

E0C6S48

4-bit Single Chip Microcomputer



- Core CPU Architecture
- Dot Matrix LCD Driver
- Programmable SVD Circuit/Sound Generator

■ DESCRIPTION

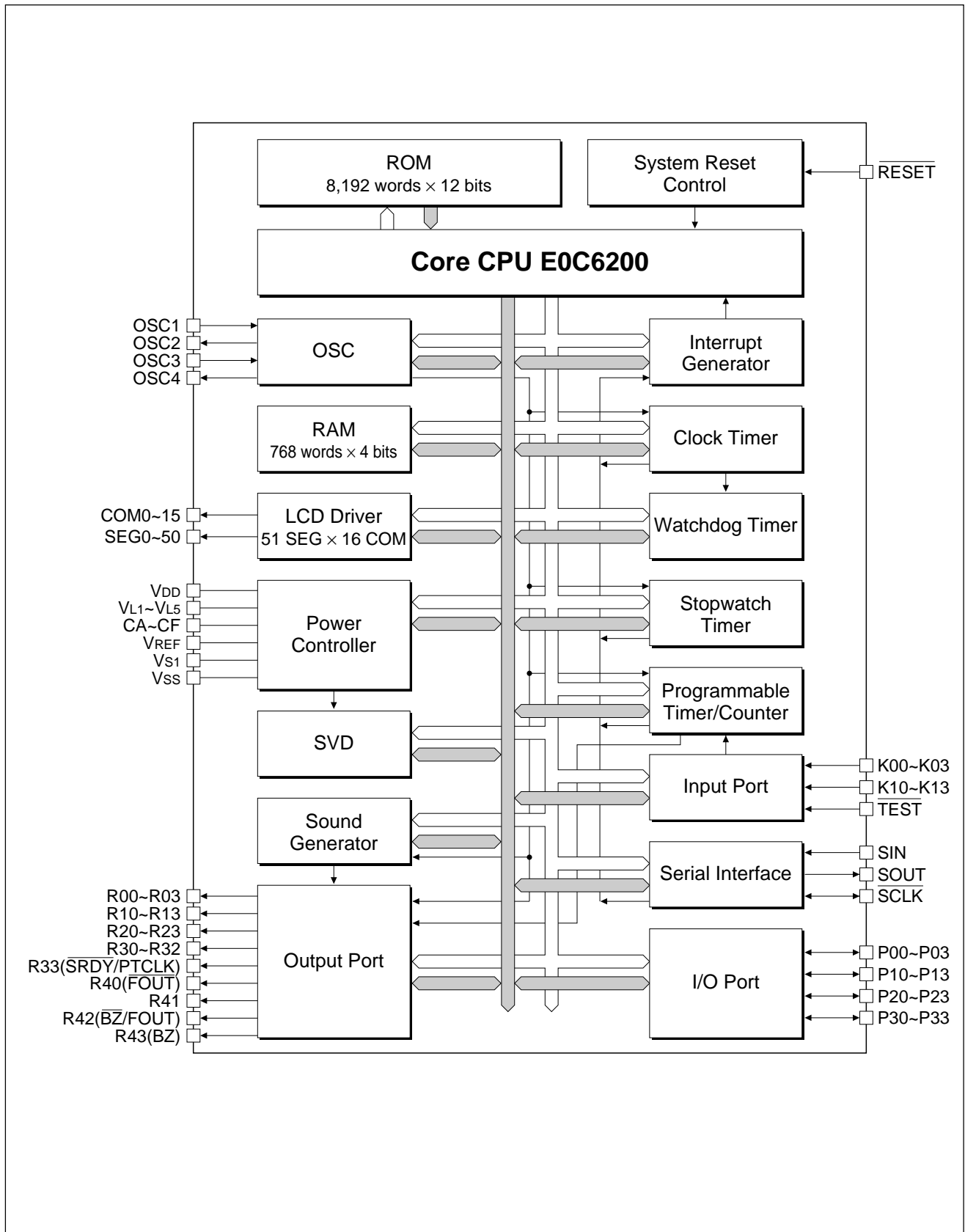
The E0C6S48 is a single-chip microcomputer made up of the 4-bit core CPU E0C6200, ROM, RAM, dot matrix LCD driver, input ports, output ports, I/O ports, clock timer, stopwatch timer, programmable timer, clock-synchronized serial interface, sound generator and watchdog timer. The E0C6S48 is most suitable for applications with equipment dot matrix display functions such as a highly functional electronic notebook.

