

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.

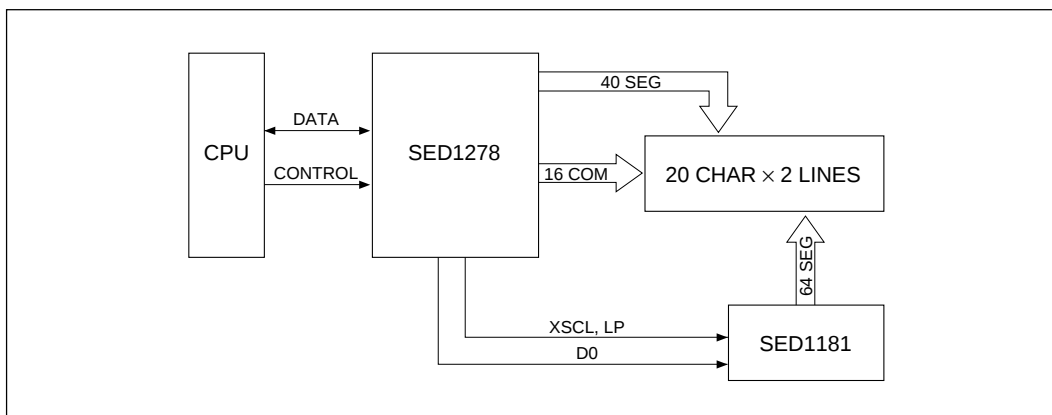
The SED1278 has 40 segment output and 16 common output built-in. Thus, one chip is capable of displaying up to 16 characters. The SED1278 can display one line of 48 characters using an SED1681F (80-bit output) as an expansion segment driver.

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.

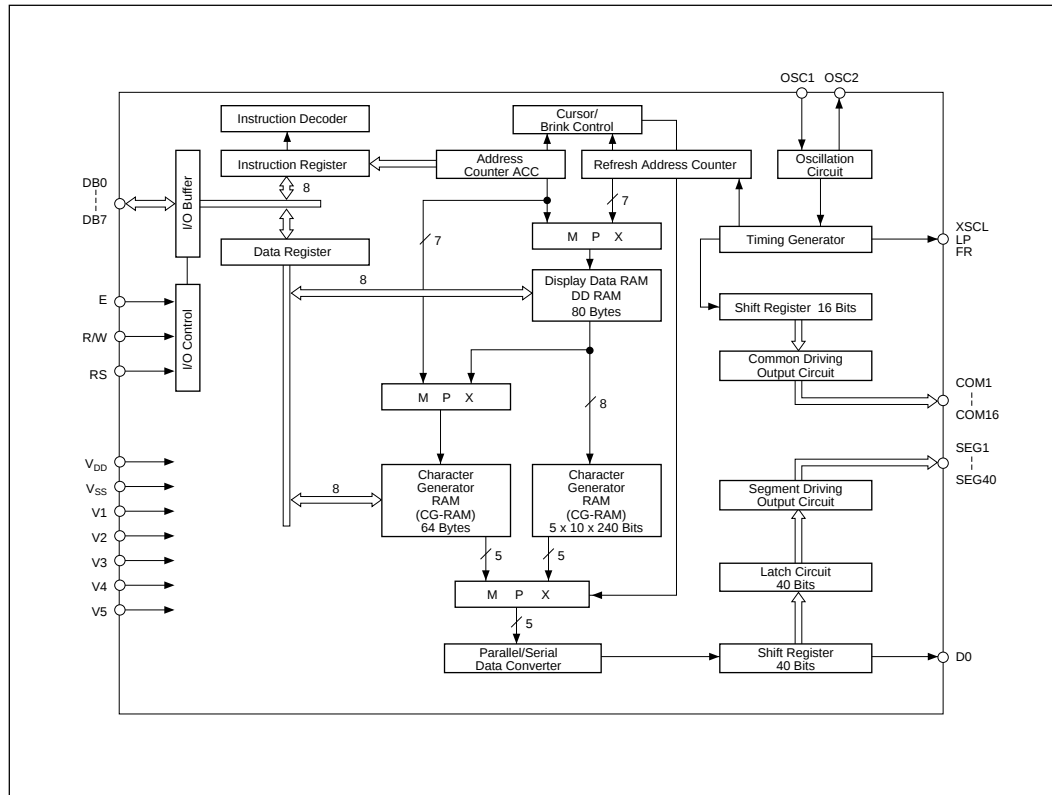
■ FEATURES

- 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)

