

E0C6S46

4-bit Single Chip Microcomputer



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

■ DESCRIPTION

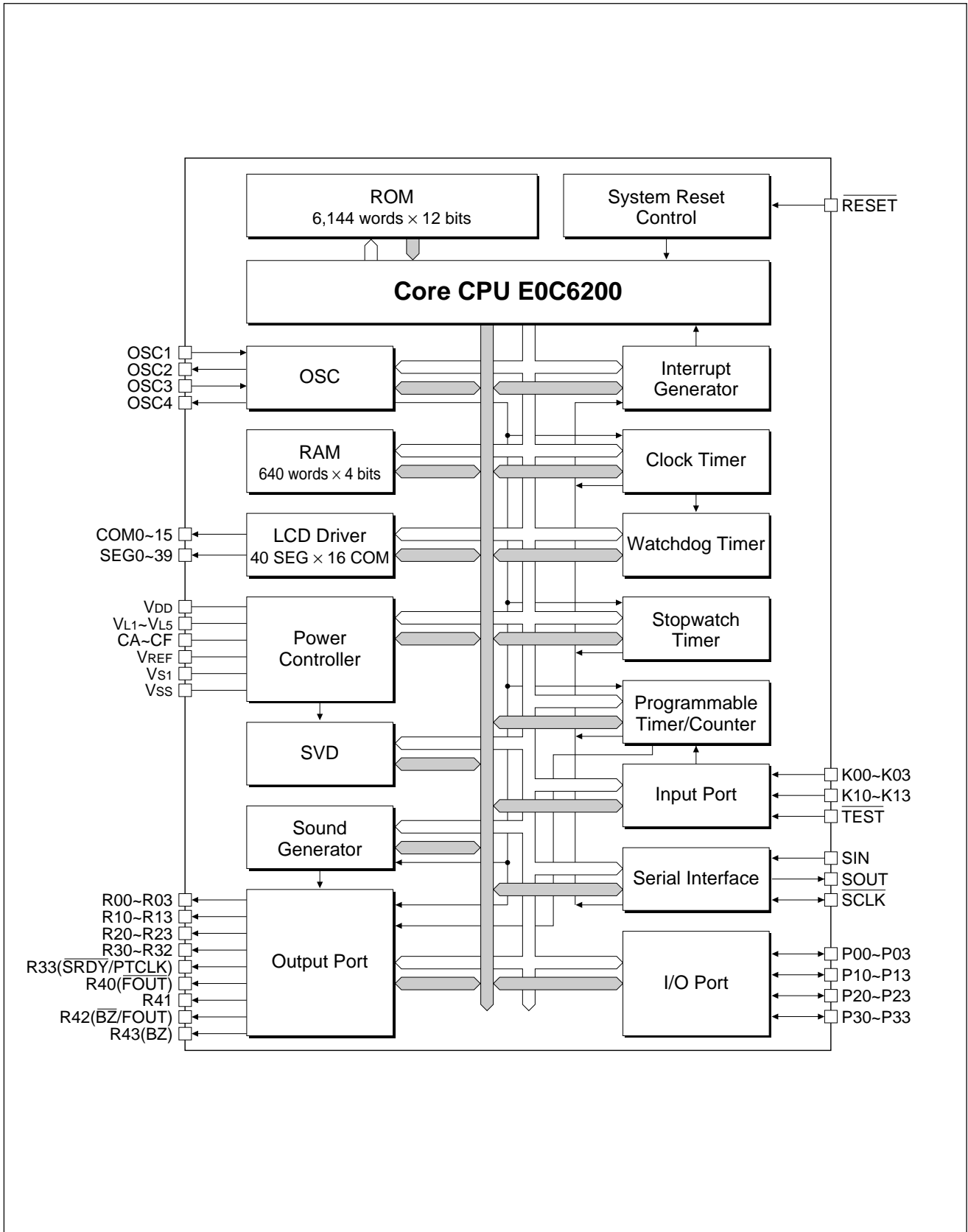
The E0C6S46 is an advanced single-chip CMOS 4-bit microcomputer consisting of the E0C6200 4-bit core CPU. The chip contains the ROM, RAM, dot matrix LCD driver, programmable SVD circuit, time base counter and clock synchronous serial port. The E0C6S46 can be applied to any system requiring large memory such as schedule reminder, and dot matrix display function.

