

# 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.

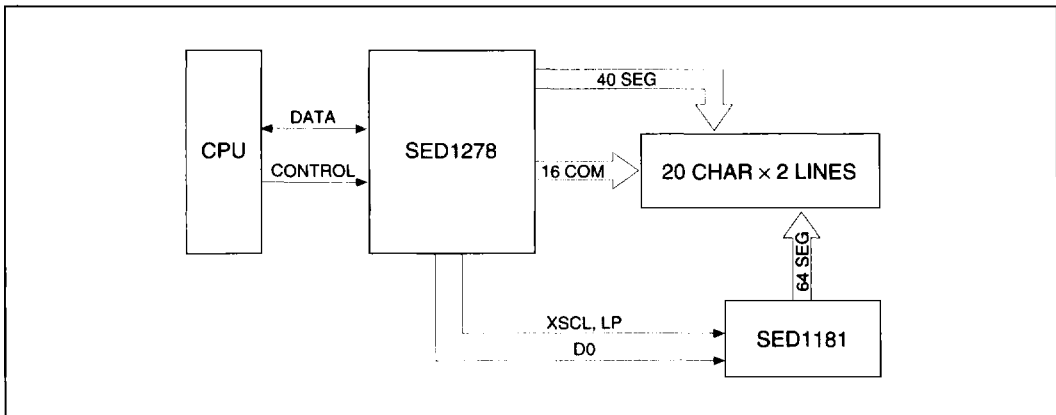
The SED1278 has 40 segment output and 16 common output built-in. Thus, one chip is capable of displaying up to 16 characters. The SED1278 can display one line of 48 characters using an SED1681F (80-bit output) as an expansion segment driver.

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.

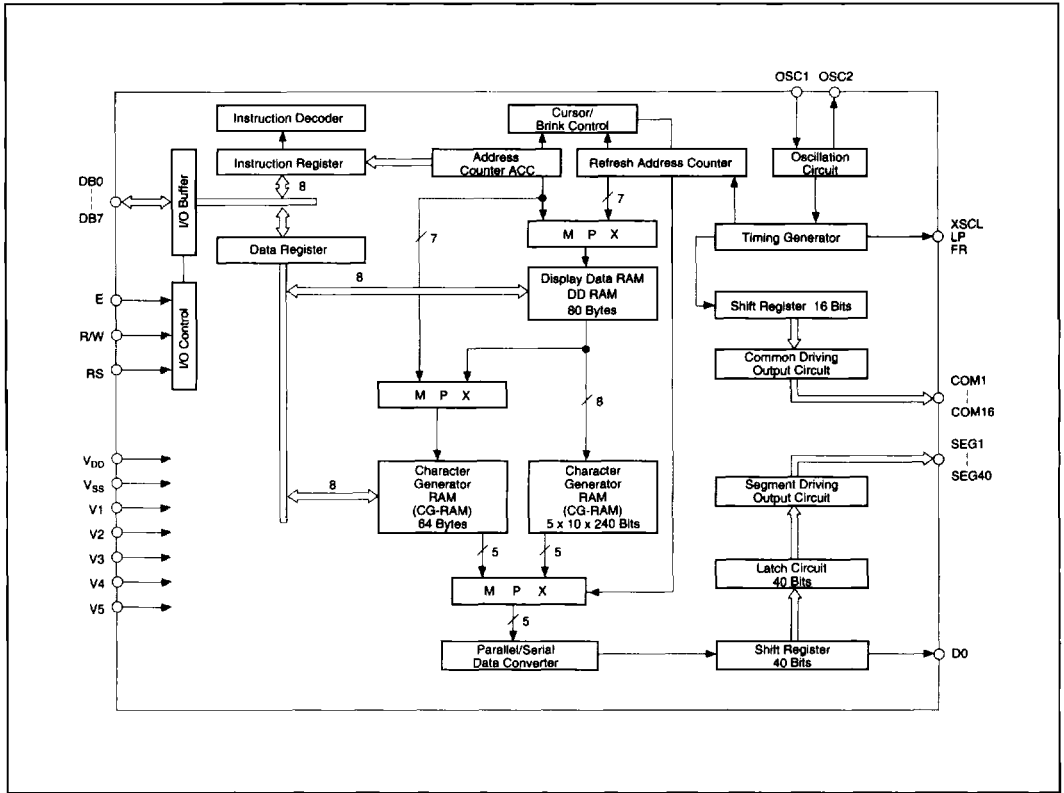
### ■ FEATURES

- 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)

