

## Micro MINI E0C6002

### 4-bit Single Chip Microcomputer



- E0C6200B Core CPU
- Low Voltage and Low Power
- Built-in LCD Driver
- Built-in R/F Converter
- Low Cost Performance

#### ■ DESCRIPTION

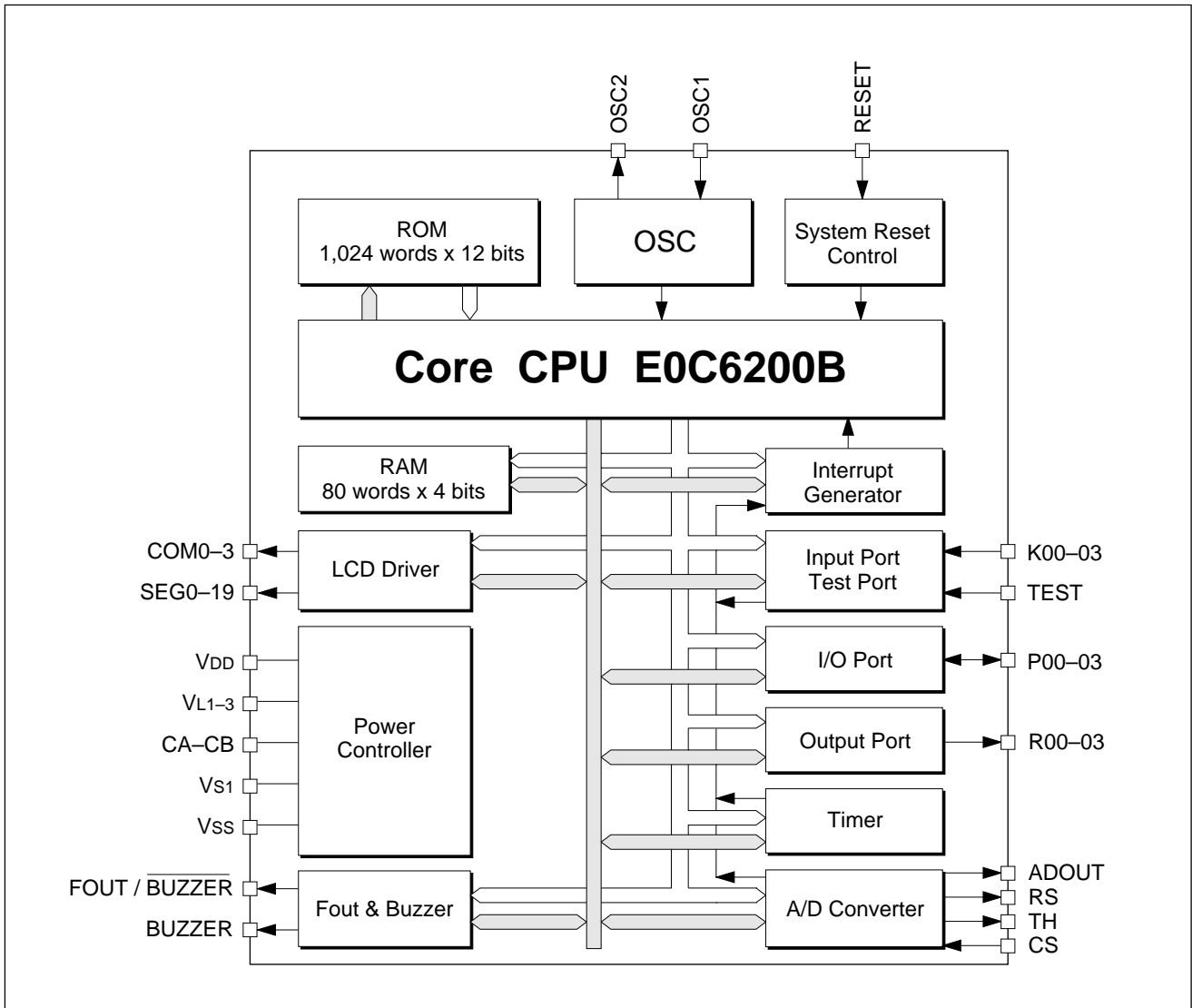
Micro MINI "E0C6002" is a single chip microcomputer for battery-driven products with 7-segment LCD display. It achieves low cost performance, and is suitable for a product added some feature instead of standard IC. It consists that Seiko Epson's original core CPU E0C6200B, LCD driver (20 segments × 4 commons), 80 words RAM, 1K words ROM, clock timer and so on.