■ FEATURES

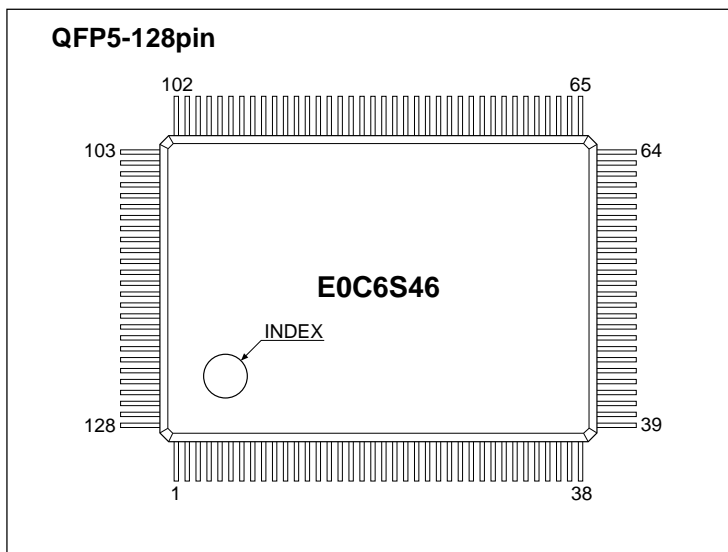
- CMOS LSI 4-bit parallel processing
- Oscillation circuit OSC1 : 32.768kHz (Typ.) Crystal oscillation circuit
OSC3 : 2MHz (Max.) CR or ceramic oscillation circuit (*1)
- Instruction set 108 instructions
- Instruction execution time 32.768kHz : 152.6μsec, 213.6μsec, 366.2μsec
(depending on the instruction) 1MHz : 5.0μsec, 7.0μsec, 12.0μsec
2MHz : 2.5μsec, 3.5μsec, 6.0μsec
- ROM capacity 6,144 words × 12 bits
- RAM capacity Data memory : 640 words × 4 bits
Display memory : 160 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 40 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 QFP5-128pin (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
1	VL3	33	SEG33	65	SEG2	97	R42
2	VL4	34	N.C.	66	SEG1	98	N.C.
3	VL5	35	SEG32	67	SEG0	99	R41
4	CF	36	SEG31	68	SCLK	100	R40
5	N.C.	37	SEG30	69	N.C.	101	R33
6	CE	38	SEG29	70	SOUT	102	R32
7	CD	39	SEG28	71	SIN	103	R31
8	CC	40	SEG27	72	K13	104	R30
9	CB	41	SEG26	73	K12	105	R23
10	CA	42	SEG25	74	K11	106	R22
11	COM0	43	SEG24	75	K10	107	R21
12	COM1	44	SEG23	76	K03	108	R20
13	COM2	45	SEG22	77	K02	109	R13
14	COM3	46	SEG21	78	K01	110	R12
15	COM4	47	SEG20	79	K00	111	R11
16	COM5	48	SEG19	80	P33	112	R10
17	COM6	49	SEG18	81	P32	113	R03
18	COM7	50	SEG17	82	P31	114	R02
19	COM8	51	SEG16	83	P30	115	R01
20	COM9	52	SEG15	84	P23	116	R00
21	COM10	53	SEG14	85	P22	117	Vss
22	COM11	54	SEG13	86	P21	118	RESET
23	COM12	55	SEG12	87	P20	119	TEST
24	COM13	56	SEG11	88	P13	120	OSC4
25	COM14	57	SEG10	89	P12	121	OSC3
26	COM15	58	SEG9	90	P11	122	Vs1
27	SEG39	59	SEG8	91	P10	123	OSC2
28	SEG38	60	SEG7	92	P03	124	OSC1
29	SEG37	61	SEG6	93	P02	125	VDD
30	SEG36	62	SEG5	94	P01	126	VREF
31	SEG35	63	SEG4	95	P00	127	VL1
32	SEG34	64	SEG3	96	R43	128	VL2

