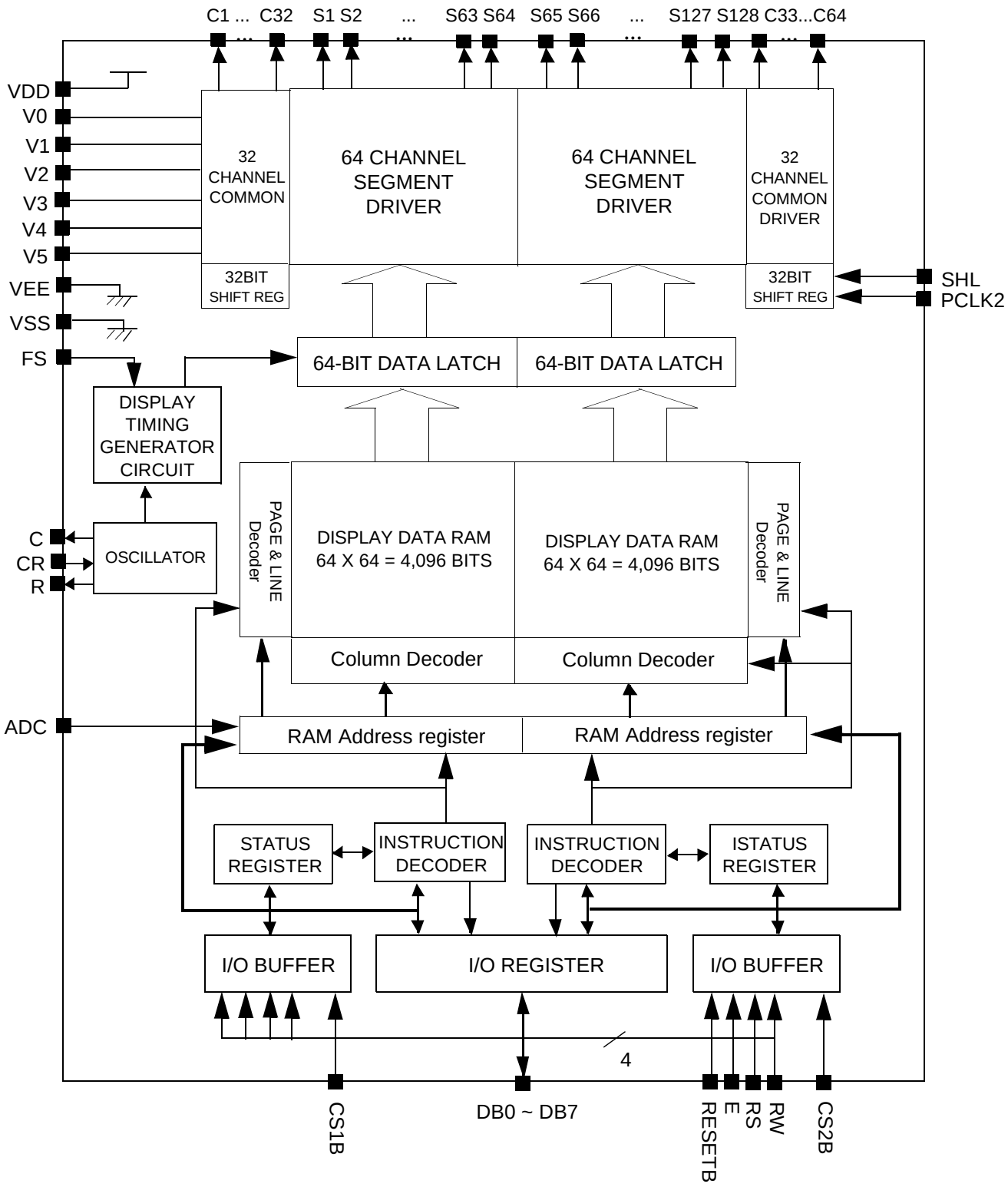
INTRODUCTION

KS0708 is a single-chip LCD driver LSI for liquid crystal dot-matrix graphic display systems. It incorporates 192 driver circuit for 64 commom and 128 segment and 64x128-bit bit-map RAM. It is capable of interfacing with the microprocessor, accepting 8-bit parallel display data directly from it, and storing data in an onechip Display Data RAM. And it generates internal signals for using LCD driving independent of microprocessor clock.

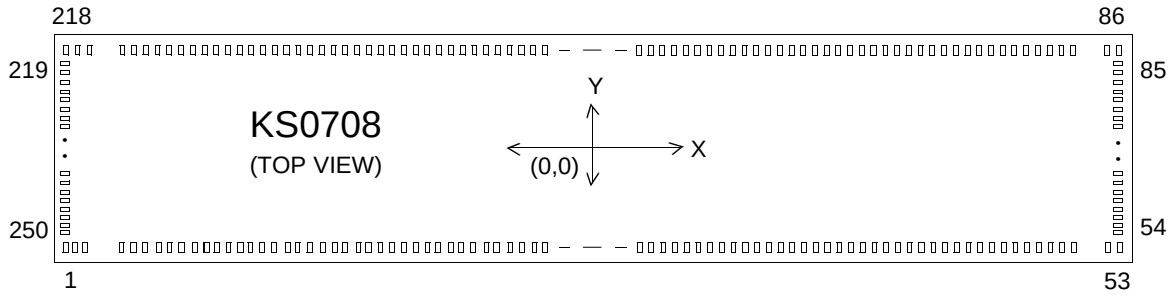
FEATURES

¡Ü 64-Channel COMMON & 128-Channel SEGMENT Driver for DOT matrix LCD
¡Ü On-chip display data RAM : 64 X 128 = 8192bits
¡Ü Display data is stored in display data RAM from MPU
  - RAM bit data : ON(1), OFF(0)
¡Ü Internal timing generator circuit for dynamic display
¡Ü 8-bit parallel bi-directional data bus
¡Ü Applicable LCD duty : 1/64
¡Ü Power supply voltages : Power supply voltage range : 4.5 ~ 5.5 V(VDD)
  LCD Driving voltage range : 8.0 ~ 17.0 V(VLCD = VDD - VEE)
¡Ü Wide operating temperature range : Ta = -30 ¡É ~ 85¡É
¡Ü High Voltage CMOS process
¡Ü Package : available bumped chip

BLOCK DIAGRAM



PAD CONFIGURATION



ITEM	PAD NO...	SIZE		UNIT
		X	Y	
CHIP SIZE	-	12590	3630	¥ìm
PAD PITCH	-	90(MIN)		
BUMPED PAD SIZE	1 ~ 53	56	140	
	54 ~ 85	140	56	
	86 ~ 218	56	140	
	219 ~ 250	140	56	
BUMPED PAD HEIGHT	ALL PAD	18 ¡¾ 3		

