

## INTRODUCTION

The S6A0065 is a LCD driver IC which is fabricated by low power CMOS technology. Basically this IC consists of 20 x 2 bit bi-directional shift register, 20 x 2 bit data latch and 20 x 2 bit driver. (refer to Fig 1) This IC can be used as common or segment driver.

## FUNCTION

- Dot matrix LCD driver with 40 channel output.
  - Selects function to use common/segment drivers simultaneously.
  - Input / Output signal
    - Output: 20 x 2 channel waveform for LCD driving
    - Input: Serial display data and control signal from the controller LSI.
- Bias voltage ( $V_1$ - $V_6$ )

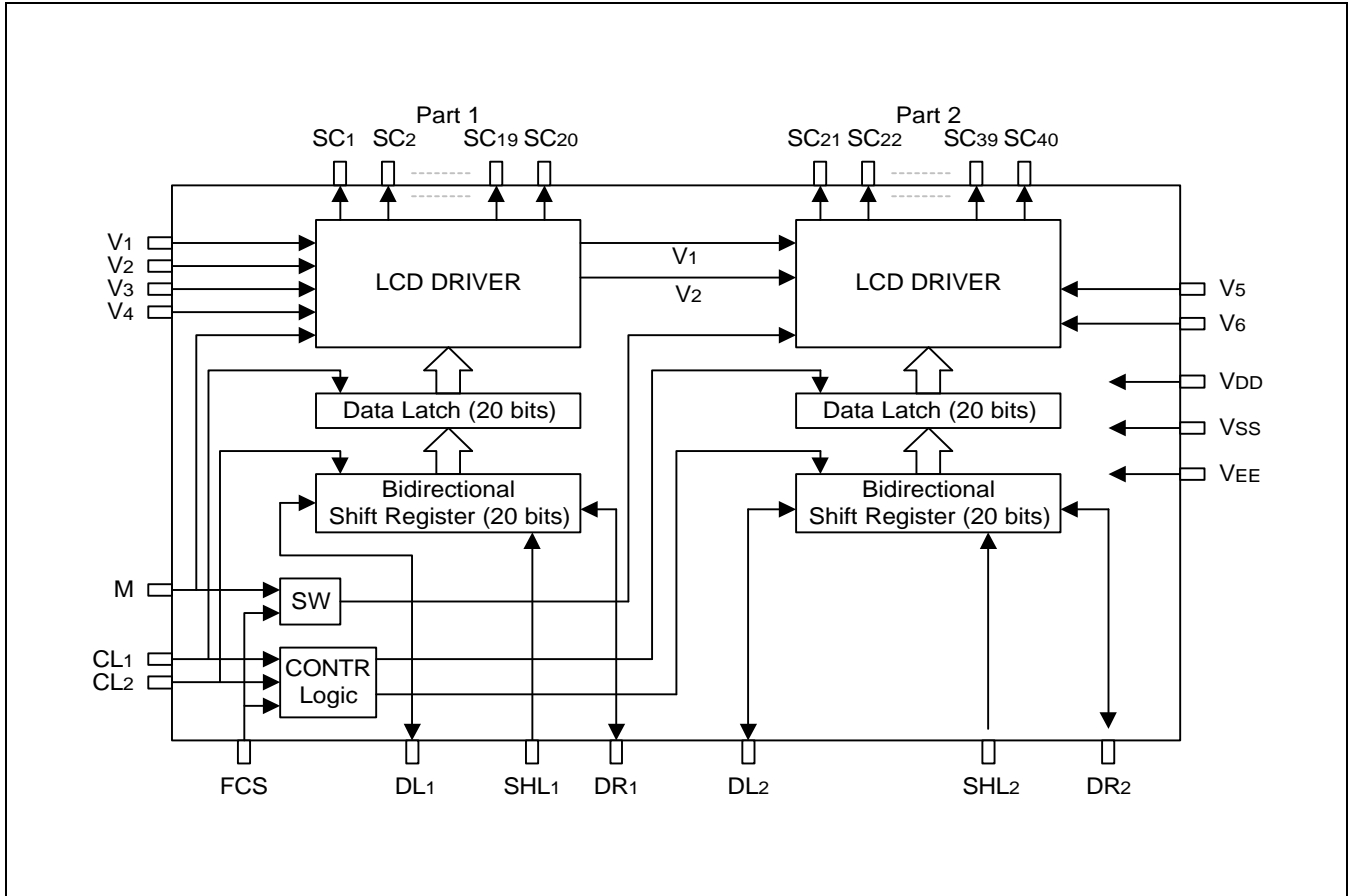
## FEATURES

- Display driving bias: static - 1/5
- Power supply voltage: 2.7- 5.5V
- Supply voltage for display: 3.0 - 13.0V ( $V_{LCD} = V_{DD} - V_{EE}$ )
- Interface

Driver (cascade connection)	Controller
Other S6A0065, S6A2067	S6A0069 S6A0070 S6A0073