N.C. = No Connection

PIN DESCRIPTION

Pin name	Pin No.	I/O	Function
VDD	125	-	Power supply (+)
Vss	117	-	Power supply (-)
Vs1	122	-	Internal logic system/oscillation system regulated voltage output
VL1-VL5	127, 128, 1-3	-	LCD system power supply 1/4 bias generated internally, 1/5 bias generated externally *1
VREF	126	O	LCD system power test pin *2
CA-CF	10-6, 4	-	LCD system voltage booster condenser connecting pin
OSC1	124	I	Crystal oscillator input
OSC2	123	O	Crystal oscillator output, Cd built-in
OSC3	121	I	CR or ceramic oscillator input *1
OSC4	120	O	CR or ceramic oscillator output *1
COM0-COM15	11-26	O	LCD common output (1/8 duty or 1/16 duty is selected on software)
SEG0-SEG39	67-35, 33-27	O	LCD segment output
K00-K03	79-76	I	Input port (pull up resistor is available by mask option) *1
K10-K13	75-72	I	Input port (pull up resistor is available by mask option) *1
P00-P03	95-92	I/O	I/O port
P10-P13	91-88	I/O	I/O port
P20-P23	87-84	I/O	I/O port
P30-P33	83-80	I/O	I/O port or output port *1
R00-R03	116-113	O	Output port
R10-R13	112-109	O	Output port
R20-R23	108-105	O	Output port
R30-R32	104-102	O	Output port
R33	101	O	Output port, SRDY output or PTCLK output *1
R40	100	O	Output port or FOUT output *1
R41	99	O	Output port
R42	97	O	Output port, BZ output or FOUT output *1
R43	96	O	Output port or BZ output *1
SIN	71	I	Serial interface data input
SOUT	70	O	Serial interface data output
SCLK	68	I/O	Serial interface clock input/output
RESET	118	I	Initial reset input terminal
TEST	119	I	Testing input terminal *3

*1 Selected by mask option

*2 Leave the VREF 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 VDD.

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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 draw 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)	fosc1		20	32.768	50	kHz	
Oscillation frequency (2)	fosc3	VSC="1"	50	1,000	1,200	kHz	
Oscillation frequency (3)	fosc3	VSC="2"	50	2,000	2,300	kHz	
Voltage booster capacitor (1)	C1			0.1		μF	
Voltage booster capacitor (2)	C2			0.1		μF	
Voltage booster capacitor (3)	C3			0.1		μF	
Capacitor between V _{DD} and V _{L1}	C4			0.1		μF	
Capacitor between V _{DD} and V _{L2}	C5			0.1		μF	
Capacitor between V _{DD} and V _{L4}	C6			0.1		μF	
Capacitor between V _{DD} and V _{L5}	C7			0.1		μF	
Capacitor between V _{DD} and V _{S1}	C8			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, fosc1=32.768kHz, fosc3=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	0.2•V _{SS}		0	V
Low level input voltage	V _{LIN}	T _a =25°C	V _{SS}		0.8•V _{SS}	V
High level input voltage	V _{HIN}	V _{SS} =-2.2 to -5.5V	-0.2		0	V
Low level input voltage	V _{LIN}	T _a =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: $V_{DD}=0V, V_{SS}=-3.0V, V_{L1}=-1.0V, V_{L2}=-2.0V, V_{L4}=-3.0V, V_{L5}=-4.0V, f_{OSC1}=32.768kHz, f_{OSC3}=1MHz, T_a=25^{\circ}C, C_1-C_8=0.047\mu F$)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
LCD drive voltage (Normal mode)	VL1	Connects a 1MΩ load resistance between V _{DD} and VL1 (No panel load)	1/2·VL2		1/2·VL2	V	
			-0.1		×0.95		
	VL2	Connects a 1MΩ load resistance between V _{DD} and VL2 (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						
VL4	Connects a 1MΩ load resistance between V _{DD} and VL4 (No panel load)	3/2·VL2		3/2·VL2	V		
VL5	Connects a 1MΩ load resistance between V _{DD} and VL5 (No panel load)	2·VL2		2·VL2	V		
				×0.95			
LCD drive voltage (Heavy load protection mode)	VL1	Connects a 1MΩ load resistance between V _{DD} and VL1 (No panel load)	Typ. ×1.12	LC="0"	Typ. ×0.88	V	
				LC="1"			-0.92
				LC="2"			-0.95
				LC="3"			-0.97
				LC="4"			-1.00
				LC="5"			-1.03
				LC="6"			-1.05
				LC="7"			-1.08
				LC="8"			-1.11
				LC="9"			-1.13
				LC="10"			-1.16
				LC="11"			-1.18
				LC="12"			-1.21
	LC="13"	-1.24					
	LC="14"	-1.26					
	LC="15"	-1.29					
	VL2	Connects a 1MΩ load resistance between V _{DD} and VL2 (No panel load)	2·VL1		2·VL1	V	
VL4	Connects a 1MΩ load resistance between V _{DD} and VL4 (No panel load)	3·VL1		3·VL1	V		
VL5	Connects a 1MΩ load resistance between V _{DD} and VL5 (No panel load)	4·VL1		4·VL1	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	

