EPSON

# E0C621A

## 4-bit Single Chip Microcomputer

Low Voltage Operation Products

- Core CPU Architecture
- 32kHz/455kHz Twin Clock Operation
- SVD Circuit/Analog Comparator
- Watchdog Timer

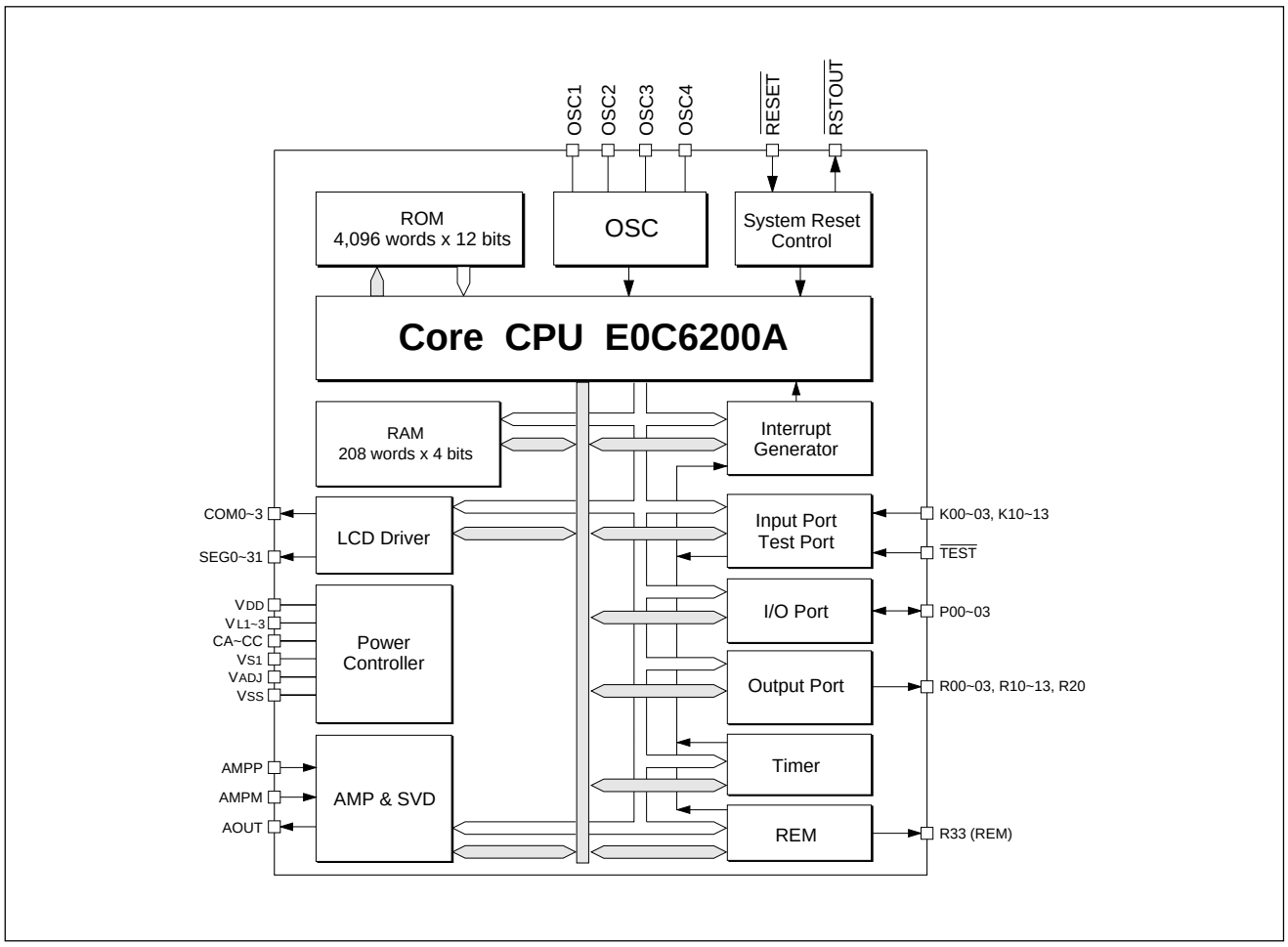
## ■ DESCRIPTION

The E0C621A is a CMOS 4-bit microcomputer using an E0C6200A as its core processor. It contains ROM, RAM, LCD driver circuit, remote-control carrier output circuit, time base counter, analog comparator, watchdog timer and other functions on a single chip. The E0C621A provides an excellent solution for low-power system applications such as an infrared remote controller with clock function.
One time PROM version is available.

