

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.

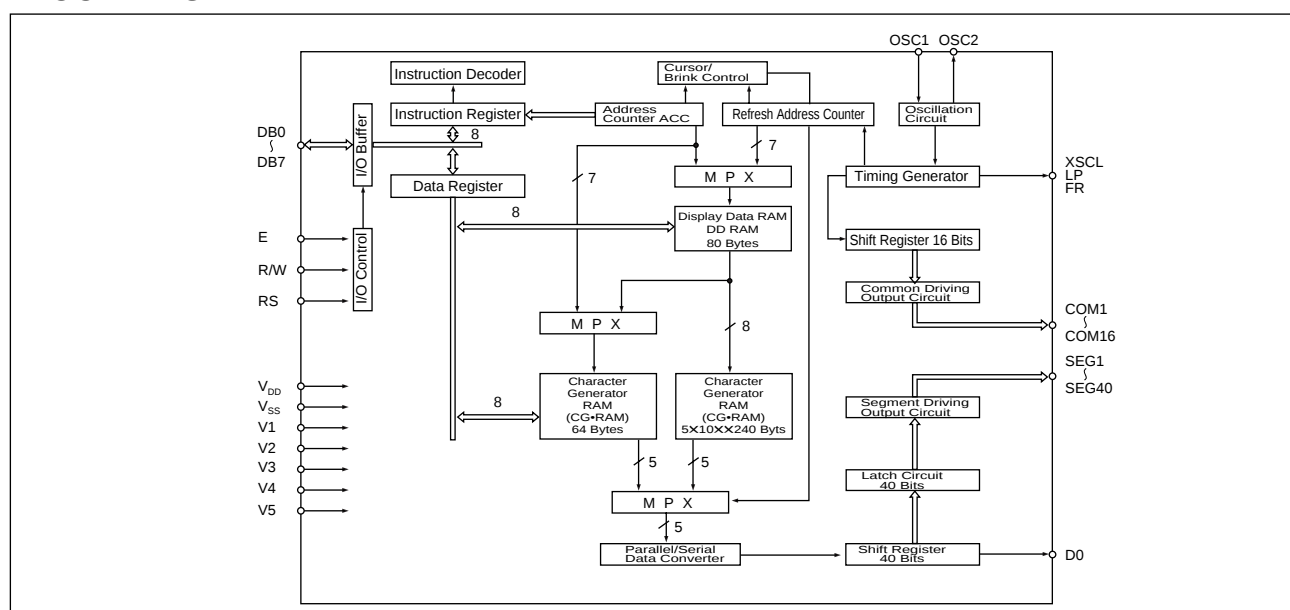
The built-in character generator ROM has an extended capacity of 240 different characters, each being generated in a 5×10 dots font compatible with a 1/11 duty. In addition, the SED1278F/D contains 64 bytes of character generator RAM in which the user can store 8 different characters, each consisting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