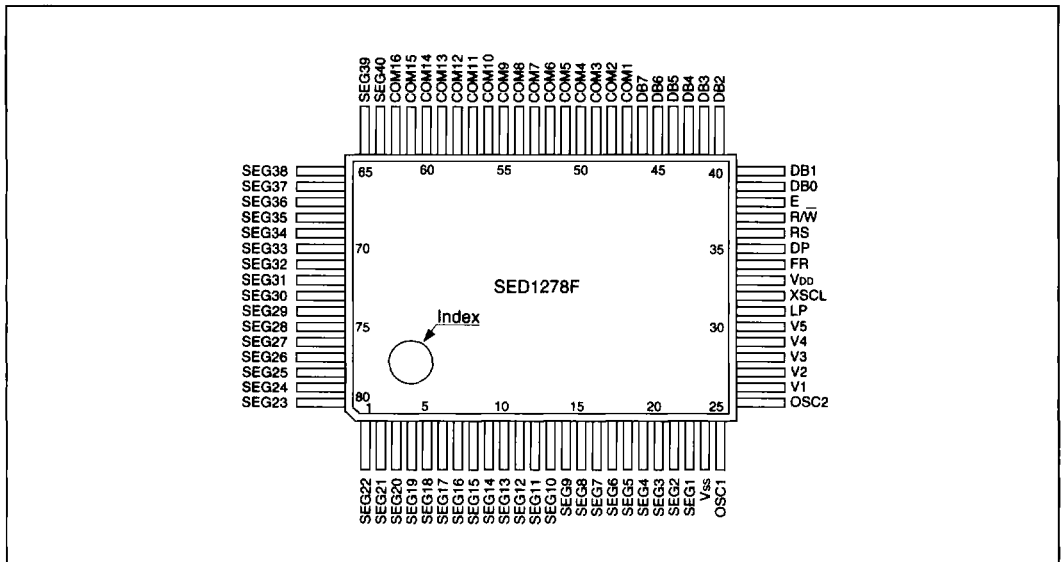
### ■ SYSTEM BLOCK DIAGRAM



■ 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 ( $V5 \geq V_{SS}$ )
VDD	1	+5V
VSS	1	0V (GND)
OSC1 OSC2	2	Used to connect resistor (typ. 91K $\Omega$ ) 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

( $V_{SS} = 0V$ ,  $T_a = 25^\circ C$ )

Parameter	Symbol	Rating	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	Vi	-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:  $V_{DD} \geq V1 \geq V2 \geq V3 \geq V4 \geq V5$

● DC Characteristics

(VDD = 5.0V ±10%, VSS = 0V, Ta = -20 to 75°C)

Parameter	Symbol	Condition	Applicable Pin	Min	Typ	Max	Unit
"H" level input voltage (1)	VIH1		DB0~DB7	2.0	—	VDD	V
"L" level input voltage (1)	VIL1		RS, R/W, E	VSS	—	0.8	V
"H" level input voltage (2)	VIH2		OSC1	VDD-1.0	—	VDD	V
"L" level input voltage (2)	VIL2			VSS	—	1.0	V
"H" level output voltage (1)	VOH1	IOH=-0.205mA	DB0~DB7	2.4	—	—	V
"L" level output voltage (1)	VOL1	IOL=1.6mA		—	—	0.4	V
"H" level output voltage (2)	VOH2	IOH=-0.04mA	XSCL LP D0	0.9VDD	—	—	V
"L" level output voltage (2)	VOL2	IOL=0.04mA		—	—	0.1VDD	V
Driver-on resistor (COM)	RCOM	IVCOM-VnI=0.5V	COM1~16	—	2	10	kΩ
Driver-on resistor (SEG)	RSEG	IVSEG-VnI=0.5V	SEG1~40	—	2.5	10	kΩ
I/O leakage current	IIL	Vi=0 to VDD		—	—	1	μA
Pull-up MOS current	-IP	VDD=5V		50	125	250	μA
Supply current	Iop	Rf oscillation, from external clock VDD=5V, fosc=fcp=270kHz	VDD	—	0.5	0.8	mA
External clock operation							
External clock operating frequency	fEXTCL			125	250	350	kHz
External clock duty	Duty			45	50	55	%
External clock rise time	tREXTCL			—	—	0.2	μs
External clock fall time	tFEXTCL			—	—	0.2	μs
Internal clock operation (Rf oscillation)							
Oscillation frequency	fosc	Rf=91kΩ±2%		190	270	350	kHz
Internal clock operation (Ceramic filter oscillation)							
Oscillation frequency	fosc	Ceramic filter		245	250	255	kHz
LCD driving voltage	VLCD	VDD-V5		3.0	—	VDD	V