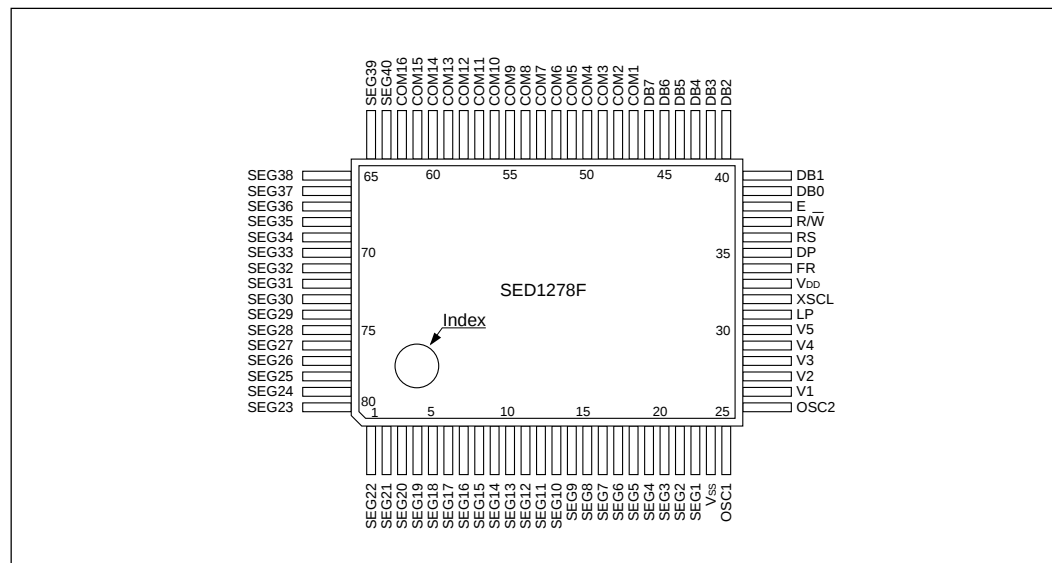
■ SYSTEM BLOCK DIAGRAM



■ BLOCK DIAGRAM



■ PIN CONFIGURATION



■ PIN DESCRIPTION

Symbol	No. of signals	Functions	
RS	1	Register select signal	*1
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≥Vss)	
VDD	1	+5V	
Vss	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_{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 ±10%, V_{SS} = 0V, T_a = -20 to 75°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	kΩ
Driver-on resistor (SEG)	R _{SEG}	V _{SEG} -V _n =0.5V	SEG1~40	—	2.5	10	kΩ
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}	R _f 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 (R _f oscillation)							
Oscillation frequency	f _{osc}	R _f =91kΩ±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 ± 10%, V_{SS} = 0V, T_a = -20 to 75°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
Read data output delay	t _{RD}	C _L =100pF	—	—	120	ns
Read data hold time	t _{DHR}		20	—	—	ns

