

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 (5×8 pixels), with minimum external components.

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

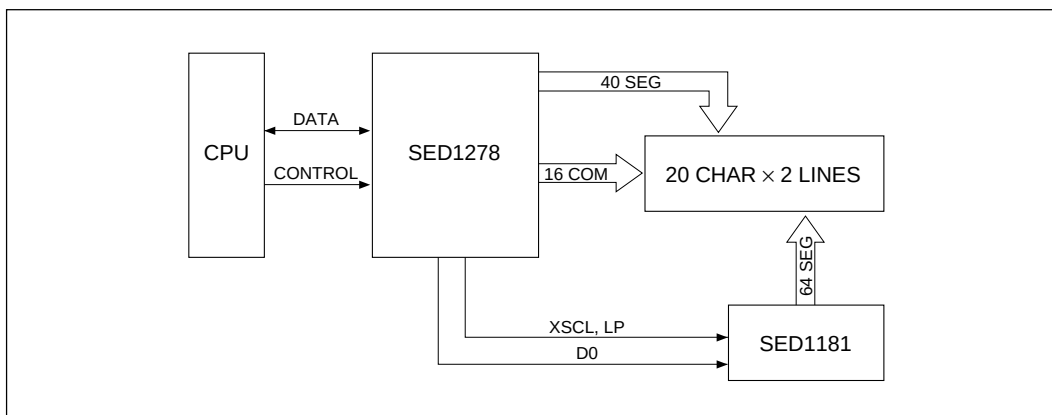
The SED1278 has 40 segment output and 16 common output built-in. Thus, one chip is capable of displaying up to 16 characters. The SED1278 can display one line of 48 characters using an SED1681F (80-bit output) as an expansion segment driver.

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.

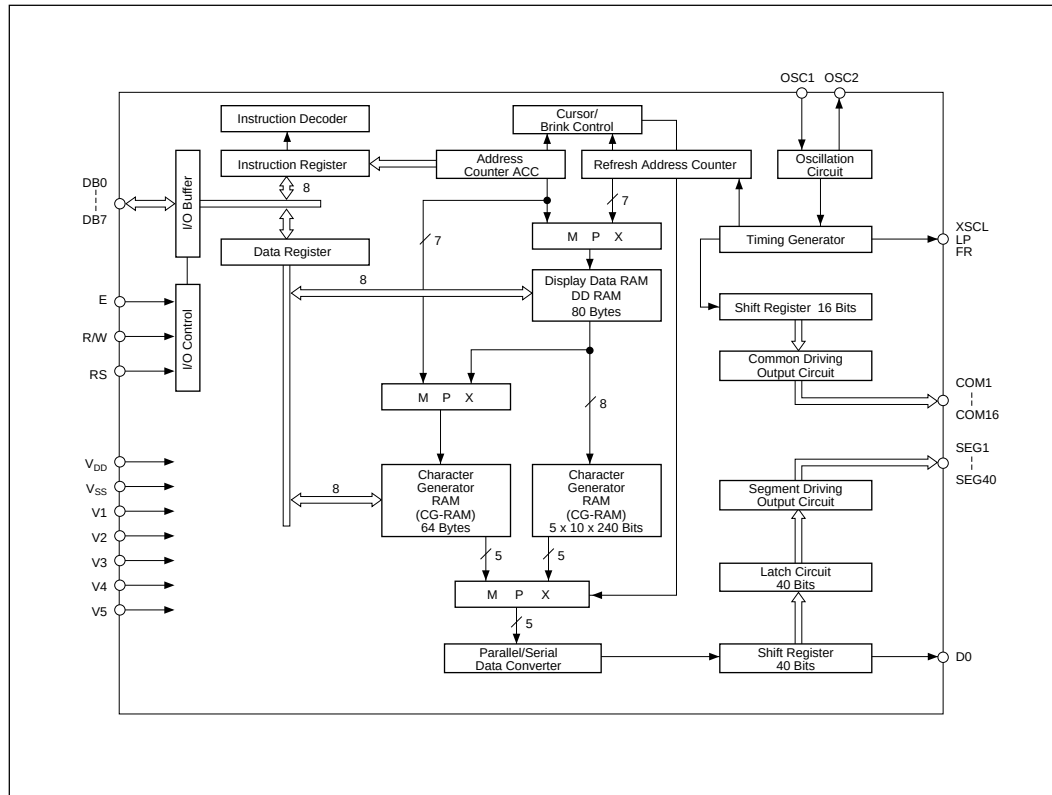
■ FEATURES

- 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: ... 80×8 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)

