
HD66137T

High-Voltage Durable 240-Channel Common Driver
for Dot-Matrix STN LCD

HITACHI

ADE-207-291(Z)

Rev. 2

Aug. 03, 1999

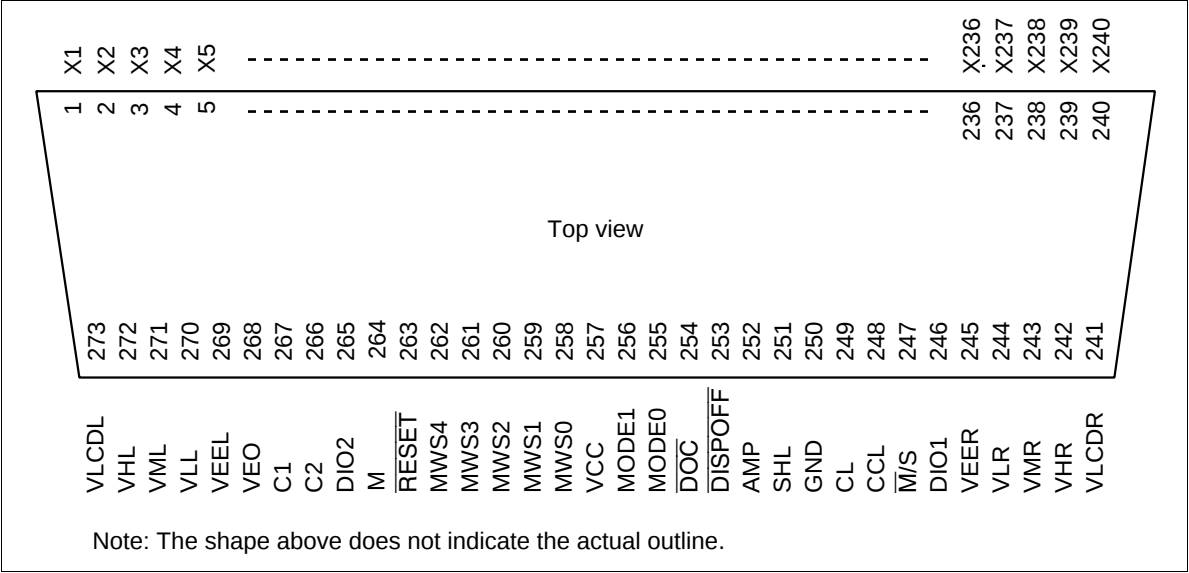
Description

The HD 66137T is a 240-channel common driver which drives a dot matrix STN LCD panel. By changing the mode, this can be applied to 240- and 200- and 160- channel output. Through the use of a 43-V high-voltage CMOS process technology, a high-voltage drive of +21.5 V and -21.5 V, centering on VM is possible. -21.5V generated from +21.5 V with built-in switching circuit and external capacity. Low logic-drive voltage (3 V) is used. This device is used together with the segment driver HD66130, HD66134ST or HD66136.

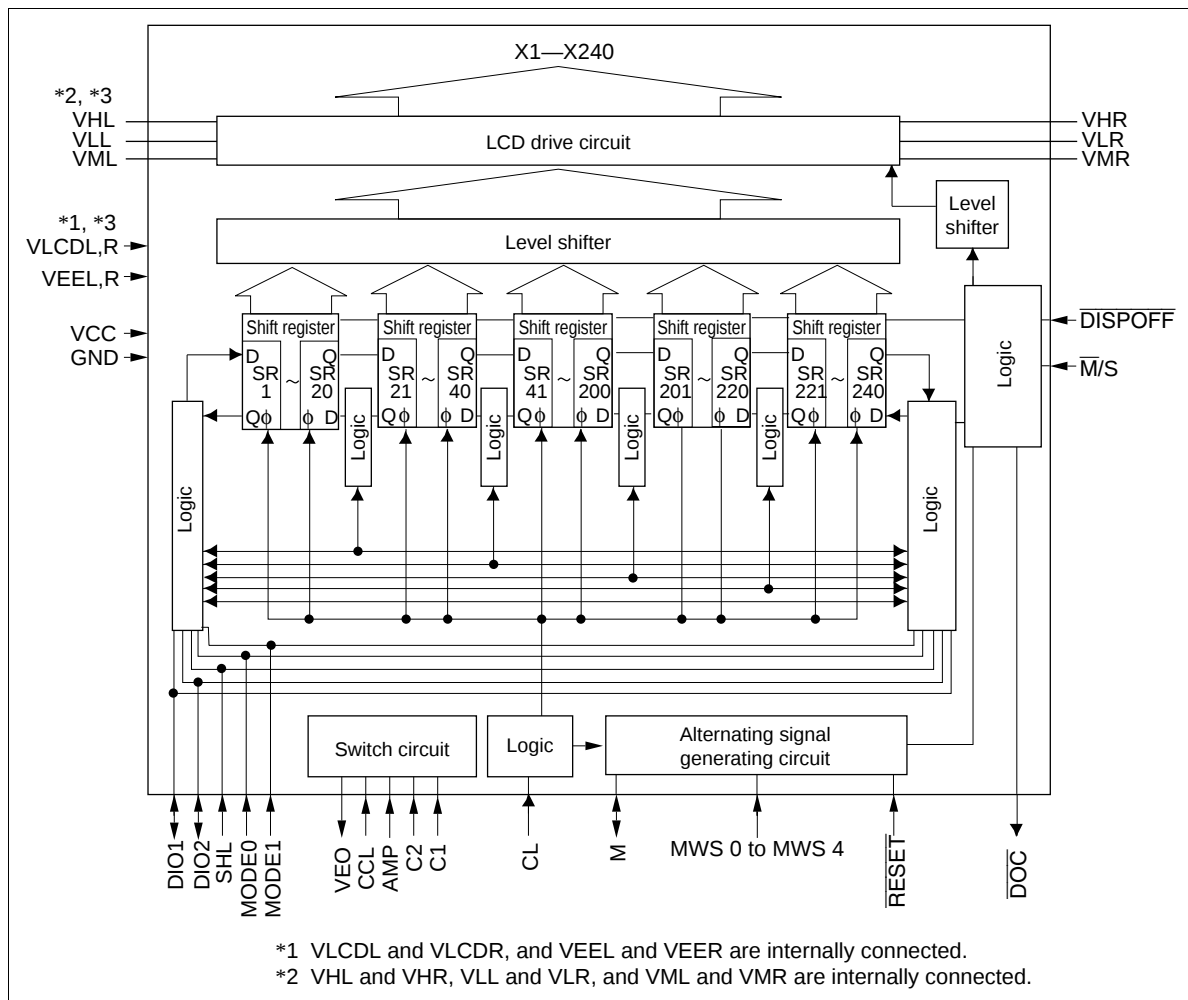
Features

- Display duty: Up to 1/240
- LCD drive voltage: 43 V max
- Built-in switching circuit (to generate -21.5 V)
- Number of LCD drive circuit: 240
- Operating voltage: 2.5 to 5.5 V
- Intermediate voltage I/F
- Built-in alternating signal generation circuit Pin programmable
- Output mode change: 240-output mode
200-output mode
160-output mode
- Built-in display-off function
- Flex TCP

Pin Arrangement



Block Diagram



Internal Block Diagram

1. LCD drive Circuit

This circuit selects and outputs the three level signals for the LCD drive. By a combination of the data in the shift register and M, either VH, VL, or VM is selected and transmitted to the output circuit.

