

Micro MINI E0C6001

4-bit Single Chip Microcomputer



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

■ DESCRIPTION

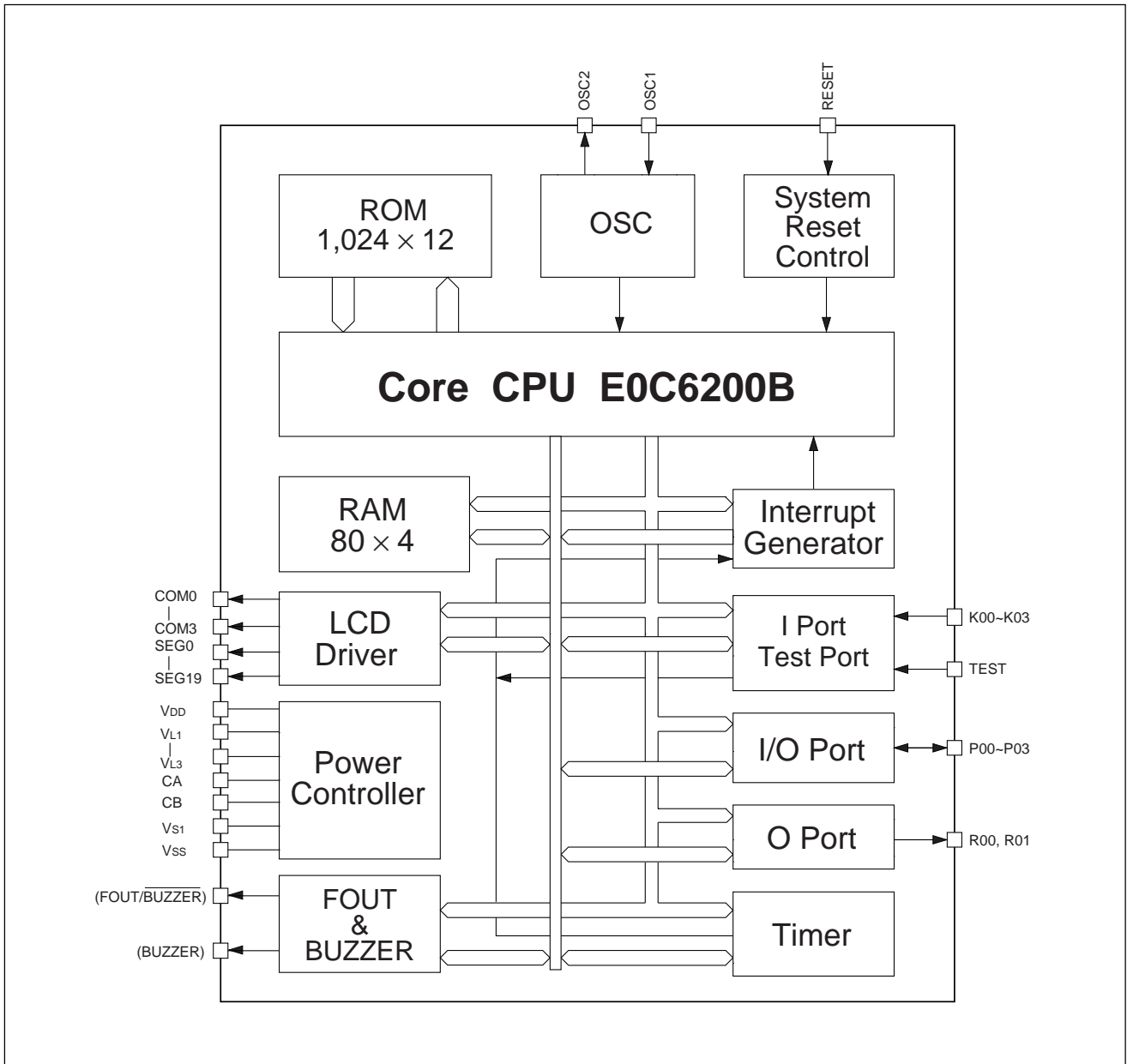
Micro MINI "E0C6001" is a single chip microcomputer for battery-driven products with 7-segment LCD display. It achieves low cost performance, and is suitable for a product added some feature instead of standard IC. It consists that Seiko Epson's original core CPU E0C6200B, LCD driver (20 segments × 4 commons), 80 words RAM, 1K words ROM, clock timer and so on.

