

SED1330

CMOS GRAPHIC LCD CONTROLLER

This part is replaced by SED1335. Some pin differences between SED1330 and SED1335 exist. Please check SED1335 data sheet. S-MOS Systems, Inc., will continue to support existing designs which use SED1330.

DESCRIPTION

The SED1330 is a CMOS low-power dot matrix liquid crystal graphic display controller. The device stores in external RAM display data sent by an 8-bit microcomputer, and generates all the signals required by the LCD drivers. The LSI incorporates an internal character generator ROM which supports user-defined characters (also an external CGROM can be supported).

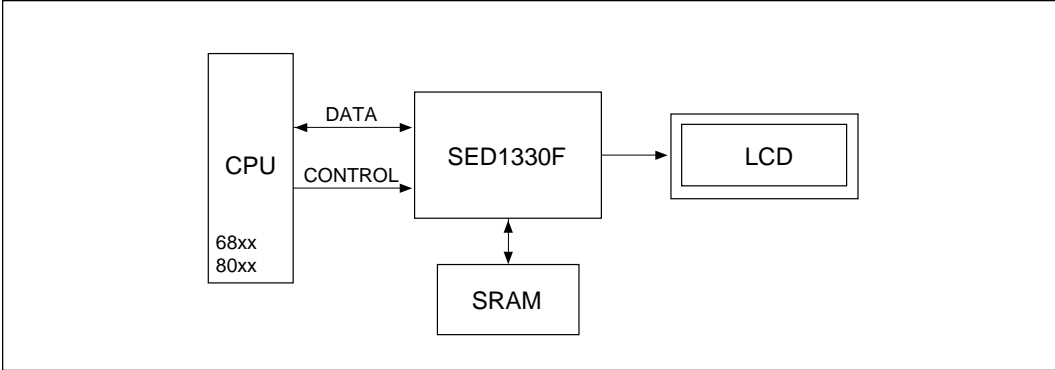
The SED1330 can be interfaced to high-speed microprocessors such as the Intel family or Motorola family. The controller supports a set of rich commands that will allow the user to create a layered display of characters and graphics.

Also, the controller functions as a pipeline buffer between the MPU and display memory so that low-cost, medium-speed SRAM can be used.

FEATURES

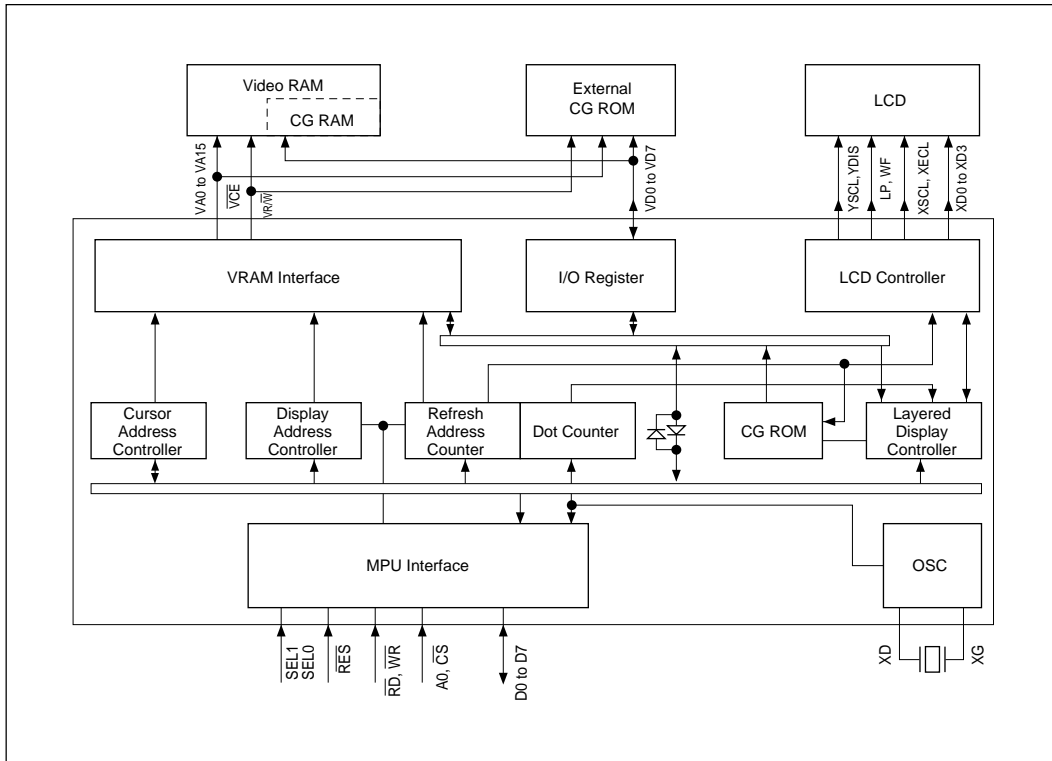
- CMOS low-power graphic and character display controller
- Selectable MPU interface is compatible with both the Intel family and the Motorola family
- Smooth scrolling support:
Horizontal and vertical scroll
Scrolling of selected areas of the display
- Multimode display:
2 layers of overlapping character and graphics
3 layers of overlapping graphics
- Selectable display synthesis:
Inverse video
Flashing display, cursor on/off/blink
Under and bar cursor, block cursor
Simple animation
- Programmable cursor
- Internal character generator ROM
- Supports external character generator ROM:
8 × 8 or 8 × 16 pixel characters
Allows mixing of ROM and RAM character sets
- Supports 64K bytes of memory:
2 of 32K × 8 100ns SRAM
or 8 of 8K × 8 100ns SRAM
- Display duty 1/2 to 1/256
- Low power dissipation 5mA (typical)
0.05µA (typical), standby
- Logic power supply 4.5 to 5.5V
- Package Plastic QFP5-60 pin (FBA)
Plastic QFP6-60 pin (FBB)

