

# SED1278F

## CMOS DOT MATRIX LCD CONTROLLER DRIVER

### DESCRIPTION

The SED1278F is a dot matrix LCD controller/driver which is dedicated to character display. It is capable of displaying up to 80 characters under 4-bit/8-bit MPU control.

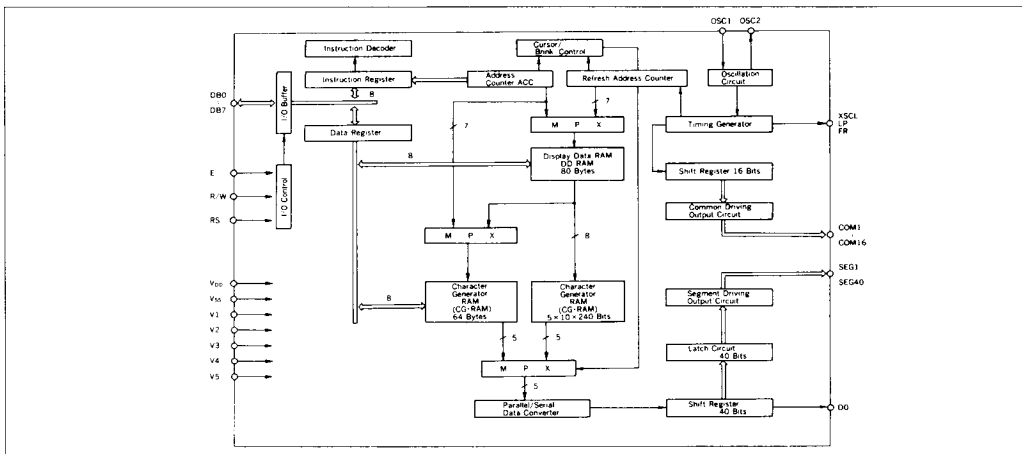
The built-in character generator ROM has an extended capacity of 240 different characters, each being generated in a 5×10 dots font compatible with a 1/11 duty. In addition, the SED1278F contains 64 bytes of character generator RAM in which the user can store 8 different characters, each consisting of 5×8 dots. These memory features offer high flexibility in character display.

The guaranteed minimum LCD driving voltage is 3V, and this makes the SED1278F suitable for driving low voltage LCDs.

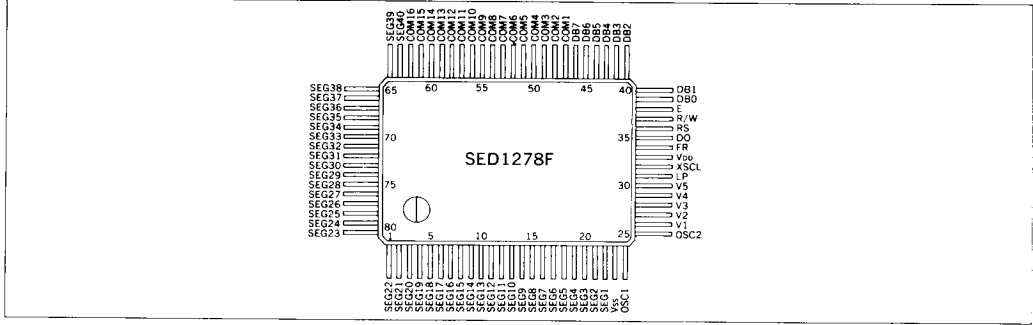
### FEATURES

- Display RAM ..... 80 bytes (80 characters)
- Character generator ROM ..... 240 characters (Able to 256 characters)
- Character generator RAM ..... 8 characters
- Built-in CR oscillator, Built-in power-on reset circuit
- Maximum display dimension ..... 80 characters × 1 line, 40 characters × 2 lines  
(When accompanied with SED1181F<sub>LA</sub>)
- 1/8, 1/11 or 1/16 duty cycle matrix drive (fixed by command)
- 2 flame AC wave-form drive
- High-speed bus interface with 4-bit/8-bit MPU
- Powerful display control instructions
- Character font ..... 5×7 dots + Cursor line (5×8 dots also possible)  
5×10 dots + Cursor line
- Single power supply ..... 5V ± 10% (Logic)
- Low LCD driving voltage .....  $V_{DD} - V_5 \geq 3.0V$
- Package ..... 80-pin QFP (plastic)

