0	1	0	0	Vref x 3.608
1	0	0	1	0	1	Vref x 3.640
1	0	0	1	1	0	Vref x 3.672
1	0	0	1	1	1	Vref x 3.704
1	0	1	0	0	0	Vref x 3.736
1	0	1	0	0	1	Vref x 3.768
1	0	1	0	1	0	Vref x 3.800
1	0	1	0	1	1	Vref x 3.832
1	0	1	1	0	0	Vref x 3.864
1	0	1	1	0	1	Vref x 3.896
1	0	1	1	1	0	Vref x 3.928
1	0	1	1	1	1	Vref x 3.960
1	1	0	0	0	0	Vref x 3.992
1	1	0	0	0	1	Vref x 4.024
1	1	0	0	1	0	Vref x 4.056
1	1	0	0	1	1	Vref x 4.088
1	1	0	1	0	0	Vref x 4.120
1	1	0	1	0	1	Vref x 4.152
1	1	0	1	1	0	Vref x 4.184
1	1	0	1	1	1	Vref x 4.216
1	1	1	0	0	0	Vref x 4.248
1	1	1	0	0	1	Vref x 4.280
1	1	1	0	1	0	Vref x 4.312
1	1	1	0	1	1	Vref x 4.344
1	1	1	1	0	0	Vref x 4.376
1	1	1	1	0	1	Vref x 4.408
1	1	1	1	1	0	Vref x 4.440
1	1	1	1	1	1	Vref x 4.472

Note: Vref is the internal reference voltage equals to 1.25V.

VDC3-0: Set amplitude magnification of VDC. These bits amplify the VDC voltage 2.9 to 4.4 times the Vref voltage set by VDC3-0.

VDC3	VDC2	VDC1	VDC0	VDC Voltage
0	0	0	0	Vref x 2.9
0	0	0	1	Vref x 3.0
0	0	1	0	Vref x 3.1
0	0	1	1	Vref x 3.2
0	1	0	0	Vref x 3.3
0	1	0	1	Vref x 3.4
0	1	1	0	Vref x 3.5
0	1	1	1	Vref x 3.6

VDC3	VDC2	VDC1	VDC0	VDC Voltage
1	0	0	0	Vref x 3.7
1	0	0	1	Vref x 3.8
1	0	1	0	Vref x 3.9
1	0	1	1	Vref x 4.0
1	1	0	0	Vref x 4.1
1	1	0	1	Vref x 4.2
1	1	1	0	Vref x 4.3
1	1	1	1	Vref x 4.4

Note: Vref is the internal reference voltage equals to 1.25V.

VRC1-0: Set the VCIX2 charge pump voltage clamp.
VRC[1:0]=00, 5.2V
VRC[1:0]=01, 5.4V
VRC[1:0]=10, 5.6V
VRC[1:0]=11, 5.8V

XDK: When XDK=0, VCIX2 is 2 stage pumping from VCI. (VCIX2=3 x VCI) When XDK=1, VCIX2 is 2 phase pumping from VCI. (VCIX2=2 x VCI)

X2EN: When X2EN=0, VCIX2 pumping circuit is disabled. When X2EN=1, VCIX2 pumping circuit is enabled.

Function Control (R04h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	REV	PA2	PA1	PA0	AGM	SEQ	PS	0	REG	PSHUT	GDIS	COMG
Default		0	0	0	0	0	0	0	0	1	0	x	0	1	x	1	1

COMG: When COMG=0, VCOM circuit is disabled. When COMG=1, VCOM circuit is enabled.

GDIS: When GDIS=0, VGL has no discharge path to VSS in standby mode. When GDIS=1, VGL will discharge to VSS in standby mode.

PSHUT: When PSHUT=0, all power circuits are shut down. When PSHUT=1, all internal power circuits are enabled.

REG: REG=1, internal VDD regulator is turn on. REG=0, VDD should be shorted to VDDIO on system.

PS: PS=1, parallel RGB input interface. PS=0, serial RGB input interface.

SEQ: SEQ=1, reverse data pin sequence. SEQ=0, data pin sequence is as pad define.

AGM: AGM=1, aging mode pattern is auto changed. AGM=0, aging mode pattern is controlled by PA2-0.

PA2-0: Define the display pattern in aging mode when AGM=0.

REV: REV=1, input data is inverted. REV=0, input data is send to display without inversion.

PWM Control (R05h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	PSWE	DUS	DU4	DU3	DU2	DU1	DU0	PWMA	FBA2	FBA1	FBA0	PWMB	FBB2	FBB1	FBB0
Default		0	0	0	1	1	1	1	1	1	1	0	0	1	1	0	0

FBB2-0: Set 2nd PWM feedback level adjustment.
000: 0.8V
001: 0.85V
010: 0.9V
011: 0.95V
100: 1.0V
101: 1.05V
110: 1.1V
111: 1.15V

PWMB: When PWMB=0, 2nd PWM function is disabled. When PWMB=1, 2nd PWM function is enabled.

FBA2-0: Set 1st PWM feedback level adjustment.
000: 0.8V
001: 0.85V
010: 0.9V
011: 0.95V
100: 1.0V
101: 1.05V
110: 1.1V
111: 1.15V

PWMA: When PWMA=0, 1st PWM function is disabled. When PWMA=1, 1st PWM function is enabled.

DU4-0: Define the supply current of 1st PWM (PWM A) for LED backlight. The register value is effective only when DUS bit=0. This setting will combine with CABC function to control the LED backlight brightness dynamically.

DU4-0	Supply current	DU4-0	Supply current
00000	1/32	10000	17/32
00001	2/32	10001	18/32
00010	3/32	10010	19/32
00011	4/32	10011	20/32
00100	5/32	10100	21/32
00101	6/32	10101	22/32
00110	7/32	10110	23/32
00111	8/32	10111	24/32
01000	9/32	11000	25/32
01001	10/32	11001	26/32
01010	11/32	11010	27/32
01011	12/32	11011	28/32
01100	13/32	11100	29/32
01101	14/32	11101	30/32
01110	15/32	11110	31/32
01111	16/32	11111	32/32

DUS: Set the DU4-0 is defined by SPI register or hardware pins. When DUS=0, SPI register is effective. When DUS=1, hardware pins are effective.

