



# LC4100C

## LCD Dot Matrix Common Driver for STN Displays

### Overview

The LC4100C is a common driver for large-scale dot matrix LCD panels. It includes a 240-bit bidirectional shift register and 4-level LCD driver circuits. The number of bits can be further increased by using the provided input and output pins to connect multiple LC4100Cs in cascade. The LC4100C and LC4101C form a large-screen LCD panel driver chip set.

### Features

- Fabricated in a CMOS (P-sub) high-voltage process.
- LCD drive voltage: 36 V
- Logic system power-supply voltage: 3.0 to 5.5 V
- $f_{load}$  max: 1 MHz
- Slim chip (output pads are concentrated on one of the longer sides)
- 240 outputs (pad pitch: 70  $\mu$ m)
- Bidirectional shift register
- The shift register can be split into two 120-bit registers.
- DISPOFF function that locks the drive voltages output to the LCD at fixed levels.
- Display duty: 1/160 to 1/480

### Specifications

**Absolute Maximum Ratings at  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ , standard  $V_{SS}$ ,  $V_{EE1} = V_{EE1}$  or  $V_{EE2}$ ,  $V_{SS1} = V_{SS1}$  or  $V_{SS2}$**

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	$V_{DD}$		-0.3 to +7	V
	$V_{EE1}$		-0.3 to +40	V
	$V_{SS1}$		-0.3 to +0.3	V
Input voltage	$V_{IN}$	LOAD, L/R, DISP, DF, EIO1, EIO3, EIO4	-0.3 to $V_{DD} + 0.3$	V
	$V_0, V_1$		$V_{EE} - 7$ to $V_{DD} + 0.3$	V
	$V_4$		-0.3 to $V_{SS} + 7$	V
	$V_5$		-0.3 to +0.3	V
Operating temperature	$T_{opr}$		-20 to +75	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-55 to +125	$^\circ\text{C}$

Note: The voltages  $V_1$ ,  $V_2$ ,  $V_3$ ,  $V_4$ , and  $V_5$  must obey the relationships  $V_{EE1} + 0.3 \geq V_0 \geq V_1 \geq V_{EE} - 7$ , and  $7 \geq V_4 \geq V_5 \geq V_{SS1} - 0.3$ . (Unit: V)

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### Allowable Operating Ranges at Ta = -20 to +75°C, standard V<sub>SS</sub>, V<sub>EE1</sub> = V<sub>EE1</sub> or V<sub>EE2</sub>, V<sub>SS1</sub> = V<sub>SS1</sub> or V<sub>SS2</sub>

Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Supply voltage		V <sub>DD</sub>		3.0		5.5	V
		V <sub>EE1</sub>		20		36	V
		V <sub>SS1</sub>			0		V
Input high-level voltage		V <sub>IH</sub>	LOAD, L/R, DISP, DF, EIO1, EIO3, EIO4	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V
Input low-level voltage		V <sub>IL</sub>	LOAD, L/R, DISP, DF, EIO1, EIO3, EIO4	0		0.2 V <sub>DD</sub>	V
Input voltage		V <sub>0</sub> , V <sub>1</sub>	V <sub>0</sub> , V <sub>1</sub>	V <sub>EE1</sub> - 7		V <sub>EE1</sub>	V
		V <sub>4</sub>	V <sub>4</sub>	0		V <sub>EE1</sub> + 7	V
		V <sub>5</sub>	V <sub>5</sub>		0		V
V <sub>DD</sub> = 5 V ± 10%	Clock frequency	f <sub>load</sub>	LOAD			1	MHz
	High-level clock pulse width	t <sub>w (ldh)</sub>	LOAD	50			ns
	EIO input setup time	t <sub>su (ei)</sub>	LOAD, EIO1, EIO3, EIO4	100			ns
	EIO input hold time	t <sub>ho (ei)</sub>	LOAD, EIO1, EIO3, EIO4	30			ns
V <sub>DD</sub> = 3 to 4.5 V	Clock frequency	f <sub>load</sub>	LOAD			200	kHz
	High-level clock pulse width	t <sub>w (ldh)</sub>	LOAD	120			ns
	EIO input setup time	t <sub>su (ei)</sub>	LOAD, EIO1, EIO3, EIO4	120			ns
	EIO input hold time	t <sub>ho (ei)</sub>	LOAD, EIO1, EIO3, EIO4	40			ns

