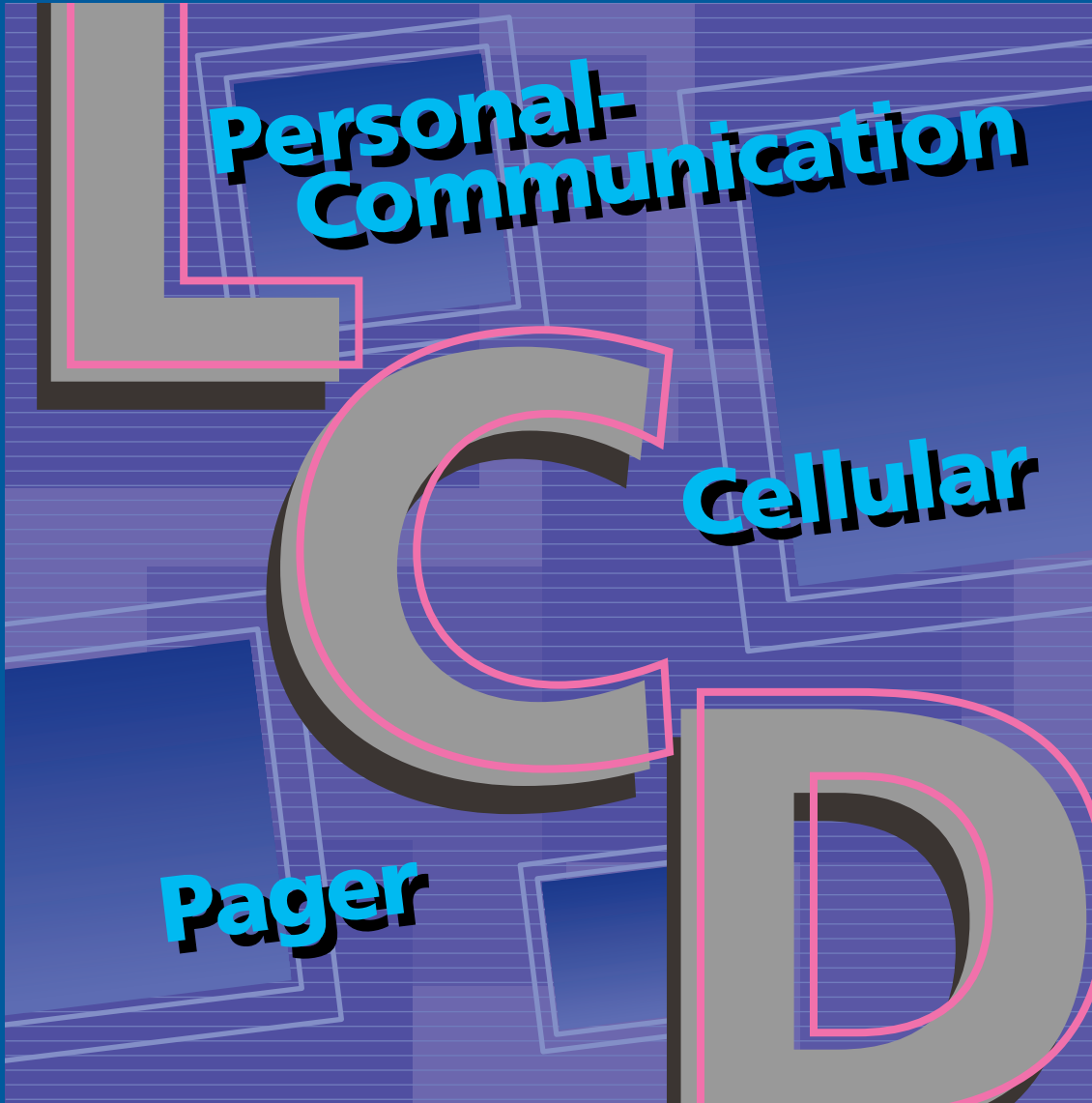


LCD Module for Mobile Communication

Product Catalog



1998/1999



SEIKO EPSON CORPORATION

Seiko Epson presents a new lineup of LCD modules designed specifically for the needs of the telecommunication market. The field of mobile communications has grown immensely over the last few years, bringing with it a strong demand for low-cost, compact, low-power consumption. This trend is expected to further intensify in future.

During the development of quartz watches, Seiko Epson gained extensive experience in high-precision manufacturing techniques for miniature devices. This experience, along with TCP (tape carrier package) technology and other advanced techniques has been applied to create LCD drivers and panels that operate with low drive voltages and consume very little power.

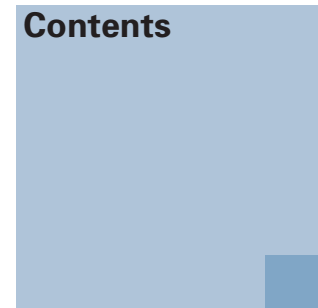
LCD modules from Seiko Epson are already being used extensively in the most important market sector of mobile communications, namely cellular telephones and pagers. Further reductions in power consumption and extremely high contrast are the main features of several products developed for use in PDAs, Smart Phones and other information terminals.

By using standard devices from Seiko Epson, a drastic reduction in development time and cost is possible.

With a versatile array of devices and components, Seiko Epson can also provide customized modules and provide consistent support from the planning stage through development and design up to production.

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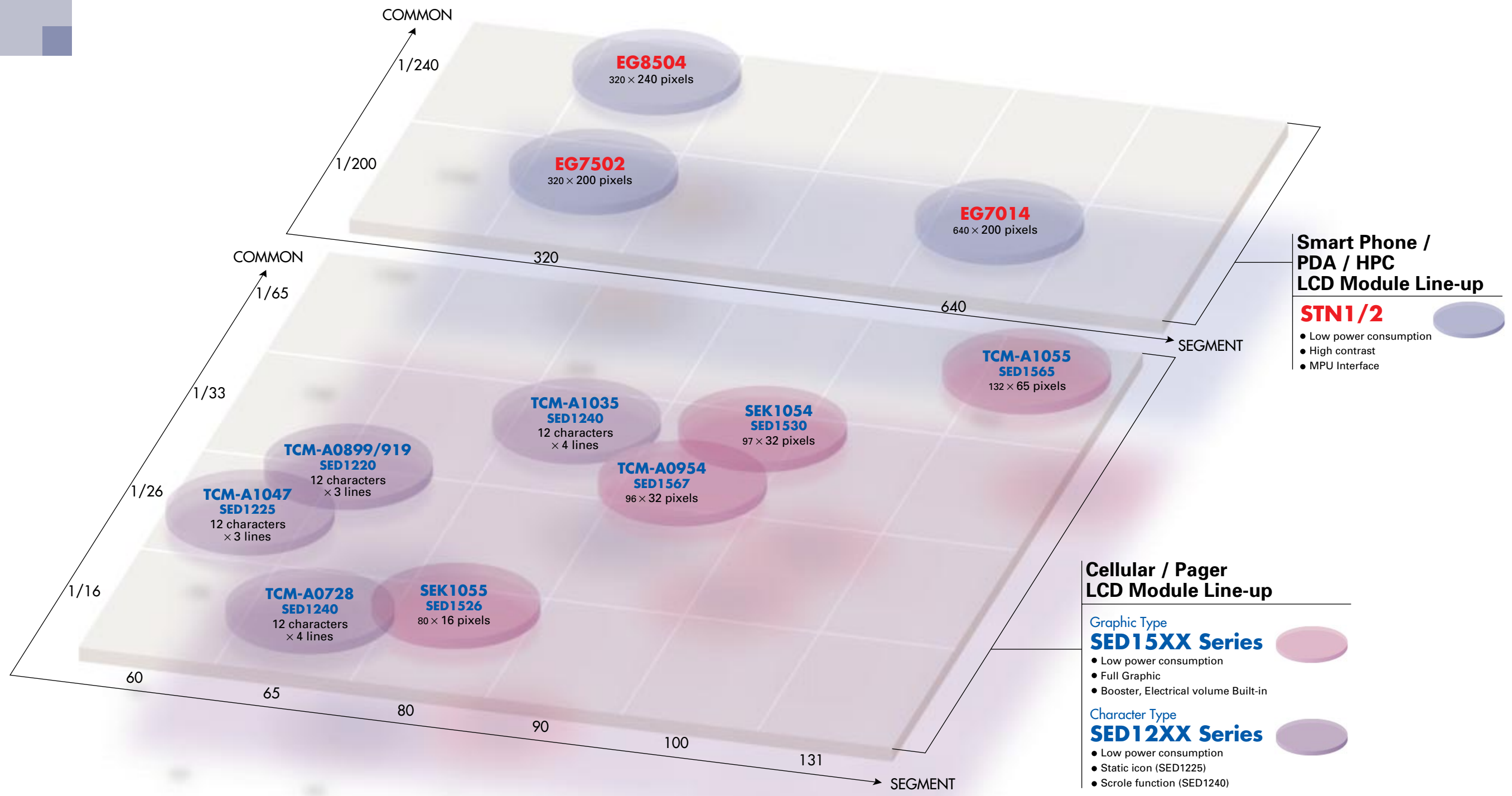
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Lineup of Standard Modules



Standard Module Lineup

Cellular / Pager LCD Module



Graphic display type

- Power supply for driving the LCD included (doubler, tripler and quadrupler)
- Extremely low current consumption
- High capacity RAM included
- Maximum available character display is 8 characters × 4 lines (In case of 16 × 16 chinese character font)

Device type designation	Display format	Module construction	Page
SEK1055B0A	80 × 16 pixels and icons (STN)	LCD + heat seal + TCP	10
SEK1055B1A	80 × 16 pixels and icons (FTN)	LCD + heat seal + TCP	10
SEK1054B0A	97 × 32 pixels and icons (STN)	LCD + heat seal + TCP	11
SEK1054B1A	97 × 32 pixels and icons (FTN)	LCD + heat seal + TCP	11
TCM-A0954	96 × 32 pixels and icons (FTN)	LCD + COG + FPC	12
TCM-A1055	132 × 65 pixels (FTN)	LCD + TCP	13

Character display type

- Power supply for driving the LCD included (doubler and tripler)
- Extremely low current consumption
- CGROM included
- Maximum available character display is 16 characters × 4 lines, with 48 icons
- Static icon function provided

Device type designation	Display format	Module construction	Page
TCM-A0728	12 characters × 4 lines + Icons (FTN)	LCD + TCP	14
TCM-A0899	12 characters × 3 lines + Icons (FTN)	LCD + TCP	15
TCM-A0919	12 characters × 3 lines + Icons (FTN)	LCD + COG + FPC	15
TCM-A1035	16 characters × 4 lines + Icons (FTN)	LCD + TCP	16
TCM-A1047	12 characters × 3 lines + Icons (FTN)	LCD + TCP	17

Smart phone / PDA / HPC LCD Module



Smart Phone

- Ultra-low power consumption (lowest in the industry)
- Single 3.3 V driver
- High contrast

Device type designation	Display format	Module construction	Page
EG7502x-xx	320 × 200 pixels (FTN positive)	LCD + TCP + PCB + plastic case (*1, 2)	18

*1: Can be fitted with electroluminescent backlight as option. *2: Can be fitted with LED backlight as option.

Mobile information terminal

- Ultra-low power consumption (lowest in the industry)
- Single 3.3 V driver (EG7014)
- High contrast

Device type designation	Display format	Module construction	Page
EG8504x-xx	320 × 240 pixels (FTN positive)	LCD + TCP + PCB + plastic case (*1)	20
EG7014x-xx	640 × 200 pixels (FTN positive)	LCD + TCP + PCB + plastic case	19

*1: Can be fitted with electroluminescent backlight as option.

Other standard LCD Module

SEK1049 Series

(Vehicle Information and Communications System)
FM multiplex broadcasting support

- 15 characters × 2 lines display of mixed kanji and kana, corresponding to VICS level 1
- Power supply for driving the LCD included (tripler)
- Low current consumption of 700 μA (typical during operation)
- High capacity internal RAM

Device type designation	Display format	Module construction	Page
SEK1049B0A	248 × 60 pixels (STN positive)	LCD + heat seal + TCP + PCB + TCP + PCB	21
SEK1049B1A	248 × 60 pixels (STN negative)	LCD + heat seal + TCP + PCB	21
SEK1049B2A	248 × 60 pixels (STN transfective positive)	LCD + heat seal + TCP + PCB	21

Note: Please contact to your Epson sales office about the specification of the mass product.