PSWE: When PSWE=0, internal switch for 2nd PWM is disabled. When PSWE=1, internal switch for 2nd PWM is enabled.

VCOM Control (R06h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	nOTP	VMC4	VMC3	VMC2	VMC1	VMC0	0	0	eOTP	VDV4	VDV3	VDV2	VDV1	VDV0
Default		0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	0

VDV4-0: Set the COMPP voltage. These bits define the VCOMPP voltage 1.5 to 2.7 times the Vref voltage.

VDV4	VDV3	VDV2	VDV1	VDV0	COMPP
0	0	0	0	0	Reference from external voltage
0	0	0	0	1	Vref x 1.50
0	0	0	1	0	Vref x 1.54
0	0	0	1	1	Vref x 1.58
0	0	1	0	0	Vref x 1.62
:	:	:	:	:	: Step = 0.04 :
1	1	1	0	0	Vref x 2.58
1	1	1	0	1	Vref x 2.62
1	1	1	1	0	Vref x 2.66
1	1	1	1	1	Vref x 2.70

Note: Vref is the internal reference voltage equals to 1.25V.

eOTP: eOTP=0, COMPP voltage is set by programmed OTP value. eOTP=1, COMPP voltage is set by VD4-0 SPI register.

VMC4-0: Set the COMC voltage. These bits define the VCOM DC voltage 0.22 to 2.02 times the Vref voltage.

VMC4	VMC3	VMC2	VMC1	VMC0	COMC
0	0	0	0	0	Reference from external voltage
0	0	0	0	1	Vref x 0.22
0	0	0	1	0	Vref x 0.28
0	0	0	1	1	Vref x 0.34
0	0	1	0	0	Vref x 0.40
:	:	:	:	:	: Step = 0.06 :
1	1	1	0	0	Vref x 1.84
1	1	1	0	1	Vref x 1.90
1	1	1	1	0	Vref x 1.96
1	1	1	1	1	Vref x 2.02

Note: Vref is the internal reference voltage equals to 1.25V.

nOTP: nOTP=0, COMC voltage is set by programmed OTP value. nOTP=1, COMC voltage is set by VMC4-0 SPI register.

Vertical Porch (R07h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	0	0	0	0	VBP6	VBP5	VBP4	VBP3	VBP2	VBP1	VBP0
Default		0	0	0	0	0	0	0	0	0	x	x	x	x	x	x	x

PS: RES=1, VBP default value: 0001100, RES=0, VBP default value: 0010010

VBP6-0: Set the delay period from falling edge of VSYNC to first valid line. The line data within this delay period will be treated as dummy line. The setting is only effective in SYNC mode timing.

VBP6	VBP5	VBP4	VBP3	VBP2	VBP1	VBP0	No. of clock cycle of HSYNC
0	0	0	0	0	0	0	Can't set
0	0	0	0	0	0	1	Can't set
0	0	0	0	0	1	0	2
0	0	0	0	0	1	1	3
0	0	0	0	1	0	0	4
							: Step = 1 :
1	1	1	1	1	0	0	124
1	1	1	1	1	0	1	125
1	1	1	1	1	1	0	126
1	1	1	1	1	1	1	127

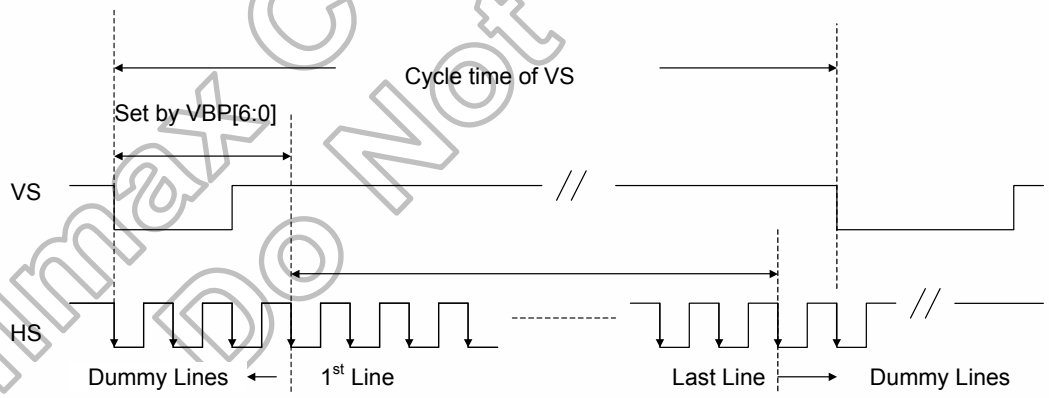


Figure 8.3 Vertical Data

Horizontal Porch (R08h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	0	STH1	STH0	HBP7	HBP6	HBP5	HBP4	HBP3	HBP2	HBP1	HBP0
Default		0	0	0	0	0	0	0	0	x	x	x	x	x	x	x	x

Note: RES=1, HBP default value: 00101011, RES=0, HBP default value: 01100110

HBP7-0: Set the delay period from falling edge of HSYNC signal to first valid data. The data exceeds 480 pixels and before the first valid data will be treated as dummy data. The setting is only effective in SYNC mode timing.