■ FEATURES

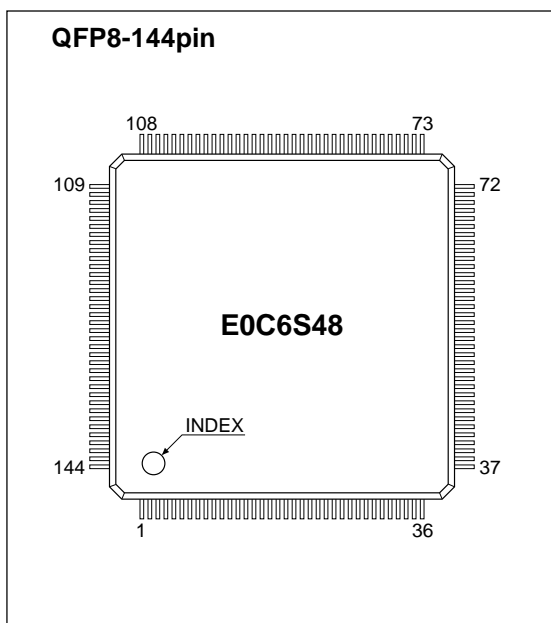
- CMOS LSI 4-bit parallel processing
 - Oscillation circuit OSC1 : 32.768kHz (Typ.) Crystal or CR oscillation circuit (*1)
OSC3 : 2MHz (Max.) CR or ceramic oscillation circuit (*1)
 - Instruction set 108 instructions
 - Instruction execution time 32.768kHz : 152.6μsec, 213.6μsec, 366.2μsec
(depending on the instruction) 1MHz : 5.0μsec, 7.0μsec, 12.0μsec
2MHz : 2.5μsec, 3.5μsec, 6.0μsec
 - ROM capacity 8,192 words × 12 bits
 - RAM capacity Data memory : 768 words × 4 bits
Display memory : 204 words × 4 bits
 - Input port 8 bits (pull-up resistors may be supplemented *1)
 - Output port 20 bits (buzzer and clock outputs are possible *1)
 - I/O port 16 bits
 - Serial interface 8-bit clock synchronous system × 1 ch.
 - Dot matrix type LCD driver 51 segments × 16 or 8 commons (*2)
 - Time base counter Clock timer, stopwatch timer
 - Programmable timer 8-bit timer × 1 ch., with event counter and clock output functions
 - Watchdog timer Built-in
 - Sound generator 8 programmable sounds (8 types of frequency)
with envelope and 1-shot output functions
 - Supply voltage detection (SVD) -2.2, -2.5, -3.1, -4.2V programmable (VDD standard)
 - Interrupts External : Input port interrupt 2 systems
Internal : Clock timer interrupt 1 system
Stopwatch timer interrupt 1 system
Programmable timer interrupt 1 system
Serial interface interrupt 1 system
 - Power supply voltage 2.2V to 5.5V (Min. 1.8V when the OSC3 oscillation circuit is not used)
 - Operating temperature range -20°C to 70°C
 - Current consumption (Typ.) HALT mode : 32.768kHz (crystal oscillation), 3.0V 2.5μA
OPERATING mode : 32.768kHz (crystal oscillation), 3.0V 6.5μA
2MHz (CR oscillation), 3.0V 1mA
 - Package QFP8-144pin (plastic) or chip
- *1: Can be selected with mask option *2: Can be selected with software

