

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.

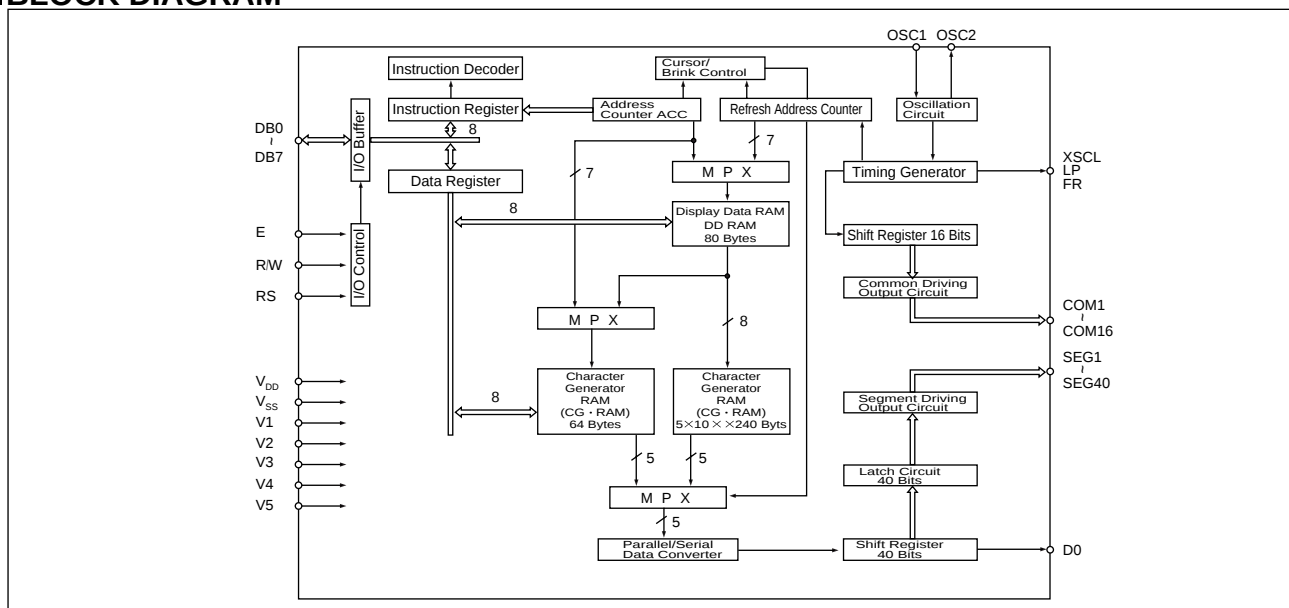
The built-in character generator ROM has an extended capacity of 240 different characters, each being generated in a 5×10 dots font compatible with a 1/11 duty. In addition, the SED1278F/D contains 64 bytes of character generator RAM in which the user can store 8 different characters, each consisting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

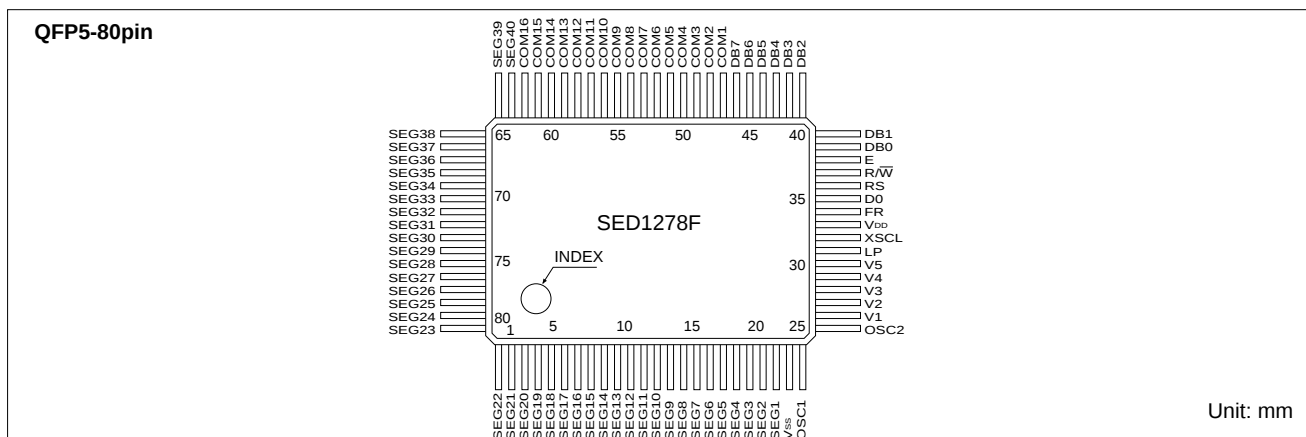
- Display RAM 80 bytes (80 characters)
- Character generator ROM 240 characters (Able to 256 characters)
- Character generator RAM 8 characters
- Built-in CR oscillator, Built-in power-on reset circuit
- Maximim display dimension 40 characters × 2 lines, 80 characters × 1 line (When accompanied with 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 5 × 7 dots+Cursor line (5 × 8 dots also possible)
5 × 10 dots+Cursor line
- 6 Kinds of character font
- Single power supply 5V±10% (Logic)
- Low LCD driving voltage $V_{DD}-V_5 \geq 3.0V$
- Package SED1278F: QFP5-80pin (plastic)
SED1278D: Die form (Al pad)