HBP7	HBP6	HBP5	HBP4	HBP3	HBP2	HBP1	HBP0	No. of clock cycle
0	0	0	0	0	0	0	0	Can't set
0	0	0	0	0	0	0	1	Can't set
0	0	0	0	0	0	1	0	Can't set
0	0	0	0	0	0	1	1	Can't set
0	0	0	0	0	1	0	0	Can't set
0	0	0	0	0	1	0	1	Can't set
0	0	0	0	0	1	1	0	Can't set
0	0	0	0	0	1	1	1	Can't set
0	0	0	0	1	0	0	0	Can't set
0	0	0	0	1	0	0	1	9
								: Step = 1 :
1	1	1	1	1	1	1	0	254
1	1	1	1	1	1	1	1	255

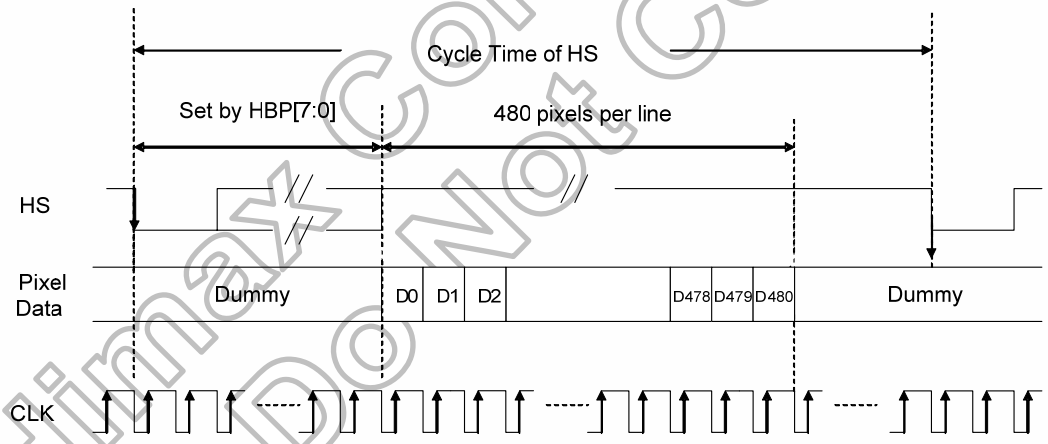


Figure 8.4 Horizontal Data

STH1-0: Adjust the first valid data by dot clock. This setting is only valid in serial RGB input interface.
STH=00: +0 dot clock
STH=01: +1 dot clock
STH=10: +2 dot clock
STH=11: +3 dot clock

Brightness/contrast control (R09h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	BR6	BR5	BR4	BR3	BR2	BR1	BR0	0	0	0	CON4	CON3	CON2	CON1	CON0
Default		0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0

CON4-0: Display Contrast level adjustment. (0.125/step) Adjust range from 00h (level=0) to 1Fh(level=3.875). Default value is 08h(level=1).
BR6-0: Display Brightness level adjustment. (2/step) Adjust range from 00h (level=-128) to 7Fh(level=+126). Default value is 40h(level=0).

CABC function control (R0Fh)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	1	0	0	Dout	1	0	1	0	0	0	0	0	DBEN
Default		0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0

DBEN: DBEN=0, CABC function is disabled. DBEN=1, CABC function is enabled.
Dout: When use CPWM signal to drive external LED driver, please set Dout bit to 1.

Gamma control 1 (R10h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PKP 12	PKP 11	PKP 10	0	0	0	0	0	PKP 02	PKP 01	PKP 00
Default		0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0

Gamma control 2 (R11h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PKP 32	PKP 31	PKP 30	0	0	0	0	0	PKP 22	PKP 21	PKP 20
Default		0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1

Gamma control 3 (R12h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PKP 52	PKP 51	PKP 50	0	0	0	0	0	PKP 42	PKP 41	PKP 40
Default		0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

Gamma control 4 (R13h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PRP 12	PRP 11	PRP 10	0	0	0	0	0	PRP 02	PRP 01	PRP 00
Default		0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0

Gamma control 5 (R14h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PKN 12	PKN 11	PKN 10	0	0	0	0	0	PKN 02	PKN 01	PKN 00
Default		0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1

Gamma control 6 (R15h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PKN 32	PKN 31	PKN 30	0	0	0	0	0	PKN 22	PKN 21	PKN 20
Default		0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0

Gamma control 7 (R16h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PKN 52	PKN 51	PKN 50	0	0	0	0	0	PKN 42	PKN 41	PKN 40
Default		0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	1

Gamma control 8 (R17h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	0	0	PRN 12	PRN 11	PRN 10	0	0	0	0	0	PRN 02	PRN 01	PRN 00
Default		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Gamma control 9 (R18h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	VRP 14	VRP 13	VRP 12	VRP 11	VRP 10	0	0	0	0	VRP 03	VRP 02	VRP 01	VRP 00
Default		0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	1

Gamma control 10 (R19h)

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
W	1	0	0	0	VRN 14	VRN 13	VRN 12	VRN 11	VRN 10	0	0	0	0	VRN 03	VRN 02	VRN 01	VRN 00
Default		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

9. OTP Programming

OTP write sequence

Step	VMC OTP Operation
1	Power up the module. Set nOTP=1 and find out the appropriate value of VMC[4:0] and power off the system.
2	Power up the system with VDD=VDDIO=2.5V. If REG bit=1, set R02h=16'h3662.
3	Set appropriate values found from step 1 to register of VMC (R06h)
4	Set 04h=16'h0001 to stop internal power circuit. Wait 0.5s.
5	Set R60h=16'h8000
6	Set R60h=16'hC000
7	Connect 7.3V to VGH and 0V to VGL
8	Set R60h=16'hC200
9	Set R60h=16'hC280
10	Wait 200us for completing this program
11	Set R60h=16'hC200
12	Remove 7.3V from VGH and 0V from VGL
13	Set R60h=16'h8200
14	Set R60h=16'h0200
15	Set R60h=16'h0040
16	Set R60h=16'h0000

Step	VDV OTP Operation
1	Power up the module. Set eOTP=1 and find out the appropriate value of VDV[4:0] and power off the system.
2	Power up the system with VDD=VDDIO=2.5V. If REG bit=1, set R02h=16'h3662.
3	Set appropriate values found from step 1 to register of VDV (R06h)
4	Set 04h=16'h0001 to stop internal power circuit. Wait 0.5s.
5	Set R60h=16'h8000
6	Set R60h=16'hC000
7	Connect 7.3V to VGH and 0V to VGL
8	Set R60h=16'hC000
9	Set R60h=16'hC080
10	Wait 200us for completing this program
11	Set R60h=16'hC000
12	Remove 7.3V from VGH and 0V from VGL
13	Set R60h=16'h8000
14	Set R60h=16'h0000
15	Set R60h=16'h0040
16	Set R60h=16'h0000

If you want to check if the OTP cell is still available for COMC/COMPP programming, you can read the current status from R61h shown below. R61h is only for read.

