241-channel Gate Driver with an Internal Power Supply for 262,144-color Displays

IS2200

Contents

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241-channel gate driver with an internal power supply for 262,144-color displays

1. Outline

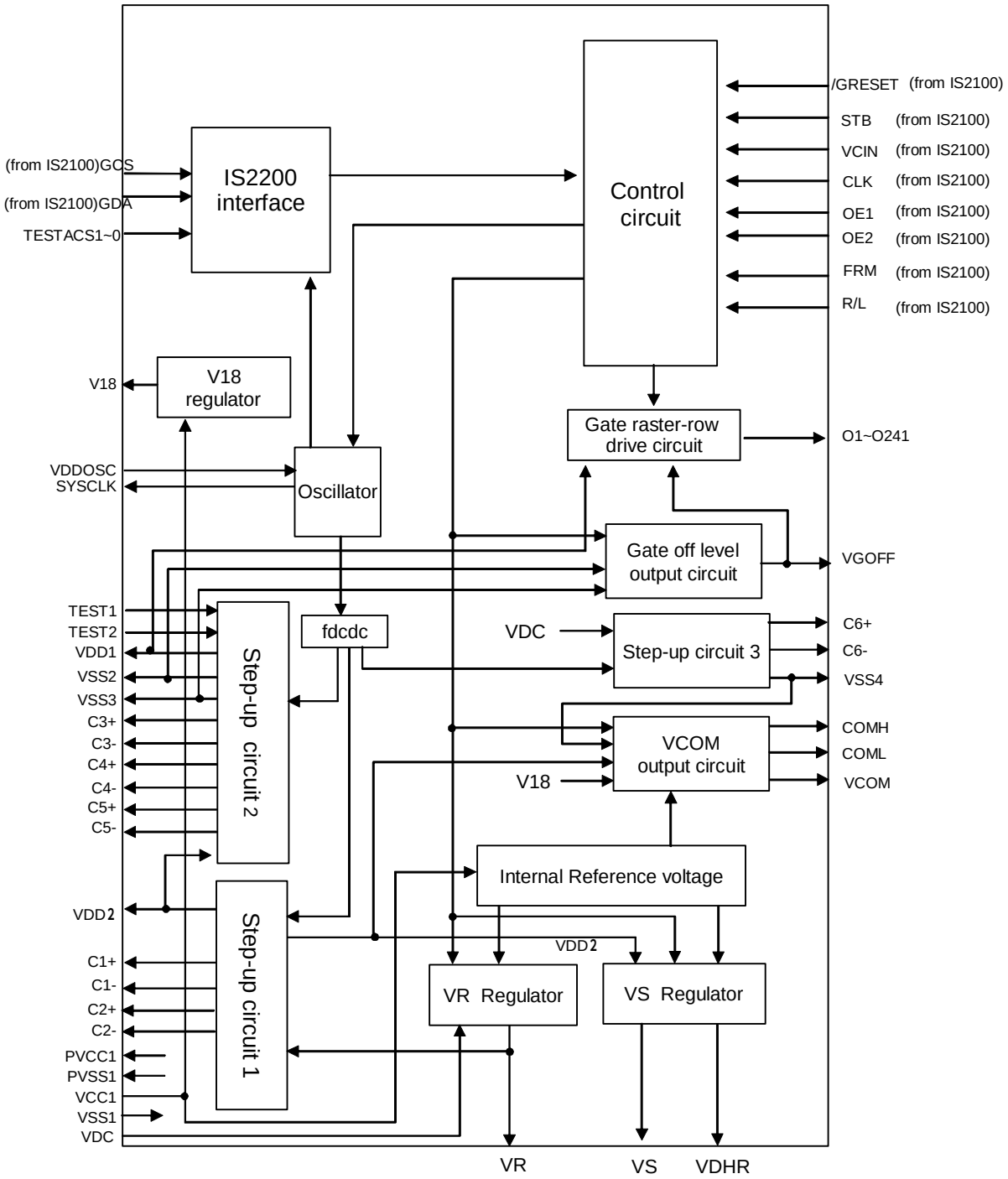
This LSI is a gate driver for TFT color LCD, incorporating an internal LCD drive power supply. The IS2200 can display 176RGB x 240-dots displays maximum in combination with the IS2100 that incorporates an internal RAM.
It has multiple step-up circuits and regulators to generate power supply voltage for the source and the gate of TFT Panel.

2. Features

- **Super slim chip design 1.20mm x 13.28mm**
- Low power consumption (At the time of no-load, total of 2mW combined with the IS2100)
- Capable of using the system power supply (1.7V-1.95V) However, the power supply for the step-up is necessary (2.5V-3.1 V)
- Capable of using a single power supply (2.5V-3.1V)
- The internal 241-channel gate raster-row drive circuit
- Grayscale reference voltage: 4V-5.25V
- Gate raster-row drive voltage: ±6V- ±16.5V
- The internal oscillation circuit for the system
- Capable of setting operation mode from the source driver (IS2100)

(Note) Substrate of the IS2200 is VSS3 (negative potential). Remind that substrate of IS2100 is VSS (GND potential).