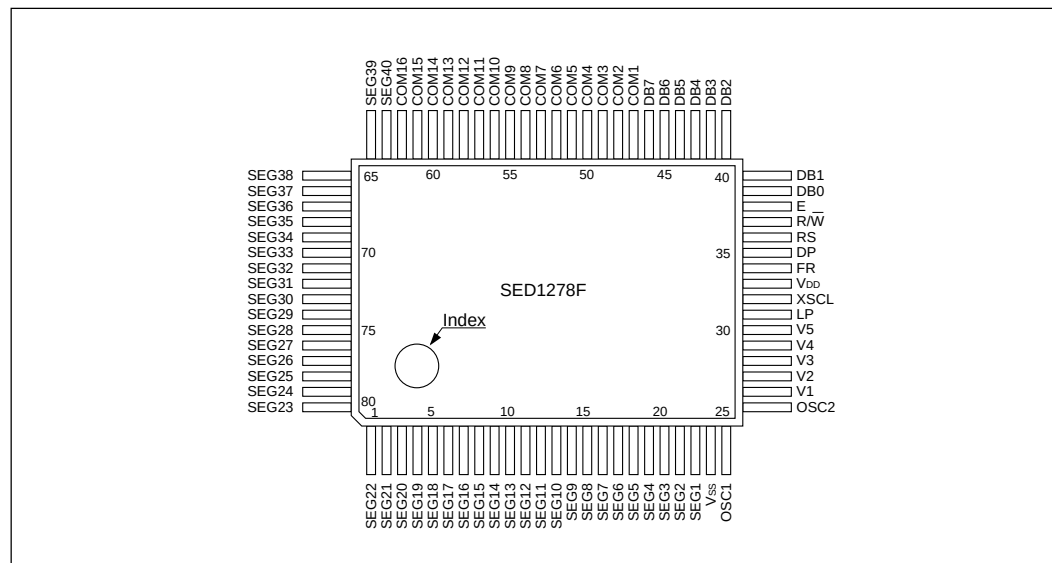
■ SYSTEM BLOCK DIAGRAM



■ 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 _{DD}	1	+5V
V _{SS}	1	0V (GND)
OSC1 OSC2	2	Used to connect resistor (typ. 91K Ω) 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°C)

Parameter	Symbol	Rating	Unit
Supply voltage (1)	V _{DD}	-0.3 to 7.0	V
Supply voltage (2)	V1 to V5	-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

● **DC Characteristics**

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

Parameter	Symbol	Condition	Applicable Pin	Min	Typ	Max	Unit
"H" level input voltage (1)	V_{IH1}		DB0~DB7	2.0	—	V_{DD}	V
"L" level input voltage (1)	V_{IL1}		RS, R/W, E	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 D0	$0.9V_{DD}$	—	—	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	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 $75^\circ C$)

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, $\overline{R/W}$ setup time	t_{AS}		40	—	—	ns
RS, $\overline{R/W}$ 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