#### ■ FEATURES

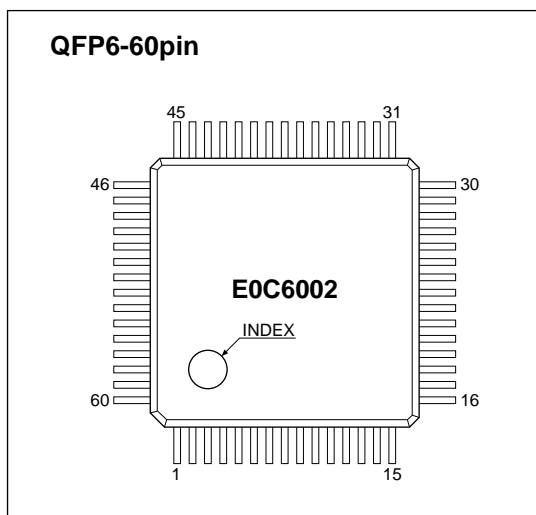
- CMOS LSI 4-bit parallel processing
- Clock ..... 32.768kHz (X'tal or CR oscillation by mask option)
- Instruction set ..... 100 instructions
- ROM capacity ..... 1K × 12 bits
- RAM capacity ..... 80 × 4 bits
- I/O port ..... I: 4 bits (with pull-down resistor selectable by mask option)  
O: 4 bits (buzzer output possible by mask option)  
I/O: 4 bits
- Supply voltage detector (SVD) ..... No support
- Clock timer ..... 1ch.
- LCD driver ..... 20 segments × 4/3/2 commons
- R/F converter ..... 1ch.
- Interrupt ..... External : Key interrupt 1 line  
Internal : Clock timer interrupt 1 line
- Operation voltage ..... 1.2 to 1.8V (E0C60L02)  
2.4 to 3.6V (E0C6002)
- Power consumption ..... 1.0μA (32.768kHz X'tal, 3.0V, HALT)  
2.5μA (32.768kHz X'tal, 3.0V, RUN)
- Package ..... Die form (pad pitch = 130μm) or QFP6-60pin