R/W	RS	IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
R	1	0	0	IDA	VDV 4	VDV 3	VDV 2	VDV 1	VDV 0	0	0	IDC	VMC 4	VMC 3	VMC 2	VMC 1	VMC 0

You can check the IDC/IDA bit to see if the VMC/VDV is still programmable or not. If IDC=0, you can program new VMC[4:0] value to OTP. If IDC=1, it means that the OTP cell have already programmed twice and you can't program it any more. The meaning of IDA is the same.

OTP programming circuit

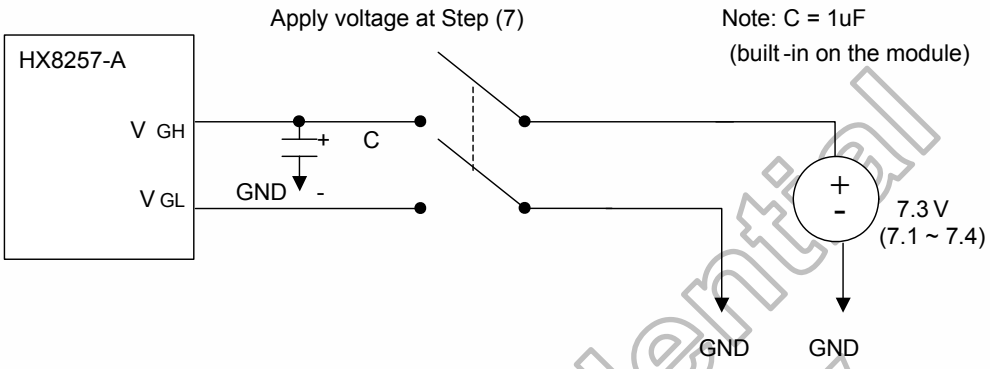


Figure 9.1 OTP Programming Circuit

10. DC Characteristics

Absolute Maximum Rating

(DVSS = AVSS = VCHS = VSSRC = 0V)

Symbol	Parameter	Spec.			Unit
		Min.	Typ.	Max.	
VDDIO	Logic Power Supply	-0.3	-	4.0	V
VCI	Booster Power Supply	-0.3	-	5.0	V
VCIP	Analog Circuit Power Supply	-0.3	-	5.0	V
VCIX2J	Power supply of analog block and VLCD/VDC regulation	-0.3	-	6.0	V
VDD	Power pin for internal logic circuit	-0.3	-	2.7	V
VGH-VGL	Using External VGH、VGL	-0.3	-	45.0	V
T_A	Operating Temperature	-30	-	85	V
T_{STG}	Storage Temperature	-55	-	125	℃

DC characteristics

(Unless otherwise specified, Voltage Referenced to DVSS, VDDIO = 2.2V, T_A = 25℃)

Symbol	Parameter	Test condition	Spec.			Unit
			Min.	Typ.	Max.	
VDDIO	Power supply pin of IO pins	Recommend Operating Voltage Possible Operating Voltage	1.8	-	3.6	V
VCI	Booster Reference Supply Voltage Range	Recommend Operating Voltage Possible Operating Voltage	≧VDDIO & ≧3	-	3.6	V
I_{sleep}	Sleep mode current	-	-	50		μA
I_{VCI}	VCI Operating mode current	VCI=3.3V、VDDIO=3.3V at Black Pattern with 4.3” Panel	-	13	16	mA
VCL	Negative V_{CI} Output Voltage	No panel loading	- VCI	-	- VCI+0.7	V
VCIX2	VCIX2 primary booster efficiency(3)	No panel loading, ITO for VCIX2,VCI and VCHS = 10 Ohm	5.2	5.4	5.6	V
VDC	VDC Output Voltage	VDC[3:0]=1011	4.9	5	5.1	V
VGH	Gate driver High Output Voltage Booster efficiency(1)	No panel loading; 3x booster	84	89.5	-	%
		No panel loading; 4x booster	80	88.5	-	%
VGL	Gate driver Low Output Voltage	VGL= -2 x VDC VDC[3:0]=1011	-10	-10	-9	V
COMH	VCOM High Output Voltage(2)	-	-3%	COMC+COMPP	3%	V
COML	VCOM Low Output Voltage(2)	-	-3%	COMC-COMPP	3%	V
VLCD	VLCD Output Voltage	VRH[5:0]=110011	5.0	5.1	5.2	V
V_{OH1}	Logic High Output Voltage	I out = -100μA	0.9*VDDIO	-	VDDIO	V
V_{VD}	Source Output Voltage Deviation	-	-	±20	±30	mV
V_{OS}	Source Output Voltage Offset	-	-	-	±30	mV
V_{OL1}	Logic Low Output Voltage	I out = 100μA	0	-	0.1*VDDIO	V
V_{IH1}	Logic High Input voltage	2.5V < VDDIO < 3.6V 1.8V < VDDIO ≦ 2.5V	0.7*VDDIO 0.8*VDDIO	-	VDDIO	V
V_{IL1}	Logic Low Input voltage	2.5V < VDDIO < 3.6V 1.8V < VDDIO ≦ 2.5V	0	-	0.3*VDDIO 0.2*VDDIO	V
I_{OH}	Logic High Output Current Source	V out = VDD – 0.4V	50	-	-	μA
I_{OL}	Logic Low Output Current Drain	V out = 0.4V	-	-	-50	μA
I_{OZ}	Logic Output Tri-state Current Drain Source	-	-1	-	1	μA
$I_{IL/I\ IH}$	Logic Input Current	-	-1	-	1	μA

Note : (1) VGH efficiency = VGH / (VDC x n) x 100% (where n = booster factor)
(2) COML < 0V, COMH < VCIX2J, COMH > VCI
(3) VCIX2 voltage is related with VCI voltage & VCIX2 loading.Figure10.1 shows the estimated VCIX2 voltage under different VCIX2 current loading when ITO for VCIX2、VCI and VCHS = 10Ω.