PAD LOCATION

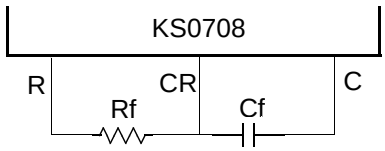
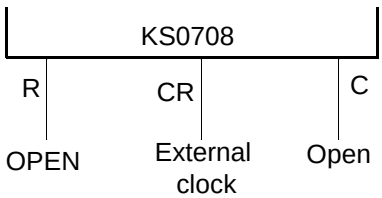
PAD NO.	PAD NAME	X	Y	PAD NO.	PAD NAME	X	Y	PAD NO.	PAD NAME	X	Y	PAD NO.	PAD NAME	X	Y
1	DUMMY	-6115	-1600	64	C11	6115	-486.5	127	S40	2205	1635	190	S103	-3465	1635
2	DUMMY	-6025	-1600	65	C12	6115	-396.5	128	S41	2115	1635	191	S104	-3555	1635
3	DUMMY	-5935	-1600	66	C13	6115	-306.5	129	S42	2025	1635	192	S105	-3645	1635
4	VEE	-5477	-1600	67	C14	6115	-216.5	130	S43	1935	1635	193	S106	-3735	1635
5	VEE	-5257	-1600	68	C15	6115	-126.5	131	S44	1845	1635	194	S107	-3825	1635
6	VEE	-5037	-1600	69	C16	6115	-36.5	132	S45	1755	1635	195	S108	-3915	1635
7	V5	-4817	-1600	70	C17	6115	53.5	133	S46	1665	1635	196	S109	-4005	1635
8	V5	-4597	-1600	71	C18	6115	143.5	134	S47	1575	1635	197	S110	-4095	1635
9	V5	-4377	-1600	72	C19	6115	233.5	135	S48	1485	1635	198	S111	-4185	1635
10	V4	-4157	-1600	73	C20	6115	323.5	136	S49	1395	1635	199	S112	-4275	1635
11	V4	-3937	-1600	74	C21	6115	413.5	137	S50	1305	1635	200	S113	-4365	1635
12	V4	-3717	-1600	75	C22	6115	503.5	138	S51	1215	1635	201	S114	-4456	1635
13	V3	-3497	-1600	76	C23	6115	593.5	139	S52	1125	1635	202	S115	-4545	1635
14	V3	-3277	-1600	77	C24	6115	683.5	140	S53	1035	1635	203	S116	-4635	1635
15	V3	-3057	-1600	78	C25	6115	773.5	141	S54	945	1635	204	S117	-4725	1635
16	V2	-2837	-1600	79	C26	6115	863.5	142	S55	855	1635	205	S118	-4815	1635
17	V2	-2617	-1600	80	C27	6115	953.5	143	S56	765	1635	206	S119	-4905	1635
18	V2	-2397	-1600	81	C28	6115	1043.5	144	S57	675	1635	207	S120	-4995	1635
19	V1	-2177	-1600	82	C29	6115	1133.5	145	S58	585	1635	208	S121	-5085	1635
20	V1	-1957	-1600	83	C30	6115	1223.5	146	S59	495	1635	209	S122	-5175	1635
21	V1	-1737	-1600	84	C31	6115	1313.5	147	S60	405	1635	210	S123	-5265	1635
22	V0	-1517	-1600	85	C32	6115	1403.5	148	S61	315	1635	211	S124	-5355	1635
23	V0	-1297	-1600	86	DUMMY	6115	1635	149	S62	225	1635	212	S125	-5445	1635
24	V0	-1077	-1600	87	DUMMY	6025	1635	150	S63	135	1635	213	S126	-5535	1635
25	VDD	-857	-1600	88	S1	5715	1635	151	S64	45	1635	214	S127	-5625	1635
26	VDD	-637	-1600	89	S2	5625	1635	152	S65	-45	1635	215	S128	-5715	1635
27	VDD	-417	-1600	90	S3	5535	1635	153	S66	-135	1635	216	DUMMY	-5935	1635
28	VSS	-197	-1600	91	S4	5445	1635	154	S67	-225	1635	217	DUMMY	-6025	1635
29	VSS	23	-1600	92	S5	5355	1635	155	S68	-315	1635	218	DUMMY	-6115	1635
30	VSS	243	-1600	93	S6	5265	1635	156	S69	-405	1635	219	C64	-6115	1403.5
31	PCLK2	463	-1600	94	S7	5175	1635	157	S70	-495	1635	220	C63	-6115	1313.5
32	FS	683	-1600	95	S8	5085	1635	158	S71	-585	1635	221	C62	-6115	1223.5
33	SHL	903	-1600	96	S9	4995	1635	159	S72	-675	1635	222	C61	-6115	1133.5
34	ADC	1123	-1600	97	S10	4905	1635	160	S73	-765	1635	223	C60	-6115	1043.5
35	CS2B	1343	-1600	98	S11	4815	1635	161	S74	-855	1635	224	C59	-6115	953.5
36	C	1563	-1600	99	S12	4725	1635	162	S75	-945	1635	225	C58	-6115	863.5
37	CR	1783	-1600	100	S13	4635	1635	163	S76	-1035	1635	226	C57	-6115	773.5
38	R	2003	-1600	101	S14	4545	1635	164	S77	-1125	1635	227	C56	-6115	683.5
39	DB0	2175	-1600	102	S15	4455	1635	165	S78	-1215	1635	228	C55	-6115	593.5
40	DB1	2467	-1600	103	S16	4365	1635	166	S79	-1305	1635	229	C54	-6115	503.5
41	DB2	2759	-1600	104	S17	4275	1635	167	S80	-1395	1635	230	C53	-6115	413.5
42	DB3	3051	-1600	105	S18	4185	1635	168	S81	-1485	1635	231	C52	-6115	323.5
43	DB4	3343	-1600	106	S19	4095	1635	169	S82	-1575	1635	232	C51	-6115	233.5
44	DB5	3635	-1600	107	S20	4005	1635	170	S83	-1665	1635	233	C50	-6115	143.5
45	DB6	3927	-1600	108	S21	3915	1635	171	S84	-1755	1635	234	C49	-6115	53.5
46	DB7	4219	-1600	109	S22	3825	1635	172	S85	-1845	1635	235	C48	-6115	-36.5
47	RS	4559	-1600	110	S23	3735	1635	173	S86	-1935	1635	236	C47	-6115	-126.5
48	RW	4779	-1600	111	S24	3645	1635	174	S87	-2025	1635	237	C46	-6115	-216.5
49	E	4999	-1600	112	S25	3555	1635	175	S88	-2115	1635	238	C45	-6115	-306.5
50	CS1B	5219	-1600	113	S26	3465	1635	176	S89	-2205	1635	239	C44	-6115	-396.5
51	RESETB	5439	-1600	114	S27	3375	1635	177	S90	-2295	1635	240	C43	-6115	-486.5
52	DUMMY	6025	-1600	115	S28	3285	1635	178	S91	-2385	1635	241	C42	-6115	-576.5
53	DUMMY	6115	-1600	116	S29	3195	1635	179	S92	-2475	1635	242	C41	-6115	-666.5
54	C1	6115	-1386.5	117	S30	3105	1635	180	S93	-2565	1635	243	C40	-6115	-756.5
55	C2	6115	-1296.5	118	S31	3015	1635	181	S94	-2655	1635	244	C39	-6115	-846.5
56	C3	6115	-1206.5	119	S32	2925	1635	182	S95	-2745	1635	245	C38	-6115	-936.5
57	C4	6115	-1116.5	120	S33	2835	1635	183	S96	-2835	1635	246	C37	-6115	-1026.5
58	C5	6115	-1026.5	121	S34	2745	1635	184	S97	-2925	1635	247	C36	-6115	-1116.5
59	C6	6115	-936.5	122	S35	2655	1635	185	S98	-3015	1635	248	C35	-6115	-1206.5
60	C7	6115	-846.5	123	S36	2565	1635	186	S99	-3105	1635	249	C34	-6115	-1296.5
61	C8	6115	-756.5	124	S37	2475	1635	187	S100	-3195	1635	250	C33	-6115	-1386.5
62	C9	6115	-666.5	125	S38	2385	1635	188	S101	-3285	1635				
63	C10	6115	-576.5	126	S39	2295	1635	189	S102	-3375	1635				

PAD DESCRIPTION

Power Supply

Name	I/O	Description
VDD	Supply	Power supply
VSS	Supply	Ground
VEE	Supply	For LCD driver circuit
V0, V1 V2, V3 V4, V5	Supply	LCD driver supply voltages The voltages must satisfy the following relationship VDD ¡Ã V0 ¡Ã V1 ¡Ã V2 ¡Ã V3 ¡Ã V4 ¡Ã V5 ¡Ã VEE

Oscillator

Name	I/O	Description
C CR R	O I O	RC Oscillator ¥¡) Internal clock  Rf : 47k¥Ø Cf : 20pF ¥¢) External clock 
FS	I	Frequency Selection When the frame frequency is 70Hz, the oscillation frequency should be as following table.

