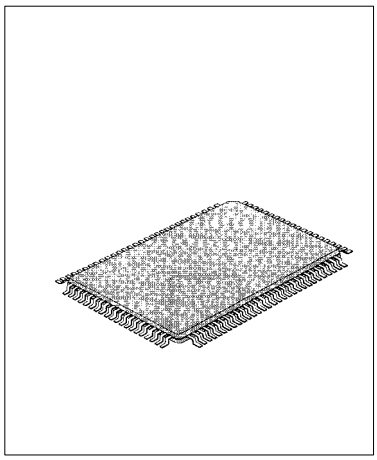
INTRODUCTION

100 QFP



The KS0068 is a dot matrix LCD driver & controller LSI which is fabricated by low power CMOS technology.

FUNCTION

- Character type dot matrix LCD driver & controller
- Internal driver: 16 common and 60 segment signal output.
- Display character format; 5x7 dots + cursor, 5x10 dots + cursor
- Easy interface with a 4-bit or 8-bit MPU
- Display character pattern:
  5x7 dots format: 192 kinds, 5x10 dots format: 32kinds
- The special character pattern can be programmable by Character Generator RAM directly.
- A customer character pattern can be programmable by mask option (KS0068B-00; Standard type)

KS0068-00
English, Japanese Numeral

- Automatic power on reset function.
- It can drive a maximum 80 characters by using the kS0065B or KS0063 externally.
- It is possible to read both Character Generator and Display Data RAM from MPU.

FEATURES

- Internal Memory
  - Character Generator ROM: 8320bits
  - Character Generator RAM: 512 bits
  - Display Data RAM: 80x8bits for 80 digits.
- Power Supply Voltage; +5V±10%
- Supply voltage for display: 0~-5V(V_{EE})
- CMOS process
- 1/8 duty, 1/11 duty or 1/16 duty: selectable
  (1/8 duty; 5x7 dots format 1 line, 1/11 duly; 5 x 10 dots format I line, 1/16 duty: 5x7 dots format 2 line)
- 100 QFP or bare chip available.

BLOCK DIAGRAM

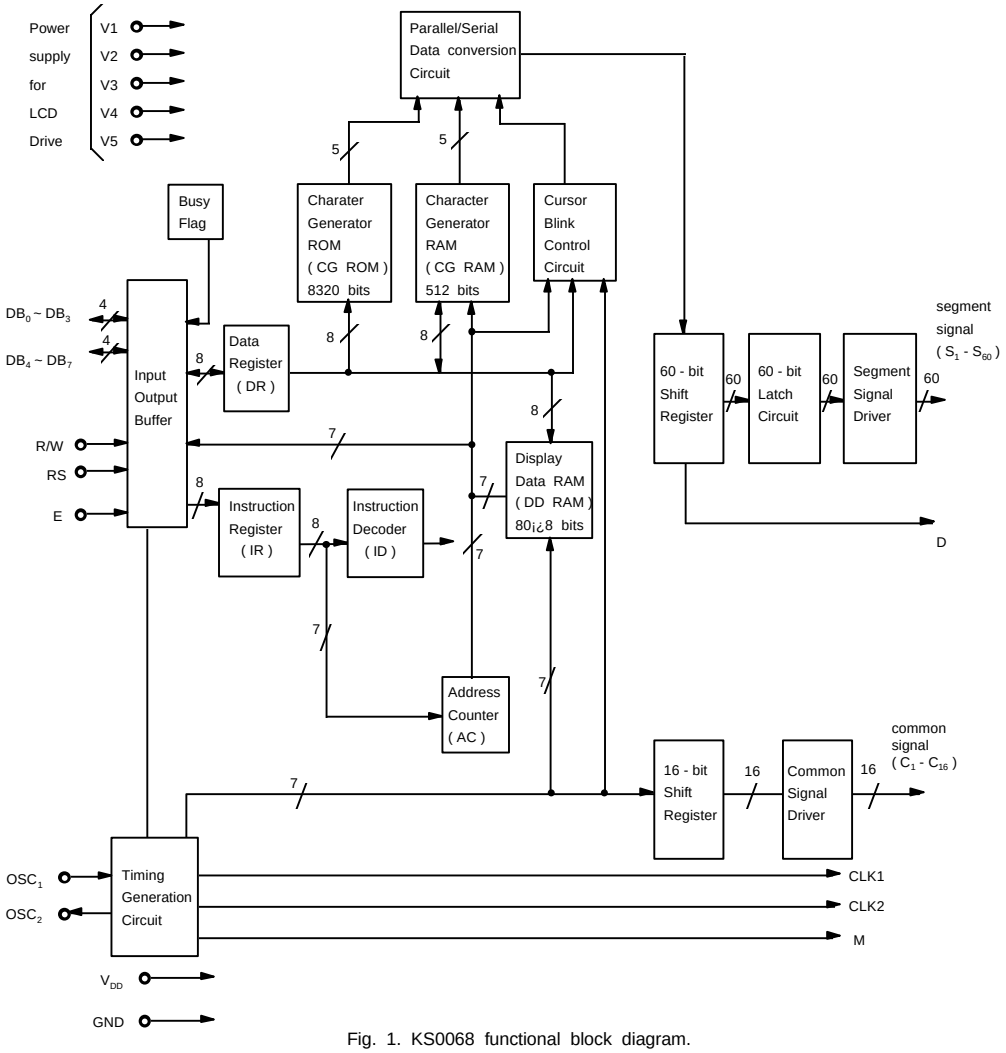


Fig. 1. KS0068 functional block diagram.