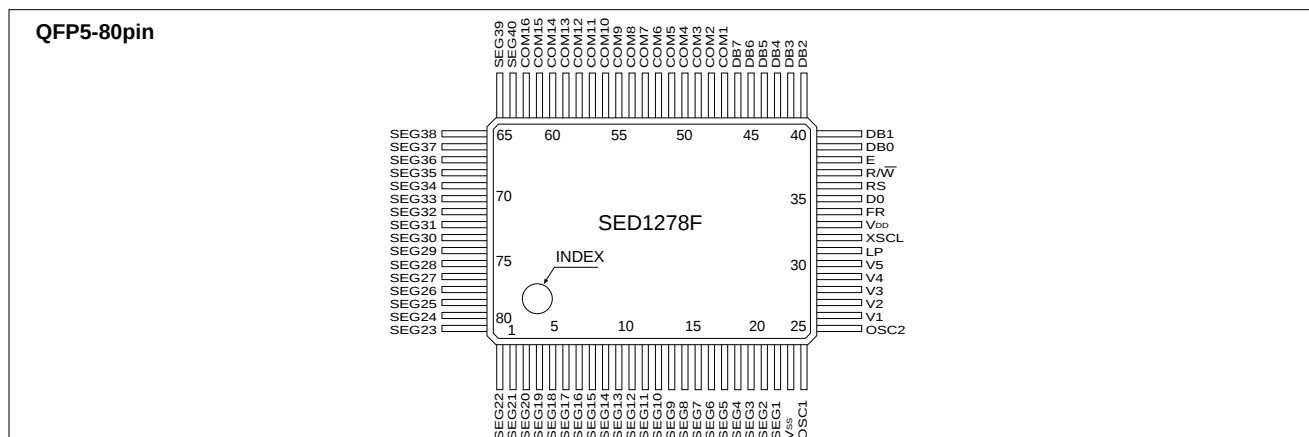
FEATURES

- 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}—V₅≥.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 _{DD}	1	+5V
V _{SS}	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_{SS} = 0V, Ta = 25°C)

Rating	Symbol	Value	Unit
Supply voltage (1)	V _{DD}	-0.3 to 7.0	V
Supply voltage (2)	V ₁ to V ₅	-0.3 to V _{DD} +0.3	V
Input voltage	V _I	-0.3 to V _{DD} +0.3	V
Output voltage	V _O	-0.3 to V _{DD} +0.3	V
Power dissipation	P _D	300	mW
Operating temperature	T _{opr}	-20 to 75	°C
Storage temperature	T _{stg}	-65 to 150	°C
Soldering temperature and time	T _{sol}	260°C•10s (at lead)	—

Note: The following condition must always hold true: V_{DD} ≥ V₁ ≥ V₂ ≥ V₃ ≥ V₄ ≥ V₅

■ 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 Ω
Driver-on resistor (SEG)	R_{SEG}	$ V_{SEG} - V_n = 0.5V$	SEG1~40	—	2.5	10	k Ω
I/O leakage current	I_{IL}	$V_I = 0$ to V_{DD}		—	—	1	μA
Pull-up MOS current	$-I_P$	$V_{DD} = 5V$		50	125	250	μA
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	t_{rEXTCL}			—	—	0.2	μs
External clock fall time	t_{fEXTCL}			—	—	0.2	μs
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

