

## Micro MINI E0C6003

### 4-bit Single Chip Microcomputer



- E0C6200B Core CPU
- Low Voltage and Low Power
- Built-in LCD Driver
- Low Cost Performance

#### ■ DESCRIPTION

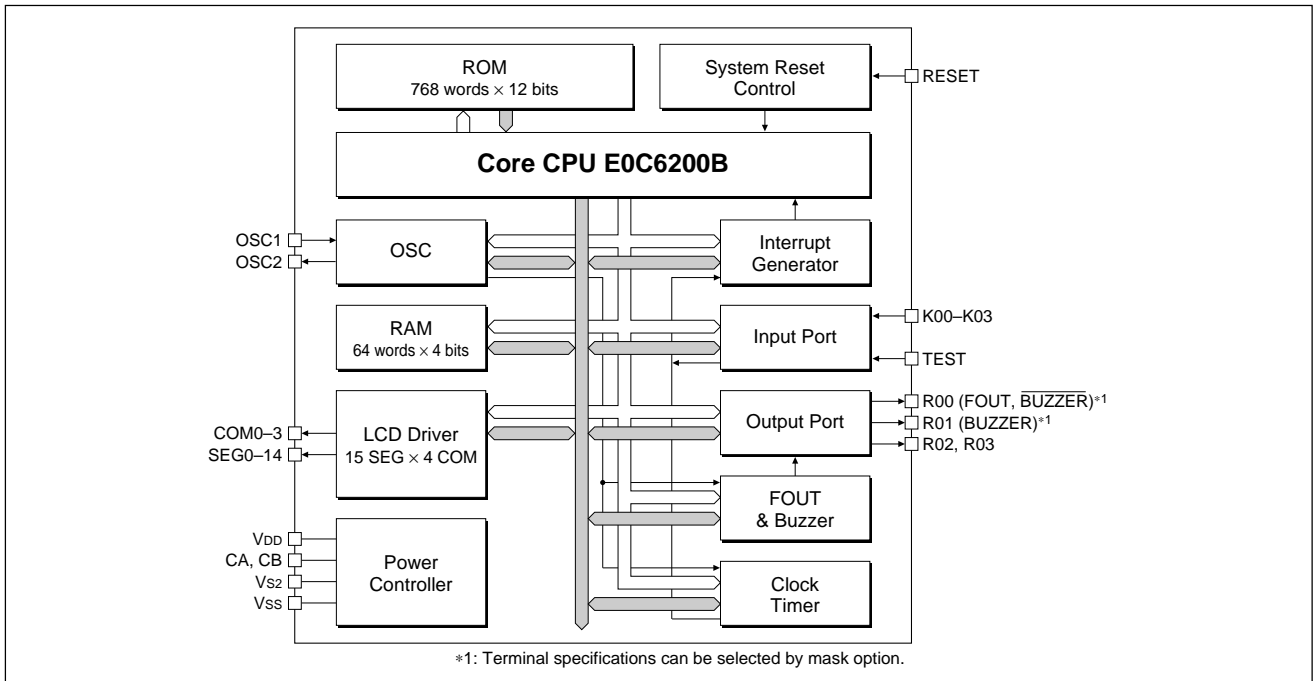
Micro MINI "E0C6003" is a single chip microcomputer for battery-driven products with 7-segment LCD display. It achieves low cost performance, and is suitable for a product added some feature instead of standard IC. It consists that Seiko Epson's original core CPU E0C6200B, LCD driver (15 segments × 4 commons), 64 words RAM, 768 words ROM, clock timer and so on.

#### ■ FEATURES

- CMOS LSI 4-bit parallel processing
- Clock ..... 32.768kHz (X'tal or CR oscillation by mask option)
- Instruction set ..... 100 instructions
- ROM capacity ..... 768 × 12 bits
- RAM capacity ..... 64 × 4 bits
- I/O port ..... I: 4 bits (with pull-down resistor selectable by mask option)  
O: 4 bits (buzzer output possible by mask option)  
I/O: 0 bits
- Supply voltage detector (SVD) ..... No support
- Clock timer ..... 1ch.
- LCD driver ..... 15 segments × 4/3/2 commons
- Interrupt ..... External : Key interrupt            1 line  
Internal : Clock timer interrupt    1 line
- Operation voltage ..... 1.2 to 2.0V (E0C60L03)  
2.4 to 3.6V (E0C6003)
- Power consumption ..... 1.0μA (32.768kHz X'tal, 3.0V, HALT)  
2.0μA (32.768kHz X'tal, 3.0V, RUN)
- Package ..... Die form (pad pitch = 130μm)