SYSTEM BLOCK DIAGRAM

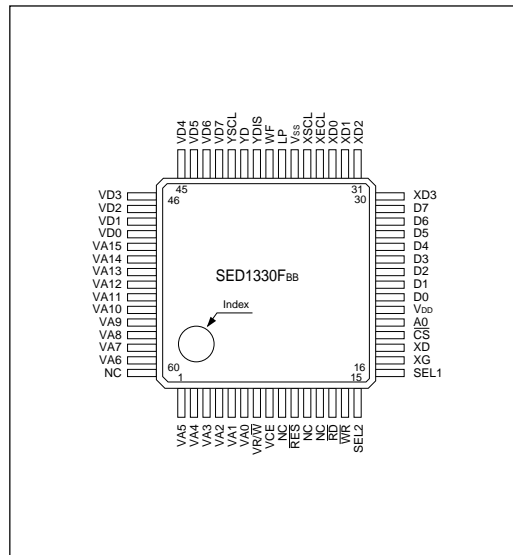
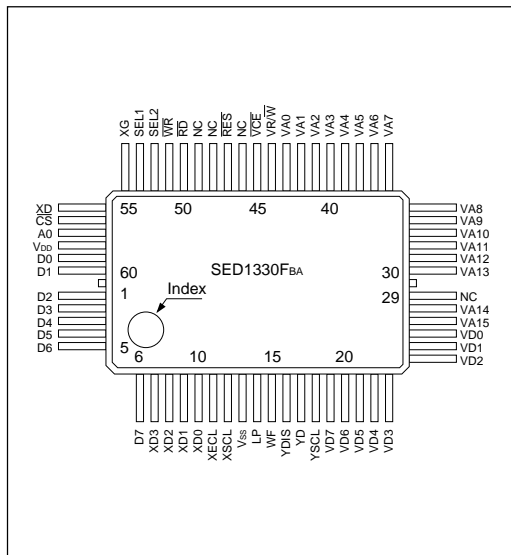


SED1330

■ BLOCK DIAGRAM



■ PINOUT



■ PIN DESCRIPTIONS

Pin Name	Pin No.		I/O	Functions
	SED1330FBA	SED1330FBB		
XG	54	17	I	Oscillator terminal
XD	55	18	O	Oscillator terminal
V _{DD}	58	21	+5V	Power supply
V _{SS}	13	36	GND (0V)	Power supply
SEL1, 2	53 • 52	16 • 15	I	MPU interface format selection
D0 to D7	59 to 60 1 to 6	22 to 29	I/O	Data bus
A0	57	20	I	Data type selection
\overline{RD}	50	13	I	80 series Read strobe signal 68 series "E" clock
\overline{WR}	51	14	I	80 series Write strobe signal 68 series R/W signal
\overline{CS}	56	19	I	Chip select
\overline{RES}	47	10	I	Reset
VA0 to VA15	43 to 30 28 to 27	6 to 1 59 to 50	O	VRAM address bus
VD0 to VD7	26 to 19	49 to 42	I/O	VRAM data bus
VR \overline{W}	44	7	O	VRAM R/W signal
\overline{VCE}	45	8	O	Memory control signal
XD0 to XD3	10 to 7	33 to 30	O	Dot data output bus to X driver
XSCL	12	35	O	Dot data shift clock for X driver
XECL	11	34	O	Chip enable shift clock for Y driver
LP	14	37	O	Dot data latch pulse
WF	15	38	O	Frame signal
YSCL	18	41	O	Scan data shift clock for Y driver
YD	17	40	O	Scan data output
YDIS	16	39	O	Power down signal when display OFF