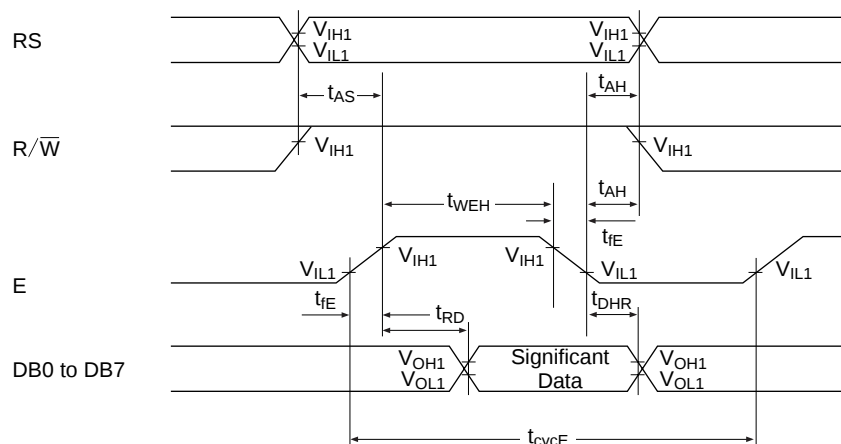
○ Write Cycle

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

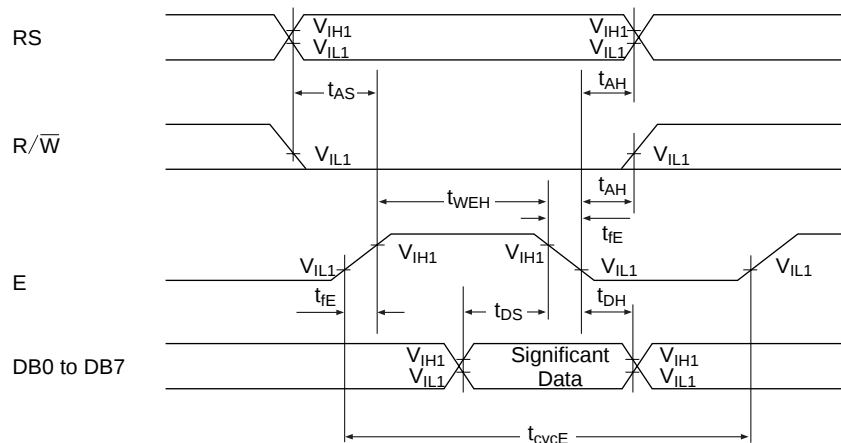
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Enable cycle time	t_{cycE}		500	—	—	ns
Enable "H" level pulse width	t_{WEH}		220	—	—	ns
Enable rise/fall time	t_{rE}, t_{fE}		—	—	25	ns
RS, R/ $\bar{W}$ setup time	t_{AS}		40	—	—	ns
RS, R/ $\bar{W}$ address hold time	t_{AH}		10	—	—	ns
Data setup time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