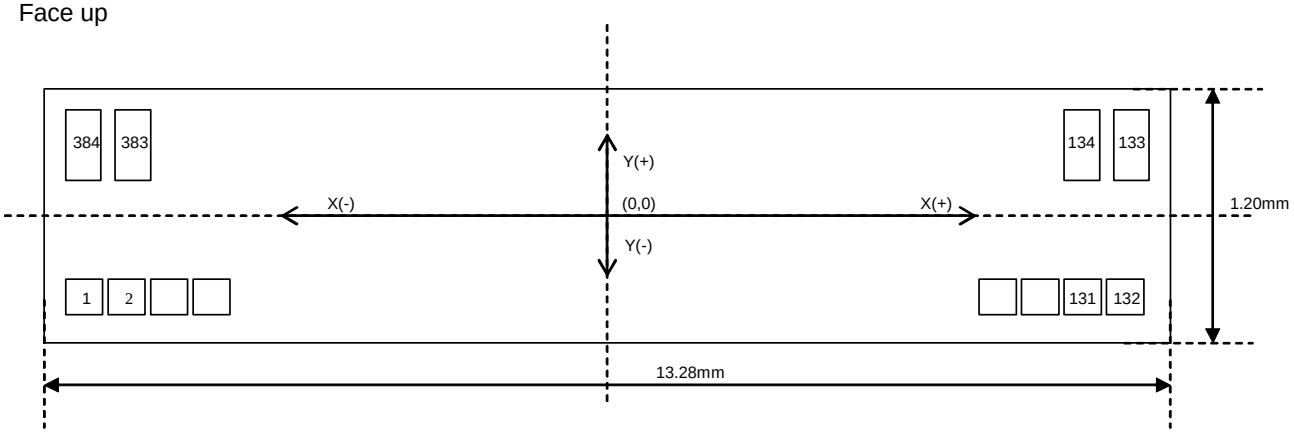
3. Block Diagram



4. Bump Layout

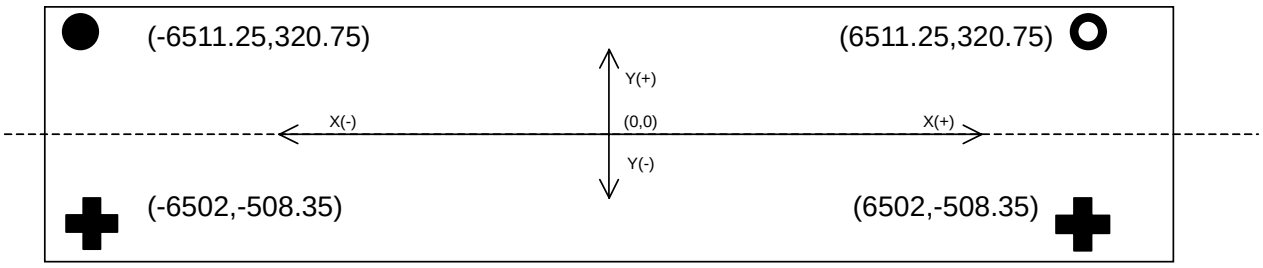
4.1 General

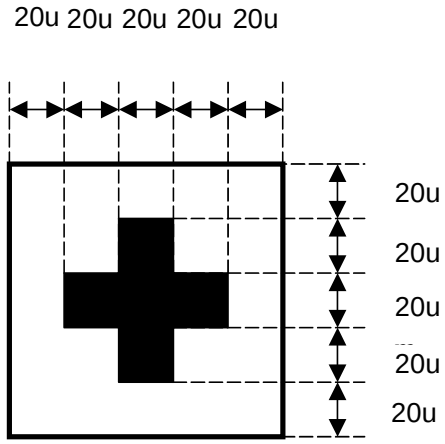
Face up



4.2 Arraignment Mark

Face up

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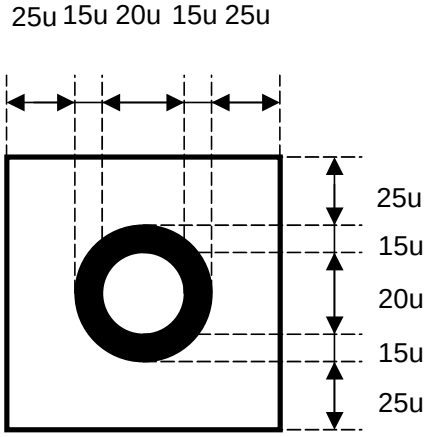
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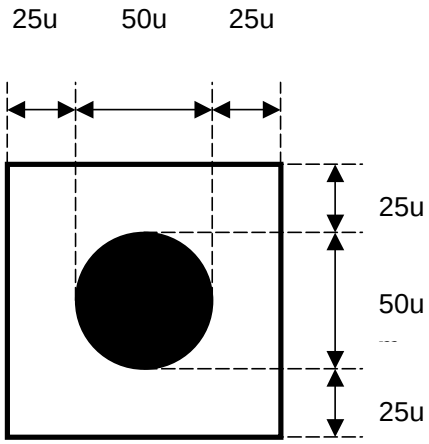
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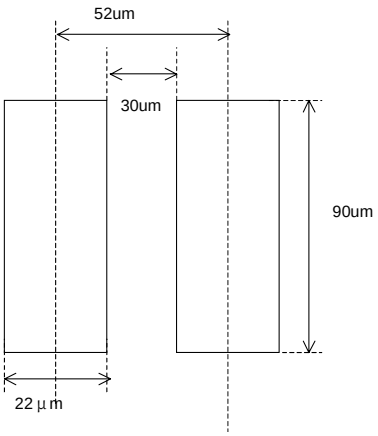
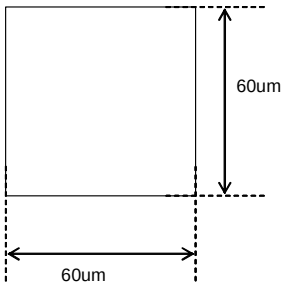
4.3 Bump Specification

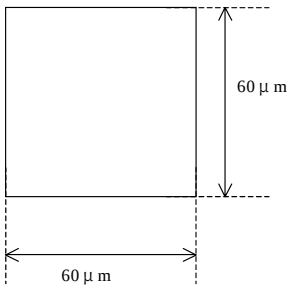
Bump type A
Bump height 18um
バンプ高　18μm



Bump type B
Bump height 18um



Bump type C
Bump height 18μm



4.4 Bump Coordinates

Bump No.	Bump name	X (um)	Y (um)	Bump type
1	DUMMY	-6349.90	-523.35	B
2	FRM	-6259.10	-523.35	B
3	CLK	-6134.70	-523.35	B
4	OE2	-6040.20	-523.35	B
5	OE1	-5915.80	-523.35	B
6	GDA	-5821.30	-523.35	B
7	GCS	-5696.90	-523.35	B
8	/GRESET	-5602.40	-523.35	B
9	SYSCLK	-5470.10	-523.35	B
10	PVCC1	-5368.55	-523.35	B
11	VCIN	-5277.75	-523.35	B
12	PVSS1	-5170.95	-523.35	B
13	STB	-5080.15	-523.35	B
14	DUMMY	-4966.05	-523.35	B
15	DUMMY	-4886.05	-523.35	B
16	V18	-4806.05	-523.35	B
17	V18	-4726.05	-523.35	C
18	V18	-4646.05	-523.35	C
19	V18	-4566.05	-523.35	B
20	VDDOSC	-4477.75	-523.35	B
21	VDDOSC	-4397.75	-523.35	C
22	VDDOSC	-4312.75	-523.35	B
23	VDHR	-4216.75	-523.35	B
24	VDHR	-4136.75	-523.35	C
25	VDHR	-4056.75	-523.35	C
26	VDHR	-3976.75	-523.35	B
27	VS	-3852.75	-523.35	B
28	VS	-3772.75	-523.35	C
29	VS	-3692.75	-523.35	C
30	VS	-3612.75	-523.35	C
31	VS	-3532.75	-523.35	B
32	VR	-3435.75	-523.35	B
33	VR	-3355.75	-523.35	C
34	VR	-3275.75	-523.35	B
35	VSS1	-3195.75	-523.35	B
36	VSS1	-3115.75	-523.35	C
37	VSS1	-3035.75	-523.35	C
38	VSS1	-2955.75	-523.35	C
39	VSS1	-2875.75	-523.35	C
40	VSS1	-2795.75	-523.35	C
41	VSS1	-2715.75	-523.35	C
42	VSS1	-2635.75	-523.35	B
43	VCC1	-2555.75	-523.35	B
44	VCC1	-2475.75	-523.35	C
45	VCC1	-2395.75	-523.35	B
46	VDC	-2315.75	-523.35	B
47	VDC	-2235.75	-523.35	C
48	VDC	-2155.75	-523.35	C
49	VDC	-2075.75	-523.35	C
50	VDC	-1995.75	-523.35	C
51	VDC	-1915.75	-523.35	B
52	DUMMY	-1835.75	-523.35	B
53	DUMMY	-1755.75	-523.35	B
54	VSS1	-1675.75	-523.35	B
55	VSS1	-1595.75	-523.35	C
56	VSS1	-1515.75	-523.35	B
57	VDD2	-1418.25	-523.35	B
58	VDD2	-1338.25	-523.35	C
59	VDD2	-1258.25	-523.35	C
60	VDD2	-1153.75	-523.35	B
61	C1+	-1073.75	-523.35	B
62	C1+	-993.75	-523.35	C
63	C1+	-913.75	-523.35	B
64	C1-	-755.05	-523.35	B
65	C1-	-675.05	-523.35	C
66	C1-	-595.05	-523.35	B
67	C2+	-212.15	-523.35	B
68	C2+	-132.15	-523.35	C

Bump No.	Bump name	X (um)	Y (um)	Bump type
69	C2+	-52.15	-523.35	B
70	C2-	191.85	-523.35	B
71	C2-	271.85	-523.35	C
72	C2-	351.85	-523.35	B
73	DUMMY	506.00	-523.35	B
74	DUMMY	586.00	-523.35	B
75	DUMMY	666.00	-523.35	B
76	DUMMY	746.00	-523.35	B
77	DUMMY	826.00	-523.35	B
78	VDD1	906.00	-523.35	B
79	VDD1	986.00	-523.35	C
80	VDD1	1066.00	-523.35	B
81	C3+	1198.00	-523.35	B
82	C3+	1278.00	-523.35	B
83	C3-	1447.30	-523.35	B
84	C3-	1527.30	-523.35	B
85	C4+	1699.30	-523.35	B
86	C4+	1779.30	-523.35	B
87	C4-	1948.60	-523.35	B
88	C4-	2028.60	-523.35	B
89	C5+	2120.60	-523.35	B
90	C5+	2200.60	-523.35	B
91	C5-	2289.90	-523.35	B
92	C5-	2369.90	-523.35	B
93	C6+	2449.90	-523.35	B
94	C6+	2529.90	-523.35	B
95	C6-	2630.75	-523.35	B
96	C6-	2710.75	-523.35	B
97	VSS2	2790.75	-523.35	B
98	VSS2	2870.75	-523.35	B
99	VSS4	2954.75	-523.35	B
100	VSS4	3034.75	-523.35	C
101	VSS4	3114.75	-523.35	B
102	VSS3	3194.75	-523.35	B
103	VSS3	3274.75	-523.35	B
104	VGOFF	3354.75	-523.35	B
105	VGOFF	3434.75	-523.35	C
106	VGOFF	3584.90	-523.35	B
107	COMH	3664.90	-523.35	B
108	COMH	3744.90	-523.35	B
109	COML	3915.20	-523.35	B
110	COML	3995.20	-523.35	B
111	VCOM	4165.30	-523.35	B
112	VCOM	4245.30	-523.35	B
113	TEST2	4645.00	-523.35	B
114	TEST1	4769.40	-523.35	B
115	PVSS1	4860.20	-523.35	B
116	PVCC1	4995.40	-523.35	B
117	R/L	5075.40	-523.35	B
118	DUMMY	5165.30	-523.35	B
119	DUMMY	5245.30	-523.35	B
120	DUMMY	5325.30	-523.35	B
121	DUMMY	5405.30	-523.35	B
122	DUMMY	5485.30	-523.35	B
123	DUMMY	5565.30	-523.35	B
124	DUMMY	5645.30	-523.35	B
125	PVSS1	5725.30	-523.35	B
126	TESTACS0	5805.30	-523.35	B
127	TESTACS1	5929.70	-523.35	B
128	DUMMY	6029.90	-523.35	B
129	DUMMY	6109.90	-523.35	B
130	DUMMY	6189.90	-523.35	B
131	DUMMY	6269.90	-523.35	B
132	DUMMY	6349.90	-523.35	B
133	DUMMY	6526.00	487.05	A
134	DUMMY	6474.00	487.05	A
135	O1	6422.00	487.05	A
136	O2	6370.00	487.05	A