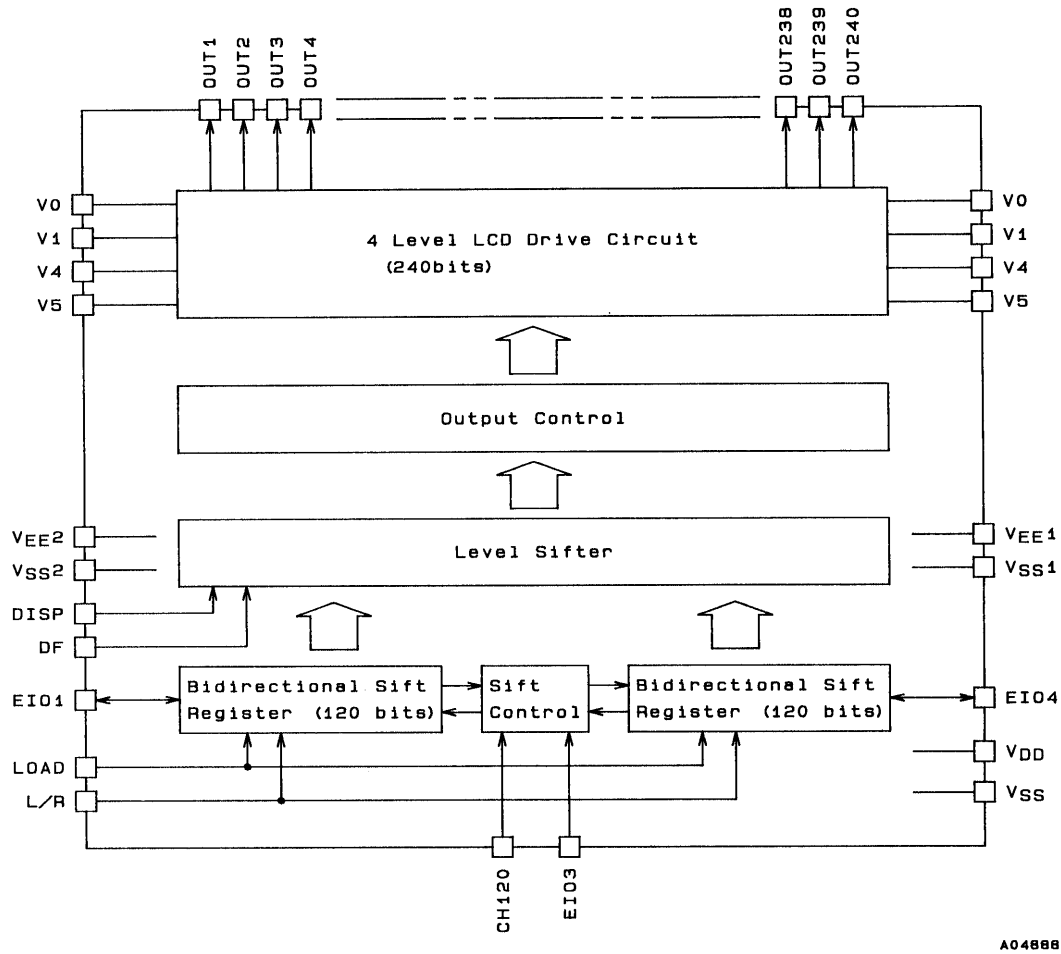
Note: 1. The voltages V<sub>1</sub>, V<sub>2</sub>, V<sub>3</sub>, V<sub>4</sub>, and V<sub>5</sub> must obey the relationships V<sub>EE1</sub> ≥ V<sub>0</sub> ≥ V<sub>1</sub> ≥ V<sub>EE</sub> - 7, and 7 ≥ V<sub>4</sub> ≥ V<sub>5</sub> ≥ V<sub>SS1</sub>. (Unit: V)  
 2. When turning on the power supplies, first turn on the logic system power supply and then turn on the high-voltage system power supply; alternatively, turn both on at the same time.  
 When turning off the power supplies, first turn off the high-voltage system power supply and then turn off the logic system power supply; alternatively, turn both off at the same time.