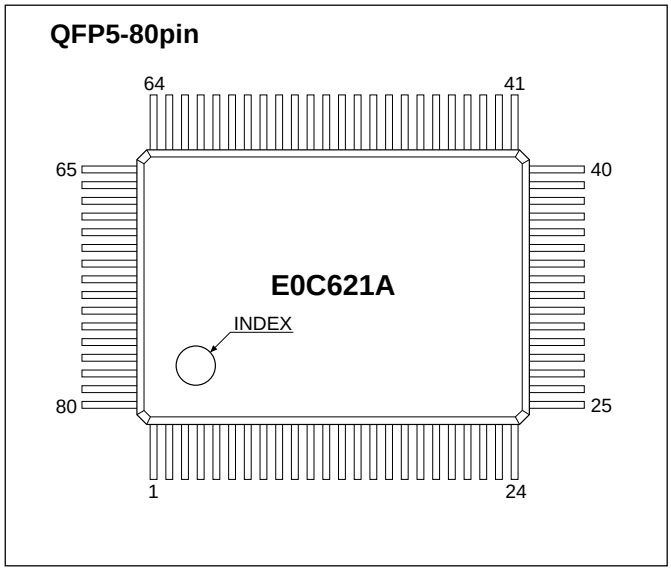
## ■ FEATURES

- CMOS LSI 4-bit parallel processing
- Twin clock ..... 32.768kHz (Typ.) Crystal
  455kHz (Typ.) CR or Ceramic oscillation circuit
  (selectable by mask option)
- Instruction set ..... 100 instructions
- Instruction cycle time ..... 32kHz clock mode : 153µsec, 214µsec or 366µsec
  455kHz clock mode : 11µsec, 15µsec or 26µsec
- ROM capacity ..... 4,096 × 12 bits
- RAM capacity ..... 208 × 4 bits
- Input port ..... 8 bits (pull-up resistors are available by mask option)
- Output port ..... 9 bits (clock, buzzer output is available by mask option)
- I/O port ..... 4 bits
- Remote control carrier (REM) ..... 1 bit (hardware timer or software timer is selectable by software)
- LCD driver ..... 32 segments × 3 commons or 32 segments × 4 commons
  (1/3 or 1/4 duty is selectable by mask option)
- Built-in LCD power supplies ..... Voltage regulator, voltage doubler and voltage tripler
- Built-in SVD circuit ..... 2.3V ± 0.1V (supply voltage detector) Criteria voltage
- Built-in amplifier ..... Operational amplifier for MOS input analog comparator
- Built-in watchdog timer (Mask option)
- Interrupts ..... External : Input interrupt 2 lines
  Internal : Timer interrupt (32Hz, 8Hz, 2Hz) 1 line (3ch.)
  REM interrupt 1 line
- Supply voltage ..... 3.0V (2.2V to 3.5V)
- Current consumption ..... HALT mode (32.768kHz) : 2µA (Typ.)
  OPERATING mode (455kHz) : 130µA (Typ.)
- Package ..... QFP5-80pin (plastic), QFP14-80pin (plastic)
  Die form

## ■ BLOCK DIAGRAM




## ■ PIN CONFIGURATION




| No. | Pin name | No. | Pin name | No. | Pin name | No. | Pin name |
|---|---|---|---|---|---|---|---|
| 1 | SEG16 | 21 | COM0 | 41 | OSC4 | 61 | K11 |
| 2 | SEG15 | 22 | CC | 42 | $V_{S1}$ | 62 | K12 |
| 3 | SEG14 | 23 | CB | 43 | R00 | 63 | K13 |
| 4 | SEG13 | 24 | CA | 44 | R01 | 64 | $\overline{TEST}$ |
| 5 | SEG12 | 25 | $V_{L3}$ | 45 | R02 | 65 | N.C. |
| 6 | SEG11 | 26 | $V_{L2}$ | 46 | R03 | 66 | SEG31 |
| 7 | SEG10 | 27 | $\overline{RESET}$ | 47 | R10 | 67 | SEG30 |
| 8 | SEG9 | 28 | $V_{ADJ}$ | 48 | R11 | 68 | SEG29 |
| 9 | SEG8 | 29 | $V_{L1}$ | 49 | R12 | 69 | SEG28 |
| 10 | SEG7 | 30 | R33 (REM) | 50 | R13 | 70 | SEG27 |
| 11 | SEG6 | 31 | $\overline{RSTOUT}$ | 51 | R20 | 71 | SEG26 |
| 12 | SEG5 | 32 | AMPP | 52 | P00 | 72 | SEG25 |
| 13 | SEG4 | 33 | AMPM | 53 | P01 | 73 | SEG24 |
| 14 | SEG3 | 34 | AOUT | 54 | P02 | 74 | SEG23 |
| 15 | SEG2 | 35 | $V_{DD}$ | 55 | P03 | 75 | SEG22 |
| 16 | SEG1 | 36 | N.C. | 56 | K00 | 76 | SEG21 |
| 17 | SEG0 | 37 | OSC1 | 57 | K01 | 77 | SEG20 |
| 18 | COM3 | 38 | OSC2 | 58 | K02 | 78 | SEG19 |
| 19 | COM2 | 39 | $V_{SS}$ | 59 | K03 | 79 | SEG18 |
| 20 | COM1 | 40 | OSC3 | 60 | K10 | 80 | SEG17 |