EA-D series



- Built-in SED1278 dedicated character display LCD controller and driver (HD44780 equivalent)
- Interface to 4-bit or 8-bit MPU
- Single 5 V power supply
- Built-in font ROM, 160 characters (complies with JIS) + 32 characters (special characters)
- Font RAM for arbitrary character pattern display (maximum 8 characters)
- STN type for high contrast and wide viewing angle

■ EA-D series character type LCD module TN type (STN type)

Model name	Display capacity Characters × lines	Panel specification	Backlight	Duty	Character size W × H (mm)	Character pitch (mm)	Pixel pitch W × H (mm)	External dimensions W × H × D (mm)	Effective display size W × H (mm)	Operating temperature (°C)	Storage temperature (°C)	Power consumption(*1) (mW) Max.	Weight (g)
EA-D16015AR(-S)	16 × 1	Reflective	—	1/16	3.07 × 6.56	3.77	0.55 × 0.75	80.0 × 36.0 × 10.3	64.5 × 13.8	0 to 50	-20 to 60	15	30
EA-D16015PR(-S)	16 × 1	Transmissive	LED	1/16	3.07 × 6.56	3.77	0.55 × 0.75	80.0 × 36.0 × 12.3	64.5 × 13.8	0 to 50	-20 to 60	15	30
EA-D16025AR(-S)	16 × 2	Reflective	—	1/16	2.96 × 5.56	3.55	0.56 × 0.66	84.0 × 44.0 × 10.3	61.0 × 15.8	0 to 50	-20 to 60	15	40
EA-D16025PR(-S)	16 × 2	Transmissive	LED	1/16	2.96 × 5.56	3.55	0.56 × 0.66	84.0 × 44.0 × 12.3	61.0 × 15.8	0 to 50	-20 to 60	15	40
EA-D20025AR(-S)	20 × 2	Reflective	—	1/16	3.20 × 5.55	3.70	0.60 × 0.65	116.0 × 39.0 × 10.3	83.0 × 18.6	0 to 50	-20 to 60	15	50
EA-D20025PR(-S)	20 × 2	Transmissive	LED	1/16	3.20 × 5.55	3.70	0.60 × 0.65	116.0 × 39.0 × 12.3	83.0 × 18.6	0 to 50	-20 to 60	15	50

Note: Because of replacement by new products, production of models listed above may be terminated.
Details listed above may be changed without notice because of improvements, and before use confirmation should be made with the specification.

*1: According to standard Seiko Epson measurements. Does not include backlight power

EG series

“Full graphic” modules adopt STN (Super Twisted Nematic) and/or FTN (Formulated STN) to give high contrast and wide viewing angle.

■ EG series Full graphic LCD module FTN /STN type

Model name	Display capacity	Panel specification	Backlight	Duty	Pixel pitch W × H (mm)	Display dimensions (mm)	External dimensions W × H × D (mm)	Weight (g)	Logic voltage (v)	Liquid crystal drive voltage polarity (°C)	Operating temperature (°C)	Storage temperature (°C)	Power (*1) consumption (mW)
EG7014C-AS	640 × 200	FTN Reflective	—	1/200	0.18 × 0.18	115.19 × 35.99	128.7 × 49.0 × 5.5	40	3.3	Built-in	0 to 50	-20 to 70	5
EG7502C-RS/AS	320 × 200	FTN Transflective	LED	1/200	0.18 × 0.18	57.59 × 35.97	71.1 × 49.0 × 6.2	25	3.3	Built-in	0 to 50	-20 to 70	3
EG8504C-AZ	320 × 240	FTN Reflective	—	1/240	0.24 × 0.24	76.79 × 57.59	94.0 × 73.6 × 7.1	45	3.3	+	0 to 50	-20 to 60	9
EG8504C-FZ	320 × 240	FTN Transflective	EL (White)	1/240	0.24 × 0.24	76.79 × 57.59	94.0 × 73.6 × 7.1	45	3.3	+	0 to 50	-20 to 60	9
EG8503B-NZ(-1)	320 × 240	STN Blue Transmissive	CCFT	1/240	0.36 × 0.36	115.17 × 86.37	161.3 × 122.8 × 10.6	225	5	Negative	0 to 50	-20 to 60	140

Note: Because of replacement by new products, production of models listed above may be terminated.
Details listed above may be changed without notice because of improvements, and before use confirmation should be made with the specification.

*1: According to standard Seiko Epson measurements. Does not include backlight power

Cellular / Pager LCD Module

Graphic Display Type

These LCD modules are especially suitable for cellular and pagers. They can display Japanese characters (kanji) on a 16 × 16 font characters (max. 8 characters × 4 lines + Icons). Through the use of the SED 1526, SED 1530, or SED 1565 series as LCD drivers, current and voltage requirements are kept extremely low, and dimensions and thickness are minimized.

Since the power supply for driving the LCD (voltage booster doubler, tripler and quadruple) is included, external drive circuitry is not required. This contributes to simplicity of circuit design and helps to reduce costs.

SEK1055B_{0A} (STN positive) SEK1055B_{1A} (FTN positive)

Photograph shows SEK1055B_{1A}



■ Features

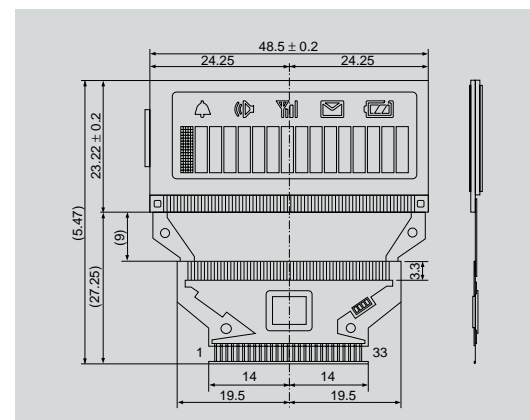
- Maximum 16 characters × 2 lines (5 × 8 font)
- Low current consumption of 60 μA (typical value while illuminated, with V_{DD} = 3.0 V and voltage doubler).
- Use of a standard module contributes to reduced development times and a reduction of development cost.
- This module is constructed with LCD and TCP connected together with a heat seal, so as to minimize size and weight.

■ Specifications

Module construction	LCD + heat seal + TCP
Display format	80 × 16 pixels + Icons
Liquid crystal panel	STN / FTN (transflective, t = 0.7 mm)
LCD driver	SED1526T _{0A}
Interface	8 bit parallel (68/80 series) or serial
Power Supply Voltage	2.4 to 6.0 V
Liquid crystal drive power supply	Voltage booster (doubler, tripler)
Current consumption	60 μA (*1)
Glass External Dimensions	48.5 × 23.22 mm
Operating Temperature	-20 to 70°C (STN), -20 to 60°C (FTN)
Storage Temperature	-30 to 80°C (STN), -30 to 70°C (FTN)

*1 Typical value while illuminated, with V_{DD} = 3.0 V, voltage doubler, internal power ON.

■ External Dimensions



■ Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	10	CL	19	M/S	28	V ₅
2	D7	11	FR	20	V _{SS}	29	V ₄
3	D6	12	A0	21	CAP1+	30	V ₃
4	D5	13	/CS1	22	CAP1-	31	V ₂
5	D4	14	CS2	23	CAP2+	32	V ₁
6	D3	15	/RD	24	CAP2-	33	N.C.
7	D2	16	/WR	25	V _{OUT}		
8	D1	17	SR1	26	V _{DD}		
9	D0	18	SR2	27	V _R		

SEK1054B_{0A} STN positive SEK1054B_{1A} FTN positive



■ Features

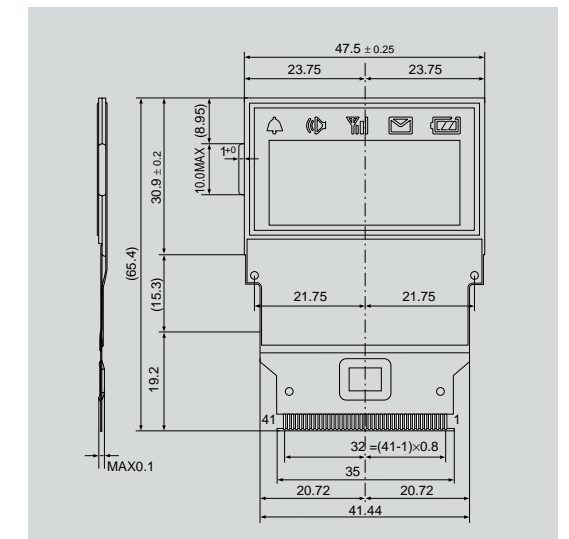
- Chinese characters (kanji) display: 6 characters × 2 lines (16 × 16 font characters).
- Low current consumption of 150 μA is available (typical value while illuminated, with V_{DD} = 3.0 V and voltage tripler).
- Use of a standard module contributes to reduced development times and a reduction of development cost.
- This module is constructed with LCD and TCP connected together by heat seal, so as to minimize size and weight.

■ Specifications

Module construction	LCD + heat seal + TCP
Display format	97 × 32 pixels + Icons
Liquid crystal panel	STN / FTN (transflective, t=0.7 mm)
LCD driver	SED1530T _{AA}
Interface	8 bit parallel (68/80 type) or serial
Power Supply Voltage	2.4 to 6.0 V
Liquid crystal drive power supply	Voltage booster (doubler, tripler, quadrupler)
Current consumption	150 μA (*1)
Glass External Dimensions	48.75 × 30.9 mm
Operating Temperature	-20 to 70°C (STN), -20 to 60°C (FTN)
Storage Temperature	-30 to 80°C (STN), -30 to 70°C (FTN)

*1 Typical value while illuminated, with V_{DD} = 3.0 V, voltage tripler, internal power ON.

■ External Dimensions



■ Pin Connections

Pin No	Pin name	Pin No	Pin name	Pin No	Pin name	Pin No	Pin name
1	N.C.	12	CS2	23	D5	34	V _R
2	FRS	13	C86	24	D6	35	V _{DD}
3	FR	14	A0	25	D7	36	V ₁
4	DY0	15	/WR	26	V _{SS}	37	V ₂
5	CL	16	/RD	27	V _{OUT}	38	V ₃
6	DF0	17	V _{DD}	28	CAP3-	39	V ₄
7	V _{S1}	18	D0	29	CAP1+	40	V ₅
8	M/S	19	D1	30	CAP1-	41	N.C
9	/RES	20	D2	31	CAP2+		
10	P/S	21	D3	32	CAP2-		
11	/CS1	22	D4	33	V ₅		

TCM-A0954



Features

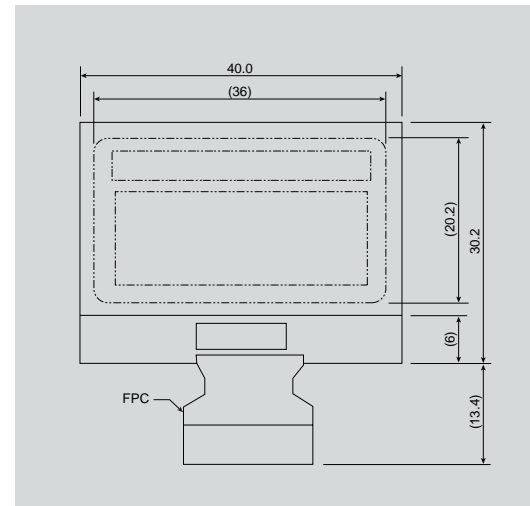
- Display capability for 6 characters × 2 lines (16 × 16 font characters) of Japanese characters (kanji), particularly suitable for cellular and pager
- Standard module with compact dimensions and low profile, thanks to COG mounting technique
- Internal RAM driver SED 1567 for further reduced current consumption

Specifications

Module construction	LCD + COG + FPC
Display format	96 × 32 pixels + Icons
Liquid crystal panel	FTN Reflective
LCD driver	SED1567D
Duty	1/33
Interface	8 bit parallel (68/80 series) or serial
Power Supply Voltage	2.7 to 3.3 V (recommended)
Liquid crystal drive power supply	Voltage booster (doubler, tripler, quadrupler)
Current consumption	160 μA (Typ.) (*1)
Glass External Dimensions	40.0 × 30.2 mm
Operating Temperature	-20 to 70°C
Storage Temperature	-30 to 80°C

*1 Typical value while illuminated, with $V_{DD} = 3.0$ V, voltage tripler, high power mode, internal power ON.

External Dimensions



Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	/CS1	9	D3	17	V_{OUT}	25	V_3
2	/RES	10	D4	18	CAP3-	26	V_4
3	AO	11	D5	19	CAP1+	27	V_5
4	/WR(R/W)	12	D6(SCL)	20	CAP1-	28	V_R
5	/RD(E)	13	D7(SI)	21	CAP2-	29	C86
6	D0	14	V_{DD}	22	CAP2+	30	P/S
7	D1	15	V_{SS}	23	V_1	31	/HPM
8	D2	16	V_{SS2}	24	V_2	32	IRS

Note: Please contact to your Epson sales office about the specification of the mass product.