BLOCK DIAGRAM



SED1278F/D

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

($V_{DD}=5.0V\pm10\%$, $V_{SS}=0V$, $T_a=-20$ to $75^\circ C$)

Characteristic	Symbol	Condition	Applicable Pin	Min.	Typ.	Max.	Unit
"H" level input voltage (1)	V_{IH1}		DB0~DB7	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 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

($V_{DD}=5.0V\pm10\%$, $V_{SS}=0V$, $T_a=-20$ 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/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

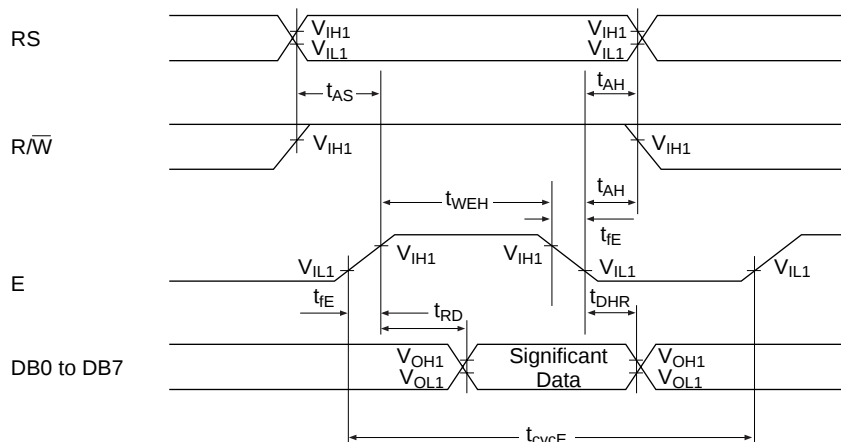
($V_{DD}=5.0V\pm10\%$, $V_{SS}=0V$, $T_a=-20$ to $75^\circ C$)

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/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

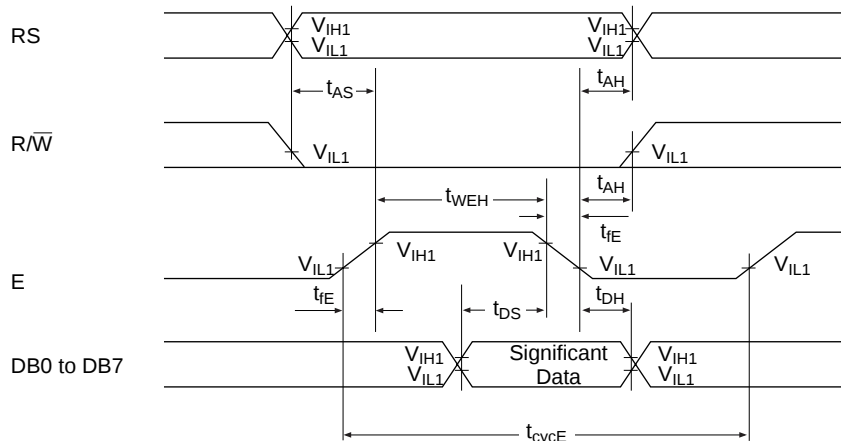
SED1278F/D

● Timing Chart

○ Read Cycle



○ Write Cycle



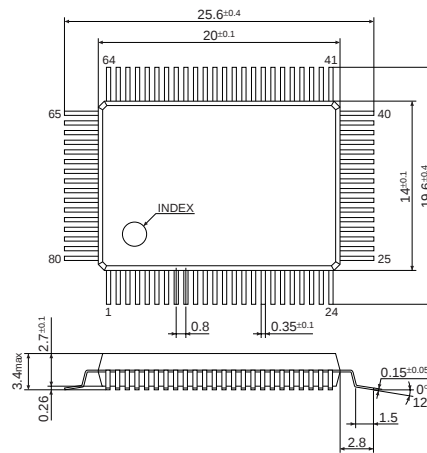
■ DISPLAY COMMAND

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	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

