

# SED1278F/D

## Dot Matrix LCD Controller Driver

- 1/8, 1/11 or 1/16 Duty Dot Matrix Drive
- Built-in Character Generator ROM and RAM (ROM 240 characters RAM 8 characters)
- Maximum Simultaneous Display of 80 Characters (With extension LCD driver)

### DESCRIPTION

The SED1278F/D 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.

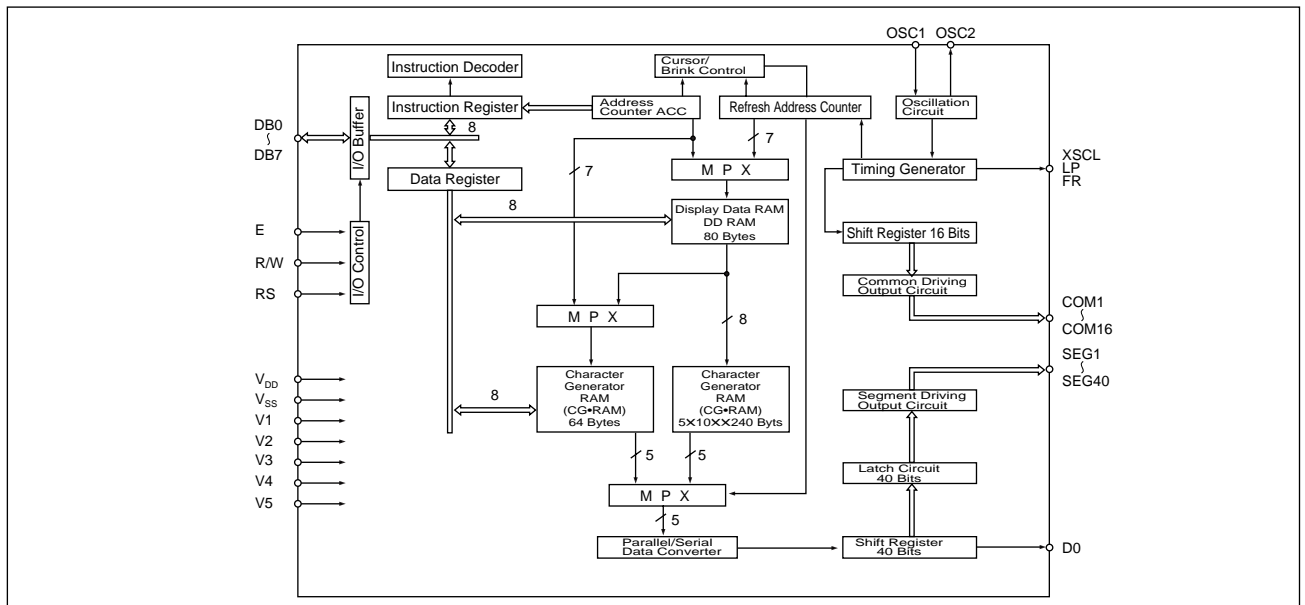
The built-in character generator ROM has an extended capacity of 240 different characters, each being generated in a 5×10 dots font compatible with a 1/11 duty. In addition, the SED1278F/D contains 64 bytes of character generator RAM in which the user can store 8 different characters, each consisting of 558 dots. These memory features offer high flexibility in character display.