2. Level shifter

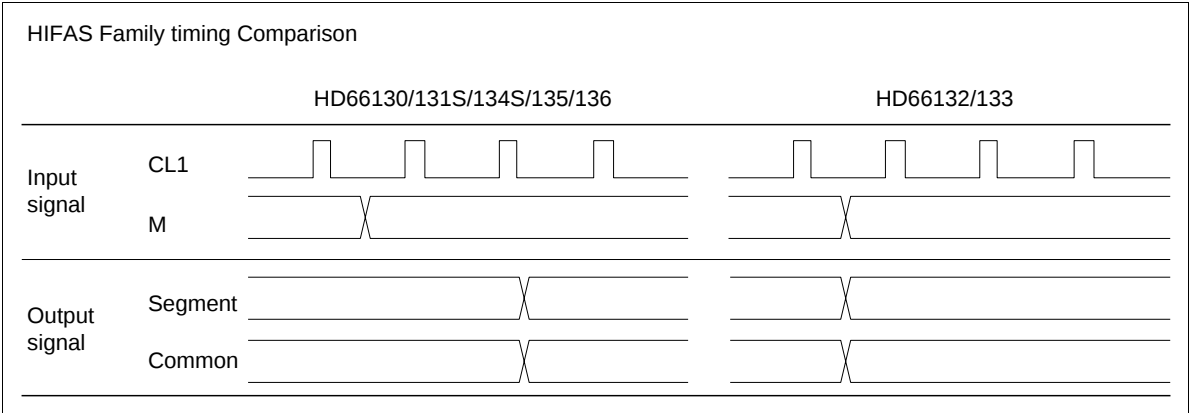
This boosts a 5-V signal to a high-voltage signal for LCD drive.

3. Shift register

This is a 240-bit bidirectional shift register circuit. The first line marker signal output from the DIO1 pin and DIO2 pin is sequentially shifted by shift clock CL. The shift direction is determined by the SHL pin.

4. Alternating signal generating circuit

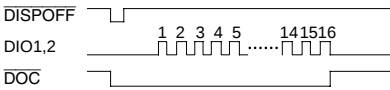
This circuit generates an alternating signal (M signal) for LCD display. To suppress cross-talk, the signal is alternated in a unit from several lines to several tens of lines. By connecting MWS0 to MWS4 pins to V_{CC} or GND, the desired number of signals can be alternated. When alternating signals are externally input, all pins (MWS0 to MWS4) are connected to GND.



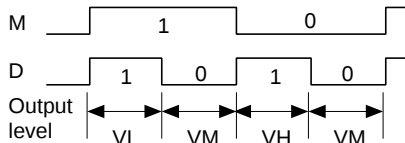
Pin Function

Classification	Symbol	Pin No.	Connected to	I/O	Functions																																																									
Power supply	VLCDL, R	273, 241	Power supply	—	VLCDL, R–VEEL, R : Power supply for LCD drive																																																									
	VEEL, R	269, 245			VLCDL, R : Power supply for switch circuit																																																									
	V _{CC} , R	257	Power supply	Input	V _{CC} –GND : Power supply for logic circuit																																																									
	GND	250																																																												
	VHL, R	272, 242			Power supply for LCD drive level																																																									
VLL, R	270, 244	Power supply	Input	VHL, R : Selected level (Set to the same voltage as VLCDL, R.)																																																										
VML, R	271, 243			VLL, R : Selected level (Set to the same voltage as VEEL, R.)																																																										
					VML, R : Non-selected level and Power supply for switch circuit																																																									
	VEO	268	VEEL, R	output	When use built -in switching circuit and generate VEE, VEO pin connect to VEEL, R pins. VM voltage is point of reference and reversed and output the voltage input to the voltage between VLCD and VM. If built-in switching circuit is not used, don't connect any lines to this pin.																																																									
	C1, C2	267, 266	Capacitance	—	External capacitance should be connected here when using the switch circuit for generate VEE. If built-in switching circuit is not used, don't connect any lines to this pin.																																																									
Control signal	CL	249	MPU	Input	Shift clock input. Data is shifted at the falling edge of shift clock CL of the shift register.																																																									
	M	264	Extension driver or MPU	I/O	Inputs or outputs the alternating current for LCD drive output.																																																									
	MWS0	258	—	Input	This pin specifies the cycle of the alternating signal (M signal) in the unit of the number of lines. The number of lines, which is an integer from 2 to 31, is specified as follows. Usually, specify the number of lines within a range from 10 to 31. When the HD66131T is driven by an external alternating signal, specify the number of lines as zero.																																																									
	MWS1	259																																																												
	MWS2	260																																																												
	MWS3	261																																																												
	MWS4	262																																																												
						<table><tr><th>Number of lines</th><th>MWS4</th><th>MWS3</th><th>MWS2</th><th>MWS1</th><th>MWS0</th><th>Line alternating waveform</th><th>M-pin status</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>—</td><td>Input</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>Prohibited</td><td>Output</td></tr><tr><td>2</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>2 lines alternated</td><td></td></tr><tr><td>3</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>3 lines alternated</td><td></td></tr><tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td></td></tr><tr><td>31</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>31 lines alternated</td><td></td></tr></table>	Number of lines	MWS4	MWS3	MWS2	MWS1	MWS0	Line alternating waveform	M-pin status	0	0	0	0	0	0	—	Input	1	0	0	0	0	1	Prohibited	Output	2	0	0	0	1	0	2 lines alternated		3	0	0	0	1	1	3 lines alternated		⋮	⋮	⋮	⋮	⋮	⋮	⋮		31	1	1	1	1	1	31 lines alternated	
	Number of lines	MWS4	MWS3	MWS2	MWS1	MWS0	Line alternating waveform	M-pin status																																																						
	0	0	0	0	0	0	—	Input																																																						
1	0	0	0	0	1	Prohibited	Output																																																							
2	0	0	0	1	0	2 lines alternated																																																								
3	0	0	0	1	1	3 lines alternated																																																								
⋮	⋮	⋮	⋮	⋮	⋮	⋮																																																								
31	1	1	1	1	1	31 lines alternated																																																								

Pin Functions (cont)