### BLOCK DIAGRAM



■ PIN CONFIGURATION



■ PIN DESCRIPTION

Symbol	No. of signals	Functions	
RS	1	Register select signal	* 1
R/W	1	Read/write select signal	
E	1	Read/write execute signal	
DB0 to DB7	8	Data bus	
LP	1	Data latching pulse	
XSCL	1	Data transfer clock	
FR	1	LCD AC driving signal	
DO	1	Serial data	
COM1 to COM16	16	Common outputs COM9 to COM16 : non-select for 1/8 duty COM12 to COM16 : non-select for 1/11 duty	
SEG1 to SEG40	40	Segment outputs	
V1 to V5	5	LCD driving power (V5 ≥ Vss)	
VDD	1	+5V	
VSS	1	0V (GND)	
OSC1	2	Used to connect resistor (typ. 91K-ohms) for oscillation ; OSC1 is for external clock input.	
OSC2			

\* 1

RS	R/W	E	Operation
0	0		Instruction write cycle
0	1	1	Busy flag read cycle Address counter read cycle
1	0		DD RAM or CG RAM data write cycle
1	1	1	DD RAM or CG RAM data read cycle

■ ABSOLUTE MAXIMUM RATINGS

(VSS = 0V, Ta = 25°C)

Parameter	Symbol	Ratings	Unit
Supply voltage (1)	VDD	-0.3 to 7.0	V
Supply voltage (2)	V1 to V5	-0.3 to VDD+0.3	V
Input voltage	V1	-0.3 to VDD+0.3	V
Output voltage	VO	-0.3 to VDD+0.3	V
Power dissipation	PD	300	mW
Operating temperature	Topr	-20 to 75	°C
Storage temperature	Tstg	-65 to 150	°C
Soldering temperature and time	Tsol	260°C·10s (at lead)	—

Note) The following condition must always hold true : VDD ≥ V1 ≥ V2 ≥ V3 ≥ V4 ≥ V5

■ ELECTRICAL CHARACTERISTICS

● DC Characteristics

(V<sub>DD</sub> = 5.0V ± 10%, V<sub>SS</sub> = 0V, T<sub>a</sub> = -20 to 75°C)

Parameter	Symbol	Conditions	Applicable Pin	Min	Typ	Max	Unit
"H" level input voltage (1)	V <sub>IH1</sub>		DB0~DB7	2.0	—	V <sub>DD</sub>	V
"L" level input voltage (1)	V <sub>IL1</sub>		RS, R/W, E	V <sub>SS</sub>	—	0.8	V
"H" level input voltage (2)	V <sub>IH2</sub>		OSC1	V <sub>DD</sub> - 1.0	—	V <sub>DD</sub>	V
"L" level input voltage (2)	V <sub>IL2</sub>			V <sub>SS</sub>	—	1.0	V
"H" level output voltage (1)	V <sub>OH1</sub>	I <sub>OH</sub> = -0.205mA	DB0~DB7	2.4	—	—	V
"L" level output voltage (1)	V <sub>OL1</sub>	I <sub>OL</sub> = 1.6mA		—	—	0.4	V
"H" level output voltage (2)	V <sub>OH2</sub>	I <sub>OH</sub> = -0.04mA	XSCL LP DO	0.9V <sub>DD</sub>	—	—	V
"L" level output voltage (2)	V <sub>OL2</sub>	I <sub>OL</sub> = 0.04mA		—	—	0.1V <sub>DD</sub>	V
Driver-on resistor (COM)	R <sub>COM</sub>	V <sub>COM</sub> - V <sub>n</sub>   = 0.5V	COM1~16	—	2	10	kΩ
Driver-on resistor (SEG)	R <sub>SEG</sub>	V <sub>SEG</sub> - V <sub>n</sub>   = 0.5V	SEGI~40	—	2.5	10	kΩ
I/O leakage current	I <sub>IL</sub>	V <sub>i</sub> = 0 to V <sub>DD</sub>		—	—	1	μA
Pull-up MOS current	-I <sub>P</sub>	V <sub>DD</sub> = 5V		50	125	250	μA
Supply current	I <sub>op</sub>	Rf oscillation, external clock V <sub>DD</sub> = 5V, f <sub>osc</sub> = f <sub>cp</sub> = 270kHz	V <sub>DD</sub>	—	0.5	0.8	mA
External clock operation							
External clock operating frequency	f <sub>EXTCL</sub>			125	250	350	kHz
External clock duty	Duty			45	50	55	%
External clock rise time	t <sub>rEXTCL</sub>			—	—	0.2	μs
External clock fall time	t <sub>fEXTCL</sub>			—	—	0.2	μs
Internal clock operation (Rf oscillation)							
Internal clock oscillation frequency	f <sub>OSC</sub>	R <sub>f</sub> = 91kΩ ± 2%		190	270	350	kHz
LCD driving voltage	V <sub>LCD</sub>	V <sub>DD</sub> - V <sub>5</sub>		3.0	—	V <sub>DD</sub>	V