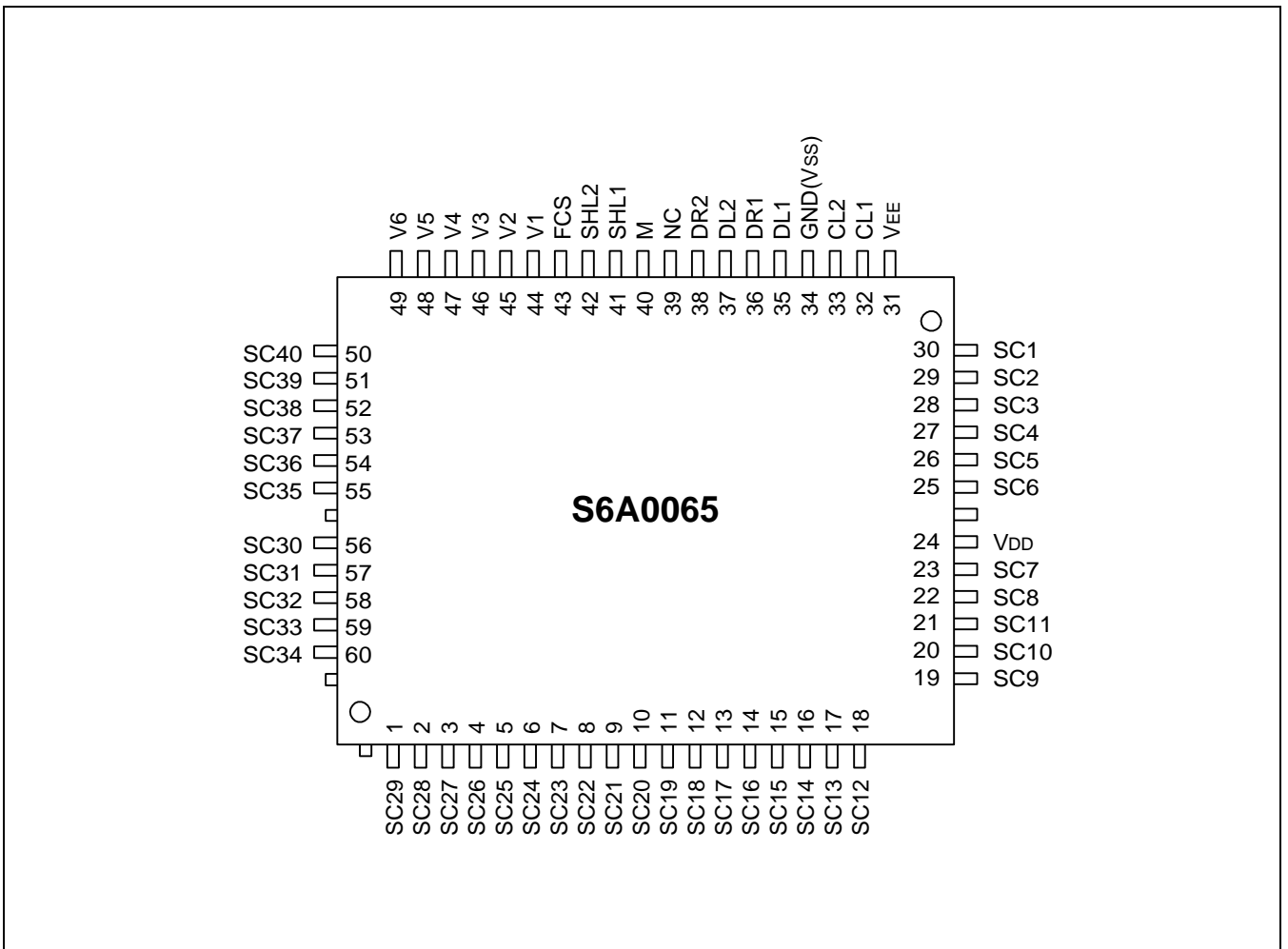
- CMOS Process
- 64QFP or bare chip available