PIN CONFIGURATION

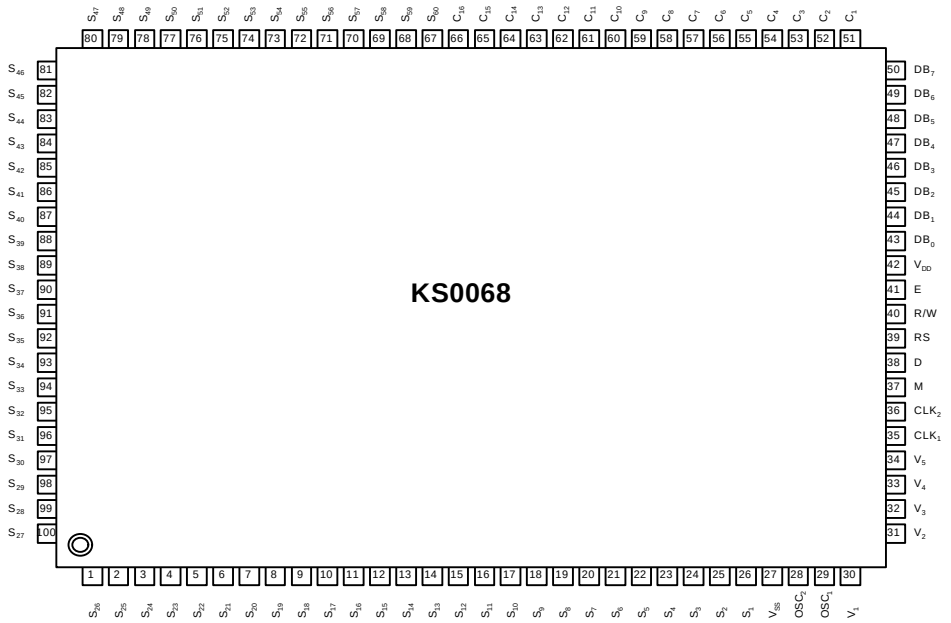
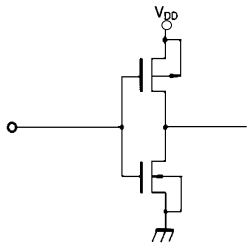
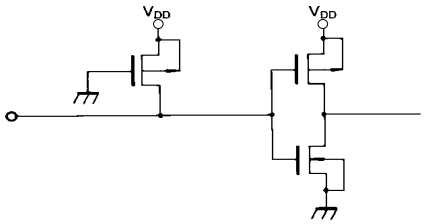
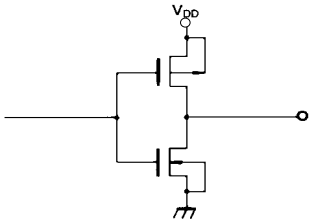
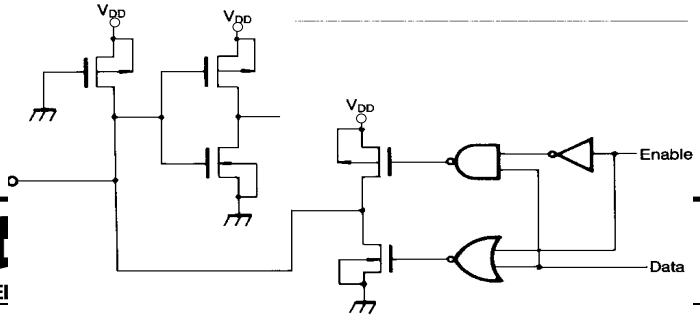


Fig2. 100QFP Top View

PIN DESCRIPTION

PIN(No).	INPUT/OUTPUT	NAME	DESCRIPTION	INTERFACE
V_{DD}(42)	Power	Operating Voltage	for logical circuit (+5V±10%)	Power Supply
V_{SS}(GND) (27)			0V (GND)	
V_1-V_5(30-34)		Negative Supply Voltage	Bias voltage level for LCD driving	
S_1-S_{60} (1-26, 67-100)	Output	Segment output	Segent signal output for LCD driving	LCD
C_1-C_{16} (51-66)	Output	Common output	Common signal output for LCD driving	LCD
OSC_1, OSC_2 (29) (28)	Input (OSC1) Output (OSC2)	Oscillator	Both pin connected to Rf resistor or ceramic resonator for internal oscillator circuit. In case of external frequency use only, the frequency is input to OSC1 terminal.	Resistor or Ceramic Resonator
CLK1 (35)	Output	Data latch clock	Clock output terminal for the serially transfered data to be latched to the driver.	KS0065B or KS0063
CLK2 (36)		Data shift clock	Clock output terminal used when D terminal data output shifts the inside of the driver.	
M (37)		Alternated signal for LCD driver output	The alternating signal to convert LCD drive waveform to AC	
D (38)		Display data interface	Character pattern data, which is corresponding to each common signal, is supplied to driver serially. High: Selection Low: Non selection	
E(41)	Input	Enable	Start enable signal to read or write the data	MPU
R/W(40)		Read/Write	R/W signal input is used to select the read/write mode High: Read mode Low: Write mode	
RS (39)		Register select	register selection input High: Data register (for read and write) Low: Instruction register (for write), Busy flag, address counter (for read)	
DB_0-DB_7 (43-50)	Input/Output	Data interface	Used for data transfer between the MPU and KS0068. These terminals are for data bus with bidirectional three-state. Initial 4 bit (DB_0-DB_3) are not used during 4-bit operation (DB_7 can be used as a busy flag)	

Internal logic of input/output terminal

Input/Output		Logic diagram	Applicable pin
Input	No Pull up		E
	with pull up		RS, R/W
Output			CLK1, CLK2 M,D
Input Output			DB_0-DB_7

MAXIMUM ABSOLUTE LIMIT (Ta=25°C)

Characteristic	Symbol	Value	Unit
Operating Voltage	V_{DD}	-0.3~+7.0	V
Driver Supply Voltage	V_{LCD}	V_{DD}-11.5~V_{DD}+0.3	V
Input Voltage	V_{IN}	-0.3 ~ V_{DD}+0.3	V
Power Dissipation	P_D	500	mW
Operating Temperature	T_{OPR}	-20~+75	°C
Storage Temperature	T_{STG}	-55~+125	°C

* Voltage greater than above may damage to the circuit ($V_{DD} \geq V_1 \geq V_2 \geq V_3 \geq V_4 \geq V_5$)

ELECTRICAL CHARACTERISTICS

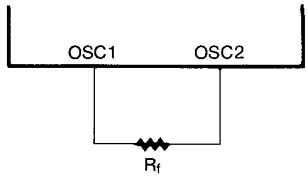
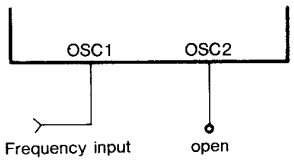
DC Characteristics (V_{DD}=+5V±10%, V_{SS}=0V, T_a=-20 ~ +75°C)