TCM-A1099

Features

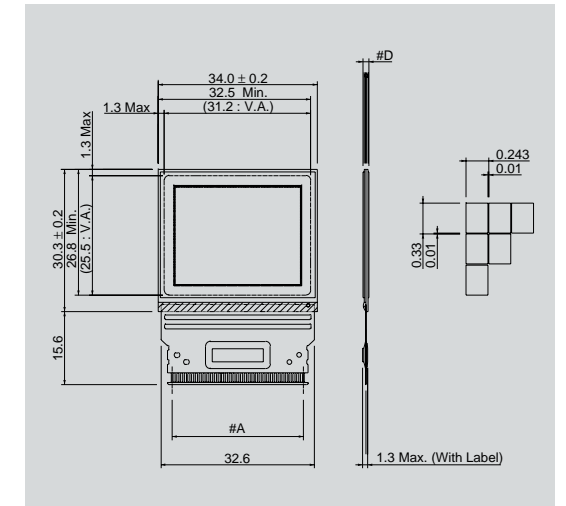
- Display employs 132 × 65 pixels making it most suitable for the cellular and pager.
- This module is constructed with LCD and TCP, and is thus a simple standard module.
- Built-in LCD drive power circuit and oscillator circuit gives low power consumption

Specifications

Module construction	LCD + TCP
Display format	132 × 65 pixels
Liquid crystal panel	FTN transfective
LCD driver	SED1565D
Duty	1/65
Interface	8bit parallel (68/80 series) or serial
Power Supply Voltage	2.7 to 3.3 V
Liquid crystal drive power supply	Voltage booster (doubler, tripler, quadrupler)
Current consumption	150 μA (Typ.) (*1)
Glass External Dimensions	
Operating Temperature	-20 to 70°C
Storage Temperature	-30 to 80°C

*1 Typical value while illuminated, with $V_{DD} = 3.0$ V, voltage quadrupler, high power mode, internal power ON.

External Dimensions



Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	10	D2	19	CAP3-	28	V_4
2	CC	11	D3	20	CAP1+	29	V_5
3	/CSI	12	D4	21	CAP1-	30	V_R
4	/RES	13	D5	22	CAP2-	31	CLS
5	A0	14	D6,SCL	23	CAP2+	32	C86
6	/WR,/R/W	15	D7,SI	24	VRS	33	P/S
7	/RD,E	16	$V_{DD}(CS2,M/S)$	25	V_1	34	/HPM
8	D0	17	V_{SS},V_{SS2}	26	V_2	35	IRS
9	D1	18	V_{OUT}	27	V_3	36	N.C.

Character Display Type

These LCD modules are designed for cellular. They can display 5 × 7 or 8 font characters (max. 16 characters × 4 lines + Icons). By using TCPs of the SED 1240 or SED 1220/1230 series, current and voltage requirements are kept extremely low, and dimensions and thickness are minimized.

Since the power supply for driving the LCD (voltage booster doubler or tripler) is included, external drive circuitry is not required. This contributes to simplicity of circuit design and helps to reduce costs.

TCM-A0728

Photograph shows 2 lines display



Features

- Maximum available display 12 characters × 4 lines (5 × 7 font characters), particularly suitable for cellular.
- This module is constructed with LCD and TCP, and is thus a simple standard module.

Specifications

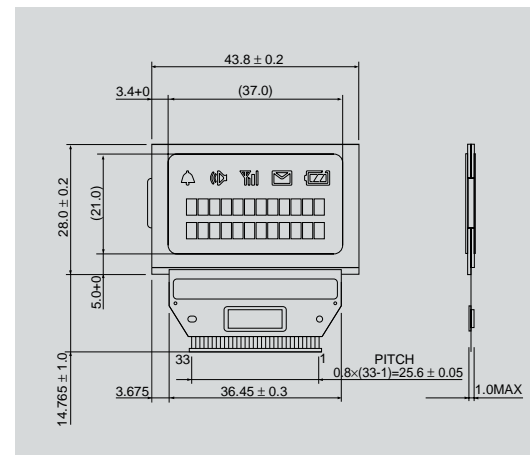
Module construction	LCD + TCP
Display format	Maximum 12 characters × 4 lines + 48 Icons (*1)
Liquid crystal panel	FTN (STN) transfective, t=0.4/0.55/0.7 mm (*2)
LCD driver	SED1232 (SED1230/SED1231/SED1233) (*1)
Interface	4/8 bit parallel (68/80 series) or serial
Power Supply Voltage	2.4 to 3.6 V
Liquid crystal drive power supply	Voltage booster (doubler, tripler)
Current consumption	100 μA (*3)
Glass External Dimensions	43.8 × 33.0 × 1.3-2.1 mm (*2)
Operating Temperature	-20 to 70°C
Storage Temperature	-30 to 80°C

*1 Other display formats than the above can be selected by the driver.
Optional settings (12 characters × 4 lines, 12 characters × 3 lines, 16 characters × 2 lines)

*2 The overall thickness can be varied according to the glass used.

*3 Typical value while illuminated, with $V_{DD} = 3.0$ V, voltage tripler, internal power ON.

External Dimensions



Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	10	D2	19	V ₁	28	V _{DD}
2	A0	11	D1	20	V ₀	29	V _{S1}
3	WR	12	D0	21	V _R	30	P/S
4	CS	13	V _{DD}	22	V _{OUT}	31	IF
5	D7	14	V _{SS}	23	CAPS2-	32	RES
6	D6	15	V _S	24	CAPS2+	33	N.C.
7	D5	16	V ₄	25	CAPS1-		
8	D4	17	V ₃	26	CAPS1+		
9	D3	18	V ₂	27	V _{SS}		

Note: Please contact to your Epson sales office about the specification of the mass product.

TCM-A0899 (LCD+TCP) TCM-A0919 (COG+FPC)

Photograph shows TCM-A0919



Features

- 12 characters × 3 lines (5 × 8 font characters) ideal for cellular
- LCD + TCP / COG + FPC construction for simple, standard module
- Built-in LCD drive power circuit and oscillator circuit gives low power consumption

Specifications

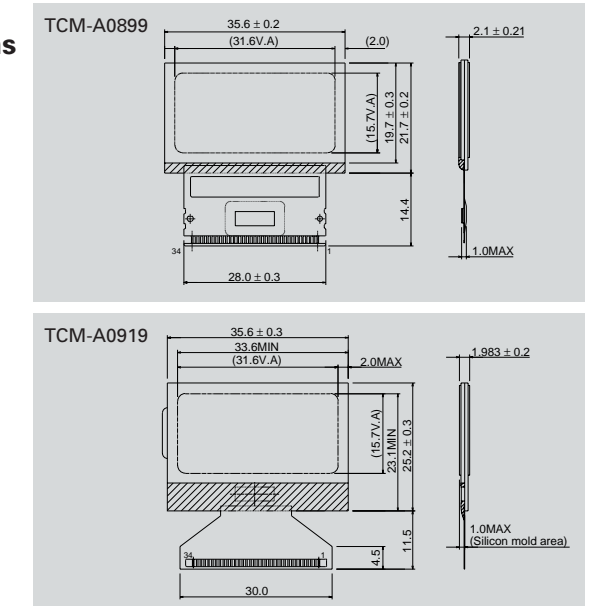
Module construction	LCD + TCP / COG + FPC
Display format	Maximum 12 characters × 3 lines + Icons (*1)
Liquid crystal panel	FTN (STN) transfective, t = 0.55/0.7 mm (*2)
LCD driver	SED1220D _{AB} (SED1220D _{AB}) (*1)
Duty	1/26
Interface	4/8 bit parallel (68/80 series) or serial
Power Supply Voltage	2.4 to 3.6 V
Liquid crystal drive power supply	Voltage booster (doubler, tripler)
Current consumption	80 μA (*3)
Glass External Dimensions	35.6 × 21.7mm
Operating Temperature	-20 to 70°C
Storage Temperature	-30 to 80°C

*1 Other display formats than the above can be selected by the driver used.
SED1221D_{AB} : 12 characters + 2 lines + Icons

*2 The overall thickness can be varied according to the glass used.

*3 Typical value while illuminated, with $V_{DD} = 3.0$ V, voltage tripler, internal power ON.

External Dimensions



Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	10	D2	19	V ₁	28	V _{DD}
2	A0	11	D1	20	V ₀	29	CK
3	WR	12	D0	21	V _R	30	V _{S1}
4	CS	13	V _{DD}	22	V _{OUT}	31	P/S
5	D7	14	V _{SS}	23	CAP2-	32	IF
6	D6	15	V _S	24	CAP2+	33	RES
7	D5	16	V ₄	25	CAP1-	34	N.C.
8	D4	17	V ₃	26	CAP1+		
9	D3	18	V ₂	27	V _{SS}		

Note: Please contact to your Epson sales office about the specification of the mass product.

TCM-A1035



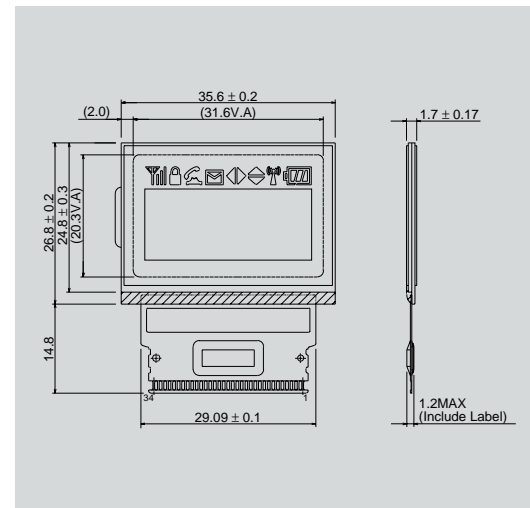
■ Features

- 16 characters × 4 lines + icons (5 × 8 font characters) ideal for cellular and pagers
- This module is constructed with LCD and TCP, and is thus a simple standard module.
- Built-in LCD drive power circuit and oscillator circuit gives low power consumption
- Thanks to its abundant command functions, many different kinds of indications are available. (Vertical double-size letters, whole line scrolling, normal and reversed indications, etc.)

■ Specifications

Module construction	LCD + TCP
Display format	16 characters × 4 lines + Icons
Liquid crystal panel	FTN transfective
LCD driver	SED1240
Duty	1/34
Interface	4bit, 8bit parallel (68/80 series) or serial
Power Supply Voltage	2.4 to 3.6 V (recommended)
Liquid crystal drive power supply	Voltage booster (doubler, tripler)
Current consumption	TBD
Glass External Dimensions	35.6 × 26.8 mm
Operating Temperature	-20 to 70°C
Storage Temperature	-30 to 80°C

■ External Dimensions



■ Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	10	D2	19	V ₁	28	/CK
2	A0	11	D1	20	V ₀	29	V _{S1}
3	/WR	12	D0	21	V _R	30	P/S
4	/CS	13	V _{DD}	22	V _{OUT}	31	IF
5	D7(SI)	14	V _{SS}	23	CAP2-	32	C86
6	D6(SCL)	15	V ₅	24	CAP2+	33	/RES
7	D5	16	V ₄	25	CAP1-	34	N.C.
8	D4	17	V ₃	26	CAP1+		
9	D3	18	V ₂	27	V _{SS2}		

TCM-A1047



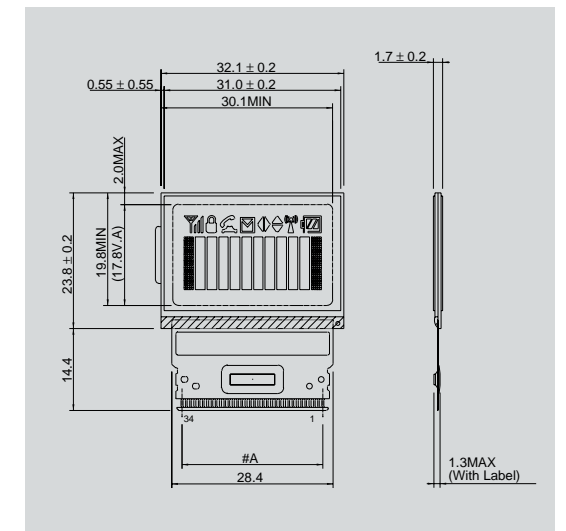
■ Features

- 12 characters × 3 lines + icons (5 × 8 font characters) ideal for cellular
- This module is constructed with LCD and TCP, and is thus a simple standard module.
- Built-in LCD drive power circuit and oscillator circuit gives low power consumption
- Thanks to its abundant command functions, many different kinds of indications are available. (Vertical double-size letters, normal and reversed indications, etc.)

■ Specifications

Module construction	LCD + TCP
Display format	12 characters × 3 lines + Icons
Liquid crystal panel	FTN transfective
LCD driver	SED1225
Duty	1/26
Interface	4bit, 8bit parallel (68/80 series) or serial
Power Supply Voltage	1.7 to 3.6 V
Liquid crystal drive power supply	Voltage booster (trippler)
Current consumption	TBD
Glass External Dimensions	32.1 × 23.8 mm
Operating Temperature	-20 to 70°C
Storage Temperature	-30 to 80°C

■ External Dimensions



■ Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	10	D2	19	V ₃	28	C86
2	A0	11	D1	20	V ₁	29	PS
3	XWR	12	D0	21	V _{REG1}	30	IF
4	XCS	13	XLE1	22	V _{REG2}	31	RES
5	D7(SI)	14	XLE2	23	OCA	32	XCK
6	D6(SCL)	15	V _{DD}	24	OCB	33	V _{S1}
7	D5	16	V _{SS}	25	OCC	34	N.C.
8	D4	17	V ₅	26	OCD		
9	D3	18	V ₄	27	OCE		

Smart phone / PDA / HPC LCD Module

Full dot display type

These LCD modules feat are the industry's lowest power consumption thanks to the power supply circuit developed by us, which is ideal for smart phones, PDAs and HPCs requiring low power consumption. High contrast is also achived thanks to the adoption of a newly developed panel process.