# E0C6002

## ■ BLOCK DIAGRAM



## ■ PIN CONFIGURATION



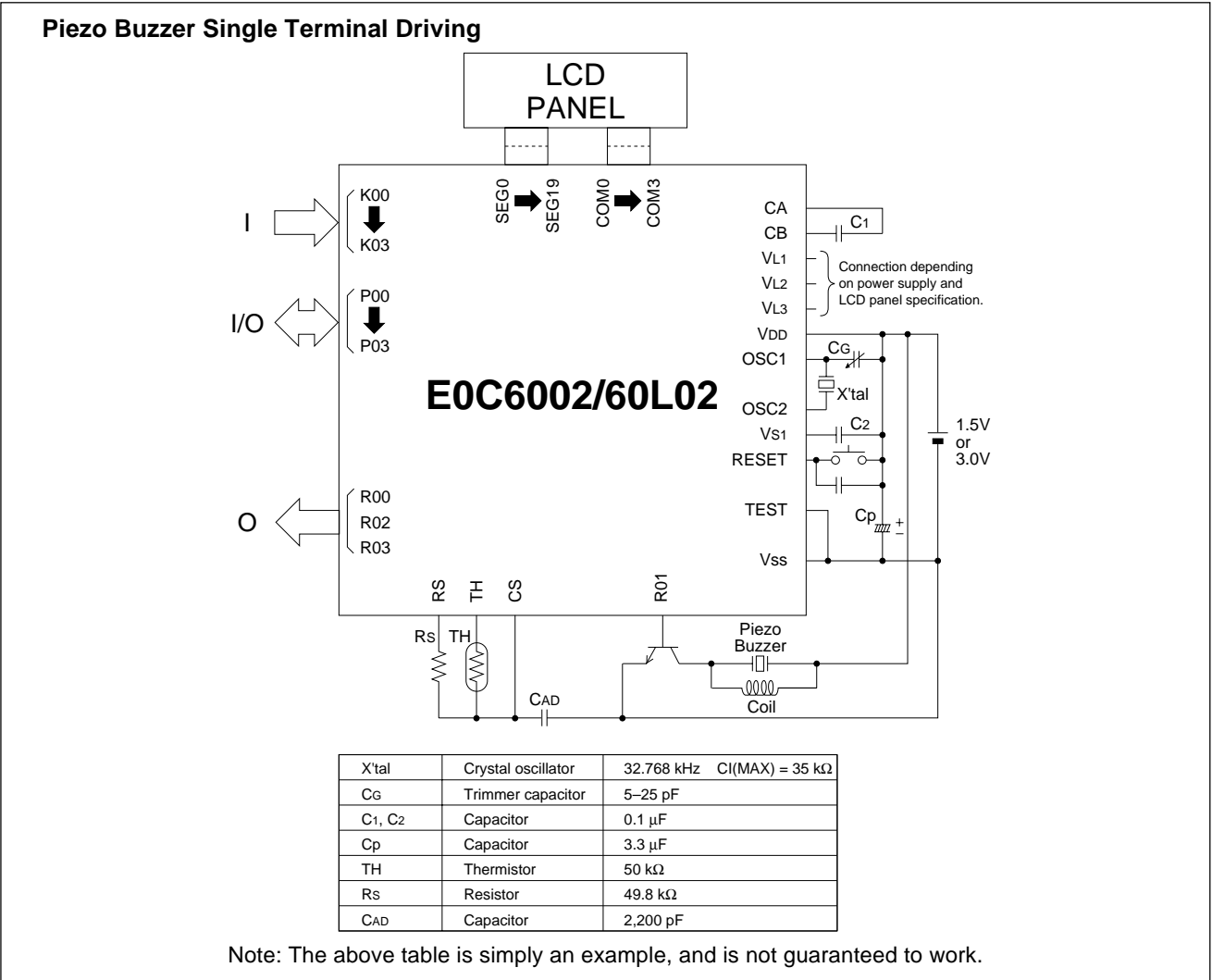
Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	SEG0	16	N.C.	31	N.C.	46	N.C.
2	SEG1	17	TEST	32	VL3	47	K00
3	SEG2	18	RESET	33	VL2	48	K01
4	SEG3	19	SEG12	34	VL1	49	K02
5	SEG4	20	SEG13	35	CA	50	K03
6	SEG5	21	SEG14	36	CB	51	R00
7	SEG6	22	SEG15	37	Vss	52	R01
8	SEG7	23	SEG16	38	VDD	53	R02
9	SEG8	24	SEG17	39	OSC1	54	R03
10	SEG9	25	SEG18	40	OSC2	55	RS
11	SEG10	26	SEG19	41	Vs1	56	TH
12	SEG11	27	COM0	42	P00	57	CS
13	N.C.	28	COM1	43	P01	58	ADOUT
14	N.C.	29	COM2	44	P02	59	N.C.
15	N.C.	30	COM3	45	P03	60	N.C.