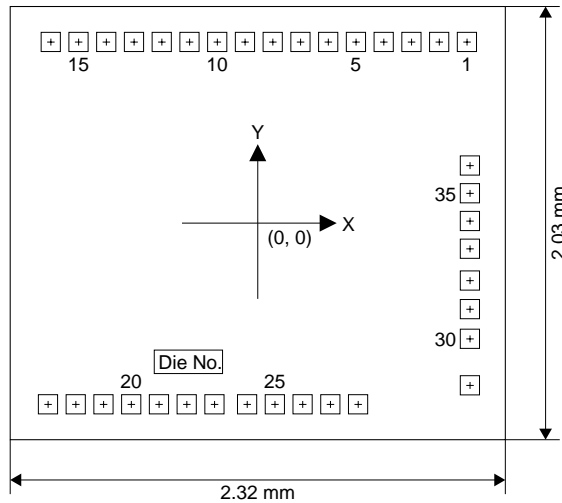
# E0C6003

## ■ BLOCK DIAGRAM



## ■ PAD LAYOUT

Pad Layout Diagram



Chip thickness: 400µm  
Pad opening: 95µm

Pad Coordinates

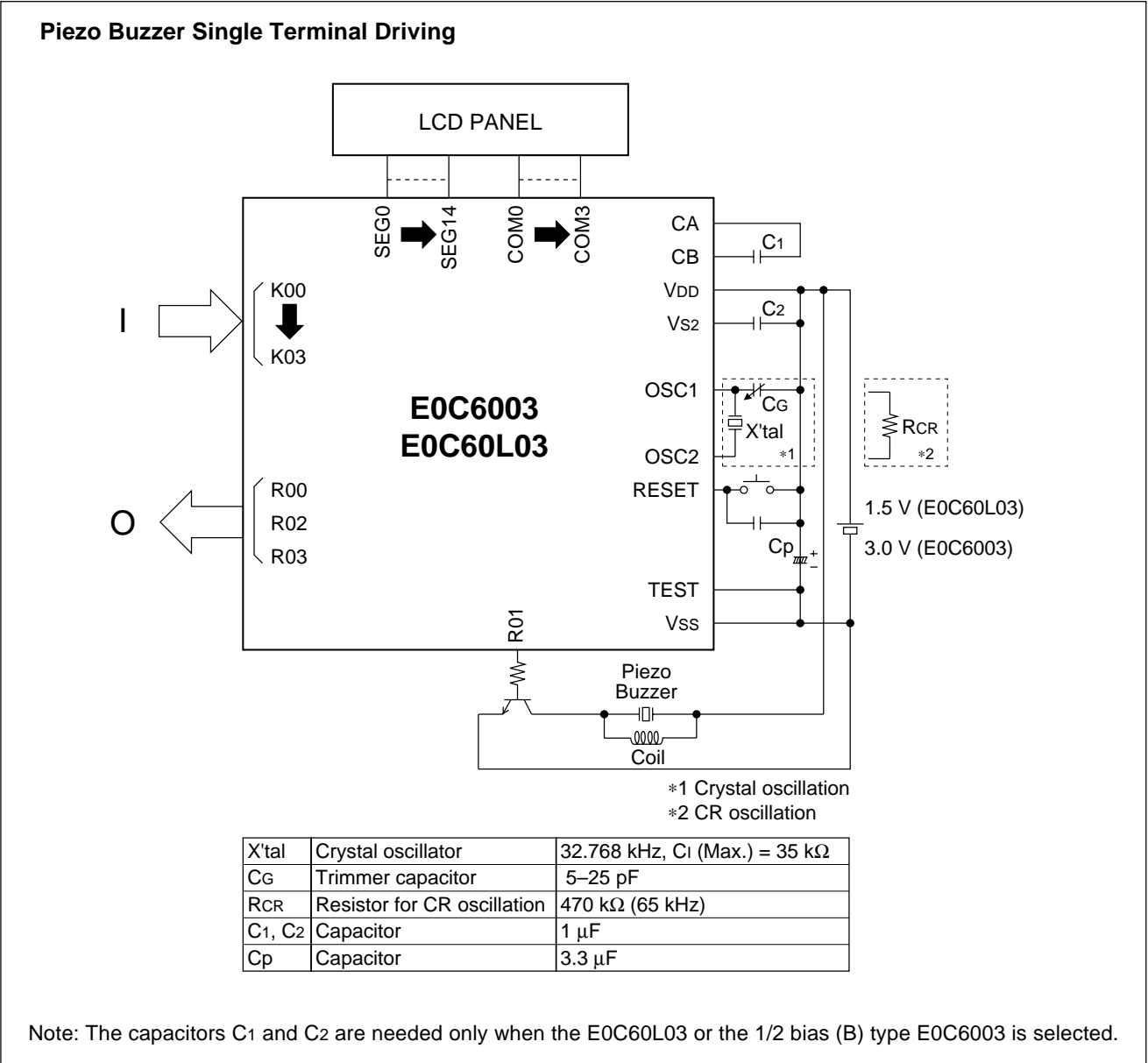
No.	Pad name	X	Y	No.	Pad name	X	Y	No.	Pad name	X	Y
1	TEST	980	849	13	SEG3	-580	849	25	OSC2	80	-849
2	SEG14	850	849	14	SEG2	-710	849	26	OSC1	210	-849
3	SEG13	720	849	15	SEG1	-840	849	27	VDD	340	-849
4	SEG12	590	849	16	SEG0	-970	849	28	RESET	470	-849
5	SEG11	460	849	17	COM0	-983	-849	29	R00	994	-760
6	SEG10	330	849	18	COM1	-853	-849	30	R01	994	-542
7	SEG9	200	849	19	COM2	-723	-849	31	R02	994	-403
8	SEG8	70	849	20	COM3	-593	-849	32	R03	994	-269
9	SEG7	-60	849	21	CA	-463	-849	33	K00	994	-120
10	SEG6	-190	849	22	CB	-333	-849	34	K01	994	10
11	SEG5	-320	849	23	Vs2	-203	-849	35	K02	994	140
12	SEG4	-450	849	24	Vss	-50	-849	36	K03	994	270