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

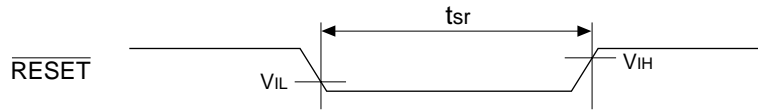
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● AC Characteristics

RESET Input

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

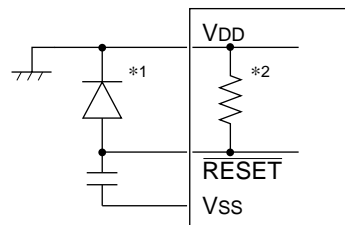
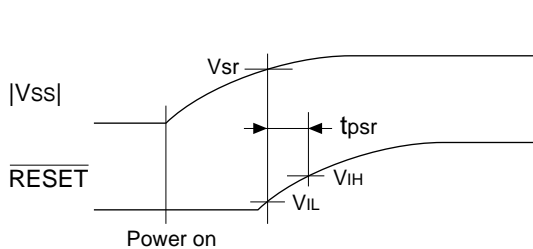
Characteristic	Symbol	Min.	Typ.	Max.	Unit
RESET input time	t_{sr}	2.0			ms



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} =built-in, $R_{FX}=10M\Omega$, $T_a=25^{\circ}C$, $V_{SC}=""$)

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			$M\Omega$

OSC3 CR Oscillation Circuit (1)

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

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f_{osc3}	$R_{CR2}=60k\Omega$	Typ. $\times 70\%$	1,000	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 (2)

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

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f_{osc3}	$R_{CR2}=30k\Omega$	Typ. $\times 70\%$	2.0	Typ. $\times 130\%$	MHz
Oscillation start time	t_{sta}	$V_{SS}=-3.5$ to $-5.5V$			10	ms
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-3.5$ to $-5.5V$	-5		+5	%

OSC3 Ceramic Oscillation Circuit (1)

(Unless otherwise specified: $V_{DD}=0V$, $V_{SS}=-3.0V$, $T_a=25^\circ C$, $VSC="1"$, 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	t_{sta}	$V_{SS}=-2.2$ to $-5.5V$			10	ms
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-2.2$ to $-5.5V$	-3		+3	%