Characteristic		Symbol	Test condition		Min	Typ	Max	Unit	Applicable Pin
Operating Voltage		V_{DD}	-		4.5	-	5.5	V	
Operating Current (*1)		I_{DD1}	Ceramic resonator fosc=250KHz		-	0.65	0.9	mA	
		I_{DD2}	Resistor oscillation external clock operation fosc=270KHz		-	0.45	0.7		
Input Voltage 1	High	V_{IH1}	-		2.2	-	V_{DD}	V	E, DB_0-DB_7, R/W, RS
	Low	V_{IL1}	-		-0.3	-	0.6		
Input Voltage 2	High	V_{IH2}	-		V_{DD} -1.0	-	V_{DD}		OSC1
	Low	V_{IL2}	-		-0.2	-	1.0		
Output Voltage 1	High	V_{OH1}	I_{OH}=-0.205mA		2.4	-	-		DB_0-DB_7
	Low	V_{OL1}	I_{OL}=1.2mA		-	-	0.4		
Output Voltage 2	High	V_{OH2}	I_O=-40µA		0.9 V_{DD}	-	-		CLK1, CLK2, M, D
	Low	V_{OL2}	I_O=40µA		-	-	0.1V_{DD}		
Voltage Drop (*2)	COM	Vd_{COM}	I_O=±0.1mA		-	-	1		C1-C16
	SEG	Vd_{SEG}			-	-	1		S1-S60
Input Leakage Current		I_{LKG}	V_{IN}=0 or V_{DD}		-1	-	1	µA	E
Input Low Current		I_{IN}	V_{DD}=5V (test pull up R)		-50	-125	-250		RS,R/W
External Clock	Frequency (*3)	f_{EC}	-		125	250	350	KHz	OSC1
	Duty	duty			45	50	55	%	
	Rise time	t_R			-	-	0.2	µs	
	Fall time	t_F			-	-	0.2	µs	
Internal Clock Frequency(*3)		f_{OSC1}	Rf=91KΩ±2%		190	270	360	KHz	OSC1, OSC2
Ceramic Resonator Oscillation Frquency (*3)		f_{OSC2}	-		245	250	255		
LCD Driving Voltage (*4)		V_{LCD1}	V_{DD}-V_5	1/5 bias	4.6	-	10.0	V	V_1-V_5
		V_{LCD2}		1/4 bias	3.0	-	10.0		

Note: *1) Applies to the current value flown in terminal V_{DD} when power is input as follows; V_{DD}=5V, GND=0V, V1=3.4V, V2=1.8V, V3=0.2V, V4=-1.4V and V5=-3V.

*2) Applied to the voltage drop occuring from terminals V_{DD}, V1, V4 and V5 to each common terminal (C1-C16) when 0.1mA is flown in or out to and from all COM and SEG terminals, and also to voltage drop occuring from terminals V_{DD}, V2, V3 and V5 to each SEG terminal (S1-S60). When the output level is at V_{DD}, V1 or V2 level, 0.1mA is flown out, while 0.1mA flow in when the output level is at V3, V4 or V5 level. This occurs when 5V or -5V is input to V_{DD}, V1 and V3 or to V2, V4, and V5 respectively.

*3) Oscillator circuit

Resistor circuit	External clock cirucit
 R_f: 91kΩ±2%	

*4) Input the voltage listed in the table below to V_1-V_5

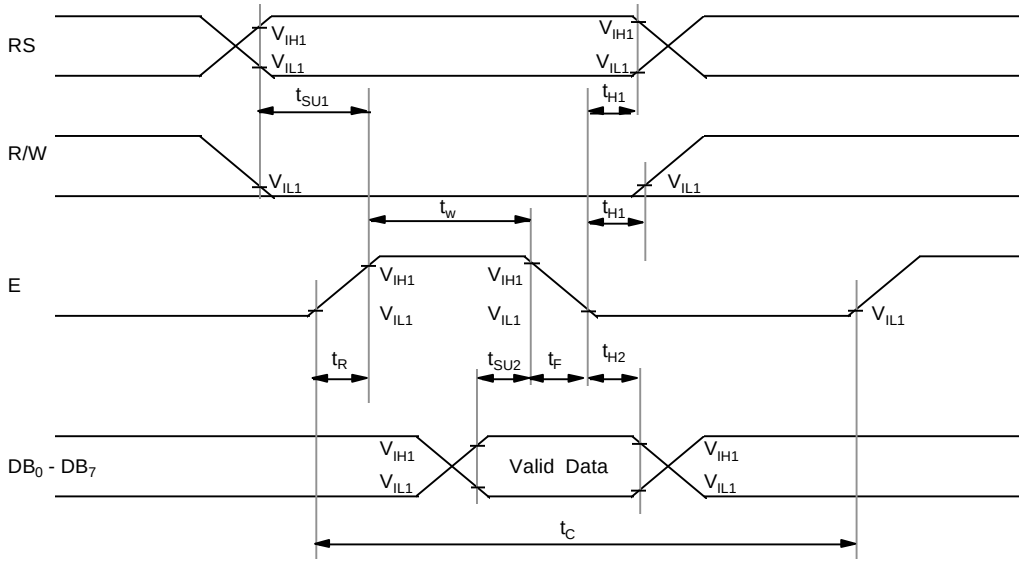
Duty / Bias / Power supply	1/8, 1/11	1/16
	1/4	1/5
V_1	V_{DD}-V_{LCD}/4	V_{DD}-V_{LCD}/5
V_2	V_{DD}-V_{LCD}/2	V_{DD}-2V_{LCD}/5
V_3	V_{DD}-V_{LCD}/2	V_{DD}-3V_{LCD}/5
V_4	V_{DD}-3V_{LCD}/4	V_{DD}-4V_{LCD}/5
V_5	V_{DD}-V_{LCD}	V_{DD}-V_{LCD}

*V_{LCD} is the LCD driving voltage, refer to the initial set of the instruction code.

AC Characteristics (V_{DD}=5V±10%, V_{SS}=0V, Ta=-20 ~ +75°C)

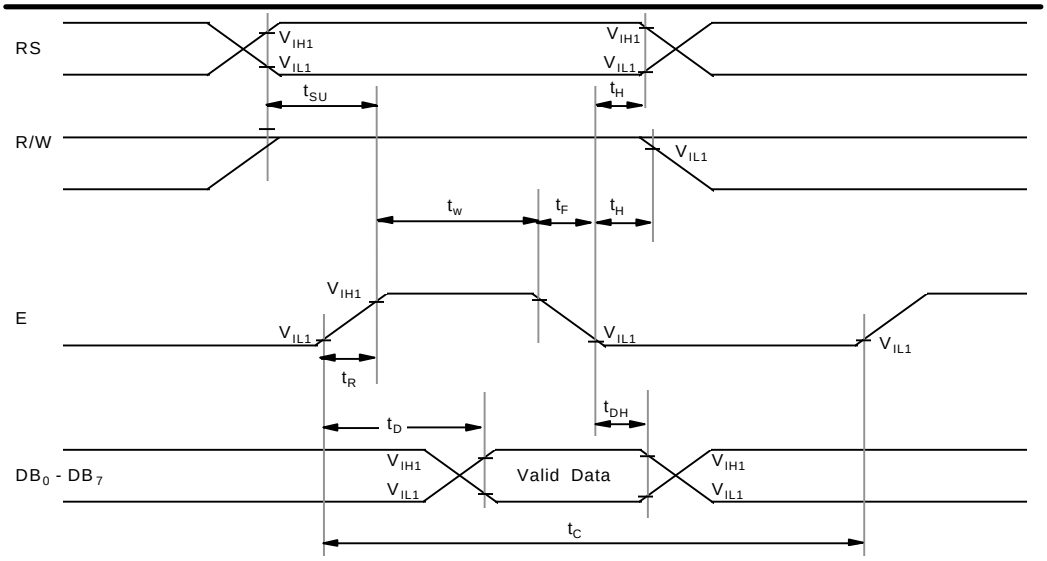
(1) Write mode(Writing data from Micom to KS0068)