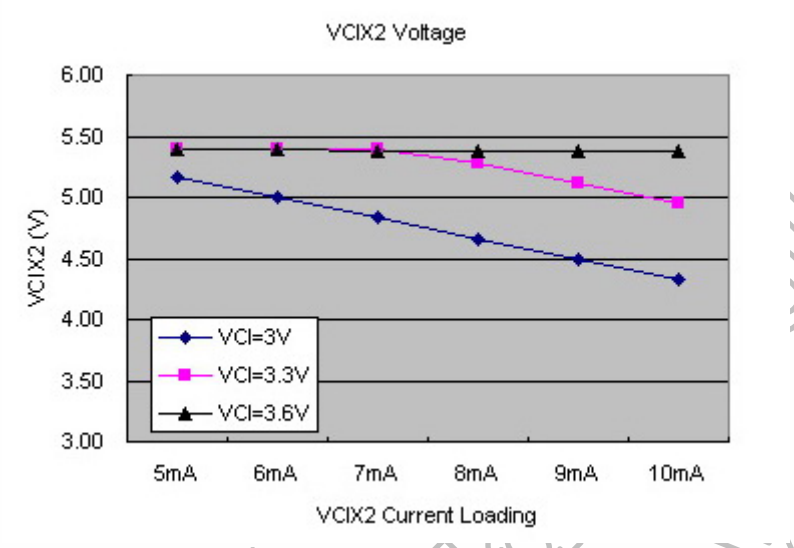


Figure 10.1 VCIX2 Voltage

11. AC Characteristics

The HX8257-A both supports DE mode and Sync mode timing. The mode was decided by DE signal internally. When DE is pulled low, the HX8257-A uses HS+VS for timing control and this timing mode is sync mode. When DE is pulled high for active data and pulled low for blanking data, the HX8257-A uses DE for timing control and this timing mode is DE mode. The detail timing chart showed below.

11.1 Timing relationship among DE、Source Output、Gate Output、VCOM

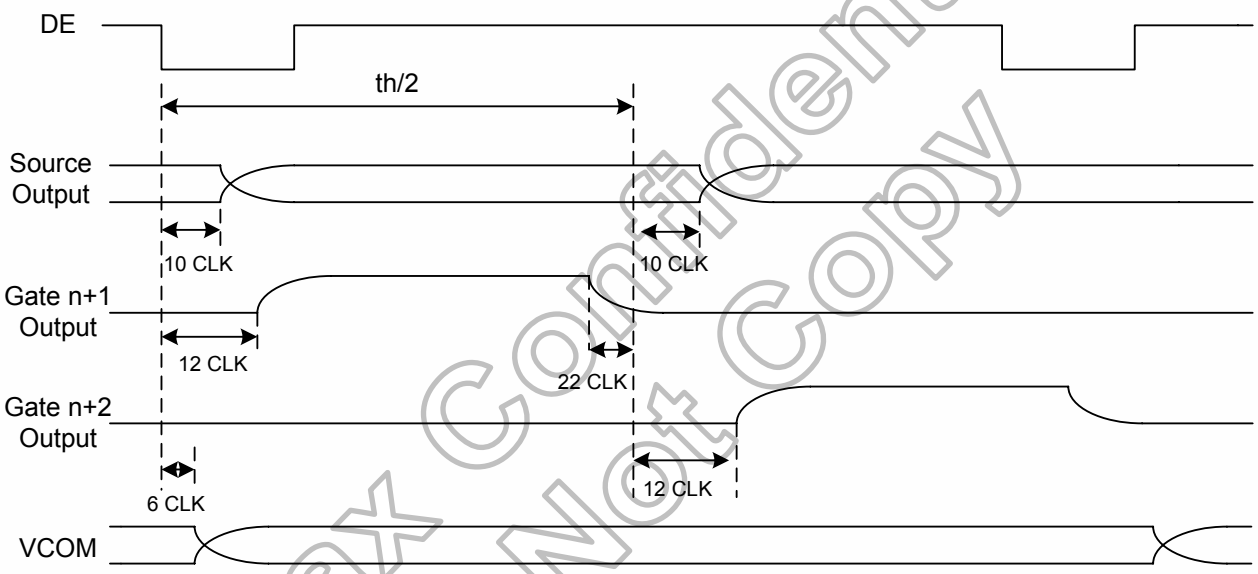


Figure 11.1 Timing Relationship

11.2 Parallel RGB input timing requirement

(480RGBx272, T_A=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock cycle	f_{CLK} (1)	-	9	15	MHz
Hsync cycle	1/th	-	17.14	-	KHz
Vsync cycle	1/tv	-	59.94	-	Hz
Horizontal Signal					
Horizontal cycle	th	525	525	605	CLK
Horizontal display period	thd	480	480	480	CLK
Horizontal front porch	thf	2	2	82	CLK
Horizontal pulse width	thp (2)	2	41	41	CLK
Horizontal back porch	thb (2)	2	2	41	CLK
Vertical Signal					
Vertical cycle	tv	285	286	399	H (1)
Vertical display period	tvd	272	272	272	H (1)
Vertical front porch	tvf	1	2	227	H (1)
Vertical pulse width	tvp (2)	1	10	11	H (1)
Vertical back porch	tvb (2)	1	2	11	H (1)

Note: (1) Unit: CLK=1/ f_{CLK} , H= th,
(2) It is necessary to keep tvp+tvb=12 and thp+thb=43 in sync mode. DE mode is unnecessary to keep it.