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■ BLOCK DIAGRAM



PIN CONFIGURATION



No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name
1	CB	30	SEG41	59	SEG15	88	P33	117	R13
2	CA	31	SEG40	60	SEG14	89	P32	118	R12
3	N.C.	32	SEG39	61	SEG13	90	P31	119	R11
4	COM0	33	SEG38	62	SEG12	91	P30	120	R10
5	COM1	34	SEG37	63	SEG11	92	P23	121	R03
6	COM2	35	N.C.	64	SEG10	93	P22	122	R02
7	COM3	36	N.C.	65	SEG9	94	P21	123	R01
8	COM4	37	SEG36	66	SEG8	95	P20	124	R00
9	COM5	38	SEG35	67	SEG7	96	P13	125	V _{SS}
10	COM6	39	SEG34	68	SEG6	97	N.C.	126	RESET
11	COM7	40	SEG33	69	SEG5	98	P12	127	TEST
12	COM8	41	SEG32	70	SEG4	99	P11	128	OSC4
13	COM9	42	SEG31	71	SEG3	100	P10	129	OSC3
14	COM10	43	SEG30	72	SEG2	101	P03	130	V _{S1}
15	COM11	44	SEG29	73	SEG1	102	P02	131	OSC2
16	COM12	45	SEG28	74	SEG0	103	P01	132	OSC1
17	COM13	46	SEG27	75	N.C.	104	P00	133	N.C.
18	COM14	47	SEG26	76	SCLK	105	R43	134	V _{DD}
19	N.C.	48	SEG25	77	SOUT	106	R42	135	V _{REF}
20	COM15	49	SEG24	78	SIN	107	R41	136	VL1
21	SEG50	50	N.C.	79	K13	108	R40	137	VL2
22	SEG49	51	SEG23	80	K12	109	R33	138	VL3
23	SEG48	52	SEG22	81	K11	110	R32	139	VL4
24	SEG47	53	SEG21	82	K10	111	R31	140	VL5
25	SEG46	54	SEG20	83	K03	112	R30	141	CF
26	SEG45	55	SEG19	84	N.C.	113	R23	142	CE
27	SEG44	56	SEG18	85	K02	114	R22	143	CD
28	SEG43	57	SEG17	86	K01	115	R21	144	CC
29	SEG42	58	SEG16	87	K00	116	R20		

N.C. = No Connection

PIN DESCRIPTION

Pin name	Pin No.	I/O	Function
V _{DD}	134	-	Power supply (+)
V _{SS}	125	-	Power supply (-)
V _{S1}	130	-	Internal logic system/oscillation system regulated voltage output
VL1-VL5	136-140	-	LCD system power supply 1/4 bias generated internally, 1/5 bias generated externally *1
V _{REF}	135	O	LCD system power test pin *2
CA-CF	2, 1, 144-141	-	LCD system voltage booster condenser connecting pin
OSC1	132	I	Crystal or CR oscillator input *1
OSC2	131	O	Crystal or CR oscillator output *1, C _D built-in
OSC3	129	I	CR or ceramic oscillator input *1
OSC4	128	O	CR or ceramic oscillator output *1
COM0-COM15	4-18, 20	O	LCD common output (1/8 duty or 1/16 duty is selected on software)
SEG0-SEG50	74-51, 49-37, 34-21	O	LCD segment output
K00-K03	87-85, 83	I	Input port (pull up resistor is available by mask option) *1
K10-K13	82-79	I	Input port (pull up resistor is available by mask option) *1
P00-P03	104-101	I/O	I/O port
P10-P13	100-98, 96	I/O	I/O port
P20-P23	95-92	I/O	I/O port
P30-P33	91-88	I/O	I/O port or output port *1
R00-R03	124-121	O	Output port
R10-R13	120-117	O	Output port
R20-R23	116-113	O	Output port
R30-R32	112-110	O	Output port
R33	109	O	Output port, SRDY output or PTCLK output *1
R40	108	O	Output port or FOUT output *1
R41	107	O	Output port
R42	106	O	Output port, BZ output or FOUT output *1
R43	105	O	Output port or BZ output *1
SIN	78	I	Serial interface data input
SOUT	77	O	Serial interface data output
SCLK	76	I/O	Serial interface clock input/output
RESET	126	I	Initial reset input terminal
TEST	127	I	Testing input terminal *3

*1 Selected by mask option

*2 Leave the V_{REF} pin unconnected (N.C.).