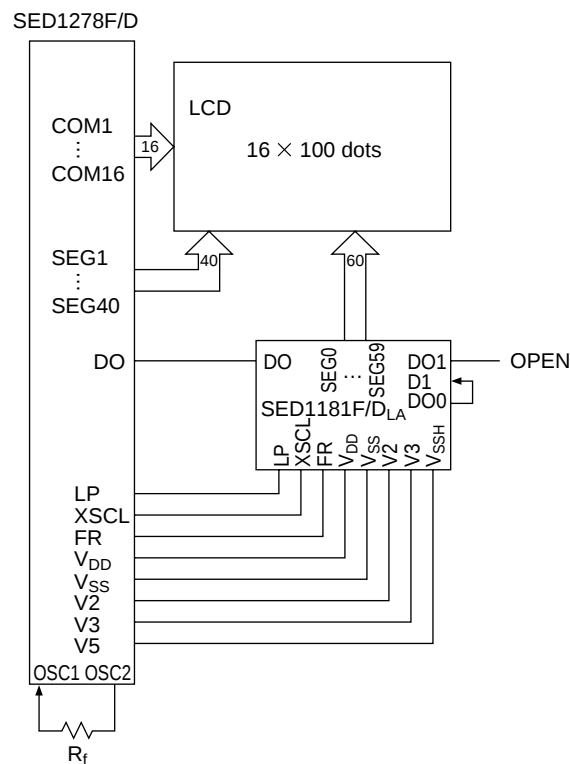
■ PACKAGE DIMENSIONS

Plastic QFP5-80pin



Unit: mm

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



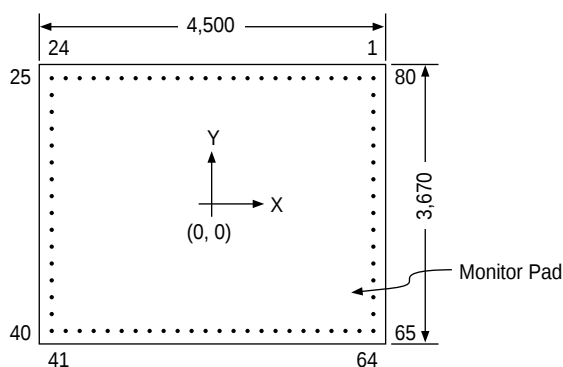
SED1278F/D is usually connected to 8-bit MPU via I/O ports.

SED1278F/D

SED1278D

● PAD LAYOUT

Unit: μm



Pad size: 109 × 109

● 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	V ₃	-2,087	819	55	COM9	452	-1,671
2	SEG21	1,905		29	V ₄		637	56	COM10	633	
3	SEG20	1,723		30	V ₅		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	V _{CC}		-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	V ₁		1,183	53	COM7	91		80	SEG23		1,365
27	V ₂		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 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	a	q
	2	CG RAM (3)		"	2	B	R	b	r			ˆ	ı	ı	ı	p	θ
	3	CG RAM (4)		#	3	C	S	c	s			ı	ı	ı	ı	ı	ı
	4	CG RAM (5)		\$	4	D	T	d	t			ı	ı	ı	ı	ı	ı
	5	CG RAM (6)		%	5	E	U	e	u			.	ı	ı	ı	ı	ı
	6	CG RAM (7)		&	6	F	V	f	v			ı	ı	ı	ı	ı	ı
	7	CG RAM (8)		'	7	G	W	g	w			ı	ı	ı	ı	ı	ı
	8	CG RAM (1)		(	8	H	X	h	x			ı	ı	ı	ı	ı	ı
	9	CG RAM (2)		)	9	I	Y	i	y			ı	ı	ı	ı	ı	ı
	A	CG RAM (3)		*	*	J	Z	j	z			ı	ı	ı	ı	ı	ı
	B	CG RAM (4)		+	;	K	[	k	[			ı	ı	ı	ı	ı	ı
	C	CG RAM (5)		,	<	L	]	l	]			ı	ı	ı	ı	ı	ı
	D	CG RAM (6)		-	=	M	_	m	_			ı	ı	ı	ı	ı	ı
	E	CG RAM (7)		.	>	N	^	n	^			ı	ı	ı	ı	ı	ı
	F	CG RAM (8)		/	?	O	_	o	_			ı	ı	ı	ı	ı	ı