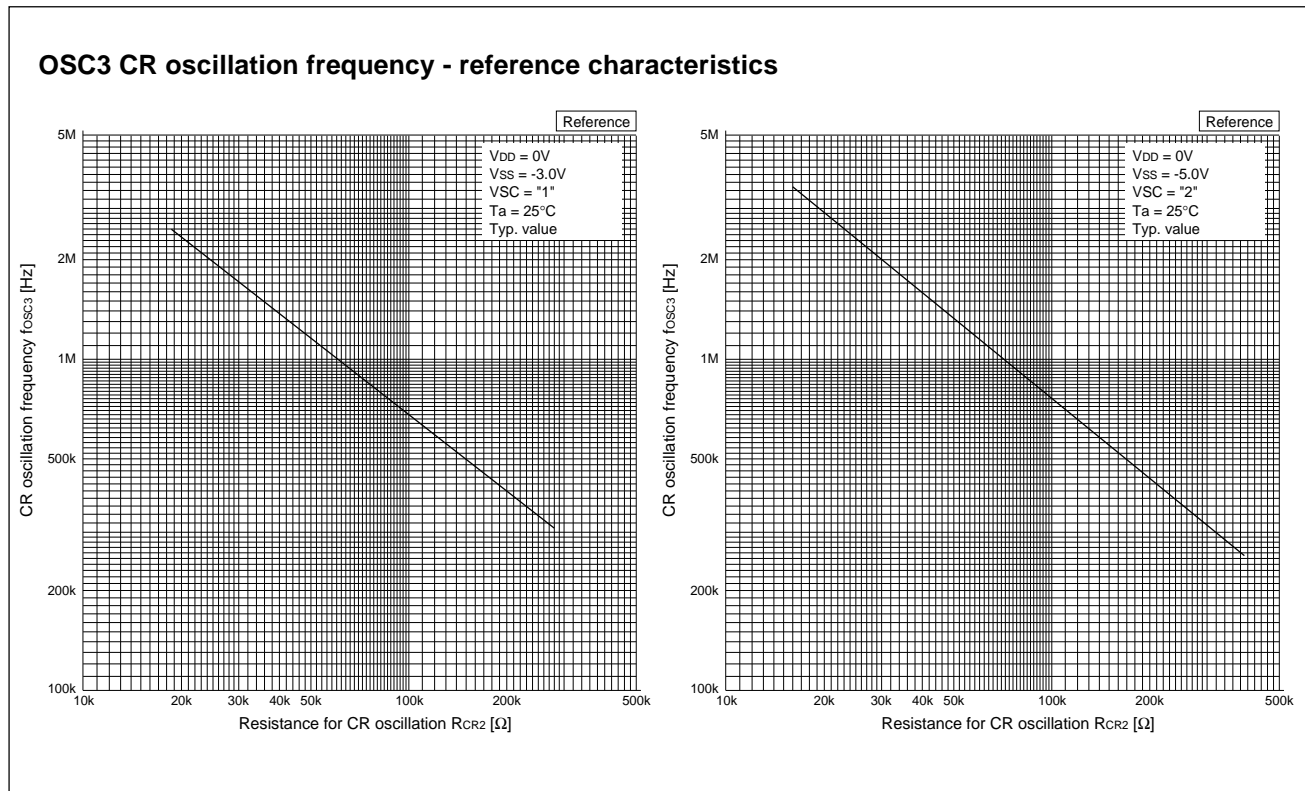
*1: Made by Murata Mfg. Co.

OSC3 Ceramic Oscillation Circuit (2)