FS	- Oscillation Frequency
1	fose = 430 kHz
0	fosc = 215kHz

Microprocessor Interface

<table>
<tr><th>Name</th><th>I/O</th><th>Description</th></tr>
<tr><td>CS1B</td><td>I</td><td>First Chip(S1 ~ S64) Select input.
Data input/output is enabled via E, RS, RW, and DB[0:7]when CS1B = Low.</td></tr>
<tr><td>CS2B</td><td>I</td><td>Second Chip(S65 ~ S128) Select input.
Data input/output is enabled via E, RS, RW, and DB[0:7] when CS2B = Low.</td></tr>
<tr><td>RS</td><td>I</td><td>Register Selection
- HIGH : The data in DB[7:0] is display data
- LOW : The data in DB[7:0] is control data</td></tr>
<tr><td>RW</td><td>I</td><td>Read or Write
<table>
<tr><th>RW</th><th>Description</th></tr>
<tr><td>H</td><td>Data appears at DB< 7:0 > when E = High.</td></tr>
<tr><td>L</td><td>Display data DB < 7:0 > can be written at falling edge of E.</td></tr>
</table></td></tr>
<tr><td>E</td><td></td><td>Enable signal.
<table>
<tr><th>RW</th><th>Description</th></tr>
<tr><td>H</td><td>Read data in DB< 7:0 > appears the while E is high level.</td></tr>
<tr><td>L</td><td>Display data DB < 7:0 > is latched at falling edge of E.</td></tr>
</table></td></tr>
<tr><td>DB0 ~ DB7</td><td>I/0</td><td>Data Bus [0 ~ 7]
- Bi-directional data bus</td></tr>
</table>

Reset

Name	I/O	Description
RESETB	I	Reset input - Chip is initialized when RESETB is LOW

LCD Driver Outputs

<table>
<tr><th>Name</th><th>I/O</th><th>Description</th></tr>
<tr><td>C1 ~ C64</td><td>O</td><td>LCD driver common output</td></tr>
<tr><td>S1 ~ S128</td><td>O</td><td>LCD driver segment output</td></tr>
<tr><td>PCLK2</td><td>I</td><td>Phase of internal shift clock (CLK2)
<table>
<tr><th>PCLK2</th><th>Phase of Internal Shift Clock (CLK2)</th></tr>
<tr><td>0</td><td>Data shift at the falling edge of CLK2</td></tr>
<tr><td>1</td><td>Data shift at the rising edge of CLK2</td></tr>
</table></td></tr>
<tr><td>ADC</td><td>I</td><td>Address Control signal of Y address counter.
<table>
<tr><th>ADC</th><th>Segment output direction</th></tr>
<tr><td>H</td><td>S1 ¡æ S2 ....S63 ¡æ S65 ¡æ S66 ....S127 ¡æ S128</td></tr>
<tr><td>L</td><td>S64 ¡æ S63 ....S2 ¡æ S1 ¡æ S128 ¡æ S127 ....S66 ¡æ S65</td></tr>
</table></td></tr>
<tr><td>SHL</td><td>I</td><td>Selection of data shift direction
<table>
<tr><th>SHL</th><th>Data shift direction</th></tr>
<tr><td>H</td><td>C1 ¡æ C2 ¡æ C3 .... C62 ¡æ C63 ¡æ C64</td></tr>
<tr><td>L</td><td>C64 ¡æ C63 ¡æ C62 .... C3 ¡æ C2 ¡æ C1</td></tr>
</table></td></tr>
</table>

FUNCTIONAL DESCRIPTION

Chip Select input

The KS0708 has two chip select pin, CS1B and CS2B. It can interface with a mircoprocessor when these pins(CS1B or CS2B)is Low. When both of these pins are set to High, DB0 to DB7 are high impedance and RS, RW, and E inputs are disabled. CS1B pin controls the display status of S1 to S64, and CS2B does that of S65 to S128. When CS1B and CS2B are Low at the same time, it is impossible to execute read operation. Therefore one of CS1B or CS2B should be set to Low((CS1B = ¡¨H¡¨& CS2B = ¡¨L¡¨)or (CS1B = ¡¨L¡¨ & CS2B = ¡¨H¡¨)) in read operation. The RESETB signal is entered independet of the status of Chip Select.

CS1B	CS2B	Read Operation		Write Operation	
		CS1	CS2	CS1	CS2
H	H	X	X	X	X
L	H	¡Û	X	¡Û	X
H	L	X	¡Û	X	¡Û
L	L	-	-	¡Û	¡Û

(- : Not Recommended, ¡Û : Operation, X : No Operation)
Table 1. Relationship between Chip Select pins and Read/Write Operation

Microprocessor Interface

KS0708 transfers 8-bit parallel in either direction between the controlling microprocessor and the KS0708 through the 8-bit I/O buffer(DB0 TO DB7).
RS, RW and E identify the type of parallel data transfer to be made as shown in table 2.

RS	RW	Description
H	H	Display data read
H	L	Display data write
L	H	Status read
L	L	Writes to internal register (Instruction)

Table 2. Microprocessor Interface

Busy flag

Busy flag indicates whether KS0708 is operating or not. When busy flag is high, KS0708 is in internal operation. When low, KS0708 can accept the data or instruction. DB7 indicates busy flag of the KS0708.

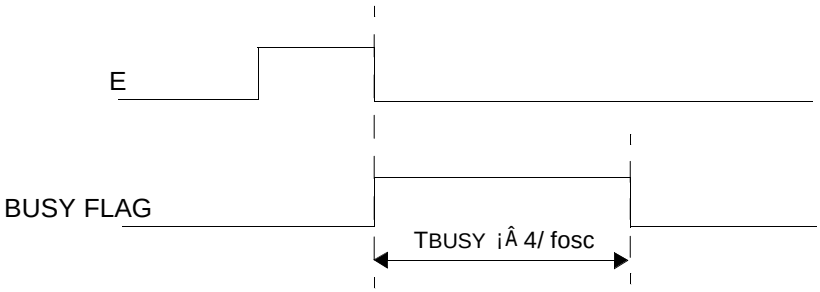


Figure 1. Busy timing

Display Timing Generator Circuit

This section explains how the timing generation circuit operates.

- Signal generation to display start line counter and display data latch circuit.
- The display clock(CLK2) generates a clock to the line counter. The display start line address of the display RAM is synchronized with the display clock. 128-bit display data is latched by the display data latch circuit in synchronization with the display clock and output to the segment LCD drive output pin.
- LCD AC signal(M) generation.

Display Data RAM

The Display Data RAM stores pixel data for the LCD. It is a 128-column x 64-row addressable array as shown in Figure 3. The 64 rows are divided into 8 pages of 8 lines. Data is read from or written to the 8 lines of each page directly through DB0 to DB7.
The microprocessor reads from and writes to RAM through the I/O buffer. Since the LCD controller operates independently, data can be written to RAM at the same time as data is being displayed, without causing the LCD to flick.

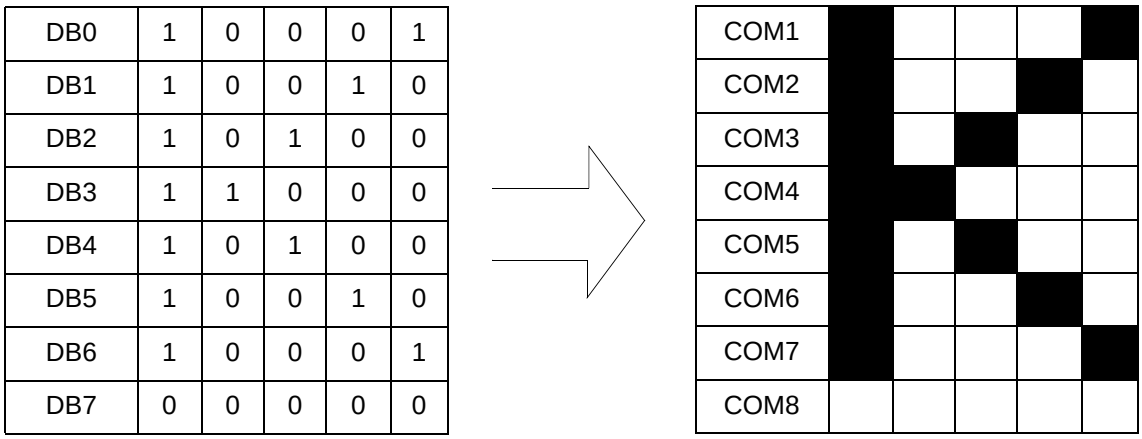


Figure 2. RAM-to-LCD data transfer

Page address	Line address	SEGMENT OUTPUT(S1~S64)									DATA BUS	SEGMENT OUTPUT(S65~S128)									Line address	Page address
		S1	S2	S3	S4	.....	S61	S62	S63	S64		S65	S66	S67	S68	.....	S125	S126	S127	S128		
0000	00 01 02 03 04 05 06 07					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					00 01 02 03 04 05 06 07	000
001	08 09 10 11 12 13 14 15					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					08 09 10 11 12 13 14 15	001
010	16 17 18 19 20 21 22 23					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					16 17 18 19 20 21 22 23	010
011	24 25 26 27 28 29 30 31					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					24 25 26 27 28 29 30 31	011
100	32 33 34 35 37 38 39					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					32 33 34 35 36 37 38 39	100
101	40 41 42 43 44 45 46 47					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					40 41 42 43 44 45 46 47	101