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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)	±		0	0	P	'	F	9	é	á	'	í	ñ	þ	τ
	1	CG RAM (2)	≡	!	1	A	Q	a	9	Q	æ	í	"	¡	ty	ü	
	2	CG RAM (3)	7	"	2	B	R	b	r	é	é	é	°	°	é	é	æ
	3	CG RAM (4)	¿	#	3	C	S	c	s	á	á	á	'	í	ñ	þ	τ
	4	CG RAM (5)	¿	\$	4	D	T	d	t	á	á	á	'	í	ñ	þ	τ
	5	CG RAM (6)	¿	%	5	E	U	e	u	á	á	á	°	°	é	é	æ
	6	CG RAM (7)	¿	&	6	F	V	f	v	á	á	á	°	°	é	é	æ
	7	CG RAM (8)	¿	'	7	G	W	g	w	á	á	á	°	°	é	é	æ
	8	CG RAM (1)	¿	(	8	H	X	h	x	á	á	á	°	°	é	é	æ
	9	CG RAM (2)	¿	)	9	I	Y	i	y	á	á	á	°	°	é	é	æ
	A	CG RAM (3)	¿	*		J	Z	j	z	á	á	á	°	°	é	é	æ
	B	CG RAM (4)	¿	+		K	C	k	c	á	á	á	°	°	é	é	æ
	C	CG RAM (5)	¿	,		L	\	l	\	á	á	á	°	°	é	é	æ
	D	CG RAM (6)	¿	-		M	]	m	]	á	á	á	°	°	é	é	æ
	E	CG RAM (7)	¿	.		N	^	n	^	á	á	á	°	°	é	é	æ
	F	CG RAM (8)	¿	/		O	_	o	_	á	á	á	°	°	é	é	æ

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

SED1278F_{0D}/D_{0E} 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	`	F			Æ	Æ	Æ	Æ	Æ	Æ
	1	CG RAM (2)		!	1	A	Q	a	q			0	a	1	✓	Q	✓
	2	CG RAM (3)		"	2	B	R	b	r			e	R	e	✓	q	✓
	3	CG RAM (4)		#	3	C	S	c	s			a	0	°	°	°	°
	4	CG RAM (5)		\$	4	D	T	d	t			a	a	✓	✓	✓	✓
	5	CG RAM (6)		%	5	E	U	e	u			a	0	°	°	°	°
	6	CG RAM (7)		&	6	F	V	f	v			°	0	°	°	°	°
	7	CG RAM (8)		'	7	G	W	g	w			✓	0	°	°	°	°
	8	CG RAM (1)		(	8	H	X	h	x			e	0	°	°	°	°
	9	CG RAM (2)		)	9	I	Y	i	y			e	4	0	°	°	°
	A	CG RAM (3)		*	*	J	Z	j	z			e	0	°	°	°	°
	B	CG RAM (4)		+	+	K	[	k	[			i	0	°	°	°	°
	C	CG RAM (5)		,	,	L	\	l	~			i	0	°	°	°	°
	D	CG RAM (6)		-	-	M	]	m	]			i	,	i	0	°	°
	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 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	a	P	`	P			7	E	A	A	C	I
	1	CG RAM (2)		!	1	A	D	a	a			0	a	1	A	o	!
	2	CG RAM (3)		"	2	B	R	b	r			e	R	O	x	e	E
	3	CG RAM (4)		#	3	C	S	c	s			A	O	O	7	4	A
	4	CG RAM (5)		\$	4	D	T	d	t			A	O	A	O	4	"
	5	CG RAM (6)		%	5	E	U	e	u			A	O	N	"	O	+
	6	CG RAM (7)		&	6	F	V	f	v			'	O	a	'	O	7
	7	CG RAM (8)		'	7	G	W	g	w			N	O	O	N	R	7
	8	CG RAM (1)		(	8	H	X	h	x			e	9	C	"	e	H
	9	CG RAM (2)		)	9	I	Y	i	y			e	e	7	H	B	7
	A	CG RAM (3)		*	*	J	Z	j	z			e	O	#	L	.	e
	B	CG RAM (4)		+	;	K	[	k	[			i	u	X	I	O	B
	C	CG RAM (5)		,	<	L	\	l	"			i	u	X	7	e	+
	D	CG RAM (6)		-	=	M	]	m	]			i	,	i	O	e	X
	E	CG RAM (7)		.	>	N	^	n	+			A	e	↑	1	e	1
	F	CG RAM (8)		/	?	O	_	o	+			H	7	↓	I	7	■

SED1278F/D

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

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