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# SED1278

## CMOS DOT MATRIX LCD CONTROLLER DRIVER

### DESCRIPTION

The SED1278 is a character LCD controller-driver, capable of driving displays as large as 2 lines of 8 characters ( $5 \times 8$  pixels), with minimum external components.

The SED1278 has an internal CGROM consisting of 240 characters ( $5 \times 7$ ) plus the underline cursor, JIS, ASCII, and eight user-programmable characters in RAM.

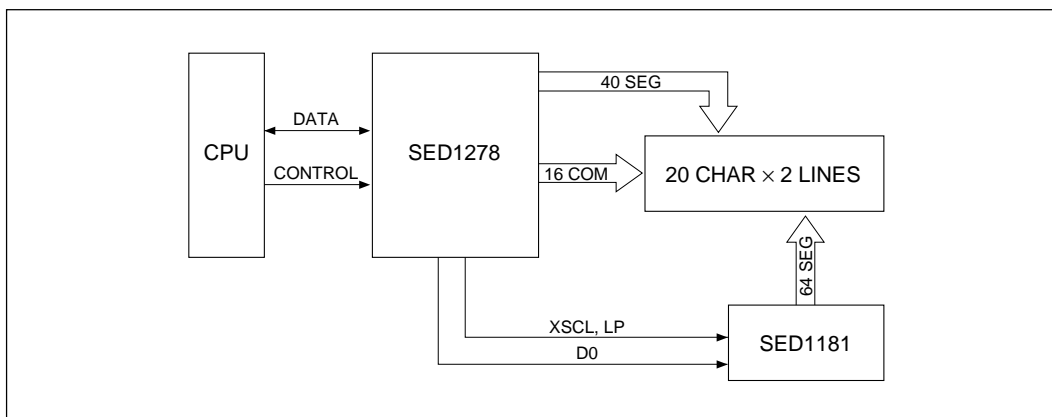
The SED1278 has 40 segment output and 16 common output built-in. Thus, one chip is capable of displaying up to 16 characters. The SED1278 can display one line of 48 characters using an SED1681F (80-bit output) as an expansion segment driver.

The SED1278 is fabricated using a silicon gate CMOS technology process and features very low power dissipation. This makes the device suitable for handheld and portable applications.