Classification	Symbol	Pin No.	Connected to	I/O	Function	
Control signal	MODE0	256	—	Input	Switch terminals for the number of LCD drive output pins.	
	MODE1	256				
	MODE0 MODE1 Shift direction					
	"H"	"H"				240 - output (X1, X2, X3.....X238, X239, X240)
	"H"	"L"				200 - output (X21, X22, X23.....X218, X219, X220)
	"L"	"H"	160 - output (X41, X42, X43.....X198, X199, X200)			
	"L"	"L"	Prohibited			
	DIO1	246	Extension driver or MPU	I/O	Serial data input output pin	
	DIO2	265				
SHL DIO1 DIO2						
	"H" level		serial output pin	serial input pin		
	"L" level		seiral input pin	seiral output pin		
CCL	248	MPU	Input	Built-in switching circuit clock input. When use built-in switching circuit and generate V _{EE} , this pin connect CL pin. If built-in switching circuit is not used, CCL must be fixed to GND		
AMP	252	—	Input	Built-in swiching circuit on-off control. When use built-in switching circuit, this pin must be fixed to V _{CC} . If built-in switching circuit is not used, this pin must be fixed to GND		
RESET	263	MPU or V _{CC}	Input	Setting this pin to GND sets initializes the alternating signal (M signal) circuit. A V _{CC} level RESET is normally used.		
DISPOFF	253	MPU	Input	Setting this pin to GND sets LCD drive output X1 to X240 to the VM level.		
M/S	247	—	Input	Controls the display-off function, and display-off signal output from DOC pin.		
					M/S DISPOFF pin state and functions	
					"H" level When DISPOFF is Low level, X1-240 set VM level	
					"L" level Until serial data input 16 times X1-X240 set VM level	
DOC	254	—	Output	M/S DOC		
					"H" level When DISPOFF is Low level, output low level When DISPOFF is High level, output High level	
					"L" level Until serial data input 16 times output low level from DOC pin	
						
					When using M/S is low level, DOC pin should be connect to SEG LSI Dispoff control pin.	

Pin Functions (cont)

Classification	Symbol	Pin No.	Connected to	I/O	Function																																
Control signal	SHL	251	—	Input	This pin switches shift directions. <table><tr><th>SHL</th><th>MODE0</th><th>MODE1</th><th>Shift direction</th></tr><tr><td>"H"</td><td></td><td></td><td>Right shift</td></tr><tr><td rowspan="3">level</td><td>"H"</td><td>"H"</td><td>DIO2→SR1.....SR240→DIO1</td></tr><tr><td>"H"</td><td>"L"</td><td>DIO2→SR21.....SR220→DIO1</td></tr><tr><td>"L"</td><td>"H"</td><td>DIO2→SR41.....SR200→DIO1</td></tr><tr><td>"L"</td><td></td><td></td><td>Left shift</td></tr><tr><td rowspan="3">level</td><td>"H"</td><td>"H"</td><td>DIO1→SR240.....SR1→DIO2</td></tr><tr><td>"H"</td><td>"L"</td><td>DIO1→SR220.....SR21→DIO2</td></tr><tr><td>"L"</td><td>"H"</td><td>DIO1→SR200.....SR41→DIO2</td></tr></table> SR1, SR2...SR240 correspond to X1, X2...X240. Note: The 40 or 80 pins invalidated at the 200-output or 160-output mode output the non-selected level synchronized every time; release these pins.	SHL	MODE0	MODE1	Shift direction	"H"			Right shift	level	"H"	"H"	DIO2→SR1.....SR240→DIO1	"H"	"L"	DIO2→SR21.....SR220→DIO1	"L"	"H"	DIO2→SR41.....SR200→DIO1	"L"			Left shift	level	"H"	"H"	DIO1→SR240.....SR1→DIO2	"H"	"L"	DIO1→SR220.....SR21→DIO2	"L"	"H"	DIO1→SR200.....SR41→DIO2
SHL	MODE0	MODE1	Shift direction																																		
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level	"H"	"H"	DIO2→SR1.....SR240→DIO1																																		
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	"L"	"H"	DIO2→SR41.....SR200→DIO1																																		
"L"			Left shift																																		
level	"H"	"H"	DIO1→SR240.....SR1→DIO2																																		
	"H"	"L"	DIO1→SR220.....SR21→DIO2																																		
	"L"	"H"	DIO1→SR200.....SR41→DIO2																																		
LCD drive output	X1 to X240	1 to 240	LCD	Output	LCD drive output By a combination of the display data and the M signal, when DISPOFF is set to V_{CC}, either VH, VL, or VM is selected and transmitted to the output circuit. 																																

Note: Configuring the LCD panel using the HD66137 when using the select SEGMENT driver.

The Select SEGMENT driver

SEGMENT driver	Select
HD66130 (320 OUT)	○
HD66132 (240 OUT)	×
HD66134S (240 OUT)	○
HD66136 (400 OUT)	○

Application Example

Application Example (1)

Figure 1 shows an application example 640×3 (collar) $\times 240$ dot Half VGA Size STN color panel.

This panel configured HD66137 $\times$ 1 piece and HD66136 $\times$ 5 pieces.

HD66137 generates M signal and DOC signal. M signal pin is connected M signal pin of HD66136 and DOC signal pin is connected DISP signal pin of HD66136.

HD66137 is able to generate voltage by external capacitor.

VEO pin is connected VEE pin and VL pin.