Bump No.	Bump name	X (um)	Y (um)	Bump type
137	O3	6318.00	487.05	A
138	O4	6266.00	487.05	A
139	O5	6214.00	487.05	A
140	O6	6162.00	487.05	A
141	O7	6110.00	487.05	A
142	O8	6058.00	487.05	A
143	O9	6006.00	487.05	A
144	O10	5954.00	487.05	A
145	O11	5902.00	487.05	A
146	O12	5850.00	487.05	A
147	O13	5798.00	487.05	A
148	O14	5746.00	487.05	A
149	O15	5694.00	487.05	A
150	O16	5642.00	487.05	A
151	O17	5590.00	487.05	A
152	O18	5538.00	487.05	A
153	O19	5486.00	487.05	A
154	O20	5434.00	487.05	A
155	O21	5382.00	487.05	A
156	O22	5330.00	487.05	A
157	O23	5278.00	487.05	A
158	O24	5226.00	487.05	A
159	O25	5174.00	487.05	A
160	O26	5122.00	487.05	A
161	O27	5070.00	487.05	A
162	O28	5018.00	487.05	A
163	O29	4966.00	487.05	A
164	O30	4914.00	487.05	A
165	O31	4862.00	487.05	A
166	O32	4810.00	487.05	A
167	O33	4758.00	487.05	A
168	O34	4706.00	487.05	A
169	O35	4654.00	487.05	A
170	O36	4602.00	487.05	A
171	O37	4550.00	487.05	A
172	O38	4498.00	487.05	A
173	O39	4446.00	487.05	A
174	O40	4394.00	487.05	A
175	O41	4342.00	487.05	A
176	O42	4290.00	487.05	A
177	O43	4238.00	487.05	A
178	O44	4186.00	487.05	A
179	O45	4134.00	487.05	A
180	O46	4082.00	487.05	A
181	O47	4030.00	487.05	A
182	O48	3978.00	487.05	A
183	O49	3926.00	487.05	A
184	O50	3874.00	487.05	A
185	O51	3822.00	487.05	A
186	O52	3770.00	487.05	A
187	O53	3718.00	487.05	A
188	O54	3666.00	487.05	A
189	O55	3614.00	487.05	A
190	O56	3562.00	487.05	A
191	O57	3510.00	487.05	A
192	O58	3458.00	487.05	A
193	O59	3406.00	487.05	A
194	O60	3354.00	487.05	A
195	O61	3302.00	487.05	A
196	O62	3250.00	487.05	A
197	O63	3198.00	487.05	A
198	O64	3146.00	487.05	A
199	O65	3094.00	487.05	A
200	O66	3042.00	487.05	A
201	O67	2990.00	487.05	A
202	O68	2938.00	487.05	A
203	O69	2886.00	487.05	A
204	O70	2834.00	487.05	A
205	O71	2782.00	487.05	A
206	O72	2730.00	487.05	A
207	O73	2678.00	487.05	A

Bump No.	Bump name	X (um)	Y (um)	Bump type
208	O74	2626.00	487.05	A
209	O75	2574.00	487.05	A
210	O76	2522.00	487.05	A
211	O77	2470.00	487.05	A
212	O78	2418.00	487.05	A
213	O79	2366.00	487.05	A
214	O80	2314.00	487.05	A
215	O81	2262.00	487.05	A
216	O82	2210.00	487.05	A
217	O83	2158.00	487.05	A
218	O84	2106.00	487.05	A
219	O85	2054.00	487.05	A
220	O86	2002.00	487.05	A
221	O87	1950.00	487.05	A
222	O88	1898.00	487.05	A
223	O89	1846.00	487.05	A
224	O90	1794.00	487.05	A
225	O91	1742.00	487.05	A
226	O92	1690.00	487.05	A
227	O93	1638.00	487.05	A
228	O94	1586.00	487.05	A
229	O95	1534.00	487.05	A
230	O96	1482.00	487.05	A
231	O97	1430.00	487.05	A
232	O98	1378.00	487.05	A
233	O99	1326.00	487.05	A
234	O100	1274.00	487.05	A
235	O101	1222.00	487.05	A
236	O102	1170.00	487.05	A
237	O103	1118.00	487.05	A
238	O104	1066.00	487.05	A
239	O105	1014.00	487.05	A
240	O106	962.00	487.05	A
241	O107	910.00	487.05	A
242	O108	858.00	487.05	A
243	O109	806.00	487.05	A
244	O110	754.00	487.05	A
245	O111	702.00	487.05	A
246	O112	650.00	487.05	A
247	O113	598.00	487.05	A
248	O114	546.00	487.05	A
249	O115	494.00	487.05	A
250	O116	442.00	487.05	A
251	O117	390.00	487.05	A
252	O118	338.00	487.05	A
253	O119	286.00	487.05	A
254	O120	234.00	487.05	A
255	O121	182.00	487.05	A
256	DUMMY	130.00	487.05	A
257	DUMMY	78.00	487.05	A
258	DUMMY	26.00	487.05	A
259	DUMMY	-26.00	487.05	A
260	DUMMY	-78.00	487.05	A
261	DUMMY	-130.00	487.05	A
262	DUMMY	-182.00	487.05	A
263	O122	-234.00	487.05	A
264	O123	-286.00	487.05	A
265	O124	-338.00	487.05	A
266	O125	-390.00	487.05	A
267	O126	-442.00	487.05	A
268	O127	-494.00	487.05	A
269	O128	-546.00	487.05	A
270	O129	-598.00	487.05	A
271	O130	-650.00	487.05	A
272	O131	-702.00	487.05	A
273	O132	-754.00	487.05	A
274	O133	-806.00	487.05	A
275	O134	-858.00	487.05	A
276	O135	-910.00	487.05	A
277	O136	-962.00	487.05	A
278	O137	-1014.00	487.05	A

Bump No.	Bump name	X (um)	Y (um)	Bump type
279	O138	-1066.00	487.05	A
280	O139	-1118.00	487.05	A
281	O140	-1170.00	487.05	A
282	O141	-1222.00	487.05	A
283	O142	-1274.00	487.05	A
284	O143	-1326.00	487.05	A
285	O144	-1378.00	487.05	A
286	O145	-1430.00	487.05	A
287	O146	-1482.00	487.05	A
288	O147	-1534.00	487.05	A
289	O148	-1586.00	487.05	A
290	O149	-1638.00	487.05	A
291	O150	-1690.00	487.05	A
292	O151	-1742.00	487.05	A
293	O152	-1794.00	487.05	A
294	O153	-1846.00	487.05	A
295	O154	-1898.00	487.05	A
296	O155	-1950.00	487.05	A
297	O156	-2002.00	487.05	A
298	O157	-2054.00	487.05	A
299	O158	-2106.00	487.05	A
300	O159	-2158.00	487.05	A
301	O160	-2210.00	487.05	A
302	O161	-2262.00	487.05	A
303	O162	-2314.00	487.05	A
304	O163	-2366.00	487.05	A
305	O164	-2418.00	487.05	A
306	O165	-2470.00	487.05	A
307	O166	-2522.00	487.05	A
308	O167	-2574.00	487.05	A
309	O168	-2626.00	487.05	A
310	O169	-2678.00	487.05	A
311	O170	-2730.00	487.05	A
312	O171	-2782.00	487.05	A
313	O172	-2834.00	487.05	A
314	O173	-2886.00	487.05	A
315	O174	-2938.00	487.05	A
316	O175	-2990.00	487.05	A
317	O176	-3042.00	487.05	A
318	O177	-3094.00	487.05	A
319	O178	-3146.00	487.05	A
320	O179	-3198.00	487.05	A
321	O180	-3250.00	487.05	A
322	O181	-3302.00	487.05	A
323	O182	-3354.00	487.05	A
324	O183	-3406.00	487.05	A
325	O184	-3458.00	487.05	A
326	O185	-3510.00	487.05	A
327	O186	-3562.00	487.05	A
328	O187	-3614.00	487.05	A
329	O188	-3666.00	487.05	A
330	O189	-3718.00	487.05	A
331	O190	-3770.00	487.05	A
332	O191	-3822.00	487.05	A
333	O192	-3874.00	487.05	A
334	O193	-3926.00	487.05	A
335	O194	-3978.00	487.05	A
336	O195	-4030.00	487.05	A
337	O196	-4082.00	487.05	A
338	O197	-4134.00	487.05	A
339	O198	-4186.00	487.05	A
340	O199	-4238.00	487.05	A
341	O200	-4290.00	487.05	A
342	O201	-4342.00	487.05	A
343	O202	-4394.00	487.05	A
344	O203	-4446.00	487.05	A
345	O204	-4498.00	487.05	A
346	O205	-4550.00	487.05	A
347	O206	-4602.00	487.05	A
348	O207	-4654.00	487.05	A
349	O208	-4706.00	487.05	A
350	O209	-4758.00	487.05	A