Characteristic	Symbol	Min	Typ	Max	Unit	Test pin
E Cycle Time	t_c	500	-	-	ns	E
E Rise Time	t_R	-	-	25	ns	E
E Fall Time	t_F	-	-	25	ns	E
E Pulse Width (High, Low)	t_W	220	-	-	ns	E
R/W And RS Set-Up Time	t_{SU1}	40	-	-	ns	R/W, RS
R/W And RS Hold Time	t_{H1}	10	-	-	ns	R/W, RS
Data Set-Up Time	t_{SU2}	60	-	-	ns	DB_0~DB_7
Data Hold Time	t_{H2}	10	-	-	ns	DB_0~DB_7



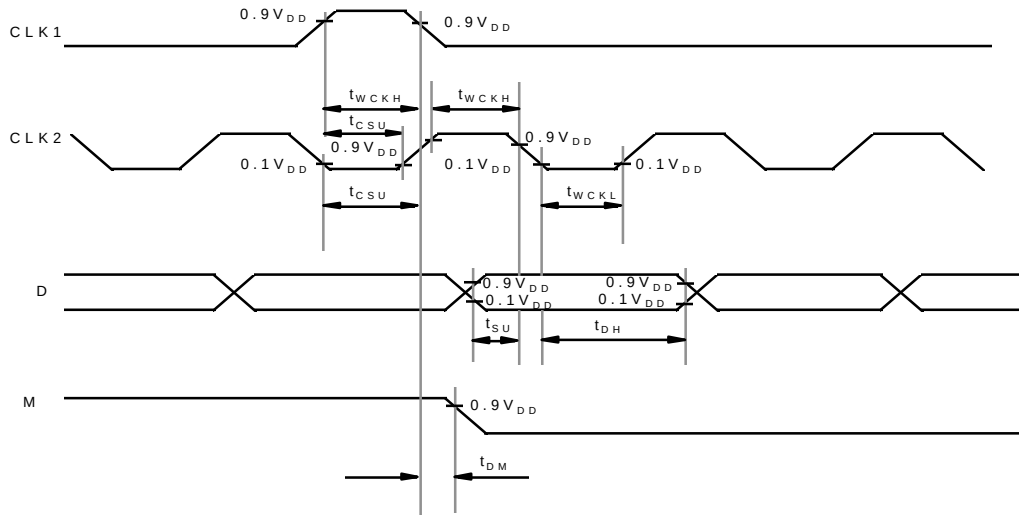
(2) Read mode(Reading data from KS0068 to Micom)

Characteristic	Symbol	Min	Typ	Max	Unit	Test pin
E Cycle Time	t_c	500	-	-	ns	E
E Rise Time	t_R	-	-	25	ns	E
E Fall Time	t_F	-	-	25	ns	E
E Pulse Width (High, Low)	t_W	220	-	-	ns	E
R/W And RS Set-Up Time	t_{SU}	40	-	-	ns	R/W, RS
R/W And RS Hold Time	t_H	10	-	-	ns	R/W, RS
Data Output Delay Time	t_D	-	-	120	ns	DB_0~DB_7
Data Hold Time	t_{DH}	20	-	-	ns	DB_0~DB_7



(3) Interface mode with KS0065B, KS0063

Characteristic	Symbol	Min	Typ	Max	Unit	Test pin
Clock Pulse Width High	t_{WCKH}	800	-	-	ns	CLK
Clock Pulse Width Low	t_{WCKL}	800	-	-	ns	CLK
Data Set-Up Time	t_{SU}	300	-	-	ns	D
Data Hold Time	t_{DH}	300	-	-	ns	D
Clock Set-Up Time	t_{CSU}	500	-	-	ns	CLK
M Delay Time	t_{DM}	-1000	-	1000	ns	M



CONTROL and DISPLAY COMMAND

Command	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0	Execution time (fosc=250KHz)	Remark
DISPLAY CLEAR	L	L	L	L	L	L	L	L	L	H	1.64ms	
RETURN HOME	L	L	L	L	L	L	L	L	H	X	1.64ms	cursor move to first digit
ENTRY MODE SET	L	L	L	L	L	L	L	H	I/D	SH	40µs	•I/D; set cursor move direction I/D: H Increase; L Decrease •SH: Specifies shift of display SH: H display is shifted; L display is not shifted
DISPLAY ON/OFF	L	L	L	L	L	L	H	D	C	B	40µs	•Display D: H Display on; L Display off •Cursor C: H Cursor on; L Cursor off •Blinking B: H Blinking on; L Blinking off
SHIFT	L	L	L	L	L	H	S/C	R/L	X	X	40µs	SC: H Display shift; L Cursor move R/L: H Right shift; L Left shift
SET FUNCTION	L	L	L	L	H	DL	N	F	X	X	40µs	DL: H 8 bits interface; L 4 bits interface N: H 2 line display; L 1 line display F: H 5x10 dots; L 5x7 dots

Table 1.

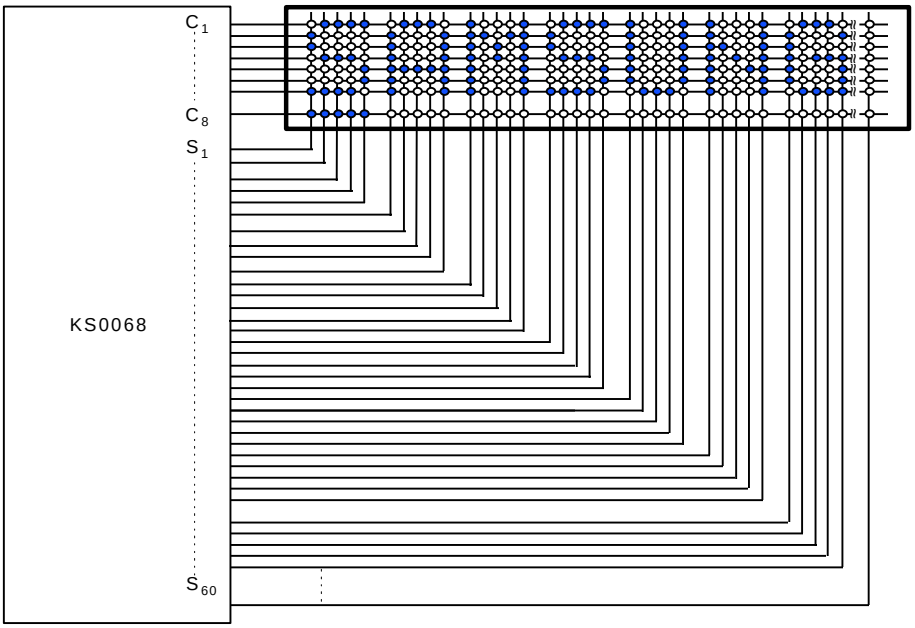
CONTROL and DISPLAY COMMAND (continued)