N.C. : No Connection

**PIN DESCRIPTION**

Pin name	Pin No.	In/Out	Function
VDD	38	(I)	Power source (+) terminal
VSS	37	(I)	Power source (-) terminal
VS1	41	O	Oscillation and internal logic system regulated voltage output terminal
VL1	34	O	LCD system regulated voltage output terminal
VL2	33	O	LCD system booster output terminal
VL3	32	O	LCD system booster output terminal
CA, CB	35, 36	-	Booster capacitor connecting terminal
OSC1	39	I	Crystal or CR oscillation input terminal
OSC2	40	O	Crystal or CR oscillation output terminal
K00-K03	47-50	I	Input terminal
P00-P03	42-45	I/O	I/O terminal
R00-R03	51-54	O	Output terminal
SEG0-19	1-12 19-26	O	LCD segment output terminal (convertible to DC output terminal by mask option)
COM0-3	27-30	O	LCD common output terminal
CS	57	I	A/D converter CR oscillation input terminal
RS	55	O	A/D converter CR oscillation output terminal
TH	56	O	A/D converter CR oscillation output terminal
ADOUT	58	O	A/D converter oscillation frequency output terminal
RESET	18	I	Initial setting input terminal
TEST	17	I	Test input terminal

**BASIC EXTERNAL CONNECTION DIAGRAM**



# E0C6002

## ■ ELECTRICAL CHARACTERISTICS

### ● Absolute Maximum Ratings

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

Rating	Symbol	Value	Unit
Power 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>I</sub> osc	V <sub>SS</sub> - 0.3 to 0.5	V
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)	—
Allowable dissipation *1	P <sub>D</sub>	250	mW

\*1: In case of plastic package (QFP6-60pin).

### ● Recommended Operating Conditions

#### E0C6002

(T<sub>a</sub>=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Power voltage	V <sub>SS</sub>	V <sub>DD</sub> =0V	-3.5	-3.0	-1.8	V
Oscillation frequency	fosc1	Crystal oscillation		32.768		kHz
	fosc2	CR oscillation, R=420kΩ		65	80	kHz
Booster capacitor	C1		0.1			μF
Capacitor between V <sub>DD</sub> and V <sub>S1</sub>	C2		0.1			μF

#### E0C60L02

(T<sub>a</sub>=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Power voltage	V <sub>SS</sub>	V <sub>DD</sub> =0V *3	-2.0	-1.5	-1.2	V
		V <sub>DD</sub> =0V, With software correspondence *1	-2.0	-1.5	-0.9 *2	V
Oscillation frequency	fosc1	Crystal oscillation		32.768		kHz
	fosc2	CR oscillation, R=420kΩ		65	80	kHz
Booster capacitor	C1		0.1			μF
Capacitor between V <sub>DD</sub> and V <sub>S1</sub>	C2		0.1			μF

\*1: When switching to the heavy load protection mode.

\*2: The voltage which can be displayed on the LCD panel will differ according to the characteristics of the LCD panel.

\*3: When there is no software correspondence during CR oscillation or crystal oscillation.

## ● DC Characteristics

### E0C6002

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage (1)	$V_{IH1}$		$0.2 \cdot V_{SS}$		0	V
High level input voltage (2)	$V_{IH2}$		$0.15 \cdot V_{SS}$		0	V
Low level input voltage (1)	$V_{IL1}$		$V_{SS}$		$0.8 \cdot V_{SS}$	V
Low level input voltage (2)	$V_{IL2}$		$V_{SS}$		$0.85 \cdot V_{SS}$	V
High level input current (1)	$I_{IH1}$	$V_{IH1}=0V$ , No pull down resistor	0		0.5	$\mu A$
High level input current (2)	$I_{IH2}$	$V_{IH2}=0V$ , With pull down resistor	5		16	$\mu A$
High level input current (3)	$I_{IH3}$	$V_{IH3}=0V$ , With pull down resistor	30		100	$\mu A$
Low level input current	$I_{IL}$	$V_{IL}=V_{SS}$	-0.5		0	$\mu A$
High level output current (1)	$I_{OH1}$	$V_{OH1}=0.1 \cdot V_{SS}$			-1.0	mA
High level output current (2)	$I_{OH2}$	$V_{OH2}=0.1 \cdot V_{SS}$ (built-in protection resistance)			-1.0	mA
High level output current (3)	$I_{OH3}$	$V_{OH3}=-1.0V$			-1.0	mA
Low level output current (1)	$I_{OL1}$	$V_{OL1}=0.9 \cdot V_{SS}$	3.0			mA
Low level output current (2)	$I_{OL2}$	$V_{OL2}=0.9 \cdot V_{SS}$ (built-in protection resistance)	3.0			mA
Low level output current (3)	$I_{OL3}$	$V_{OL3}=-2.0V$	3.0			mA
Common output current	$I_{OH4}$	$V_{OH4}=-0.05V$			-3	$\mu A$
	$I_{OL4}$	$V_{OL4}=V_{L3}+0.05V$	3			$\mu A$
Segment output current (during LCD output)	$I_{OH5}$	$V_{OH5}=-0.05V$			-3	$\mu A$
	$I_{OL5}$	$V_{OL5}=V_{L3}+0.05V$	3			$\mu A$
Segment output current (during DC output)	$I_{OH6}$	$V_{OH6}=0.1 \cdot V_{SS}$			-300	$\mu A$
	$I_{OL6}$	$V_{OL6}=0.9 \cdot V_{SS}$	300			$\mu A$