N.C. = No Connection

## ■ PIN DESCRIPTION

| Pin name | Pin No. | In/Out | Function |
|---|---|---|---|
| $V_{DD}$ | 35 | I | Power source (+) terminal |
| $V_{SS}$ | 39 | I | Power source (-) terminal |
| $V_{S1}$ | 42 | – | Oscillation and internal logic system regulated voltage output terminal (approx. $V_{DD}$-2.0 V) |
| $V_{L1}$ | 29 | – | LCD system regulated voltage output terminal (approx. $V_{DD}$-$V_L$) |
| $V_{L2}$ | 26 | – | LCD system booster output terminal ($V_{DD}$-2$V_L$) |
| $V_{L3}$ | 25 | – | LCD system booster output terminal ($V_{DD}$-3$V_L$) |
| $V_{ADJ}$ | 28 | I | $V_L$ input adjustment terminal |
| CA–CC | 22–24 | – | Booster capacitor connecting terminal |
| OSC1 | 37 | I | Crystal oscillation input terminal |
| OSC2 | 38 | O | Crystal oscillation output terminal |
| OSC3 | 40 | I | Ceramic or CR oscillation input terminal |
| OSC4 | 41 | O | Ceramic or CR oscillation output terminal |
| K00–03, K10–13 | 56–63 | I | Input terminal |
| P00–03 | 52–55 | I/O | I/O terminal |
| R00–03, R10, R11 | 43–48 | O | Output terminal |
| R12 | 49 | O | Output terminal (DC, FOUT or $\overline{BZ}$ output may be selected by mask option) |
| R13 | 50 | O | Output terminal (DC or BZ output may be selected by mask option) |
| R20 | 51 | O | Output terminal |
| R33(REM) | 30 | O | Remote control carrier output terminal |
| AMPP | 32 | I | Analog comparator non-inverted input terminal |
| AMPM | 33 | I | Analog comparator inverted input terminal |
| AOUT | 34 | O | Analog comparator outout terminal |
| SEG0–31 | 1–17, 66–80 | O | LCD segment output terminal (Convertible to DC output by mask option) |
| COM0–3 | 18–21 | O | LCD common output terminal |
| $\overline{RESET}$ | 27 | I | Initial reset input terminal |
| $\overline{TEST}$ | 64 | I | Test input terminal |
| $\overline{RSTOUT}$ | 31 | O | Initial reset output terminal |

## ■ ABSOLUTE MAXIMUM RATINGS

($V_{DD}$=0V)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage | $V_{SS}$ | -5.2 to 0.5 | V |
| Input voltage | $V_I$ | $V_{SS}$ -0.3 to 0.3 | V |
| | $V_{IOSC}$ | $V_{S1}$ -0.3 to 0.3 | V |
| Operating temperature | Topr | -20 to 70 | °C |
| Storage temperature | Tstg | -65 to 150 | °C |
| Soldering temperature and time | Tsol | 260°C, 10sec (at lead) | – |
| Power dissipation | $P_D$ | 250 | mW |

## ■ RECOMMENDED OPERATING CONDITIONS

(Ta=-20 to 70°C)

| Condition | Symbol | Remark | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{SS}$ | $V_{DD}$ = 0 V | -3.5 | -3.0 | -2.2 | V |
| Oscillation frequency | $f_{OSC1}$ | | – | 32.768 | – | kHz |
| | $f_{OSC3}$ | duty : 50 ± 5% | 50 | 455 | 600 | kHz |
| Power supply voltage for LCD driver | $V_{L1}$ | | -1.6 | -1.03 | – | V |
| CR oscillation external resistor | $R_{CR}$ | | 100 | 140 | 500 | kΩ |