Command	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0	Excution time (fosc=250KHz)	Remark
SET CG RAM ADDRESS	L	L	L	H	CG RAM address (corresponds to cursor address)						40μs	CG RAM Data is sent and received after this setting
SET DD RAM ADDRESS	L	L	H	DD RAM address							40μs	DD RAM Data is sent and recevied after this setting
READ BUSY FLAG & ADDRESS	L	H	BF	Address Counter used for Both DD & CG RAM address							0μs	BF: H = Busy, L = Ready - Reads BF indication internal operating is being performed. - reads address counter contents
WRITE DATA	H	L	Write Data								46μs	Write data into DD or CGRAM
READ DATA	H	H	Read Data								46μs	Read data from DD or CGRAM

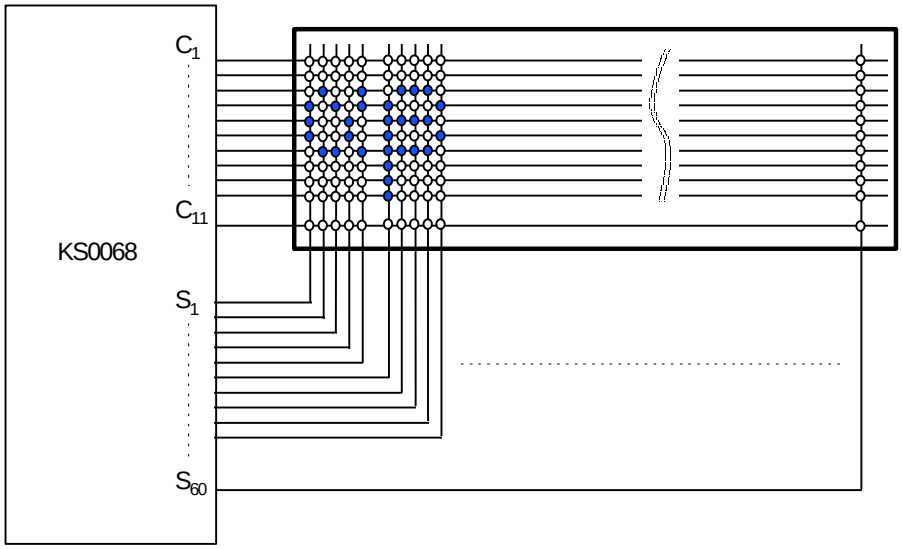
X : Don't care

APPLICATION INFORMATION ACCORDING TO LCD PANEL

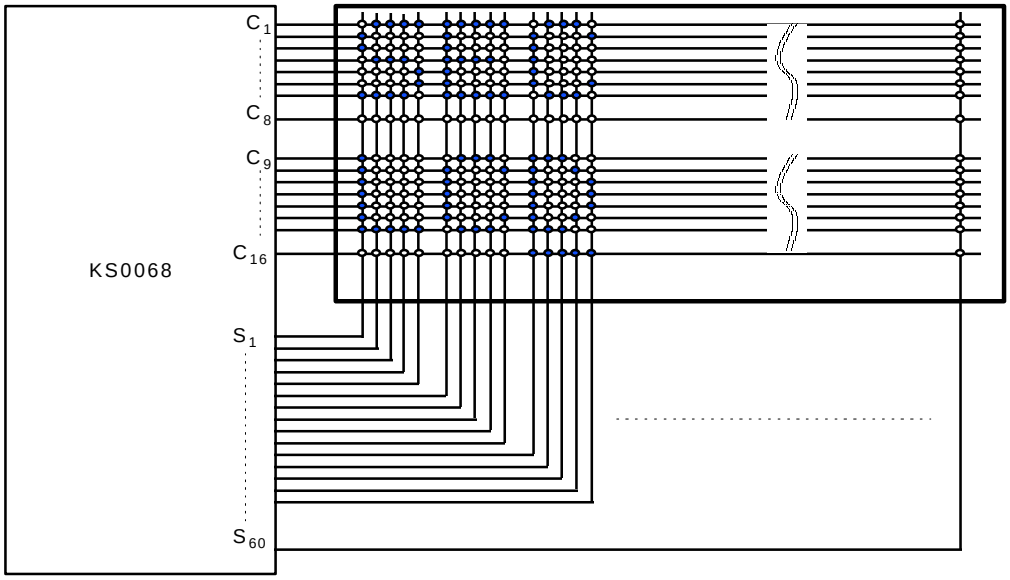
1) LCD Panel: 12 characterx1 line, character format; 5x7 dots + 1 cursor line (1/4 bias, 1/8 duty)



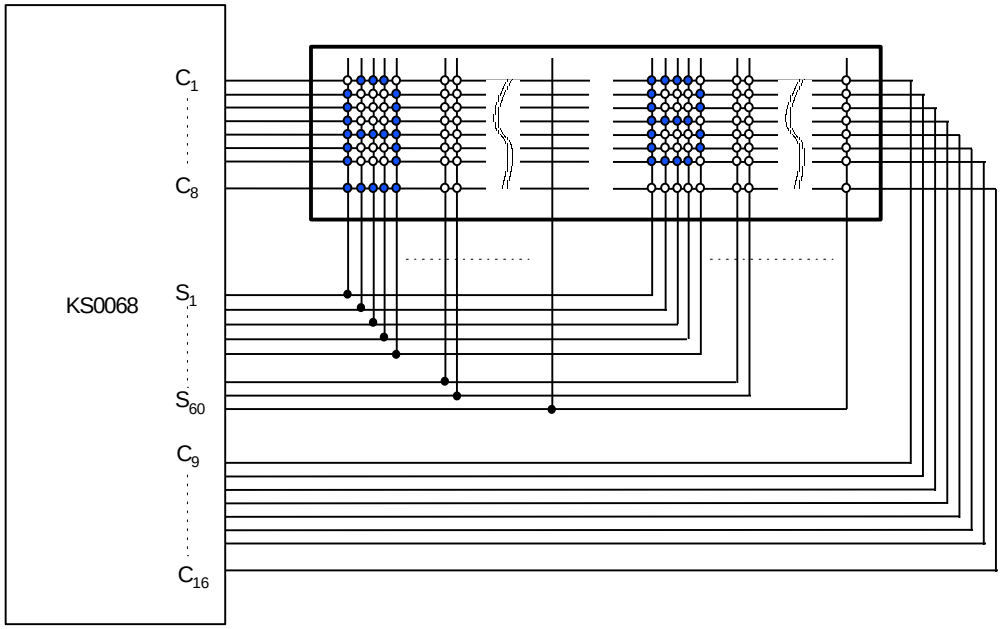
2) LCD Panel: 12 characterx1 line, character format; 5x10 dots + 1 cursor line (1/4 bias, 1/11 duty)



