

# E0C621C

## 4-bit Single Chip Microcomputer



- Core CPU Architecture
- R/F Converter
- Remote-control Carrier Output
- LCD Driver

### ■ DESCRIPTION

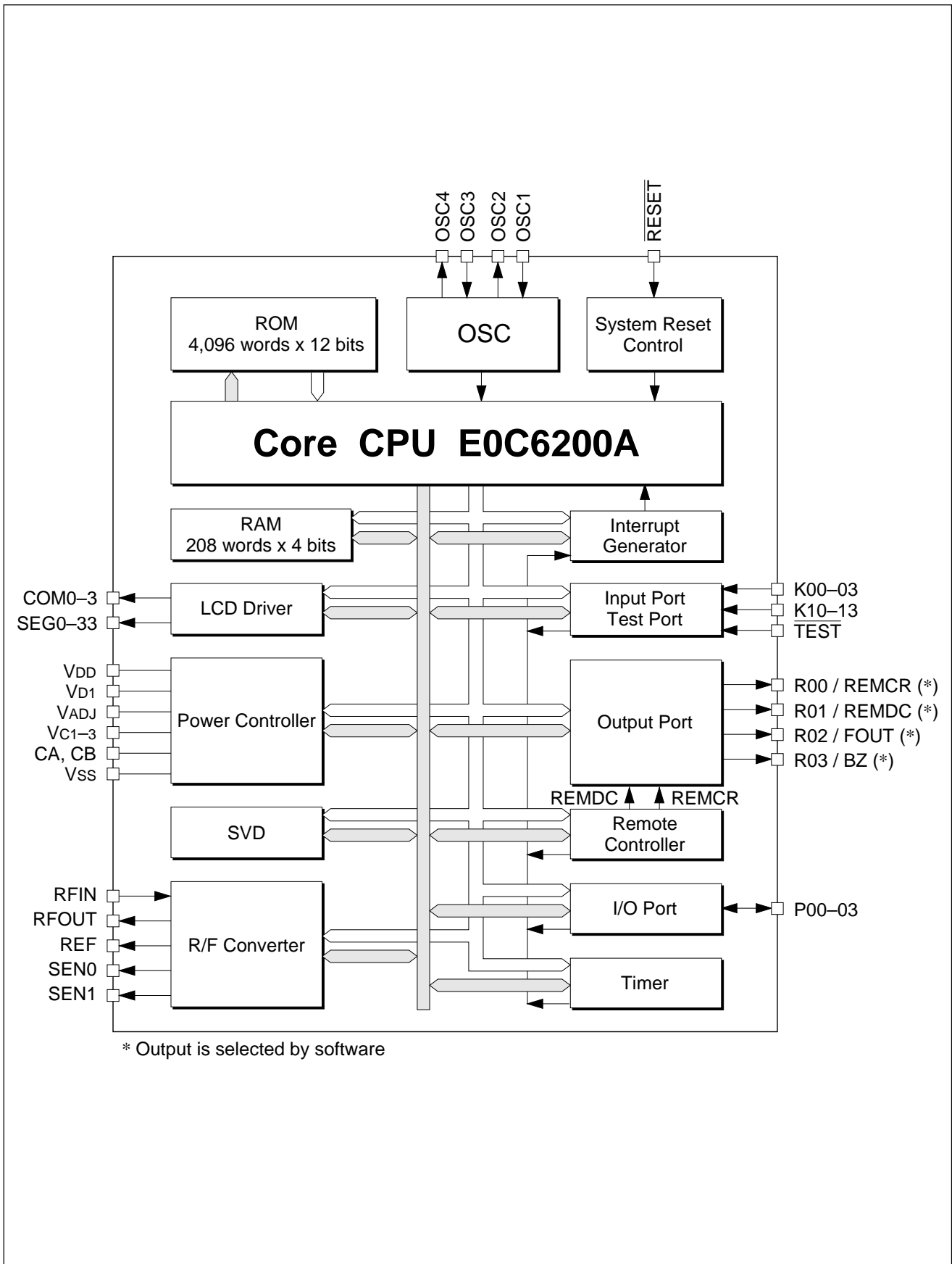
The E0C621C is a single-chip microcomputer made up of the 4-bit core CPU E0C6200A, ROM, RAM, remote controller, R/F converter, SVD circuit, LCD driver, watchdog timer and time base counter. The E0C621C is most suitable for remote controllers with temperature measurement functions, such as a remote control unit for an air conditioner.