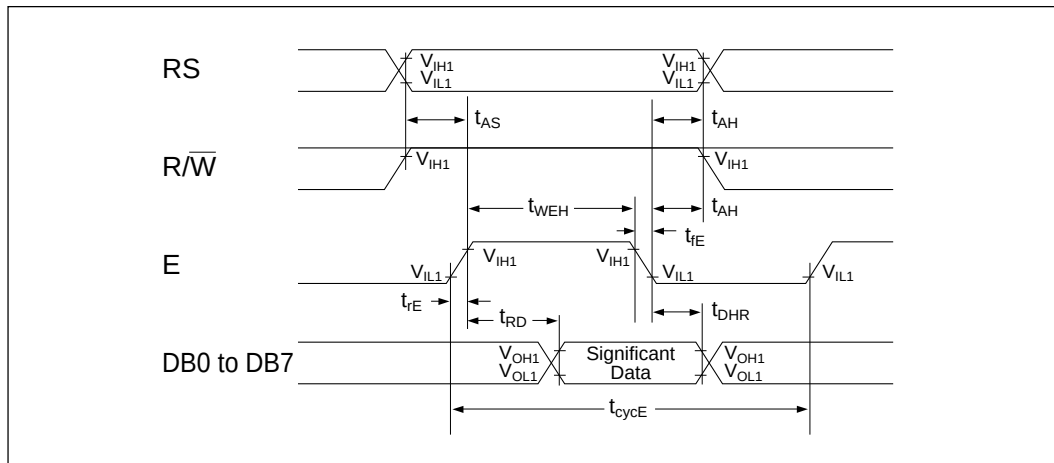
- Write cycle

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

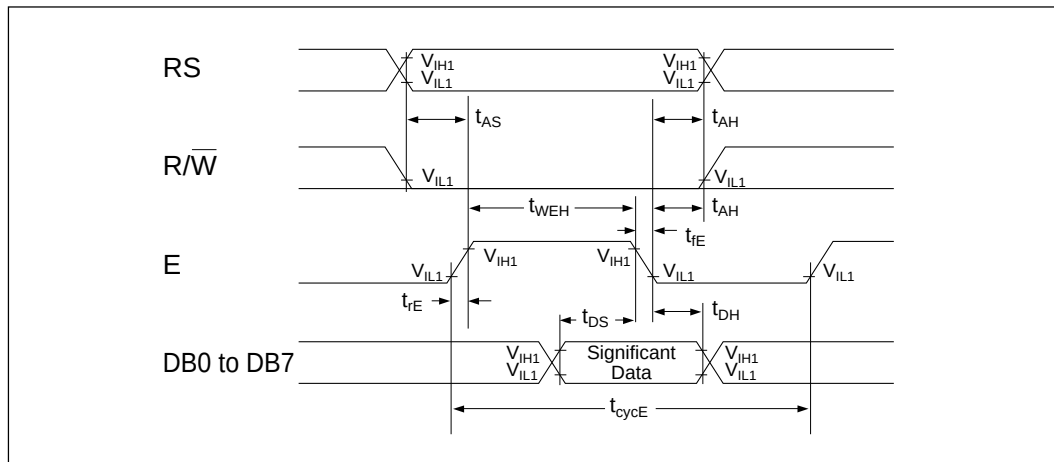
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}		500	—	—	ns
Enable "H" level pulse width	t_{WEH}		220	—	—	ns
Enable rise/fall time	t_{rE}, t_{fE}		—	—	25	ns
RS, R/W setup time	t_{AS}		40	—	—	ns
RS, R/W address hold time	t_{AH}		10	—	—	ns
Data setup time	t_{DS}		60	—	—	ns
Write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