NC: No Connection

■ ELECTRICAL CHARACTERISTICS

● Absolute Maximum Ratings

(V_{SS} = 0V)

Parameter	Symbol	Ratings	Unit
Supply voltage	V _{DD}	-0.3 to 7.0	V
Input voltage	V _i	-0.5 to V _{DD} +0.5	V
Power dissipation	P _D	300	mW
Operating temperature	T _{opr}	-20 to 75	°C
Storage temperature	T _{stg}	-60 to 150	°C
Soldering temperature and time	T _{sol}	260°C, 10s (at lead)	—

● DC ELECTRICAL CHARACTERISTICS

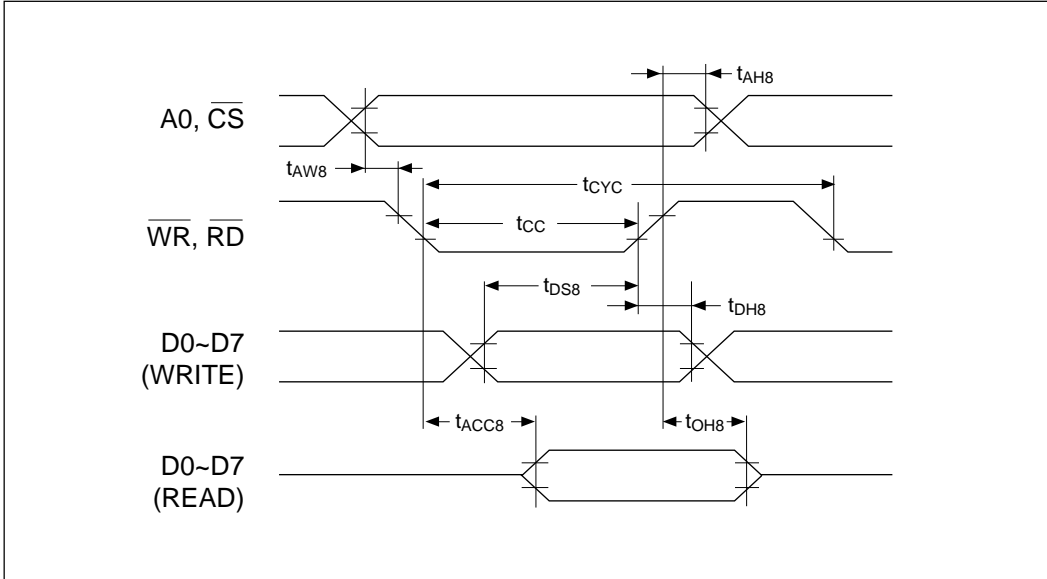
(V_{DD} = 5V±10%, V_{SS} = 0V, T_a = -20 to 75°C)

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Operating voltage		V _{DD}		4.5	5.0	5.5	V
Register data retention voltage		V _{OH}		2.0	—	6.0	V
T T L	High level input voltage	V _{IHT}	D0 to D7, A0, \overline{CS} , \overline{RD} , \overline{WR} ,	2.2	—	V _{DD} +0.3	V
	Low level input voltage	V _{ILT}	VD0 to VD7, I _{OH} = -5.0mA,	-0.3	—	0.8	V
	High level output voltage	V _{OHT}	I _{OL} =5.0mA, $\overline{VR}/\overline{W}$, \overline{VCE} ,	2.4	—	—	V
	Low level output voltage	V _{OLT}	\overline{REF}	—	—	0.4	V
C M O S	High level input voltage	V _{IHC}	I _{OH} =1.6mA, I _{OL} = -1.6mA,	0.8V _{DD}	—	—	V
	Low level input voltage	V _{ILC}	SEL1, 2, SYNC, YD, XD0 to	—	—	0.2V _{DD}	V
	High level output voltage	V _{OHC}	XD3, XSCL, XECL, LP, FR,	V _{DD} -0.4	—	—	V
	Low level output voltage	V _{OLC}	YSCL, YDIS, OSC1, OSC2	—	—	0.4	V
SCHMITT	Positive trigger threshold voltage	V _{T+}	\overline{RES} *	0.5V _{DD}	0.7V _{DD}	0.8V _{DD}	V
	Negative trigger threshold voltage	V _{T-}		0.2V _{DD}	0.3V _{DD}	0.5V _{DD}	V
Input leakage current		I _{LI}	V _I =V _{DD} or V _{SS}	—	0.05	2.0	μA
Output leakage current		I _{LO}		—	0.10	5.0	μA
Average operating current		I _{DDA}	f _{osc} =10MHz, No load (No external V-RAM)	—	8	12	mA
Standby current		I _{DDS}	XG= \overline{CS} =V _{DD}	—	0.05	20	μA
Oscillation frequency		f _{OSC}	AT X'tal XG, XD	1.0	—	10.0	MHz
External clock frequency		f _{CLK}		—	—	10.0	MHz
Feed back resistance		R _f		0.5	1.0	5.0	MΩ

* \overline{RES} input pulse should be longer than 1.0ms.