*3 The TEST pin is used when the IC load is being detected. During ordinary operation be certain to connect this pin to V_{DD}.

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■ ELECTRICAL CHARACTERISTICS

● Absolute Maximum Ratings

(V_{DD}=0V)

Rating	Symbol	Value	Unit
Supply voltage	V _{SS}	-7.0 to 0.5	V
Input voltage (1)	V _I	V _{SS} - 0.3 to 0.5	V
Input voltage (2)	V _{IOSC}	V _{S1} - 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)	—
Permissible dissipation *2	P _D	250	mW
Electrostatic proof pressure	V _E	EIAJ test method (C=200pF) 150V or more MIL test method (C=100pF, R=1.5kΩ) 900V or more	V

*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.

● Recommended Operating Conditions

(T_a=-20 to 70°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit	
Supply voltage	V _{SS}	V _{DD} =0V	VSC="0"	-3.8	-3.0	-1.8	V
			VSC="1"	-5.5	-3.0	-2.2	V
			VSC="2"	-5.5	-5.0	-3.5	V
Oscillation frequency (1)	f _{osc1}		20	32.768	50	kHz	
Oscillation frequency (2)	f _{osc3}	VSC="1"	50	1,000	1,200	kHz	
Oscillation frequency (3)	f _{osc3}	VSC="2"	50	2,000	2,300	kHz	
Voltage booster capacitor (1)	C ₁			0.1		μF	
Voltage booster capacitor (2)	C ₂			0.1		μF	
Voltage booster capacitor (3)	C ₃			0.1		μF	
Capacitor between V _{DD} and V _{L1}	C ₄			0.1		μF	
Capacitor between V _{DD} and V _{L2}	C ₅			0.1		μF	
Capacitor between V _{DD} and V _{L4}	C ₆			0.1		μF	
Capacitor between V _{DD} and V _{L5}	C ₇			0.1		μF	
Capacitor between V _{DD} and V _{S1}	C ₈			0.1		μF	

● DC Characteristics

(Unless otherwise specified: V_{DD}=0V, V_{SS}=-3.0V, V_{L1}=-1.0V, V_{L2}=-2.0V, V_{L4}=-3.0V, V_{L5}=-4.0V, f_{osc1}=32.768kHz, f_{osc3}=1MHz, T_a=25°C, C₁-C₈=0.047μF)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage	V _{HIN}	V _{SS} =-2.2 to -5.5V Ta=25°C	0.2•V _{SS}		0	V
Low level input voltage	V _{LIN}	Ta=25°C	V _{SS}		0.8•V _{SS}	V
High level input voltage	V _{HIN}	V _{SS} =-2.2 to -5.5V RESET	-0.2		0	V
Low level input voltage	V _{LIN}	Ta=25°C	V _{SS}		V _{SS} +0.2	V
High level input current	I _{IH}	V _{SS} =-3.0V V _{IH} =0V	0		0.5	μA
Low level input current (1)	I _{IL1}	V _{SS} =-3.0V V _{IL1} =V _{SS} With pull-up resistor	-45		-15	μA
Low level input current (2)	I _{IL2}	V _{SS} =-3.0V V _{IL2} =V _{SS} No pull-up resistor	-0.5		0	μA
High level output current (1)	I _{OH1}	V _{SS} =-2.2V V _{OH1} =-0.5V			-1.0	mA
Low level output current (1)	I _{OL1}	V _{SS} =-2.2V V _{OL1} =V _{SS} +0.5V	2.0			mA
High level output current (2)	I _{OH2}	V _{SS} =-2.2V V _{OH2} =-0.5V			-2.0	mA
Low level output current (2)	I _{OL2}	V _{SS} =-2.2V V _{OL1} =V _{SS} +0.5V	4.0			mA
Common output current	I _{OH3}	V _{OH3} =-0.05V			-30	μA
	I _{OL3}	V _{OL3} =V _{L5} +0.05V	30			μA
Segment output current	I _{OH4}	V _{OH4} =-0.05V			-10	μA
	I _{OL4}	V _{OL4} =V _{L5} +0.05V	10			μA