(480RGBx240, T_A=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock cycle	f_{CLK}(1)	-	9.6	15	MHz
Hsync cycle	1/th	-	15.72	-	KHz
Vsync cycle	1/tv	-	60	-	Hz
Horizontal Signal					
Horizontal cycle	th	525	612	-	CLK
Horizontal display period	thd	480	480	480	CLK
Horizontal front porch	thf	2	30	-	CLK
Horizontal pulse width	thp	2	46	-	CLK
Horizontal back porch	thb	2	56	-	CLK
Vertical Signal					
Vertical cycle	tv	-	262	275	H(1)
Vertical display period	tvd	-	240	-	H(1)
Vertical front porch	tvf	1	4	-	H(1)
Vertical pulse width	tvp	1	3	-	H(1)
Vertical back porch	tvb	1	15	-	H(1)

Note: (1) Unit: CLK=1/ f_{CLK} , H=th,

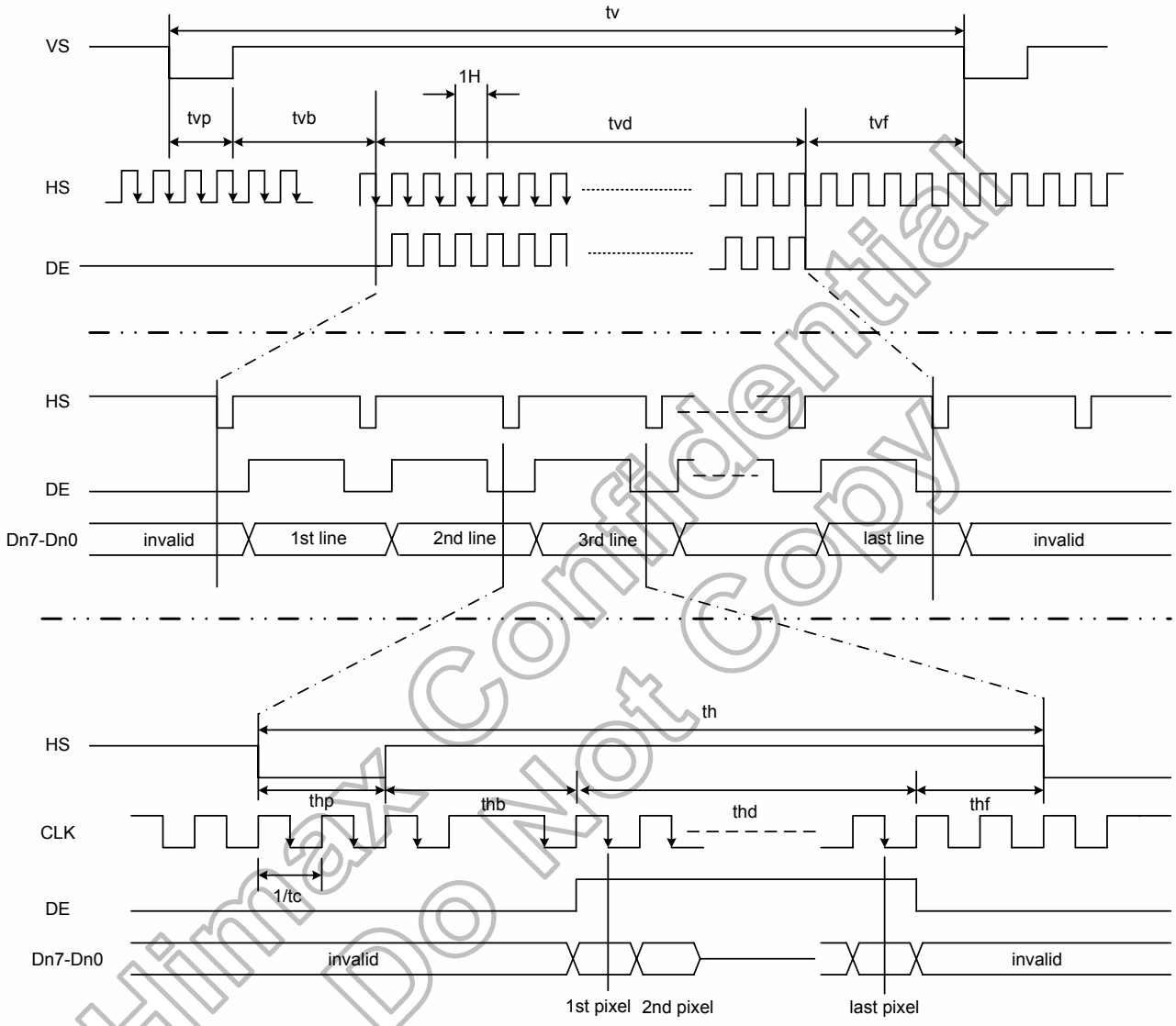


Figure 11.2 Parallel RGB Input Timing

11.3Serial RGB input timing requirement

(480RGBx272, T_A=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock cycle	f_{CLK}(1)	-	27	33	MHz
Hsync cycle	1/th	-	17.14	-	KHz
Vsync cycle	1/tv	-	59.94	-	Hz
Horizontal Signal					
Horizontal cycle	th	1575	1575	1815	CLK
Horizontal display period	thd	1440	1440	1440	CLK
Horizontal front porch	thf	6	6	246	CLK
Horizontal pulse width	thp	6	123	123	CLK
Horizontal back porch	thb	6	6	123	CLK
Vertical Signal					
Vertical cycle	tv	285	286	399	H(1)
Vertical display period	tvd	272	272	272	H(1)
Vertical front porch	tvf	1	2	227	H(1)
Vertical pulse width	tvp	1	10	11	H(1)
Vertical back porch	tvb	1	2	11	H(1)

Note: (1) Unit: CLK=1/ f_{CLK} , H=th

(480RGBx240, T_A=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V)

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock cycle	f_{CLK}(1)	-	28.8	33	MHz
Hsync cycle	1/th	-	15.72	-	KHz
Vsync cycle	1/tv	-	60	-	Hz
Horizontal Signal					
Horizontal cycle	th	1575	1836	-	CLK
Horizontal display period	thd	1440	1440	1440	CLK
Horizontal front porch	thf	6	90	-	CLK
Horizontal pulse width	thp	6	138	-	CLK
Horizontal back porch	thb	6	168	-	CLK
Vertical Signal					
Vertical cycle	tv	-	262	275	H(1)
Vertical display period	tvd	-	240	-	H(1)
Vertical front porch	tvf	1	4	-	H(1)
Vertical pulse width	tvp	1	3	-	H(1)
Vertical back porch	tvb	1	15	-	H(1)