● AC Characteristics

○ Read Cycle

(V<sub>DD</sub> = 5.0V ± 10%, V<sub>SS</sub> = 0V, T<sub>a</sub> = -20 to 75°C)

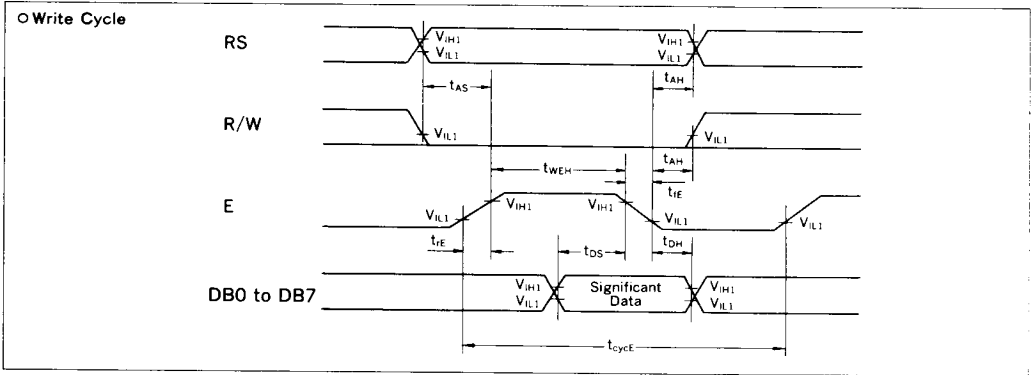
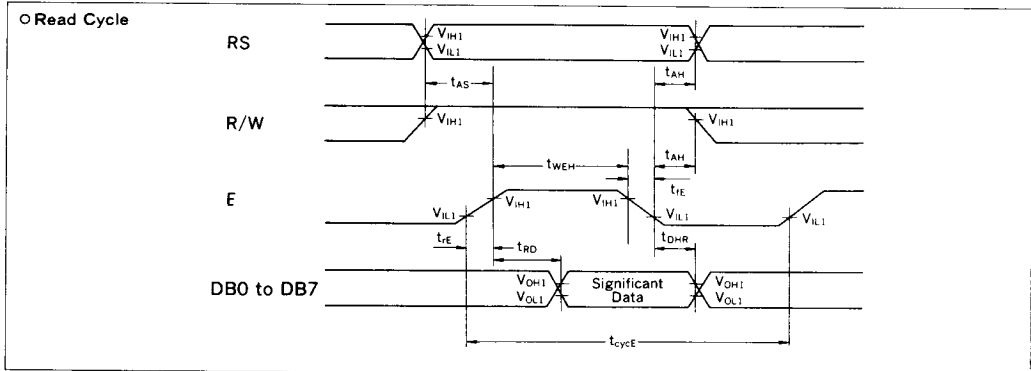
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	t <sub>cycE</sub>		500	—	—	ns
Enable "H" level pulse width	t <sub>WEH</sub>		220	—	—	ns
Enable rise/fall time	t <sub>rE</sub> , t <sub>fE</sub>		—	—	25	ns
RS, R/W setup time	t <sub>AS</sub>		40	—	—	ns
RS, R/W address hold time	t <sub>AH</sub>		10	—	—	ns
Read data output delay	t <sub>RD</sub>	C <sub>L</sub> = 100pF	—	—	120	ns
Read data hold time	t <sub>DHR</sub>		20	—	—	ns