VL5 should be OFF when \overline{RES} is "L".

- AC CHARACTERISTICS
 - System Bus READ/WRITE Timing I (8080)

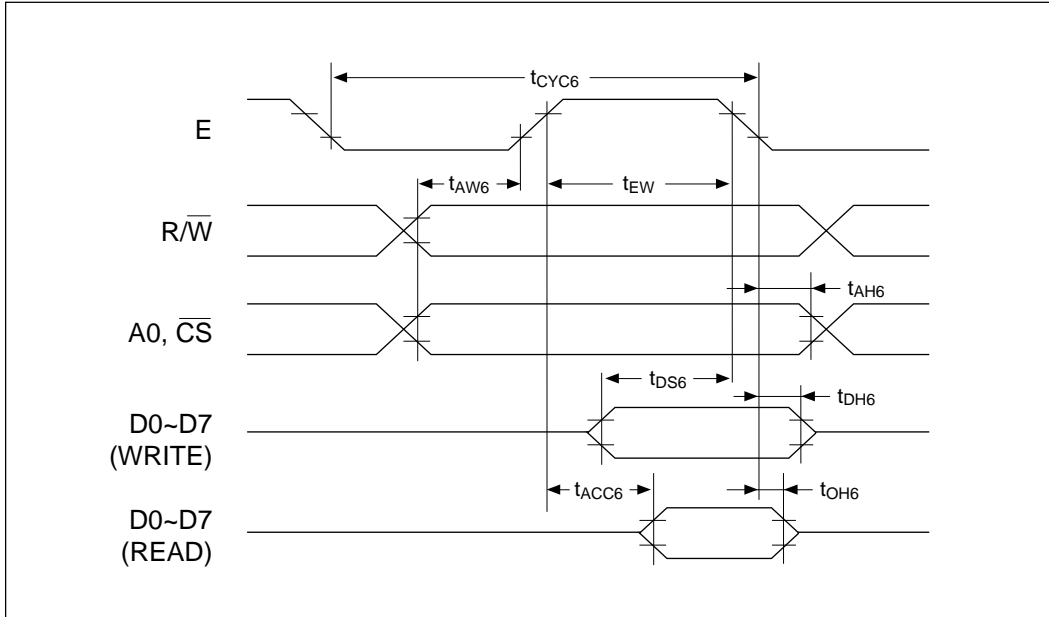


Signal	Parameter	Symbol	Rating		Unit	Remark
			Min	Max		
A0, \overline{CS}	Address hold time	t_{AH8}	10	—	ns	CL = 100 pF + 1TTL
	Address setup time	t_{AW8}	30	—	ns	
\overline{WR} , \overline{RD}	System cycle time	t_{CYC}	*1	—	ns	
	Control pulse width	t_{CC}	220	—	ns	
D0 to D7	Data setup time	t_{DS8}	120	—	ns	
	Data hold time	t_{DH8}	10	—	ns	
	\overline{RD} access time	t_{ACC8}	—	120	ns	
	Output disable time	t_{OH8}	10	50	ns	

*1. $t_{CYC} = 2t_b + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$ Memory control/movement control commands.
 = $4t_c + t_{CC} + 30$ All other commands.

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○ System Bus READ/WRITE Timing II (6800)