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

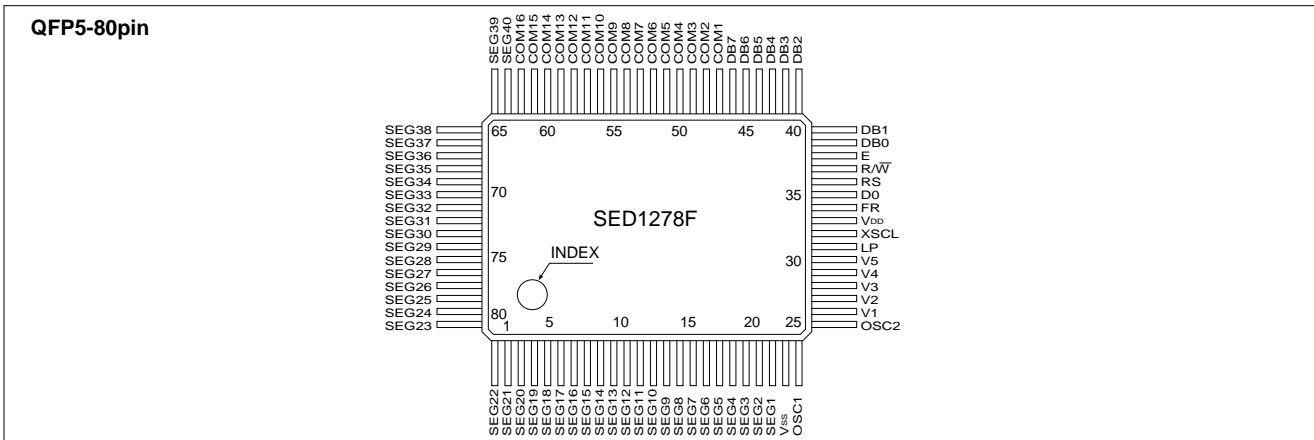
### FEATURES

- 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
- Maximim display dimension ..... 40 characters52 lines, 80 characters51 line  
(When accompanied with SED1181FLA/DLA, SED1681FOA/DOA)
- 1/8, 1/11 or 1/16 duty matirx 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 ..... 5X7 dots+Cursor line (5X8 dots also possible)  
5X10 dots+Cursor line
- 6 Kinds of character font
- Single power supply ..... 5V±10% (Logic)
- Low LCD driving voltage .....  $V_{DD}-V_5 \geq 0.0V$
- Package ..... SED1278F: QFP5-80pin (plastic)  
SED1278D: Die form (Al pad)

### BLOCK DIAGRAM



■ PIN CONFIGURATION



■ PIN DESCRIPTION

Symbol	No. of signals	Function
RS	1	Register select signal
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
COM 1 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 ( $V_5 \geq V_{SS}$ )
V <sub>DD</sub>	1	+5V
V <sub>SS</sub>	1	0V (GND)
OSC1		Used to connect resistor (typ. 91K-ohms) for oscillation;
OSC2	2	OSC1 is for external clock input.

*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

(V<sub>SS</sub> = 0V, Ta = 25°C)

Rating	Symbol	Value	Unit
Supply voltage (1)	V <sub>DD</sub>	-0.3 to 7.0	V
Supply voltage (2)	V <sub>1</sub> to V <sub>5</sub>	-0.3 to V <sub>DD</sub> +0.3	V
Input voltage	V <sub>I</sub>	-0.3 to V <sub>DD</sub> +0.3	V
Output voltage	V <sub>O</sub>	-0.3 to V <sub>DD</sub> +0.3	V
Power dissipation	P <sub>D</sub>	300	mW
Operating temperature	T <sub>opr</sub>	-20 to 75	°C
Storage temperature	T <sub>stg</sub>	-65 to 150	°C
Soldering temperature and time	T <sub>sol</sub>	260°C•10s (at lead)	—

Note: The following condition must always hold true: V<sub>DD</sub> ≥ V<sub>1</sub> ≥ V<sub>2</sub> ≥ V<sub>3</sub> ≥ V<sub>4</sub> ≥ V<sub>5</sub>

■ ELECTRICAL CHARACTERISTICS

● DC Characteristics

( $V_{DD} = 5.0V \pm 10\%$ ,  $V_{SS} = 0V$ ,  $T_a = -20$  to  $75^\circ C$ )

Characteristic	Symbol	Condition	Applicable Pin	Min.	Typ.	Max.	Unit
"H" level input voltage (1)	$V_{IH1}$		DB0~DB7 RS, R/W, E	2.0	—	$V_{DD}$	V
"L" level input voltage (1)	$V_{IL1}$			$V_{SS}$	—	0.8	V
"H" level input voltage (2)	$V_{IH2}$		OSC1	$V_{DD}-1.0$	—	$V_{DD}$	V
"L" level input voltage (2)	$V_{IL2}$			$V_{SS}$	—	1.0	V
"H" level output voltage (1)	$V_{OH1}$	$I_{OH} = -0.205mA$	DB0~DB7	2.4	—	—	V
"L" level output voltage (1)	$V_{OL1}$	$I_{OL} = 1.6mA$		—	—	0.4	V
"H" level output voltage (2)	$V_{OH2}$	$I_{OH} = -0.04mA$	XSCL LP DO	$0.9V_{DD}$	—	—	V
"L" level output voltage (2)	$V_{OL2}$	$I_{OL} = 0.04mA$		—	—	$0.1V_{DD}$	V
Driver-on resistor (COM)	$R_{COM}$	$ V_{COM}-V_n  = 0.5V$	COM1~16	—	2	10	k $\Omega$
Driver-on resistor (SEG)	$R_{SEG}$	$ V_{SEG}-V_n  = 0.5V$	SEG1~40	—	2.5	10	k $\Omega$
I/O leakage current	$I_{IL}$	$V_I = 0$ to $V_{DD}$		—	—	1	$\mu A$
Pull-up MOS current	$-I_P$	$V_{DD} = 5V$		50	125	250	$\mu A$
Supply current	$I_{OP}$	Rf oscillation, from external clock $V_{DD} = 5V$ , $f_{osc} = f_{CP} = 270kHz$	$V_{DD}$	—	0.5	0.8	mA
External clock operation							
External clock operating frequency	$f_{EXTCL}$			125	250	350	kHz
External clock duty	Duty			45	50	55	%
External clock rise time	$tr_{EXTCL}$			—	—	0.2	$\mu S$
External clock fall time	$tf_{EXTCL}$			—	—	0.2	$\mu S$
Internal clock operation (Rf oscillation)							
Oscillation frequency	$f_{OSC}$	$R_f = 91K\Omega \pm 2\%$		190	270	350	kHz
Internal clock operation (Ceramic filter oscillation)							
Oscillation frequency	$f_{OSC}$	Ceramic filter		245	250	255	kHz
LCD driving voltage	$V_{LCD}$	$V_{DD}-V_5$		3.0	—	$V_{DD}$	V