## ■ ELECTRICAL CHARACTERISTICS

($V_{DD}$=0V, $V_{SS}$=-2.2 to -3.5V, $V_{L3}$=-3.0V, Ta=-20 to 70°C)

| Parameter | Symbol | Condition | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| High level input voltage (1) | $V_{IH1}$ | | K00–K03, K10–K13, P00–P03 | 0.2$V_{SS}$ | | 0 | V |
| Low level input voltage (1) | $V_{IL1}$ | | K00–K03, K10–K13, P00–P03 | $V_{SS}$ | | 0.8$V_{SS}$ | V |
| High level input voltage (2) | $V_{IH2}$ | | $\overline{\text{RESET}}$ | 0.1$V_{SS}$ | | 0 | V |
| Low level input voltage (2) | $V_{IL2}$ | | $\overline{\text{RESET}}$ | $V_{SS}$ | | 0.9$V_{SS}$ | V |
| High level input current | $I_{IH}$ | $V_{IH}$ = $V_{DD}$ | | | | 1 | µA |
| Low level input current | $I_{IL1}$ | $V_{IL1}$ = $V_{SS}$ | No pull up, K00–K03, K10–K13 | -1 | | | µA |
| | $I_{IL2}$ | $V_{IL2}$ = $V_{SS}$ | Pull up, K00–K03, K10–K13 | -5 | | -0.35 | µA |
| | $I_{IL3}$ | $V_{IL3}$ = $V_{SS}$ | $\overline{\text{RESET}}$ pin | -5 | | -0.35 | µA |
| | $I_{IL4}$ | $V_{IL4}$ = 0.2$V_{SS}$ | Pull up, K00–K03, K10–K13 | -30 | | | µA |
| | $I_{IL5}$ | $V_{IL5}$ = 0.2$V_{SS}$ | $\overline{\text{RESET}}$ pin | -40 | | | µA |
| | $I_{IL6}$ | $V_{IL6}$ = $V_{SS}$ | P00–P03 * | -15 | | -2 | µA |
| High level output current (1) | $I_{OH1}$ | $V_{OH1}$ = 0.1$V_{SS}$ | R00–R03, R10–R13, $\overline{\text{RSTOUT}}$ | | | -250 | µA |
| Low level output current (1) | $I_{OL1}$ | $V_{OL1}$ = 0.9$V_{SS}$ | R00–R03, R10–R13, $\overline{\text{RSTOUT}}$ | 1.0 | | | mA |
| High level output current (2) | $I_{OH2}$ | $V_{OH2}$ = 0.1$V_{SS}$ | R20 | | | -1.8 | mA |
| Low level output current (2) | $I_{OL2}$ | $V_{OL2}$ = 0.9$V_{SS}$ | R20 | 1.0 | | | mA |
| High level output current (3) | $I_{OH3}$ | $V_{OH3}$ = 0.1$V_{SS}$ | P00–P03 | | | -250 | µA |
| Low level output current (3) | $I_{OL3}$ | $V_{OL3}$ = 0.9$V_{SS}$ | P00–P03 | 1.0 | | | mA |
| High level output current (4) | $I_{OH4}$ | $V_{OH4}$ = 0.1$V_{SS}$ | R33 (REM) | | | -1.8 | mA |
| Low level output current (4) | $I_{OL4}$ | $V_{OL4}$ = 0.9$V_{SS}$ | R33 (REM) | 1.0 | | | mA |
| Common output current | $I_{OH5}$ | $V_{OH5}$ = -0.05V | COM0–COM3 | | | -3.0 | µA |
| | $I_{OL5}$ | $V_{OL5}$ = $V_{L3}$ + 0.05V | | 3.0 | | | µA |
| Segment output current (in LCD output mode) | $I_{OH6}$ | $V_{OH6}$ = -0.05V | SEG0–SEG31 | | | -3.0 | µA |
| | $I_{OL6}$ | $V_{OL6}$ = $V_{L3}$ + 0.05V | | 3.0 | | | µA |
| Segment output current (in DC output mode) | $I_{OH7}$ | $V_{OH7}$ = 0.1$V_{SS}$ | SEG0–SEG31 | | | -50 | µA |
| | $I_{OL7}$ | $V_{OL7}$ = 0.9$V_{SS}$ | | 70 | | | µA |
| Internal voltage | $V_{L1}$ | $V_{ADJ}$ = $V_{L1}$, $I_{L1}$ = 5 µA | | -1.11 | -1.03 | -0.95 | V |
| | $V_{L2}$ | 1 MΩ load connected between $V_{DD}$ and $V_{L2}$ | | 2$V_{L1}$ | | 2$V_{L1}$ +0.1 | V |
| | $V_{L3}$ | 1 MΩ load connected between $V_{DD}$ and $V_{L3}$ | | 3$V_{L1}$ | | 3$V_{L1}$ +0.3 | V |
| SVD voltage | $V_{SVD}$ | | | -2.4 | -2.3 | -2.2 | V |
| Current consumption | $I_{OP}$ | HALT mode | OSCC = 0, $V_{ADJ}$ = $V_{L1}$, No panel load | | 2 | 5 | µA |
| | | OSC1 mode *1 | OSCC = 0, $V_{ADJ}$ = $V_{L1}$, No panel load | | 9 | 18 | µA |
| | | OSC3 mode *1, *2 | $V_{ADJ}$ = $V_{L1}$, No panel load | | 130 | 250 | µA |