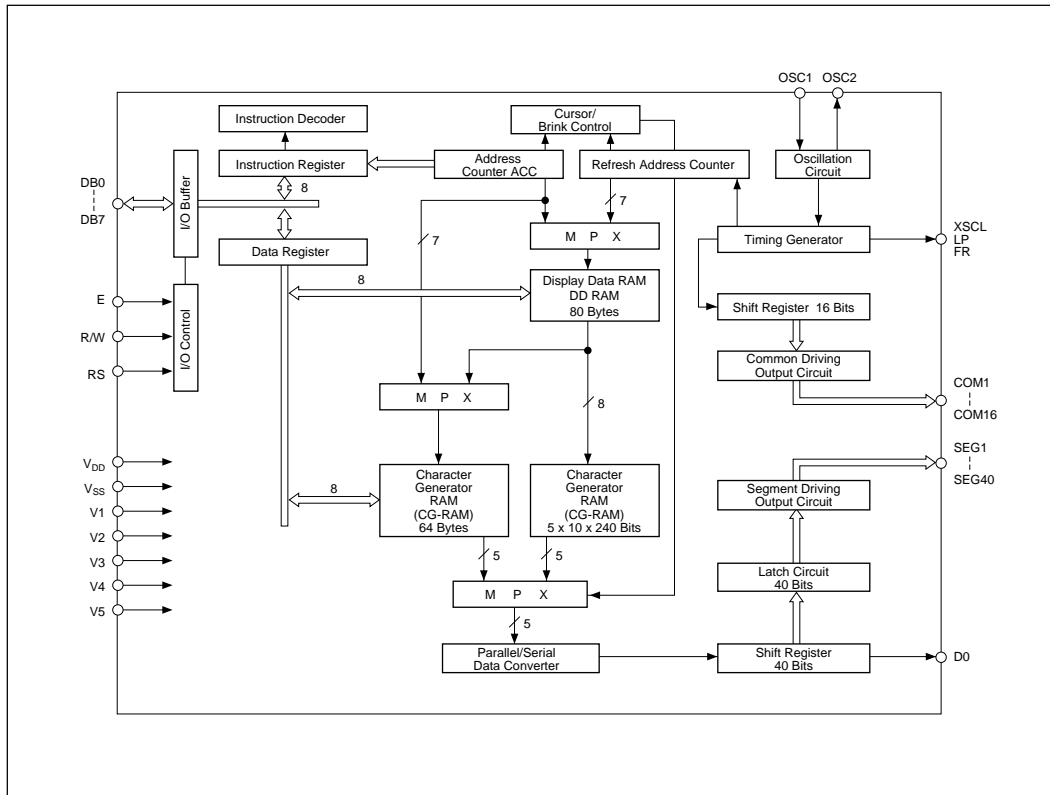
### FEATURES

- Low-power CMOS technology
- 40 segment output
- 16 common output
- Duty: 1/8 or 1/16 (set by command)
- 4/8-bit CPU data interface, TTL compatible
- Two frame AC drive wave form
- CGROM: ..... 240 characters
- CGRAM: ..... 8 characters
- Display data RAM: ...  $80 \times 8$  bits (80 characters)
- Recommended expansion segment driver:  
SED1181FLA (64 output)  
SED1681F (80 output)
- Built-in power on power-on reset
- Built-in RC oscillator
- Built-in LCD driver voltage-divider network
- TTL compatible CPU interface
- Supply voltage ..... Logic: 4.5V to 5.5V  
LCD: 3.5V to 5.5V
- Package:  
QFP5-80 pins (F0A, F0B, F0C, F0D, F0G, F0H)  
AI pad (D0A, D0B, D0C, D0D, D0G, D0H)

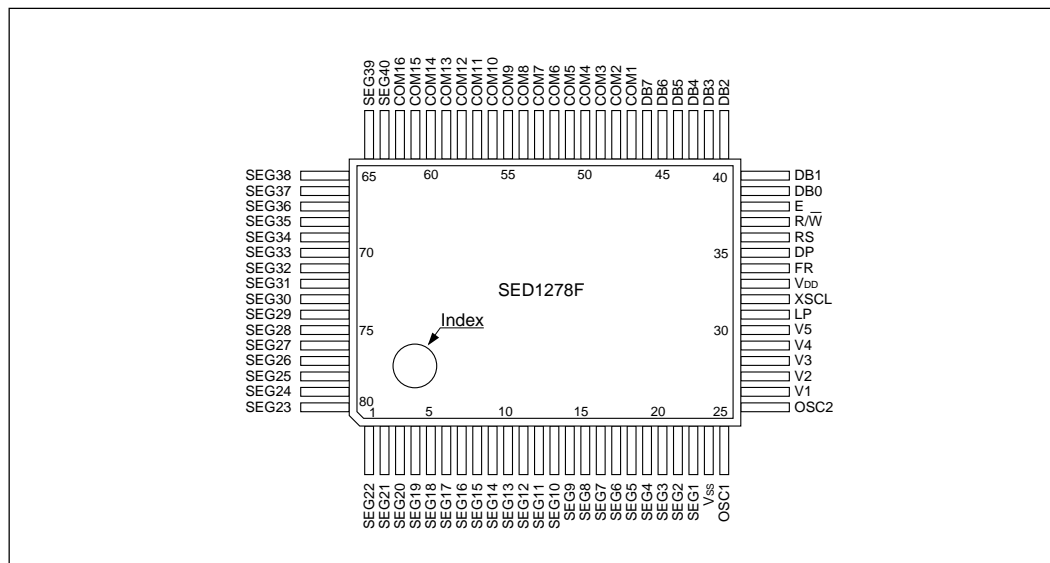
### SYSTEM BLOCK DIAGRAM



■ BLOCK DIAGRAM



■ PIN CONFIGURATION



■ PIN DESCRIPTION

Symbol	No. of signals	Functions
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
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 ( $V5 \geq V_{SS}$ )
V <sub>DD</sub>	1	+5V
V <sub>SS</sub>	1	0V (GND)
OSC1 OSC2	2	Used to connect resistor (typ. 91KΩ) for oscillation; 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

■ ELECTRICAL CHARACTERISTICS

● Absolute Maximum Ratings

(V<sub>SS</sub> = 0V, T<sub>a</sub> = 25°C)

Parameter	Symbol	Rating	Unit
Supply voltage (1)	V <sub>DD</sub>	-0.3 to 7.0	V
Supply voltage (2)	V1 to V5	-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> ≥ V1 ≥ V2 ≥ V3 ≥ V4 ≥ V5

