

## Micro MINI E0C6005

### 4-bit Single Chip Microcomputer



- E0C6200B Core CPU
- Low Voltage and Low Power
- Built-in LCD Driver
- Built-in R/F Converter (2ch.)

#### ■ DESCRIPTION

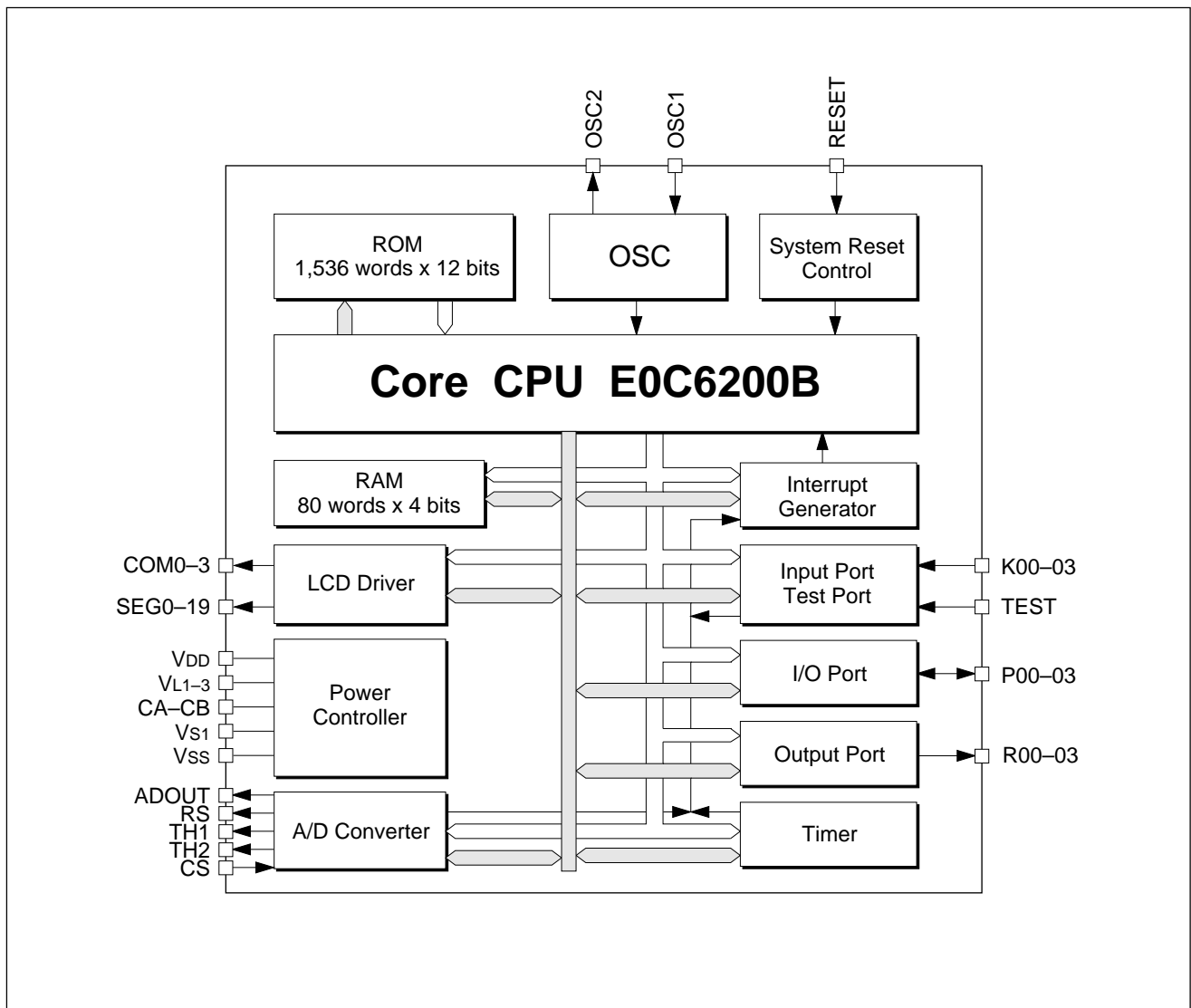
Micro MINI "E0C6005" is a single chip microcomputer for battery-driven products with 7-segment LCD display. It achieves low cost performance, and is suitable for a product added some feature instead of standard IC. It consists that Seiko Epson's original core CPU E0C6200B, LCD driver (20 segments × 4 commons), 80 words RAM, 1.5K words ROM, R/F converter, clock timer and so on.