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

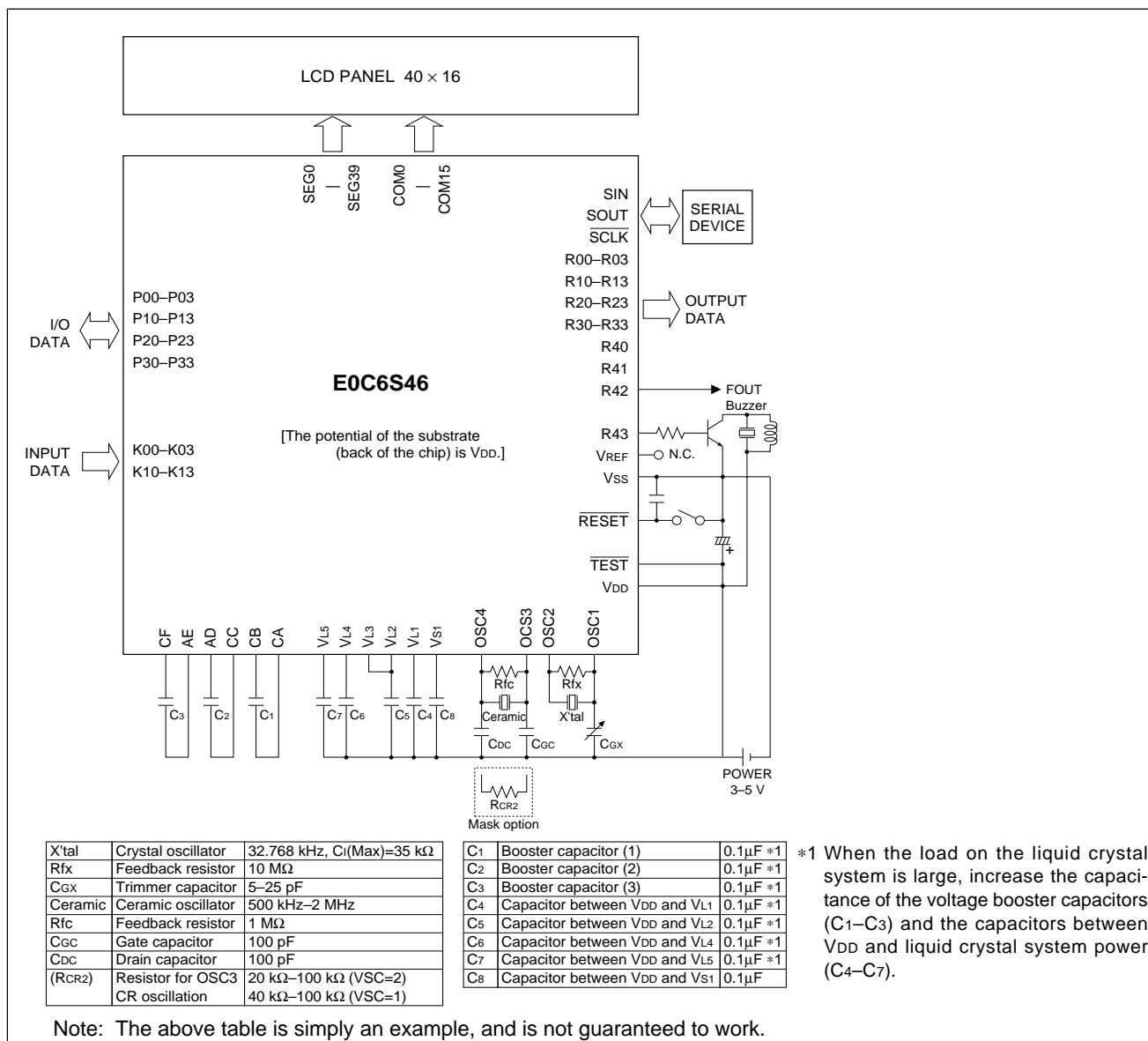
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start time	t_{sta}	$V_{SS}=-3.5$ to $-5.5V$			10	ms
Frequency/voltage deviation	$\partial f/\partial V$	$V_{SS}=-3.5$ to $-5.5V$	-3		+3	%

*1: Made by Murata Mfg. Co.



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■ BASIC EXTERNAL CONNECTION DIAGRAM



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SEIKO EPSON CORPORATION

ELECTRONIC DEVICES MARKETING DIVISION

IC Marketing & Engineering Group

ED International Marketing Department I (Europe & U.S.A.)

421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN

Phone : 042-587-5812 FAX : 042-587-5564

ED International Marketing Department II (Asia)

421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN

Phone : 042-587-5814 FAX : 042-587-5110