Page address	Line address	SEGMENT OUTPUT(S1~S64)									DATA BUS	SEGMENT OUTPUT(S65~S128)									Line address	Page address
		S1	S2	S3	S4	.....	S61	S62	S63	S64		S65	S66	S67	S68	.....	S125	S126	S127	S128		
110	48 49 50 51 52 53 54 55					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					48 49 50 51 52 53 54 55	110
111	56 57 58 59 60 61 62 63					.....					DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7					.....					56 57 58 59 60 61 62 63	111
ADC	1	0	1	2	4	.....	60	61	62	63		0	1	2	4	.....	60	61	62	63	1	ADC
	0	63	62	61	60	.....	3	2	1	0		63	62	61	60	.....	3	2	1	0	0	
		Column address										Column address										
Chip Select (CS1B)												Chip Select (CS2B)										

Figure 3. Display Data RAM

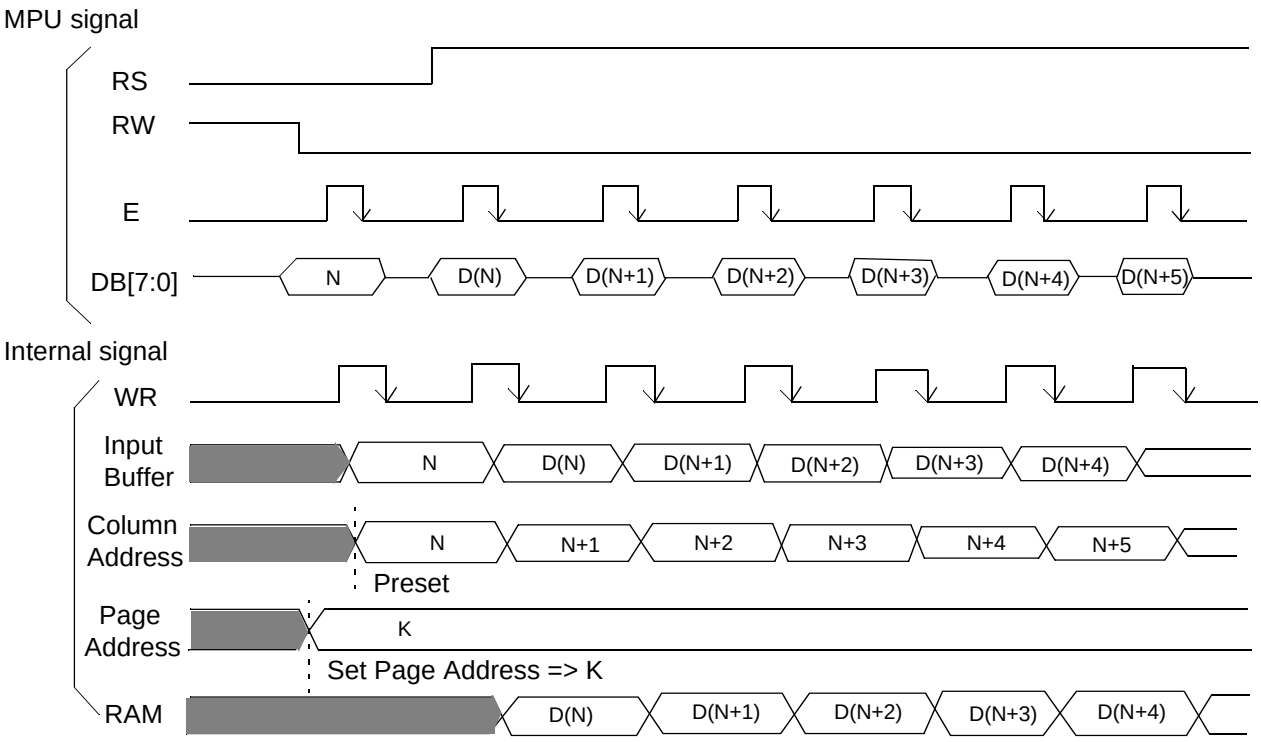


Figure 4. Write Timing

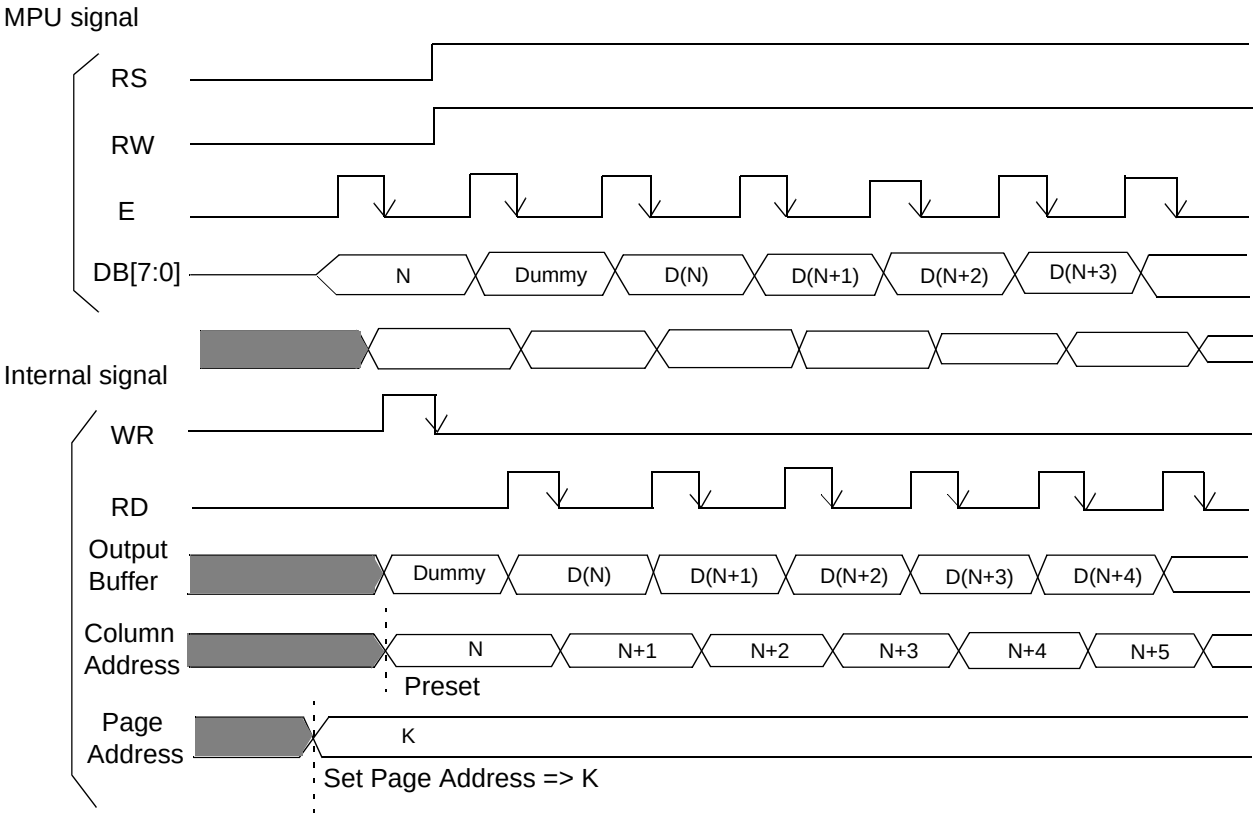


Figure 5. Read timing

Data Tramsfer

To match the timing of the display data RAM and registers to that of the controlling microprocessor, KS0708 uses an internal data bus and bus buffer. When the microprocessor reads the contents of display data RAM, the data for the initial read cycle is first stored inthe bus buffer (dummy read cycle). On the next read cycle, the data is read from the bus buffer onto the microprocessor bus. At the same time, the next block of data is transferred from RAM to the bus buffer. Otherwise, when the microprocessor write data to display data RAM. the data is written to RAM atfer the falling edge of £àE£§. Therefore, it is necessary to check Busy Flag to write or read the next data. (refer to Figure4, 5)

Page Address Register

The 3-bit Page Address register provides the page address to display data RAM (refer to Figure 3). The microprocessor issues Set Page Address instruction to change the page and to access another page.