■ FEATURES

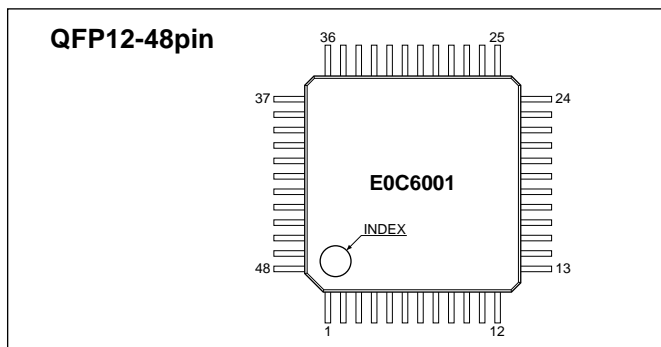
- CMOS LSI 4-bit parallel processing
- Clock 32.768kHz (X'tal or CR oscillation by mask option)
- Instruction set 100 instructions
- ROM capacity 1,024 × 12 bits
- RAM capacity 80 × 4 bits
- I/O port I: 4 bits (with pull-down resistor selectable by mask option)
O: 2 bits (buzzer output possible by mask option)
I/O: 4 bits
- Supply voltage detector (SVD) No support
- Clock timer 1ch.
- LCD driver 20 segments × 4/3 commons
- Interrupt External : Key interrupt 1 line
Internal : Clock timer interrupt 1 line
- Operation voltage 1.2 to 2.0V (E0C60L01)
1.8 to 3.6V (E0C6001)
- 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 QFP12-48pin

E0C6001

■ BLOCK DIAGRAM



■ PIN CONFIGURATION



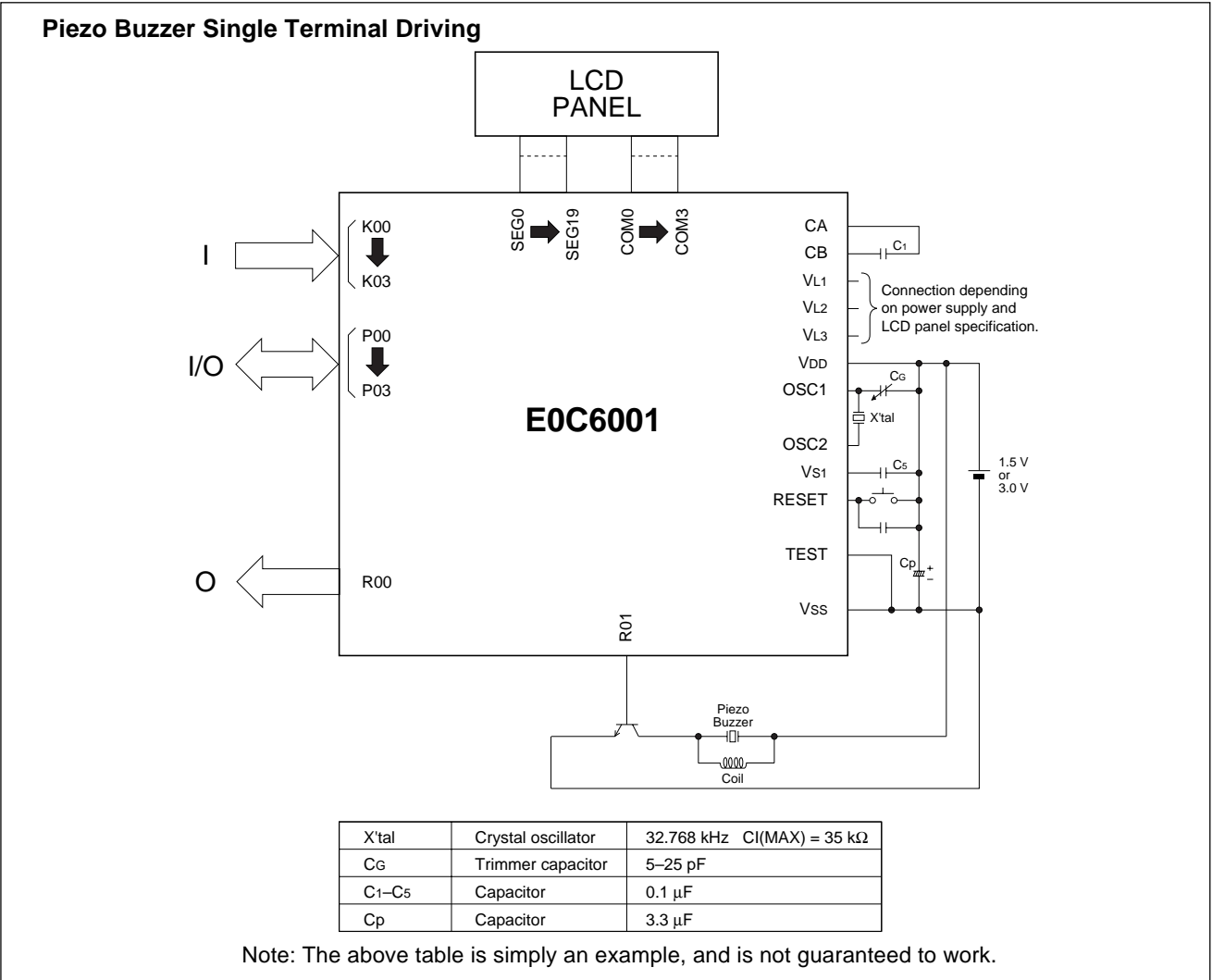
No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name
1	OSC2	13	R01	25	TEST	37	COM0
2	Vs1	14	R00	26	RESET	38	COM1
3	N.C.	15	SEG19	27	SEG9	39	COM2
4	P00	16	SEG18	28	SEG8	40	COM3
5	P01	17	SEG17	29	SEG7	41	VL3
6	P02	18	SEG16	30	SEG6	42	VL2
7	P03	19	SEG15	31	SEG5	43	VL1
8	K00	20	SEG14	32	SEG4	44	CA
9	K01	21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