● Analog Circuit Characteristics and Current Consumption

(Unless otherwise specified: V_{DD}=0V, V_{SS}=-3.0V, V_{L1}=-1.0V, V_{L2}=-2.0V, V_{L4}=-3.0V, V_{L5}=-4.0V, f_{osc1}=32.768kHz, f_{osc3}=1MHz, T_a=25°C, C₁-C₈=0.047μF)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
LCD drive voltage (Normal mode)	V _{L1}	Connects a 1MΩ load resistance between V _{DD} and V _{L1} (No panel load)	1/2·V _{L2}		1/2·V _{L2}	V	
			-0.1		×0.95		
	V _{L2}	Connects a 1MΩ load resistance between V _{DD} and V _{L2} (No panel load)	LC="0"	Typ. ×1.12	-1.80	Typ. ×0.88	V
			LC="1"		-1.85		
			LC="2"		-1.90		
			LC="3"		-1.95		
			LC="4"		-2.01		
			LC="5"		-2.06		
			LC="6"		-2.11		
			LC="7"		-2.17		
			LC="8"		-2.22		
			LC="9"		-2.27		
			LC="10"		-2.32		
			LC="11"		-2.38		
			LC="12"		-2.43		
LC="13"	-2.48						
LC="14"	-2.53						
LC="15"	-2.59						
V _{L4}	Connects a 1MΩ load resistance between V _{DD} and V _{L4} (No panel load)	3/2·V _{L2}		3/2·V _{L2}	V		
V _{L5}	Connects a 1MΩ load resistance between V _{DD} and V _{L5} (No panel load)	2·V _{L2}		2·V _{L2}	V		
				×0.95			
LCD drive voltage (Heavy load protection mode)	V _{L1}	Connects a 1MΩ load resistance between V _{DD} and V _{L1} (No panel load)	Typ. ×1.12	-0.92	Typ. ×0.88	V	
				LC="1"			-0.95
				LC="2"			-0.97
				LC="3"			-1.00
				LC="4"			-1.03
				LC="5"			-1.05
				LC="6"			-1.08
				LC="7"			-1.11
				LC="8"			-1.13
				LC="9"			-1.16
				LC="10"			-1.18
				LC="11"			-1.21
				LC="12"			-1.24
	LC="13"	-1.26					
	LC="14"	-1.29					
LC="15"	-1.32						
V _{L2}	Connects a 1MΩ load resistance between V _{DD} and V _{L2} (No panel load)	2·V _{L1}		2·V _{L1}	V		
V _{L4}	Connects a 1MΩ load resistance between V _{DD} and V _{L4} (No panel load)	3·V _{L1}		3·V _{L1}	V		
V _{L5}	Connects a 1MΩ load resistance between V _{DD} and V _{L5} (No panel load)	4·V _{L1}		4·V _{L1}	V		
				×0.90			
SVD voltage	V _{SVD0}	SVC="0"	-2.35	-2.20	-2.05	V	
	V _{SVD1}	SVC="1"	-2.70	-2.50	-2.30	V	
	V _{SVD2}	SVC="2"	-3.30	-3.10	-2.90	V	
	V _{SVD3}	SVC="3"	-4.50	-4.20	-3.90	V	
SVD circuit response time	t _{SVD}			100	μs		
Current consumption *1 (OSC1/crystal oscillation)	I _{hit}	During HALT (VSC="0", OSC="0")		2.5	5.0	μA	
	I _{EX1}	During operation at 32kHz (VSC="0", OSC="0")		6.5	9.0	μA	
	I _{EX2}	During operation at 1MHz (VSC="1")		400	600	μA	
	I _{EX3}	During operation at 2MHz (VSC="2", V _{SS} =-5.0V)		1,000	1,500	μA	
Current consumption *1 (OSC1/CR oscillation)	I _{hit}	During HALT (VSC="0" or "1", OSC="0")		20	70	μA	
	I _{EX1}	During operation at f _{osc1} (VSC="0" or "1", OSC="0")		25	80	μA	
	I _{EX2}	During operation at 1MHz (VSC="1")		420	600	μA	
	I _{EX3}	During operation at 2MHz (VSC="2", V _{SS} =-5.0V)		1,000	1,500	μA	

*1: No panel load. The SVD circuit is in OFF status.