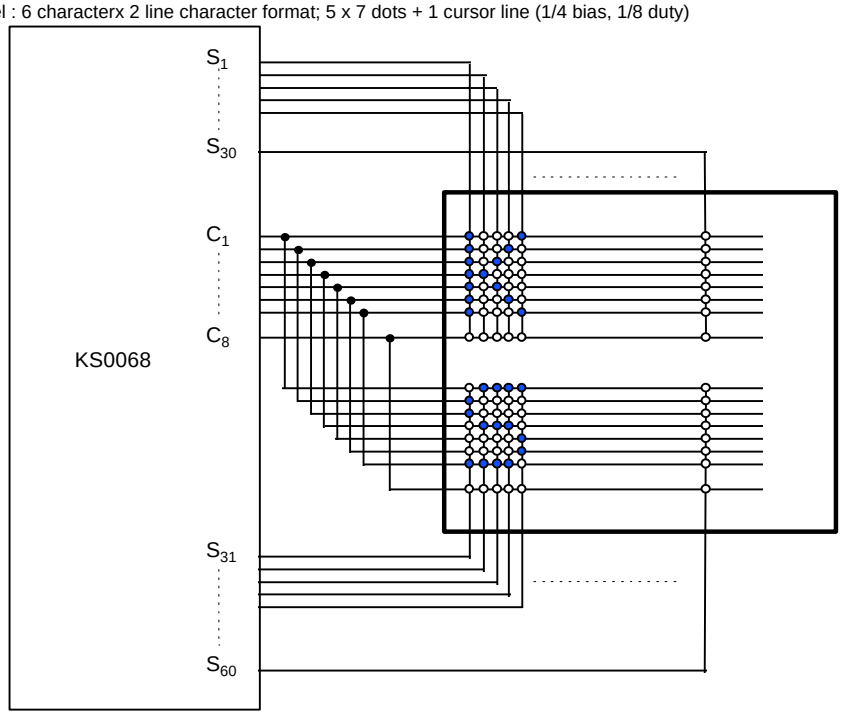
3) LCD Panel : 12 character x 2 line character format; 5x7 dots + 1 cursor line (1/5 bias, 1/16 duty)



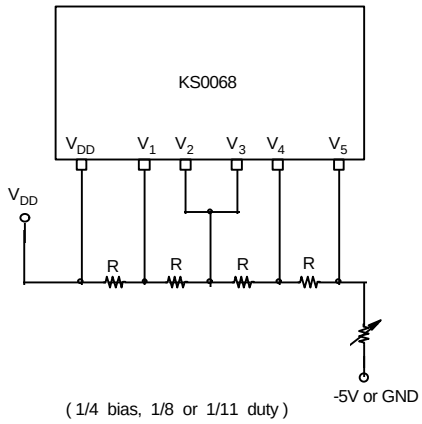
4) LCD Panel : 24 character ¡¿ 1 line, character format; 5 x 7 dots + 1 dots + 1 cursor line (1/5 bias, 1/16 duty)



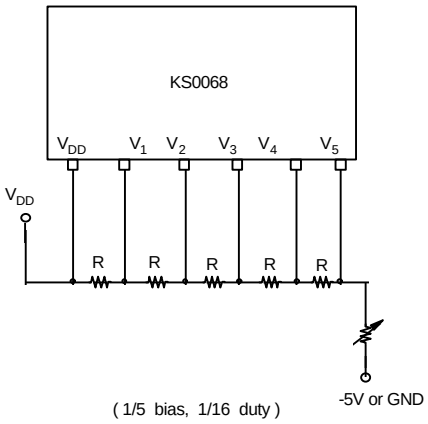
5) LCD Panel : 6 characterx 2 line character format; 5 x 7 dots + 1 cursor line (1/4 bias, 1/8 duty)