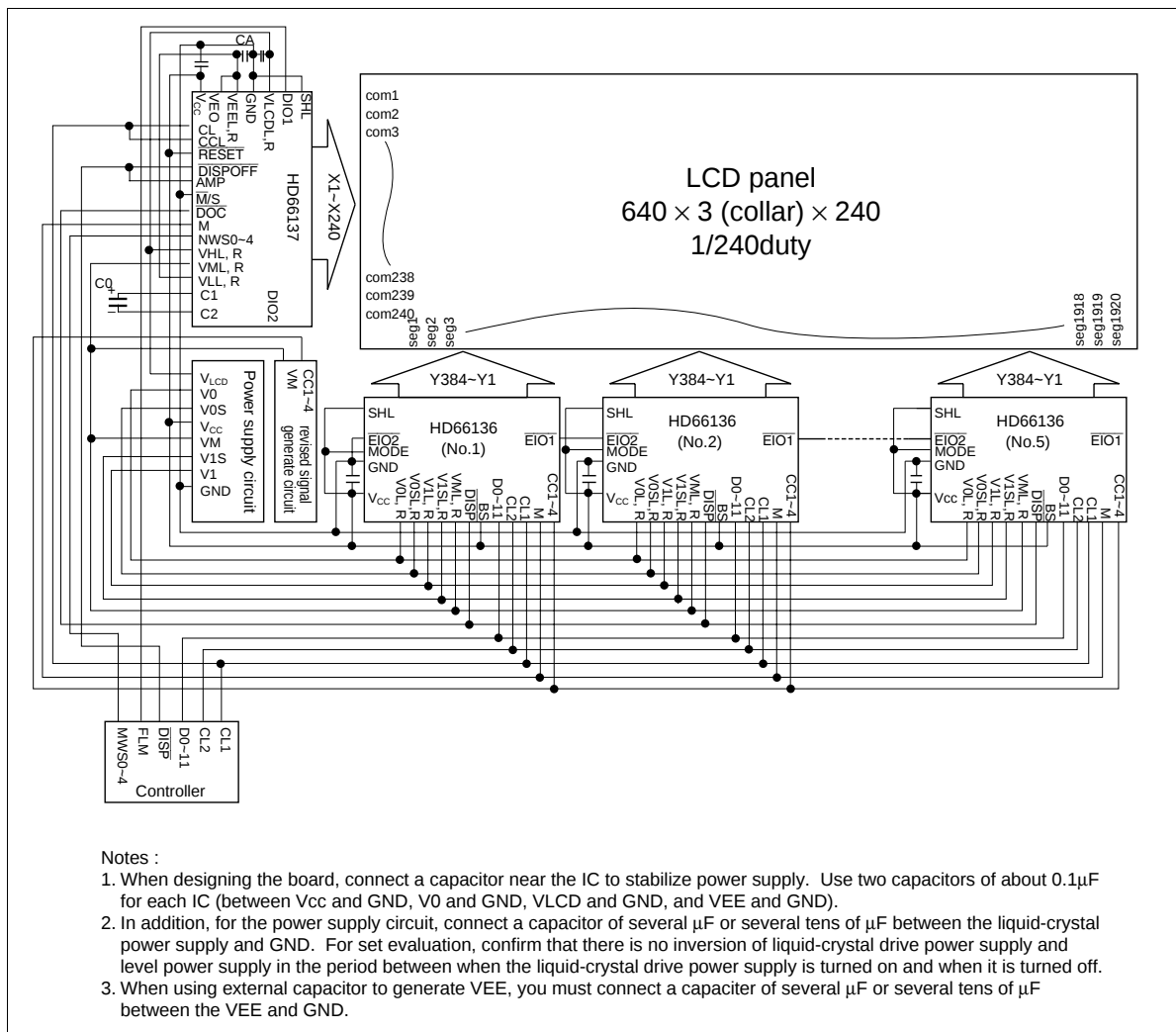


Figure 1 Application Example (1)

Application Example (2)

Figure 2 shows an application example 320×3 (collar) $\times 240$ dot Quarter VGA Size STN color panel.

This panel configured HD66137 $\times 1$ piece and HD66130 $\times 3$ pieces.

HD66137 generates M signal and DOC signal. M signal pin is connected M signal pin of HD66130 and DOC signal pin is connected DISP signal pin of HD66136.

HD66137 is able to generate - voltage by external capacitor.

VEO pin is connected VEE pin and VL pin.

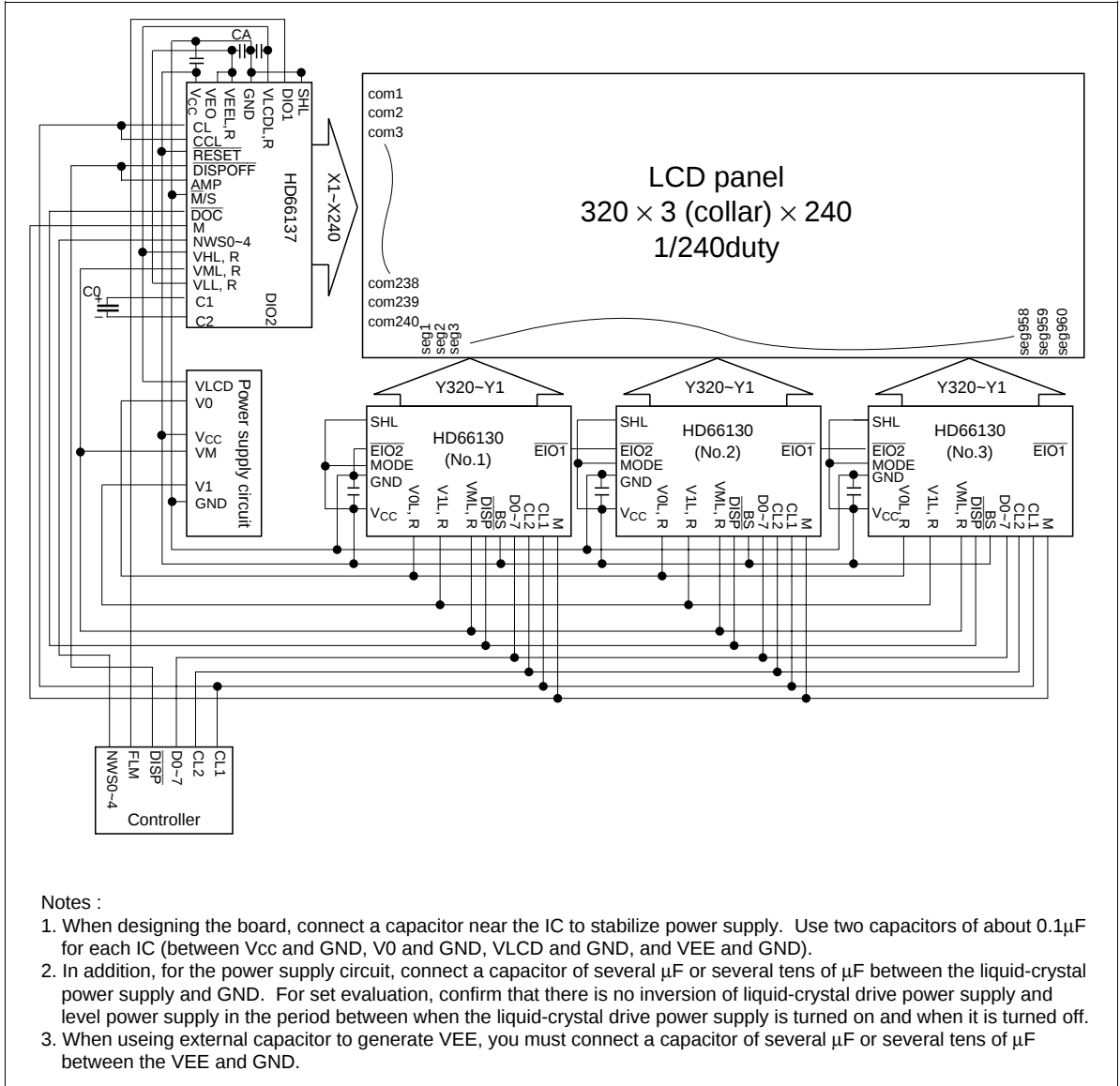


Figure 2 Application Example (2)

Power Supply Circuit Example

Figure 3 shows a power supply circuit example.