### ■ FEATURES

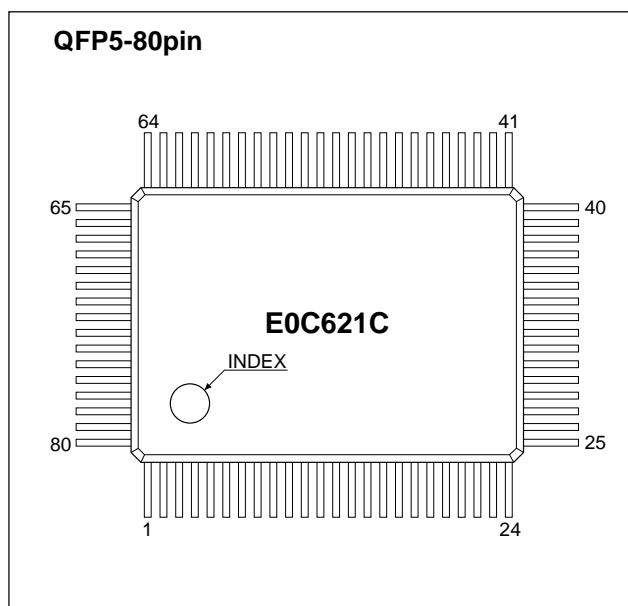
- CMOS LSI 4-bit parallel processing
- Twin clock ..... Crystal oscillation circuit (with built-in drain capacitance)
  - 32.768kHz (Typ.)
  - CR or Ceramic oscillation circuit (mask option)
  - 455kHz (Typ.) / 1MHz (Max.)
- Instruction set ..... 108 instructions
- Instruction execution time ..... During operation at 32.768kHz : 153μsec, 214μsec, 366μsec  
(depending on instruction) During operation at 455kHz : 11μsec, 15μsec, 26μsec  
During operation at 1MHz : 5μsec, 7μsec, 12μsec
- ROM capacity ..... 4,096 words × 12 bits
- RAM capacity ..... 208 words × 4 bits
- Input port ..... 8 bits (pull up resistors may be supplemented by mask option)
- Output port ..... 4 bits (complementary output or Nch open drain output may be selected by mask option)  
Buzzer, clock and REM (carrier, DC) outputs may be set by software
- I/O port ..... 4 bits
- LCD driver ..... 34 segments × 1–4 commons  
Static drive or 1/2–1/4 duty dynamic drive may be selected by software
- Remote controller ..... Infrared remote-control carrier output and DC output (level output)  
Soft-timer mode or hard-timer mode may be selected by software
- R/F converter ..... 1 reference resistance × 2 sensors, 16-bit counter  
DC bias sensor may be connected
- Time base counter ..... Clock timer 1 system
- Watchdog timer
- Supply voltage detection (SVD) circuit .. 2.3 ± 0.15V
- Interrupts ..... External : Input port interrupt 2 systems  
Internal : Timer interrupt 1 system  
Remote controller interrupt 1 system  
R/F converter interrupt 1 system
- Supply voltage ..... 2.2V to 5.5V
- Current consumption ..... HALT mode (3.0V) : 3.0μA (Typ.)  
OPERATING mode (32.768kHz/3.0V) : 7.0μA (Typ.)  
OPERATING mode (455kHz/3.0V) : 170μA (Typ.)  
OPERATING mode (1MHz/3.0V) : 250μA (Typ.)
- Package ..... QFP5-80pin (plastic)  
Die form

# E0C621C

## ■ BLOCK DIAGRAM



## ■ PIN CONFIGURATION



Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	REF	21	R02	41	CA	61	SEG14
2	N.C.	22	R01	42	CB	62	SEG15
3	N.C.	23	R00	43	COM0	63	SEG16
4	SEN0	24	TEST	44	COM1	64	SEG17
5	SEN1	25	K13	45	COM2	65	SEG18
6	N.C.	26	K12	46	COM3	66	SEG19
7	N.C.	27	K11	47	SEG0	67	SEG20
8	N.C.	28	K10	48	SEG1	68	SEG21
9	RFIN	29	K03	49	SEG2	69	SEG22
10	RFOUT	30	K02	50	SEG3	70	SEG23
11	Vss	31	K01	51	SEG4	71	SEG24
12	N.C.	32	K00	52	SEG5	72	SEG25
13	OSC1	33	P03	53	SEG6	73	SEG26
14	OSC2	34	P02	54	SEG7	74	SEG27
15	Vd1	35	P01	55	SEG8	75	SEG28
16	OSC3	36	P00	56	SEG9	76	SEG29
17	OSC4	37	VADJ	57	SEG10	77	SEG30
18	VDD	38	Vc1	58	SEG11	78	SEG31
19	RESET	39	Vc2	59	SEG12	79	SEG32
20	R03	40	Vc3	60	SEG13	80	SEG33