● AC Characteristics

○ Read cycle

(VDD = 5.0V ± 10%, VSS = 0V, Ta = -20 to 75°C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	t <sub>cyE</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>	CL=100pF	—	—	120	ns
Read data hold time	t <sub>DHR</sub>		20	—	—	ns

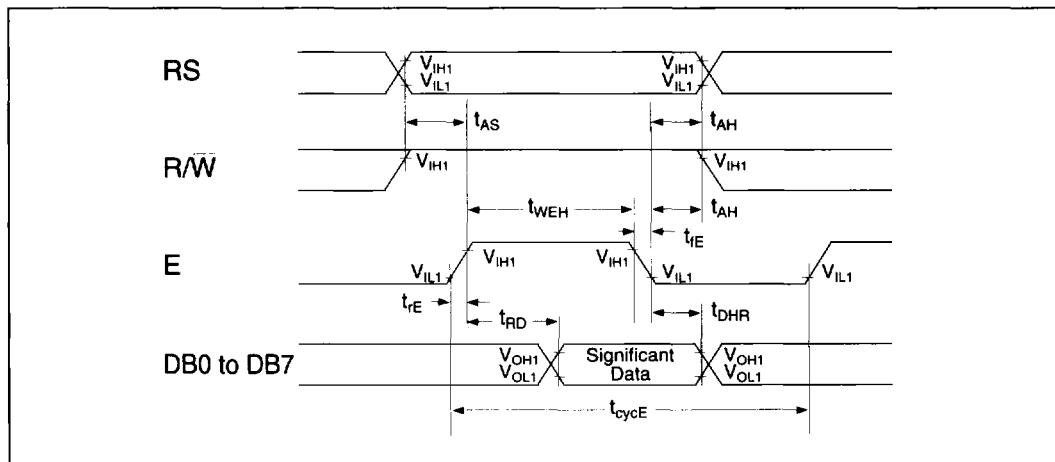
○ Write cycle

(VDD = 5.0V±10%, VSS = 0V, Ta = -20 to 75°C)

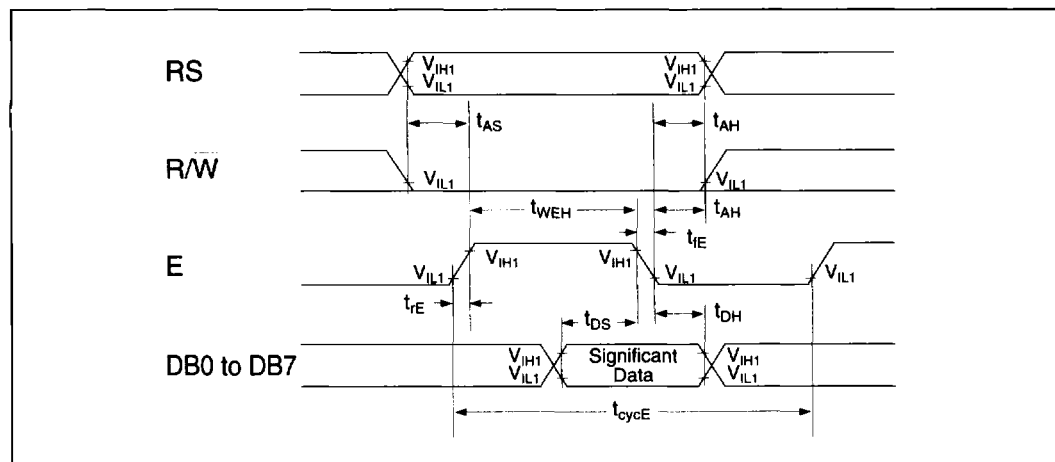
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	t <sub>cycE</sub>		500	—	—	ns
Enable "H" level pulse width	t <sub>WEH</sub>		220	—	—	ns
Enable rise/fall time	t <sub>rE</sub> , t <sub>fE</sub>		—	—	25	ns
RS, R/W setup time	t <sub>AS</sub>		40	—	—	ns
RS, R/W address hold time	t <sub>AH</sub>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