Bump No.	Bump name	X (um)	Y (um)	Bump type
351	O210	-4810.00	487.05	A
352	O211	-4862.00	487.05	A
353	O212	-4914.00	487.05	A
354	O213	-4966.00	487.05	A
355	O214	-5018.00	487.05	A
356	O215	-5070.00	487.05	A
357	O216	-5122.00	487.05	A
358	O217	-5174.00	487.05	A
359	O218	-5226.00	487.05	A
360	O219	-5278.00	487.05	A
361	O220	-5330.00	487.05	A
362	O221	-5382.00	487.05	A
363	O222	-5434.00	487.05	A
364	O223	-5486.00	487.05	A
365	O224	-5538.00	487.05	A
366	O225	-5590.00	487.05	A
367	O226	-5642.00	487.05	A
368	O227	-5694.00	487.05	A
369	O228	-5746.00	487.05	A
370	O229	-5798.00	487.05	A
371	O230	-5850.00	487.05	A
372	O231	-5902.00	487.05	A
373	O232	-5954.00	487.05	A
374	O233	-6006.00	487.05	A
375	O234	-6058.00	487.05	A
376	O235	-6110.00	487.05	A
377	O236	-6162.00	487.05	A
378	O237	-6214.00	487.05	A
379	O238	-6266.00	487.05	A
380	O239	-6318.00	487.05	A
381	O240	-6370.00	487.05	A
382	O241	-6422.00	487.05	A
383	DUMMY	-6474.00	487.05	A
384	DUMMY	-6526.00	487.05	A

5. Pin Description

Bump No.	Pin Symbol	Pin Name	I/O	Connect to	Function
135-255 263-382	O1~O241	Gate output	O	TFT panel	Gate output pin
3	CLK	CLK input	I	IS2100	Clock input Connect to GCLK of the IS2100
5	OE1	Display OFF input	I	IS2100	Display OFF input Connect to GOE1 of the IS2100
4	OE2	Display ON input	I	IS2100	Turns on all the gate raster-rows when the LOW level is input Connect to GOE2 of the IS2100
117	R/L	Shift direction setting	I	Power supply	Configures the gate shift direction. (For more info, see 17.2. Gate Scan--IS2100)
2	FRM	FRM input	I	IS2100	Frame synchronization signal Connect to GFRM of the IS2100
7	GCS	Chip select	I	IS2100	Chip selection pin Connect to GCS of the IS2100
6	GDA	Data input	I	IS2100	Serial data input pin Connect to GDA of the IS2100
8	/GRESET	Reset	I	IS2100	Reset pin Connect to /GRESET of the IS2100
11	VCIN	Signal for AC drive input	I	IS2100	Input pin for A/C signal of VCOM and VGOFF Connect to VCOUT2 of the IS2100
32-34	VR	Step-up reference voltage output	O	Bypass capacitor	Step-up reference voltage output pin. Connect a capacitor (capacity=1μF, withstand voltage=10V) between the pin and the ground.
27-31	VS	Power supply for the source driver	O	IS2100 Bypass capacitor	Power supply for the Source raster-row drive Connect a capacitor (capacity=1uF, withstand voltage=10V) between the pin and the ground.
23-26	VDHR	Grayscale reference power supply	O	IS2100	Grayscale Reference power supply. Connect to VDHR of IS2100
16-19	V18	Power supply for logic	O	IS2100 Bypass capacitor	Supplies VDDOSC and V18 of the IS2100 with2.0V when the system power supply is 2.5 ~3.1V. Connect a capacitor (capacity=1.0uF, withstand voltage=10V) between the pin and ground, even when not in use.
61-63 67-69 81-82 85-86 89-90 93-94	C1+ C2+ C3+ C4+ C5+ C6+	C1+ C2+ C3+ C4+ C5+ C6+	O	Step-up capacitor	Positive connection pin of the step-up capacitor Refer to Chapter 10 for a recommended capacitor and how to connect.
64-66 70-72 83-84 87-88 91-92 95-96	C1- C2- C3- C4- C5- C6-	C1- C2- C3- C4- C5- C6-	O	Step-up capacitor	Negative connection pin of the step-up capacitor Refer to Chapter 10 for a recommended capacitor and how to connect.
78-80	VDD1	VDD1	O	Bypass capacitor	VDD2 x 2 or VDD2x3 output (gate raster-row drive negative voltage) Refer to Chapter 10 for a recommended capacitor and how to connect.
57-60	VDD2	VDD2	O	Bypass capacitor	VR x 2 output Refer to Chapter 10 for a recommended capacitor and how to connect.

Bump No.	Pin Symbol	Pin Name	I/O	Connect to	Function
97-98	VSS2	VSS2	O	Bypass capacitor	VDD2 x (-1) or VDD2 x (–2) output (gate raster-row drive negative voltage) Refer to Chapter 10 for a recommended capacitor and how to connect.
102-103	VSS3	VSS3	O	Bypass capacitor	VDD2 x (-2) or VDD2 x (-3) output (gate raster-row drive negative voltage) Refer to Chapter 10 for recommended capacitor and how to connect. Connect a shot key barrier diode in order to VSS1 (please make sure it to be VR≥30V)
99-101	VSS4	VSS4	O	Bypass capacitor	VDC x (-1) output Refer to Chapter 10 for recommended capacitor and how to connect.
107-108	COMH	COMH	O	Bypass capacitor	“High” level of VCOM at the A/C drive. Connect a capacitor (capacity=1μF, withstand voltage=10V) between the pin and the ground.
109-110	COML	COML	O	Bypass capacitor	“Low” level of VCOM at the A/C drive. Connect a capacitor (capacity=1μF, withstand voltage=10V) between the pin and the ground.
111-112	VCOM	VCOM	O	TFT panel	Power supply for COM electrode of TFT liquid crystal panel
46-51	VDC	Step-up power supply	I	Power supply	Power supply pin for the step-up circuit Connect to the system power supply when the power supply is between 2.5v and 3.1v. Connect to the step-up power supply when the power supply is 1.8v.
43-45	VCC1	Logic power supply	I	Power supply	Power supply for the logic system, Connect to the system power supply. We recommend that you connect a capacitor (capacity=over 1μF, withstand voltage=10V) between the pin and the ground.
20-22	VDDOSC	Power supply for Oscillation	I	V18/ Power supply	Power supply pin for the oscillation circuit. Connect to V18.
35-42 54-56	VSS1	Ground	-	Power supply	Connect to the ground
10,116	PVCC1	For Pull-up	-		The pull-up power supply for mode setting
12、115	PVSS1	For Pull-down	-		The pull-down source for mode setting
104-106	VGOFF	Gate-Off	O		Outputs the gate off potential. Must not be connected
9	SYSCLK	Clock	O	IS2100	System clock output. Connect to SYSCLK of the IS2100.
13	STB	Stand-by	I	IS2100	Stand-by signal input. Connect to STB of the IS2100.
113-114	TEST1~2	Test	I	PVSS1	Test pin. Connect to PVSS1.
127	TESTACS1	Test	I	PVSS1	Test pin. Connect to PVSS1.
126	TESTACS0	Test	I	PVSS1 / PVCC1	Test pin. Connect to PVSS1 or PVCC1.
1,14,15,52 53,73-77 118-124 128-134 256-262 383,384	DUMMY	DUMMY			Dummy pins Must not be connected (Not examined at shipping. Do not use this pin for relay etc.)

Note!! Please make sure all the capacitors are of B rank concerning temperature, frequency, and applied voltage temperature.

6. Power supply Connection

According to the system voltage, connect as listed below.

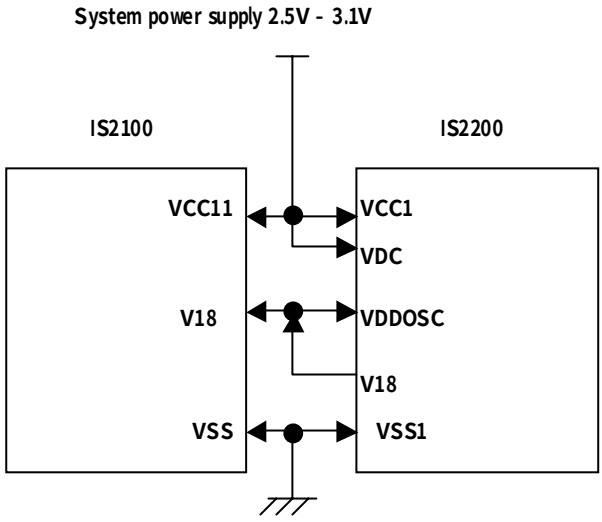


Fig. 6-1 System power supply 2.5V - 3.1V

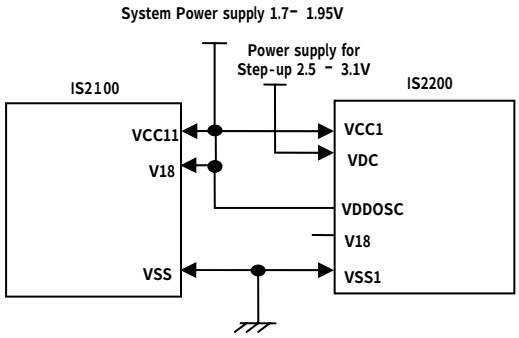


Fig. 6-2 System power supply 1.7 V - 1.95V

7. Control Interface

The operating mode of the IS2200 is specified with setting the internal registers. If you set the source driver of the IS2100, the internal register settings will be automatically sent to the IS2200 via the serial interface.