N.C. : No Connection

## ■ PIN DESCRIPTION

Pin name	Pin No.	In/Out	Function
VDD	18	(I)	Power supply pin (+)
VSS	11	(I)	Power supply pin (-)
Vd1	15	O	Oscillation and internal logic system regulated voltage output pin
Vc1	38	O	LCD system regulated voltage output pin
Vc2	39	O	LCD system booster voltage output pin ( $V_{c1} \times 2$ )
Vc3	40	O	LCD system booster voltage output pin ( $V_{c1} \times 3$ )
VADJ	37	I	Vc1 voltage adjustment pin
CA, CB	41, 42	-	Voltage booster capacitor connecting pin
OSC1	13	I	Crystal oscillation input pin
OSC2	14	O	Crystal oscillation output pin
OSC3	16	I	Ceramic or CR oscillation input pin (selected by mask option)
OSC4	17	O	Ceramic or CR oscillation output pin (selected by mask option)
COM0-COM3	43-46	O	LCD common output pin (static or 1/2-1/4 duty dynamic drive, programmable)
SEG0-SEG33	47-80	O	LCD segment output pin (DC output may be selected by mask option)
K00-K03	32-29	I	Input port pin
K10-K13	28-25	I	Input port pin
P00-P03	36-33	I/O	I/O port pin
R00	23	O	Output port pin (DC or REMCR output may be selected by software)
R01	22	O	Output port pin (DC or REMDC output may be selected by software)
R02	21	O	Output port pin (DC or FOUT output may be selected by software)
R03	20	O	Output port pin (DC or BZ output may be selected by software)
REF	1	O	Reference resistance connecting pin for R/F converter
SEN0, SEN1	4, 5	O	Sensor connecting pin for R/F converter
RFIN	9	I	R/F converter CR oscillation input pin
RFOUT	10	O	R/F converter oscillation frequency output pin
RESET	19	I	Initial reset input pin
TEST	24	I	Testing input pin

# E0C621C

## ■ ELECTRICAL CHARACTERISTICS

### ● Absolute Maximum Ratings

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

Rating	Symbol	Value	Unit
Supply voltage	V <sub>DD</sub>	-0.5 to 7.0	V
Input voltage (1)	V <sub>I</sub>	-0.5 to V <sub>DD</sub> + 0.3	V
Input voltage (2)	V <sub>Iosc</sub>	-0.5 to V <sub>D1</sub> + 0.3	V
Permissible total output current *1	ΣI <sub>VDD</sub>	10	mA
Operating temperature	T <sub>opr</sub>	-40 to 85	°C
Storage temperature	T <sub>stg</sub>	-65 to 150	°C
Soldering temperature / time	T <sub>sol</sub>	260°C, 10sec (lead section)	–
Permissible dissipation *2	P <sub>D</sub>	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 (QFP5-80pin).

### ● Recommended Operating Conditions

(T<sub>a</sub> = -40 to 85°C)

Condition	Symbol	Remark	Min.	Typ.	Max.	Unit
Supply voltage	V <sub>DD</sub>	V <sub>SS</sub> = 0V	2.2	3.0	5.5	V
Oscillation frequency	f <sub>osc1</sub>		–	32.768	–	kHz
	f <sub>osc3</sub>	Duty 50±5%	300	500	1,300	kHz
LCD output voltage	V <sub>C1</sub>			1.05	1.60	V

### ● DC Characteristics

(Unless otherwise specified:

V<sub>SS</sub> = 0V, V<sub>DD</sub> = 3.0V, f<sub>osc1</sub> = 32.768kHz, T<sub>a</sub> = 25°C, V<sub>D1</sub>/V<sub>C1</sub>/V<sub>C2</sub>/V<sub>C3</sub> are internal voltage, C1–C6 = 0.1μF)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage (1)	V <sub>IH1</sub>	K00–K03, K10–K13 P00–P03	0.8·V <sub>DD</sub>		V <sub>DD</sub>	V
High level input voltage (2)	V <sub>IH2</sub>	RESET, TEST	0.9·V <sub>DD</sub>		V <sub>DD</sub>	V
Low level input voltage (1)	V <sub>IL1</sub>	K00–K03, K10–K13 P00–P03	0		0.2·V <sub>DD</sub>	V
Low level input voltage (2)	V <sub>IL2</sub>	RESET, TEST	0		0.1·V <sub>DD</sub>	V
High level input current	I <sub>IH</sub>	V <sub>IH</sub> = 3.0V K00–K03, K10–K13 P00–P03 RESET, TEST	0		0.5	μA
Low level input current (1)	I <sub>IL1</sub>	V <sub>IL1</sub> = V <sub>SS</sub> Without pull up resistor K00–K03, K10–K13 P00–P03	-0.5		0	μA
Low level input current (2)	I <sub>IL2</sub>	V <sub>IL2</sub> = V <sub>SS</sub> With pull up resistor K00–K03, K10–K13 P00–P03 RESET, TEST	-15	-10	-5	μA
High level output current	I <sub>OH1</sub>	V <sub>OH1</sub> = 0.9·V <sub>DD</sub> R00–R03, P00–P03 RFOUT			-1	mA
Low level output current	I <sub>OL1</sub>	V <sub>OL1</sub> = 0.1·V <sub>DD</sub> R00–R03, P00–P03 RFOUT	3			mA
Common output current	I <sub>OH2</sub>	V <sub>OH2</sub> = V <sub>DD</sub> - 0.05V			-3	μA
	I <sub>OL2</sub>	V <sub>OL2</sub> = V <sub>C3</sub> + 0.05V	3			μA
Segment output current (during LCD output)	I <sub>OH3</sub>	V <sub>OH3</sub> = V <sub>DD</sub> - 0.05V			-3	μA
	I <sub>OL3</sub>	V <sub>OL3</sub> = V <sub>C3</sub> + 0.05V	3			μA
Segment output current (during DC output)	I <sub>OH4</sub>	V <sub>OH4</sub> = 0.9·V <sub>DD</sub>			-200	μA
	I <sub>OL4</sub>	V <sub>OL4</sub> = 0.1·V <sub>DD</sub>	200			μA

## ● Analog Circuit Characteristics and Current Consumption

(Unless otherwise specified:

$V_{SS} = 0V$ ,  $V_{DD} = 3.0V$ ,  $f_{OSC1} = 32.768kHz$ ,  $C_G = 25pF$ ,  $T_a = 25^\circ C$ ,  $V_{D1}/V_{C1}/V_{C2}/V_{C3}$  are internal voltage,  $C1-C6 = 0.1\mu F$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
LCD drive voltage	VC1	$V_{ADJ} = V_{C1}$ , $I_{C1} = 5\mu A$	0.95	1.05	1.15	V	
	VC2	Connect $1M\Omega$ load resistor between $V_{SS}$ and $V_{C2}$ (Without panel load)	$2 \cdot V_{C1} \times 0.9$		$2 \cdot V_{C1} + 0.1$	V	
	VC3	Connect $1M\Omega$ load resistor between $V_{SS}$ and $V_{C3}$ (Without panel load)	$3 \cdot V_{C1} \times 0.9$		$3 \cdot V_{C1} + 0.1$	V	
SVD voltage	$V_{SVD}$		2.15	2.30	2.45	V	
SVD circuit response time	$t_{SVD}$				100	$\mu S$	
Power current consumption	IOP	During HALT (32kHz)	Without panel load		3	6	$\mu A$
		During execution (32kHz) *1		7	15	nA	
		During execution (455kHz) *1		170	300	$\mu A$	
		During execution (1MHz) *1		250	500	$\mu A$	
		During execution (32kHz) *2		40	120	$\mu A$	
		During execution (32kHz) *3		10	30	$\mu A$	

\*1 The R/F converter and SVD circuit are in OFF status.

\*2 The R/F converter is in ON status. The SVD circuit is in OFF status.

\*3 The R/F converter is in OFF status. The SVD circuit is in ON status.