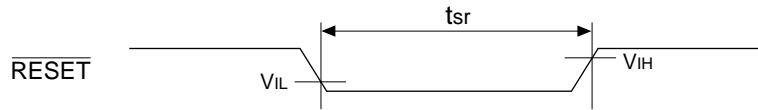
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● AC Characteristics

RESET Input

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $f_{osc1}=32.768kHz$, $T_a=25^{\circ}C$, $V_{IH}=0.5V_{SS}$, $V_{IL}=0.9V_{SS}$)

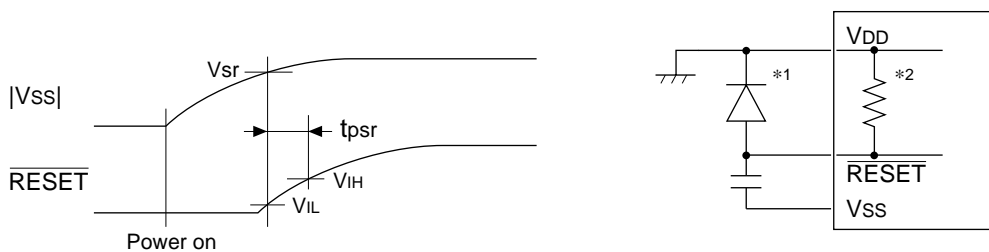
Characteristic	Symbol	Min.	Typ.	Max.	Unit
RESET input time	t_{sr}	2.0			ms



Power-on Reset

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $f_{osc1}=32.768kHz$, $T_a=25^{\circ}C$)

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Operating power voltage	V_{sr}	-2.2			V
RESET input time	t_{psr}	2.0			ms



*1 Because the potential of the \overline{RESET} terminal not reached V_{DD} level or higher.

*2 Built-in pull-up resistor

● Oscillation Characteristics

The oscillation characteristics change depending on the conditions (components used, board pattern, etc.). Use the following characteristics as reference values.

OSC1 Crystal Oscillation Circuit

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, Crystal: C-002R($C_I=35k\Omega$), $C_{GX}=25pF$, $C_{DX}=\text{built-in}$, $R_{FX}=10M\Omega$, $T_a=25^{\circ}C$, $V_{SC}="0"$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start time	t_{sta}	$V_{SS}=-2.2$ to $-5.5V$			5	s
Built-in drain capacitance	C_D	Package as assembled		20		pF
		Bare chip		19		pF
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-2.2$ to $-5.5V$			5	ppm
Frequency/IC deviation	$\partial f/\partial IC$		-10		10	ppm
Frequency adjustable range	$\partial f/\partial C_G$	$C_G=5$ to $25pF$	35	45		ppm
Harmonic oscillation start voltage	V_{hho}	$C_G=5pF$ (V_{SS})			-5.5	V
Permitted leak resistance	R_{leak}	Between OSC1 and V_{DD} , V_{S1}	200			$M\Omega$

OSC1 CR Oscillation Circuit

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $T_a=25^{\circ}C$, $V_{SC}="0"$ or "1")

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f_{osc1}	$R_{CR1}=1.6M\Omega$	Typ. $\times 70\%$	32	Typ. $\times 130\%$	kHz
Oscillation start time	t_{sta}	$V_{SS}=-2.2$ to $-5.5V$			10	ms
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-2.2$ to $-5.5V$	-5		+5	%

OSC3 CR Oscillation Circuit (1)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $T_a=25^\circ C$, $V_{SC}="1"$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency	fosc3	Rcr2=60kΩ	Typ. ×70%	1,000	Typ. ×130%	kHz
Oscillation start time	tsta	Vss=-2.2 to -5.5V			10	ms
Frequency/voltage deviation	∂f/∂V	Vss=-2.2 to -5.5V	-5		+5	%