N.C. = No Connection

■ PIN DESCRIPTION

Pin name	Pin No.	In/Out	Function
VDD	47	(I)	Power source (+) terminal
VSS	46	(I)	Power source (-) terminal
Vs1	2	O	Oscillation and internal logic system regulated voltage output terminal
VL1	43	O	LCD system reducer output terminal ($V_{L2} \times 1/2$) / LCD system reducer output terminal ($V_{L3} \times 1/3$)
VL2	42	O	LCD system booster output terminal ($V_{L1} \times 2$) / LCD system reducer output terminal ($V_{L3} \times 2/3$)
VL3	41	O	LCD system booster output terminal ($V_{L1} \times 3$) / LCD system booster output terminal ($V_{L2} \times 3/2$)
CA, CB	44, 45	-	Booster capacitor connecting terminal
OSC1	48	I	Crystal or CR oscillation input terminal
OSC2	1	O	Crystal or CR oscillation output terminal
K00-K03	8-11	I	Input terminal
P00-P03	4-7	I/O	I/O terminal
R00, R01	14, 13	O	Output terminal
SEG0-19	36-27 24-15	O	LCD segment output terminal (convertible to DC output terminal by mask option)
COM0-3	37-40	O	LCD common output terminal
RESET	26	I	Initial setting input terminal
TEST	25	I	Test input terminal

■ BASIC EXTERNAL CONNECTION DIAGRAM



E0C6001

■ ELECTRICAL CHARACTERISTICS

● Absolute Maximum Ratings

(V_{DD}=0V)

Rating	Symbol	Value	Unit
Power voltage	V _{SS}	-5.0 to 0.5	V
Input voltage (1)	V _I	V _{SS} - 0.3 to 0.5	V
Input voltage (2)	V _{Iosc}	V _{SS} - 0.3 to 0.5	V
Permissible total output current *1	ΣI _{VSS}	10	mA
Operating temperature	T _{opr}	-20 to 70	°C
Storage temperature	T _{stg}	-65 to 150	°C
Soldering temperature / Time	T _{sol}	260°C, 10sec (lead section)	—
Allowable dissipation *2	P _D	250	mW

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

*2: In case of plastic package (QFP12-48pin).