EG8504 series

(Working sample name: TCM-A0813 series)



Features

- Newly developed power supply circuit and low-voltage liquid crystal for low power consumption
- Ideal for products requiring low power consumption such as portable information display devices
- Provision of a standard module contributes to shorter development lead times and lower development cost

Specifications

Display format	320 × 240 pixels
Dot pitch	0.24 × 0.24 mm
Dot size	0.225 × 0.225 mm
Duty	1/240
Interface	4 bit parallel (*1)
Power Supply Voltage	2.75 to 5.25 V
Liquid crystal drive power supply	35 V (max.)
Current consumption	9 mW
External Dimensions	94.0 × 73.6 × 7.1 mm
Operating Temperature	0 to 50°C
Storage Temperature	-20 to 60°C

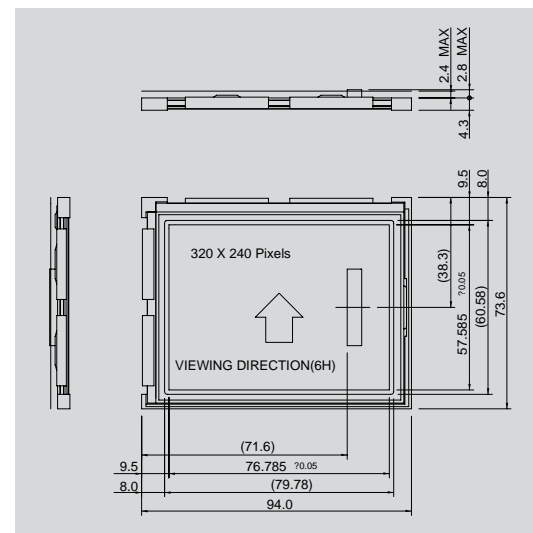
*1: With driver support, 8-bit support possible

Lineup

Mass production name	Working sample name	Display mode	Module construction
EG8504C-AZ	—	FTN Reflective	LCD+TCP+PCB+ Plastic case
EG8504C-FZ-1	—	FTN Transflective	LCD+TCP+PCB+ Plastic case+EL(white)

* An optional setting allows to support the touch panel.

External Dimensions

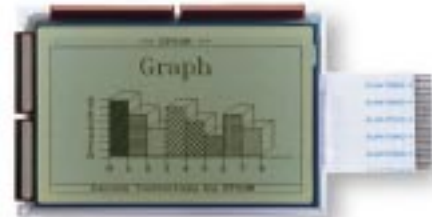


Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	DIN	6	V _{SS}	11	D0	16	D5
2	LP	7	V _{DOH}	12	D1	17	D6
3	XSCL	8	V _{LCD}	13	D2	18	D7
4	N.C.(FR)	9	V _{SS}	14	D3	19	/DISPOFF
5	V _{DD}	10	N.C.	15	D4	20	N.C.

EG7502 series

(Working sample name: TCM-A0822 series)



Winner of the "Commendation from the Chair-man of the Energy Conservation Center"

at 7th "Energy Conservation Vanguard 21" in 1996

Features

- Newly developed power supply circuit for industry leading ultra low power consumption
- Built-in DC/DC converter allows operation from single 3.3 V power supply
- Adoption of new panel process provides high contrast
- Provision of a standard module contributes to shorter development lead times and lower development cost

Specifications

Display format	320 × 200 pixels
Pixel pitch	0.18 × 0.18 mm
Pixel size	0.165 × 0.165 mm
Duty	1/200
Contrast ratio	8:1
Interface	8 bit parallel
Power Supply Voltage	3.3 V single supply voltage
Liquid crystal drive power supply	Built-in DC/DC converter
Power consumption (Typ.)	3 mW
External Dimensions	71.1 × 49.0 × 5.5 mm (*1)
Operating Temperature	0 to 50°C
Storage Temperature	-20 to 70°C

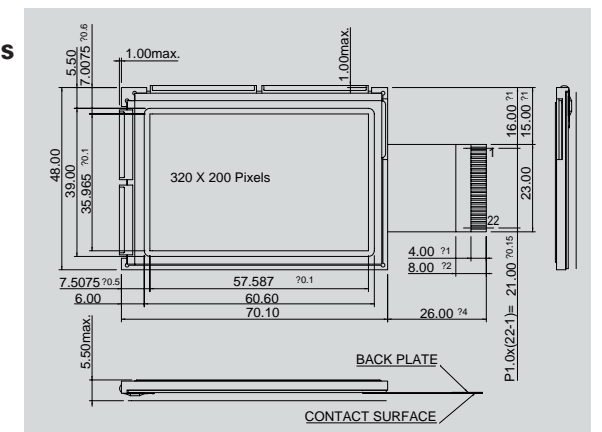
*1: With LED backlight fitted as an option, the height dimension is different.

Lineup

Mass production name	Working sample name	Display mode	Module construction
EG7502x-xx	TCM-A0822-20	FTN Reflective	LCD+TCP+PCB+ Plastic case
EG7502C-RS	—	FTN Transflective	LCD+TCP+PCB+ Plastic case+LED
EG7502x-xx	TCM-A1013-1	FTN Transflective	LCD+TCP+PCB+ Plastic case+EL (BG)

* An optional setting allows to support the touch panel.

External Dimensions



Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	V _{DD}	7	YD	13	XD2	19	V _{SS}
2	V _{SS}	8	LP	14	XD3	20	V _{OL-1}
3	V _{SS}	9	XSCL	15	XD4	21	V _{OL-2}
4	/DOFF1	10	V _{SS}	16	XD5	22	V _{OL-3}
5	/DOFF2	11	XD0	17	XD6		
6	N.C.	12	XD1	18	XD7		

EG7014 series

(Working sample name: TCM-A0824 series)



Winner of the
"Commendation from the Chair-man of
the Energy Conservation Center"
at 7th "Energy Conservation Vanguard 21" in 1996

Features

- Newly developed power supply circuit for industry leading ultra low power consumption
- Built-in DC/DC converter allows operation from single 3.3 V power supply
- Adoption of new panel process provides high contrast
- Provision of a standard module contributes to shorter development lead times and lower development cost

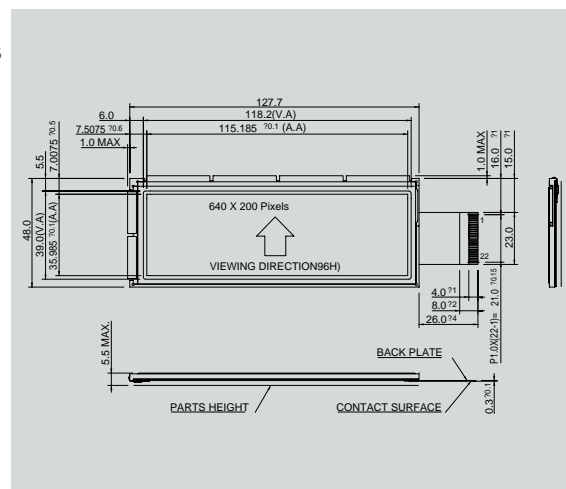
Specifications

Display format	640 × 200 pixels
Pixel pitch	0.18 × 0.18 mm
Pixel size	0.165 × 0.165 mm
Duty	1/200
Contrast ratio	8:1
Interface	8 bit parallel
Power Supply Voltage	3.3 V single supply voltage
Liquid crystal drive power supply	Built-in DC/DC converter
Power consumption (Typ.)	5 mW
External Dimensions	128.7 × 49.0 × 5.5 mm
Operating Temperature	0 to 50°C
Storage Temperature	-20 to 70°C

Lineup

Mass production name	Working sample name	Display mode	Module construction
EG7014C-AS	—	FTN Reflective	LCD+TCP+PCB+ Plastic case

External Dimensions



Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	V _{DD}	7	YD	13	XD2	19	V _{SS}
2	V _{SS}	8	LP	14	XD3	20	V _{OL-1}
3	V _{SS}	9	XSCL	15	XD4	21	V _{OL-2}
4	/DOFF1	10	V _{SS}	16	XD5	22	V _{OL-3}
5	/DOFF2	11	XD0	17	XD6		
6	N.C.	12	XD1	18	XD7		

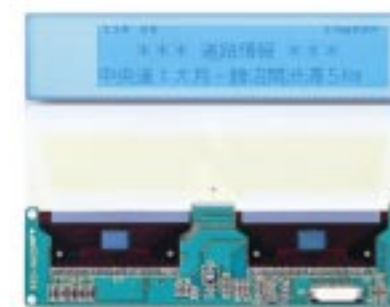
Other standard LCD Module

Full dot display type

This is an LCD module capable of graphic display on a field 248 × 60 pixels (Chinese characters (kanji): 15 characters × 2 lines) (supporting VICS level 1 FM multiplex broadcasting), and particularly suitable for application to text information services. By the use of two TCPs of the SED 1560 series as LCD drivers, low power consumption and low supply voltage, as well as compactness and thickness, have been implemented. Moreover, since a power supply for driving the LCD (tripler) is included, no external drive circuit is required, and the liquid crystal display can be operated using a single 5V power supply.

SEK1049B_{0A} (STN positive) SEK1049B_{1A} (STN negative) SEK1049B_{2A} (STN transreflective)

Photograph shows SEK10490A (CCFT used for backlight)



Features

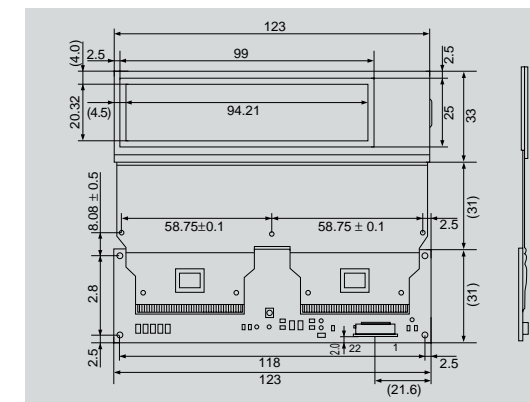
- By using a display screen of 248 × 60 pixels, supporting FM multiplex broadcasting / VICS level 1, 15 characters × 2 lines of Japanese text can be displayed.
- Low current consumption of 700 μA (typical value while illuminated, with V_{DD} = 5.0 V and voltage tripler).
- Use of a standard module contributes to reduced development times and a reduction of development cost.
- This module is constructed with LCD and PCB connected together with TCP and heat seal, specially adapted to minimize device size and weight.

Specifications

Module construction	LCD + heat seal + TCP + PCB
Display format	248 × 60 pixels
Liquid crystal panel	STN (FTN) (transflective, t = 1.1 mm)
LCD driver	SED1560T _{0B} × 2
Interface	8 bit parallel (68/80 series)
Power Supply Voltage	Single 5V input
Liquid crystal drive power supply	Internal (typical V _{OPR} = 13.2 V)
Current consumption	700 μA (*1)
External Dimensions	123 × 96 mm
Operating Temperature	-20 to 70°C
Storage Temperature	-40 to 80°C

*1 Typical value when illuminated, with V_{DD} = 5.0 V and voltage tripler
* This module isn't built in backlight.