● AC Characteristics

○ Read Cycle

( $V_{DD} = 5.0V \pm 10\%$ ,  $V_{SS} = 0V$ ,  $T_a = -20$  to  $75^\circ C$ )

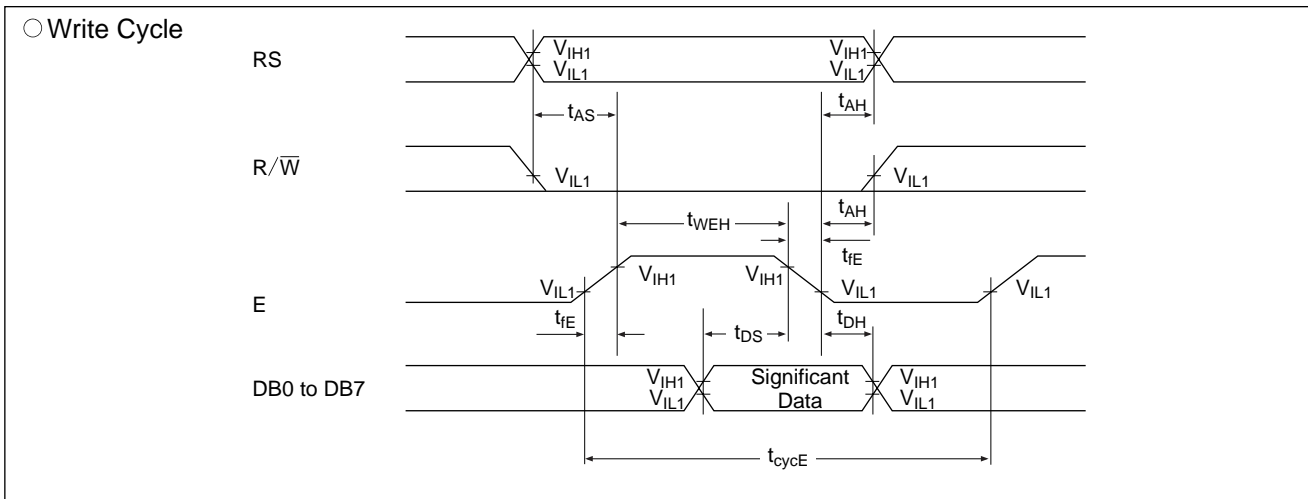
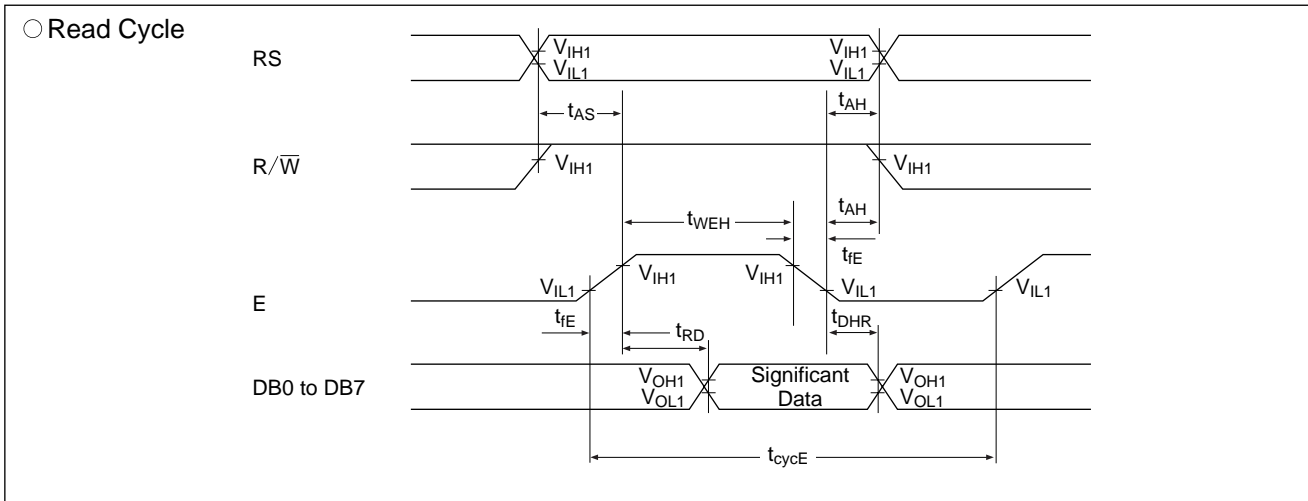
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Enable cycle time	$t_{cycE}$		500	—	—	ns
Enable "H" level pulse width	$t_{WEH}$		220	—	—	ns
Enable rise/fall time	$t_{rE}, t_{fE}$		—	—	25	ns
RS, R/ $\bar{W}$ setup time	$t_{AS}$		40	—	—	ns
RS, R/ $\bar{W}$ address hold time	$t_{AH}$		10	—	—	ns
Read data output delay	$t_{RD}$	$C_L = 100pF$	—	—	120	ns
Read data hold time	$t_{DHR}$		20	—	—	ns