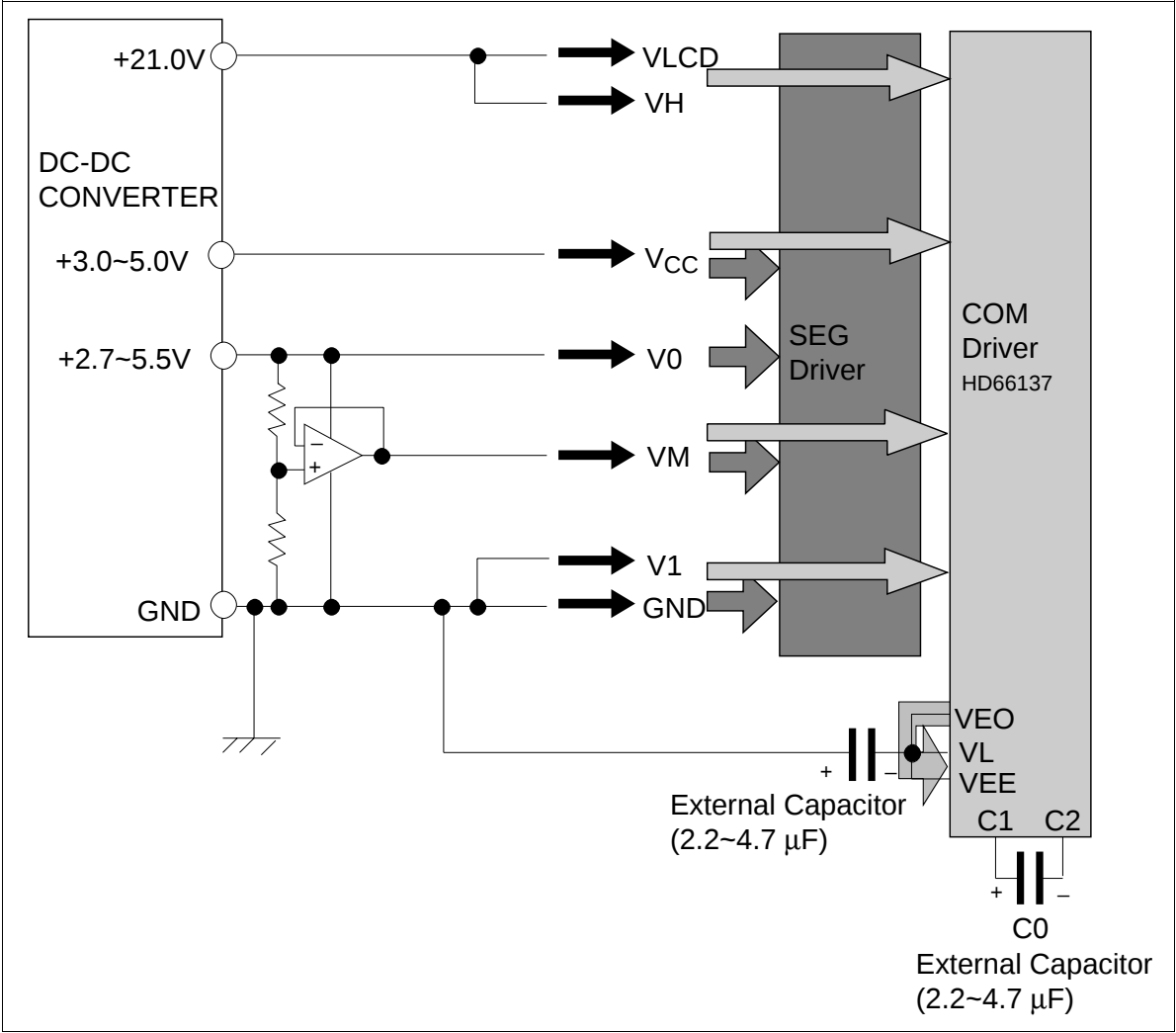


Figure 3 Power Supply Circuit Example

Absolute Maximum Rating

Item		Symbol	Ratings	Unit	Notes
Power supply voltage	Logic circuit	V_{CC}	-0.3 to +7.0	V	1, 8
	LCD drive circuit	V_{LCD}	-0.3 to +25.0	V	1, 3, 8
		V_{EE}	-20.0 to +0.3	V	1, 4, 8
Input voltage (1)		VT1	-0.3 to $V_{CC} + 0.3$	V	1, 2
Input voltage (2)		VH	-0.3 to V_{LCD}	V	1, 5, 8
Input voltage (3)		VL	+0.3 to V_{EE}	V	1, 6, 8
Input voltage (4)		VM	-0.3 to + 5.0	V	1, 7, 8
Operating temperature		Topr	-30 to +75	°C	
Storage temperature		Tstg	-55 to +110	°C	

Notes: 1. Voltage from GND.

2. Applicable to DIO1, $\overline{DISPOFF}$, SHL, M, NWS0, NWS1, NWS2, NWS3, NWS4, $\overline{RESET}$, MODE0, MODE1, CL, $\overline{M/S}$, AMP, CCL, DIO2.

3. Applicable to V_{LCDL} , R pins.

4. Applicable to V_{EEL} , R pins.

5. Applicable to V_{HL} , R pins.

6. Applicable to V_{LL} , R pins.

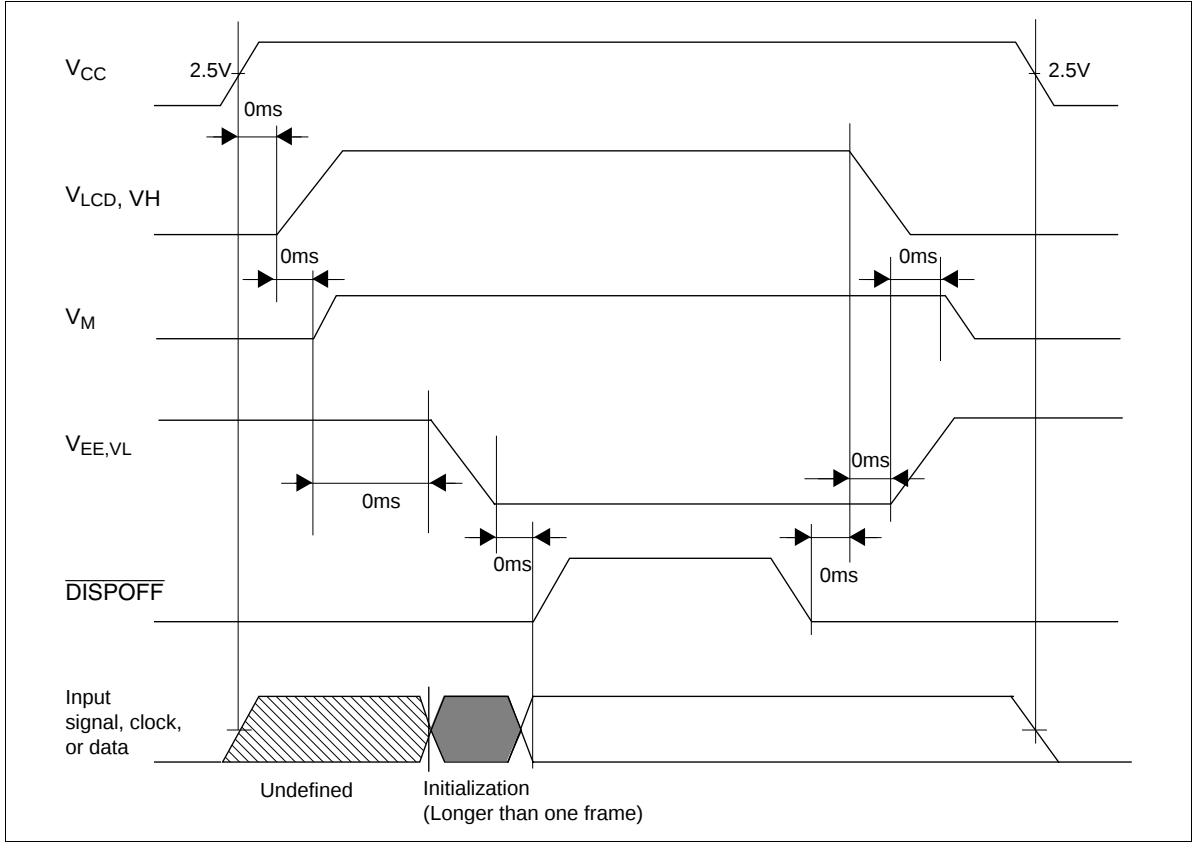
7. Applicable to V_{ML} , R pins.