Column Address Counter

The column address counter is a 6-bit presettable counter that provides column address to display data RAM (refer to Figure 3). It is incremented by 1 automatically after execution of each Read/Write Data instruction. The column address counter loops the values 0 to 127, and it is independent of page address register. The ADC pin is issued to change the relationship between RAM Column address and display segment output.

Display Start Line Register

The display start line register stores the line address of display data RAM that corresponds to the first (normally the top) line(COM1) of liquid crystal display(LCD) panel. See Figure 3. When displaying contents in display data RAM on the LCD panel, 6-bit data(DB[5:0]) of the Set Display Start Line is latched in display start line register. Latched data are transferred to the line address counter just before COM1 is active High, presetting the line address counter. The line counter is then incremented on the display latch clock signal once for every display line. It is used for vertical scrolling of the liquid crystal display screen.

LCD Driver

LCD driver circuit has 192 outputs of 128 segment outputs, 64 common outputs for LCD driving.
Each common output has a shift register. LCD driving output voltage is determined by the combination of display data and internal AC signal.

Display Data	Common output	Segment output
0	V1	V2
	V4	V3
1	V5	V0
	V0	V5
Display OFF	-	V2 or V3

Table 4. Relationship between data for each input signal and the LCD drive output.

Reset Circuit

Reset function can initialize system by setting RESETB terminal at Low level. When RESETB becomes low, following procedure occurs.

- Display start line : 0(First)
- Display ON/OFF : OFF

While RESETB is in Low level, no instruction except Status Read can be accepted. Reset status appears at DB4. Refers to Read Status of ¢©INSTRUCTION DESCRIPTION¢©.
The conditions of power supply at initial power up are shown in table 3.

Item	Symbol	Min	Typ	Max	Unit
Reset time	t_{RESETB}	1.0	-	-	us
Rise time	tr	-	-	200	ns

Table 5. Power supply initial Conditions.

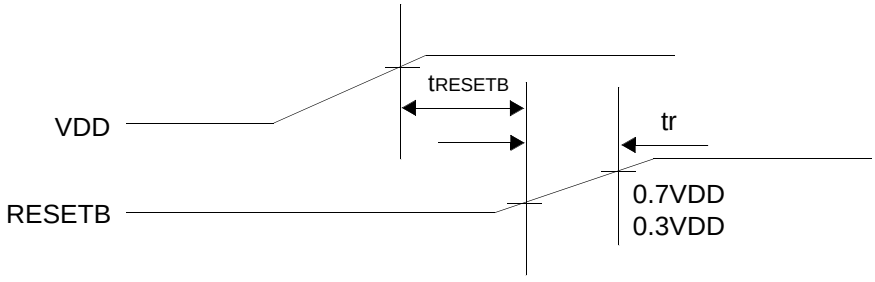


Figure 6. Reset Timing

INSTRUCTION DESCRIPTION

Instruction Table

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Read display data	1	1	Read data								Reads data (DB[0:7]) from display data RAM to the data bus.
Write display data	1	0	Write data								Writes data(DB[0:7]) into display data RAM. After writing instruction, column address is incremented by 1 automatically.
Status Read	0	1	BUSY	0	ON/ OFF	RE-SET	0	0	0	0	Reads status BUSY -0 : Ready -1 : In operation ON/OFF -0 : Display ON -1 : Display OFF RESET -0 : Normal -1 : Reset
Set Column Address	0	0	0	1	Column address (0 ~ 63)						Sets the Column address at the Column address counter
Set Display Start Line	0	0	1	1	Display Start Line (0 ~ 63)						Indicates the display data RAM displayed at the top of the screen.
Set Page Address	0	0	1	0	1	1	1	Page (0 ~ 7)			Sets the Page address at the Page address register.
Display ON/OFF	0	0	0	0	1	1	1	1	1	0/1	Controls the display on or off. Internal status and display RAM data is not affected. L:OFF, H:ON

Instructions

¡á Read Display Data

Reads 8-bit data display data RAM area specified by column address and page address. As the column address is incremented by 1 automatically after each read operation, the microprocessor can continue to read data of multiple words.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	Read data							

¡á Write Display Data

Writes 8-bit data in display data RAM. As the column address is incremented by 1 automatically after each write operation, the microprocessor can continue to write data of multiple words.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	Write data							

¡á Read Status

Indicates the internal status conditions of the device to the microprocessor.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BUSY	0	ON/OFF	RESET	0	0	0	0

Flag	Description
BUSY	The device is busy due to internal operation or reset. Any instruction is rejected until BUSY goes Low.
ON/OFF	Indicates whether the display is on or off. When goes Low, the display is on. When goes High, the display is off. This is the opposite of Display ON/OFF instruction.
RESET	Indicates the initialization is in progress by RESETB signal. When Low, the chip is in active. When High, the chip is being reset.

¡á Set Page Address

Sets the page address of display RAM from the microprocessor into the page address register. Along with Column address register, Page address register assigns the address of the display RAM to be written to or read from display data. Changing the address doesn ¢¥t affect the display status.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	1	1	X2	X1	X0

X2	X1	X0	Page
0	0	0	0
0	0	1	1
:	:	:	:
1	1	1	7

¡á Set Column Address

Sets the Column address of display RAM from the microprocessor into the Column address register. When the microprocessor reads or writes display data to or from display RAM, the address are automatically incremented.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	Y5	Y4	Y3	Y2	Y1	Y0

Y5	Y4	Y3	Y2	Y1	Y0	Column address
0	0	0	0	0	0	0
0	0	0	0	0	1	1
:	:	:	:	:	:	:
1	1	1	1	1	0	62
1	1	1	1	1	1	63

¡á Set Display Start Line

Sets the line address of display RAM to determine the display start line. The display data on the specified line of the display RAM is displayed at the top row COM1 of LCD panel. It is followed by the higher number of lines in ascending order corresponding to the determined duty cycle. When this instruction changes the display start line address, the LCD panel can be scrolled.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB0	DB0
0	0	1	1	Z5	Z4	Z3	Z2	Z1	Z0

Z5	Z4	Z3	Z2	Z1	Z0	Line address
0	0	0	0	0	0	0
0	0	0	0	0	1	1
:	:	:	:	:	:	:
1	1	1	1	1	0	62
1	1	1	1	1	1	63

¡á Display ON/OFF

Turns the display ON or OFF.

