EPSON

SED1240 Series

LCD Controller Driver

Preliminary

■ DESCRIPTION

The dot-matrix LCD controller driver SED1240 series is designed to display characters and capable of displaying up to 64 characters, 6 user-defined characters and 160 symbols using 4- or 8-bit or serial data sent from the microcomputer.

The built-in character generator ROM is equipped with up to 544 types of character fonts, which consist of 5 × 8 dots respectively, enabling the maximum consecutive calls of 256 types by switching register options. This enables various character fonts to be applied to each purpose or country, etc., further widening the use of this IC. The user-defined character RAM for 6 characters of 5 × 8 dots is also built in, enabling display of high degree of freedom through the symbol register.

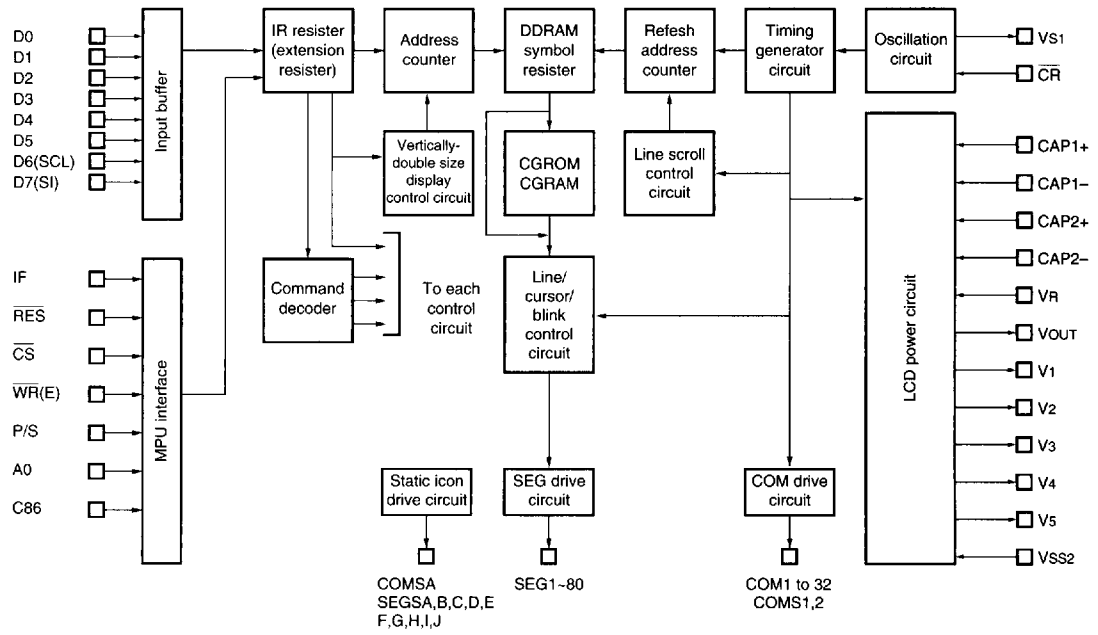
Thanks to its ultra-low power consumption, sleep and standby modes, it can operate handy equipment with the minimum power demand.