#### ■ FEATURES

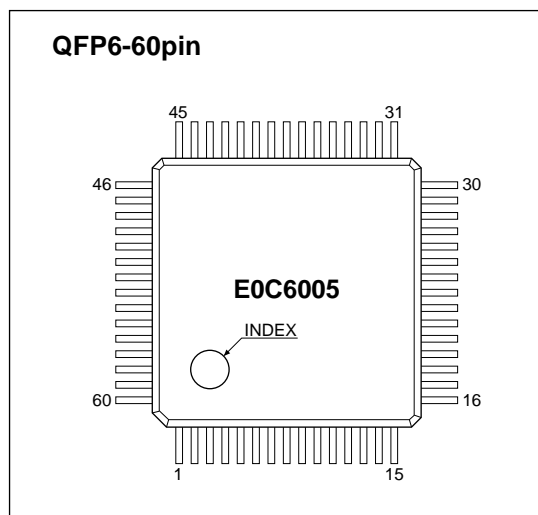
- CMOS LSI 4-bit parallel processing
- Clock ..... 32.768kHz (X'tal or CR oscillation by mask option)
- Instruction set ..... 100 instructions
- ROM capacity ..... 1.5K × 12 bits
- RAM capacity ..... 80 × 4 bits
- I/O port ..... I: 4 bits (with pull-down resistor selectable by mask option)  
O: 4 bits  
I/O: 4 bits
- Supply voltage detector (SVD) ..... No support
- Clock timer ..... 1ch.
- LCD driver ..... 20 segments × 4/3/2 commons
- R/F converter ..... 2ch.
- Interrupt ..... External : Key interrupt 1 line  
Internal : Clock timer interrupt 1 line
- Operation voltage ..... 1.2 to 2.0V  
1.8 to 3.5V
- Power consumption ..... 0.8μA (32.768kHz X'tal, 3.0V, HALT)  
1.5μA (32.768kHz X'tal, 3.0V, RUN)
- Package ..... Die form (pad pitch = 130μm) or QFP6-60pin

# E0C6005

## ■ BLOCK DIAGRAM



## ■ PIN CONFIGURATION



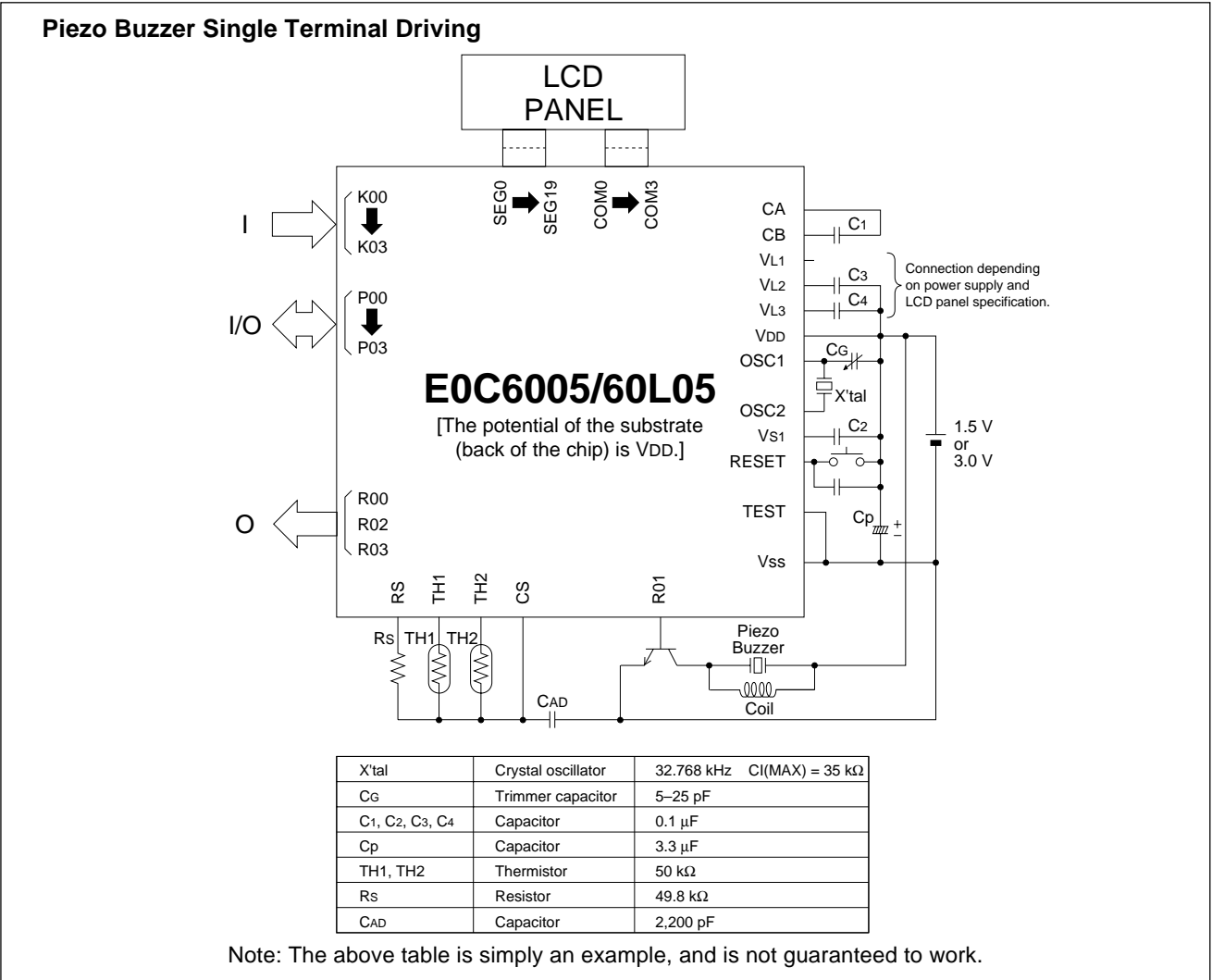
Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	N.C.	16	N.C.	31	TEST	46	VL3
2	N.C.	17	ADOUT	32	RESET	47	VL2
3	K00	18	SEG0	33	SEG12	48	VL1
4	K01	19	SEG1	34	SEG13	49	CA
5	K02	20	SEG2	35	SEG14	50	CB
6	K03	21	SEG3	36	SEG15	51	Vss
7	R00	22	SEG4	37	SEG16	52	VDD
8	R01	23	SEG5	38	SEG17	53	OSC1
9	R02	24	SEG6	39	SEG18	54	OSC2
10	R03	25	SEG7	40	SEG19	55	Vs1
11	RS	26	SEG8	41	COM0	56	P00
12	TH1	27	SEG9	42	COM1	57	P01
13	TH2	28	SEG10	43	COM2	58	P02
14	CS	29	SEG11	44	COM3	59	P03
15	N.C.	30	N.C.	45	N.C.	60	N.C.