(Caution)

Operating the LSI in excess of the absolute maximum rating will result in permanent damage. Use the LSI observing electrical characteristic conditions in normal operation. Exceeding the conditions will cause malfunctions or will affect LSI reliability.

8. Observe the sequence of activation and inactivation for the following power supplies and signals. And this sequence apply to use built - in switching circuit.

If the sequence is not observed, it may cause LSI malfunction, permanent damage, or adverse effects.



8.1 Power on

- (1) Turn on the power supply in the order of GND- V_{CC} , GND- V_{LCD} (VH), and VM. VM-VEE is generated automatically. In this case, input GND to the $\overline{DISPOFF}$ pin.
- (2) The LCD level forcibly outputs the VM level by the $\overline{DISPOFF}$ function.
- (3) The $\overline{DISPOFF}$ function has a priority even if input signal distortion occurs immediately after V_{CC} input.
- (4) Then input the predetermined signals to initialize the driver registers. In this case, assure a period for more than one frame.
- (5) Preparation for normal display is thus completed. Cancel the $\overline{DISPOFF}$ function by setting the $\overline{DISPOFF}$ pin to V_{CC} . At this point, the levels of VEE (VL), VLCD (VH) and VM must have reached the predetermined respective voltage.

8.2 Shut down

As a rule, shut down in order opposite to that used for power on.

- (1) Set the $\overline{DISPOFF}$ pin to GND.
- (2) At first shut off the LCD power supply GND- V_{LCD} (VH), at same time GND-VEE (VL) get to VM. Next shut off the VM.
- (3) Set V_{CC} and the input signal to GND.

At this point, VEE (VL), VLCD (VH) and VM pin input must completely drop to 0 V.

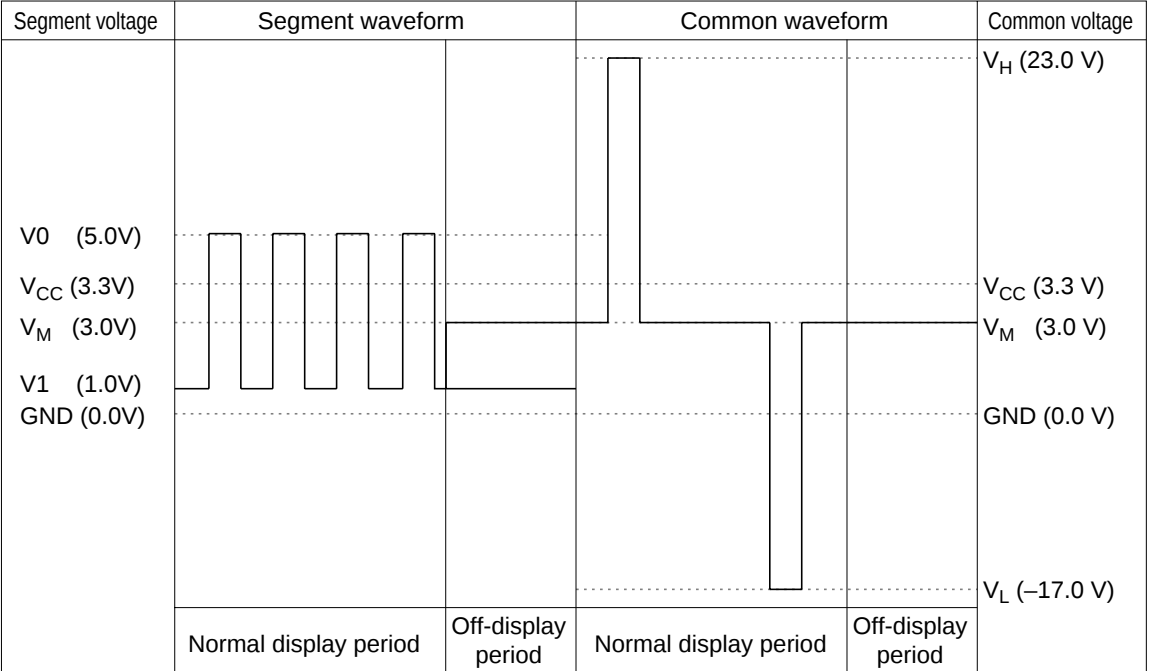
Since the $\overline{DISPOFF}$ function is inactivated when the V_{CC} level drops to GND, the LCD output may output a level other than VM. Therefore, an incorrect display may appear at shut down or power on.

Electrical Characteristics

DC Characteristics ($V_{CC} = 2.5$ to 5.5 V, $GND = 0$ V, $V_{LCD} - V_{EE} = 15$ to 43 V, $T_a = -30$ to $+75$ °C)

Item	Symbol	Applicable Pins	Min.	Typ.	Max.	Unit	Measurement Conditions	Notes
Input high-level voltage	V_{IH}	DIO1, $\overline{DISPOFF}$, SHL, M, $\overline{M/S}$, MWS0-4, $\overline{RESET}$,	$0.7 \times V_{CC}$	—	V_{CC}	V		
Input low-level voltage	V_{IL}	CL, MODE0, MODE1, $\overline{DOC}$, AMP, CCL, DIO2	0	—	$0.3 \times V_{CC}$	V		
Output high-level voltage	V_{OH}	M, $\overline{DOC}$, DIO1, DIO2	$V_{CC} - 0.4$	—	—	V	$I_{OH} = -0.4$ mA	
Output low-level voltage	V_{OL}	M, $\overline{DOC}$, DIO1, DIO2	—	—	0.4	V	$I_{OL} = 0.4$ mA	
ON resistance between Vi-Yj	R_{ON}	X1 to X240, V pin	—	0.7	2.0	k Ω	$I_{ON} = 150$ μ A	1
Input leak current (1)	I_{IL1}	DIO1, $\overline{DISPOFF}$, SHL, M, $\overline{M/S}$, MWS0-4, $\overline{RESET}$, CL, MODE0, MODE1, $\overline{DOC}$, AMP, CCL, DIO2	-5	—	5	μ A	$V_{IN} = V_{CC}$ to GND	
Input leak current (2)	I_{IL2}	VH, VL, VM, C1, C2	-25	—	25	μ A		
Current consumption (1)	I_{CC1}	V_{CC}	—	10	40	μ A	$V_{CC} = 3.3$ V, $V_{LCD} - V_{EE} = 40$ V, $f_{CL} = 19.2$ kHz, $f_M = 1.5$ kHz	2
Current consumption (2)	I_{CC2}	V_{CC}	—	20	50	μ A	$V_{CC} = 5.0$ V, $V_{LCD} - V_{EE} = 40$ V, $f_{CL} = 19.2$ kHz, $f_M = 1.5$ kHz	
Current consumption (3)	I_{LCD}	V_{LCD}	—	25	50	μ A	$V_{CC} = 3.3$ V, $V_{LCD} - V_{EE} = 40$ V, $f_{CL} = 19.2$ kHz, $f_M = 1.5$ kHz	