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB0	DB0
0	0	0	0	1	1	1	1	1	D0

D0 = 1 : Display ON
D0 = 0 : Display OFF

¡á APPLICATION DIAGRAM1 (ADC = H, SHL = H)

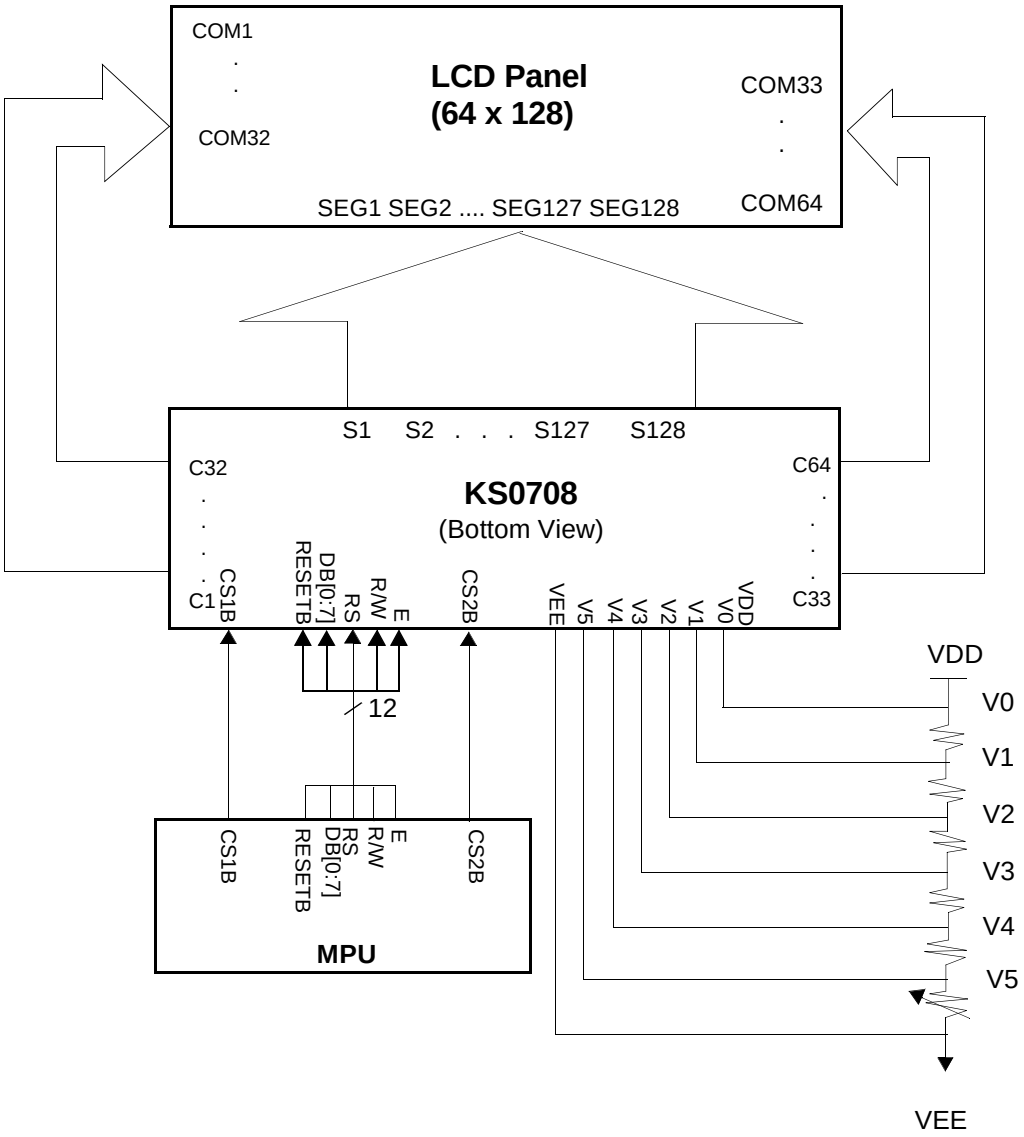
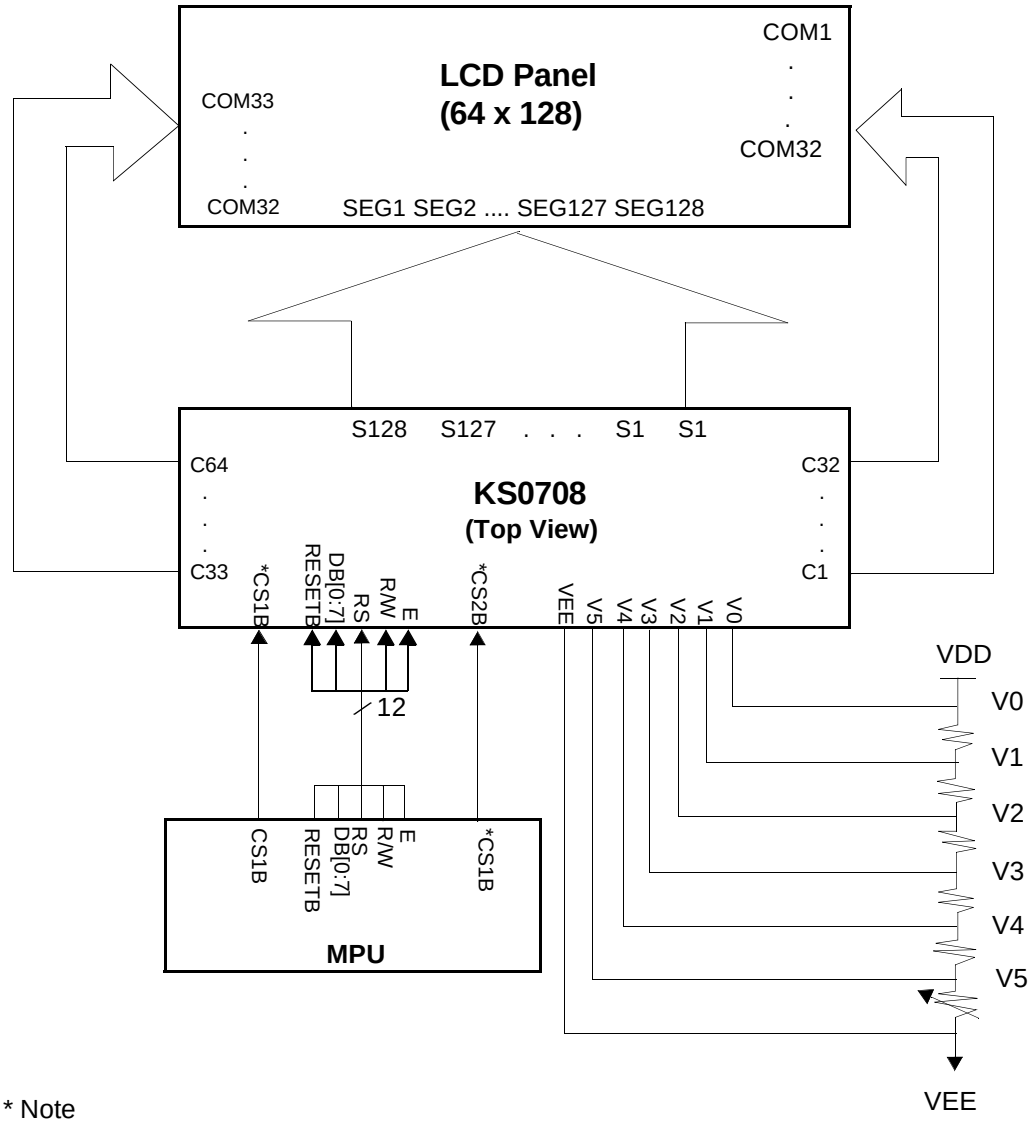