## ● 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:  $V_{SS} = 0V$ ,  $V_{DD} = 3.0V$ , 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	$V_{sta}$	$t_{sta} \leq 3sec$ ( $V_{DD}$ )	2.2			V
Oscillation stop voltage	$V_{stp}$	$t_{stp} \leq 10sec$ ( $V_{DD}$ )	2.2			V
Built-in capacitance (drain)	$C_D$	Including incidental capacitance inside IC		20		pF
Frequency/voltage deviation	$\partial f/\partial V$	$V_{DD} = 2.2$ to $5.5V$			5	ppm
Frequency/IC deviation	$\partial f/\partial IC$		-10		10	ppm
Frequency adjustment range	$\partial f/\partial C_G$	$C_G = 5$ to $25pF$	35			ppm
Harmonic oscillation start voltage	$V_{hho}$	$C_G = 5pF$ ( $V_{DD}$ )			7	V
Permitted leak resistance	$R_{leak}$	Between OSC1 and $V_{DD}$ , $V_{SS}$	200			$M\Omega$

### OSC3 ceramic oscillation circuit

(Unless otherwise specified:  $V_{SS} = 0V$ ,  $V_{DD} = 3.0V$ , Ceramic oscillator: 1MHz,  $C_{cc} = C_{dc} = 100pF$ ,  $T_a = 25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation start voltage	$V_{sta}$	( $V_{DD}$ )	2.2			V
Oscillation start time	$t_{sta}$	$V_{DD} = 2.2$ to $5.5V$			3	mS
Oscillation stop voltage	$V_{stp}$	( $V_{DD}$ )	2.2			V

### OSC3 CR oscillation circuit

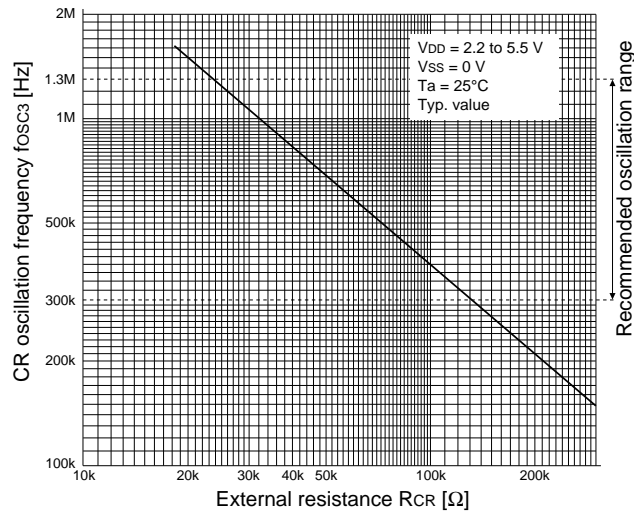
(Unless otherwise specified:  $V_{SS} = 0V$ ,  $V_{DD} = 3.0V$ ,  $R_{CR} = 33k\Omega$ ,  $T_a = 25^\circ C$ )

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Oscillation frequency dispersion	$f_{osc3}$		-30	(1MHz)	30	%
Oscillation start voltage	$V_{sta}$	( $V_{DD}$ )	2.2			V
Oscillation start time	$t_{sta}$	$V_{DD} = 2.2$ to $5.5V$			3	mS
Oscillation stop voltage	$V_{stp}$	( $V_{DD}$ )	2.2			V