**BLOCK DIAGRAM**



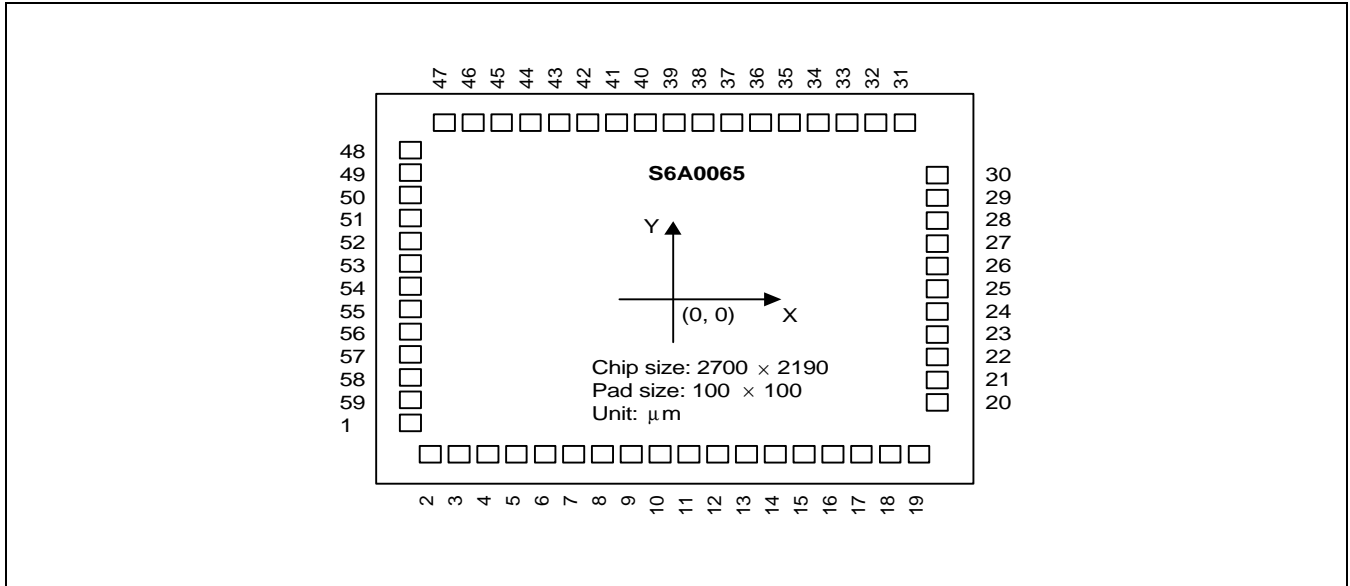
**Figure 1. S6A0065 Functional Block Diagram**

**PIN CONFIGURATION**



**Figure 2. 60 QFP Top View**

**PAD DIAGRAM**



**NOTE:** (0,0) is center in the chip.

## PAD CENTER COORDINATES

Unit: um

PAD NUMBER	PAD NAME	COORDINATE		PAD NUMBER	PAD NAME	COORDINATE	
		X	Y			X	Y
1	VEE	-1120.2	-642.5	31	SC28	1117.5	865.2
2	CL1	-1062.5	-865.2	32	SC27	992.5	865.2
3	CL2	-937.5	-865.2	33	SC26	867.5	865.2
4	VSS	-812.5	-865.2	34	SC25	742.5	865.2
5	DL1	-687.5	-865.2	35	SC24	617.5	865.2
6	DR1	-562.5	-865.2	36	SC23	492.5	865.2
7	DL2	-437.5	-865.2	37	SC22	367.5	865.2
8	DR2	-312.5	-865.2	38	SC21	242.5	865.2
9	M	-187.5	-865.2	39	SC20	117.5	865.2
10	SHL1	-62.5	-865.2	40	SC19	-7.5	865.2
11	SHL2	62.5	-865.2	41	SC18	-132.5	865.2
12	FCS	187.5	-865.2	42	SC17	-257.5	865.2
13	V1	332.5	-865.2	43	SC16	-382.5	865.2
14	V2	457.5	-865.2	44	SC15	-507.5	865.2
15	V3	582.5	-865.2	45	SC14	-632.5	865.2
16	V4	707.5	-865.2	46	SC13	-757.5	865.2
17	V5	832.5	-865.2	47	SC12	-882.5	865.2
18	V6	957.5	-865.2	48	SC9	-1120.2	857.2
19	SC40	1082.5	-865.2	49	SC10	-1120.2	732.5
20	SC39	1120.2	-627.5	50	SC11	-1120.2	607.5
21	SC38	1120.2	-502.5	51	SC8	-1120.2	482.5
22	SC37	1120.2	-377.5	52	SC7	-1120.2	357.5
23	SC36	1120.2	-252.5	53	VDD	-1120.2	232.5
24	SC35	1120.2	-127.5	54	SC6	-1120.2	107.5
25	SC30	1120.2	-2.5	55	SC5	-1120.2	-17.5
26	SC31	1120.2	122.5	56	SC4	-1120.2	-142.5
27	SC32	1120.2	247.5	57	SC3	-1120.2	-267.5
28	SC33	1120.2	372.5	58	SC2	-1120.2	-392.5
29	SC34	1120.2	497.5	59	SC1	-1120.2	-517.5
30	SC29	1120.2	622.5				