BIAS VOLTAGE DIVIDE CIRCUIT

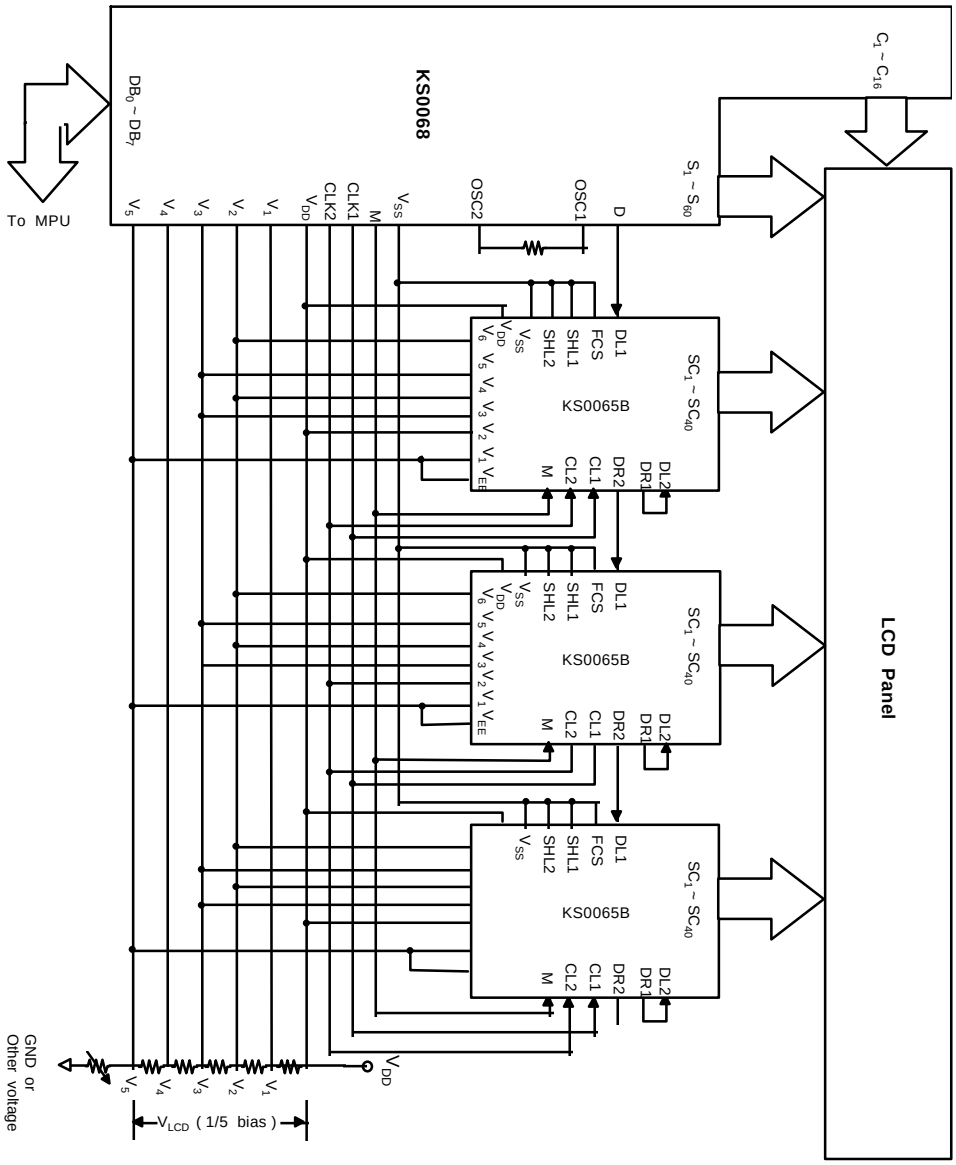


(1/4 bias, 1/8 or 1/11 duty)



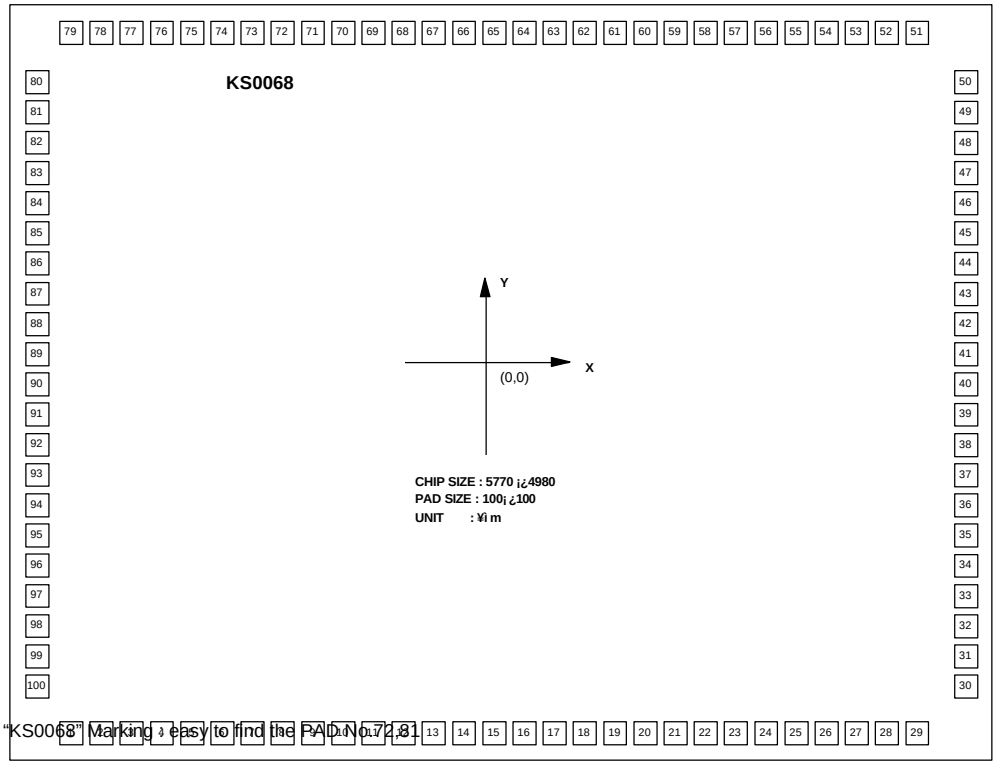
(1/5 bias, 1/16 duty)

APPLICATION CIRCUIT



When KS0065B is externally connected to the KS0068, you can increase the number of display digits up to 80 characters.

PAD DIAGRAM



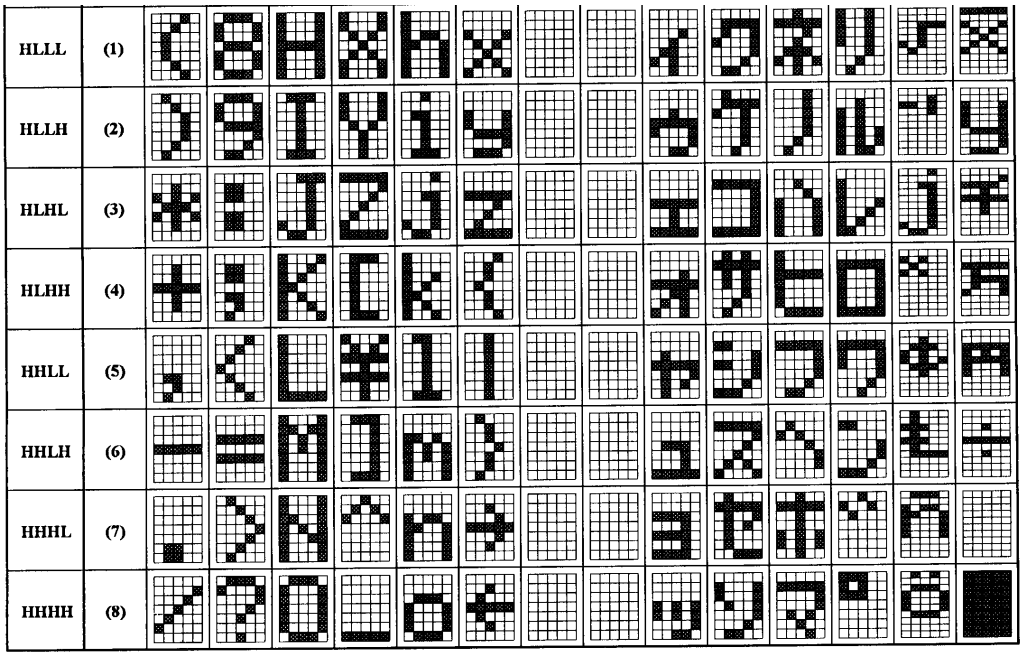
* "KS0068" Marking is easy to find the PAD No. 72,81.