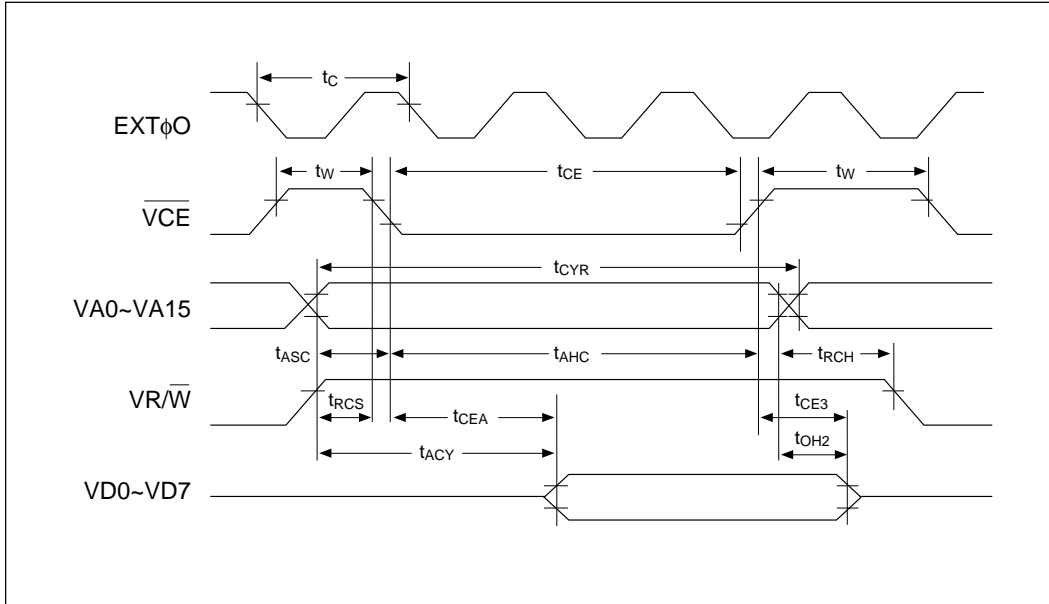
Signal	Parameter	Symbol	Rating		Unit	Remark
			Min	Max		
A0, \overline{CS} , R/W	System cycle time	t_{CYC6}^{*1}	*2	—	ns	CL = 100 pF + 1 TTL
	Address setup time	t_{AW6}	30	—	ns	
	Address hold time	t_{AH6}	10	—	ns	
D0 to D7	Data setup time	t_{DS6}	120	—	ns	
	Data hold time	t_{DH6}	10	—	ns	
	Output disable time	t_{OH6}	10	50	ns	
	Access time	t_{ACC6}	—	120	ns	
E	Enable pulse width	t_{EW}	220	—	ns	

*1. t_{CYC6} means a cycle of ($\overline{CS}.E$) not E alone.

*2. $t_{CYC6} = 2t_c + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$ Memory control/movement control commands.

= $4t_c + t_{EW} + 30$ All other commands.

o Display Memory READ Timing



Signal	Parameter	Symbol	Rating		Unit	Remark
			Min	Max		
EXT φ0	Clock cycle	tc	100	—	ns	CL = 100 pF + 1TTL
VCE	VCE high-level pulse width	tw	tc - 40	—	ns	
	VCE low-level pulse width	tCE	2tc - 40	—	ns	
VA0 to VA15	Read cycle time	tCVR	*1	—	ns	
	VCE address setup time (fall)	tASC	tc - 45	—	ns	
	VCE address hold time (fall)	tAHC	2tc - 40	—	ns	
VR/W	VCE read cycle setup time (fall)	tRCS	tc - 45	—	ns	
	VCE read cycle hold time (fall)	tRCH	tc/2 - 35	—	ns	
VD0 to VD7	Address access time	tACV	—	*2	ns	
	VCE access time	tCEA	—	*3	ns	
	Output data hold time	tOH2	0	—	ns	
	VCE data off time	tCE3	0	—	ns	