## PIN DESCRIPTION

Pin (No.)	I/O	Name	Description	Interface																					
V <sub>DD</sub> (24)	Power	Operating Voltage	For logical circuit (2.7 - 5.5V)	Power Supply																					
GND(34)			0V (GND)																						
V <sub>EE</sub> (31)		Negative Supply Voltage	For LCD driver circuit																						
V1, V2 (44,45)	I	Bias Voltage	Bias voltage level for LCD drive (select level)	Power																					
SC <sub>1</sub> - SC <sub>20</sub>	O	Part 1	LCD driver	LCD driver output	LCD																				
V3, V4 (46, 47)	I		Bias Voltage	Bias voltage level for LCD drive (non-select level)	Power																				
SHL1(41)	I		Data interface	Selection of the shift direction of Part 1 shift register <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>SHL1</th> <th>DL1</th> <th>DR1</th> </tr> </thead> <tbody> <tr> <td>V<sub>DD</sub></td> <td>out</td> <td>in</td> </tr> <tr> <td>V<sub>SS</sub></td> <td>in</td> <td>out</td> </tr> </tbody> </table>	SHL1	DL1	DR1	V <sub>DD</sub>	out	in	V <sub>SS</sub>	in	out	V <sub>DD</sub> or V <sub>SS</sub>											
SHL1	DL1		DR1																						
V <sub>DD</sub>	out	in																							
V <sub>SS</sub>	in	out																							
DL1, DR1 (35, 36)	I/O	Data input/output of Part 1 shift register	Controller or S6A0065																						
SC <sub>21</sub> - SC <sub>40</sub>	O	Part 2	LCD driver	LCD driver output																					
V5, V6 (48, 49)	I		Bias Voltage	Bias voltage level for LCD drive (non-select level)	Power																				
SHL2(42)	I		Data interface	Selection of the shift direction of Part 2 shift register <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>SHL2</th> <th>DL2</th> <th>DR2</th> </tr> </thead> <tbody> <tr> <td>V<sub>DD</sub></td> <td>out</td> <td>in</td> </tr> <tr> <td>V<sub>SS</sub></td> <td>in</td> <td>out</td> </tr> </tbody> </table>	SHL2	DL2	DR2	V <sub>DD</sub>	out	in	V <sub>SS</sub>	in	out	V <sub>DD</sub> or V <sub>SS</sub>											
SHL2	DL2		DR2																						
V <sub>DD</sub>	out	in																							
V <sub>SS</sub>	in	out																							
DL2,DR2 (37, 38)	I/O	Data input/output of Part 2 shift register	Controller or S6A0065																						
M (40)	I	Alternated signal for LCD driver output	<table border="1" style="margin-left: 20px;"> <thead> <tr> <th>PART</th> <th>FCS</th> <th>CL1</th> <th>CL2</th> <th>M polarity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">1</td> <td>V<sub>SS</sub></td> <td>latch clock</td> <td>shift clock</td> <td rowspan="2">M</td> </tr> <tr> <td>V<sub>DD</sub></td> <td></td> <td></td> </tr> <tr> <td rowspan="2">2</td> <td>V<sub>SS</sub></td> <td>latch clock</td> <td>shift clock</td> <td rowspan="2"><math>\bar{M}</math></td> </tr> <tr> <td>V<sub>DD</sub></td> <td></td> <td></td> </tr> </tbody> </table>	PART	FCS	CL1	CL2	M polarity	1	V <sub>SS</sub>	latch clock	shift clock	M	V <sub>DD</sub>			2	V <sub>SS</sub>	latch clock	shift clock	$\bar{M}$	V <sub>DD</sub>			Controller
PART	FCS	CL1		CL2	M polarity																				
1	V <sub>SS</sub>	latch clock		shift clock	M																				
	V <sub>DD</sub>																								
2	V <sub>SS</sub>	latch clock	shift clock	$\bar{M}$																					
	V <sub>DD</sub>																								
CL1,CL2 (32,33)	I	Data shift /latch clock																							
FCS(43)	I	Mode selection	Shift/latch clock of display data and polarity of M signal are changed by FCS signal. By setting FCS to V <sub>DD</sub> level, user can select the function that use Part 1 as segment driver and Part 2 as common driver simultaneously.																						
NC(39)			No connection pin	NC																					

**MAXIMUM ABSOLUTE LIMIT** ( $T_a = 25^\circ\text{C}$ )

Characteristic	Symbol	Value	Unit
Operating Voltage	$V_{DD}$	- 0.3 to + 7.0	V
Driver Supply Voltage	$V_{LCD}$	$V_{DD} - 15.0$ to $V_{DD} + 0.3$	V
Input Voltage 1	$V_{IN1}$	- 0.3 to $V_{DD} + 0.3$	V
Input Voltage 2 ( $V_1 - V_6$ )	$V_{IN2}$	$V_{DD} + 0.3$ to $V_{EE} - 0.3$	V
Operating Temperature	$T_{OPR}$	- 30 to + 85	$^\circ\text{C}$
Storage Temperature	$T_{SRG}$	- 55 to + 125	$^\circ\text{C}$

\* Voltage greater than above may damage the circuit

\*  $V_{EE}$ : connect a protection resistor ( $220\Omega \pm 5\%$ )

**ELECTRICAL CHARACTERISTICS**

**DC Characteristics** ( $V_{DD} = 2.7 - 5.5\text{V}$ ,  $V_{DD} - V_{EE} = 3 - 13\text{V}$ ,  $V_{SS} = 0\text{V}$ ,  $T_a = -30 - +85^\circ\text{C}$ )