N.C. : No Connection

**PIN DESCRIPTION**

Pin name	Pin No.	In/Out	Function
VDD	52	(I)	Power source (+) terminal
VSS	51	(I)	Power source (-) terminal
VS1	55	O	Oscillation and internal logic system regulated voltage output terminal
VL1	48	O	LCD system regulated voltage output terminal
VL2	47	O	LCD system booster output terminal
VL3	46	O	LCD system booster output terminal
CA, CB	49, 50	-	Booster capacitor connecting terminal
OSC1	53	I	Crystal or CR oscillation input terminal
OSC2	54	O	Crystal or CR oscillation output terminal
K00-K03	3-6	I	Input terminal
P00-P03	56-59	I/O	I/O terminal
R00-R03	7-10	O	Output terminal
SEG0-19	18-29 33-40	O	LCD segment output terminal (convertible to DC output terminal by mask option)
COM0-3	41-44	O	LCD common output terminal
CS	14	I	A/D converter CR oscillation input terminal
RS	11	O	A/D converter CR oscillation output terminal
TH1, TH2	12, 13	O	A/D converter CR oscillation output terminal
ADOUT	17	O	A/D converter oscillation frequency output terminal
RESET	32	I	Initial setting input terminal
TEST	31	I	Test input terminal

**BASIC EXTERNAL CONNECTION DIAGRAM**



# E0C6005

## ■ 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>Iosc</sub>	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

#### E0C6005

(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	f <sub>osc1</sub>	Crystal oscillation		32.768		kHz
	f <sub>osc2</sub>	CR oscillation, R=420kΩ		65	80	kHz
Booster capacitor	C <sub>1</sub>		0.1			μF
Capacitor between V <sub>DD</sub> and V <sub>S1</sub>	C <sub>2</sub>		0.1			μF

#### E0C60L05

(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 *1	-2.0	-1.5	-1.2	V
Oscillation frequency	f <sub>osc1</sub>	Crystal oscillation		32.768		kHz
	f <sub>osc2</sub>	CR oscillation, R=420kΩ		65	80	kHz
Booster capacitor	C <sub>1</sub>		0.1			μF
Capacitor between V <sub>DD</sub> and V <sub>S1</sub>	C <sub>2</sub>		0.1			μF

\*1: When there is no software control during CR oscillation or crystal oscillation.