■ PAD DESCRIPTION

Pad name	Pad No.	I/O	Function
V <sub>DD</sub>	27	(I)	Power supply terminal (+)
V <sub>SS</sub>	24	(I)	Power supply terminal (-)
V <sub>S2</sub>	23	O	LCD system voltage doubler (2·V <sub>SS</sub> )/halver (V <sub>SS</sub> /2) output
CA, CB	21, 22	-	Booster capacitor connecting terminal
OSC1	26	I	Crystal or CR oscillation input terminal *
OSC2	25	O	Crystal or CR oscillation output terminal *
K00-03	33-36	I	Input port terminal
R00	29	O	Output port terminal, BUZZER or FOUT output terminal *
R01	30	O	Output port terminal or BUZZER output terminal *
R02, R03	31, 32	O	Output port terminal
SEG0-14	2-16	O	LCD segment output or DC output terminal *
COM0-3	17-20	O	LCD common output terminal (1/4, 1/3 or 1/2 duty are selectable *)
RESET	28	I	Initial reset input terminal
TEST	1	I	Test input terminal

\* Can be selected by mask option

■ BASIC EXTERNAL CONNECTION DIAGRAM



# E0C6003

## ■ ELECTRICAL CHARACTERISTICS

### ● Absolute Maximum Ratings

(V<sub>DD</sub>=0V)

Rating	Symbol	Value	Unit
Supply voltage	V <sub>SS</sub>	-5.0 to 0.5	V
Input voltage (1)	V <sub>I</sub>	V <sub>SS</sub> - 0.3 to 0.5	V
Input voltage (2)	V <sub>Iosc</sub>	V <sub>SS</sub> - 0.3 to 0.5	V
Permissible total output current *1	ΣI <sub>VSS</sub>	10	mA
Operating temperature	T <sub>opr</sub>	-20 to 70	°C
Storage temperature	T <sub>stg</sub>	-65 to 150	°C
Soldering temperature / time	T <sub>sol</sub>	260°C, 10sec (lead section)	—
Permissible dissipation	P <sub>D</sub>	250	mW

\*1: The permissible total output current is the sum total of the current (average current) that simultaneously flows from the output pin (or is drawn in).