### Electrical Characteristics at Ta = -20 to +75°C, standard V<sub>SS</sub>, V<sub>DD</sub> = 3 to 5.5 V

Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Input high-level current		I <sub>IH</sub>	V <sub>IN</sub> = V <sub>DD</sub> : LOAD, L/R, DISP, DF, EIO1, EIO3, EIO4			1	μA
Input low-level current		I <sub>IL</sub>	V <sub>IN</sub> = V <sub>SS</sub> : LOAD, L/R, DISP, DF, EIO1, EIO3, EIO4	-1			μA
Output high-level voltage		V <sub>OH</sub>	I <sub>O</sub> = -0.4 mA: EIO1, EIO4	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V
Output low-level voltage		V <sub>OL</sub>	I <sub>O</sub> = 0.4 mA: EIO1, EIO4	V <sub>SS</sub>		0.2 V <sub>DD</sub>	V
Output on resistance		R <sub>OUT</sub>	V <sub>EE1</sub> , V <sub>EE2</sub> = 20 V, V <sub>0</sub> = 20 V, V <sub>0</sub> - V <sub>0</sub> = 0.5 V, V <sub>1</sub> = 20 V, V <sub>1</sub> - V <sub>0</sub> = 0.5 V, V <sub>4</sub> = 0 V, V <sub>0</sub> - V <sub>4</sub> = 0.5 V, V <sub>5</sub> = 0 V, V <sub>0</sub> - V <sub>5</sub> = 0.5 V: OUT1 to OUT240		0.3	0.6	kΩ
Current drain (1)		I <sub>DD</sub>	V <sub>DD</sub> = 3 to 5.5 V, f <sub>cp</sub> = 50 kHz, f <sub>DF</sub> = 100 Hz, with no output load			300	μA
Current drain (2)		I <sub>EE</sub>	V <sub>EE1</sub> = 36 V, 1 data shift			750	μA

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### Block Diagram



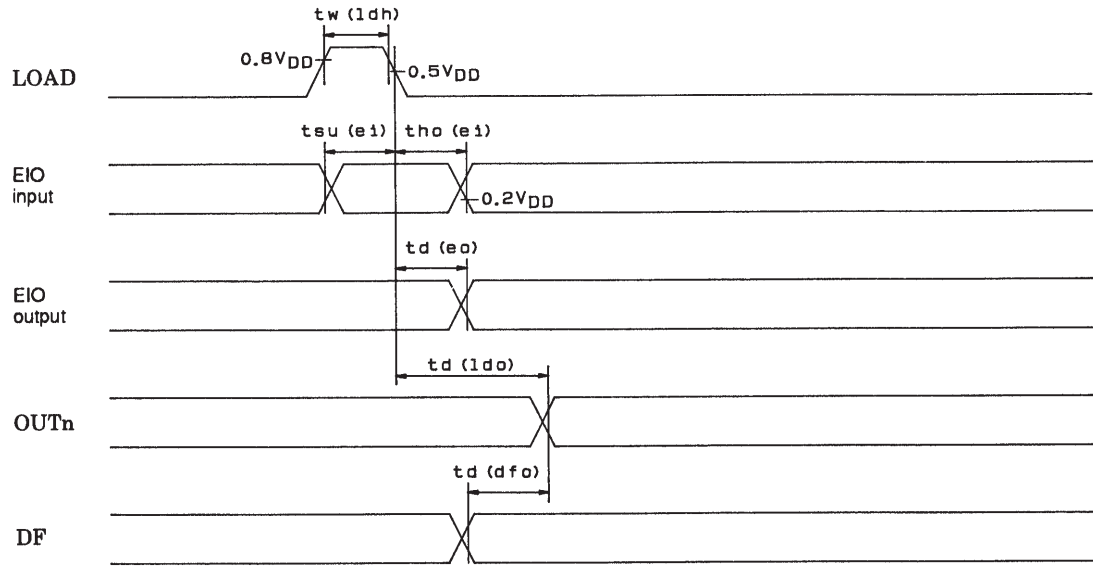
### Switching Characteristics at $V_{DD} = 5\text{ V} \pm 10\%$ , $T_a = -20\text{ to }+75^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
EIO output delay time	$t_{d(eo)}$	30 pF capacitance load: LOAD, EIO1, EIO4			180	ns
LOAD-OUTn delay time	$t_{d(ldo)}$	100 pF capacitance load: LOAD, OUTn			700	ns
DF-OUTn delay time	$t_{d(dfo)}$	100 pF capacitance load: DF, OUTn			1.2	$\mu\text{s}$