● Timing Chart

○ Read cycle



○ Write cycle

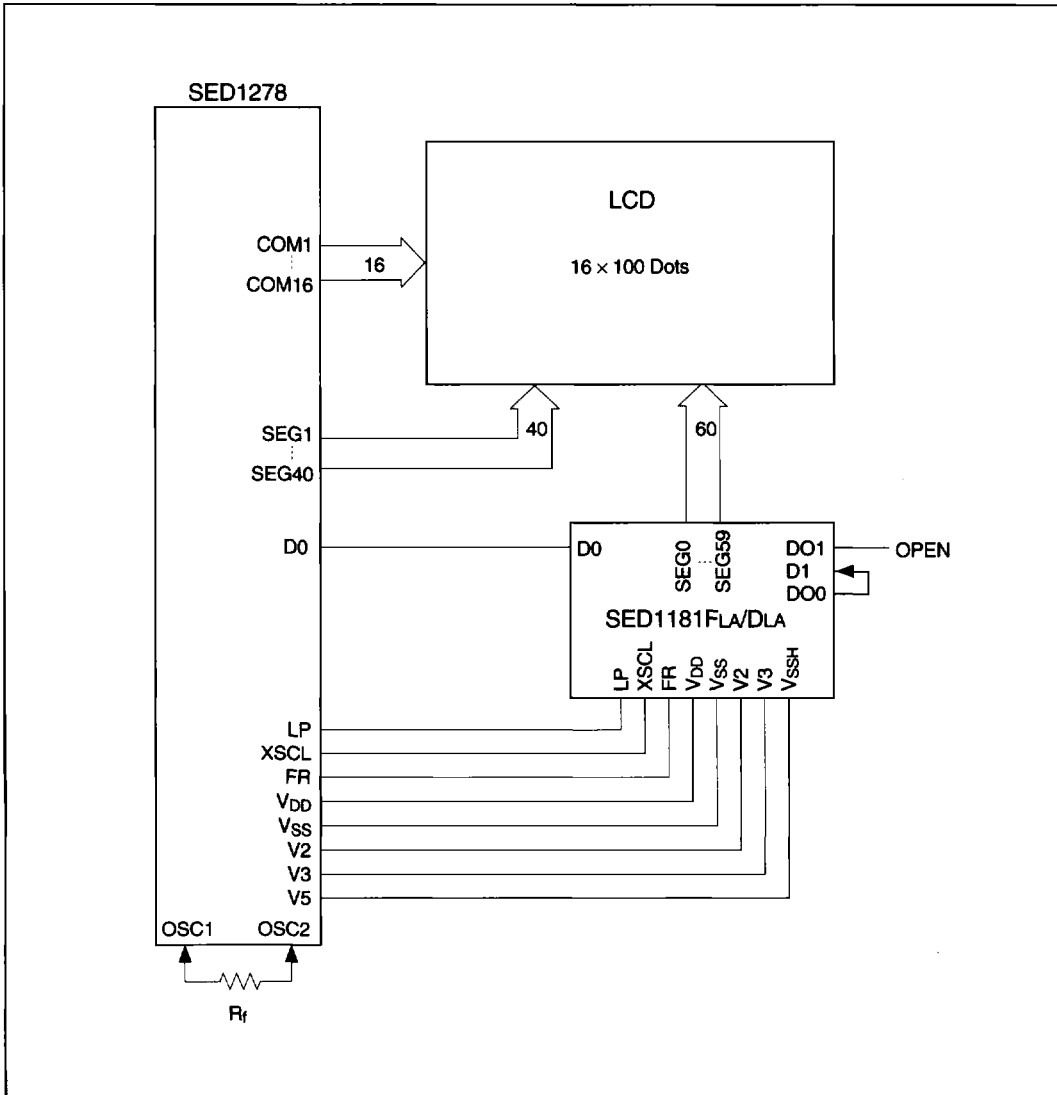


■ DISPLAY COMMAND

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								

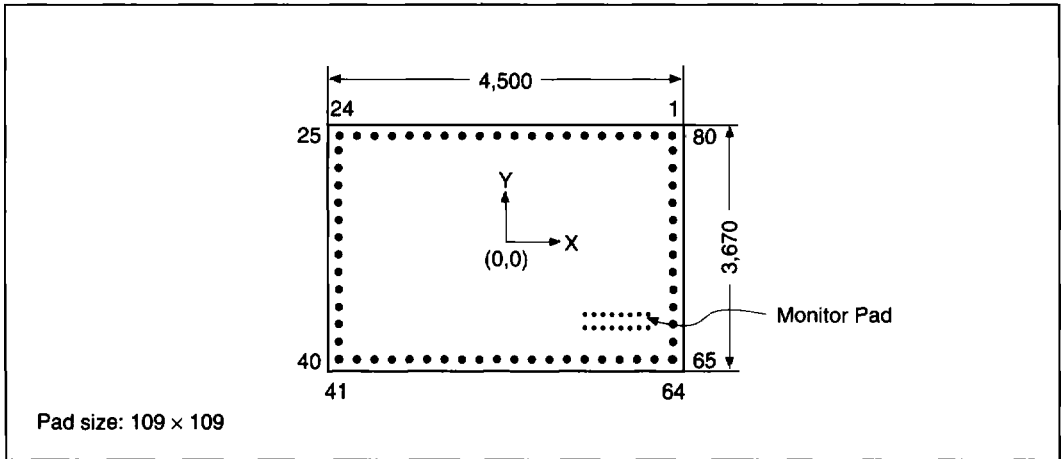
\* Don't care

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

■ 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	0	P	'	P	5	5	5	5	5	5	5	5
	1	CG RAM (2)	≡	!	!	A	0	a	a	0	a	a	!	!	!	!	!
	2	CG RAM (3)	7	"	"	2	R	R	r	r	a	a	5	5	5	5	5
	3	CG RAM (4)	⊂	#	#	3	S	S	s	s	a	a	0	0	0	0	0
	4	CG RAM (5)	⊂	⊂	⊂	4	T	T	t	t	a	a	5	5	5	5	5
	5	CG RAM (6)	√	%	%	5	E	E	e	e	a	a	5	5	5	5	5
	6	CG RAM (7)	√	%	%	6	F	F	f	f	a	a	0	0	0	0	0
	7	CG RAM (8)	√	'	'	7	G	G	g	g	a	a	5	5	5	5	5
	8	CG RAM (1)	√	'	'	8	H	H	h	h	a	a	5	5	5	5	5
	9	CG RAM (2)	√	)	)	9	I	I	i	i	a	a	0	0	0	0	0
	A	CG RAM (3)	⊂	*	*		J	J	j	j	a	a	5	5	5	5	5
	B	CG RAM (4)	⊂	+	+		K	K	k	k	a	a	5	5	5	5	5
	C	CG RAM (5)	≡	.	.		L	L	l	l	a	a	5	5	5	5	5
	D	CG RAM (6)	⊂	-	-		M	M	m	m	a	a	5	5	5	5	5
	E	CG RAM (7)	⊂	.	.		N	N	n	n	a	a	5	5	5	5	5
	F	CG RAM (8)	≡	/	/		O	O	o	o	a	a	5	5	5	5	5