● DC Characteristics

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

Parameter	Symbol	Condition	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 D0	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	SEG1~40	—	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>	R <sub>f</sub> oscillation, from 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 (R <sub>f</sub> oscillation)							
Oscillation frequency	f <sub>osc</sub>	R <sub>f</sub> =91kΩ±2%		190	270	350	kHz
Internal clock operation (Ceramic filter oscillation)							
Oscillation frequency	f <sub>osc</sub>	Ceramic filter		245	250	255	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

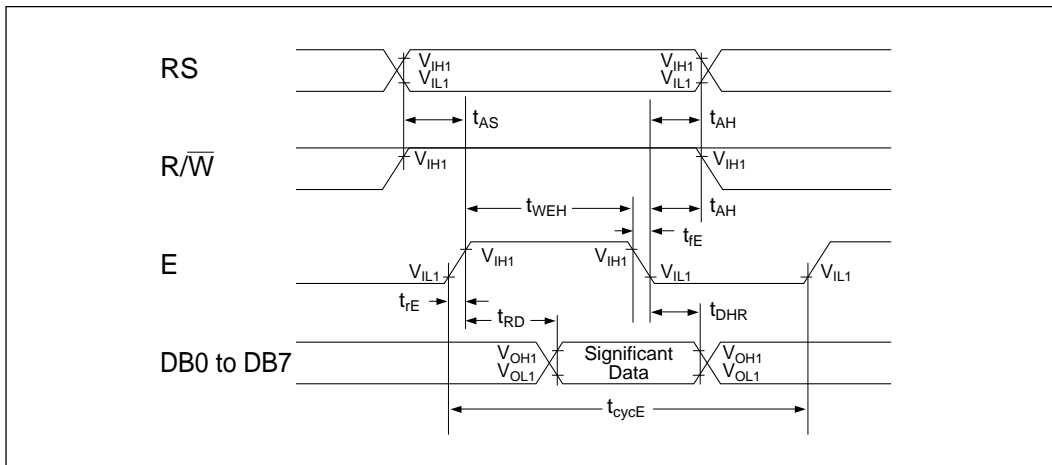
○ Write cycle

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

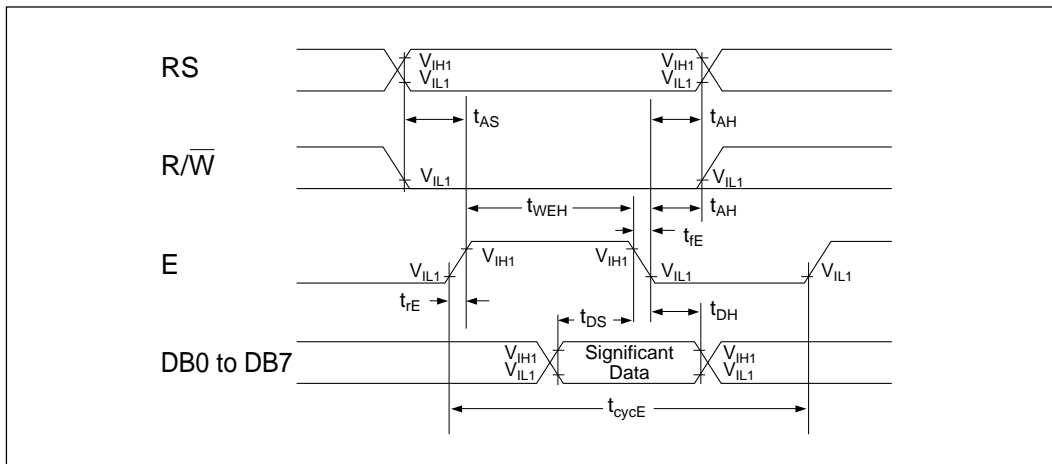
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	$t_{cycE}$		500	—	—	ns
Enable "H" level pulse width	$t_{WEH}$		220	—	—	ns
Enable rise/fall time	$t_{rE}$ , $t_{fE}$		—	—	25	ns
RS, R/W setup time	$t_{AS}$		40	—	—	ns
RS, R/W address hold time	$t_{AH}$		10	—	—	ns
Data setup time	$t_{DS}$	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