PAD LOCATION

UNIT (μm)

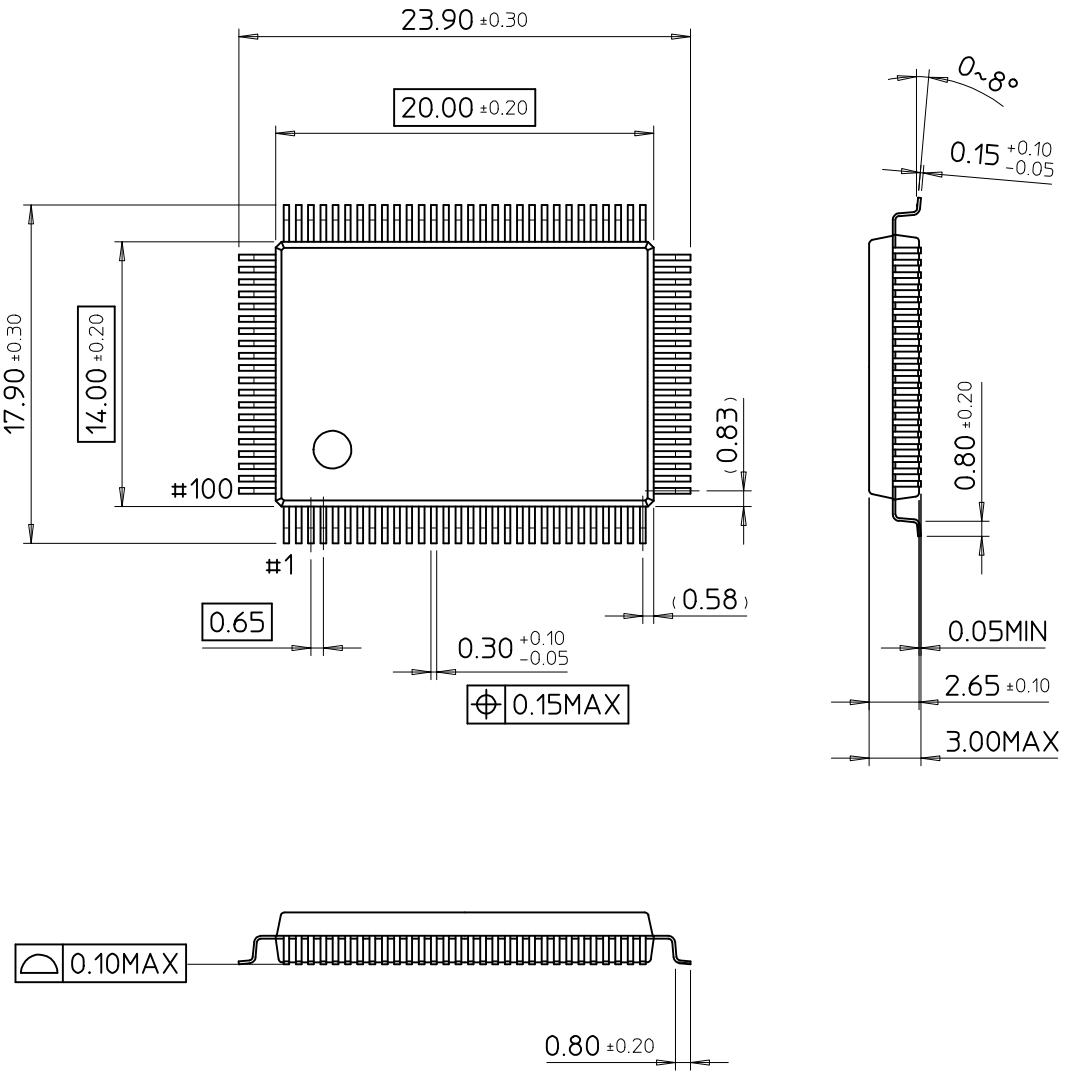
PAD NUMBER	PAD NAME	COORDINATE		PAD NUMBER	PAD NAME	COORDINATE		PAD NUMBER	PAD NAME	COORDINATE	
		X	Y			X	Y			X	Y
	S26	-2670	-2316	35	CLK1	2593	-848	69	S58	-808	2316
1	S25	-2490	-2316	36	CLK2	2593	-664	70	S57	-988	2316
2	S24	-2310	-2316	37	M	2593	-480	71	S56	-1168	2316
3	S23	-2130	-2316	38	D	2593	-296	72	S55	-1348	2316
4	S22	-1950	-2316	39	RS	2593	-111	73	S54	-1528	2316
5	S21	-1770	-2316	40	R/W	2593	73	74	S53	-1708	2316
6	S20	-1590	-2316	41	E	2593	257	75	S52	-1888	2316
7	S19	-1410	-2316	42	VDD	2593	434	76	S51	-2068	2316
8	S18	-1230	-2316	43	DB0	2593	604	77	S50	-2248	2316
9	S17	-1050	-2316	44	DB1	2593	788	78	S49	-2428	2316
10	S16	-870	-2316	45	DB2	2593	972	79	S48	-2608	2316
11	S15	-690	-2316	46	DB3	2593	1156	80	S47	-2728	1792
12	S14	-510	-2316	47	DB4	2593	1340	81	S46	-2728	1612
13	S13	-330	-2316	48	DB5	2593	1524	82	S45	-2728	1432
14	S12	-150	-2316	49	DB6	2593	1708	83	S44	-2728	1252
15	S11	29	-2316	50	DB7	2593	1892	84	S43	-2728	1072
16	S10	209	-2316	51	C1	2395	2316	85	S42	-2728	892
17	S9	389	-2316	52	C2	2215	2315	86	S41	-2728	712
18	S8	569	-2316	53	C3	2035	2315	87	S40	-2728	532
19	S7	749	-2316	54	C4	1855	2315	88	S39	-2728	352
20	S6	929	-2316	55	C5	1675	2315	89	S38	-2728	172
21	S5	1109	-2316	56	C6	1495	2315	90	S37	-2728	-8
22	S4	1289	-2316	57	C7	1315	2315	91	S36	-2728	-188
23	S3	1469	-2316	58	C8	1135	2316	92	S35	-2728	-368
24	S2	1649	-2316	59	C9	955	2315	93	S34	-2728	-548
25	S1	1829	-2316	60	C10	775	2315	94	S33	-2728	-728
26	VSS	2030	-2316	61	C11	595	2316	95	S32	-2728	-908
27	OSC2	2333	-2178	62	C12	415	2315	96	S31	-2728	-1088
28	OSC1	2517	-2178	63	C13	235	2315	97	S30	-2728	-1268
29	V1	2593	-1781	64	C14	55	2315	98	S29	-2728	-1448
30	V2	2593	-1597	65	C15	-124	2315	99	S28	-2728	-1628
31	V3	2593	-1413	66	C16	-304	2316	100	S27	-2728	-1808
32	V4	2593	-1229	67	S60	-448	2316				
33	V5	2593	-1045	68	S59	-628	2316				
34											

Standard Character Pattern (KS0068-00)



100-QFP-1420C

Dimensions in Milimeters



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