Characteristic	Symbol	Test condition	Min	Max	Unit	Applicable pin
Operating Current *	$I_{DD}$	$f_{CL2} = 400\text{kHz}$	-	1	mA	-
Supply Current *	$I_{EE}$	$f_{CL1} = 1\text{kHz}$	-	10	$\mu\text{A}$	
Input High Voltage	$V_{IH}$	-	$0.7V_{DD}$	$V_{DD}$	V	CL1, CL2, DL1, DL2 DR1, DR2, SHL1, SHL2 M, FCS
Input Low Voltage	$V_{IL}$		0	$0.3V_{DD}$		
Input Leakage Current	$I_{LKG}$	$V_{IN} = 0 - V_{DD}$	-5	5	$\mu\text{A}$	
Output High Voltage	$V_{OH}$	$I_{OH} = -0.4\text{mA}$	$V_{DD} - 0.4$	-	V	DL1, DL2, DR1, DR2
Output Low Voltage	$V_{OL}$	$I_{OL} = +0.4\text{mA}$	-	0.4		
Voltage Descending	$V_{D1}$	$I_{ON} = 0.1\text{mA}$ for one of SC1-SC40	-	1.1		V(V1-V6)-SC(SC1-SC40)
	$V_{D2}$	$I_{ON} = 0.05\text{mA}$ for each SC1-SC40	-	1.5		
Leakage Current	$I_V$	$V_{IN} = V_{DD} - V_{EE}$ (Output SC1-SC40 : floating)	-10	10	$\mu\text{A}$	V1-V6

**AC Characteristics** ( $V_{DD} = 2.7$  to  $5.5V$ ,  $V_{DD}-V_{EE} = 3$  to  $13V$ ,  $V_{SS} = 0V$ ,  $T_a = -30$  to  $+85$  °C)

Characteristic	Symbol	Test condition	Min	Max	Unit	Applicable pin
Data Shift Frequency	$f_{CL}$	-	-	400	kHz	CL2
Clock High Level Width	$t_{WCKH}$	-	800	-	ns	CL1, CL2
Clock Low Level Width	$t_{WCKL}$	-	800	-		CL2
Clock Set-up Time	$t_{SL}$	from CL2 to CL1	500	-		CL1, CL2
	$t_{LS}$	from CL1 to CL2	500	-		
Clock Rise/Fall Time	$t_R/t_F$	-	-	200		
Data Set-up Time	$t_{SU}$	-	300	-		DL1, DL2, DR1, DR2, FLM
Data Hold Time	$t_{DH}$	-	300	-		
Data Delay Time	$t_D$	$C_L = 15pF$	-	500		DL1, DL2, DR1, DR2

\* Input/Output current is excluded; When input is at the intermediate level with CMOS, excessive current flows through the input circuit to the power supply, To avoid this, input level must be fixed at "H" or "L".