### ● Recommended Operating Conditions

#### E0C6003

(T<sub>a</sub>=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Supply voltage	V <sub>SS</sub>	V <sub>DD</sub> =0V	-3.6	-3.0	-1.8	V
Oscillation frequency	f <sub>osc</sub>	Crystal oscillation		32.768		kHz
		CR oscillation, R <sub>CR</sub> =470kΩ	50	65	80	kHz
Booster capacitor	C1		0.1			μF
Capacitor between V <sub>DD</sub> and V <sub>S2</sub>	C2		0.1			μF

#### E0C60L03

(T<sub>a</sub>=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Supply voltage	V <sub>SS</sub>	V <sub>DD</sub> =0V	-0.2	-1.5	-1.2	V
Oscillation frequency	f <sub>osc</sub>	Crystal oscillation		32.768		kHz
		CR oscillation, R <sub>CR</sub> =470kΩ	50	65	80	kHz
Booster capacitor	C1		0.1			μF
Capacitor between V <sub>DD</sub> and V <sub>S2</sub>	C2		0.1			μF

## ● DC Characteristics

### E0C6003

(Unless otherwise specified: VDD=0V, VSS=-3.0V, fosc=32.768kHz, Ta=25°C, Vs2 is internal voltage, C1=C2=0.1μF)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage (1)	V <sub>IH1</sub>		0.2•V <sub>SS</sub>		0	V
High level input voltage (2)	V <sub>IH2</sub>		0.15•V <sub>SS</sub>		0	V
Low level input voltage (1)	V <sub>IL1</sub>		V <sub>SS</sub>		0.8•V <sub>SS</sub>	V
Low level input voltage (2)	V <sub>IL2</sub>		V <sub>SS</sub>		0.85•V <sub>SS</sub>	V
High level input current (1)	I <sub>IH1</sub>	V <sub>IH1</sub> =0V, No pull down resistor	0		0.5	μA
High level input current (2)	I <sub>IH2</sub>	V <sub>IH2</sub> =0V, With pull down resistor	10		40	μA
High level input current (3)	I <sub>IH3</sub>	V <sub>IH3</sub> =0V, With pull down resistor	30		100	μA
Low level input current	I <sub>IL</sub>	V <sub>IL</sub> =V <sub>SS</sub>	-0.5		0	μA
High level output current (1)	I <sub>OH1</sub>	V <sub>OH1</sub> =0.1•V <sub>SS</sub>			-1.0	mA
High level output current (2)	I <sub>OH2</sub>	V <sub>OH2</sub> =0.1•V <sub>SS</sub> (built-in protection resistance)			-1.0	mA
Low level output current (1)	I <sub>OL1</sub>	V <sub>OL1</sub> =0.9•V <sub>SS</sub>	3.0			mA
Low level output current (2)	I <sub>OL2</sub>	V <sub>OL2</sub> =0.9•V <sub>SS</sub> (built-in protection resistance)	3.0			mA
Common output current	I <sub>OH3</sub>	V <sub>OH3</sub> =-0.05V			-3	μA
	I <sub>OL3</sub>	V <sub>OL3</sub> =V <sub>L3</sub> +0.05V	3			μA
Segment output current (during LCD output)	I <sub>OH4</sub>	V <sub>OH4</sub> =-0.05V			-3	μA
	I <sub>OL4</sub>	V <sub>OL4</sub> =V <sub>L3</sub> +0.05V	3			μA
Segment output current (during DC output)	I <sub>OH5</sub>	V <sub>OH5</sub> =0.1•V <sub>SS</sub>			-300	μA
	I <sub>OL5</sub>	V <sub>OL5</sub> =0.9•V <sub>SS</sub>	300			μA