■ FEATURES

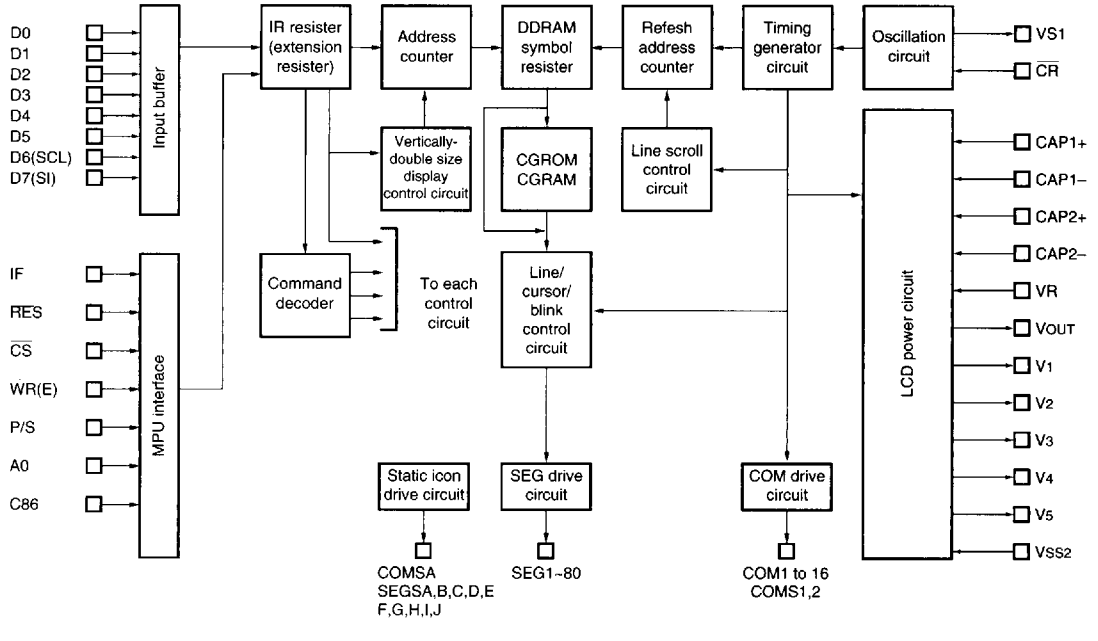
- Built-in display data RAM: 80 characters + 6 user-defined characters + 160 symbols
- CGROM (up to 544 characters), CGRAM (6 characters) and symbol register (160 symbols)
- Number of displaying digits and lines
  <Normal mode>
  1) (16 digits) × 4 lines + 160 symbols + 10 static icons (SED1240)
  2) (16 digits) × 2 lines + 160 symbols + 10 static icons (SED1241)
  <Standby mode>
  1) 10 static icons (SED1240)
  2) 10 static icons (SED1241)
- Vertically-double size displaying function
- Line vertical scrolling function
- Line blinking function
- Symbol blinking function
- On-chip CR oscillation circuit (C and R on chip)
- External clock input available
- High-speed MPU interface
  Compatible with both 68- and 80-series MPUs
  4- and 8-bit interface available
- Serial interface available
- Character font: 5 × 8 dots
- Duty ratio: 1) 1/34 (SED1240)
  2) 1/18 (SED1241)
- Simple command setting
- Built-in liquid crystal drive power circuit
  Power boosting and voltage regulating circuits, voltage followers (× 4), bias switching command available, built-in resistance for power regulating circuit
- Built-in electronic volume function
- Low power demand:
  80 μA max. (during normal operation (display): Including the internal power supply operating current)
  500 μA max. (during normal operation (access): fcyc = 200kHz, including the internal power supply operating current)
  20 μA max. (in standby mode: Oscillation = On, power = Off, static icon display)
  5 μA max. (in sleep mode: Oscillation = Off, power = Off, display = Off)
- Power
  V_{DD} – V_{SS}: –2.4 V to –3.6 V
  V_{DD} – V_5: –5.0 V to –11.0 V
- Wide operating temperature range: Ta = –30 to 85°C
- CMOS process
- Pad pitch: 90 μm (min.)
- Package to be shipped
  Chip (gold bump model): SED124*D**
  TCP: SED124*T**
- This IC is not designed to resist radiation or intense light noise.