**TIMING CHARACTERISTICS**

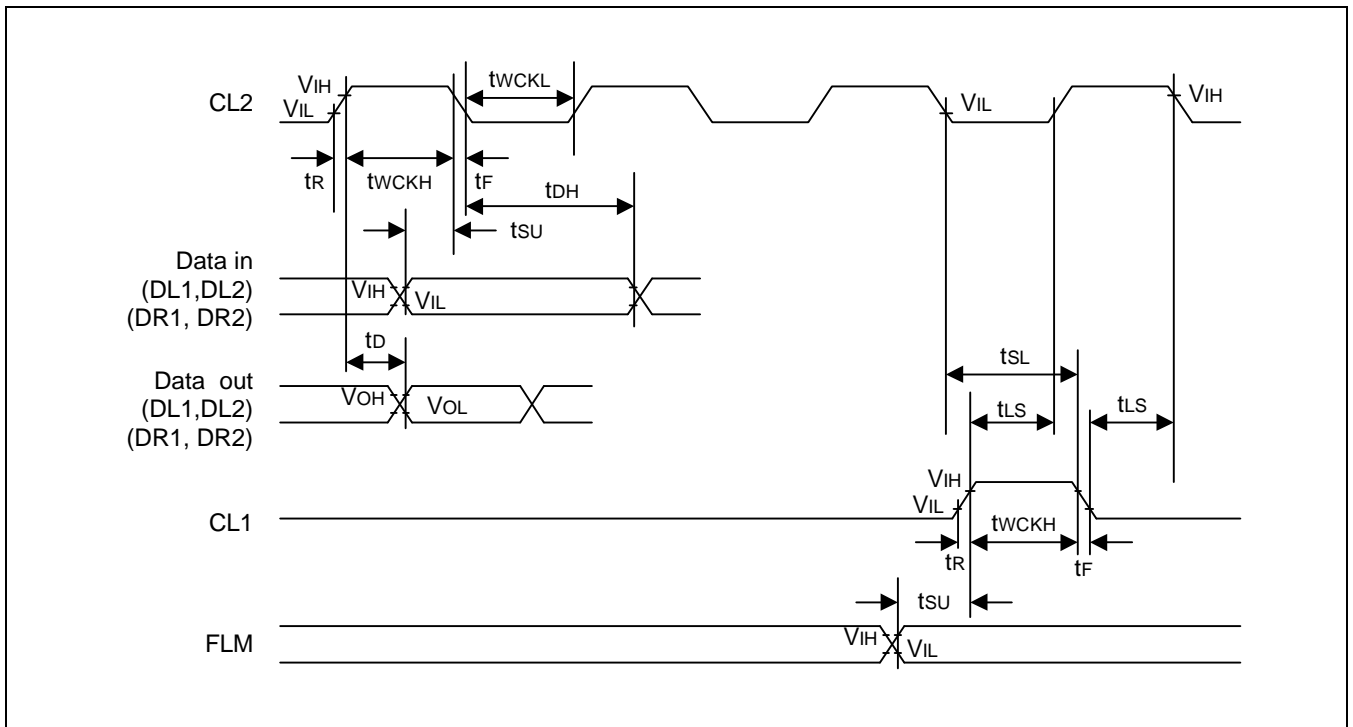


Figure 3. AC characteristics

**FUNCTIONAL DESCRIPTION**

**1) To Drive Segment Type**

When the FCS is connected to  $V_{SS}$ , S6A0065 (SC1-SC40) is operated as segment driver. (refer to Fig 4)

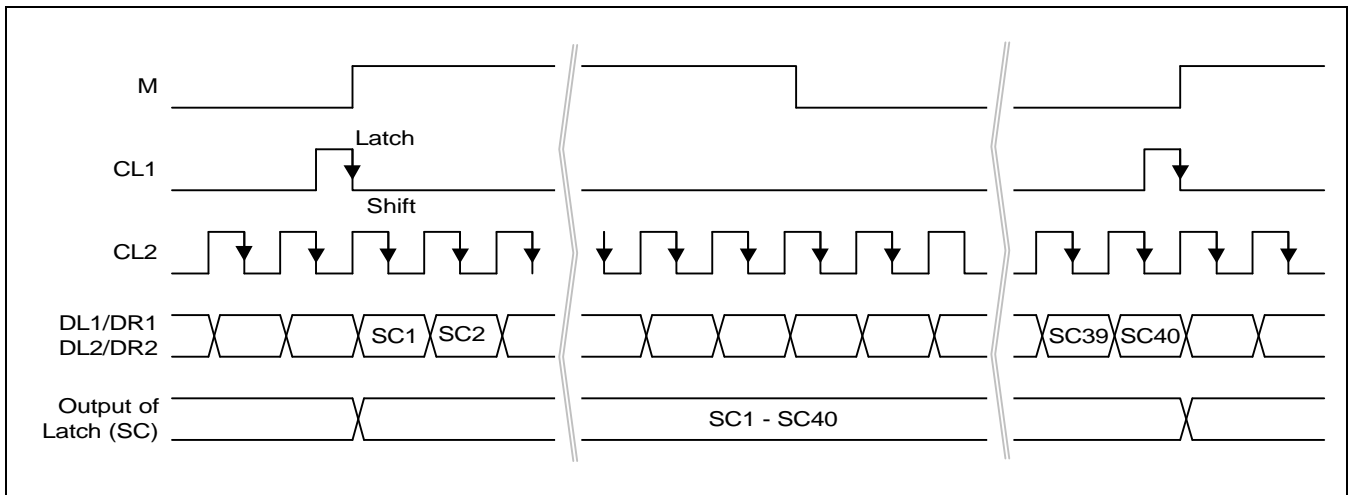
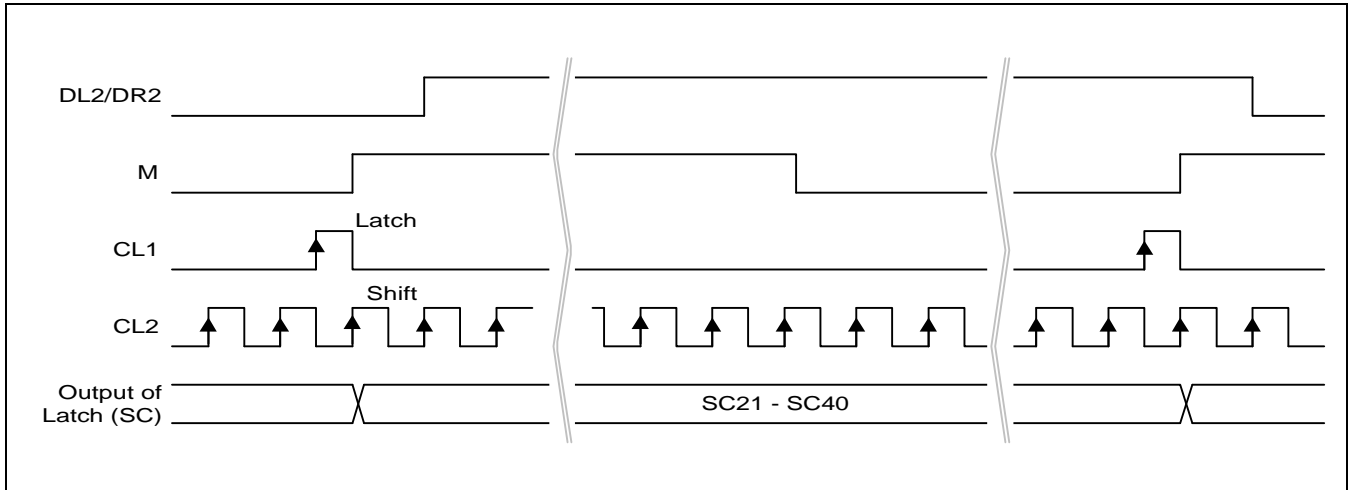