External Dimensions



Connector type: 52745-22XX (Molex)

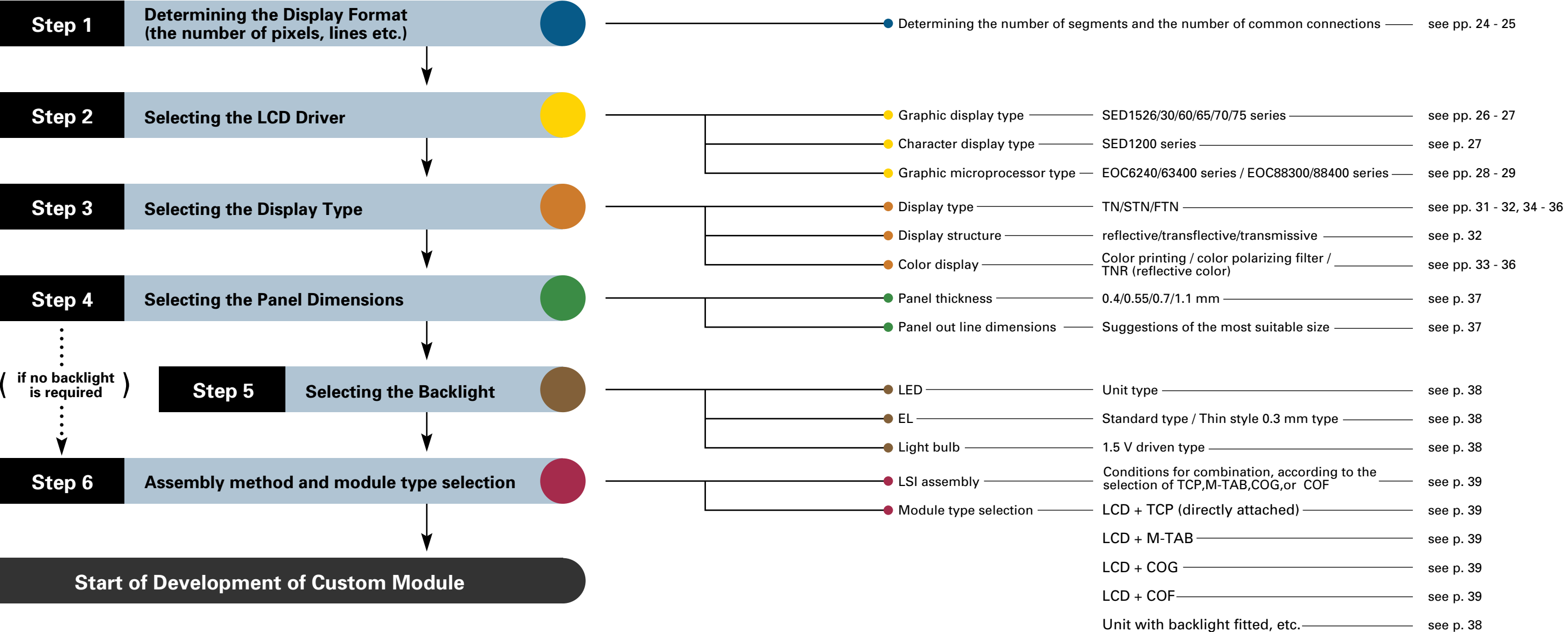
Pin Connections

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	LED+	7	/CSIS	13	D1	19	D7
2	LED-	8	P/S	14	D2	20	V _{DD}
3	/RD	9	SI	15	D3	21	N.C.
4	/WR	10	SCL	16	D4	22	V _{SS}
5	A0	11	/RES	17	D5		
6	/CSIM	12	D0	18	D6		

Custom Module Applications

Custom Module Development Step

In response to widespread customer demand, Seiko-Epson can provide original client custom modules by making available a consistent support structure from the planning stage through the stages of specification proposal, development and design and right up to production. In developing these custom products, the liquid crystal panel and the LCD driver and so on, which are pivotal components, are selected from among the lineup of standard products made by Seiko-Epson. Further, we will also plan the method and the technique for fitting the backlight and the printed circuit board on the basis of abundant experience. For your convenience, we introduce some of the principal components in the following set of outline steps for determination of the specification.



*There are some types of driver and liquid crystal panel which cannot be combined.
 *Please consult us specifically about the detailed module specifications regarding electrical characteristics, interfaces, and the like.
 *The LSIs described in this catalog are only a selection from our complete lineup. For more details, see our catalog of CMOS-LSI products

5 × 7 pixel characters

● LCD driver

Lines	Number of characters		8	10	12	16	20	24
	Common	Segments	40	50	60	80	100	120
1	8			SED1522	SED1526	SED1526		SED1232 SED1220
2	16			SED1526	SED1220 SED1225 SED1232	SED1526 SED1233	SED1526	
3	24				SED1528 SED1231 SED1221	SED1528	SED1530	
4	32				SED1528 SED1230	SED1240 SED1530	SED1530	

● Microcomputer

Lines	Number of characters		8	10	12	16	20	24
	Common	Segments	40	50	60	80	100	120
1	8		EOC6244/4A EOC63404/454	EOC6248/4C	EOC88316 EOC6247 EOC63458			
2	16		EOC88308 EOC6244/4A EOC63404/454	EOC88308/4C EOC6248	EOC88316 EOC6247 EOC63458	EOC88365		
3	24							
4	32			EOC88316				

16 × 16 pixel characters

● LCD driver

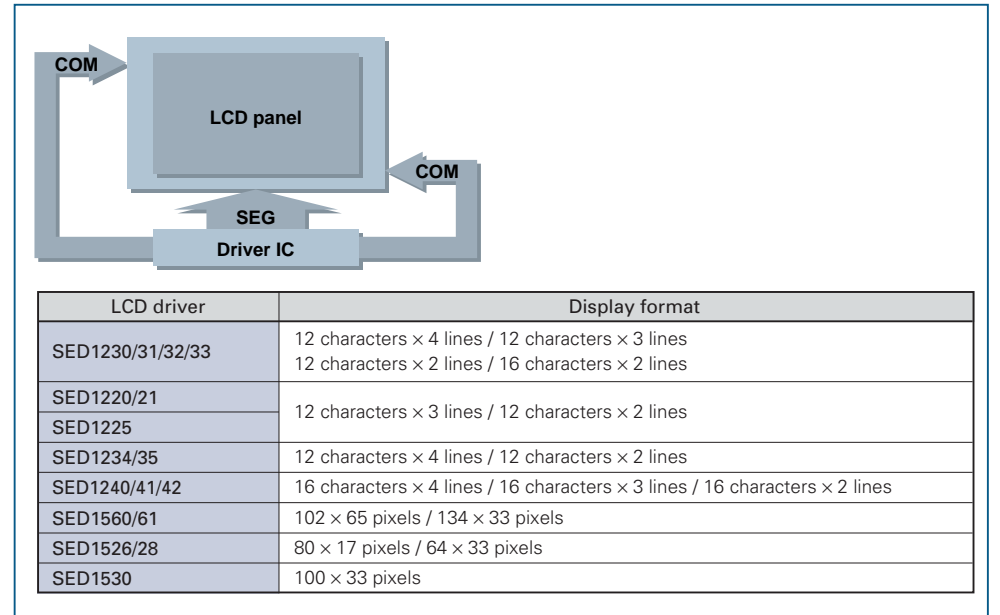
Lines	Number of characters		6	8	10	12	16
	Common	Segments	96	128	160	192	256
1	8			SED1562 SMC88316/308 + SED152A			
2	16		SED1530	SED1561			
3	48		SED1560	SED1531 + SED1635	SED1560 + SED1670		
4	64		SED1560	SED1531 + SED1635	SED1560 + SED1670	SED1532 × 2	SED1560 × 2

● Microcomputer

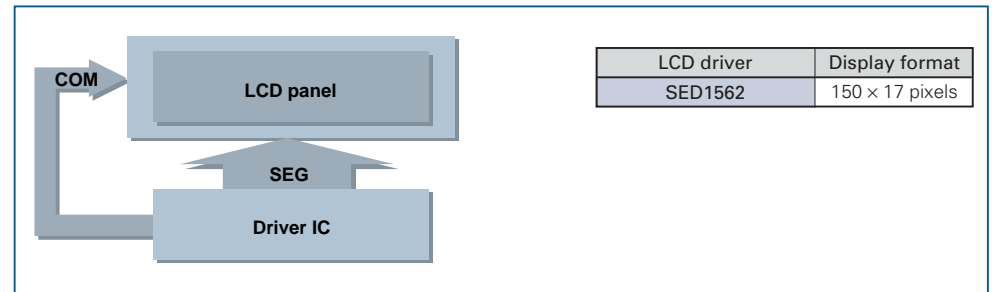
Lines	Number of characters		6	8	10	12	16
	Common	Segments	40	50	60	80	100
1	16		EOC624A + SED1521	EOC88316/308 + SED152A	EOC88365 + SED152A		
2	32		EOC88308 + SED152A	EOC88316 + SED152A			
3	48						
4	64						

Examples of connections between a liquid crystal panel and driver(s)

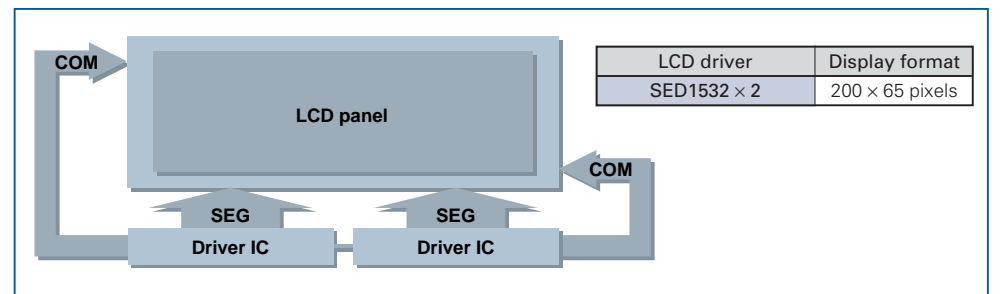
● Connection Example 1



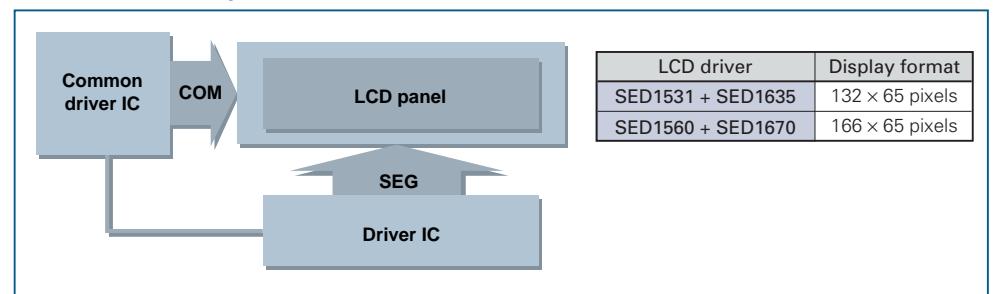
● Connection Example 2



● Connection Example 3



● Connection Example 4



LCD drivers for graphic display

■ Features

- Built in LCD driving power supply (voltage doubler, tripler, quadrupler)
- Extremely low current consumption
- Internal contrast control
- Internal voltage follower / voltage adjustment circuit
- Various different packages available (bare chip / TCP / QTP / QFP)

● SED1526/1530/1560 series

Part number	Supply voltage(V)	LCD drive voltage(V)	Duty	Segment outputs	Common outputs	Display RAM	MPU interface	Frequency (kHz)	Remarks			
SED1526	2.4 to 6.0	3.5 to power supply × 3	1/8,1/9	80	17	80 × 33 bits	8-bit parallel or serial	20	built in liquid crystal power supply circuit (tripler voltage booster)			
SED1528			1/16,1/17	64	33							
SED1530			1/32,1/33	100								
SED1531		4.5 to 16	1/64,1/65	132	—	132 × 65 bits			—	—	built in liquid crystal power supply circuit (quadrupler voltage booster)	
SED1532				100	33							
SED1533				1/17	116							17
SED1534				1/9	124							9
SED1560		6.0 to 16	1/48,1/49 1/64,65	102	65	166 × 65 bits			—	18	built in liquid crystal power supply circuit (tripler voltage booster)	
SED1561				1/24,1/25 1/32,33	134							33
SED1562				1/16,1/17 (1/5 bias)	150							17
SED1565	1.8 to 5.5	4.5 to 16	1/65 (1/7, 1/9 bias)	132	65	132 × 65 bits	—	33	built in liquid crystal power supply circuit (quadrupler voltage booster)			
SED1566					1/49 (1/6, 1/8 bias)					49		
SED1567					1/33 (1/5, 1/6 bias)					33		
SED1569					1/53					53		
SED1570	2.7 to 5.5	8.0 to 20	1/64 to 1/200	80	—	200 × 80 bits	4 bit	—	built in auto refresh function			
SED1575*	2.4 to 6.0	4.5 to 16	1/65	168	65	200 × 65 bits	8-bit parallel or serial	TBD	—	built in liquid crystal power supply circuit (quadrupler voltage booster)		
SED1577*			1/33	200	33							

* Under Development

Common drivers

■ Features

- Combination with SED15 series drivers
- Supplied in bare chip or QFP

● SED1600 series

Part number	Supply voltage (V)	LCD drive voltage (V)	Duty	Common outputs
SED1623	4.5 to 5.5	12 to 28	1/6 to 1/300	86
SED1651	2.7 to 5.5	8 to 28		100
SED1672				68

LCD drivers for character display

■ Features

- Built in LCD driving power supply (voltage booster: doubler • tripler)
- Extremely low current consumption
- Built in contrast control
- Built in voltage follower / voltage adjustment circuit
- Static drive. Standard font
- Supplied in bare chip or TCP

● SED1200 series

Part number	Supply voltage(V)	LCD drive voltage(V)	Duty	Segment outputs	Common outputs	Display RAM	MPU interface	Frequency (kHz)	Remarks
SED1220	2.4 to 3.6	4.0 to 7.0	1/26	64	26	40 characters	4,8 - bit serial	—	Built in liquid crystal drive power supply Three standard font (JIS, ASCII, cellular use)
SED1221			1/18						
SED1222				60					
SED1225					1/18,1/26					26
SED1230	2.4 to 3.6	4.0 to 12.0	1/30	65	23	48 characters	4,8 - bit serial	—	SED1220/21/2A/22/25 SED1230/31/32/33: Static drive
SED1231			1/23						
SED1232			1/16	80	16				
SED1233									
SED1234			1/30	62	30				
SED1235			1/16							16
SED1240	1.8 to 3.6	4.0 to 10.0	1/18,1/34	80	34	80 characters	—	—	Flashing of lines and vertical scroll.

* Under Development

4-bit microcomputer (dot matrix)

Features

- 4-bit MPU
- Internal liquid crystal drive power supply
- Low current consumption
- Low voltage operation
- Internal timer function
- Can be supplied in bare chip or QFP form.