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

■ 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	a	p	'	p			æ	é	á	ŕ	ŷ	ŷ
	1	CG RAM (2)	!	1	Q	a	a					ú	a	í	√	á	ŷ
	2	CG RAM (3)	"	2	B	R	b	r			æ	É	ó	é	ŷ	ŷ	ŷ
	3	CG RAM (4)	#	3	O	S	o	s			á	ó	ó	'	ŷ	ŷ	ŷ
	4	CG RAM (5)	\$	4	O	T	o	t			á	ó	á	é	ŷ	ŷ	#
	5	CG RAM (6)	%	5	E	U	e	u			á	ó	á	'	ó	ŷ	ŷ
	6	CG RAM (7)	&	6	F	V	f	v			'	ó	a	'	ŷ	ŷ	ŷ
	7	CG RAM (8)	'	7	E	W	e	w			ŷ	ó	ó	é	ŷ	ŷ	ŷ
	8	CG RAM (1)	(	8	H	X	h	x			æ	ó	ó	ŷ	ŷ	ŷ	ŷ
	9	CG RAM (2)	)	9	I	Y	i	y			æ	é	é	ŷ	ŷ	ŷ	ŷ
	A	CG RAM (3)	*	*	J	Z	j	z			æ	ó	#	ŷ	,	ŷ	ŷ
	B	CG RAM (4)	+	+	K	K	k	k			ŷ	é	ŷ	ŷ	ŷ	ŷ	ŷ
	C	CG RAM (5)	,	<	L	\	l	'			ŷ	ŷ	ŷ	ŷ	ŷ	ŷ	ŷ
	D	CG RAM (6)	-	=	M	n	m	)			ŷ	,	ŷ	ŷ	ŷ	ŷ	ŷ
	E	CG RAM (7)	.	>	N	^	n	+			æ	é	ŷ	ŷ	ŷ	ŷ	ŷ
	F	CG RAM (8)	/	?	O	_	o	+			ŷ	ŷ	ŷ	ŷ	ŷ	ŷ	ŷ

■ SED1278Fog/Dog 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	P	'	P					Y	E	A	O	I		
	1	CG RAM (2)	!		1	A	O	a	a					U	a	l	a	o	l
	2	CG RAM (3)	"		2	B	R	b	r					e	a	a	a	e	e
	3	CG RAM (4)	#		3	C	S	c	s					a	o	o	o	a	a
	4	CG RAM (5)	\$		4	D	T	d	t					a	o	a	o	a	a
	5	CG RAM (6)	%		5	E	U	e	u					a	o	a	o	a	a
	6	CG RAM (7)	&		6	F	V	f	v					'	o	a	'	o	a
	7	CG RAM (8)	'		7	G	W	g	w					g	o	o	h	e	a
	8	CG RAM (1)	(		8	H	X	h	x					e	o	o	u	o	h
	9	CG RAM (2)	)		9	I	Y	i	y					e	e	'	h	o	'
	A	CG RAM (3)	*		A	J	Z	j	z					e	o	h	l	.	e
	B	CG RAM (4)	+		B	K	Y	k	y					l	u	h	l	o	h
	C	CG RAM (5)	,		C	L	X	l	x					l	u	h	l	o	h
	D	CG RAM (6)	-		D	M	N	m	n					l	l	l	u	e	h
	E	CG RAM (7)	.		E	N	O	n	o					a	e	t	l	e	l
	F	CG RAM (8)	/		F	O	L	o	l					a	e	l	u	h	h

■ SED1278F<sub>0H/D0H</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	.	2	K
	1	CG RAM (2)	!		1	A	Q	a	a				7	A	u	.	U	A
	2	CG RAM (3)	"		2	B	R	b	r				E	6	e	.	U	A
	3	CG RAM (4)	#		3	C	S	c	s				H	6	v	.	z	A
	4	CG RAM (5)	\$		4	D	T	t	t				3	n	e	.	o	a
	5	CG RAM (6)	%		5	E	U	e	u				K	e	a	.	u	'
	6	CG RAM (7)	&		6	F	V	v	v				K	n	n	.	u	'
	7	CG RAM (8)	'		7	G	W	w	w				J	a	a	.	I	'
	8	CG RAM (1)	(		8	H	X	x	x				n	k	u	.	'	'
	9	CG RAM (2)	)		9	I	Y	y	y				V	n	t	.	'	'
	A	CG RAM (3)	*		A	J	Z	z	z				Q	k	.	z	'	'
	B	CG RAM (4)	+		B	K	X	x	x				4	a	'	n	'	'
	C	CG RAM (5)	,		C	L	Y	y	y				u	n	'	n	'	'
	D	CG RAM (6)	-		D	M	Z	z	z				B	n	'	n	'	'
	E	CG RAM (7)	.		E	N	X	x	x				K	n	'	'	'	'
	F	CG RAM (8)	/		F	O	L	o	e				a	t	'	'	'	'

\* 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.