● Timing Chart

○ Read Cycle



○ Write Cycle

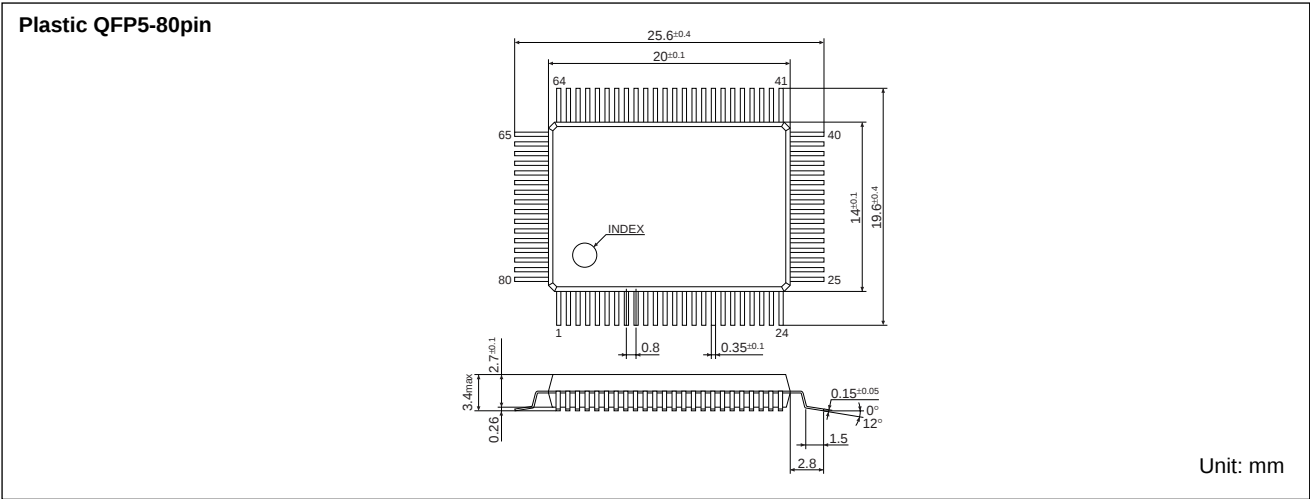


■ DISPLAY COMMAND

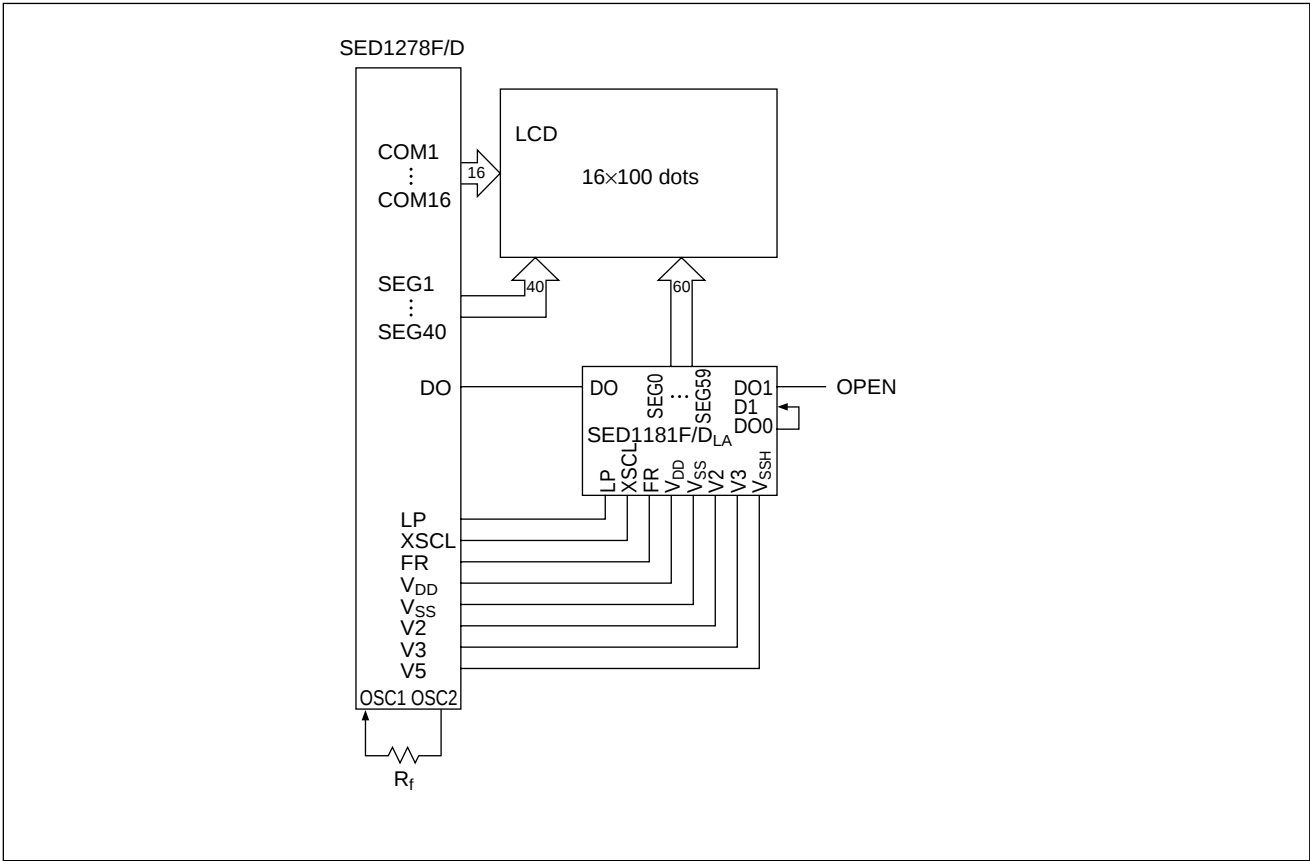
Parameter	RS	R/ $\overline{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Note
CLEAR DISPLAY	0	0	0	0	0	0	0	0	0	1	
CURSOR HOME	0	0	0	0	0	0	0	0	1	1	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	I/D	DB1 = 1 : Increment, DB1 = 0 : Decrement DB0 = 1 : The display is shifted. DB0 = 0 : The display is not shifted.
DISPLAY ON/OFF	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