### Switching Characteristics at $V_{DD} = 3\text{ to }4.5\text{ V}$ , $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
EIO output delay time	$t_{d(eo)}$	30 pF capacitance load: LOAD, EIO1, EIO4			350	ns
LOAD-OUTn delay time	$t_{d(ldo)}$	100 pF capacitance load: LOAD, OUTn			3	$\mu\text{s}$
DF-OUTn delay time	$t_{d(dfo)}$	100 pF capacitance load: DF, OUTn			3	$\mu\text{s}$

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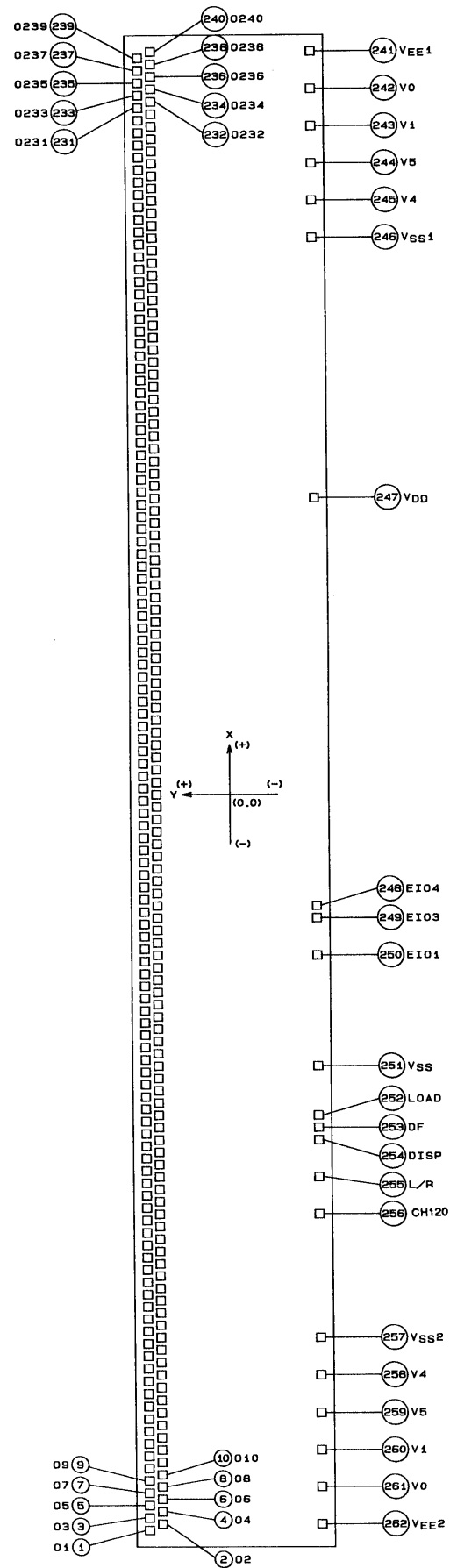