## ● Characteristic Curves

### • CR oscillation frequency characteristic

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



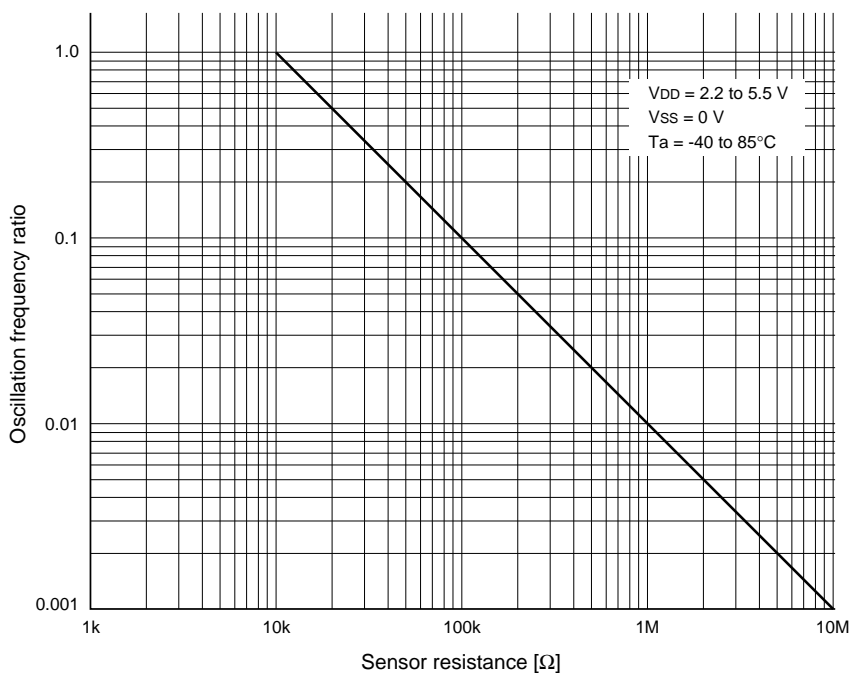
CR oscillation frequency characteristic

### • R/F converter sensor resistance - oscillation frequency ratio characteristic

The following figure shows the oscillation frequency ratio (ratio of oscillation frequency by the reference resistance to oscillation frequency by the sensor resistance) when the following elements are connected. (Typ.)

If the R/F conversion uses SEN0 or SEN1, both characteristics will be the same.

- Reference resistance (RREF) ..... 10kΩ
- Sensor resistance (RSEN0, RSEN1) ..... 10kΩ to 20MΩ
- Oscillating capacitor (CRF) ..... 2,200pF

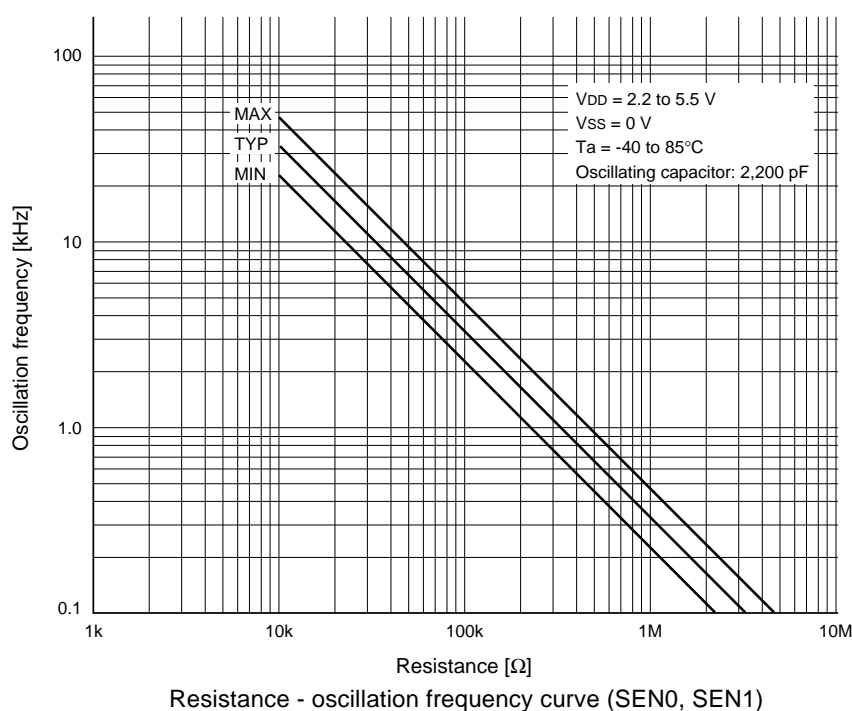
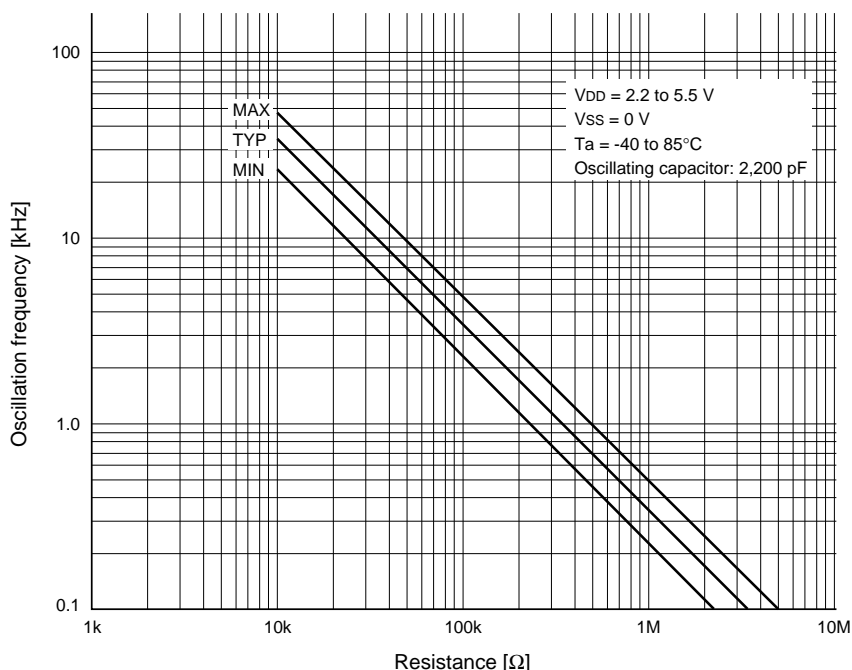