- Notes: 1. This is a resistance value between the X and V pins (either of VH, VL, or VM) when a load current is applied to one of x1 to x240 pins. These values are regulated under the conditions of $V_{LCD} = V_H = 21.75$ V, $V_{EE} = V_L = -18.5$ V, $V_M = 1.75$ V, $GND = 0$ V, Use VH, VL, and VM in the range of $V_{LCD} - V_M \geq V_H - V_M = 21.5$ to 7.5 V, $V_{EE} - V_M \leq V_L - V_M = -21.5$ to -7.5 V, with the relation of $V_H > V_M > V_L$.
2. The current applied between the input and output is excluded. When an input to a CMOS gate is at an intermediate level, through current flows between the power supplies, and the power supply current increases. Therefore, use $V_{IH} = V_{CC}$ and $V_{IL} = GND$.
3. The voltage relationship of each signal is as follows :



AC Characteristics (1) (V_{CC} = 2.5 to 5.5 V, GND = 0 V, V_{LCD}-V_{EE} = 15 to 43 V, Ta = -30 to +75 °C)

Item	Symbol	Pin Name	min.	max.	Dimensions	Note
Clock cycle time	t _{CYC}	CL	400	—	ns	
CL high-level width	t _{CWH}	CL	25	—	ns	
CL low-level width	t _{CWL}	CL	370	—	ns	
CL rising time	t _r	CL	—	30	ns	
CL falling time	t _f	CL	—	30	ns	
Data set-up time	t _{DS}	DIO1, DIO2, CL	100	—	ns	
Data hold time	t _{DH}	DIO1, DIO2, CL	10	—	ns	
Data output delay time	t _{DD}	DIO1, DIO2, CL	—	200	ns	1
M output delay time	t _{MD}	M, CL	—	200	ns	1
M set-up time	t _{MS}	M, CL	20	—	ns	
M Hold time	t _{MH}	M, CL	20	—	ns	
DOC delay time 1	t _{DOC1}	$\overline{\text{DISPOFF}}$, $\overline{\text{DOC}}$	—	300	ns	2
DOC delay time 2	t _{DOC2}	DIO1, DIO2, $\overline{\text{DOC}}$	—	300	ns	2

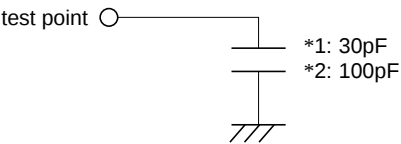
AC Characteristics (2) ($V_{CC} = 2.5$ to 4.5 V, $GND = 0$ V, $V_{LCD}-V_{EE} = 43$ V, $T_a = -30$ to $+75$ °C)

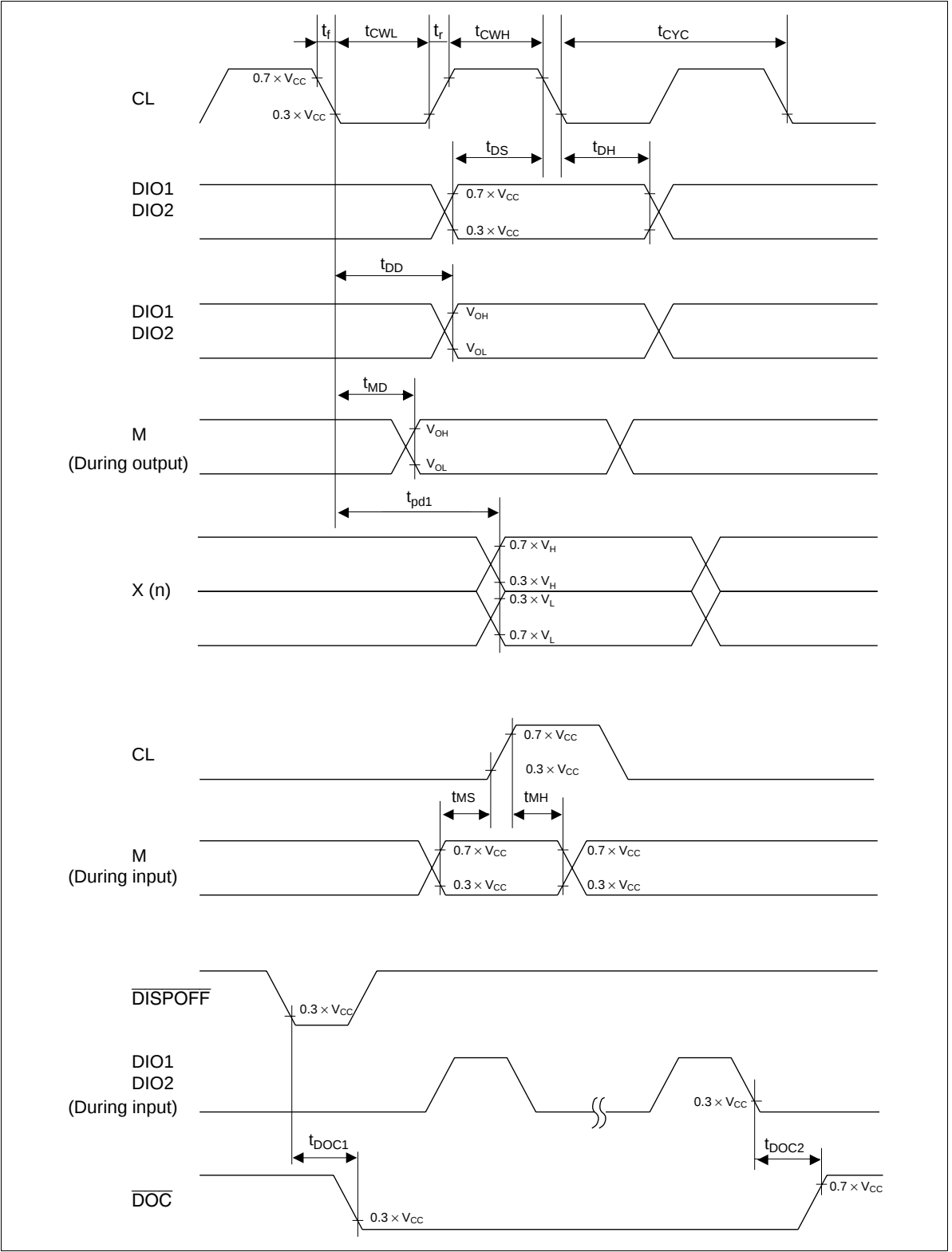
Item	Symbol	Pin Name	min.	max.	Dimensions	Note
Output delay time1	t_{pd1}	X(n), M	—	1.2	μ S	2