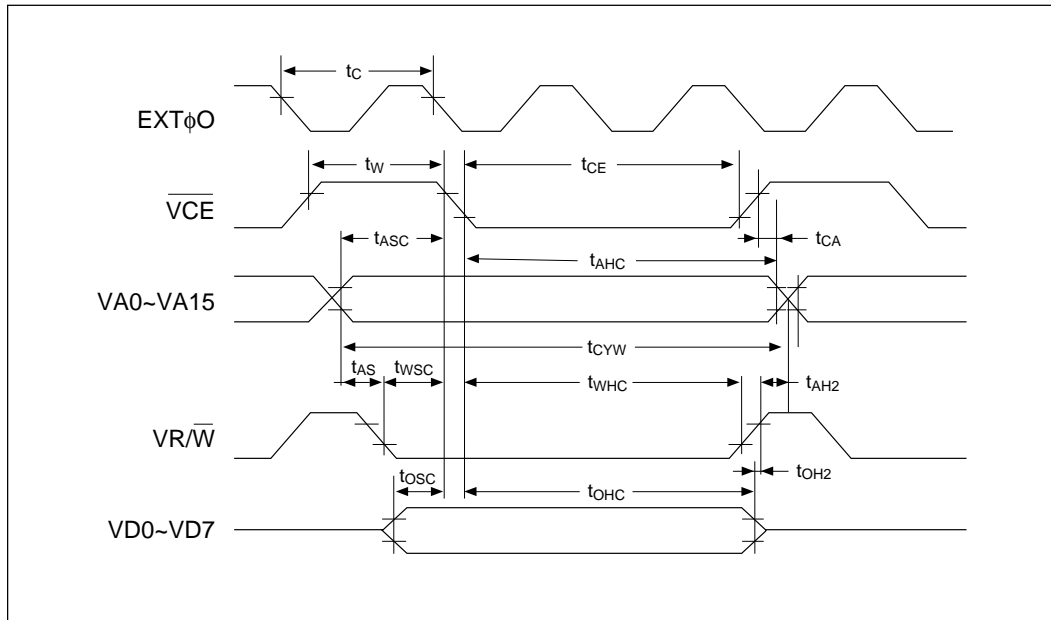
*1. tCVR = 3tc

*2. tACV = 3tc - 120

*3. tCEA = 2tc - 120

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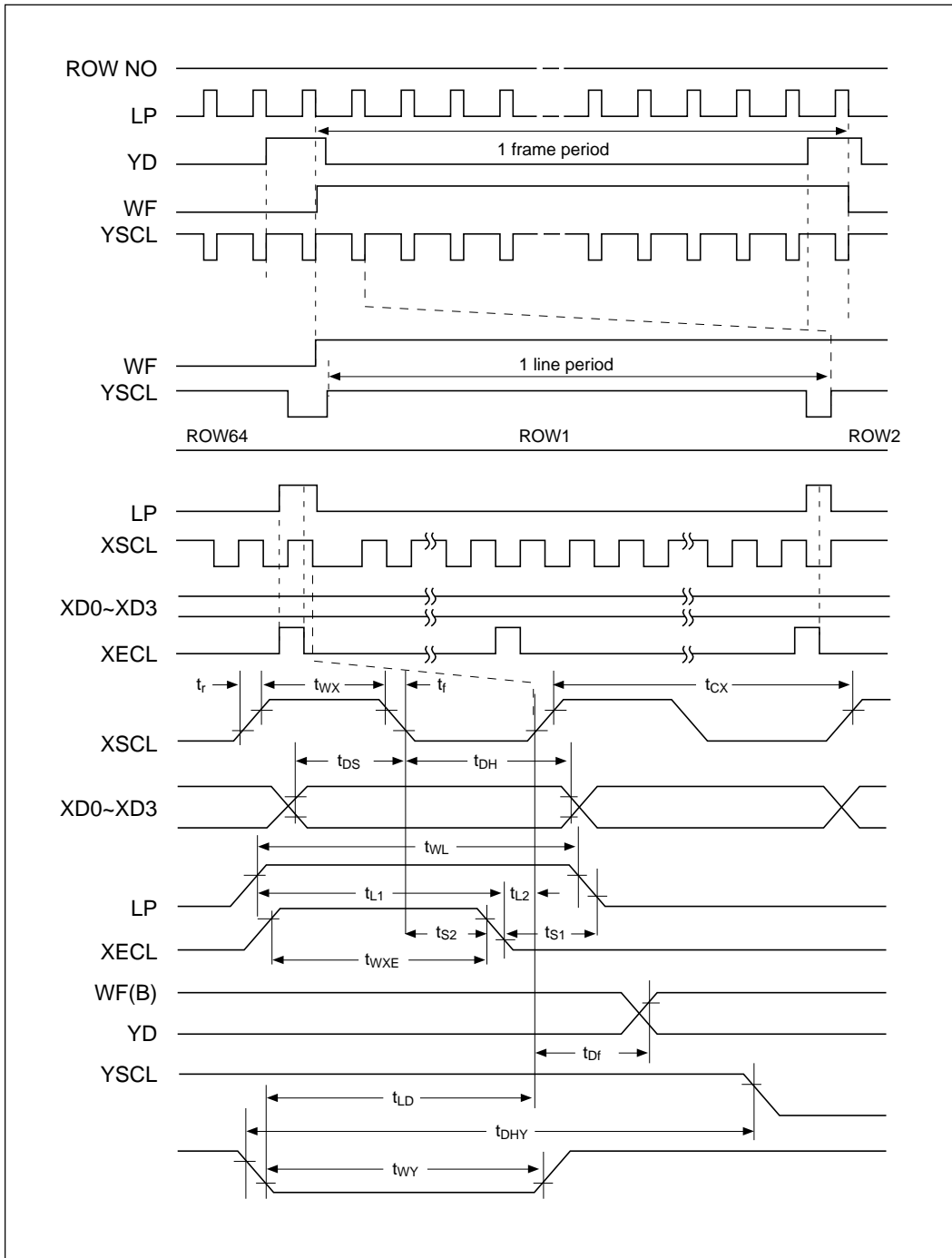
○ Display Memory WRITE Timing