■ BLOCK DIAGRAM

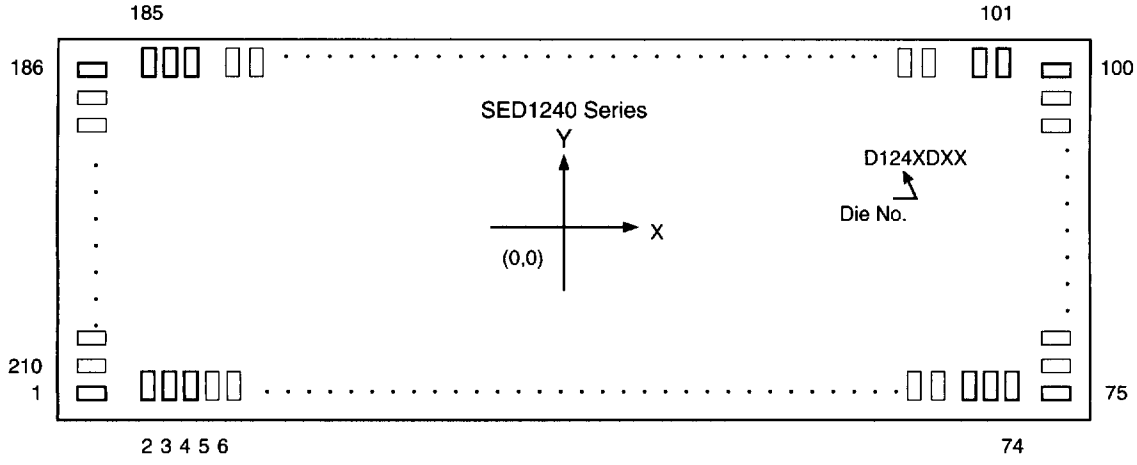
[SED1240*]**



[SED1241*]**



■ PAD LAYOUT

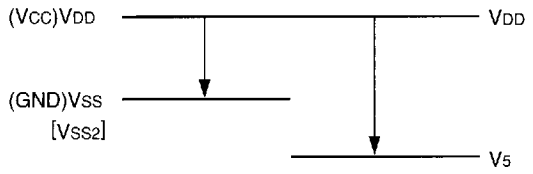


SED124****
CGROM pattern change corresponding digit

Chip size:	8.70 mm × 2.80 mm
Pad pitch:	90 μm (min.)
Chip thickness (reference):	625 ± 50 μm (SED124*D**)
Au bump specifications	
Bump size:	60.0 μm × 81.5 μm (A type)
	81.5 μm × 60.0 μm (B type)
	85.0 μm × 85.0 μm (C type)
	60.0 μm × 85.0 μm (D type)
Bump height (reference):	22.5 μm ± 5.5 μm
(refer to the pad coordinate diagram for the bump types)	

■ ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit
Supply voltage (1)		V_{SS}	−7.0 to +0.3	V
Supply voltage (2)	Double boosting Triple boosting	V_{SS2}	−7.0 to +0.3 −7.0 to +0.3 −6.0 to +0.3	V
Supply voltage (2)		V_5, V_{OUT}	−18.0 to +0.3	V
Supply voltage (3)		V_1, V_2, V_3, V_4	V_5 to +0.3	V
Input voltage		V_{IN}	V_{SS} −0.3 to +0.3	V
Output voltage		V_O	V_{SS} −0.3 to +0.3	V
Operating temperature		Topr	−30 to +85	°C
Storing temperature	TCP	Tstr	−55 to +100	°C
	Bare chip		−65 to +125	



Notes

1. All voltages refer to V_{DD} as 0 V.
2. For voltages V_1, V_2, V_3 and V_4, be sure to keep the conditions of "$V_{DD} \geq V_1 \geq V_2 \geq V_3 \geq V_4 \geq V_5$" and "$V_{DD} \geq (V_{SS}, V_{SS2}) \geq V_5 \geq V_{OUT}$".
3. If the LSI is used outside the absolute maximum ratings, it may permanently break. Use under the electrical characteristics conditions is recommended for normal operation, otherwise, the LSI may malfunction, disadvantageously affecting its reliability.

■ DC CHARACTERISTICS

V_{SS} = –3.6 V to –2.4 V and Ta = –30 to 85°C unless otherwise specified.

Parameter		Symbol	Condition		Rating Min.	Rating Typ.	Rating Max.	Units	Pin used
Supply voltage (1)	Recommended operation	V_{SS}	—		–3.6	–3.0	–2.4	V	V_{SS} *1
	Data holding voltage		—		–5.5	—	–1.8		
Supply voltage (2)	Recommended operation	V_{SS2}	—		–3.6	—	–2.4	V	V_{SS2} *2, *9
	Operation enabled		—		–6.0	—	–1.8		
Supply voltage (3)	Recommended operation	V_5	—		–11.0	—	–5.0	V	V_5 *2
	Operation enabled	V_1, V_2	—		0.6 × V_5	—	V_{DD}	V	V_1, V_2
	Operation enabled	V_3, V_4	—		V_5	—	0.4 × V_5	V	V_3, V_4
High-level input voltage		V_{IHC}	—		0.2 × V_{SS}	—	V_{DD}	V	*3
Low-level input voltage		V_{ILC}	—		V_{SS}	—	0.8 × V_{SS}	V	*3
Input leakage current		I_{LI}	V_{IN} = V_{DD} or V_{SS}		–1.0	—	1.0	µA	*3
Liquid crystal driver ON resistance		R_{ON}	Ta = 25°C, ΔV = 0.1 V	V_5 = –7.0 V	—	20	4.0	kΩ	COM, SEG *4
Static current consumption		I_{DDQ}	—		—	0.1	5.0	µA	V_{DD}
Dynamic current consumption		I_{DD}	During display	V_5 = –6 V, unloaded	—	—	80	µA	V_{DD} *5
			In standby mode	Oscillation = On, power = Off	—	—	20	µA	V_{DD} *6
			In sleep mode	Oscillation = On, power = Off	—	—	5	µA	V_{DD}
			During access	fcyc = 200 kHz	—	—	500	µA	V_{DD} *7
Input pin capacity		C_{IN}	Ta = 25°C, f = 1 MHz		—	5.0	8.0	pF	*3