8. Format for Register Setting

The format for register setting consists of 16 bits. Upper eight bits are for the register address configuration. The data are transferred from MSB to LSB and are synchronized with SYSCLK, which is sent from the IS2100 to the IS2200.

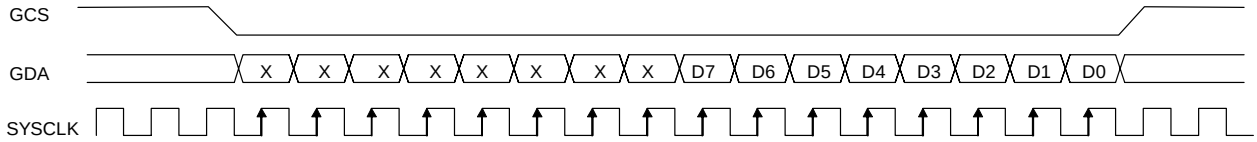


Fig. 8-1 Data format

Register	Function	RS	R/W	D15 to 8	D7	D6	D5	D4	D3	D2	D1	D0
R24	Power supply system control register 1	0	W	0001 1000		RGONR		VS3ON	VS2ON	VD2ON	VD1ON	DCON
R25	Power supply system control register 2	0	W	0001 1001				VRSEL2	VRSEL1	VRSEL0		
R26	Power supply system control register 3	0	W	0001 1010		FUP	CLS1	CLS0	FS3	FS2	FS1	FS0
R27	Power supply system control register 4	0	W	0001 1011					VSEL2	VSEL1	VSEL0	RGON
R29	Power supply system control register 6	0	W	0001 1101						SCN2	SCN1	SCN0
R30	Power supply system control register 7	0	W	0001 1110				COMHI				
R31	Power supply system control register 8	0	W	0001 1111	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
R32	Power supply system control register 9	0	W	0010 0000	CDA7	CDA6	CDA5	CDA4	CDA3	CDA2	CDA1	CDA0
R33	Power supply system control register 10	0	W	0010 0001			PONM	PON				
R34	Power supply system control register 11	0	W	0010 0010								RES

Fig. 8-2 Instruction Table

9. Command Description

9.1 Power Supply Control Register 1 (R24)

D7	D6	D5	D4	D3	D2	D1	D0
	RGONR		VS3ON	VS2ON	VD2ON	VD1ON	DCON

RGONR: Control OFF/ON of VR regulator.

0: Off. The output is Hi-Z.

1: On

VS3ON: Control OFF/ON of VSS3 and VSS4 outputs.

0: Off. The output is VSS1.

1: On

VS2ON: Control OFF/ON of VSS2 output.

0: Off. The output is VSS1.

1: On

VD2ON: Control OFF/ON of VDD2 output.

0: Off. The output is VR.

1: On

VD1ON: Control OFF/ON of VDD1 output.

0: Off. The output is VDD2.

1: On

You can't set VD1ON as 0, when you set DCON as 1.

DCON: Control OFF/ON of the DC/DC converter.

0: Off VS,VDHR,VR,COMH,COML,VCOM, VGOFF are VSS1.

1: On

VS3ON	VS2ON	Output of VSS3	Output of VSS2	The voltage of VGOFF
1	0	Output of CP2	Fix to VSS	Fix to VSS3
1	1	Output of CP2	Output of CP2	VSS2-VSS3 reverse
0	1	Configuration prohibited		
0	0	Configuration prohibited		

9.2 Power Supply Control Register 2 (R25)

D7	D6	D5	D4	D3	D2	D1	D0
			VRSEL2	VRSEL1	VRSEL0		

VRSEL2, VRSEL1, VRSEL0

Set the output voltage of the VR regulator as VR≤ VDC—0.15V

VRSEL2	VRSEL1	VRSEL0	VR
0	0	0	1.8V
0	0	1	1.9V
0	1	0	2.0V
0	1	1	2.2V
1	0	0	2.4V
1	0	1	2.6V
1	1	0	2.7V
1	1	1	2.8V

*These values are for output voltages at VDC=2.8V. When VDC changes, these values also change in proportion.

9.3. Power Supply Control Register 3 (R26)

D7	D6	D5	D4	D3	D2	D1	D0
	FUP	CLS1	CLS0	FS3	FS2	FS1	FS0

FUP, CLS1, CLS0

Select the fdcdc frequency for the DC/DC converter according to the panel.

FUP	CLS1	CLSO	Step-up frequency fdcdc	(Examples)
0	0	0	SYSCLK÷40	When SYSCLK=600KHz, 600÷40＝15KHz
0	0	1	SYSCLK÷30	When SYSCLK=600KHz, 600÷30＝20KHz
0	1	0	SYSCLK÷20	When SYSCLK=600KHz, 600÷20＝30KHz
0	1	1	Configuration prohibited	
1	0	0	SYSCLK÷20	When SYSCLK=600KHz, 600÷20＝30KHz
1	0	1	SYSCLK÷15	When SYSCLK=600KHz, 600÷15＝40KHz
1	1	0	SYSCLK÷10	When SYSCLO=600KHz, 600÷10＝60KHz
1	1	1	Configuration prohibited	

FS3、FS2

Select the frequency of the step-up circuit of VDD1, VSS2, VSS 3 and VSS4 according to the panel.

FS3	FS2	Step-up frequency
0	0	fdcdc/2
0	1	fdcdc/4
1	0	fdcdc/8
1	1	fdcdc/16

FS1, FS0

Select the frequency of the step-up circuit of VDD2 according to the panel.

FS1	FS0	Step-up frequency
0	0	fdcdc/2
0	1	fdcdc/4
1	0	fdcdc/8
1	1	fdcdc/16

9.4 Power Supply Control Register 4 (R27)

D7	D6	D5	D4	D3	D2	D1	D0
				VSEL2	VSEL1	VSEL0	RGON

VSEL2 — 0

Select the output voltage of the VS regulator and set its value as VS/VDHR≤ VDD2—0.15V.

From DC characteristics of the IS2100, the value of VS/VDHR=3.5V is not permitted.

VSEL2	VSEL1	VSEL0	VS/VDHR
0	0	0	3.5V
0	0	1	4.0V
0	1	0	4.25V
0	1	1	4.5V
1	0	0	4.75V
1	0	1	5V
1	1	0	5.25V
1	1	1	5.25V

*These values are for output voltages at VDC=2.8V. When VDC changes, these values also changes in proportion.

RGON

Control the OFF/ON of the VS regulator and the VDHR regulator.

0: Off The VS output is Hi-Z. And the VDHR output is VSS1.

1: On

9.5 Power Supply Control Register 6 (R29)

D7	D6	D5	D4	D3	D2	D1	D0
					SCN2	SCN1	SCN0

R/L, SCN2 — SCN0: Specify the gate scan mode.

R/L	SCN2	SCN1	SCN0	Scan Mode
1	1	1	1	MODE1R
0	1	1	1	MODE1L
1	0	1	1	MODE2R
0	0	1	1	MODE2L
1	1	0	1	MODE3R
0	1	0	1	MODE3L
1	0	0	1	MODE4R
0	0	0	1	MODE4L
1	1	X	0	MODE5R
0	1	X	0	MODE5L

Please see IS2100 Specification “17 Gate Driver IS2100 Output Control” section for more details.

9.6 Power Supply Control Register 7 (R30)

D7	D6	D5	D4	D3	D2	D1	D0
			COMHI				

COMHI: Select the VCOM output.

0: Hi-Z

1: Normal

9.7 Power Supply Control Register 8 (R31)

D7	D6	D5	D4	D3	D2	D1	D0
DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0

DA7—DA0: Set the amplitude of COM.

DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	COM amplitude V
0	0	0	0	0	0	0	0	Prohibited to use
:								
0	0	1	1	0	0	1	0	
0	0	1	1	0	0	1	1	2.6358
0	0	1	1	0	1	0	0	2.6672
0	0	1	1	0	1	0	1	2.6986
:								: (0.0314V Step)
1	0	1	1	0	1	0	0	6.6864
1	0	1	1	0	1	0	1	Prohibited to use
:								
1	1	1	1	1	1	1	1	

VCOM amplitude = 2.6358 + (DA [7:0] Value — 51)× 0.0314V

*These values are for output voltages at VDC=2.8V. When VDC changes, these values also changes in proportion.

9.8 Power Supply Control Register 9 (R32)

D7	D6	D5	D4	D3	D2	D1	D0
CDA7	CDA6	CDA5	CDA4	CDA3	CDA2	CDA1	CDA0

CDA7—CDA0: Set a center voltage of the VCOM output.