Signal	Parameter	Symbol	Rating		Unit	Remark
			Min	Max		
EXT $\phi 0$	Clock cycle	tc	100	—	ns	CL = 100 pF + 1TTL
\overline{VCE}	\overline{VCE} HIGH-level pulse width	tw	tc - 40	—	ns	
	\overline{VCE} LOW-level pulse width	tCE	2tc - 40	—	ns	
VA0 to VA15	Write cycle time	tcYW	3tc	—	ns	
	\overline{VCE} address hold time (fall)	tAHC	2tc - 40	—	ns	
	\overline{VCE} address setup time (fall)	tASC	tc - 55	—	ns	
	\overline{VCE} address hold time (rise)	tCA	5	—	ns	
	VR/W address setup time (fall)	tAS	0	—	ns	
VR/W	VR/W address hold time (rise)	tAH2	15	—	ns	
	\overline{VCE} write setup time (fall)	twSC	tc - 55	—	ns	
VD0 to VD7	\overline{VCE} write hold time (fall)	tWHC	2tc - 40	—	ns	
	\overline{VCE} data input setup time (fall)	tdSC	twSC - 10	—	ns	
	\overline{VCE} data input hold time (fall)	tdHC	2tc - 30	—	ns	
	VR/W data hold time (rise)	tdH2	10*	50	ns	

* Lines VD0 to VD7 are latched.

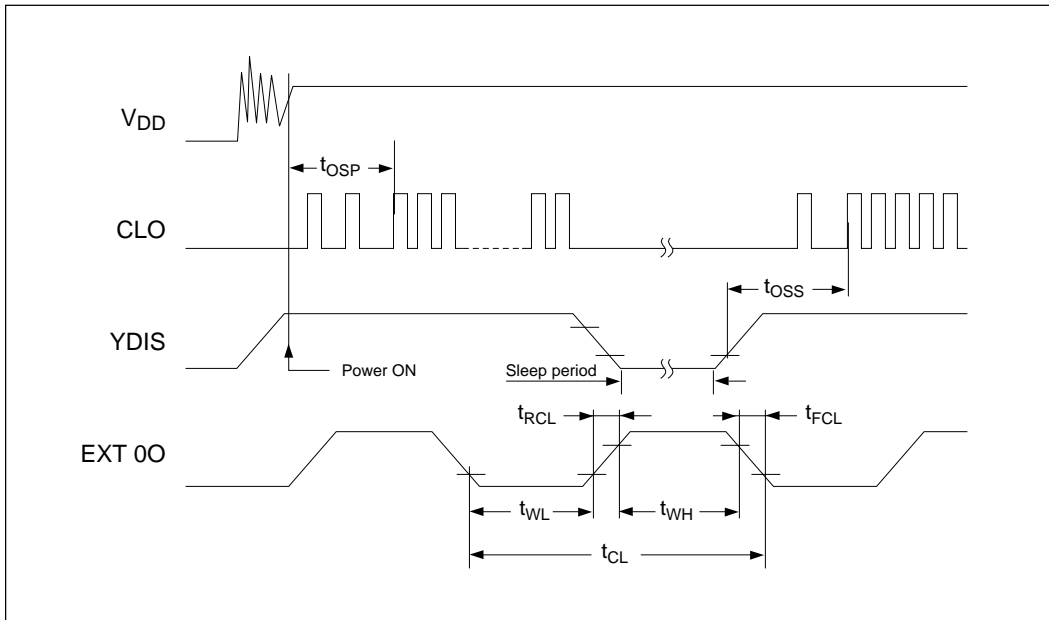
o LCD Control Timing



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Signal	Parameter	Symbol	Rating		Unit	Remark
			Min	Max		
EXT ϕ 0	Clock cycle	tc	100	—	ns	V _{DD} = 5.0V ± 10% CL = 150F
	Rising time	tr	—	35	ns	
	Falling time	tf	—	35	ns	
XSCL	Shift clock cycle time	tcX	4tc	—	ns	
	XSCL clock pulse width	twX	tcX2 – 80	—	ns	
XD0 to XD3	X-data hold time	tDH	tcX2 – 100	—	ns	
	X-data setup time	tDS	tcX2 – 100	—	ns	
LP	Latch data setup time	tLS	tcX2 – 100	—	ns	
	LP signal pulse width	tWL	tcX4 – 80	—	ns	
XECL	XECL setup time	tL1	tcX3 – 100	—	ns	
	XECL data hold time	tL2	tc – 30	—	ns	
	Enable setup time	ts1	tc – 30	—	ns	
	Enable delay time	ts1	tc – 30	—	ns	
	XECL clock pulse width	twXE	tcX3 – 80	—	ns	
WF	Time allowance of WF delay	tDF	—	100	ns	
YSCL	LP delay time against YSCL	tLD	tcX4 – 100	—	ns	
	YSCL clock pulse width	twY	tcX4 – 80	—	ns	
YD	Y-data hold time	tDHY	tcX6 – 100	—	ns	