OSC3 CR Oscillation Circuit (2)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-5.0V$, $T_a=25^\circ C$, $V_{SC}="2"$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency	fosc3	Rcr2=30kΩ	Typ. ×70%	2.0	Typ. ×130%	MHz
Oscillation start time	tsta	Vss=-3.5 to -5.5V			10	ms
Frequency/voltage deviation	∂f/∂V	Vss=-3.5 to -5.5V	-5		+5	%

OSC3 Ceramic Oscillation Circuit (1)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $T_a=25^\circ C$, $V_{SC}="1"$, Ceramic oscillator: CSB 1000J *1 (1MHz), $C_{GC}=C_{DC}=100pF$, $R_{fc}=1M\Omega$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start time	tsta	Vss=-2.2 to -5.5V			10	ms
Frequency/voltage deviation	∂f/∂V	Vss=-2.2 to -5.5V	-3		+3	%

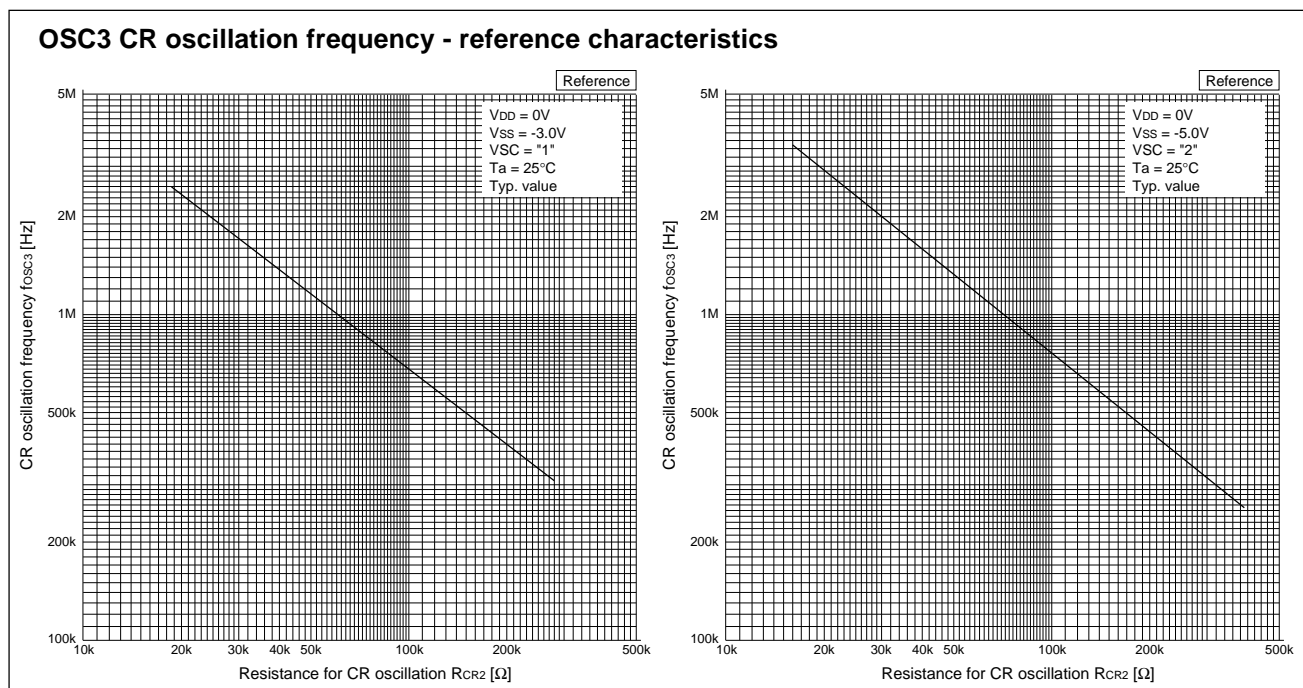
*1: Made by Murata Mfg. Co.