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## Pin Functions

Symbol	I/O	Function																								
OUT1 to OUT240	O	LCD drive outputs																								
		<table><tr><td>DF</td><td>Data</td><td>DISP</td><td>OUTn</td></tr><tr><td>0</td><td>1</td><td>1</td><td>V<sub>0</sub></td></tr><tr><td>1</td><td>0</td><td>1</td><td>V<sub>1</sub></td></tr><tr><td>0</td><td>0</td><td>1</td><td>V<sub>4</sub></td></tr><tr><td>1</td><td>1</td><td>1</td><td>V<sub>5</sub></td></tr><tr><td>*</td><td>*</td><td>0</td><td>V<sub>5</sub></td></tr></table>	DF	Data	DISP	OUTn	0	1	1	V <sub>0</sub>	1	0	1	V <sub>1</sub>	0	0	1	V <sub>4</sub>	1	1	1	V <sub>5</sub>	*	*	0	V <sub>5</sub>
		DF	Data	DISP	OUTn																					
		0	1	1	V <sub>0</sub>																					
		1	0	1	V <sub>1</sub>																					
		0	0	1	V <sub>4</sub>																					
1	1	1	V <sub>5</sub>																							
*	*	0	V <sub>5</sub>																							
Note: * don't care (0 or 1). These values must be fixed at either 0 or 1.																										
V <sub>0</sub>	I	<div><div>V<sub>0</sub> level drive voltage input</div><div>V<sub>1</sub> level drive voltage input</div><div>V<sub>4</sub> level drive voltage input</div><div>V<sub>5</sub> level drive voltage input</div><div>}</div><div>All pins with the same name must be set to the same potential.</div></div>																								
V <sub>1</sub>	I																									
V <sub>4</sub>	I																									
V <sub>5</sub>	I																									
V <sub>EE1</sub> /V <sub>EE2</sub>	—	High-voltage block power supply. V <sub>EE1</sub> and V <sub>EE2</sub> must have the same potential.																								
V <sub>SS1</sub> /V <sub>SS2</sub>	—	High-voltage block ground. V <sub>SS1</sub> and V <sub>SS2</sub> must have the same potential.																								
DISP	I	All outputs will be held at a fixed V <sub>5</sub> level when this pin is low.																								
DF	I	Alternation input																								
LOAD	I	Data shift pulse input (falling edge)																								
L/R	I	Data shift direction specification input																								
CH120	I	High: 120 × 2, low: 240 × 1																								
EIO1 EIO3 EIO4	I/O  I  I/O	Enable inputs and outputs																								
		<table><tr><th>L/R</th><th>CH120</th><th>Shift direction</th></tr><tr><td>H</td><td>L</td><td>EIO1 → OUT1 → → OUT240 → EIO4</td></tr><tr><td>H</td><td>H</td><td>EIO1 → OUT1 → → OUT120 EIO3 → OUT121 → → OUT240 → EIO4</td></tr><tr><td>L</td><td>L</td><td>EIO1 ← OUT1 ← ← OUT240 ← EIO4</td></tr><tr><td>L</td><td>H</td><td>EIO1 ← OUT1 ← ← OUT120 ← EIO3 OUT121 ← ← OUT240 ← EIO4</td></tr></table>	L/R	CH120	Shift direction	H	L	EIO1 → OUT1 → → OUT240 → EIO4	H	H	EIO1 → OUT1 → → OUT120 EIO3 → OUT121 → → OUT240 → EIO4	L	L	EIO1 ← OUT1 ← ← OUT240 ← EIO4	L	H	EIO1 ← OUT1 ← ← OUT120 ← EIO3 OUT121 ← ← OUT240 ← EIO4									
		L/R	CH120	Shift direction																						
		H	L	EIO1 → OUT1 → → OUT240 → EIO4																						
		H	H	EIO1 → OUT1 → → OUT120 EIO3 → OUT121 → → OUT240 → EIO4																						
		L	L	EIO1 ← OUT1 ← ← OUT240 ← EIO4																						
L	H	EIO1 ← OUT1 ← ← OUT120 ← EIO3 OUT121 ← ← OUT240 ← EIO4																								
V <sub>DD</sub>	—	Logic system power supply																								
V <sub>SS</sub>	—	Logic system ground																								