○ Write Cycle

(V<sub>DD</sub> = 5.0V ± 10%, V<sub>SS</sub> = 0V, T<sub>a</sub> = -20 to 75°C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	t <sub>cycE</sub>		500	—	—	ns
Enable "H" level pulse width	t <sub>WEH</sub>		220	—	—	ns
Enable rise/fall time	t <sub>rE</sub> , t <sub>fE</sub>		—	—	25	ns
RS, R/W setup time	t <sub>AS</sub>		40	—	—	ns
RS, R/W address hold time	t <sub>AH</sub>		10	—	—	ns
Data setup time	t <sub>DS</sub>		60	—	—	ns
Write data hold time	t <sub>DH</sub>		10	—	—	ns

●Timing Chart

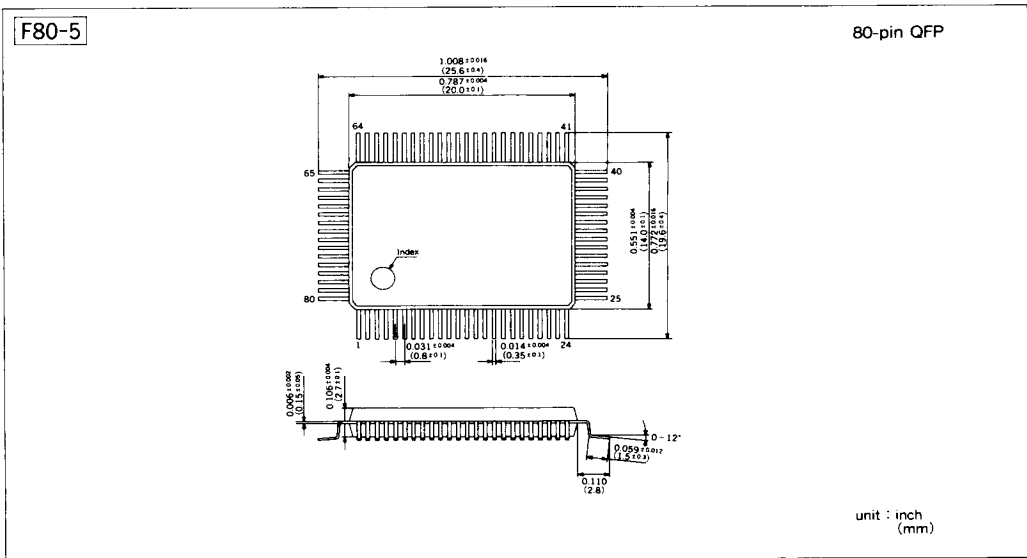


■DISPLAY COMMAND

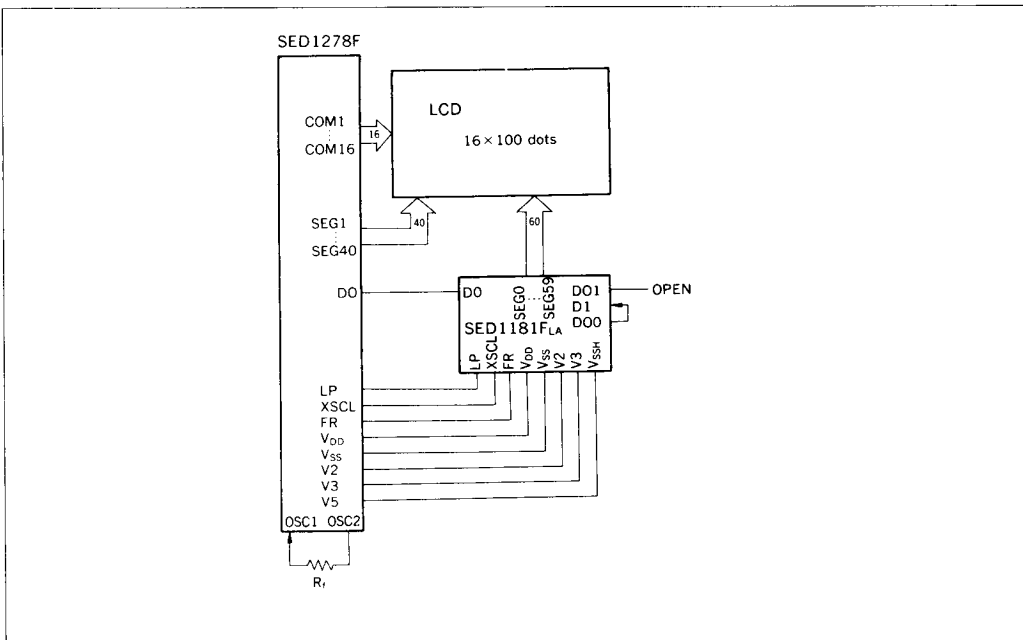
コマンド名	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Note
CLEAR DISPLAY	0	0	0	0	0	0	0	0	0	1	
CURSOR HOME	0	0	0	0	0	0	0	0	1	*	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	S	DB1=1: Increment, DB1=0: Decrement DB0=1: The display is shifted, DB0=0: The display is not shifted.
DISPLAY ON/OFF	0	0	0	0	0	0	1	D	C	B	DB2=1: Display on DB2=0: Display off DB1=1: Cursor on DB1=0: Cursor off DB0=1: Brinking on DB0=0: Brinking off
CURSOR/DISPLAY SHIFT	0	0	0	0	0	1	S/C	R/L	*	*	DB3=1: Shifts display one character DB2=1: Right shift, DB2=0: Left shift
SYSTEM SET	0	0	0	0	1	DL	N	F	*	*	DB4=1: 8 bits, DB4=0: 4 bits DB3=1: 2 lines display (1/16 duty), DB3=0: 1 line display (DB2=1: 5×10 dots, 1/11 duty) (DB2=0: 5×7 dots, 1/8 duty)
SET CGRAM ADDRESS	0	0	0	1	ACG					The address length that can be set is 64 addresses.	
SET DDRAM ADDRESS	0	0	1	ADD					The address length that can be set is 80 addresses.		