● Timing Chart

○ Read cycle



○ Write cycle

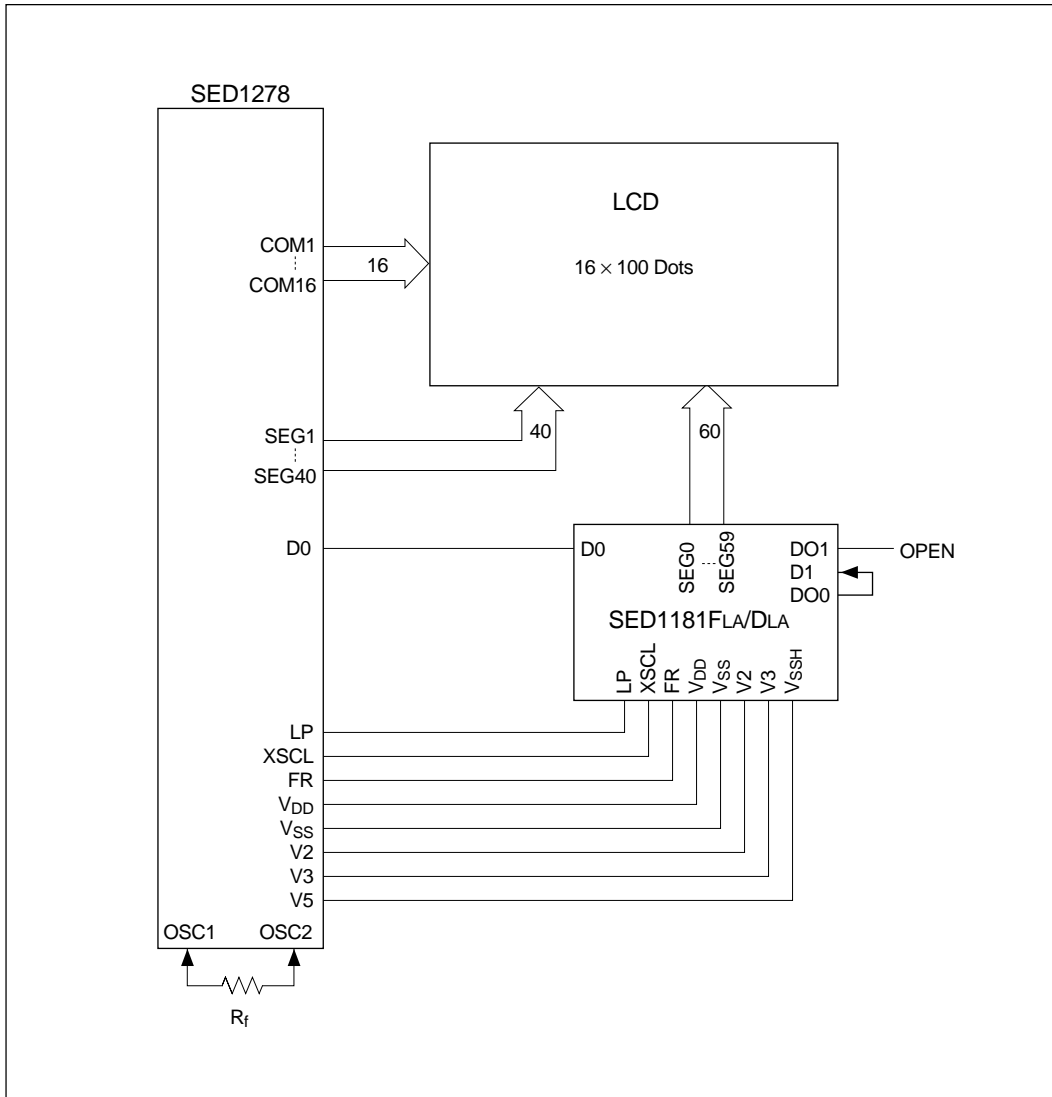


■ DISPLAY COMMAND

Parameter	RS	R/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 : 5x10 dots, 1/11 duty) (DB2=0 : 5x7dots, 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