* Only at read cycle using internal program.

*1 The SVD circuit and analog comparator are in the OFF status.

*2 OSC3 mode: Ceramic oscillation (455 kHz) or CR oscillation (R = 140 kΩ)

## ■ OSCILLATION CHARACTERISTICS

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

### ● OSC1 (Crystal)

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

| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Oscillation start time | tsta | $V_{SS}$=-2.2 to -3.5V | – | – | 5 | Sec |
| Built-in capacitance (drain) | $C_D$ | Package as assembled | – | 25 | – | pF |
| | | Bare chip | – | 24 | – | pF |
| Frequency/voltage deviation | ∂f/∂V | $V_{SS}$=-2.2 to -3.5V | – | – | 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 | – | – | -3.5 | V |
| Permitted leak resistance | $R_{leak}$ | Between OSC1 and other pins | 200 | – | – | MΩ |

### ● OSC3 (CR oscillation)

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-3.0V, $R_{CR}$=140kΩ, Ta=25°C)

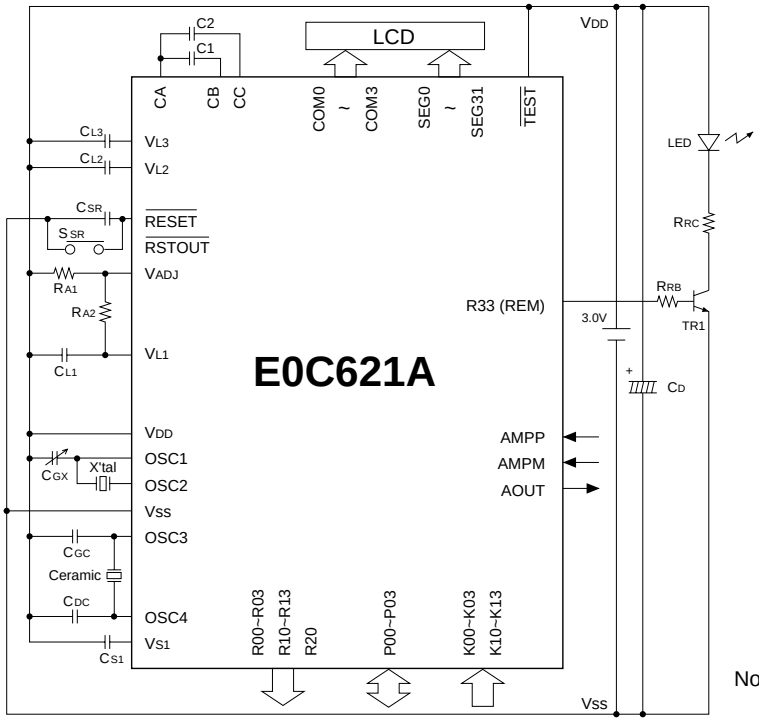
| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Oscillation frequency | $f_{OSC3}$ | | – | 280 | – | kHz |
| Oscillation start voltage | Vsta | ($V_{SS}$) | -2.2 | – | – | V |
| Oscillation start time | tsta | $V_{SS}$=-2.2 to -3.5V | – | 3 | – | mS |
| Oscillation stop voltage | Vstp | ($V_{SS}$) | -2.2 | – | – | V |