● Recommended Operating Conditions

E0C6001

(T_a=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Power voltage	V _{SS}	V _{DD} =0V	-3.6	-3.0	-1.8	V
Oscillation frequency	fosc1	Crystal oscillation		32.768		kHz
	fosc2	CR oscillation, R=470kΩ	50	65	80	kHz
Booster capacitor	C1		0.1			μF
Capacitor between V _{DD} and V _{L1}	C2		0.1			μF
Capacitor between V _{DD} and V _{L2}	C3		0.1			μF
Capacitor between V _{DD} and V _{L3}	C4		0.1			μF
Capacitor between V _{DD} and V _{S1}	C5		0.1			μF

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(T_a=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Power voltage	V _{SS}	V _{DD} =0V	-2.0	-1.5	-1.2	V
Oscillation frequency	fosc1	Crystal oscillation		32.768	80	kHz
	fosc2	CR oscillation, R=470kΩ	50	65		kHz
Booster capacitor	C1		0.1			μF
Capacitor between V _{DD} and V _{L1}	C2		0.1			μF
Capacitor between V _{DD} and V _{L2}	C3		0.1			μF
Capacitor between V _{DD} and V _{L3}	C4		0.1			μF
Capacitor between V _{DD} and V _{S1}	C5		0.1			μF

● DC Characteristics

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(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, $C_1-C_5=0.1\mu F$)

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	μA
High level input current (2)	I_{IH2}	$V_{IH2}=0V$, With pull down resistor	10		40	μA
High level input current (3)	I_{IH3}	$V_{IH3}=0V$, With pull down resistor	30		100	μA
Low level input current	I_{IL}	$V_{IL}=V_{SS}$	-0.5		0	μA
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
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
Common output current	I_{OH3}	$V_{OH3}=-0.05V$			-3	μA
	I_{OL3}	$V_{OL3}=V_{L3}+0.05V$	3			μA
Segment output current (during LCD output)	I_{OH4}	$V_{OH4}=-0.05V$			-3	μA
	I_{OL4}	$V_{OL4}=V_{L3}+0.05V$	3			μA
Segment output current (during DC output)	I_{OH5}	$V_{OH5}=0.1 \cdot V_{SS}$			-300	μA
	I_{OL5}	$V_{OL5}=0.9 \cdot V_{SS}$	300			μA

E0C60L01

(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, $C_1-C_5=0.1\mu F$)

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	μA
High level input current (2)	I_{IH2}	$V_{IH2}=0V$, With pull down resistor	5.0		20	μA
High level input current (3)	I_{IH3}	$V_{IH3}=0V$, With pull down resistor	9.0		100	μA
Low level input current	I_{IL}	$V_{IL}=V_{SS}$	-0.5		0	μA
High level output current (1)	I_{OH1}	$V_{OH1}=0.1 \cdot V_{SS}$			-200	μA
High level output current (2)	I_{OH2}	$V_{OH2}=0.1 \cdot V_{SS}$ (built-in protection resistance)			-200	μA
Low level output current (1)	I_{OL1}	$V_{OL1}=0.9 \cdot V_{SS}$	700			μA
Low level output current (2)	I_{OL2}	$V_{OL2}=0.9 \cdot V_{SS}$ (built-in protection resistance)	700			μA
Common output current	I_{OH3}	$V_{OH3}=-0.05V$			-3	μA
	I_{OL3}	$V_{OL3}=V_{L3}+0.05V$	3			μA
Segment output current (during LCD output)	I_{OH4}	$V_{OH4}=-0.05V$			-3	μA
	I_{OL4}	$V_{OL4}=V_{L3}+0.05V$	3			μA
Segment output current (during DC output)	I_{OH5}	$V_{OH5}=0.1 \cdot V_{SS}$			-100	μA
	I_{OL5}	$V_{OL5}=0.9 \cdot V_{SS}$	130			μA

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● Analog Circuit Characteristics and Current Consumption

E0C6001 (Normal Operating Mode)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $f_{osc}=32.768kHz$ (crystal oscillation), $T_a=25^{\circ}C$, $C_G=25pF$, $V_{S1}/V_{L1}-V_{L3}$ are internal voltage, $C_1-C_5=0.1\mu F$)

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	IOP	During HALT	Without panel load	1.0	2.5	μA
		During execution		2.5	5.0	μA

E0C6001 (Heavy Load Protection Mode)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $f_{osc}=32.768kHz$ (crystal oscillation), $T_a=25^{\circ}C$, $C_G=25pF$, $V_{S1}/V_{L1}-V_{L3}$ are internal voltage, $C_1-C_5=0.1\mu F$)

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	IOP	During HALT	Without panel load	2.0	5.5	μA
		During execution		5.5	10.0	μA

E0C60L01 (Normal Operating Mode)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-1.5V$, $f_{osc}=32.768kHz$ (crystal oscillation), $T_a=25^{\circ}C$, $C_G=25pF$, $V_{S1}/V_{L1}-V_{L3}$ are internal voltage, $C_1-C_5=0.1\mu F$)