### E0C60L02

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage (1)	$V_{IH1}$		$0.2 \cdot V_{SS}$		0	V
High level input voltage (2)	$V_{IH2}$		$0.15 \cdot V_{SS}$		0	V
Low level input voltage (1)	$V_{IL1}$		$V_{SS}$		$0.8 \cdot V_{SS}$	V
Low level input voltage (2)	$V_{IL2}$		$V_{SS}$		$0.85 \cdot V_{SS}$	V
High level input current (1)	$I_{IH1}$	$V_{IH1}=0V$ , No pull down resistor	0		0.5	$\mu A$
High level input current (2)	$I_{IH2}$	$V_{IH2}=0V$ , With pull down resistor	2.0		16	$\mu A$
High level input current (3)	$I_{IH3}$	$V_{IH3}=0V$ , With pull down resistor	9.0		100	$\mu A$
Low level input current	$I_{IL}$	$V_{IL}=V_{SS}$	-0.5		0	$\mu A$
High level output current (1)	$I_{OH1}$	$V_{OH1}=0.1 \cdot V_{SS}$			-200	$\mu A$
High level output current (2)	$I_{OH2}$	$V_{OH2}=0.1 \cdot V_{SS}$ (built-in protection resistance)			-200	$\mu A$
High level output current (3)	$I_{OH3}$	$V_{OH3}=-0.5V$			-200	$\mu A$
Low level output current (1)	$I_{OL1}$	$V_{OL1}=0.9 \cdot V_{SS}$	700			$\mu A$
Low level output current (2)	$I_{OL2}$	$V_{OL2}=0.9 \cdot V_{SS}$ (built-in protection resistance)	700			$\mu A$
Low level output current (3)	$I_{OL3}$	$V_{OL3}=-1.0V$	700			$\mu A$
Common output current	$I_{OH4}$	$V_{OH4}=-0.05V$			-3	$\mu A$
	$I_{OL4}$	$V_{OL4}=V_{L3}+0.05V$	3			$\mu A$
Segment output current (during LCD output)	$I_{OH5}$	$V_{OH5}=-0.05V$			-3	$\mu A$
	$I_{OL5}$	$V_{OL5}=V_{L3}+0.05V$	3			$\mu A$
Segment output current (during DC output)	$I_{OH6}$	$V_{OH6}=0.1 \cdot V_{SS}$			-100	$\mu A$
	$I_{OL6}$	$V_{OL6}=0.9 \cdot V_{SS}$	130			$\mu A$