Oscillation frequency ratio - resistance curve

**• R/F converter resistance - oscillation frequency characteristic**

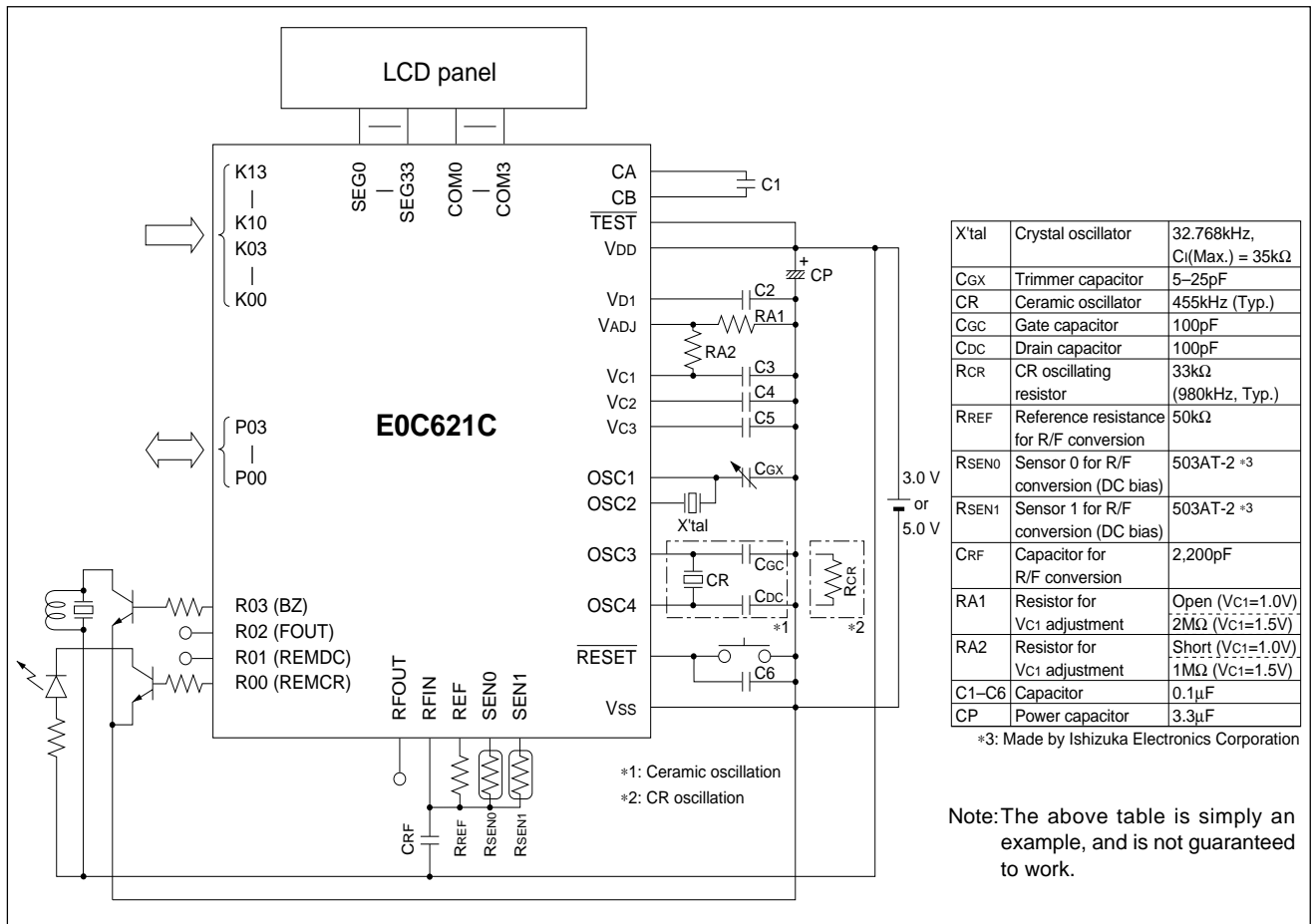
CR oscillation frequency of the R/F converter disperses in each sampling. Therefore, the initial setting value of the measurement counter should be decided after considering the fluctuation margin of the CR oscillation frequency by the reference resistance and sensor resistance to be used for the measurement.