CDA7	CDA6	CDA5	CDA4	CDA3	CDA2	CDA1	CDA0	COM Center Voltage V
0	0	0	0	0	0	0	0	0.0000
0	0	1	0	0	0	0	1	0.0157
0	0	1	0	0	0	1	0	0.0314
0	0	1	0	0	0	1	1	0.0471
:								: (0.0157V Step)
1	0	1	1	0	1	1	0	2.8574
1	0	1	1	0	1	1	1	Prohibited to use
1	1	1	1	1	1	1	1	

VCOM center voltage = CDA [7:0] value × 0.0157V

*These values are for output voltages at VDC=2.8V. When VDC changes, these values also changes in proportion.

NOTE!! VCOMH = VCOM center＋ VCOM amplitude／2 Setting range 1.92V—5.15V

VCOMH≤VDD2-0.3V

VCOML = VCOM center － VCOM amplitude／2 Setting range –2.00V—0.5V

VCOML≥VSS4+0.3V

Make sure to set DA7—0/CDA7—0 within the range specified above.

9.9 Power Supply Control Register 10 (R33)

D7	D6	D5	D4	D3	D2	D1	D0
		PONM	PON				

PON: Valid in the DC/DC external sequence mode (PONM=0)

0: Starts power supply for each power supply output after completing DC/DC booting.

1: In the process of booting DC/DC

PONM: Selection of the DC/DC booting either by the internal sequence automatically or by the external sequence.

0: External sequence

1: Internal sequence

9.10 Power Supply Control Register 11 (R34)

D7	D6	D5	D4	D3	D2	D1	D0
							RES

RES: Reset command for the IS2200. After the command is received, this bit sets as 0 automatically.

0: Normal

1: Command reset

10. Power supply Set up

IS2200 has an internal power supply output circuit to drive the TFT panel. Please set up each voltage according to the LCD panel.

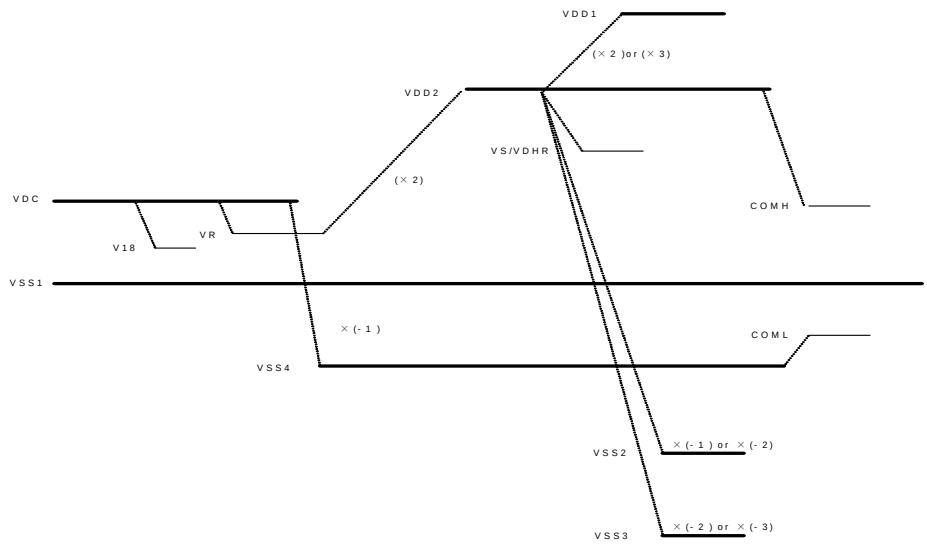
10.1 Voltage Configuration

Name	Description	Range	Note
VDD1	Gate on voltage	VDD2 x 2 – VDD2 x 3	Do not exceed 16.5V
VDD2	Output for the charge pump circuit 1	VR x 2	Power supply for VS/VDHR/VDD1/VSS2/VSS3/COMH
VSS2	Gate off voltage (Hi)	VDD2 x (-1) – VDD2 x (-2)	
VSS3	Gate off voltage (Low)	VDD2 x (-2) – VDD2 x (-3)	Do not exceed –16.5V
COML	VCOM voltage (Low)	Refer to the description for R31 and R32 registers	
COMH	VCOM voltage (Hi)		
VCOM	VCOM voltage		Outputs after changing COMH and COML according to the VCIN signal.
VS	Power supply for the source drive circuit	3.5V – 5.25V	Refer to the R27 register
VDHR	Reference voltage for gradation	3.5V – 5.25V	
VR	Reference voltage for boosting	1.8V – 2.8V	Refer to the R25 register of the IS2200

10.2. Voltage Configuration Chart

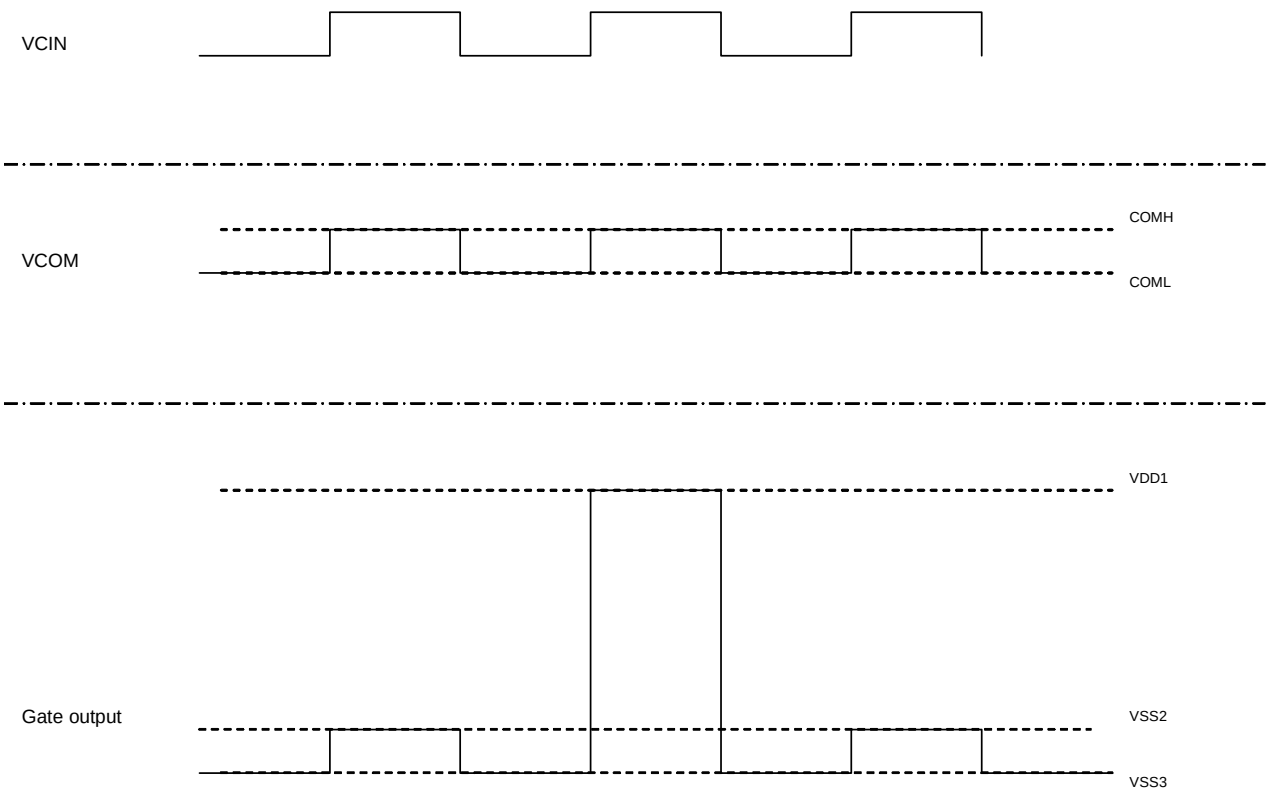
The following figure is a simplified flow chart for voltage generated by the IS2100.

Set-up	Output Voltage	Source Voltage	Step-up Type			
CP1	VDD2	VR	x 2			
CP3	VSS4	VDC	X (-1)			
CP2	VDD1	VDD2	x 3	x 3	x 2	x 2
CP2	VSS2	VDD2	x (-2)	VSS	x (-1)	VSS
CP2	VSS3	VDD2	x (-3)	x (-3)	x (-2)	x (-2)



10.3. Alternative Drive

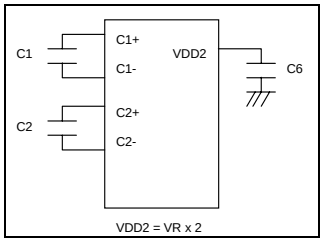
Control each power supply according to the VCIN signal from the IS2100.