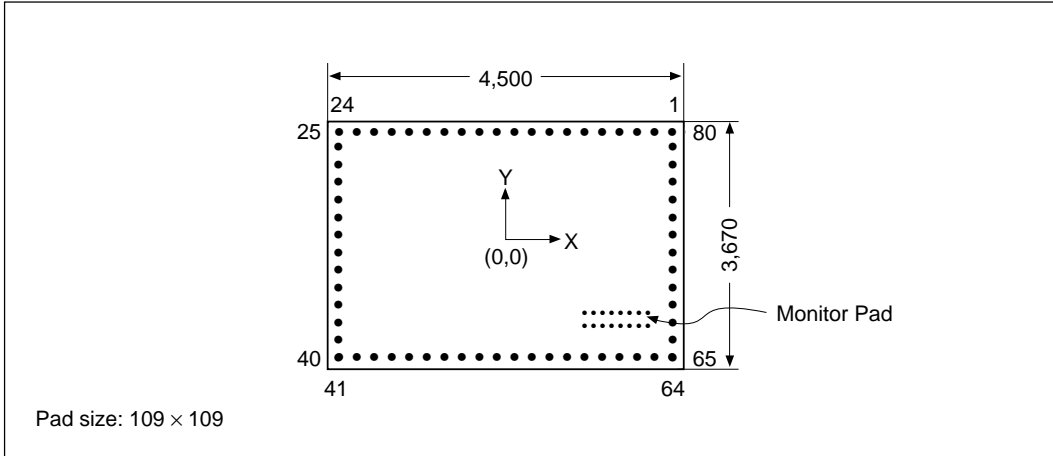
■ EXAMPLE OF APPLICATION (2 lines × 20 characters)



SED1278 is usually connected to 8-bit MPU via I/O ports.



■ PAD LAYOUT



## ● PAD COORDINATES

Pad No.	Pad Name	X	Y	Pad No.	Pad Name	X	Y
1	SEG22	2087	1671	41	DB2	-2087	-1671
2	SEG21	1905	1671	42	DB3	-1905	-1671
3	SEG20	1723	1671	43	DB4	-1723	-1671
4	SEG19	1541	1671	44	DB5	-1541	-1671
5	SEG18	1359	1671	45	DB6	-1359	-1671
6	SEG17	1177	1671	46	DB7	-1177	-1671
7	SEG16	995	1671	47	COM1	-995	-1671
8	SEG15	814	1671	48	COM2	-814	-1671
9	SEG14	633	1671	49	COM3	-633	-1671
10	SEG13	452	1671	50	COM4	-452	-1671
11	SEG12	272	1671	51	COM5	-272	-1671
12	SEG11	91	1671	52	COM6	-91	-1671
13	SEG10	-91	1671	53	COM7	91	-1671
14	SEG9	-272	1671	54	COM8	272	-1671
15	SEG8	-452	1671	55	COM9	452	-1671
16	SEG7	-633	1671	56	COM10	633	-1671
17	SEG6	-814	1671	57	COM11	814	-1671
18	SEG5	-995	1671	58	COM12	995	-1671
19	SEG4	-1177	1671	59	COM13	1177	-1671
20	SEG3	-1359	1671	60	COM14	1359	-1671
21	SEG2	-1541	1671	61	COM15	1541	-1671
22	SEG1	-1723	1671	62	COM16	1723	-1671
23	GND	-1905	1671	63	SEG40	1905	-1671
24	OSC1	-2087	1671	64	SEG39	2087	-1671
25	OSC2	-2087	1365	65	SEG38	2087	-1365
26	V1	-2087	1183	66	SEG37	2087	-1183
27	V2	-2087	1001	67	SEG36	2087	-1001
28	V3	-2087	819	68	SEG35	2087	-819
29	V4	-2087	637	69	SEG34	2087	-637
30	V5	-2087	455	70	SEG33	2087	-455
31	LP	-2087	273	71	SEG32	2087	-273
32	XSCL	-2087	91	72	SEG31	2087	-91
33	VCC	-2087	-91	73	SEG30	2087	91
34	FR	-2087	-273	74	SEG29	2087	273
35	DO	-2087	-455	75	SEG28	2087	455
36	RS	-2087	-637	76	SEG27	2087	637
37	R/W	-2087	-819	77	SEG26	2087	819
38	E	-2087	-1001	78	SEG25	2087	1001
39	DB0	-2087	-1183	79	SEG24	2087	1183
40	DB1	-2087	-1365	80	SEG23	2087	1365