EOC6240 series

Microprocessors provided with ROM, RAM, dot matrix LCD driver, timer, stopwatch function and the like. Many I/O ports are available, and internal clock-synchronized serial ports are provided, while externally fitted memory control is possible.

Part number	Features	Supply voltage(V)	Current consumption		Clock frequency Hz (Typ.)	Memory (bits)		I/O ports (bits)			Instruction set	Interrupts		LCD driver	
			During execution † μA(Typ.)	Halt mode † μA(Typ.)		ROM	RAM	In put	Output	Input/output		External interrupts	Internal interrupts	Segments	Commons
EOC6244	Dot matrix LCD driver	2.2 to 5.5	400	2.5	32.768K 1M	4,096 × 12	384 × 4	8	12	12	108	2	4	40	8.16
		3.5 to 5.5	1.000												
EOC624A	Dot matrix LCD driver	2.2 to 5.5	400	2.5	32.768K 1M	6,144 × 12	640 × 4	8	20	16	108	2	4	40	8.16
		3.5 to 5.5	1.000												
EOC6247	Dot matrix LCD driver (low power consumption)	0.9 to 3.6	80	2.0	32.768K/38.4K/50K 200K	8,192 × 12	1,792 × 4	8	20	20	108	2	4	64	8.16
			300													32.768K/38.4K/50K 1M
EOC6248	Dot matrix LCD driver	2.2 to 5.5	400	2.5	32.768K 1M	8,192 × 12	768 × 4	8	20	16	108	2	4	51	8.16
		3.5 to 5.5	1.000												
EOC624C	Dot matrix LCD driver	2.2 to 5.5	400	2.5	32.768K 1M	5,120 × 12	1,152 × 4	8	20	16	108	2	4	51	8.16
		3.5 to 5.5	1.000												

† : For devices with a twin clock specification, the value during high speed clock operation is shown.

EOC63400 series

This micro computer equips with ROM, RAM, dot matrix LCD driver and a wide variety of timer functions. Wide operating voltage range and low power consumption make it most suitable for the portable equipment that requires dot matrix display such as data banks.

Part number	Features	Supply voltage(V)	Current consumption		Clock frequency Hz (Typ.)	Memory (bits)		I/O ports (bits)			Instruction set	Interrupts		LCD driver	
			During execution † μA(Typ.)	Halt mode † μA(Typ.)		ROM	RAM	In put	Output	In put/Output		External interrupts	Internal interrupts	Segments	Commons
EOC63404	Dot matrix LCD driver	1.8 to 6.4	10	0.8	32.768K/60K	4,096 × 13	2,688 × 4	8	12	12	411	2	4	40	8,16,17
		2.2 to 6.4	290	—	32.768K/60K 1M										
EOC63454	Dot matrix LCD driver	1.8 to 6.4	10.0	1.0	32.768K/60K	4,096 × 13	1,024 × 4	4	4	8	411	1	4	40	8,16,17
		2.2 to 6.4	1000	—	32.768K/60K 1.8M/4M										
EOC63458	Dot matrix LCD driver	1.8 to 6.4	10.0	1.0	32.768K/60K	8,192 × 13	5,120 × 4	8	12	12	411	2	4	60	8,16,17
		2.2 to 6.4	1000	—	32.768K/60K 1.8M/4M										
EOC63466*	Dot matrix LCD driver	1.8 to 6.4	10.0	1.0	32.768K/60K	16,384 × 13	1,792 × 4	8	12	12	411	2	4	60	8,16,17
		2.2 to 6.4	1000	—	32.768K/60K 1.8M/4M										
EOC63474*	Dot matrix LCD driver	2.2 to 6.0	TBD	TBD	32.768K/60K 1.8M/4M	24K × 13	2K × 4	8	12	12	411	2	4	66	8,16,17
														51	32

* : Under development † : For devices with a twin clock specification, the value during high speed clock operation is shown.

8-bit microcomputer (dot matrix)

Features

- 8-bit MPU
- Internal LCD drive power supply
- Low current consumption
- Low voltage and high speed operation
- Internal timer function
- Can be supplied in bare chip or QFP form.

EOC88300 series

Processors provided with ROM, RAM, dot matrix LCD driver, serial I/O, timer, analog comparator, and so forth. The bus is brought to the outside, so that ROM, RAM, and peripherals can easily be connected, and therefore expandability is excellent.

Part number	Features	Supply voltage(V)	Current consumption		Clock frequency Hz (Typ.)	Memory (bits)		I/O ports (bits)			Instruction set	Interrupts		LCD driver	
			During execution † μA(Typ.)	Halt mode † μA(Typ.)		ROM	RAM	In put	Output	Input/output		External interrupts	Internal interrupts	Segments	Commons
EOC88308	Dot matrix LCD driver serial interface	1.8 to 5.5	1.9	2.0	32.768K 4.2M#	8K × 8	256 × 8	9	5	8	608	2	4	57	16
EOC88316	Dot matrix LCD driver serial interface	1.8 to 5.5	1.9	2.0	32.768K 4.2M#	16K × 8	2K × 8	10	9	8	608	2	4	41	32
														67	16
EOC88348*	Dot matrix LCD driver serial interface	1.8 to 5.5	1.9	2.0	32.768K 4.2M#	48K × 8	2K × 8	10	9	8	608	2	4	51	32
														67	16
EOC88365	Dot matrix LCD driver serial interface	2.2 to 5.5	1.5	10.0	153.6K 2.5M	64K × 8	3K × 8	10	17	8	608	2	4	80	18

* : Under development † : For devices with a twin clock specification, the value during high speed clock operation is shown.
: This is the value when the power supply voltage is 2.4 V. When the power supply voltage is 3.5 V, the value is 8.2 MHz (Max).

EOC88400 series

This micro computer equips with ROM, RAM, LCD controller, serial I/O and timers. Outgoing pulses allow easier connection of ROM, RAM and peripherals, thus providing it better expansion capability. The built-in LCD controller makes this micro computer best suited for mid capacity systems.

Part number	Features	Supply voltage(V)	Current consumption		Clock frequency Hz (Typ.)	Memory (bits)		I/O ports (bits)			Instruction set	Interrupts		A/D converter	D/A converter
			During execution † μA(Typ.)	Halt mode † μA(Typ.)		ROM	RAM	In put	Output	In put/Output		External interrupts	Internal interrupts		
EOC88408*	LCD controller Built in VRAM	1.8 to 5.5	TBD	TBD	32.768K 4.2M#	8K × 8	3.75K × 8	12	3	26	608	2	4	—	—
EOC88409*	LCD controller Built in VRAM A/D, D/A converter Touch panel controller	1.8 to 5.5	TBD	TBD	32.768K 4.2M#	8K × 8	3.75K × 8	12	3	26	608	2	4	10bit 8inch	8bit 2inch

† : For devices with a twin clock specification, the value during high speed clock operation is shown.
: This is the value when the power supply voltage is 2.6 V. When the power supply voltage is 1.8 V, the value is 6.6 MHz (Max).

Power Supply ICs

● DC/DC Converters

Part number	Features	Package
SC17660C0A	<ul style="list-style-type: none"> Power supply voltage conversion IC Two types of voltage conversion are easily available: in the input voltage positive potential direction or in the negative potential direction (reverse polarity - multiplication factor 1; same polarity - multiplication factor doubler) 	DIP-8pin
SC17660M0A	<ul style="list-style-type: none"> Efficiency of electrical power conversion: standard 95% 	SOP4-8pin

● DC/DC Converters and Voltage Regulators

Part number	Features	Package
SC17661C0A	<ul style="list-style-type: none"> Power supply voltage conversion IC Four types of voltage conversion are easily available: in the input voltage positive potential direction or in the negative potential direction (reverse polarity - multiplication factor 1 or 2; same polarity - multiplication factor 2 or 3) 	DIP-14pin
SC17661M0A	<ul style="list-style-type: none"> Efficiency of electrical power conversion: standard 95% Internal voltage stabilization circuit 	SOP4-14pin
SC17661M0A	<ul style="list-style-type: none"> LCD power source temperature gradient selection possible 	SSOP2-16pin
SC17654C0A	<ul style="list-style-type: none"> Power supply voltage conversion IC Generates output voltage in the negative direction multiplied by 4, 3 or 2 Efficiency of electrical power conversion: maximum 95% 	DIP-16pin
SC17654M0A	<ul style="list-style-type: none"> Internal voltage stabilization circuit LCD power source temperature gradient selection possible 	SSOP-2-16pin

● Semicustom Power Supply Arrays

Part number	Features	Package
SC17600M series	<ul style="list-style-type: none"> Development time is short and development cost is low DC/DC converter (voltage booster: doubler • tripler) 1 circuit Positive output power 4 circuits Operational amplifier, level shifter, crystal oscillator, resistance array included Low current consumption 	SOP2-24pin/ SOP2-28pin/ QFP12-48pin

For the conditions for receiving custom orders, please consult the technical manual (MF301) for the SC 17000 series.

● System Power Supplies

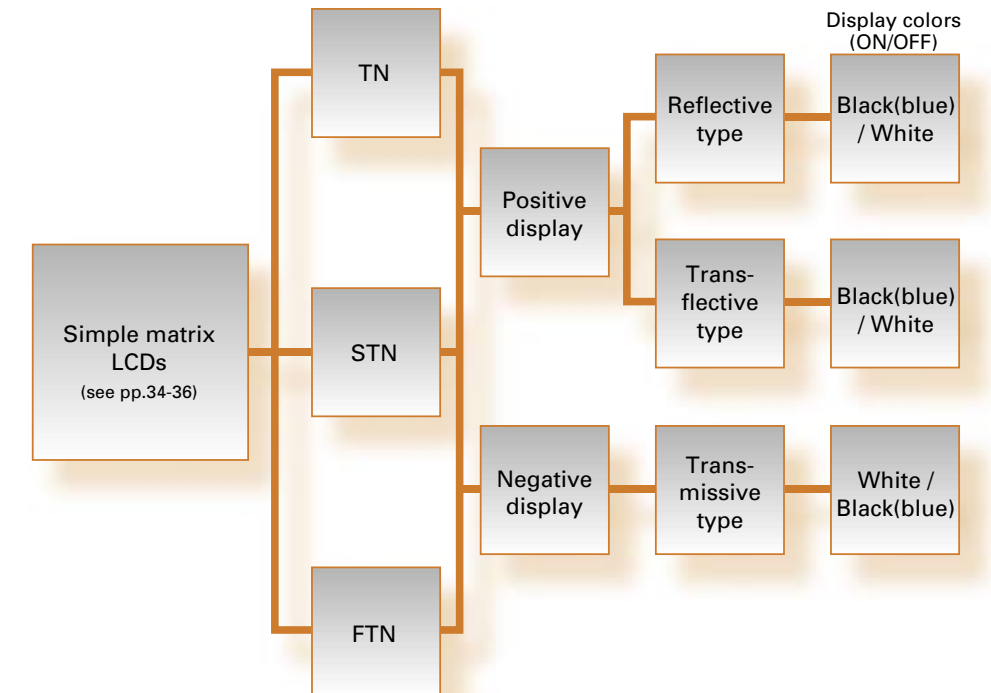
Part number	Features	Package
SC17680M series	<ul style="list-style-type: none"> Development time is short and development cost is low DC/DC converter (voltage multiplication factor 2) 1 circuit Positive output power regulator 3 circuits Voltage detector 1 circuit Switching regulator 1 circuit Low current consumption 	SSOP1-20pin SOP2-24pin

Step 3

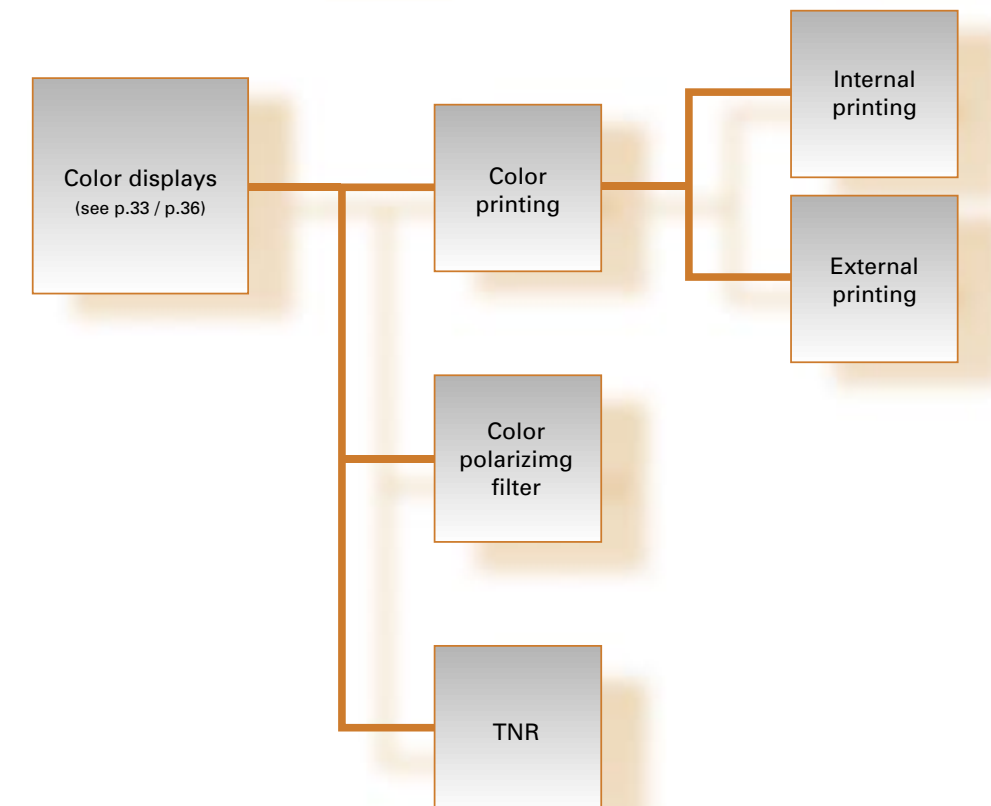
Selecting the Display Type

With liquid crystal displays, the display colors, the duty ratio upper limit, and the price differ according to the display mode. Further, the reflective, transreflective, and transmissive types have individually varying features such as brightness and contrast and the like. You are therefore recommended to select the display mode in accordance with your desired application, and in view of these various characteristics.