○ Write Cycle

( $V_{DD} = 5.0V \pm 10\%$ ,  $V_{SS} = 0V$ ,  $T_a = -20$  to  $75^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Enable cycle time	$t_{cycE}$		500	—	—	ns
Enable "H" level pulse width	$t_{WEH}$		220	—	—	ns
Enable rise/fall time	$t_{rE}, t_{fE}$		—	—	25	ns
RS, R/ $\bar{W}$ setup time	$t_{AS}$		40	—	—	ns
RS, R/ $\bar{W}$ address hold time	$t_{AH}$		10	—	—	ns
Data setup time	$t_{DS}$		60	—	—	ns
Write data hold time	$t_{DH}$		10	—	—	ns

● Timing Chart

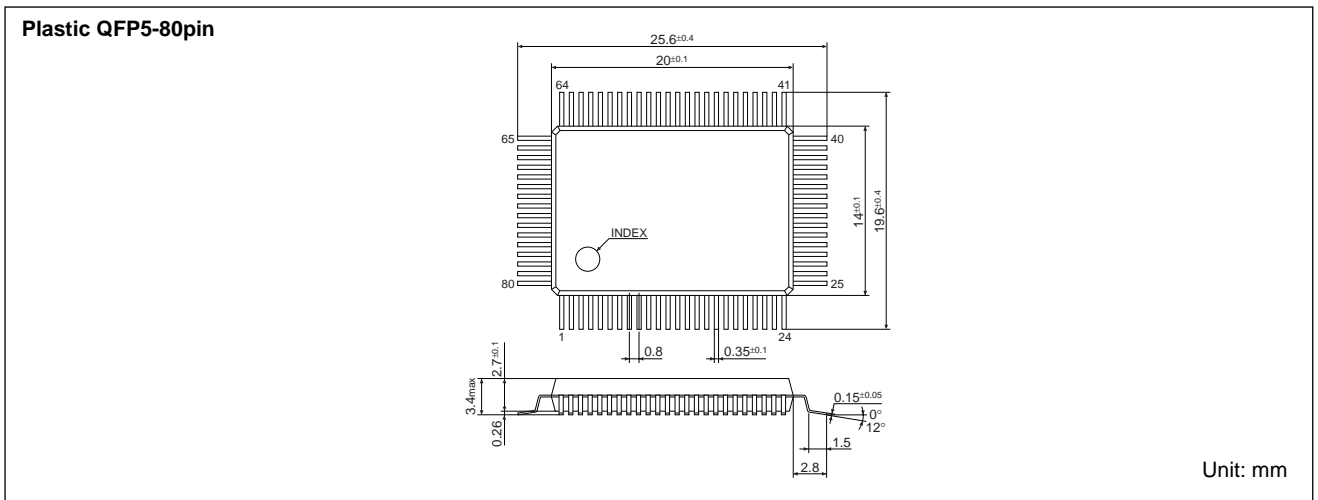


■ DISPLAY COMMAND

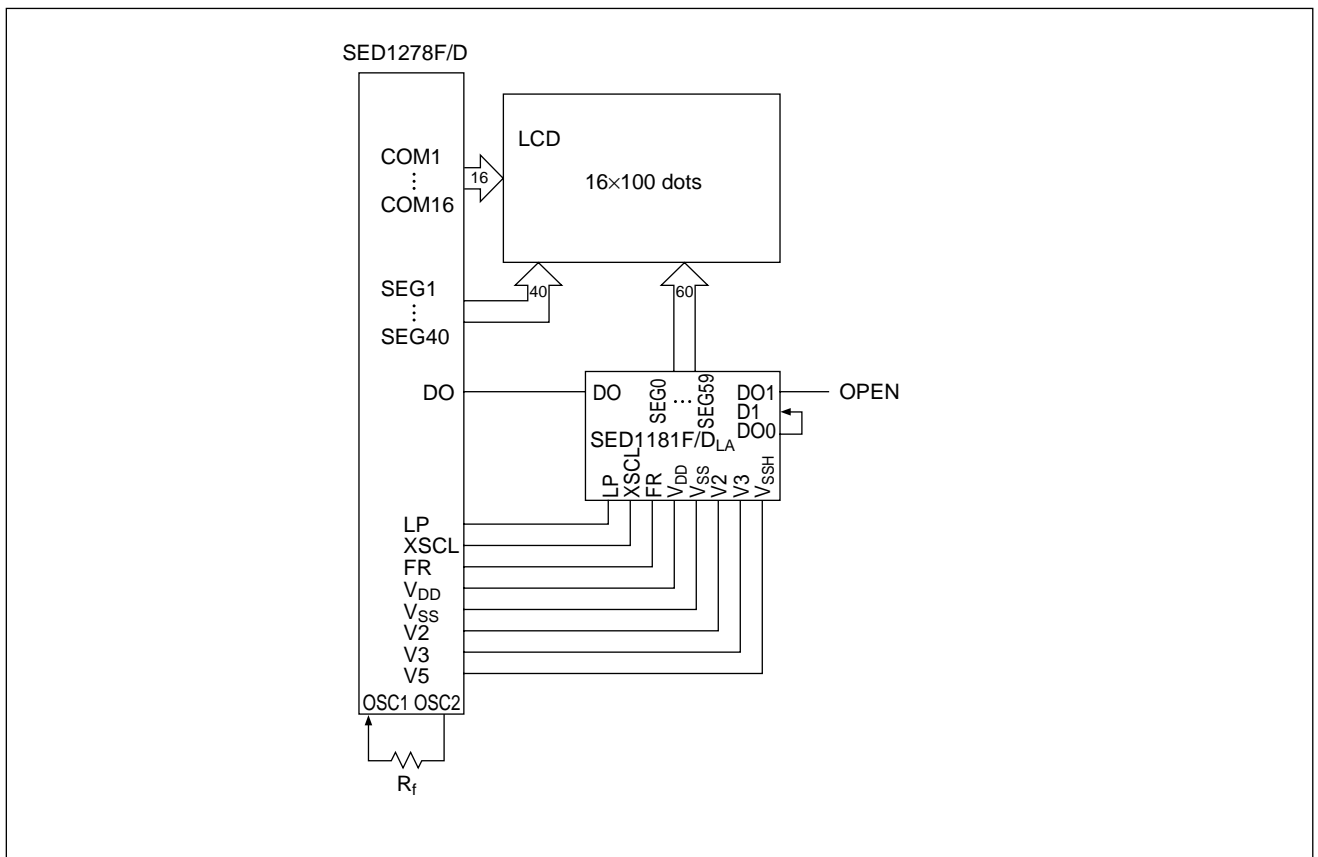
Parameter	RS	R/ $\bar{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Note
CLEAR DISPLAY	0	0	0	0	0	0	0	0	0	1	
CURSOR HOME	0	0	0	0	0	0	0	0	1	1	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	I/D	DB1 = 1 : Increment, DB1 = 0 : Decrement DB0 = 1 : The display is shifted. DB0 = 0 : The display is not shifted.
DISPLAY ON/OFF	0	0	0	0	0	0	1	D	C	C	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	$A_{CG}$					The address length that can be set is 64 addresses.	
SET DDRAM ADDRESS	0	0	1	$A_{DD}$					The address length that can be set is 80 addresses.		
READ BUSY FLUG/ 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