Figure 7. Application Diagram1

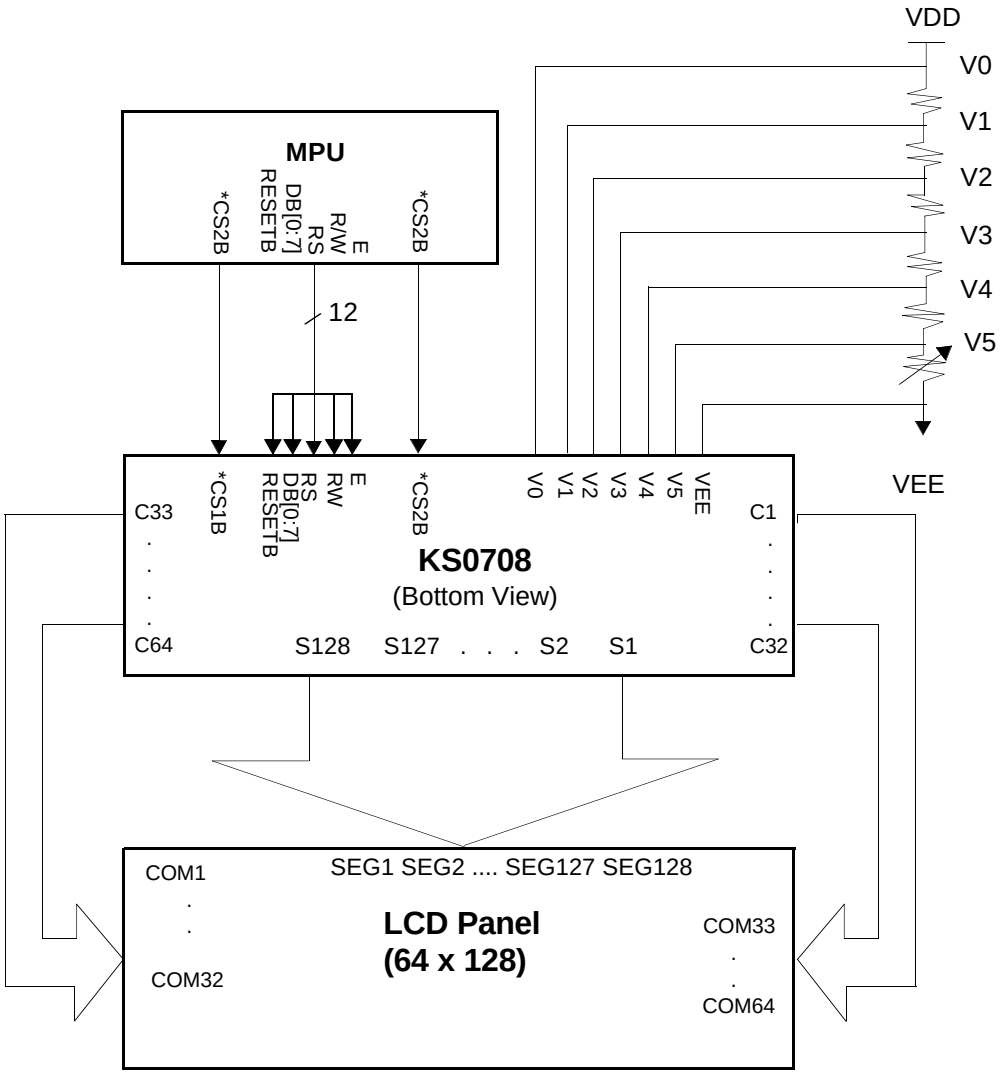
¡á APPLICATION DIAGRAM2 (ADC = L, SHL = H)



* Note
When ADC = L, connects chip select pins(CS1B,CS2B) as following.
- C1b (mpu) -> CS2B (KS0708)
- CS2B (MPU) -> CS1B (KS0708)

Figure 8. Application Diagram 2

¡á APPLICATION DIAGRAM3 (ADC = L, SHL = L)



* Note

When ADC = L, connects chip select pins (CS1B, CS2B) as following.

- CS1B (MPU) -> CS2B (KS0708)
- CS2B (MPU) -> CS1B (KS0708)

Figure 9. Application Diagram 3

¡á APPLICATION DIAGRAM4 (ADC = H, SHL = L)

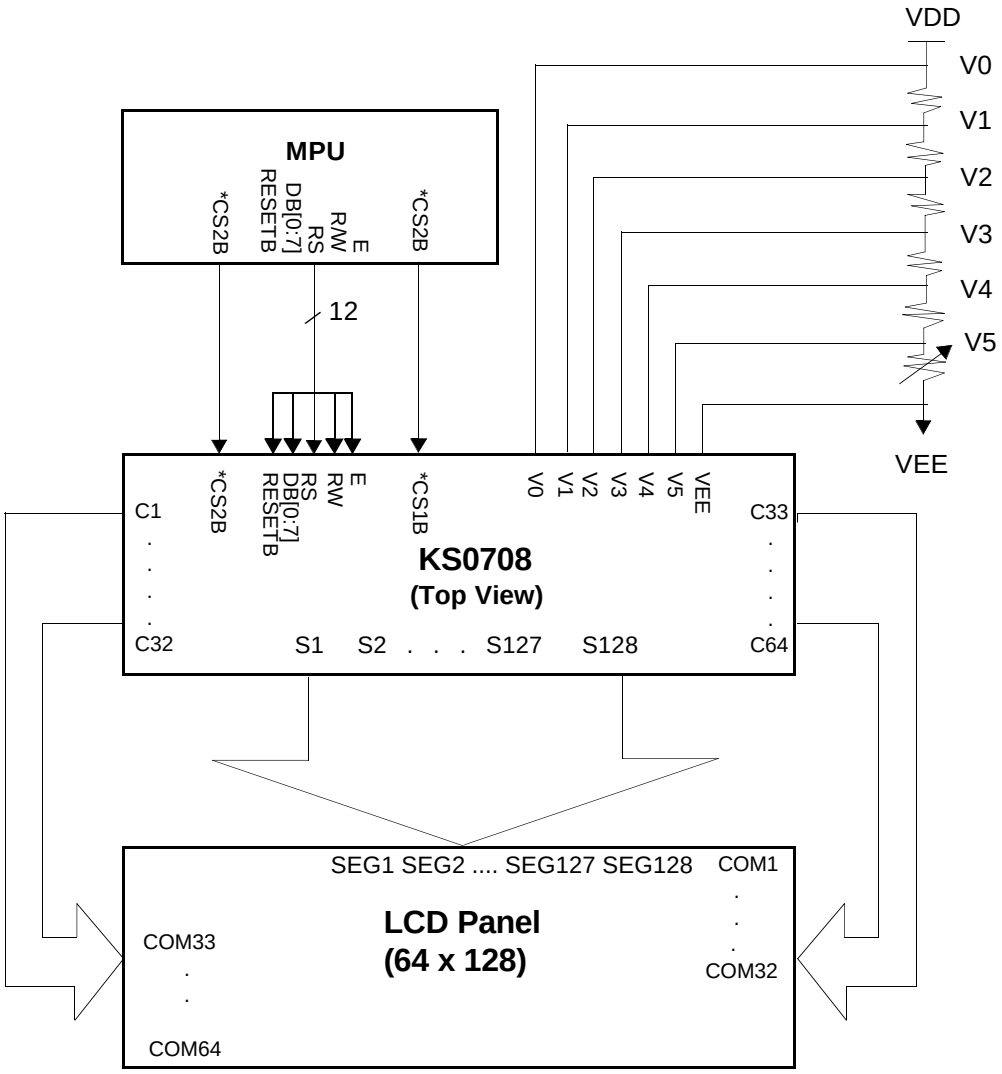


Figure 10. Application Diagram 4

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit	Note
Operating voltage	V_{DD}	-0.3 ~ +7.0	V	*1
Supply Voltage	V_{EE}	VDD-19.0 ~ VDD+0.3		*4
Driver Sypply Voltage	V_B	-0.3 ~ VDD+0.3		*1,3
	V_{LCD}	VEE-0.3 ~ VDD+0.3		*2

Note :

*1. Based on Vss = 0V
*2. VLCD = VDD - VEE
*3. Applies to SHL, FS, PCLK2, CR, RESETB, ADC, CS1B, CS2B, E, RW, RS and DB0 ~ DB7.
*4. Voltage level
VDD ¡Ã V0 ¡Ã V1 ¡Ã V2 ¡Ã V3 ¡Ã V4 ¡Ã V5 ¡Ã VEE

Temperature Characteristics

Parameter	Symbol	Rating	Unit	Note
Operating temperature	Topr	-30 ~ +85	¡É	
Storage temperature	Tstg	-55 ~ +125		

Electrical Characteristics

DC Characteristics

(VDD = 4.5 ~ 5.5V, Ta = -30 ~ +85 ¡É)

Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Operating Voltage		VDD	-	4.5	-	5.5	V	
Input High Voltage		VIH1	-	0.7VDD	-	VDD		*1
		VIH2	-	2.0	-	VDD		*2
Input Low Voltage		VIL1	-	0	-	0.3VDD		*1
		VIL2	-	0	-	0.8		*2
Output High Voltage		VOH	IOH = -200uA	2.4	-	-		*3
Output Low Voltage		VOL	IOL = 1.6mA	-	-	0.4		
Input Leakage Current		ILKG	VIN = VSS ~ VDD	-1.0	-	+1.0	uA	*4
Tri-state Leakage Current		ITSL	VIN = VSS ~ VDD	-5.0	-	+5.0		*5
Driver Input Leakage Current		IDLKG	VIN = VEE ~ VDD	-10	-	+10		*6
Operating Current		IDD1	During Display	-	-	0.8	mA	*7
		IDD2	During Access	-	-	1.0		*8
On resistance	COM	RONC	VDD - VEE = 17V ¡¾ILOAD = 0.1mA	-	-	1.5	k§Ù	*9
	SEG	RONS		-	-	7.5		*10
Oscillation frequency		fosc	Ta=25¡É, VDD=5V Rf = 47k§Ù ¡¾ 2% Cf = 20pF ¡¾ 5%	315	450	585	KHz	

Note :

*1. FS, CR, ADC, SHL, PCLK2, RESETB
*2. CS1B, CS2B, E, RW, RS, DB0 ~ DB7
*3. DB0 ~ DB7
*4. Excepted DB0 ~ DB7
*5. DB0 ~ DB7 at High Impedence
*6. V0, V1, V2, V3, V4, V5
*7. C = 20pF, R = 47 k§Ù, fose = 450 KHz, DB0 ~ DB7 = VDD, Output = No Load
*8. Excepted Clock = 430KHz, RAM Access Cycle = 1MHz
*9. V0 = 5V, V1 = 3.2V, V2 = 1.4V, V3 = -8.4V, V4 = -10.2V, V5 = -12V, C1 ~ C64
*10. V0 = 5V, V1 = 3.2V, V2 = 1.4V, V3 = -8.4V, V4 = -10.2V, V5 = -12V, S1 ~ S128

AC Characteristics

(VDD = 4.5 to 5.5V, Ta = -30 to +85 ¡É)

Mode	Item	Symbol	Min	Typ	Max	Unit
Write Mode (Refer to Figure 9)	E Cycle Time	tc	1000	-	-	ns
	E Rise / Fail Time	tr, tf	-	-	25	
	E Pulse Width(High, Low)	tw	450	-	-	
	RW and RS Setup Time	tsu1	140	-	-	
	RW and RS Hold Time	th1	10	-	-	
	Data Setup Time	tsu2	200	-	-	
	Data Hold Time	th2	10	-	-	
Read Mode (Refer to Figure 10)	E Cycle Time	tc	1000	-	-	ns
	E Rise / Fall Time	tr,tf	-	-	25	
	E Pulse Width (High, Low)	tw	450	-	-	
	Rw and Rs Setup Time	tsu	140	-	-	
	RW and RS Hold Time	th	10	-	-	
	Data Output Delay Time	t_D	-	-	320	
	Data Hold Time	t_{DH}	20	-	-	

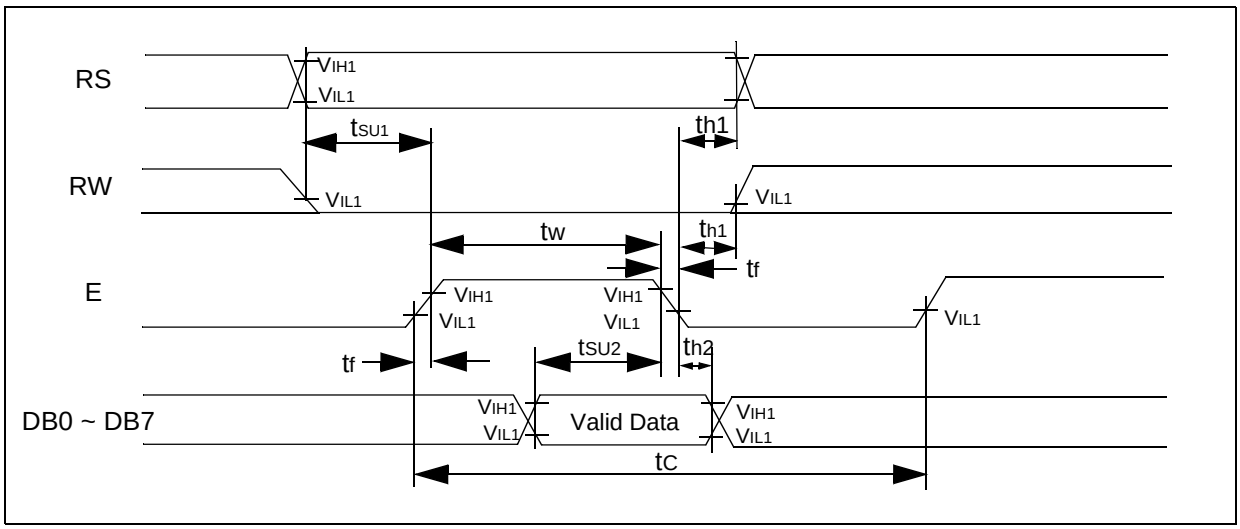


Figure 9. Write Mode Timing Diagram

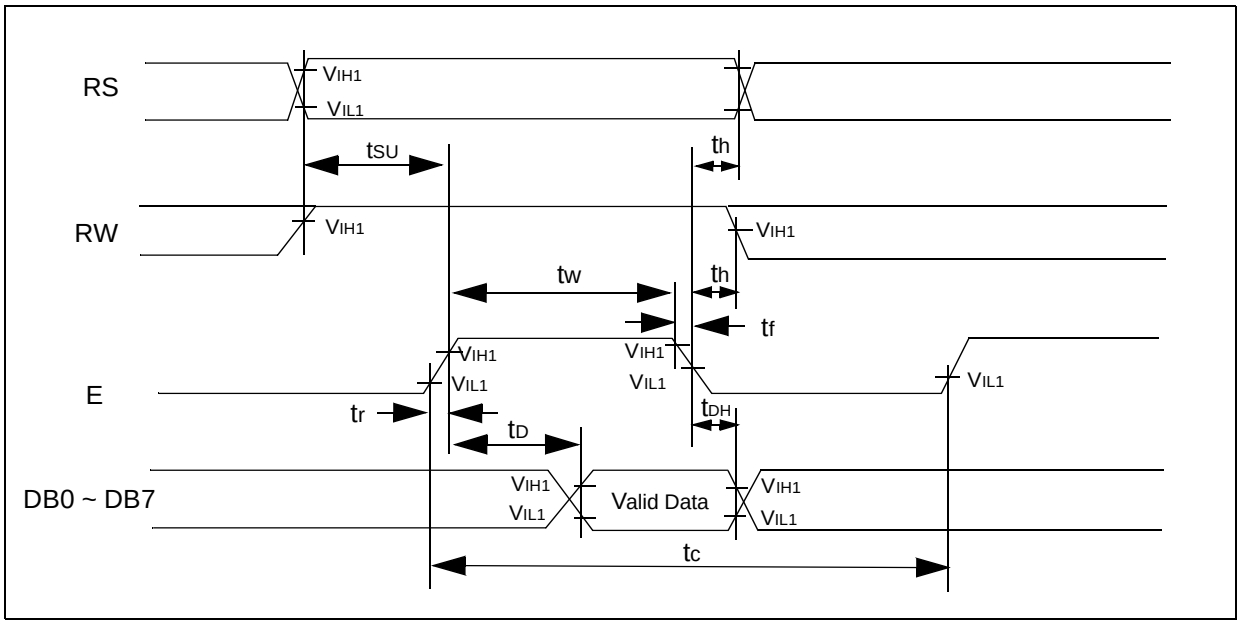


Figure 10. Read Mode Timing Diagram