Figure 4. Segment Data Waveform

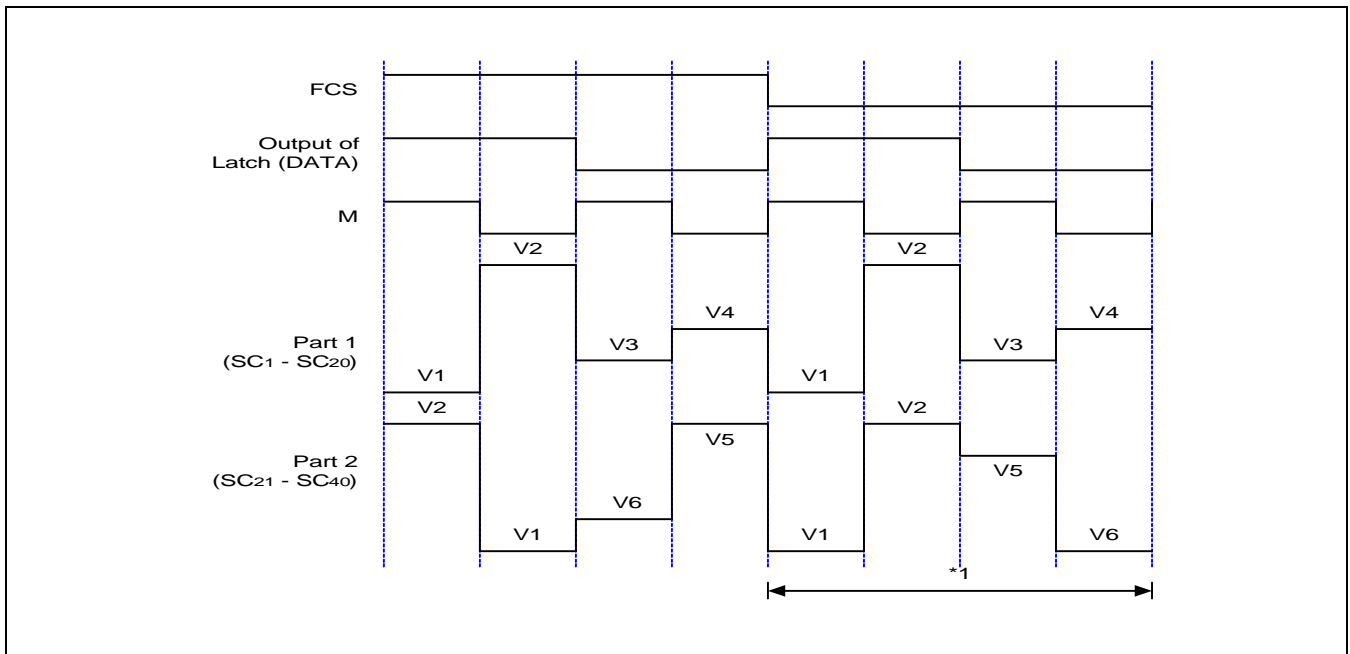
**2) To Drive Common Type**

When the FCS is connected to  $V_{DD}$ , only part2 (SC21-SC40) of S6A0065 is operated as common driver. (refer to Fig 5).