Frame frequency	f_{FR}	Ta = 25°C, V_{SS} = –3.0 V	70	100	130	Hz	*10
External clock frequency	f_{CK}	2-digit display (SED1241)	—	28.8	—	kHz	*10, *11
	f_{CK}	4-digit display (SED1240)	—	54.4	—	kHz	*10, *11

Minimum reset pulse width	t_{RW}	—	10	—	—	µs	*8
Reset start time	t_{RES}	—	50	—	—	ns	*8

Dynamic System

Built-in power supply	Input voltage	V_{SS2}	Double boosting	–7.0	—	–1.8	V	V_{SS2}
			Triple boosting	–6.0	—	–1.8		
	Boosting output voltage	V_{OUT}	Double boosting	–14.0	—	—	V	V_{OUT}
			Triple boosting	–18.0	—	—		
	Voltage follower operating voltage	V_5	—	–18.0	—	–5.0	V	—
	Reference voltage	V_{REG}	Ta = 25°C	–2.06	–2.0	–1.94	V	—

*1: Although a wide operating voltage range is guaranteed, it is not guaranteed in case of sudden voltage change during MPU access.
The low supply voltage data holding characteristics apply in the sleep mode, where MPU access is disabled.

*2: Be sure for supply voltage V_{SS2} not to exceed the operating voltage ranges for Vout and V_5 during triple boosting.

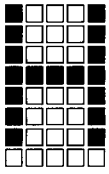
*3: D0 to D5, D6 (SCL), D7 (SI), A0, $\overline{RES}$, $\overline{CS}$, $\overline{WR}$ (E), P/S, IF, C86 and $\overline{CK}$.

*4: The resistance value when a voltage of 0.1 V is applied between output pins (SEGn, SEGSn, COMn and COMSn) and each power supply pin (V_1, V_2, V_3 and V_4). Specified in the range of supply voltage (2).

$R_{ON} = 0.1\ V/\Delta I$

(where ΔI = Current flowing when 0.1 V is applied between the power supply and the output)

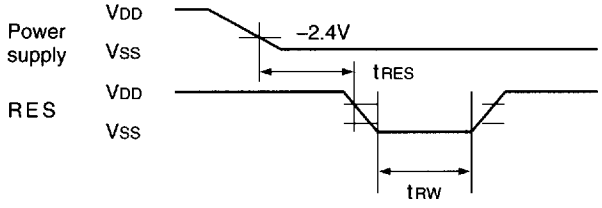
*5: Applies when there is no access from the MPU, the built-in power and oscillation circuits are operating and HPM = 0 while the following character is displayed.



*6: Applies when the built-in power circuit is turned off and the oscillation circuit turned on in the standby mode.

*7: Displays the current consumption when writing is always conducted at fcyc.
The current consumption during access is effectively proportional to the access frequency (fcyc).

*8: Specify the minimum pulse width of the $\overline{RES}$ signal. For resetting, input a pulse width of t_{RW} or wider.



*9: The boosting circuit boosts using V_{SS2} as the source voltage. Be sure for the V_{SS2} input voltage not to exceed the maximum operating voltage of V_{OUT}.

*10: The oscillation circuit frequency for driving the internal circuit (f_{OSC}) and the boosting clock (f_{BST}) depend on the machine type. The relationship between oscillating frequency f_{OSC}, boosting clock f_{BST} and frame frequency f_{FR} is as follows:

f_{OSC} = (number of digits) × (1/duty) × f_{FR}

f_{BST} = (1/2) × (1/number of digits) × f_{OSC}

*11: When using an external clock and not using the built-in oscillation circuit for operation, input the following waveform.

Duty = (t_h/t_{OSC}) × 100 = 20 to 30 %

f_{OSC} = 1/ t_{OSC}