Note: (1) Unit: CLK=1/ f_{CLK} , H=th

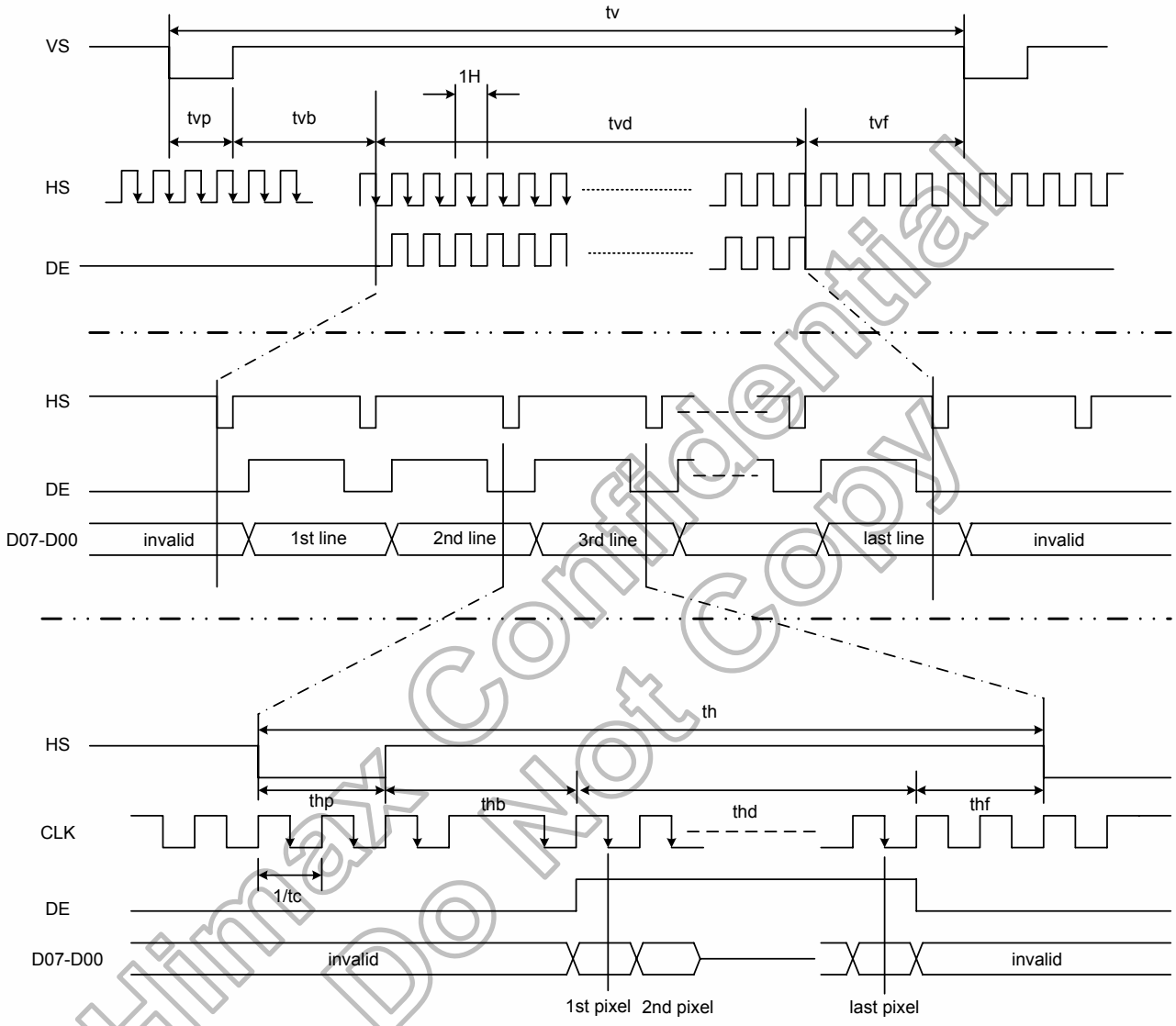


Figure 11.3 Serial RGB Input Timing

11.4 Input setup timing requirement

(T_A=25ºC, VDDIO=1.8V to 3.6V, DVSS= 0V, tr [1]=tf [1]=2ns)

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DISP setup time	t_{diss}	10	-	-	ns
DISP hold time	t_{dish}	10	-	-	ns
Clock period	PW_{CLK} [2]	66.7	-	-	ns
Clock pulse high period	PWH [2]	26.7	-	-	ns
Clock pulse low period	PWL [2]	26.7	-	-	ns
Hsync setup time	t_{hs}	10	-	-	ns
Hsync hold time	t_{hh}	10	-	-	ns
Data setup time	t_{ds}	10	-	-	ns
Data hold time	t_{dh}	10	-	-	ns
DE setup time	t_{des}	10	-	-	ns
DE hold time	t_{deh}	10	-	-	ns
Vsync setup time	t_{vhs}	10	-	-	ns
Vsync hold time	t_{vhh}	10	-	-	ns

Note: (1) tr, tf is defined 10% to 90% of signal amplitude.
(2) For parallel interface, maximum clock frequency is 15MHz.