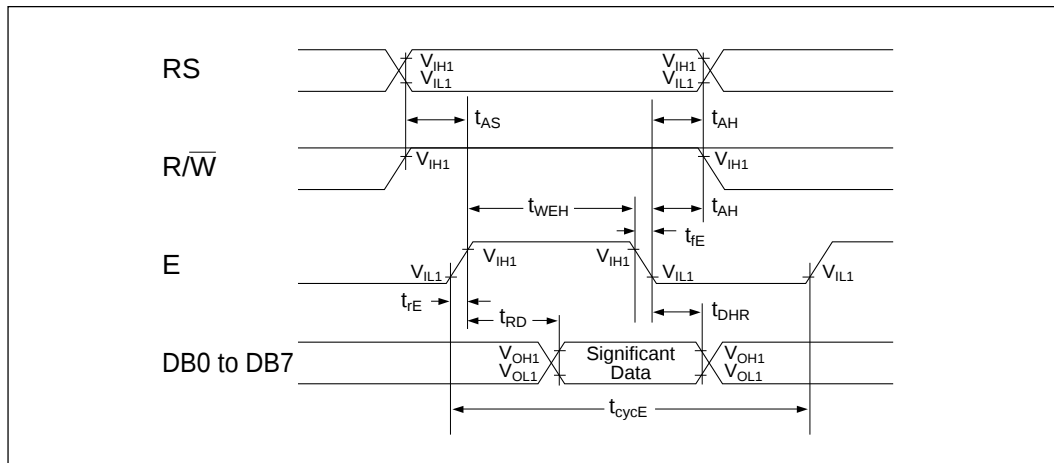
- Write cycle

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

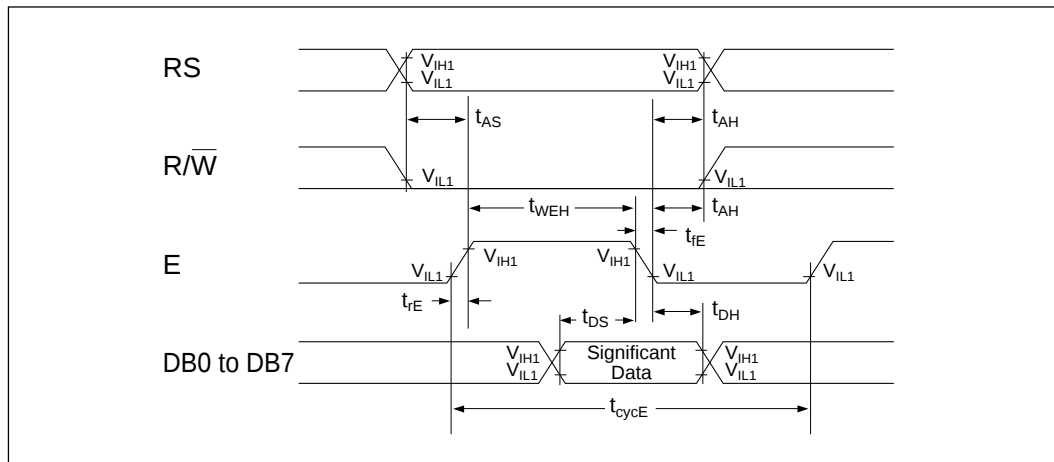
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}		500	—	—	ns
Enable "H" level pulse width	t_{WEH}		220	—	—	ns
Enable rise/fall time	t_{rE} , t_{fE}		—	—	25	ns
RS, R/W setup time	t_{AS}		40	—	—	ns
RS, R/W address hold time	t_{AH}		10	—	—	ns
Data setup time	t_{DS}		60	—	—	ns
Write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

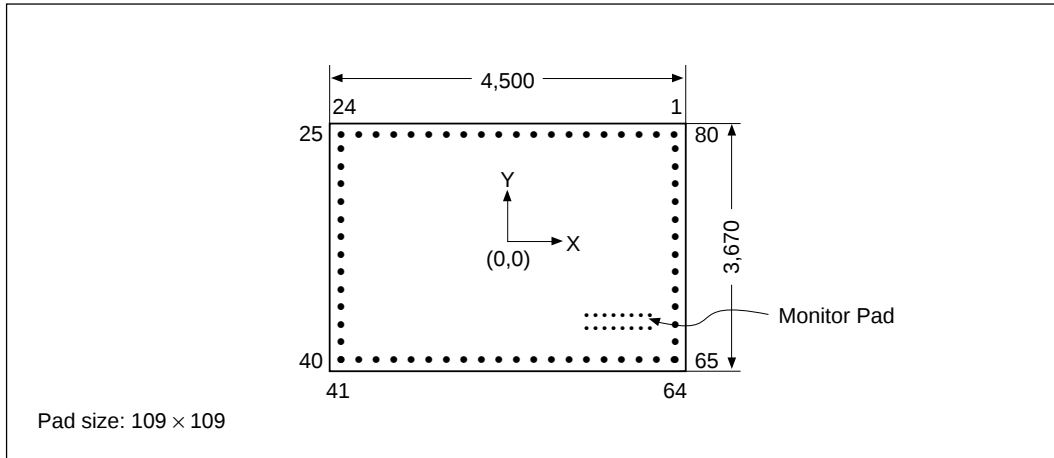
* Don't care

■ **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	3	3
	1	CG RAM (2)		!	1A0a4							.	7	7	4	ä	q
	2	CG RAM (3)		"	2BRbr							"	4	u	x	p	0
	3	CG RAM (4)		#	3CScs							!	9	t	e	z	o
	4	CG RAM (5)		\$	4DTdt							\	I	t	p	u	o
	5	CG RAM (6)		%	5Eueu							.	4	+	1	c	0
	6	CG RAM (7)		&	6Fufv							9	0	2	3	p	Σ
	7	CG RAM (8)		'	7Gw9w							7	+	7	7	g	π
	8	CG RAM (1)		(	8HXhx							4	0	*	7	5	X
	9	CG RAM (2)		)	9IYiy							o	t	7	u	7	y
	A	CG RAM (3)		*	:JZjz							z	0	n	v	j	7
	B	CG RAM (4)		+	:Kck<							*	9	t	0	*	K
	C	CG RAM (5)		,	<L*ll							+	9	7	7	+	K
	D	CG RAM (6)		—	=M]m>							u	2	^	c	t	÷
	E	CG RAM (7)		.	>N^nn>							3	t	+	7	n	
	F	CG RAM (8)		/	?0Lo+							u	u	7	7	0	