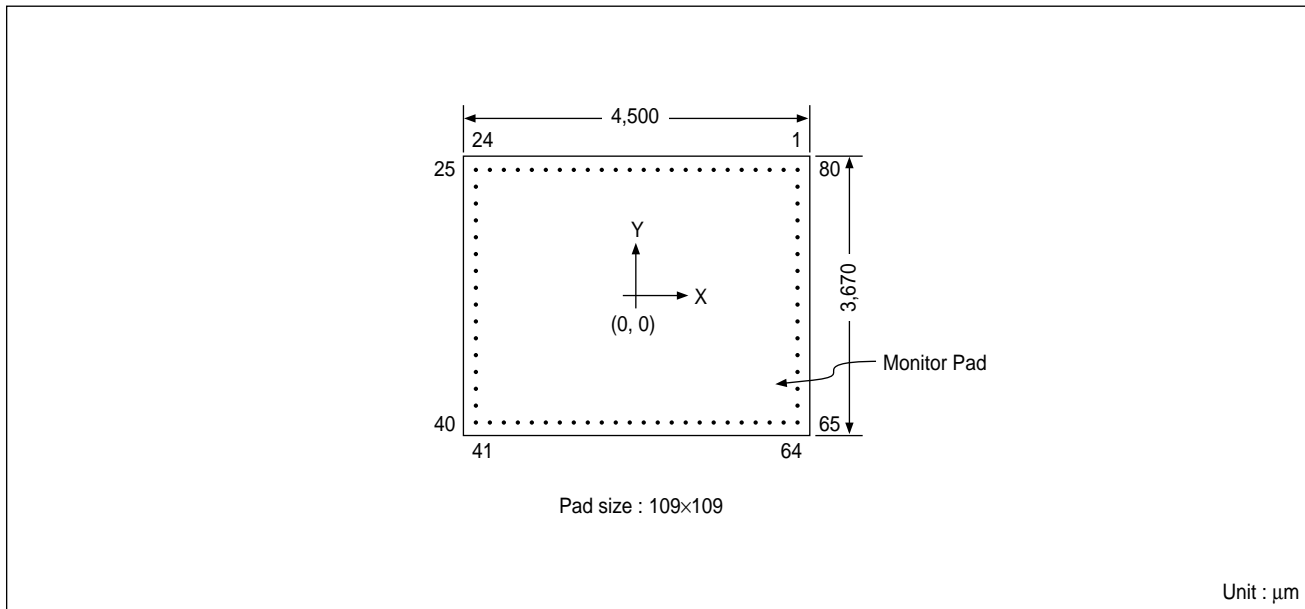
■ LCD PANEL INTERFACE EXAMPLE (2 lines×20 characters)



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

## ■ SED1278D

### ● PAD LAYOUT



### ● PAD COORDINATION

Unit : μm

Pad No.	Pad Name	X	Y	Pad No.	Pad Name	X	Y	Pad No.	Pad Name	X	Y
1	SEG22	2,087	1,671	28	V3	-2,087	819	55	COM9	452	-1,671
2	SEG21	1,905	↓	29	V4	↓	637	56	COM10	633	↓
3	SEG20	1,723	↓	30	V5	↓	455	57	COM11	814	↓
4	SEG19	1,541	↓	31	LP	↓	273	58	COM12	995	↓
5	SEG18	1,359	↓	32	XSCL	↓	91	59	COM13	1,177	↓
6	SEG17	1,177	↓	33	VCC	↓	-91	60	COM14	1,359	↓
7	SEG16	995	↓	34	FR	↓	-273	61	COM15	1,541	↓
8	SEG15	814	↓	35	DO	↓	-455	62	COM16	1,723	↓
9	SEG14	633	↓	36	RS	↓	-637	63	SEG40	1,905	↓
10	SEG13	452	↓	37	R/W	↓	-819	64	SEG39	2,087	↓
11	SEG12	272	↓	38	E	↓	-1,001	65	SEG38	↓	-1,365
12	SEG11	91	↓	39	DB0	↓	-1,183	66	SEG37	↓	-1,183
13	SEG10	-91	↓	40	DB1	↓	-1,365	67	SEG36	↓	-1,001
14	SEG9	-272	↓	41	DB2	↓	-1,671	68	SEG35	↓	-819
15	SEG8	-452	↓	42	DB3	-1,905	↓	69	SEG34	↓	-637
16	SEG7	-633	↓	43	DB4	-1,723	↓	70	SEG33	↓	-455
17	SEG6	-814	↓	44	DB5	-1,541	↓	71	SEG32	↓	-273
18	SEG5	-995	↓	45	DB6	-1,359	↓	72	SEG31	↓	-91
19	SEG4	-1,177	↓	46	DB7	-1,177	↓	73	SEG30	↓	91
20	SEG3	-1,359	↓	47	COM1	-995	↓	74	SEG29	↓	273
21	SEG2	-1,541	↓	48	COM2	-814	↓	75	SEG28	↓	455
22	SEG1	-1,723	↓	49	COM3	-633	↓	76	SEG27	↓	637
23	GND	-1,905	↓	50	COM4	-452	↓	77	SEG26	↓	819
24	OSC1	-2,087	↓	51	COM5	-272	↓	78	SEG25	↓	1,001
25	OSC2	↓	1,365	52	COM6	-91	↓	79	SEG24	↓	1,183
26	V1	↓	1,183	53	COM7	91	↓	80	SEG23	↓	1,365
27	V2	↓	1,001	54	COM8	272	↓				