### E0C60L03

(Unless otherwise specified: VDD=0V, VSS=-1.5V, fosc=32.768kHz, Ta=25°C, Vs2 is internal voltage, C1=C2=0.1μF)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage (1)	V <sub>IH1</sub>		0.2•V <sub>SS</sub>		0	V
High level input voltage (2)	V <sub>IH2</sub>		0.15•V <sub>SS</sub>		0	V
Low level input voltage (1)	V <sub>IL1</sub>		V <sub>SS</sub>		0.8•V <sub>SS</sub>	V
Low level input voltage (2)	V <sub>IL2</sub>		V <sub>SS</sub>		0.85•V <sub>SS</sub>	V
High level input current (1)	I <sub>IH1</sub>	V <sub>IH1</sub> =0V, No pull down resistor	0		0.5	μA
High level input current (2)	I <sub>IH2</sub>	V <sub>IH2</sub> =0V, With pull down resistor	5.0		20	μA
High level input current (3)	I <sub>IH3</sub>	V <sub>IH3</sub> =0V, With pull down resistor	9.0		100	μA
Low level input current	I <sub>IL</sub>	V <sub>IL</sub> =V <sub>SS</sub>	-0.5		0	μA
High level output current (1)	I <sub>OH1</sub>	V <sub>OH1</sub> =0.1•V <sub>SS</sub>			-200	μA
High level output current (2)	I <sub>OH2</sub>	V <sub>OH2</sub> =0.1•V <sub>SS</sub> (built-in protection resistance)			-200	μA
Low level output current (1)	I <sub>OL1</sub>	V <sub>OL1</sub> =0.9•V <sub>SS</sub>	700			μA
Low level output current (2)	I <sub>OL2</sub>	V <sub>OL2</sub> =0.9•V <sub>SS</sub> (built-in protection resistance)	700			μA
Common output current	I <sub>OH3</sub>	V <sub>OH3</sub> =-0.05V			-3	μA
	I <sub>OL3</sub>	V <sub>OL3</sub> =V <sub>L3</sub> +0.05V	3			μA
Segment output current (during LCD output)	I <sub>OH4</sub>	V <sub>OH4</sub> =-0.05V			-3	μA
	I <sub>OL4</sub>	V <sub>OL4</sub> =V <sub>L3</sub> +0.05V	3			μA
Segment output current (during DC output)	I <sub>OH5</sub>	V <sub>OH5</sub> =0.1•V <sub>SS</sub>			-100	μA
	I <sub>OL5</sub>	V <sub>OL5</sub> =0.9•V <sub>SS</sub>	130			μA

# E0C6003

## ● Analog Circuit Characteristics and Current Consumption

### E0C6003 (Crystal Oscillation)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S2}$  is internal voltage,  $C_1=C_2=0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
LCD drive voltage	VL1	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL1	$1/3 \cdot V_{SS}$ - 0.1	$1/3 \cdot V_{SS}$	$1/3 \cdot V_{SS}$ $\times 0.9$	V
	VL2	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL2	$2/3 \cdot V_{SS}$ - 0.1	$2/3 \cdot V_{SS}$	$2/3 \cdot V_{SS}$ $\times 0.9$	V
	VL3	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL3		$V_{SS}$		V
Current consumption	IHLT	During HALT with LCD OFF		1.0	2.5	μA
	IEXE1	During operation with LCD OFF	No panel load	2.0	5.0	μA
	IEXE2	During operation with power divider ON		15	20	μA

### E0C60L03 (Crystal Oscillation)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S2}$  is internal voltage,  $C_1=C_2=0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
LCD drive voltage	VL1	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL1	$1/3 \cdot V_{S2}$ - 0.1	$1/3 \cdot V_{S2}$	$1/3 \cdot V_{S2}$ $\times 0.9$	V
	VL2	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL2	$2/3 \cdot V_{S2}$ - 0.1	$2/3 \cdot V_{S2}$	$2/3 \cdot V_{S2}$ $\times 0.9$	V
	VL3	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL3	$V_{S2}$ - 0.1	$V_{S2}$	$V_{S2}$ $\times 0.9$	V
Current consumption	IHLT	During HALT with LCD OFF		1.0	2.5	μA
	IEXE1	During operation with LCD OFF	No panel load	2.0	5.0	μA
	IEXE2	During operation with power divider ON		15	20	μA

### E0C6003 (CR Oscillation)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=65kHz$ ,  $T_a=25^{\circ}C$ ,  $R_{CR}=470k\Omega$ ,  $V_{S2}$  is internal voltage,  $C_1=C_2=0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
LCD drive voltage	VL1	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL1	$1/3 \cdot V_{SS}$ - 0.1	$1/3 \cdot V_{SS}$	$1/3 \cdot V_{SS}$ $\times 0.9$	V
	VL2	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL2	$2/3 \cdot V_{SS}$ - 0.1	$2/3 \cdot V_{SS}$	$2/3 \cdot V_{SS}$ $\times 0.9$	V
	VL3	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL3		$V_{SS}$		V
Current consumption	IHLT	During HALT with LCD OFF		8	15	μA
	IEXE1	During operation with LCD OFF	No panel load	15	20	μA
	IEXE2	During operation with power divider ON		25	30	μA