READ BUSY FLAG/ ADDRESS COUNTER	0	1	BF	AC					DB7=1: Busy (instruction not accepted) DB7=0: Ready (instruction accepted)		
WRITE DATA	1	0	Write Data								
READ DATA	1	1	Read Data								

\*Don't care

■ PACKAGE DIMENSIONS



■ EXAMPLE OF APPLICATION (2 lines × 20 characters)



SED1278F is usually connected to 8-bit MPU via I/O ports.

■ CHARACTER CODE MAP (SED1278F<sub>0A</sub>)

		Higher 4bit (D4 to D7) of Character Code (Hexadecimal)																
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
Lower 4bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	G	P	`	P					一	ヲ	≡	ヨ	p
	1	CG RAM (2)	!	1	A	Q	a	q					。	ア	チ	△	△	q
	2	CG RAM (3)	"	2	B	R	b	r					「	イ	ウ	×	β	θ
	3	CG RAM (4)	#	3	C	S	c	s					」	ウ	テ	ε	ε	ω
	4	CG RAM (5)	\$	4	D	T	d	t					、	イ	ト	ト	μ	Ω
	5	CG RAM (6)	%	5	E	U	e	u					。	オ	ナ	1	ε	Ü
	6	CG RAM (7)	&	6	F	V	f	v					ヲ	カ	ニ	ヨ	p	Σ
	7	CG RAM (8)	'	7	G	W	g	w					フ	キ	ヌ	ヲ	gn	
	8	CG RAM (1)	(	8	H	X	h	x					ィ	ク	ホ	リ	ル	Σ
	9	CG RAM (2)	)	9	I	Y	i	y					お	ケ	ル	リ	リ	y
	A	CG RAM (3)	*	:	J	Z	j	z					エ	コ	N	V	j	〒
	B	CG RAM (4)	+	:	K	E	k	<					オ	サ	ヒ	ロ	オ	ア
	C	CG RAM (5)	,	<	L	≠	1	!					サ	シ	フ	フ	オ	ア
	D	CG RAM (6)	-	=	M	J	m	>					ユ	ス	ソ	ン	ト	÷
	E	CG RAM (7)	.	>	N	^	n	→					ヨ	セ	ホ	リ	ン	
	F	CG RAM (8)	/	?	O	_	O	+					ウ	ソ	マ	°	Ö	■

\* Character codes (00H-0FH) of SED1278F are assigned to the area of character generator RAM (CG RAM).  
 The CG ROM of the SED1278F is masked; if you wish to have your own CG ROM, consult Seiko Epson Marketing Department for conversion of the masked ROM.