# E0C6002

## ● Analog Circuit Characteristics and Current Consumption

### E0C6002 (Normal Operating Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
<During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL1 (without panel load)	1/2•VL2 -0.1		1/2•VL2 ×0.9	V
	VL2	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL2 (without panel load)		V <sub>SS</sub>		V
	VL3	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL3 (without panel load)	3/2•VL2 -0.1		3/2•VL2 ×0.9	V
Power current consumption	IOP	During HALT	Without panel load	1.0	2.5	$\mu A$
		During execution		2.5	5.0	$\mu A$
		During A/D conversion (HALT)		30	40	$\mu A$

### E0C6002 (Heavy Load Protection Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
<During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL1 (without panel load)	1/2•VL2 -0.1		1/2•VL2 ×0.85	V
	VL2	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL2 (without panel load)		V <sub>SS</sub>		V
	VL3	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL3 (without panel load)	3/2•VL2 -0.1		3/2•VL2 ×0.85	V
Power current consumption	IOP	During HALT	Without panel load	2.0	5.5	$\mu A$
		During execution		5.5	10.0	$\mu A$
		During A/D conversion (HALT)		31	41.5	$\mu A$

### E0C60L02 (Normal Operating Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
<During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL1 (without panel load)		V <sub>SS</sub>		V
	VL2	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL2 (without panel load)	2•VL1 -0.1		2•VL1 ×0.9	V
	VL3	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL3 (without panel load)	3•VL1 -0.1		3•VL1 ×0.9	V
Power current consumption	IOP	During HALT	Without panel load	1.0	2.5	$\mu A$
		During execution		2.5	5.0	$\mu A$
		During A/D conversion (HALT)		30	40	$\mu A$

### E0C60L02 (Heavy Load Protection Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=32.768kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
<During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL1 (without panel load)		V <sub>SS</sub>		V
	VL2	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL2 (without panel load)	2•VL1 -0.1		2•VL1 ×0.85	V
	VL3	Connect 1M $\Omega$ load resistor between V <sub>DD</sub> and VL3 (without panel load)	3•VL1 -0.1		3•VL1 ×0.85	V
Power current consumption	IOP	During HALT	Without panel load	2.0	5.5	$\mu A$
		During execution		5.5	10.0	$\mu A$
		During A/D conversion (HALT)		31	41.5	$\mu A$

## E0C6002 (CR, Normal Operating Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=65kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
Recommended external resistance for CR oscillation= $420k\Omega$  <During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Internal voltage	VL1	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL1 (without panel load)	$1/2 \cdot V_{L2}$ -0.1		$1/2 \cdot V_{L2}$ $\times 0.9$	V	
	VL2	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL2 (without panel load)		$V_{SS}$		V	
	VL3	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL3 (without panel load)	$3/2 \cdot V_{L2}$ -0.1		$3/2 \cdot V_{L2}$ $\times 0.9$	V	
Power current consumption	IOP	During HALT	Without panel load		8.0	15.0	$\mu A$
		During execution			15.0	20.0	$\mu A$
		During A/D conversion (HALT)			37	52.5	$\mu A$

## E0C6002 (CR, Heavy Load Protection Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $f_{osc}=65kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
Recommended external resistance for CR oscillation= $420k\Omega$  <During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Internal voltage	VL1	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL1 (without panel load)	$1/2 \cdot V_{L2}$ -0.1		$1/2 \cdot V_{L2}$ $\times 0.85$	V	
	VL2	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL2 (without panel load)		$V_{SS}$		V	
	VL3	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL3 (without panel load)	$3/2 \cdot V_{L2}$ -0.1		$3/2 \cdot V_{L2}$ $\times 0.85$	V	
Power current consumption	IOP	During HALT	Without panel load		16.0	30.0	$\mu A$
		During execution			30.0	40.0	$\mu A$
		During A/D conversion (HALT)			45	57.5	$\mu A$

## E0C60L02 (CR, Normal Operating Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=65kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
Recommended external resistance for CR oscillation= $420k\Omega$  <During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Internal voltage	VL1	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL1 (without panel load)		$V_{SS}$		V	
	VL2	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL2 (without panel load)	$2 \cdot V_{L1}$ -0.1		$2 \cdot V_{L1}$ $\times 0.9$	V	
	VL3	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL3 (without panel load)	$3 \cdot V_{L1}$ -0.1		$3 \cdot V_{L1}$ $\times 0.9$	V	
Power current consumption	IOP	During HALT	Without panel load		8.0	15.0	$\mu A$
		During execution			15.0	20.0	$\mu A$
		During A/D conversion (HALT)			37	52.5	$\mu A$