○ Oscillator Timing

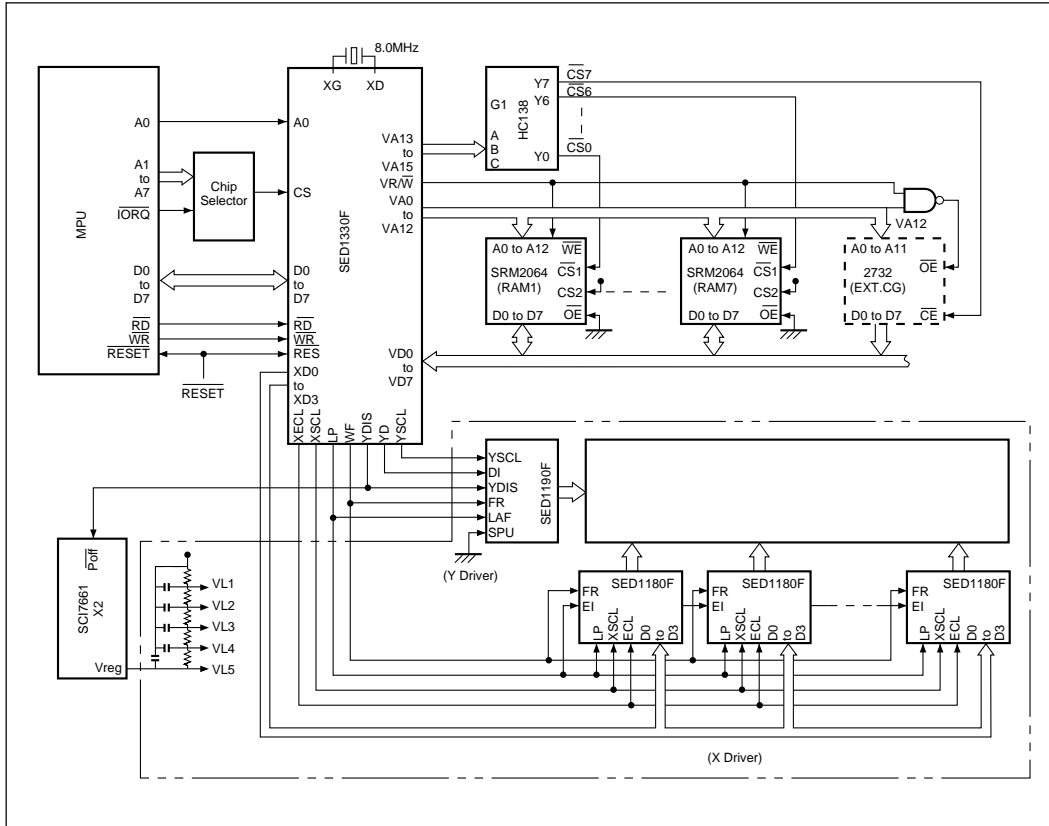


Signal	Parameter	Symbol	Rating		Unit	Remark
			Min	Max		
CLO	Time to stable CLO output after power-ON	t _{OSP}	—	3	ms	$\overline{\text{RES}} = \text{H}$ 20 pF
	Time to stable CLO after sleep OFF	t _{OSS}	—	1	ms	
EXT $\phi 0$	External clock rise time	t _{RCL}	—	15	ns	
	External clock fall time	t _{FCL}	—	15	ns	
	External clock high-pulse width	t _{WH}	*1	*2	ns	
	External clock low-pulse width	t _{WL}	*1	*2	ns	
	External clock cycle	t _{CL}	100	—	ns	

*1. $(t_c - t_{RCL} - t_{FCL}) \times 475/1000 < t_{WH}, t_{WL}$


*2. $(t_c - t_{RCL} - t_{FCL}) \times 525/1000 > t_{WH}, t_{WL}$

■ EXAMPLE OF APPLICATION



■ CHARACTER CODE TABLE (BUILT-IN CHARACTER GENERATOR)

		Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)	2		!	"	#	\$	%	&	'	()	*	+	,	-	.	/
	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
	4	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
	5	p	q	r	s	t	u	v	w	x	y	z	[\]	^	_
	6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	7	p	q	r	s	t	u	v	w	x	y	z	{		}	~	
	A		^	_	`	a	b	c	d	e	f	g	h	i	j	k	l
	B	-	^	_	`	a	b	c	d	e	f	g	h	i	j	k	l
	C	9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4
	D	3	2	1	0	9	8	7	6	5	4	3	2	1	0	9	8
	1																

Note:  means all dots of 6 × 8 matrix are on.



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