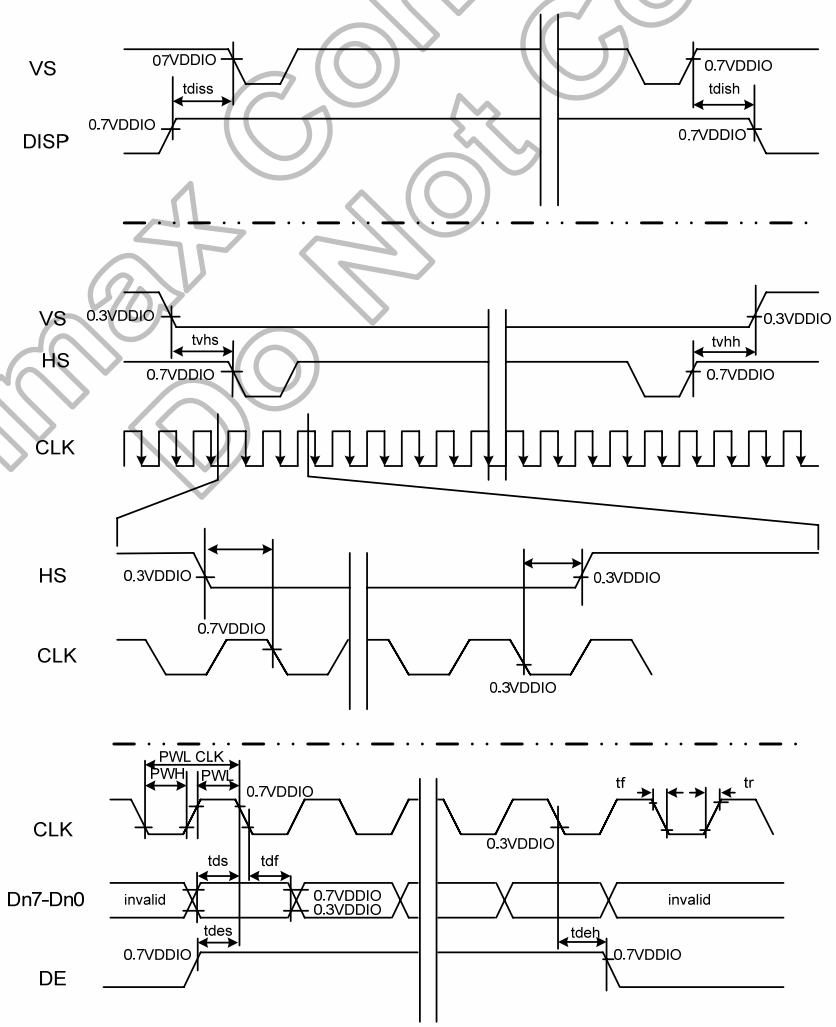


Figure 11.4 Input Setup Timing Requirement

12. Application Circuit

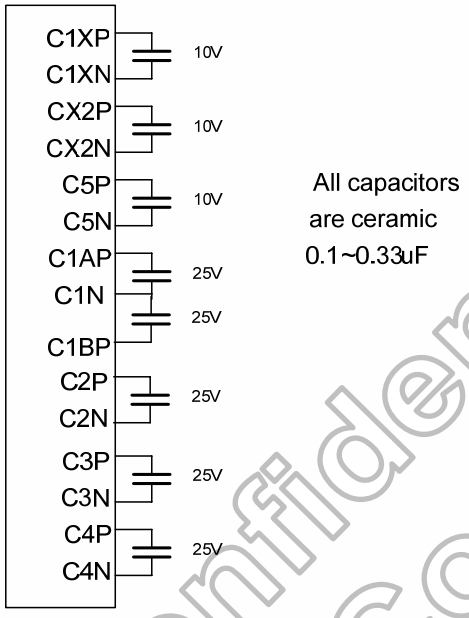


Figure 12.1 Booster Capacitors (VGH=4VDC/VGL=-2VDC)

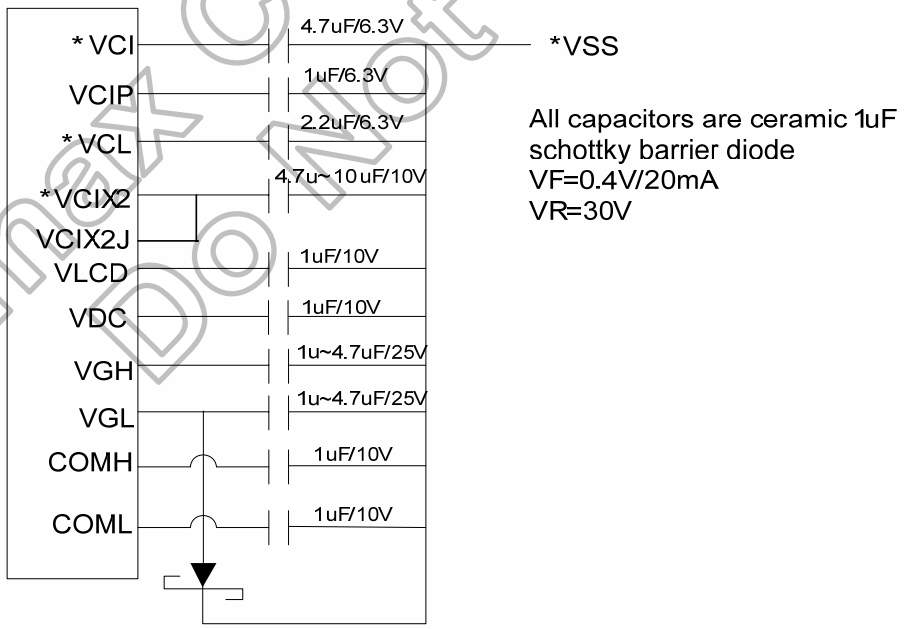


Figure 12.2 Voltage Stable Capacitors & Schottky Diode

(a) Capacitors on VCI should be 4.7uF.
(b) Capacitors on VCL should be 2.2uF
(c) Capacitors on VCIX2 should be 4.7~10uF
(d) Capacitors on VGH, VGL should be 1~4.7uF
(e) Other capacitors should be 1uF

Note: (1) VCI should be separated from VCIP at ITO layout on glass to provide noise free path
(2) DVSS, VCHS, AVSS, and VSSRC should be separated at ITO layout on glass to provide noise free path

13. Ordering Information

Part NO.	Package
HX8257-A01BPDXXX	PD：means COG XXX：means chip thickness(μm), default 400μm

14. Revision History

Version	Date	Description of Changes
01	2008/11/30	New setup