■ SED1278D<sub>0A</sub> CHARACTER FONT

		Higher 4-Bit (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	1	2	3								
	1	CG RAM (2)				4	5	6	7								
	2	CG RAM (3)				8	9	A	B								
	3	CG RAM (4)				C	D	E	F								
	4	CG RAM (5)															
	5	CG RAM (6)															
	6	CG RAM (7)															
	7	CG RAM (8)															
	8	CG RAM (1)															
	9	CG RAM (2)															
	A	CG RAM (3)															
	B	CG RAM (4)															
	C	CG RAM (5)															
	D	CG RAM (6)															
	E	CG RAM (7)															
	F	CG RAM (8)															

■ SED1278F<sub>0B</sub>/D<sub>0B</sub> CHARACTER FONT

		Higher 4-Bit (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	P	'	P	9	6	'	0	0	0	0	0	0	0
	1	CG RAM (2)	=	!	1	A	0	a	9	0	a	e	'	J	t	y	e
	2	CG RAM (3)	7	"	2	R	R	r	a	R	6	'	o	s	s	z	
	3	CG RAM (4)	2	#	3	S	s	s	a	6	6	'	P	7	e	y	
	4	CG RAM (5)	7	#	4	T	t	a	t	a	a	t	'	4	r	z	o
	5	CG RAM (6)	7	5	E	U	u	u	a	a	6	'	2	n	n	7	
	6	CG RAM (7)	7	6	F	V	v	v	a	0	*	'	u	W	0	0	
	7	CG RAM (8)	7	'	7	G	w	w	S	U	R	'	X	X	A	U	
8	CG RAM (1)	7	0	H	X	x	x	a	6	'	+	+	6	K			
9	CG RAM (2)	7	9	I	Y	y	w	6	0	i	'	2	T	A			
A	CG RAM (3)	*	*	8	J	Z	z	a	U	R	'	2	Z	U			
B	CG RAM (4)	7	+	8	K	K	C	i	R	6	'	6	T	V			
C	CG RAM (5)	=	.	<	L	\	l	i	a	6	'	*	U	6	6		
D	CG RAM (6)	w	-	=	M	m	D	i	a	6	'	*	.	U	T		
E	CG RAM (7)	6	.	>	N	n	y	a	0	0	'	0	0	0	0		
F	CG RAM (8)	6	/	>	O	o	A	a	6	6	'	0	0	0			



■ SED1278Foc/Doc CHARACTER FONT

		Higher 4-Bit (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)				O	P	'	F				e	ae	i	l	le		
	1	CG RAM (2)		!		1	A	Q	a	a				o	ae	ie	o	o	
	2	CG RAM (3)		"		2	B	R	r	r				e	ae	o	i	o	o
	3	CG RAM (4)		#		3	C	S	s	s				a	o	o	i		o
	4	CG RAM (5)		\$		4	D	T	t	t				a	o	o	i		o
	5	CG RAM (6)		%		5	E	U	u	u				a	o	o	i		o
	6	CG RAM (7)		&		6	F	V	v	v				'	o	a	"	o	a
	7	CG RAM (8)		'		7	G	W	w	w				u	o	o	i	o	a
	8	CG RAM (1)		(		8	H	X	x	x				e	ae	o	i	o	a
	9	CG RAM (2)		)		9	I	Y	y	y				e	ae	o	i	o	a
	A	CG RAM (3)		*		A	J	Z	z	z				e	ae	o	i	o	a
	B	CG RAM (4)		+		B	K	[	]	]				i	ae	i	o	o	a
	C	CG RAM (5)		,		C	L	\	]	]				i	ae	o	i	o	a
	D	CG RAM (6)		-		D	M	^	^	^				i	ae	i	o	o	a
	E	CG RAM (7)		.		E	N	_	_	_				ae	ae	o	i	o	a
	F	CG RAM (8)		/		F	O	`	`	`				ae	ae	o	i	o	a