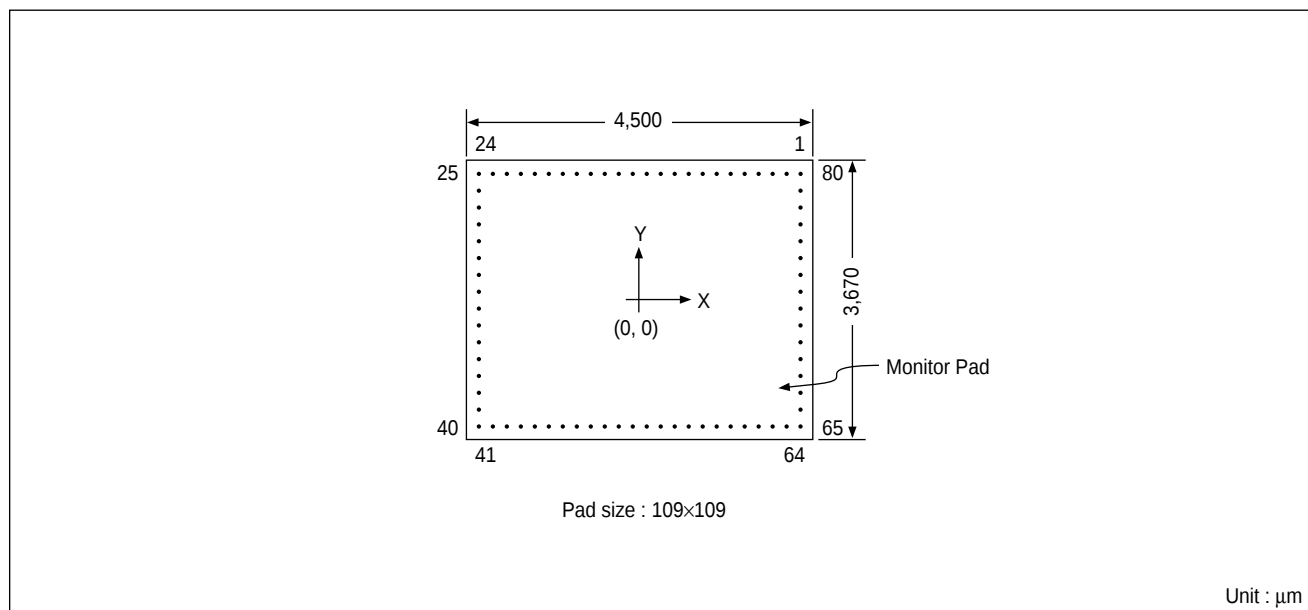
■ LCD PANEL INTERFACE EXAMPLE (2 lines×20 characters)



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_{0A} 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	a	P	`	P				—	9	3	0	p
	1	CG RAM (2)		!	1	A	Q	a	9			g	7	*	4	a	q
	2	CG RAM (3)		"	2	B	R	b	r			r	4	u	x	p	e
	3	CG RAM (4)		#	3	C	S	c	s			j	o	t	e	e	x
	4	CG RAM (5)		\$	4	D	T	d	t			\	i	t	p	u	a
	5	CG RAM (6)		%	5	E	U	e	u			.	*	*	1	e	u
	6	CG RAM (7)		&	6	F	V	f	v			3	h	c	3	p	z
	7	CG RAM (8)		'	7	G	W	g	w			7	†	7	7	g	n
	8	CG RAM (1)		(	8	H	X	h	x			4	o	*	l	j	x
	9	CG RAM (2)		)	9	I	Y	i	y			6	7	l	u	l	y
	A	CG RAM (3)		*	*	J	Z	j	z			5	o	n	v	j	7
	B	CG RAM (4)		+	;	K	[	k	[			*	9	e	o	*	7
	C	CG RAM (5)		,	<	L	*	l	l			7	3	7	7	6	7
	D	CG RAM (6)		—	=	M	]	m	]			1	z	\	c	t	÷
	E	CG RAM (7)		.	>	N	^	n	^			3	e	t	^	n	
	F	CG RAM (8)		/	?	O	_	o	_			u	v	7	7	ö	