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	IOP	During HALT	Without panel load	1.0	2.5	μA
		During execution		2.5	5.0	μA

E0C60L01 (Heavy Load Protection Mode)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-1.5V$, $f_{osc}=32.768kHz$ (crystal oscillation), $T_a=25^{\circ}C$, $C_G=25pF$, $V_{S1}/V_{L1}-V_{L3}$ are internal voltage, $C_1-C_5=0.1\mu F$)

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	IOP	During HALT	Without panel load	2.0	5.5	μA
		During execution		5.5	10.0	μA

E0C6001 (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, $C_1-C_5=0.1\mu F$, Recommended external resistance for CR oscillation= $470k\Omega$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M Ω 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 Ω load resistor between V_{DD} and VL2 (without panel load)		V _{SS}		V
	VL3	Connect 1M Ω 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	μA
		During execution		15.0	20.0	μA

E0C6001 (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, $C_1-C_5=0.1\mu F$, Recommended external resistance for CR oscillation= $470k\Omega$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M Ω 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 Ω load resistor between V_{DD} and VL2 (without panel load)		V _{SS}		V
	VL3	Connect 1M Ω 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	μA
		During execution		30.0	40.0	μA

E0C60L01 (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, $C_1-C_5=0.1\mu F$, Recommended external resistance for CR oscillation= $470k\Omega$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M Ω load resistor between V_{DD} and VL1 (without panel load)		V _{SS}		V
	VL2	Connect 1M Ω 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 Ω 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	μA
		During execution		15.0	20.0	μA

E0C60L01 (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, $C_1-C_5=0.1\mu F$, Recommended external resistance for CR oscillation= $470k\Omega$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Internal voltage	VL1	Connect 1M Ω load resistor between V_{DD} and VL1 (without panel load)		V _{SS}		V
	VL2	Connect 1M Ω 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 Ω 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	μA
		During execution		30.0	40.0	μA

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● Oscillation Characteristics

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

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(Unless otherwise specified: V_{DD}=0V, V_{SS}=-3.0V, Crystal: C-002R (C_I=35kΩ), C_G=25pF, C_D=built-in, T_a=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	V _{sta}	t _{sta} ≤5sec (V _{ss})	-1.8			V
Oscillation stop voltage	V _{stp}	t _{stp} ≤10sec (V _{ss})	-1.8			V
Built-in capacitance (drain)	C _D	Including the parasitic capacity inside the IC		20		pF
Frequency/voltage deviation	∂f/∂V	V _{ss} =-1.8 to -3.6V			5	ppm
Frequency/IC deviation	∂f/∂IC		-10		10	ppm
Frequency adjustment range	∂f/∂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}	200			MΩ

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(Unless otherwise specified: V_{DD}=0V, V_{SS}=-1.5V, Crystal: C-002R (C_I=35kΩ), C_G=25pF, C_D=built-in, T_a=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	V _{sta}	t _{sta} ≤5sec (V _{ss})	-1.2			V
Oscillation stop voltage	V _{stp}	t _{stp} ≤10sec (V _{ss})	-1.2			V
Built-in capacitance (drain)	C _D	Including the parasitic capacity inside the IC		20		pF
Frequency/voltage deviation	∂f/∂V	V _{ss} =-1.2 to -2.0V			5	ppm
Frequency/IC deviation	∂f/∂IC		-10		10	ppm
Frequency adjustment range	∂f/∂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}	200			MΩ

E0C6001 (CR)

(Unless otherwise specified: V_{DD}=0V, V_{SS}=-3.0V, R_{CR}=470kΩ, T_a=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	f _{osc}		-20	65kHz	20	%
Oscillation start voltage	V _{sta}		-1.8			V
Oscillation start time	t _{sta}	V _{ss} =-1.8 to -3.6V		3		mS
Oscillation stop voltage	V _{stp}		-1.8			V

E0C60L01 (CR)

(Unless otherwise specified: V_{DD}=0V, V_{SS}=-1.5V, R_{CR}=470kΩ, T_a=25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	f _{osc}		-20	65kHz	20	%
Oscillation start voltage	V _{sta}		-1.2			V
Oscillation start time	t _{sta}	V _{ss} =-1.2 to -2.0V		3		mS
Oscillation stop voltage	V _{stp}		-1.2			V

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