Pad Assignment



Chip size: 17.20 mm x 2.15 mm  
Chip thickness: 330 μm ± 20 μm

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### Pad Coordinates

Pad No.	Signal	X coordinate	Y coordinate	Pad No.	Signal	X coordinate	Y coordinate
1	OUT1	-8365	897	51	OUT51	-4865	897
2	OUT2	-8295	727	52	OUT52	-4795	727
3	OUT3	-8225	897	53	OUT53	-4725	897
4	OUT4	-8155	727	54	OUT54	-4655	727
5	OUT5	-8085	897	55	OUT55	-4585	897
6	OUT6	-8015	727	56	OUT56	-4515	727
7	OUT7	-7945	897	57	OUT57	-4445	897
8	OUT8	-7875	727	58	OUT58	-4375	727
9	OUT9	-7805	897	59	OUT59	-4305	897
10	OUT10	-7735	727	60	OUT60	-4235	727
11	OUT11	-7665	897	61	OUT61	-4165	897
12	OUT12	-7595	727	62	OUT62	-4095	727
13	OUT13	-7525	897	63	OUT63	-4025	897
14	OUT14	-7455	727	64	OUT64	-3955	727
15	OUT15	-7385	897	65	OUT65	-3885	897
16	OUT16	-7315	727	66	OUT66	-3815	727
17	OUT17	-7245	897	67	OUT67	-3745	897
18	OUT18	-7175	727	68	OUT68	-3675	727
19	OUT19	-7105	897	69	OUT69	-3605	897
20	OUT20	-7035	727	70	OUT70	-3535	727
21	OUT21	-6965	897	71	OUT71	-3465	897
22	OUT22	-6895	727	72	OUT72	-3395	727
23	OUT23	-6825	897	73	OUT73	-3325	897
24	OUT24	-6755	727	74	OUT74	-3255	727
25	OUT25	-6685	897	75	OUT75	-3185	897
26	OUT26	-6615	727	76	OUT76	-3115	727
27	OUT27	-6545	897	77	OUT77	-3045	897
28	OUT28	-6475	727	78	OUT78	-2975	727
29	OUT29	-6405	897	79	OUT79	-2905	897
30	OUT30	-6335	727	80	OUT80	-2835	727
31	OUT31	-6265	897	81	OUT81	-2765	897
32	OUT32	-6195	727	82	OUT82	-2695	727
33	OUT33	-6125	897	83	OUT83	-2625	897
34	OUT34	-6055	727	84	OUT84	-2555	727
35	OUT35	-5985	897	85	OUT85	-2485	897
36	OUT36	-5915	727	86	OUT86	-2415	727
37	OUT37	-5845	897	87	OUT87	-2345	897
38	OUT38	-5775	727	88	OUT88	-2275	727
39	OUT39	-5705	897	89	OUT89	-2205	897
40	OUT40	-5635	727	90	OUT90	-2135	727
41	OUT41	-5565	897	91	OUT91	-2065	897
42	OUT42	-5495	727	92	OUT92	-1995	727
43	OUT43	-5425	897	93	OUT93	-1925	897
44	OUT44	-5355	727	94	OUT94	-1855	727
45	OUT45	-5285	897	95	OUT95	-1785	897
46	OUT46	-5215	727	96	OUT96	-1715	727
47	OUT47	-5145	897	97	OUT97	-1645	897
48	OUT48	-5075	727	98	OUT98	-1575	727
49	OUT49	-5005	897	99	OUT99	-1505	897
50	OUT50	-4935	727	100	OUT100	-1435	727