■ SED1278F<sub>0D</sub>/D<sub>0E</sub> CHARACTER FONT

		Higher 4-Bit (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)				O	P	'	P					æ	å	ä	ö	
	1	CG RAM (2)		!		1	A	Q	a	a					ö	a	l	v
	2	CG RAM (3)		"		2	B	R	r	r					æ	å	ä	ö
	3	CG RAM (4)		#		3	C	S	s	s					ä	ö	ä	ö
	4	CG RAM (5)		\$		4	D	T	t	t					ä	ö	ä	ö
	5	CG RAM (6)		%		5	E	U	u	u					ä	ö	ä	ö
	6	CG RAM (7)		&		6	F	V	v	v					ö	a	l	v
	7	CG RAM (8)		'		7	G	W	w	w					æ	å	ä	ö
	8	CG RAM (1)		(		8	H	X	x	x					æ	å	ä	ö
	9	CG RAM (2)		)		9	I	Y	y	y					æ	å	ä	ö
	A	CG RAM (3)		*		A	J	Z	z	z					æ	å	ä	ö
	B	CG RAM (4)		+		B	K	[	[	[					æ	å	ä	ö
	C	CG RAM (5)		,		C	L	\	\	\					æ	å	ä	ö
	D	CG RAM (6)		-		D	M	]	]	]					æ	å	ä	ö
	E	CG RAM (7)		.		E	N	^	^	^					æ	å	ä	ö
	F	CG RAM (8)		/		F	O	_	_	_					æ	å	ä	ö

■ SED1278F<sub>0G</sub>/D<sub>0G</sub> CHARACTER FONT

		Higher 4-Bit (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)				O	P	'	F				z	e	a	o	i
	1	CG RAM (2)		!		1	A	a	a				o	a	e	o	!
	2	CG RAM (3)		"		2	R	R	r				e	e	o	a	e
	3	CG RAM (4)		#		3	S	s	s				a	o	o	z	a
	4	CG RAM (5)		\$		4	T	t	t				a	o	a	o	z
	5	CG RAM (6)		%		5	U	u	u				a	o	N	'	o
	6	CG RAM (7)		&		6	V	v	v				'	o	a	'	o
	7	CG RAM (8)		'		7	W	w	w				N	o	N	#	a
	8	CG RAM (1)		(		8	X	x	x				e	e	o	u	o
	9	CG RAM (2)		)		9	Y	y	y				e	e	z	N	o
	A	CG RAM (3)		*		A	Z	z	z				e	o	a	L	,
	B	CG RAM (4)		+		B	K	k	k				i	u	N	o	o
	C	CG RAM (5)		,		C	L	l	l				i	u	N	-	o
	D	CG RAM (6)		-		D	M	m	m				i	u	i	o	e
	E	CG RAM (7)		.		E	N	n	n				A	e	z	a	!
	F	CG RAM (8)		/		F	O	o	o				A	z	u	o	z

■ SED1278F<sub>OH</sub>/D<sub>OH</sub> CHARACTER FONT

		Higher 4-Bit (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)			G	A	P	'	F			B	M	.	J	K	
	1	CG RAM (2)	!	.	1	A	a	a			Γ	α	.	U	K		
	2	CG RAM (3)	"		2	B	b	r			E	E	u	U	K		
	3	CG RAM (4)	#		3	C	s	s			W	B	u	a	K		
	4	CG RAM (5)	\$		4	D	t	t			3	r	>	U	K		
	5	CG RAM (6)	%		5	E	u	u			N	e	x	U	'		
	6	CG RAM (7)	&		6	F	v	v			Q	W	>	u	K		
	7	CG RAM (8)	'		7	G	w	w			J	a	I	'	E		
	8	CG RAM (1)	(		8	H	x	x			n	v	u	'	*		
	9	CG RAM (2)	)		9	I	y	y			y	v	u	'	*		
	A	CG RAM (3)	*		A	J	z	z			Q	k	u	e	K		
	B	CG RAM (4)	+		B	K	w	w			4	u	'	W	*		
	C	CG RAM (5)	,		C	L	l	l			U	N	u	U	K		
	D	CG RAM (6)	-		D	M	n	n			b	w	u	W	*		
	E	CG RAM (7)	.		E	N	o	o			B	n	s	>	U	K	
	F	CG RAM (8)	/		F	O	e	e			Q	T	e	.	O	K	

\*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.

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