- Timing Chart

- Read cycle



- Write cycle

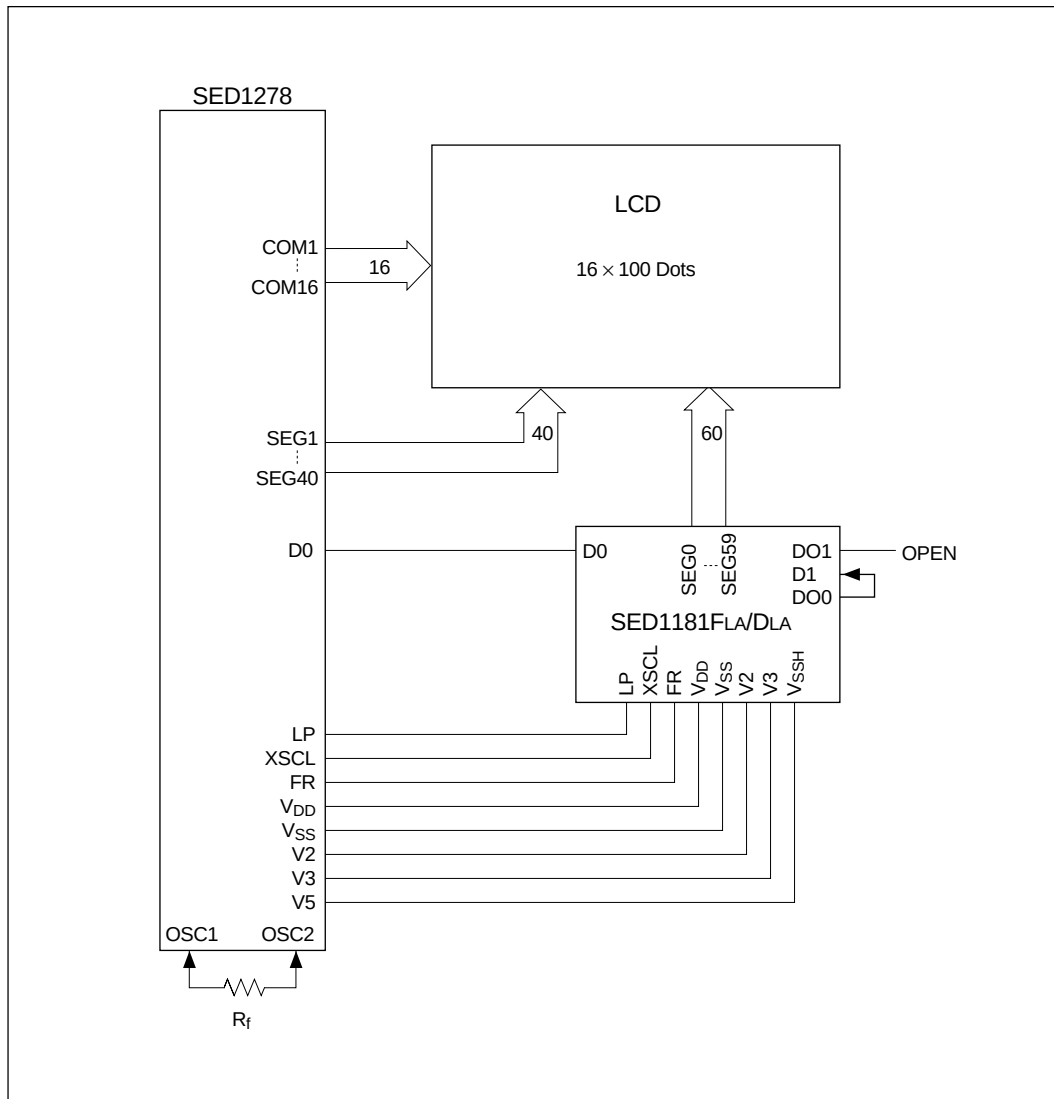


■ DISPLAY COMMAND

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								

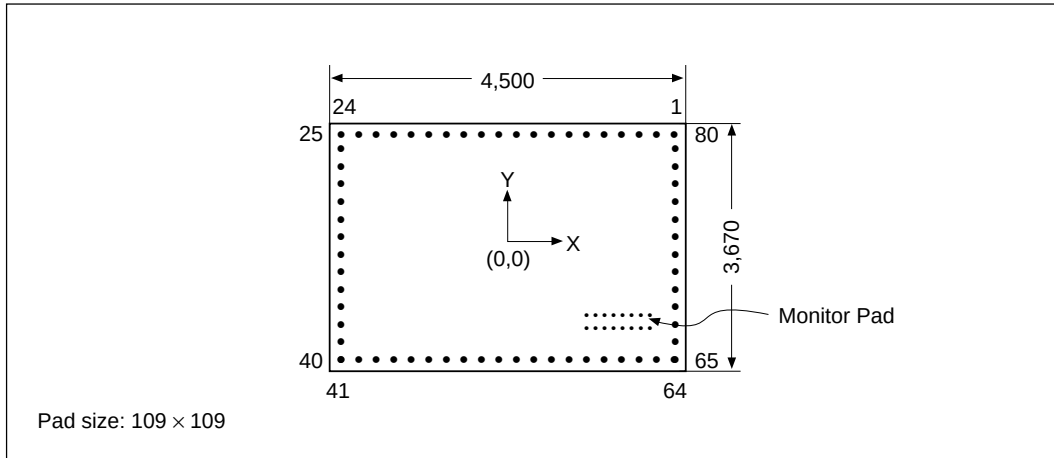
* Don't care

■ 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	RW	-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)			00P`P								—	3	3	0p	
	1	CG RAM (2)		!	1A0a4								7	7	4äq		
	2	CG RAM (3)		"	2BRbr								"	"	xpe		
	3	CG RAM (4)		#	3CScs								!	!	ee		
	4	CG RAM (5)		\$	4DTdt								\	\	tpw		
	5	CG RAM (6)		%	5Eueu								.	.	1e0		
	6	CG RAM (7)		&	6Fufv								7	7	3p2		
	7	CG RAM (8)		'	7Gw9w								7	7	7g		
	8	CG RAM (1)		(	8HXhx								4	4	7j		
	9	CG RAM (2)		)	9IYiy								9	9	7y		
	A	CG RAM (3)		*	*JZjz								7	7	7j		
	B	CG RAM (4)		+	+Kck<								7	7	7k		
	C	CG RAM (5)		,	<L*ll								7	7	7l		
	D	CG RAM (6)		—	=M]m>								7	7	7m		
	E	CG RAM (7)		.	>N^nn								7	7	7n		
	F	CG RAM (8)		/	?O_oo								7	7	7o		

■ 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	5	e	á	'	i	M	B	v
	1	CG RAM (2)	≡	!	1	A	O	a	9	U	æ	i	'	J	t	y	U
	2	CG RAM (3)	7	"	2	B	R	b	r	e	E	ó	'	o	3	8	X
	3	CG RAM (4)	¿	#	3	C	S	c	s	á	á	á	'	P	7	e	ψ
	4	CG RAM (5)	/	\$	4	D	T	d	t	ä	ä	ä	'	4	T	Z	o