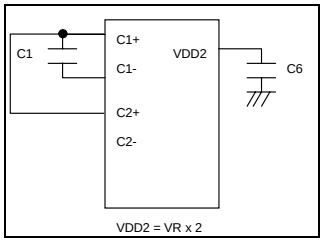


10.4. VDD1, VDD2, VSS2, VSS3, VSS4 Configuration

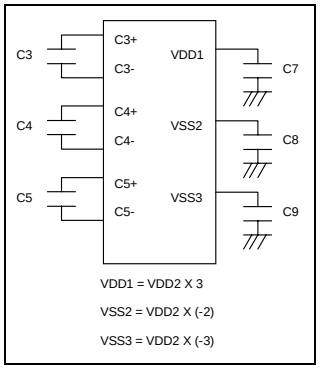
The IS2200 configures VDD1, VDD2, VSS2, VSS3, and VSS4 by connecting methods of the step-up capacitor from C1+ to C5+ and from C1- to C5-.

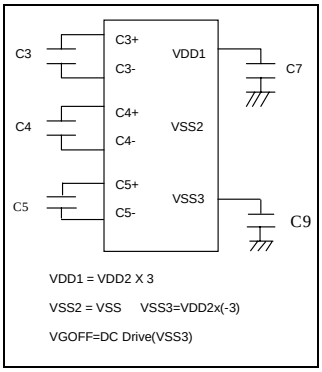
10.4.1. Configuration of the VDD2 step-up (Please select according to the panel)

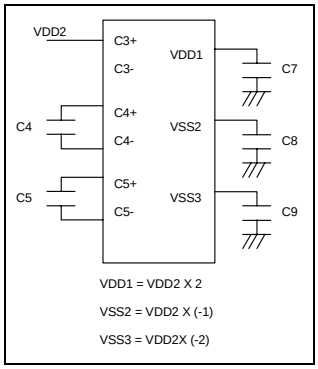


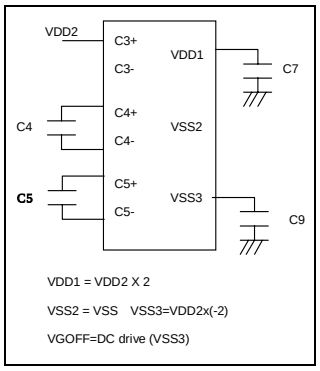


10.4.2. Configuration of the VDD1, VSS2, and VSS3 step-up

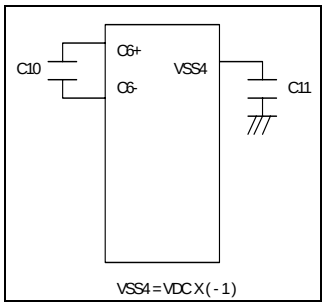








10.4.3. Configuration of the VSS4 step-up



10.5 Recommended Capacitors for the Step-Up Circuit

The following table shows recommended capacitors for the step-up circuit.

Capacitor	Capacitance (uF)	Rated voltage (V)
C1	1 - 2.2	10
C2	1 - 2.2	10
C3	0.47 -	10
C4	0.47 -	25
C5	0.47 -	25
C6	1 - 2.2	10
C7	1 -	25
C8	1 -	25
C9	1 -	25
C10	1 -	10
C11	1 -	10

Please adjust according to the panel.

Note!! Please make sure that all capacitors are of B rank concerning applied voltage temperature.

Table 10-1 Recommended capacitors for the step-up circuit

11. Power Supply Sequence

There are two ways for the power supply sequence.

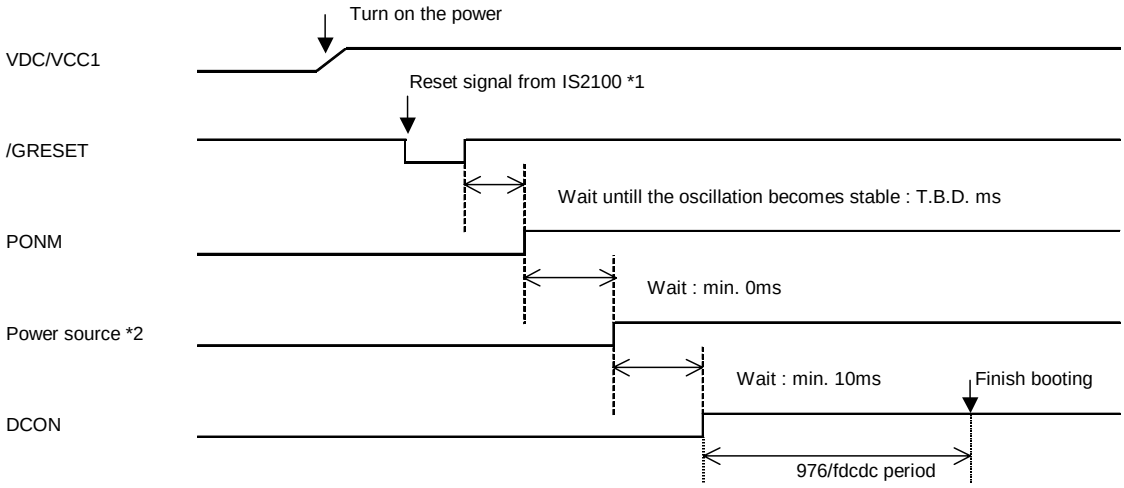
The simple sequence by IS2100 serial sequence (Prohibited to use.)

The command sequence by IS2100 serial sequence

11.1 Power-On Sequence

11.1.1. The simple sequence by the IS2100 serial sequence (Prohibited to use.)

After turning on the power supply, each command for /GRESET, PONM, VD2ON, RGONR, RGON, VS2ON, VS3ON, VD1ON and DCON will be written to the IS2100 register by the sequence listed below.



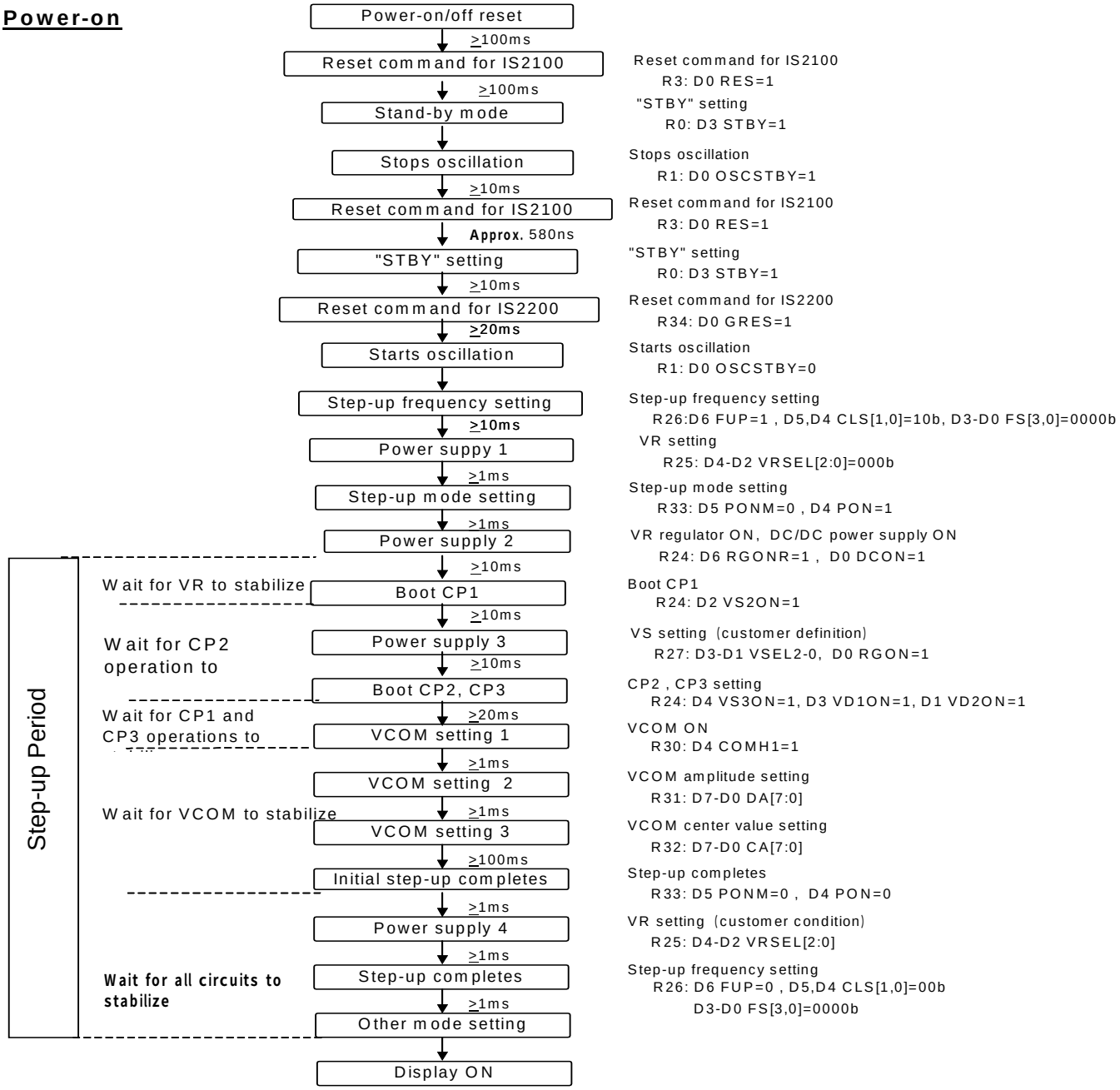
*1 The hardware reset signal to IS2100 is automatically adopted to IS2200.
The reset command to R34 is not required.