■ 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	é	á	'		í	Á	Þ
	1	CG RAM (2)	≡	!	1	A	O	a	9	U	æ	i	'		J	†	ÿ
	2	CG RAM (3)	7	"	2	B	R	b	r	é	É	ó	'		ø	3	8
	3	CG RAM (4)	¿	#	3	C	S	c	s	ä	ä	ü	'		P	¶	æ
	4	CG RAM (5)	/	\$	4	D	T	d	t	ä	ä	ö	'		4	7	z
	5	CG RAM (6)	\	%	5	E	U	e	u	ä	ä	é	'		†	Δ	η
	6	CG RAM (7)	¡	&	6	F	U	f	u	ä	ä	¶	'		↓	Ø	¶
	7	CG RAM (8)	¿	'	7	G	W	w	g	ü	R	x	'		÷	À	÷
	8	CG RAM (1)	/	(	8	H	X	h	x	é	9	'	'		÷	É	K
	9	CG RAM (2)	\	)	9	I	Y	i	y	é	0	'	'		Δ	7	Δ
	A	CG RAM (3)	*	*	*	J	Z	j	z	é	0	2	'		7	Δ	μ
	B	CG RAM (4)	+	+	+	K	C	k	c	é	0	2	'		Δ	7	Δ
	C	CG RAM (5)	=	,	<	L	\	l	\	é	0	2	'		Δ	7	Δ
	D	CG RAM (6)	~	-	=	M	I	m	i	é	0	2	'		Δ	7	Δ
	E	CG RAM (7)	²	.	>	N	^	n	^	é	0	2	'		Δ	7	Δ
	F	CG RAM (8)	³	/	?	O	_	o	_	é	0	2	'		Δ	7	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)		/	?	O	_	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	Ä
	1	CG RAM (2)		!	1A0a9							Ü	ä	1	✓	Ä	Ü
	2	CG RAM (3)		"	2BRbr							é	É	ó	É	ó	Ä
	3	CG RAM (4)		#	3CScs							ä	ö	ü	°	Ä	Ä
	4	CG RAM (5)		\$	4DTdt							ä	ö	Ä	Ä	Ä	Ä
	5	CG RAM (6)		%	5Eueu							ä	ö	Ä	°	ö	Ä
	6	CG RAM (7)		&	6Fufv							'	ö	ä	°	Ä	Ä
	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	31		
	2	CG RAM (3)		"	2BRbr							eE	6x	7f			
	3	CG RAM (4)		#	3CScs							8c	00	7	4		
	4	CG RAM (5)		\$	4DTdt							8c	00	7	4		
	5	CG RAM (6)		%	5Eueu							8c	00	7	4		
	6	CG RAM (7)		&	6Fufv							'	0a	°	0		
	7	CG RAM (8)		'	7Bwsw							90	00	7	4		
	8	CG RAM (1)		(	8HXhx							e9	c	u	0		
	9	CG RAM (2)		)	9IYiy							e4	7	4	0		
	A	CG RAM (3)		*	: JZjz							e0	4	L	.	e	
	B	CG RAM (4)		+	: Kck<							i	u	9	1	0	
	C	CG RAM (5)		,	< L\l~							i	0	4	-	0	
	D	CG RAM (6)		-	= Mln>							i	.	i	0	e	
	E	CG RAM (7)		.	> N^n~							8e	7	1	2	1	
	F	CG RAM (8)		/	? O_oe							8e	7	1	2	1	

■ SED1278F_{0H/D0H} 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)			0aP' p							B004 . dK					
	1	CG RAM (2)		!	1A0a9							Γ9w i U9					
	2	CG RAM (3)		"	2BRbr							E6v u W9					
	3	CG RAM (4)		#	3CScs							8e u u a9					
	4	CG RAM (5)		\$	4DTdt							3rē 7 φ B					
	5	CG RAM (6)		%	5EUeu							Nēa x u 7					
	6	CG RAM (7)		&	6FVfv							KwW 7 u 9					
	7	CG RAM (8)		'	7GWaw							Jc a I ' E					
	8	CG RAM (1)		(	8HXhx							n x c I ' †					
	9	CG RAM (2)		)	9IViw							Yc o † ' 9					
	A	CG RAM (3)		*	JZjz							Φ k c † e †					
	B	CG RAM (4)		+	KDk w							4a 7 K 9 †					
	C	CG RAM (5)		,	L φ l e							w n 8 4 0 1					
	D	CG RAM (6)		-	M J n 5							b n c n 4 8					
	E	CG RAM (7)		.	N ^ n 4							W n 5 7 0 9					
	F	CG RAM (8)		/	0 L o e							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 S-MOS Marketing Department for conversion of the masked ROM.

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