## ● DC Characteristics

### E0C6005

(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	10		40	$\mu A$
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			$\mu A$

### E0C60L05

(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	5.0		20	$\mu A$
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			$\mu A$

# E0C6005

## ● Analog Circuit Characteristics and Current Consumption

### E0C6005 (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	$V_{L1}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L1}$ (without panel load)	$1/2 \cdot V_{L2}$ -0.1		$1/2 \cdot V_{L2}$ $\times 0.9$	V
	$V_{L2}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L2}$ (without panel load)		$V_{SS}$		V
	$V_{L3}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L3}$ (without panel load)	$3/2 \cdot V_{L2}$ -0.1		$3/2 \cdot V_{L2}$ $\times 0.9$	V
Power current consumption	$I_{OP}$	During HALT	Without panel load	0.8	1.4	$\mu A$
		During execution		1.5	5.0	$\mu A$
		During A/D conversion (HALT)		30	40	$\mu A$

### E0C6005 (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	$V_{L1}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L1}$ (without panel load)	$1/2 \cdot V_{L2}$ -0.1		$1/2 \cdot V_{L2}$ $\times 0.85$	V
	$V_{L2}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L2}$ (without panel load)		$V_{SS}$		V
	$V_{L3}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L3}$ (without panel load)	$3/2 \cdot V_{L2}$ -0.1		$3/2 \cdot V_{L2}$ $\times 0.85$	V
Power current consumption	$I_{OP}$	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	$\mu A$

### E0C60L05 (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	$V_{L1}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L1}$ (without panel load)		$V_{SS}$		V
	$V_{L2}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L2}$ (without panel load)	$2 \cdot V_{L1}$ -0.1		$2 \cdot V_{L1}$ $\times 0.9$	V
	$V_{L3}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L3}$ (without panel load)	$3 \cdot V_{L1}$ -0.1		$3 \cdot V_{L1}$ $\times 0.9$	V
Power current consumption	$I_{OP}$	During HALT	Without panel load	0.8	1.4	$\mu A$
		During execution		1.5	5.0	$\mu A$
		During A/D conversion (HALT)		30	40	$\mu A$

### E0C60L05 (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	$V_{L1}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L1}$ (without panel load)		$V_{SS}$		V
	$V_{L2}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L2}$ (without panel load)	$2 \cdot V_{L1}$ -0.1		$2 \cdot V_{L1}$ $\times 0.85$	V
	$V_{L3}$	Connect $1M\Omega$ load resistor between $V_{DD}$ and $V_{L3}$ (without panel load)	$3 \cdot V_{L1}$ -0.1		$3 \cdot V_{L1}$ $\times 0.85$	V
Power current consumption	$I_{OP}$	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	$\mu A$

## E0C6005 (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 <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		8.0	15.0	$\mu A$
		During execution	Without panel load	15.0	20.0	$\mu A$
		During A/D conversion (HALT)		37	52.5	$\mu A$

## E0C6005 (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 <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		16.0	30.0	$\mu A$
		During execution	Without panel load	30.0	40.0	$\mu A$
		During A/D conversion (HALT)		45	57.5	$\mu A$

## E0C60L05 (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 <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		8.0	15.0	$\mu A$
		During execution	Without panel load	15.0	20.0	$\mu A$
		During A/D conversion (HALT)		37	52.5	$\mu A$

## E0C60L05 (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 <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		16.0	30.0	$\mu A$
		During execution	Without panel load	30.0	40.0	$\mu A$
		During A/D conversion (HALT)		45	57.5	$\mu A$

# E0C6005

## ● Oscillation Characteristics

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

### E0C6005

(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	$V_{hho}$	$C_G=5pF$ ( $V_{SS}$ )			-3.6	V
Allowable leak resistance	$R_{leak}$	Between OSC1 and $V_{DD}$ , and between $V_{SS}$ and OSC1	200			$M\Omega$

### E0C60L05

(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	$V_{hho}$	$C_G=5pF$ ( $V_{SS}$ )			-2.0	V
Allowable leak resistance	$R_{leak}$	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.

### E0C6005 (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	$t_{sta}$	$V_{SS}=-1.8$ to $-3.5V$		3		mS
Oscillation stop voltage	Vstp		-1.8			V

### E0C60L05 (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	$t_{sta}$	$V_{SS}=-1.2$ to $-2.0V$		3		mS
Oscillation stop voltage	Vstp		-1.2			V

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