	5	CG RAM (6)	\	%	5	E	U	e	u	ä	ä	ä	'	2	↑	Δ	η
	6	CG RAM (7)	¡	&	6	F	U	f	u	ä	ä	ä	'	4	B	B	≡
	7	CG RAM (8)	¿	'	7	G	W	w	w	ä	ä	ä	'	×	÷	Δ	U
	8	CG RAM (1)	/	(	8	H	X	h	x	e	g	'	'	÷	÷	E	K
	9	CG RAM (2)	\	)	9	I	Y	i	y	e	ä	ä	'	Δ	Γ	T	Δ
	A	CG RAM (3)	×	*	:	J	Z	j	z	e	ä	ä	'	2	7	Δ	μ
	B	CG RAM (4)	J	+	:	K	C	k	c	i	ä	ä	'	Δ	L	↑	v
	C	CG RAM (5)	=	,	<	L	\	l	l	i	ä	ä	'	Δ	Δ	Δ	Δ
	D	CG RAM (6)	~	-	=	M	I	m	i	ä	ä	ä	'	Δ	π	-	-
	E	CG RAM (7)	²	.	>	N	^	n	^	ä	ä	ä	'	Δ	Δ	p	Δ
	F	CG RAM (8)	³	/	?	O	_	o	Δ	ä	ä	ä	'	Δ	α	σ	Δ

■ SED1278F0c/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	0	P	`	P				é	á	é	l	é
	1	CG RAM (2)		:	1	A	0	a	9			0	a	1	é	0	9
	2	CG RAM (3)		"	2	B	R	b	r			é	R	ó	i	9	9
	3	CG RAM (4)		#	3	C	S	c	s			á	ó	ú	i	,	R
	4	CG RAM (5)		\$	4	D	T	d	t			á	ó	K	i	4	#
	5	CG RAM (6)		%	5	E	U	e	u			á	ó	R		ó	t
	6	CG RAM (7)		&	6	F	U	f	u			'	0	a	"	0	9
	7	CG RAM (8)		'	7	B	W	w				9	0	0	0	é	9
	8	CG RAM (1)		(	8	H	X	h	x			é	9	0	W	0	R
	9	CG RAM (2)		)	9	I	Y	i	y			é	4	0	Y	0	0
	A	CG RAM (3)		*	:	J	Z	j	z			é	0	0	A	0	é
	B	CG RAM (4)		+	:	K	C	k	<			i	é	4	i	0	R
	C	CG RAM (5)		,	<	L	\	l	~			i	0	4	A	0	R
	D	CG RAM (6)		-	=	M	J	m	>			i	A	i	0	é	÷
	E	CG RAM (7)		.	>	N	^	n	÷			Á	é	↑	9	2	
	F	CG RAM (8)		/	?	0	_	o	÷			9	0	0	0	3	0