Classification of display modes



Classification of Color display types



Display mode features

The following LCD display mode are available.

Display mode	Color (on/off)	Duty	Remarks
TN	Black / White	1/16 Max.	Intended for low duty.
STN	Purple / White	1/350 Max.	Intended high duty. Black and white display not possible.
FTN	Black / White	1/350 Max.	STN monochrome display product.

Corresponding display formats (standard)

TN : 7 segment display - character display (up to 1/16 duty)

STN : character display (1/16 duty) up to graphic display

FTN : character display (1/16 duty) up to graphic display

Display Type

The type of the display is determined according to whether positive mode or negative mode is used, and according to whether or not a backlight is provided.

	Display type	Positive/Negative	Color of non-illuminated portions	Backlight required	Features
	Reflective	Positive	White	Not required	Backlight not required. However, cannot be seen in dark locations.
	Transflective	Positive	White	Required (illuminated when necessary)	In bright locations, is used with the backlight turned off.
Recommended	Transmissive	Negative	Black	Required (always illuminated)	Is always used with the backlight turned on.

* In the case of FTN

* In communication devices the transflective type is most suitable, because low power consumption is required, and this type can be used in dark locations, while the backlight can be turned off in bright locations.

Color display types

There are various types of color display.
The proper one should be selected in accordance with the desired application.

Color printing type

[Principle] Color filters are printed at each position on the panel

[Features] Lightweight, comparatively cheap, commonly used

	Colors printed on inner surface	Colors printed on outer surface
Construction	Color filters are situated inside the liquid crystal cells	Colors are printed on the outer surface of the glass
Number of colors selectable	Few - Mixtures of R, G, B	Many - any color from the DIC color specification can be printed
Number of colors	Display colors fixed. Partial color display possible.	Display colors fixed. Partial color display possible.
Number of colors which can be displayed simultaneously	1 color, 2 colors (3 colors)	1 color, 2 colors (3 colors)
Supported display mode	TN	Yes
	STN	No
	FTN	No
Printing accuracy	± 0.05 mm	± 0.5 mm

Color polarization type

[Principle] A color polarizing filter is used

[Features] Number of colors fixed. Pale color display

	Color polarizing filter	
Construction	Color display is performed by applying color to the polarizing filter	
Number of colors selectable	Few - Blue or Red	
Number of colors	Display colors fixed. All-over color.	
Number of colors which can be displayed simultaneously	Only one color	
Supported display mode	TN	Yes
	STN	No
	FTN	No
Printing accuracy	—	

Birefringent type

[Principle] Color display without color filters and color polarizer is made possible by utilizing birefringence.

[Features] Bright color display

	TNR	
Construction	A phase difference film is tensioned within the TN panels	
Number of colors selectable	Only 2 colors on and off	
Number of colors	Display colors fixed.	
Number of colors which can be displayed simultaneously	1 colors, 2 colors (3 colors)	
Supported display mode	TN	Yes
	STN	No
	FTN	No
Printing accuracy	—	

Characteristics of the Display Modes

● TN

Operational temperature range: -10 °C to 60 °C (pager specification)

Item	Characteristics	Units	Remarks
Display type	TN transfective	—	
Duty	1/4	—	
Bias	1/3	—	
Operating temperature	-10 to 60	°C	
Storage temperature	-20 to 70	°C	
Contrast ratio	5.0 (Typ.)	—	
Drive voltage (Vop)	3.0 (Typ.)	V	$(V_{th1}+V_{th2}) / 2, T_a=25^{\circ}\text{C}$
Response time (tr+tf)	110 (Typ.)	msec	$T_a=25^{\circ}\text{C}$

Operational temperature range: -20 °C to 70 °C (cellular specification)

Item	Characteristics	Units	Remarks
Display type	TN transfective	—	
Duty	1/4	—	
Bias	1/3	—	
Operating temperature	-20 to 70	°C	
Storage temperature	-30 to 80	°C	
Contrast ratio	4.0 (Typ.)	—	
Drive voltage (Vop)	3.3 (Typ.)	V	$(V_{th1}+V_{th2}) / 2, T_a=25^{\circ}\text{C}$
Response time (tr+tf)	130 (Typ.)	msec	$T_a=25^{\circ}\text{C}$

* This is a representative specification for a seven-segment display. For the specifications when the duty, the bias, and so on are different, please enquire specially.

● STN

Operational temperature range: -20 °C to 70 °C (pager and cellular common specification)

Item	Characteristics	Units
Display type	FTN transfective	—
Duty	1/16	—
Bias	1/4	—
Operating temperature	-20 to 70	°C
Storage temperature	-30 to 80	°C
Contrast ratio	6.5	—
Drive voltage (Vop)	-20°C	4.55 V
	+25°C	4.59 V
	+70°C	4.40 V
Response time (tr+tf)	-20°C	5800 msec
	+25°C	300 msec

* This is a representative specification when displaying two lines of characters. For the specifications when the duty, the bias, and so on are different, please enquire specially.

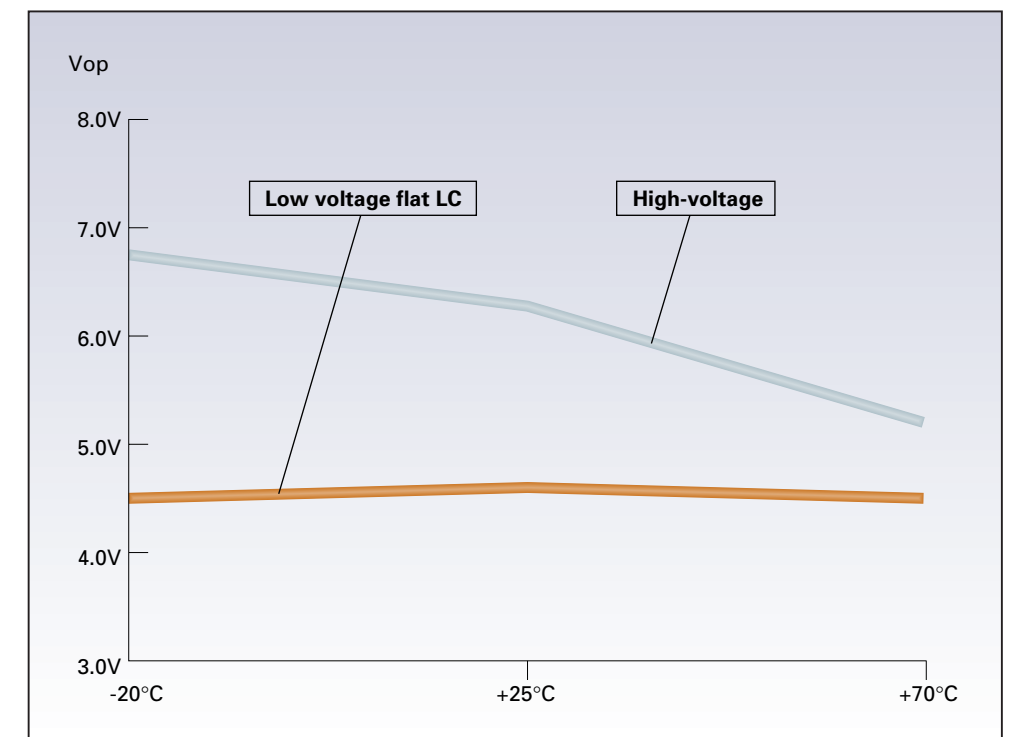
● [FTN (low voltage flat LC)]

Operational temperature range: -20 °C to 70 °C (pager and cellular common specification)

- Low voltage flat LC
- Adjustment of drive voltage upon temperature change not required
- Operation is possible over a wide temperature range (-20 °C to 70 °C)

Item	Characteristics	Units
Display type	FTN transfective	—
Duty	1/16	—
Bias	1/4	—
Operating temperature	-20 to 70	°C
Storage temperature	-30 to 80	°C
Contrast ratio	6.5	—
Drive voltage (Vop)	-20°C	4.55 V
	+25°C	4.59 V
	+70°C	4.40 V
Response time (tr+tf)	-20°C	5800 msec
	+25°C	300 msec

Temperature - Vop characteristics



* This is a representative specification when displaying two lines of characters. For the specifications when the duty, the bias, and so on are different, please enquire specially.

● **TNR**

By attaching a phase difference panel to a normal TN panel, color display is made possible without using any color filter. By doing this, a bright color display is possible even in the reflective mode.

Display colors	two-value color display, on/off
Electrical characteristics	same as for TN LCDs
Suitable duty	up to 1/8

The on and off combination of the display colors can be chosen from the following six.

Type 1	Background color	Color when on	
	Red	Green	
Type 2	Background color	Color when on	
	Blue	Yellow	
Type 3	Background color	Color when on	
	Blue	Orange	
Type 4	Background color	Color when on	
	Green	Red	
Type 5	Background color	Color when on	
	Yellow	Blue	
Type 6	Background color	Color when on	
	Orange	Blue	

Step 4

Selecting the Panel Dimensions

Panel Thickness

The overall thickness of the LCD panel is determined by the thickness of the glass used and by the display type.

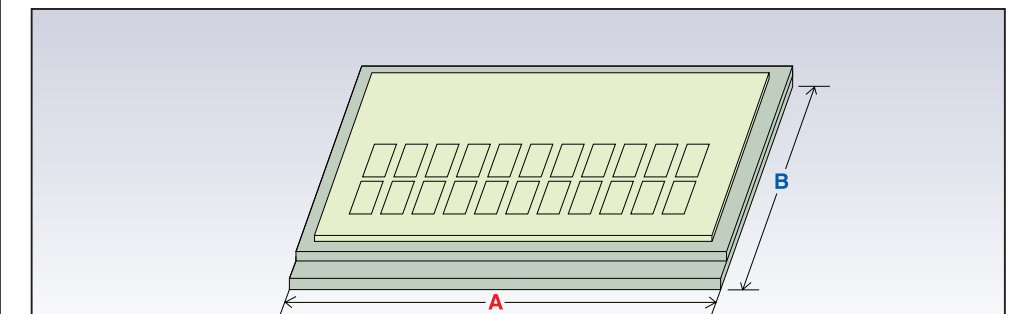
	Glass thickness	LCD panel overall thickness
	0.4mm	1.4mm ± 0.15mm
	0.55mm	1.7mm ± 0.20mm
Recommended	0.7mm	2.0mm ± 0.20mm
	1.1mm	2.8mm ± 0.30mm

* The thickness for FTN

Recommended panel out line dimensions

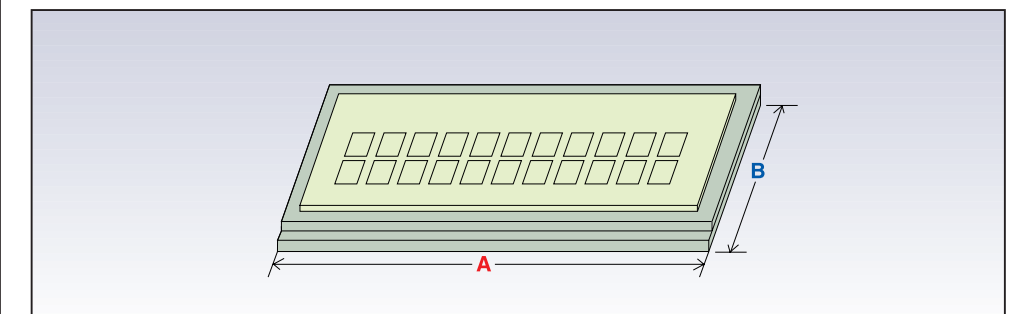
The prices of LCD panels vary according to the number obtained from a matrix glass sheet. The following panel sizes are recommended to obtain maximum screen size while holding costs up.