### E0C60L03 (CR Oscillation)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=65kHz$ ,  $T_a=25^{\circ}C$ ,  $R_{CR}=470k\Omega$ ,  $V_{S2}$  is internal voltage,  $C_1=C_2=0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
LCD drive voltage	VL1	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL1	$1/3 \cdot V_{S2}$ - 0.1	$1/3 \cdot V_{S2}$	$1/3 \cdot V_{S2}$ $\times 0.9$	V
	VL2	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL2	$2/3 \cdot V_{S2}$ - 0.1	$2/3 \cdot V_{S2}$	$2/3 \cdot V_{S2}$ $\times 0.9$	V
	VL3	Connect 1 MΩ load resistor between VDD and segment driver (SEG0–SEG14) when segment driver's level is VL3	$V_{S2}$ - 0.1	$V_{S2}$	$V_{S2}$ $\times 0.9$	V
Current consumption	IHLT	During HALT with LCD OFF		8	15	μA
	IEXE1	During operation with LCD OFF	No panel load	15	20	μA
	IEXE2	During operation with power divider ON		25	30	μA

## ● Oscillation Characteristics

Oscillation characteristics will vary according to different conditions (elements used, board pattern). Use the following characteristics as reference values.

### E0C6003 Crystal Oscillation

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=32.768kHz$ , Crystal: C-002R ( $C_i=35k\Omega$ ),  $C_G=25pF$ ,  $C_D$ =built-in,  $T_a=25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	Vsta	$t_{sta} \leq 5sec$ (Vss)	-1.8			V
Oscillation stop voltage	Vstp	$t_{stp} \leq 10sec$ (Vss)	-1.8			V
Built-in capacitance (drain)	$C_D$	Including the parasitic capacitance inside the IC (in chip)		20		pF
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-1.8$ to $-3.6V$			5	ppm
Frequency/IC deviation	$\partial f/\partial IC$		-10		10	ppm
Frequency adjustment range	$\partial f/\partial C_G$	$C_G=5$ to $25pF$	40			ppm
Harmonic oscillation start voltage	Vhho	$C_G=5pF$ (Vss)			-3.6	V
Permitted leak resistance	Rleak	Between OSC1 and $V_{DD}$	200			M $\Omega$

### E0C60L03 Crystal Oscillation

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=32.768kHz$ , Crystal: C-002R ( $C_i=35k\Omega$ ),  $C_G=25pF$ ,  $C_D$ =built-in,  $T_a=25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	Vsta	$t_{sta} \leq 5sec$ (Vss)	-1.2			V
Oscillation stop voltage	Vstp	$t_{stp} \leq 10sec$ (Vss)	-1.2			V
Built-in capacitance (drain)	$C_D$	Including the parasitic capacitance inside the IC (in chip)		20		pF
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-1.2$ to $-2.0V$			5	ppm
Frequency/IC deviation	$\partial f/\partial IC$		-10		10	ppm
Frequency adjustment range	$\partial f/\partial C_G$	$C_G=5$ to $25pF$	40			ppm
Harmonic oscillation start voltage	Vhho	$C_G=5pF$ (Vss)			-2.0	V
Permitted leak resistance	Rleak	Between OSC1 and $V_{DD}$	200			M $\Omega$

### E0C6003 CR Oscillation

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $R_{CR}=470k\Omega$ ,  $T_a=25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	fosc		-20	65kHz	20	%
Oscillation start voltage	Vsta	(Vss)	-1.8			V
Oscillation start time	tsta	$V_{SS}=-1.8$ to $-3.6V$		3		mS
Oscillation stop voltage	Vstp	(Vss)	-1.8			V

### E0C60L03 CR Oscillation

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $R_{CR}=470k\Omega$ ,  $T_a=25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	fosc		-20	65kHz	20	%
Oscillation start voltage	Vsta	(Vss)	-1.2			V
Oscillation start time	tsta	$V_{SS}=-1.2$ to $-2.0V$		3		mS
Oscillation stop voltage	Vstp	(Vss)	-1.2			V

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