OSC3 Ceramic Oscillation Circuit (2)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-5.0V$, $T_a=25^\circ C$, $V_{SC}="2"$, Ceramic oscillator: CSA 2.00MG *1 (2MHz), $C_{GC}=C_{DC}=100pF$, $R_{fc}=1M\Omega$)

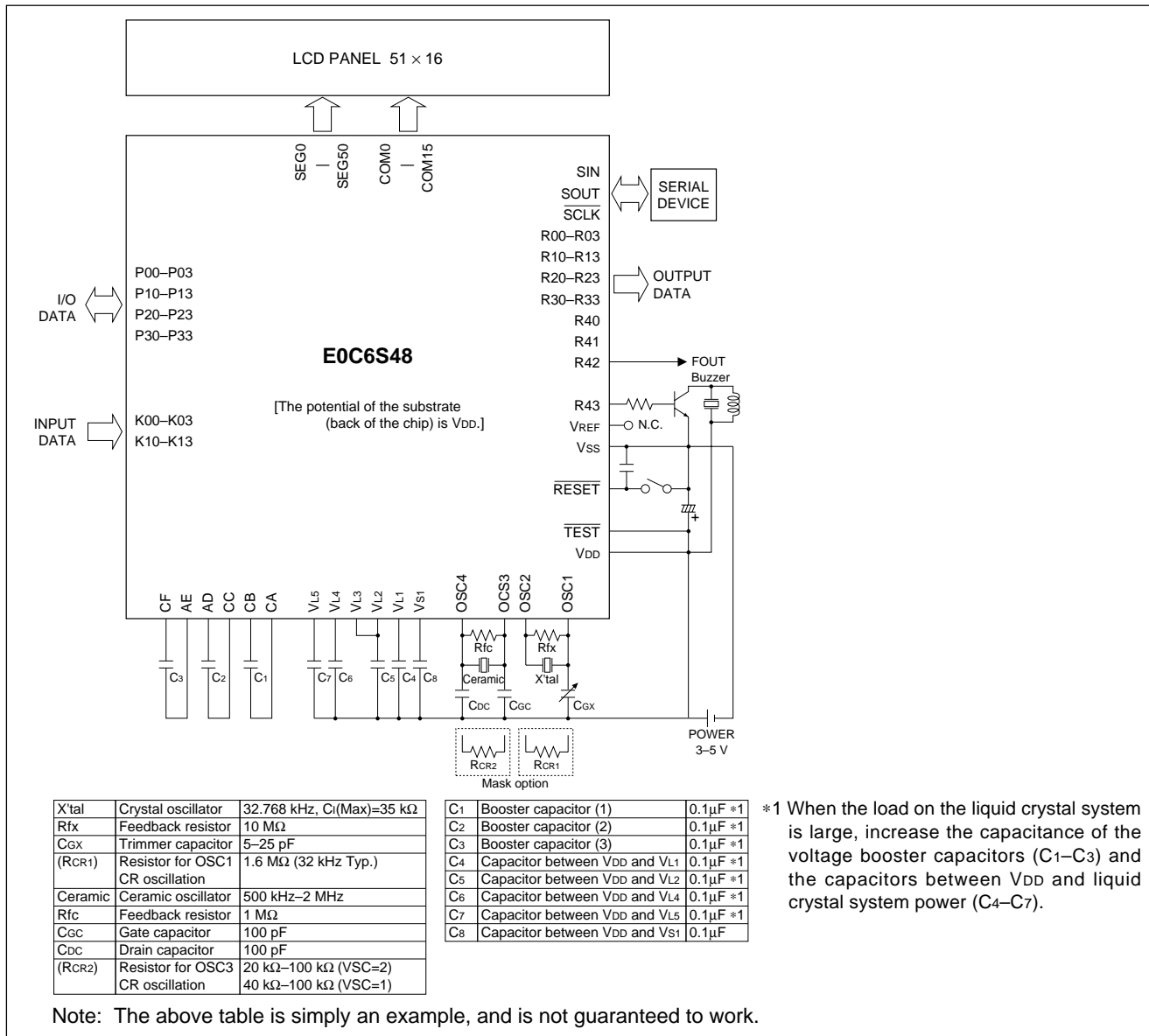
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start time	tsta	Vss=-3.5 to -5.5V			10	ms
Frequency/voltage deviation	∂f/∂V	Vss=-3.5 to -5.5V	-3		+3	%

*1: Made by Murata Mfg. Co.



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■ BASIC EXTERNAL CONNECTION DIAGRAM



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