■ SED1278F_{0B}/D_{0B} 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	0	P		P	9	é	á		í	í	í	í
	1	CG RAM (2)	≡	!	1	A	Q	a	9	Q	æ	í		J	+	y	ü
	2	CG RAM (3)	7	"	2	B	R	b	r	é	é	ó		°	o	é	æ
	3	CG RAM (4)	¿	#	3	C	S	c	s	á	á	ó		°	í	e	ü
	4	CG RAM (5)	/	*	4	D	T	d	t	á	á	ó		°	í	z	ü
	5	CG RAM (6)	/	%	5	E	U	e	u	á	á	ó		°	í	z	ü
	6	CG RAM (7)	/	%	6	F	V	f	v	á	á	ó		°	í	z	ü
	7	CG RAM (8)	/	'	7	G	W	w	g	á	á	ó		°	í	z	ü
	8	CG RAM (1)	/	(	8	H	X	x	h	á	á	ó		°	í	z	ü
	9	CG RAM (2)	/	)	9	I	Y	y	i	á	á	ó		°	í	z	ü
	A	CG RAM (3)	/	*	A	J	Z	z	j	á	á	ó		°	í	z	ü
	B	CG RAM (4)	/	+	B	K	[	k	c	á	á	ó		°	í	z	ü
	C	CG RAM (5)	/	,	C	L	\	l	á	á	ó		°	í	z	ü	
	D	CG RAM (6)	/	-	D	M	]	m	á	á	ó		°	í	z	ü	
	E	CG RAM (7)	/	.	E	N	^	n	á	á	ó		°	í	z	ü	
	F	CG RAM (8)	/	/	F	O	_	o	á	á	ó		°	í	z	ü	

■ 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)			0	a	P	'	P				e	a	e	i	R
	1	CG RAM (2)		!	1	A	Q	a	a			Q	a	i	e	Q	*
	2	CG RAM (3)		"	2	B	R	b	r			e	R	o	i	Q	*
	3	CG RAM (4)		#	3	C	S	c	s			a	o	o	i	,	R
	4	CG RAM (5)		\$	4	D	T	d	t			a	o	A	i	4	#
	5	CG RAM (6)		%	5	E	U	e	u			a	o	N	"	o	t
	6	CG RAM (7)		&	6	F	V	f	v			'	o	a	"	o	A
	7	CG RAM (8)		'	7	G	W	g	w			4	o	o	o	i	R
	8	CG RAM (1)		(	8	H	X	h	x			e	g	o	W	o	R
	9	CG RAM (2)		)	9	I	Y	i	y			e	4	B	Y	B	o
	A	CG RAM (3)		*	:	J	Z	j	z			e	o	o	A	o	e
	B	CG RAM (4)		+	:	K	[	k	[			i	g	4	i	g	o
	C	CG RAM (5)		,	<	L	\	l	~			i	W	4	A	4	t
	D	CG RAM (6)		-	=	M	]	m	]			i	A	i	U	e	÷
	E	CG RAM (7)		.	>	N	^	n	^			A	e	↑	Y	e	
	F	CG RAM (8)		/	?	O	_	o	←			4	g	4	o	3	■