**Figure 5. Common Data Waveforms**

**LCD OUTPUT WAVEFORMS**

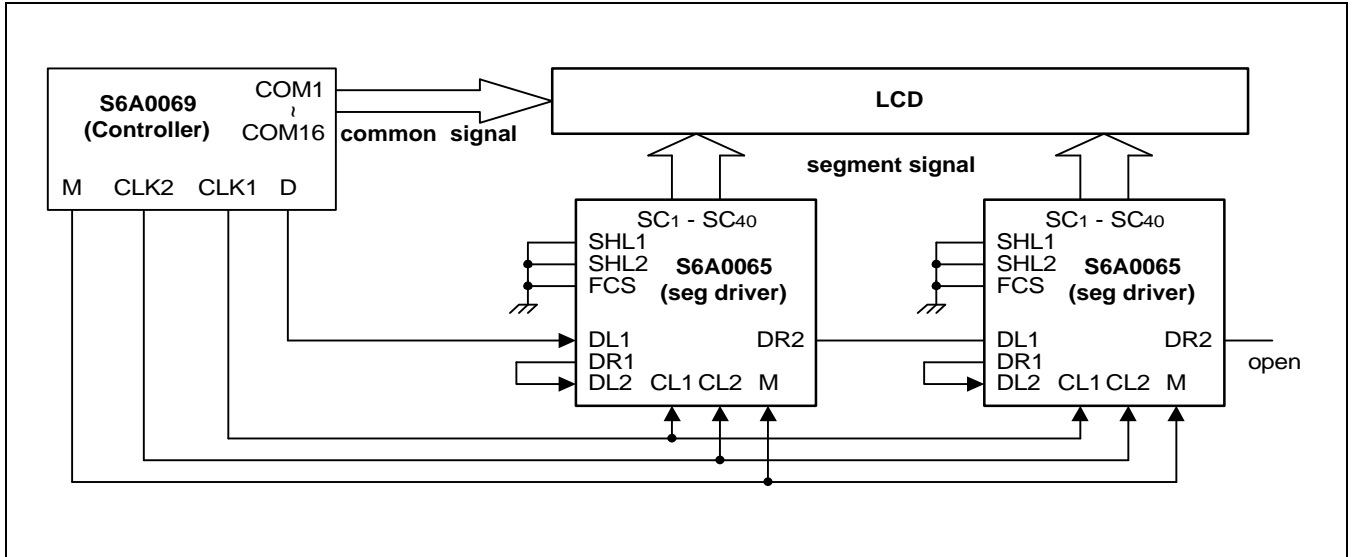


**Figure 6. Output Waveforms**

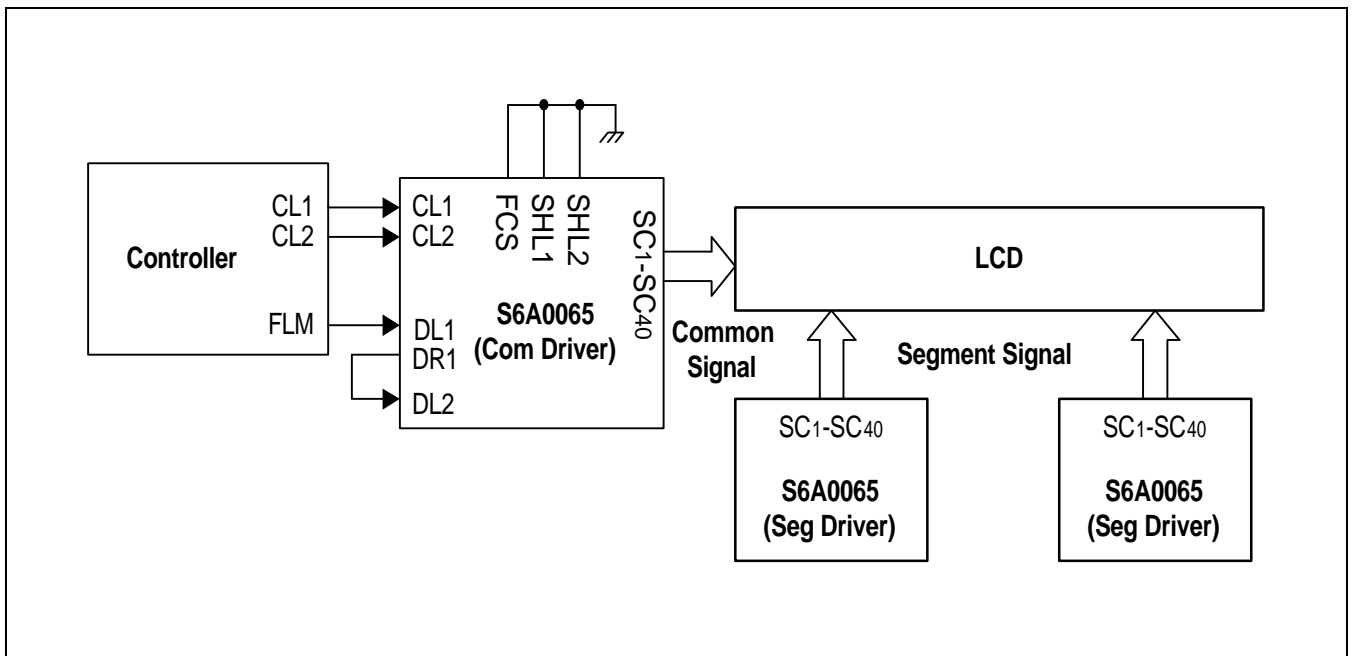
\*1: To use for same function of part 1 and part 2, V3 and V5, V4 and V6 of power supply for LCD drive are short circuited respectively.

## APPLICATION CIRCUIT

### 1) Segment Driver



### 2) Common Driver



3) Segment / Common Driver