## E0C60L02 (CR, Heavy Load Protection Mode)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $f_{osc}=65kHz$ ,  $T_a=25^{\circ}C$ ,  $C_G=25pF$ ,  $V_{S1}/V_{L1}-V_{L3}$  are internal voltage,  $C_1=C_2=0.1\mu F$   
Recommended external resistance for CR oscillation= $420k\Omega$  <During A/D conversion:  $R_S=49.8k\Omega$ ,  $T_H=50k\Omega$ ,  $C_{AD}=2,200pF$ >)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Internal voltage	VL1	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL1 (without panel load)		$V_{SS}$		V	
	VL2	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL2 (without panel load)	$2 \cdot V_{L1}$ -0.1		$2 \cdot V_{L1}$ $\times 0.85$	V	
	VL3	Connect $1M\Omega$ load resistor between $V_{DD}$ and VL3 (without panel load)	$3 \cdot V_{L1}$ -0.1		$3 \cdot V_{L1}$ $\times 0.85$	V	
Power current consumption	IOP	During HALT	Without panel load		16.0	30.0	$\mu A$
		During execution			30.0	40.0	$\mu A$
		During A/D conversion (HALT)			45	57.5	$\mu A$

# E0C6002

## ● Oscillation Characteristics

Oscillation characteristics will vary according to different conditions. Use the following characteristics as reference values.

### E0C6002

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ , 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	$t_{sta} \leq 5sec (V_{SS})$	-1.8			V
Oscillation stop voltage	Vstp	$t_{stp} \leq 10sec (V_{SS})$	-1.8			V
Built-in capacitance (drain)	$C_D$	Including the parasitic capacity inside the IC		20		pF
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-1.8$ to $-3.5V$			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	V <sub>hho</sub>	$C_G=5pF (V_{SS})$			-3.6	V
Allowable leak resistance	R <sub>leak</sub>	Between OSC1 and $V_{DD}$ , and between $V_{SS}$ and OSC1	200			M $\Omega$

### E0C60L02

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ , 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	$t_{sta} \leq 5sec (V_{SS})$	-1.2			V
Oscillation stop voltage	Vstp	$t_{stp} \leq 10sec (V_{SS})$	-1.2			V
Built-in capacitance (drain)	$C_D$	Including the parasitic capacity inside the IC		20		pF
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-1.2$ to $-2.0V (-0.9)^{*1}$			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	V <sub>hho</sub>	$C_G=5pF (V_{SS})$			-2.0	V
Allowable leak resistance	R <sub>leak</sub>	Between OSC1 and $V_{DD}$ , and between $V_{SS}$ and OSC1	200			M $\Omega$

\*1: Items enclosed in parentheses ( ) are those used when operating at heavy load protection mode.

### E0C6002 (CR)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-3.0V$ ,  $R_{CR}=420k\Omega$ ,  $T_a=25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	fosc		-20	65kHz	20	%
Oscillation start voltage	Vsta		-1.8			V
Oscillation start time	t <sub>sta</sub>	$V_{SS}=-1.8$ to $-3.5V$		3		mS
Oscillation stop voltage	Vstp		-1.8			V

### E0C60L02 (CR)

(Unless otherwise specified:  $V_{DD}=0V$ ,  $V_{SS}=-1.5V$ ,  $R_{CR}=420k\Omega$ ,  $T_a=25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	fosc		-20	65kHz	20	%
Oscillation start voltage	Vsta		-1.2			V
Oscillation start time	t <sub>sta</sub>	$V_{SS}=-1.2$ to $-2.0V$		3		mS
Oscillation stop voltage	Vstp		-1.2			V

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