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Pad No.	Signal	X coordinate	Y coordinate	Pad No.	Signal	X coordinate	Y coordinate
101	OUT101	-1365	897	151	OUT151	2135	897
102	OUT102	-1295	727	152	OUT152	2205	727
103	OUT103	-1225	897	153	OUT153	2275	897
104	OUT104	-1155	727	154	OUT154	2345	727
105	OUT105	-1085	897	155	OUT155	2415	897
106	OUT106	-1015	727	156	OUT156	2485	727
107	OUT107	-945	897	157	OUT157	2555	897
108	OUT108	-875	727	158	OUT158	2625	727
109	OUT109	-805	897	159	OUT159	2695	897
110	OUT110	-735	727	160	OUT160	2765	727
111	OUT111	-665	897	161	OUT161	2835	897
112	OUT112	-595	727	162	OUT162	2905	727
113	OUT113	-525	897	163	OUT163	2975	897
114	OUT114	-455	727	164	OUT164	3045	727
115	OUT115	-385	897	165	OUT165	3115	897
116	OUT116	-315	727	166	OUT166	3185	727
117	OUT117	-245	897	167	OUT167	3255	897
118	OUT118	-175	727	168	OUT168	3325	727
119	OUT119	-105	897	169	OUT169	3395	897
120	OUT120	-35	727	170	OUT170	3465	727
121	OUT121	35	897	171	OUT171	3535	897
122	OUT122	105	727	172	OUT172	3605	727
123	OUT123	175	897	173	OUT173	3675	897
124	OUT124	245	727	174	OUT174	3745	727
125	OUT125	315	897	175	OUT175	3815	897
126	OUT126	385	727	176	OUT176	3885	727
127	OUT127	455	897	177	OUT177	3955	897
128	OUT128	525	727	178	OUT178	4025	727
129	OUT129	595	897	179	OUT179	4095	897
130	OUT130	665	727	180	OUT180	4165	727
131	OUT131	735	897	181	OUT181	4235	897
132	OUT132	805	727	182	OUT182	4305	727
133	OUT133	875	897	183	OUT183	4375	897
134	OUT134	945	727	184	OUT184	4445	727
135	OUT135	1015	897	185	OUT185	4515	897
136	OUT136	1085	727	186	OUT186	4585	727
137	OUT137	1155	897	187	OUT187	4655	897
138	OUT138	1225	727	188	OUT188	4725	727
139	OUT139	1295	897	189	OUT189	4795	897
140	OUT140	1365	727	190	OUT190	4865	727
141	OUT141	1435	897	191	OUT191	4935	897
142	OUT142	1505	727	192	OUT192	5005	727
143	OUT143	1575	897	193	OUT193	5075	897
144	OUT144	1645	727	194	OUT194	5145	727
145	OUT145	1715	897	195	OUT195	5215	897
146	OUT146	1785	727	196	OUT196	5285	727
147	OUT147	1855	897	197	OUT197	5355	897
148	OUT148	1925	727	198	OUT198	5425	727
149	OUT149	1995	897	199	OUT199	5495	897
150	OUT150	2065	727	200	OUT200	5565	727

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Pad No.	Signal	X coordinate	Y coordinate	Pad No.	Signal	X coordinate	Y coordinate
201	OUT201	5635	897	232	OUT232	7805	727
202	OUT202	5705	727	233	OUT233	7875	897
203	OUT203	5775	897	234	OUT234	7945	727
204	OUT204	5845	727	235	OUT235	8015	897
205	OUT205	5915	897	236	OUT236	8085	727
206	OUT206	5985	727	237	OUT237	8155	897
207	OUT207	6055	897	238	OUT238	8225	727
208	OUT208	6125	727	239	OUT239	8295	897
209	OUT209	6195	897	240	OUT240	8365	727
210	OUT210	6265	727	241	V <sub>EE1</sub>	8295	-886
211	OUT211	6335	897	242	V <sub>0</sub>	7895	-863
212	OUT212	6405	727	243	V <sub>1</sub>	7495	-859
213	OUT213	6475	897	244	V <sub>5</sub>	7095	-859
214	OUT214	6545	727	245	V <sub>4</sub>	6695	-859
215	OUT215	6615	897	246	V <sub>SS1</sub>	6295	-859
216	OUT216	6685	727	247	V <sub>DD</sub>	3295	-870
217	OUT217	6755	897	248	EIO4	-1295	-870
218	OUT218	6825	727	249	EIO3	-1495	-870
219	OUT219	6895	897	250	EIO1	-1895	-870
220	OUT220	6965	727	251	V <sub>SS</sub>	-3095	-887
221	OUT221	7035	897	252	LOAD	-3695	-870
222	OUT222	7105	727	253	DF	-3895	-870
223	OUT223	7175	897	254	DISP	-4095	-870
224	OUT224	7245	727	255	L/R	-4495	-870
225	OUT225	7315	897	256	CH120	-4895	-870
226	OUT226	7385	727	257	V <sub>SS2</sub>	-6295	-859
227	OUT227	7455	897	258	V <sub>4</sub>	-6695	-859
228	OUT228	7525	727	259	V <sub>5</sub>	-7095	-859
229	OUT229	7595	897	260	V <sub>1</sub>	-7495	-859
230	OUT230	7665	727	261	V <sub>0</sub>	-7895	-863
231	OUT231	7735	897	262	V <sub>EE2</sub>	-8295	-886

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