● **Cellular applications**



TCP directly attached construction (unit :mm)				Heat seal construction (unit :mm)			
A		B		A		B	
45.8	×	30.3		45.8	×	30.6	
40.1	×	30.3		40.1	×	27.1	
40.1	×	26.8		40.1	×	27.1	
35.6	×	21.7		35.6	×	24.1	

● **Pager applications**






TCP directly attached construction (unit :mm)				Heat seal construction (unit :mm)			
A		B		A		B	
64.1	×	26.8		64.1	×	27.1	
64.1	×	23.8		64.1	×	24.1	
53.4	×	21.7		53.4	×	21.9	
45.8	×	19.7		45.8	×	19.9	

Step 5

Selecting the Backlight

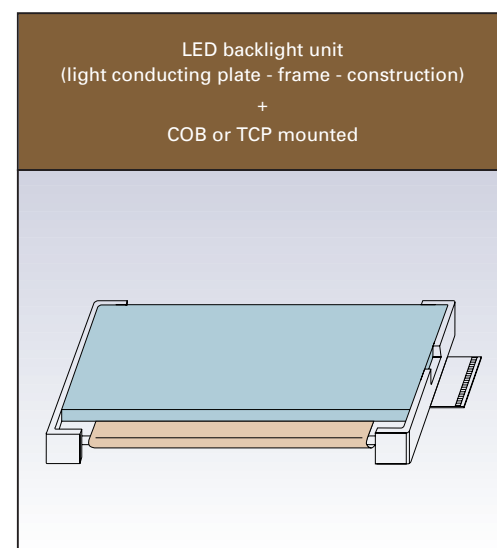
Selecting the Backlight

A backlight is required for transmissive or transmissive type. Broadly, there are three types of backlight - LED, EL, and light bulb - and each has the particular features described below. Select the proper type for your application.

	Recommended		
Type	LED	EL	Light Bulb
Format			
Features	Inverter not required Long life	Thin	Can be driven with 1.5 V Bulb is fitted to the main PCB
Lifetime	20,000H to 100,000 H	1,000 H to 5,000 H	200 H to 500 H
Drive voltage	2V DC	Minimum 30V AC	1.5V DC
Light conduction plate required	Required (thickness 0.8 to 2mm)	Not required (however, in the case of an LCD module, a separate constructional element is required)	Required (thickness 1 to 2mm)
Inverter required	Not required	Required	Not required

* We recommend the LED type of backlight, because it does not require any inverter and has a long lifetime. The EL backlight type is indicated when high thinness is required, while the light bulb type should be used when it is desired to use a drive power source of 2 V or less.

Example of construction when assembling the backlight

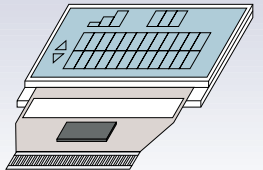
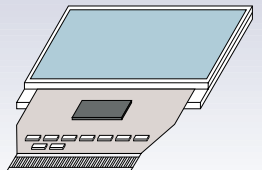


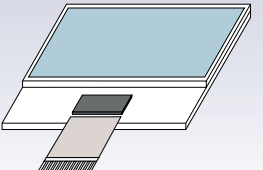
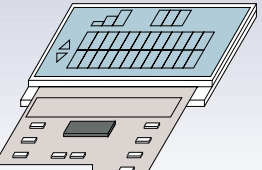
Step 6

Assembly Method and Module Type Selection

For connection to the panel terminal portion, either a TAB or a heat seal can be used, and as a method for assembling the controller driver, either a TAB or a COB can be used; and by combining one or the other of these the various types of assembly shown below can be selected. Select the proper type for your application.

Module type selection

	Recommended	
Method	TCP directly	M-TAB
Configuration		
Features	<ul style="list-style-type: none"> Simple Connector can be directly inserted (custom TCP) 	<ul style="list-style-type: none"> Possible to save space.

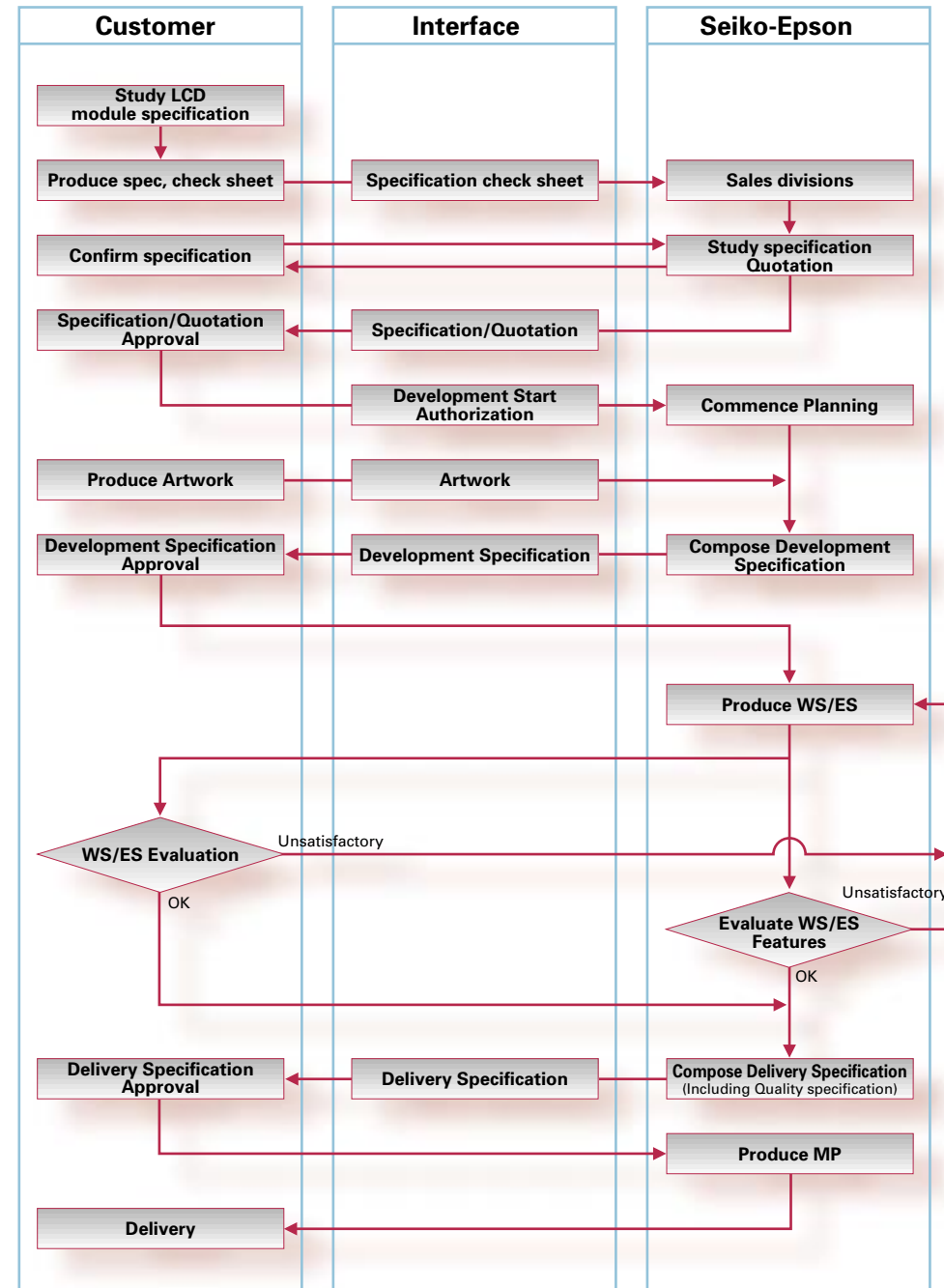
Method	COG	COF (Chip on FPC)
Configuration		
Features	<ul style="list-style-type: none"> Thinner than TCP module. 	<ul style="list-style-type: none"> Possible to mount chip components on the TCP

Combination Conditions

LSI	Package format					LCD type	
	TCP	COG	M-TAB	COF	QFP	TN/TNR	STN/FTN
Microprocessor	No	No	No	No	Yes	Yes	
LCD driver	Yes	Yes	Yes	Yes	Yes	Yes	
DC/DC converter	No	No	—	—	Yes	Yes	

* The assembly conditions differ according to the type of device, so please check carefully.

Flow Chart



Definition of Product

The names and definitions of prototype and mass production products are as follows.

Name	Definition
WS (TS)	Working sample (Test sample). Functional evaluation use only
ES	Engineering sample. Same as mass production products. Uses mass production tooling. Long-term reliability is not assured.
MP	Mass production products

GLOSSARY

Term	Explanation
COB (Chip On Board)	An IC chip is mounted onto a printed circuit board by wire bonding.
COF (Chip On FPC)	Chip parts are mounted on a TCP.
EL (Electro Luminescence)	Light generated by an electric field. An EL layer is formed on a high molecular weight film and is used as an EL light source for a liquid crystal display.
FTN (Formulated STN)	An optically compensated film is added to a STN, and is used as a monochrome display.
LED (Light Emitting Diode)	A diode which emits light.
PCB (Print Circuit Board)	A printed circuit board.
QFP (Quad Flat Package)	A package formed with leads on surfaces oriented in four directions.
QTP (Quad Tape carrier Package)	Four directional type TCP.
SMT (Surface Mount Technology)	Mounting on the surface.
STN (Super Twisted Nematic)	A nematic liquid crystal with a twist of roughly 180 degrees to 270 degrees, and the type of display that uses it.
TCP (Tape Carrier Package)	A flexible board printed with a circuit pattern, with IC chips mounted on it.
tf (Fall time)	Response time: falling edge time.
TN (Twisted Nematic)	A nematic liquid crystal with a twist of roughly 90 degrees, and the type of display that uses it.
TNR (TN with Retardation film)	A type of color display which does not use a color filter, made by attaching a phase difference plate to a normal TN panel.
tr (Rise time)	Response time: rising edge time.
V _{op} (Operating Voltage)	LCD drive voltage / liquid crystal drive voltage
V _{th} (Threshold Voltage)	A threshold voltage.

● Custom module specification check sheet

[Specification]	Appended document	External drawing Y/N	List of parts Y/N	Circuit diagram Y/N	Other documents
Panel external dimensions	(	×	×	t)	
View area	(×)		
Active area	(×)		
Number of pixels	(×)		
Pixel pitch	(×)		
Equipment	<input type="checkbox"/> Reflective	<input type="checkbox"/> Transflective	<input type="checkbox"/> Transparent		
Display type	<input type="checkbox"/> TN	<input type="checkbox"/> STN	<input type="checkbox"/> FTN	<input type="checkbox"/> Positive	<input type="checkbox"/> Negative <input type="checkbox"/> Glare <input type="checkbox"/> Anti-glare
Display construction	<input type="checkbox"/> 5 × 7 dot (cursor/icon)	<input type="checkbox"/> Full dot	<input type="checkbox"/> Other		
Pixel size	(×)		
Viewing angle	<input type="checkbox"/> 6 o'clock	<input type="checkbox"/> 12 o'clock	<input type="checkbox"/> Other (	: Duty	(1/) Duty
Drive voltage	(	±	)V		
Speed requirement	<input type="checkbox"/> Yes (	ms)	<input type="checkbox"/> No		
Module dimensions	(	×	×	) If a drawing showing the external view exists, please attach it.	
Mounting style	<input type="checkbox"/> TAB	<input type="checkbox"/> COB	<input type="checkbox"/> SMT	<input type="checkbox"/> Other ()
Backlight	<input type="checkbox"/> Yes [<input type="checkbox"/> EL, fixed color :	<input type="checkbox"/> LED, fixed color :	<input type="checkbox"/> CCFT(Side/Directly under) :	<input type="checkbox"/> None	
Inverter	<input type="checkbox"/> Required ()	<input type="checkbox"/> Not required		
Temperature conditions	Operating temperature conditions TOP	:	-	°C to	°C
	Storage temperature conditions TOP	:	-	°C to	°C
Driver specification	<input type="checkbox"/> Any	<input type="checkbox"/> Please specify : ()		
Module power supply voltage	(	±	)V		
LCD power supply	<input type="checkbox"/> Internal (	power multiplication factor)	<input type="checkbox"/> External supply		
Interface designation and connector	<input type="checkbox"/> Yes ()	<input type="checkbox"/> No		
Contrast adjustment control	<input type="checkbox"/> Required	<input type="checkbox"/> Not required			
LCD temperature compensation	<input type="checkbox"/> Required	<input type="checkbox"/> Not required			
Power consumption	(	) mW			

• Special specifications (Parts construction, block diagram, etc.)

• Points for attention when studying the specification

• Requirements for conformity to legal and public standards	<input type="checkbox"/> Yes ()	<input type="checkbox"/> No
[Expected price]	[Scheduled quantity conditions]		
• Target price : @	Prototype production (WS) :	year	month PCS
• Development fee : (including tooling fee)	Test production (ES) :	year	month PCS
	Mass production :	year	month K/M
	Yearly lot :	K/year ×	number of years continued
[Application]			

LCD module for Mobile Communication Product Catalog

1998/1999

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<http://www.epson.co.jp>