■ SED1278F0A/D0A 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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	a	P	`	P					—	9	E	o	p	
	1	CG RAM (2)		:	1	A	Q	a	A					•	7	†	4	ä	g
	2	CG RAM (3)		"	2	B	R	b	r					ˆ	4	ˆ	x	p	o
	3	CG RAM (4)		#	3	C	S	c	s					ˆ	9	†	E	e	•
	4	CG RAM (5)		\$	4	D	T	d	t					ˆ	1	†	P	u	o
	5	CG RAM (6)		%	5	E	U	e	u					•	•	†	1	e	ü
	6	CG RAM (7)		&	6	F	V	f	v					ˆ	0	ˆ	3	p	z
	7	CG RAM (8)		'	7	G	W	g	w					ˆ	†	ˆ	†	g	ˆ
	8	CG RAM (1)		(	8	H	X	h	x					ˆ	0	†	ˆ	ˆ	ˆ
	9	CG RAM (2)		)	9	I	Y	i	y					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ
	A	CG RAM (3)		*	:	J	Z	j	z					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ
	B	CG RAM (4)		+	:	K	Ʒ	k	Ʒ					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ
	C	CG RAM (5)		,	<	L	*	l	l					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ
	D	CG RAM (6)		—	=	M	ˆ	m	ˆ					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ
	E	CG RAM (7)		•	>	N	ˆ	n	ˆ					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ
	F	CG RAM (8)		/	?	O	_	o	•					ˆ	ˆ	ˆ	ˆ	ˆ	ˆ

■ SED1278F0B/D0B 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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)	±		0	0	P	'	P	9	é	á	'	i	M	B	v
	1	CG RAM (2)	≡	!	1	A	O	a	7	0	a	i	'	j	t	y	v
	2	CG RAM (3)	7	"	2	B	R	b	r	é	E	ó	'	o	é	ó	x
	3	CG RAM (4)	z	#	3	C	S	c	s	á	á	á	'	p	m	e	w
	4	CG RAM (5)	1	\$	4	D	T	t	t	á	á	á	'	4	T	Z	o
	5	CG RAM (6)	√	%	5	E	U	e	u	á	á	á	'	h	n	h	7
	6	CG RAM (7)	Y	&	6	F	V	v	v	á	á	á	'	w	l	B	B
	7	CG RAM (8)	J	'	7	G	W	w	w	á	á	á	'	x	h	l	#
	8	CG RAM (1)	√	(	8	H	X	x	x	é	é	é	'	←	←	←	←
	9	CG RAM (2)	√	)	9	I	Y	y	y	á	á	á	'	∫	∫	∫	∫
	A	CG RAM (3)	*	*	*	J	Z	z	z	é	é	é	'	∫	∫	∫	∫
	B	CG RAM (4)	J	+	*	K	K	∫	∫	á	á	á	'	∫	∫	∫	∫
	C	CG RAM (5)	≡	,	<	L	∫	∫	∫	á	á	á	'	∫	∫	∫	∫
	D	CG RAM (6)	∫	-	=	M	M	∫	∫	á	á	á	'	∫	∫	∫	∫
	E	CG RAM (7)	∫	.	>	N	n	n	n	á	á	á	'	∫	∫	∫	∫
	F	CG RAM (8)	∫	/	?	O	o	∫	∫	á	á	á	'	∫	∫	∫	∫



■ SED1278Foc/D0c 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 4-bit (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	0	a	9						0	a	1	e	0	a	
	2	CG RAM (3)	"	2	B	R	b	r						e	E	0	i	0	a	
	3	CG RAM (4)	#	3	C	S	c	s						a	0	0	i	,	R	
	4	CG RAM (5)	\$	4	D	T	d	t						a	0	K	i	4	#	
	5	CG RAM (6)	%	5	E	V	e	v						a	0	R	'	0	t	
	6	CG RAM (7)	&	6	F	V	f	v						'	0	a	"	0	A	
	7	CG RAM (8)	'	7	G	W	g	w						K	0	0	0	0	R	
	8	CG RAM (1)	(	8	H	X	h	x						e	9	c	2	0	R	
	9	CG RAM (2)	)	9	I	Y	i	y						e	4	B	Y	0	0	
	A	CG RAM (3)	*	*	J	Z	j	z						e	0	0	A	0	e	
	B	CG RAM (4)	+	+	K	K	k	k						i	e	K	i	0	R	
	C	CG RAM (5)	,	<	L	N	l	"						i	0	K	A	0	R	
	D	CG RAM (6)	-	-	M	M	m	)						i	A	i	0	e	-	
	E	CG RAM (7)	.	>	N	n	n	+						A	e	↑	0	R		
	F	CG RAM (8)	/	?	O	L	o	+						K	0	J	0	3		