■ SED1278F_{OD}/D_{OE} 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	a	P	'	P			æ	æ	æ	æ	æ	æ
	1	CG RAM (2)		!	1	A	Q	a	a			Q	a	1	✓	Q	✓
	2	CG RAM (3)		"	2	B	R	b	r			æ	æ	æ	æ	æ	æ
	3	CG RAM (4)		#	3	C	S	c	s			æ	æ	æ	æ	æ	æ
	4	CG RAM (5)		\$	4	D	T	d	t			æ	æ	æ	æ	æ	æ
	5	CG RAM (6)		%	5	E	U	e	u			æ	æ	æ	æ	æ	æ
	6	CG RAM (7)		&	6	F	V	f	v			'	Q	a	'	æ	æ
	7	CG RAM (8)		'	7	G	W	g	w			æ	æ	æ	æ	æ	æ
	8	CG RAM (1)		(	8	H	X	h	x			æ	æ	æ	æ	æ	æ
	9	CG RAM (2)		)	9	I	Y	i	y			æ	æ	æ	æ	æ	æ
	A	CG RAM (3)		*	*	J	Z	j	z			æ	æ	æ	æ	æ	æ
	B	CG RAM (4)		+	;	K	[	k	[			æ	æ	æ	æ	æ	æ
	C	CG RAM (5)		,	<	L	\	l	~			æ	æ	æ	æ	æ	æ
	D	CG RAM (6)		-	=	M	]	m	]			æ	æ	æ	æ	æ	æ
	E	CG RAM (7)		.	>	N	^	n	+			æ	æ	æ	æ	æ	æ
	F	CG RAM (8)		/	?	O	_	o	←			æ	æ	æ	æ	æ	æ

■ SED1278F_{OG}/D_{OG} 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				×	E	A	B	G	I
	1	CG RAM (2)		!	1	A	Q	a	a			Q	a	1	a	:	!
	2	CG RAM (3)		"	2	B	R	b	r			e	R	ó	x	g	f
	3	CG RAM (4)		#	3	C	S	c	s			a	ó	ó	?	4	a
	4	CG RAM (5)		\$	4	D	T	d	t			a	ó	A	ó	4	"
	5	CG RAM (6)		%	5	E	U	e	u			a	ó	N	"	ó	*
	6	CG RAM (7)		&	6	F	V	f	v			'	ó	a	'	ó	?
	7	CG RAM (8)		'	7	G	W	g	w			4	ó	N	#	1	a
	8	CG RAM (1)		(	8	H	X	h	x			e	ó	c	u	ó	N
	9	CG RAM (2)		)	9	I	Y	i	y			e	ó	?	#	ó	?
	A	CG RAM (3)		*	*	J	Z	j	z			e	ó	A	L	,	e
	B	CG RAM (4)		+	;	K	[	k	[			i	u	4	I	ó	B
	C	CG RAM (5)		,	<	L	\	l	~			i	u	4	-	ó	*
	D	CG RAM (6)		-	=	M	]	m	]			i	,	i	ó	e	X
	E	CG RAM (7)		.	>	N	^	n	^			A	e	↑	1	B	I
	F	CG RAM (8)		/	?	O	_	o	←			B	5	4	I	3	■

■ SED1278F_{OH}/D_{OH} 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	4	5	6	7	8	9	A	B	C	D	E	F
	1	CG RAM (2)		!	1	A	Q	a	q						Γ	9	w	.	U	9
	2	CG RAM (3)		"	2	B	R	b	r						E	E	6	u	W	9
	3	CG RAM (4)		#	3	C	S	c	s						W	E	W	u	a	4
	4	CG RAM (5)		\$	4	D	T	d	t						3	r	e	>	φ	9
	5	CG RAM (6)		%	5	E	U	e	u						N	e	o	x	U	-
	6	CG RAM (7)		&	6	F	V	f	v						Q	W	W	>	w	9
	7	CG RAM (8)		'	7	G	W	w							J	3	a	I	'	E
	8	CG RAM (1)		(	8	H	X	x							Π	W	o	U	'	*
	9	CG RAM (2)		)	9	I	Y	y							Y	o	o	†	'	*
	A	CG RAM (3)		*	#	J	Z	j	z						φ	k	u	4	e	4
	B	CG RAM (4)		+	;	K	[	k							4	o	"	W	9	*
	C	CG RAM (5)		,	<	L	φ	l							W	W	N	W	U	4
	D	CG RAM (6)		-	=	M	J	m							b	W	o	W	4	9
	E	CG RAM (7)		.	>	N	^	n							W	n	9	>	o	9
	F	CG RAM (8)		/	?	O	_	o							3	t	e	.	o	9

*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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