### ● OSC3 (Ceramic)

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-3.0V, Ceramic: CSB455E (Murata Mfg. Co.), $C_{GC}$=$C_{DC}$=100pF, Ta=25°C)

| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Oscillation start voltage | Vsta | ($V_{SS}$) | -2.2 | – | – | V |
| Oscillation start time | tsta | $V_{SS}$=-2.2 to -3.5V | – | 3 | – | mS |
| Oscillation stop voltage | Vstp | ($V_{SS}$) | -2.2 | – | – | V |

## ■ BASIC EXTERNAL CONNECTION DIAGRAM

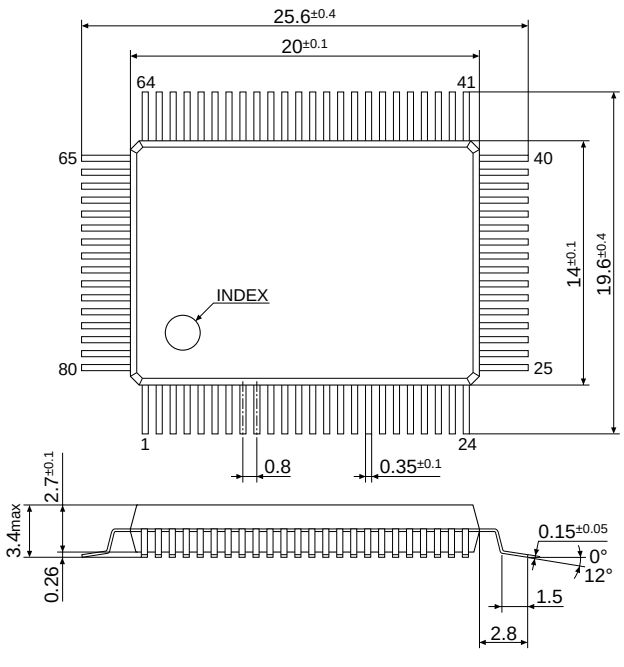



| | | | |
|---|---|---|---|
| X'tal | Crystal oscillator | 32.768kHz<br>$C_I$(Max.)=35kΩ | |
| $C_{GX}$ | Trimmer capacitor | 5–25pF | |
| $C_R$ | Ceramic oscillator | 455kHz | |
| $C_{GC}$ | | 100pF | |
| $C_{DC}$ | | 100pF | |
| $C_{SR}$ | | 0.33µF | |
| $R_{A1}$ | | $V_L$ : 1.5V | $V_L$ : 1.0V |
| | | 2MΩ | Open |
| $R_{A2}$ | | 1MΩ | Short circuit |
| $C_{L1}$ | | 0.1µF | |
| $C_{L2}$ | | 0.1µF | |
| $C_{L3}$ | | 0.1µF | |
| C1 | | 0.1µF | |
| C2 | | 0.1µF | |
| $C_{S1}$ | | 0.2µF | |
| $C_D$ | | 6.8µF | |

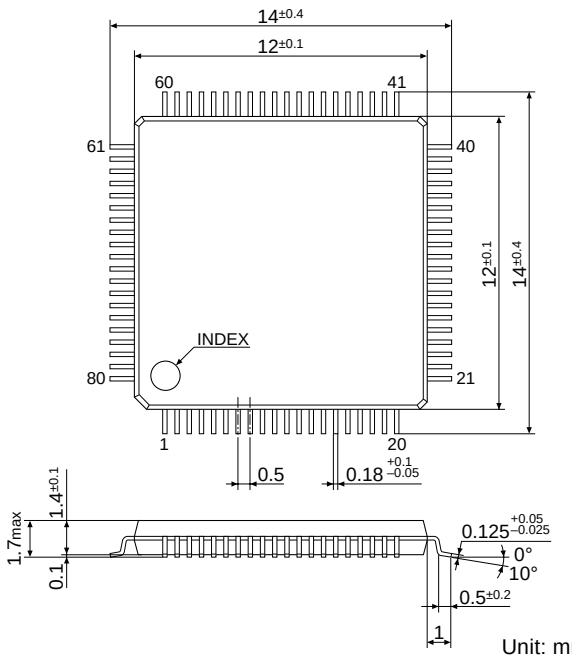
Note: The above table is simply an example, and is not guaranteed to work.

## ■ PACKAGE DIMENSIONS

**Plastic QFP5-80pin**




**Plastic QFP14-80pin**




Unit: mm

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