■ 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)			00P`P							Æ	Ä	Å	Ä	Å	Å
	1	CG RAM (2)		!	1A0a9							Ü	ä	1	✓	Ä	Å
	2	CG RAM (3)		"	2BRbr							é	É	ó	É	ç	Å
	3	CG RAM (4)		#	3CScs							ä	ö	ü	°	Ä	Å
	4	CG RAM (5)		\$	4DTdt							ä	ö	Ä	Ä	Ä	#
	5	CG RAM (6)		%	5Eueu							ä	ö	Ä	°	ö	Ä
	6	CG RAM (7)		&	6Fufv							'	ö	ä	°	Ä	Å
	7	CG RAM (8)		'	7BWbw							Ä	ö	Ä	Ä	Ä	Ä
	8	CG RAM (1)		(	8HXhx							é	é	Ä	Ä	Ä	Ä
	9	CG RAM (2)		)	9IYiy							é	é	Ä	Ä	Ä	Ä
	A	CG RAM (3)		*	:JZjz							é	ö	Ä	Ä	Ä	Ä
	B	CG RAM (4)		+	:Kck<							é	ö	Ä	Ä	Ä	Ä
	C	CG RAM (5)		,	<L\l~							é	ö	Ä	Ä	Ä	Ä
	D	CG RAM (6)		-	=M]m>							é	ö	Ä	Ä	Ä	Ä
	E	CG RAM (7)		.	>N^nn~							Ä	é	Ä	Ä	Ä	Ä
	F	CG RAM (8)		/	?O_oe							Ä	é	Ä	Ä	Ä	Ä

■ 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)			00P`P							7E	8A	9C	01		
	1	CG RAM (2)		!	1A0a9							0a	1a	2c	1		
	2	CG RAM (3)		"	2BRbr							eE	0x	9F			
	3	CG RAM (4)		#	3CScs							8c	0y	4A			
	4	CG RAM (5)		\$	4DTdt							8d	0k	4			
	5	CG RAM (6)		%	5EUeu							8e	0N	0			
	6	CG RAM (7)		&	6FUFv							'0	a°	0			
	7	CG RAM (8)		'	7BWbw							90	0H	1a			
	8	CG RAM (1)		(	8HXhx							e9	0u	0H			
	9	CG RAM (2)		)	9IViv							e4	0W	0			
	A	CG RAM (3)		*	:JZjz							e0	0L	.			
	B	CG RAM (4)		+	:Kck<							i0	0I	0			
	C	CG RAM (5)		,	<L\l~							i0	0C	0			
	D	CG RAM (6)		-	=Mln>							i0	0e	0			
	E	CG RAM (7)		.	>N^n~							8e	01	21			
	F	CG RAM (8)		/	?O_0+							85	0I	0			

■ SED1278F_{0H}/D_{0H} 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	0	a	a			Γ	9	w	.	U	P
	2	CG RAM (3)		"	2	B	R	b	r			E	6	v	u	W	P
	3	CG RAM (4)		#	3	C	S	c	s			8	e	u	u	a	P
	4	CG RAM (5)		\$	4	D	T	t	t			3	r	z	7	φ	B
	5	CG RAM (6)		%	5	E	U	e	u			N	e	a	x	U	7
	6	CG RAM (7)		&	6	F	V	f	v			K	w	w	7	w	P
	7	CG RAM (8)		'	7	G	W	w	w			J	3	a	I	'	E
	8	CG RAM (1)		(	8	H	X	h	x			Π	x	e	I	'	†
	9	CG RAM (2)		)	9	I	V	i	v			Y	6	o	†	'	o
	A	CG RAM (3)		*	*	J	Z	j	z			Φ	k	z	z	e	†
	B	CG RAM (4)		+	;	K	L	k	w			4	a	'	K	g	†
	C	CG RAM (5)		,	<	L	φ	l	e			w	w	8	u	†	†
	D	CG RAM (6)		-	=	M	I	m	5			b	w	c	M	†	g
	E	CG RAM (7)		.	>	N	^	n	4			W	n	g	7	o	9
	F	CG RAM (8)		/	?	O	_	o	e			3	t	e	'	o	g

* 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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