- Note:
- The following curves are characteristic when the oscillating capacitor is 2,200pF.
  - Typical oscillation frequency is characteristic when  $V_{DD} = 3.0V$  and  $T_a = 25^{\circ}C$ .

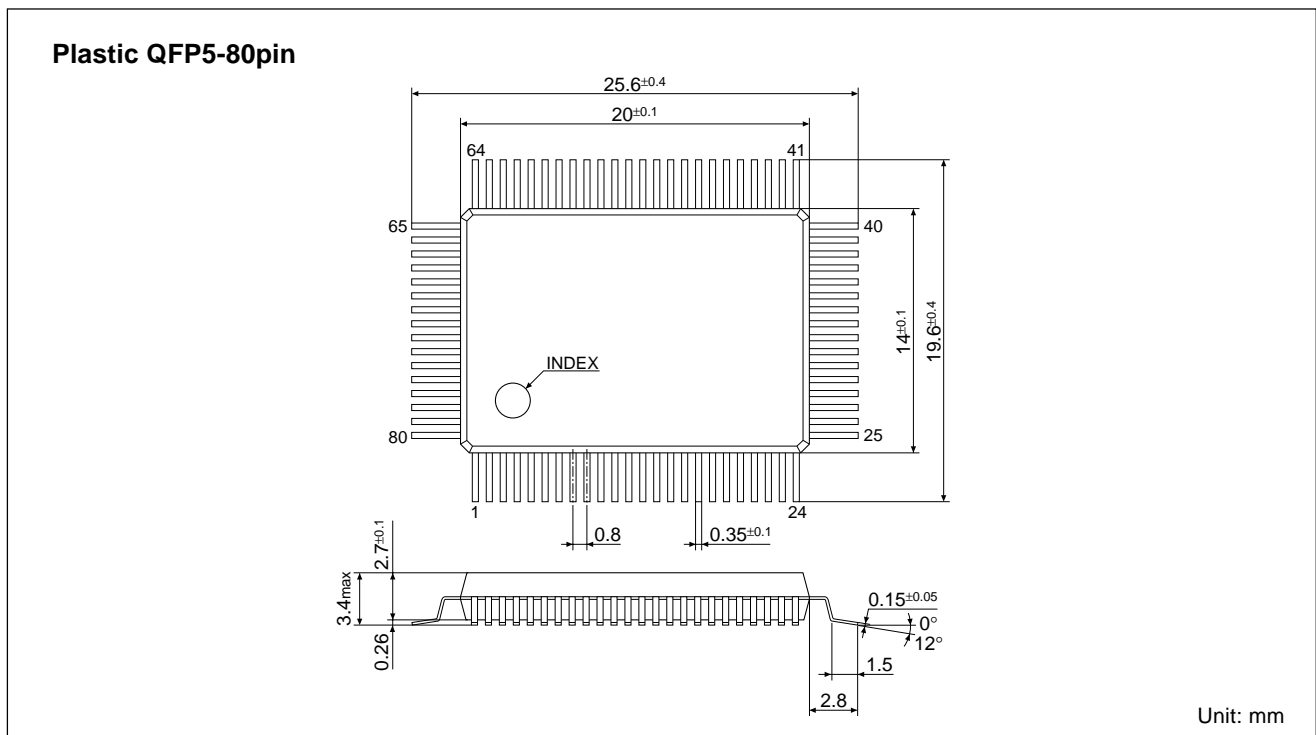


# E0C621C

## ■ BASIC EXTERNAL CONNECTION DIAGRAM



## ■ PACKAGE DIMENSIONS





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