*2 Set 1 to the registers corresponding to the power source
among VD2ON, RGONR, RGON, VS2ON, VS3ON and VD1ON.

11.2. Power-on Sequence

Follow the power-on sequence as indicated below when turning on the power supply. Each waiting time in the step-up period varies due to the external resistance and capacity, so please make sure to allow ample amount of time according to the panel's characteristics.

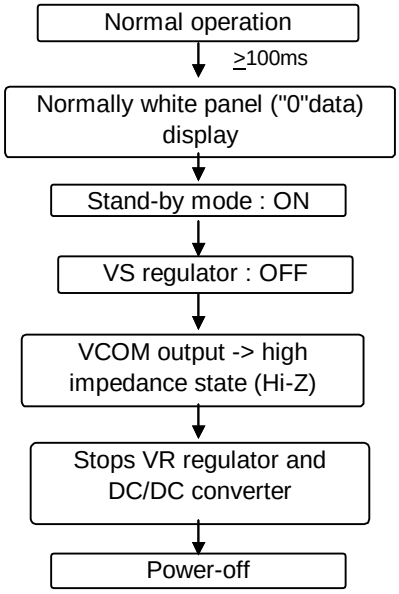
Power-on



11.2 Power-Off Sequence

Follow the power-off sequence as indicated below when turning off the power supply.

Power-off



Normally white panel ("0" data) display
R0: D7-D6 DISP1-0=01b

Stand-by mode
R0: D3 STBY=1

VR regulator OFF
R27: D0 RGON=0

VCOM output to Hi-Z
R30: D4 COMHI=0

VR regulator: OFF, DC/DC converter: OFF
R24: D6 RGONR=0
D4-D1 VS3ON, VS2ON, VD2ON, VD1ON=0000b
D0 DCON=0
Stops oscillation

R1:D0 OSCSTBY=1

12. Absolute Maximum Ratings

Item	Symbol	Rated value	Unit	Note
Power supply (1)	VCC1-GND	-0.3 — +5.0	V	
Power supply (2)	VDC-GND	-0.3 — +5.0	V	
Power supply (3)	VS-GND	-0.3 — +7.0	V	
Power supply (4)	VR-GND	-0.3 — +5.0	V	
Power supply (5)	V18-GND	-0.3 — +5.0	V	
Power supply (6)	VDD1-GND	-0.3 — +18.5	V	
Power supply (7)	VDD2-GND	-0.3 — +7.0	V	
Power supply (8)	GND-VSS2	-0.3 — +18.5	V	
Power supply (9)	GND-VSS3	-0.3 — +18.5	V	
Power supply (10)	GND-VSS4	-0.3 — +5.0	V	
Power supply (11)	VDHR-GND	-0.3 — +7.0	V	
Power supply (12)	VDD2-VSS4	-0.3 — +10.0	V	
Power supply (13)	VDD1-VSS3	-0.3 — +37.0	V	
Power supply (14)	VDD1-VSS2	-0.3 — +37.0	V	
Power supply (15)	ComH-GND	-0.3 — +7.0	V	
Power supply (16)	GND-ComL	-2.0 — +5.0	V	
Power supply (17)	ComH-ComL	-0.3 — +10.0	V	
Input voltage for digital system	Vin	- 0.3 — +0.3	V	
Operating ambient temperature	topr	-40 — +85	°C	
Storage temperature	tstr	-55 — +100	°C	

13. DC Characteristics

（Ta = Room temperature, VCC1 = 1.7 to 1.95V or 2.5V to 3.1 V, VDC = 2.5 to 3.1 V, VDD1=VDD2x2, VSS3=VDD2x (-3), VS=5V, VSS1 = 0 V）

*These values are for output voltages at VDC=2.8V. When VDC changes, these values also change accordingly.

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply voltage 1	VCC1		1.7		1.9	V
Power supply voltage 2	VCC1/VDC		2.5		3.3	V
VS output voltage	VS	No load (When set as VS=5V)	4.75 *	5.0 *	5.25 *	V
VR output voltage	VR	No load (When set as VR=2V)	1.9 *	2.0 *	2.1 *	V
V18 output voltage	V18	No load	1.8 *	2.0 *	2.2 *	V
VDD1 output voltage	VDD1	VDD2 step-up, 2x	VDD2 x 1.8		VDD2 x 2	V
		VDD2 step-up, 3x	VDD2 x 2.7		VDD2 x 3	
VDD2 output voltage	VDD2	VR step-up, 2x	VR x 1.8		VR x 2	V
VSS2 output voltage	VSS2	VDD2 step-up, −1x	VDD2x (-1)		VDD2 x (-0.9)	V
		VDD2 step-up, −2x	VDD2x (-2)		VDD2 x (-1.8)	
VSS3 output voltage	VSS3	VDD2 step-up, −2x	VDD2x (-2)		VDD2 x (-1.8)	V
		VDD2 step-up, −3x	VDD2x (-3)		VDD2 x (-2.7)	
VSS4 output voltage	VSS4	VDC step-up, -1x	VDC x (-1)		VDC x (-0.9)	
Grayscale reference voltage	VDHR	VS = VDHR=5V	4.75*	5.0*	5.25*	V
COMH output voltage	VCOMH	Amplitude 5.024V Center value 2.0078V	4.22*	4.5*	4.73*	V
COML output voltage	VCOML		-0.78*	-0.5*	-0.27*	V
Frequency of SYSCLK	SYSCLK		360	600	780	kHz
Input voltage for digital system “H”	Vih	Input voltage 2.5V ~ 3.3V	VCC1 x 0.8		VCC1	V
Input voltage for digital system “L”	Vil	Input voltage 2.5V ~ 3.3V	VSS1		VCC1 X 0.2	V
Operating current 1	I1 (VDC)	No-load, still picture VCC1 = VDC = 2.8V		600	880	μA
	I1 (VCC1)	No-load, still picture VCC1 = VDC = 2.8V		100	200	
Current at stand-by	I2			25	50	μA
Output resistance	Ron			3	6	kΩ

14. Note

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15. Revision History

15.1. Completely revised from Ver.0.72 to Ver.1.0

15.2 Revision from Ver.1.0 to Ver.1.1

Page	Ver.1.0	Ver.1.1
All	All items	Corrected any of the misspelled words and added missing words. No change to the content.
13	5. VCC1	Added, “We recommend that you connect a capacitor (capacity=over 1μF, withstand voltage=10V) between the pin and the ground.”
16	9.1. VD2ON: 0: Off The output is VCC1. VD1ON: 0: Off The output is VDC.	The output is VR. The output is VDD2.
17	9.2. VR≤ VDC—0. 5V	VR≤ VDC—0.15V
18	9.4. VS≤ VDD2—0. 5V	VS≤ VDD2 — 0. 15V. From DC characteristics of the IS2100, the value of VS/VDHR=3.5V is not permitted.
20	9.7. Limited range of VCOMH and VCOML	Added, VCOMH≤VDD2-0.3V, VCOML≥VSS4-0.3V.
20	9.7. Setting range: –1.50V to 0.5	Setting range: –2.00V to 0.5
24	10.4.1. VDD2=VDCx2	VDD2=VRX2
24	10.4.2. Configuration of the VDD1, VSS2, and VSS3 step-up	VDD1=VDD2x3 VSS2=VSS3=VDD2x(－2) VDD1=VDD2x2 VSS2=VSS3=VDD2x(－1) （Prohibited to use）
26	11.1.1. The simple sequence by the IS2100 serial sequence	（Prohibited to use.）
27	11.2. Power-on Sequence	Revised completely
28	13. VR Min. Typ. Max. 1.8 2.8	Min. Typ. Max. 1.8 2.0 2.2

15.3 Completely revised from Ver.1.0 to Ver.1.52

15.4. Revision from Version1.52.to Version1.6

Page	Version 1.52	Version 1.6
All	All items.	Corrected any of the misspelled words and added missing words. No change to the content.
4		Added (Note) in "2. Features." (Note) Substrate of the IS2200 is VSS3 (negative potential). Remind that substrate of IS2100 is VSS (GND potential).
17		Added comment (*) in "9.2 Power Supply Control Register 2". *These values are for output voltages at VDC=2.8V. When VDC changes, these values also change in proportion.
29		Revised the flow chart for power-on sequence in "11.1 Power-on sequence.
30		Added the flow chart for power-off sequence in "11.2 Power-off sequence.
31		Revised the values in "12. Absolute Maximum Ratings".

15.5. Revision from Version1.6 to Version1.61

Page	Version 1.52	Version 1.61
All	All items.	Corrected any of the misspelled words and added missing words. Changed layout. No changes to the content.
31		Revised "12. Absolute Maximum Ratings". Deleted VR1-GND/VR2-GND. Added VR-GND.