■ SED1278F0D/D0D 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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	0	P	'	P								
	1	CG RAM (2)	:	1	A	0	a	a									
	2	CG RAM (3)	"	2	B	R	b	r									
	3	CG RAM (4)	#	3	C	S	c	s									
	4	CG RAM (5)	\$	4	D	T	d	t									
	5	CG RAM (6)	%	5	E	V	e	v									
	6	CG RAM (7)	&	6	F	V	f	v									
	7	CG RAM (8)	'	7	B	w	a	w									
	8	CG RAM (1)	(	8	H	X	h	x									
	9	CG RAM (2)	)	9	I	Y	i	y									
	A	CG RAM (3)	*	:	J	Z	j	z									
	B	CG RAM (4)	+	:	K	K	<										
	C	CG RAM (5)	,	<	L	\	I	~									
	D	CG RAM (6)	-	=	M	I	n	>									
	E	CG RAM (7)	.	>	N	^	n	~									
	F	CG RAM (8)	/	?	O	_	o	~									



■ SED1278F0g/D0g 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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	0	P	'	P					7	E	á	á	Q	I
	1	CG RAM (2)	:	1	A	0	a	a					0	a	í	á	:	!	
	2	CG RAM (3)	"	2	B	R	b	r					e	E	ó	æ	ç	F	
	3	CG RAM (4)	#	3	C	S	c	s					á	é	ó	ý	ú	ú	
	4	CG RAM (5)	\$	4	D	T	d	t					á	é	ó	ú	ú	'	
	5	CG RAM (6)	%	5	E	V	e	v					á	é	ó	ú	ú	ú	
	6	CG RAM (7)	&	6	F	V	v	v					'	0	a	'	0	æ	
	7	CG RAM (8)	'	7	B	w	w	w					5	0	W	W	W	á	
	8	CG RAM (1)	(	8	H	X	h	x					e	9	ú	u	o	W	
	9	CG RAM (2)	)	9	I	V	i	v					e	e	ý	W	0	7	
	A	CG RAM (3)	*	:	J	Z	j	z					e	0	#	L	.	e	
	B	CG RAM (4)	+	:	K	K	(						i	u	W	I	0	W	
	C	CG RAM (5)	,	<	L	\	I	~					i	W	W	~	0	7	
	D	CG RAM (6)	-	=	M	I	n	)					i	.	i	U	E	I	
	E	CG RAM (7)	.	>	N	^	n	+					á	é	↑	i	á	i	
	F	CG RAM (8)	/	?	O	_	o	+					W	5	↓	W	3	W	

■ SED1278F<sub>0H</sub>/D<sub>0H</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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	a	P	'	P			B	0	4	.	Δ	Δ
	1	CG RAM (2)	!	1	A	0	a	a			Γ	9	w	.	U	P	
	2	CG RAM (3)	"	2	B	R	b	r			E	6	u	u	W	P	
	3	CG RAM (4)	#	3	O	S	c	s			#	e	u	u	a	Δ	Δ
	4	CG RAM (5)	\$	4	D	T	a	t			3	r	u	?	o	Δ	Δ
	5	CG RAM (6)	%	5	E	U	e	u			N	e	a	z	u	?	?
	6	CG RAM (7)	&	6	F	V	f	v			N	w	w	?	y	u	Δ
	7	CG RAM (8)	'	7	G	W	w	w			J	5	a	z	'	Δ	Δ
	8	CG RAM (1)	(	8	H	X	h	x			n	w	e	u	'	Δ	Δ
	9	CG RAM (2)	)	9	I	Y	i	y			Y	6	a	?	'	Δ	Δ
	A	CG RAM (3)	*	*	J	Z	j	z			0	k	u	Δ	e	Δ	Δ
	B	CG RAM (4)	+	;	K	X	k	x			4	a	'	N	g	?	Δ
	C	CG RAM (5)	,	<	L	o	l	e			w	w	#	u	Δ	Δ	Δ
	D	CG RAM (6)	-	=	M	J	m	j			b	w	Δ	N	#	Δ	Δ
	E	CG RAM (7)	.	>	N	^	n	^			M	n	g	?	o	Δ	Δ
	F	CG RAM (8)	/	?	O	L	o	e			3	r	e	'	o	Δ	Δ

\* 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 S-MOS Marketing Department for conversion of the masked ROM.



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