AC Characteristics (3) ($V_{CC} = 4.5$ to 5.5 V, $GND = 0$ V, $V_{LCD}-V_{EE} = 43$ V, $T_a = -30$ to $+75$ °C)

Item	Symbol	Pin Name	min.	max.	Dimensions	Note
Output delay time1	t_{pd1}	X(n), M	—	0.7	μ S	2

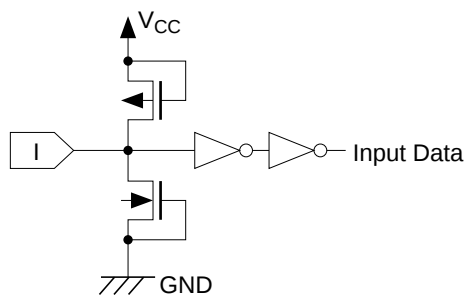
*1, *2. The following timing is regulated with the circuit at the right connected.





Terminal Configuration

Terminal Configuration (1)

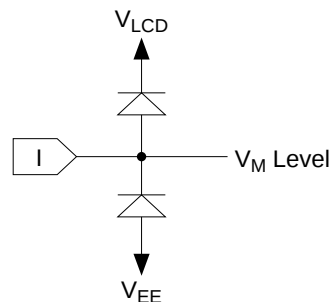


Input Terminal 1

Applicable terminals :

CL, CCL, SHL, MODE0,1, AMP

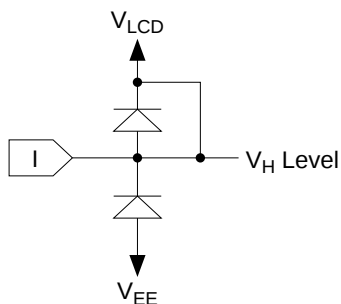
$\overline{\text{DISPOFF}}$, RESET, MWS0~4, $\overline{\text{M/S}}$



Input Terminal 2

Applicable terminals : $V_{MR, L}$

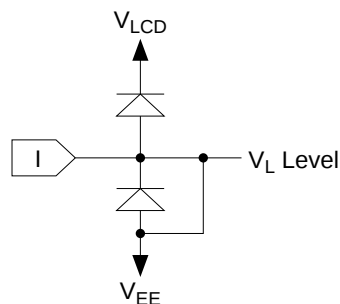
* V_{MR} terminal connect with V_{ML} terminal in LSI.



Input Terminal 3

Applicable terminals : $V_{HR, L}$

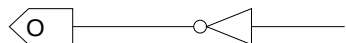
* V_{HR} terminal connect with V_{HL} terminal in LSI.



Input Terminal 4

Applicable terminals : $V_{LR, L}$

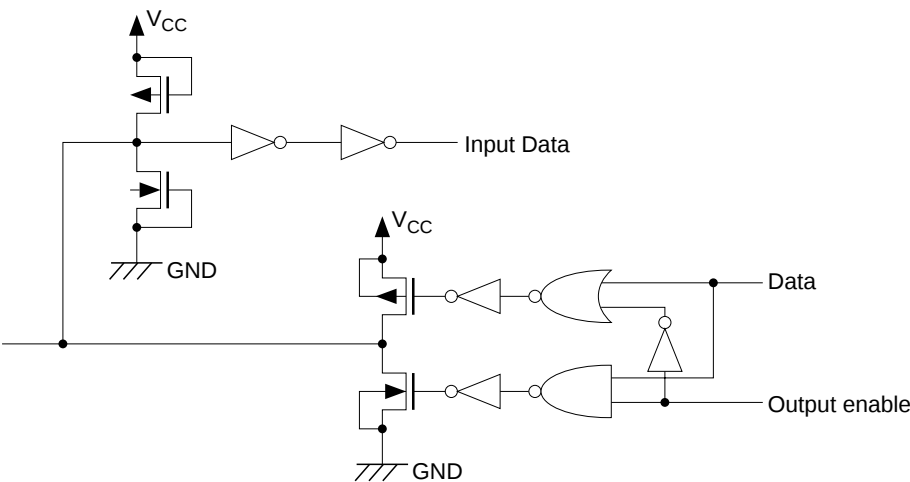
* V_{LR} terminal connect with V_{LL} terminal in SLI.



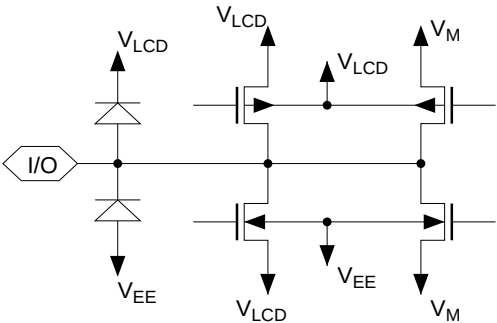
Output Terminal 1

Applicable terminals : $\overline{\text{DOC}}$

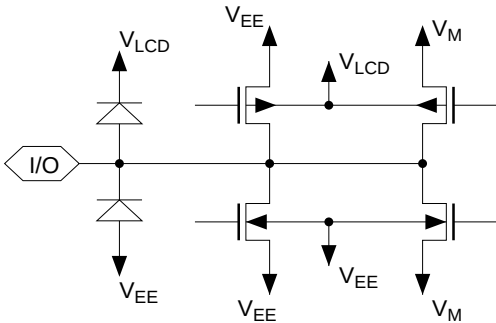
Terminal Configuration (2)



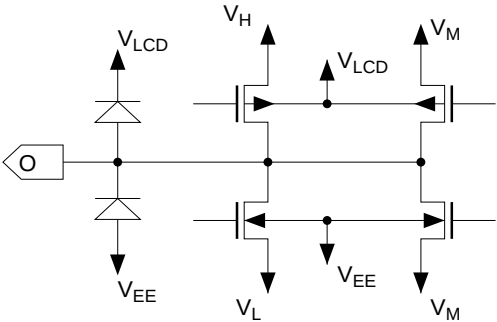
I/O Terminal 1
Applicable terminals : DIO1, DIO2, M,



I/O Terminal 2
Applicable terminals : C1



I/O Terminal 3
Applicable terminals : C2



LCD drive Output Terminal
Applicable terminals : X1 to X240

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