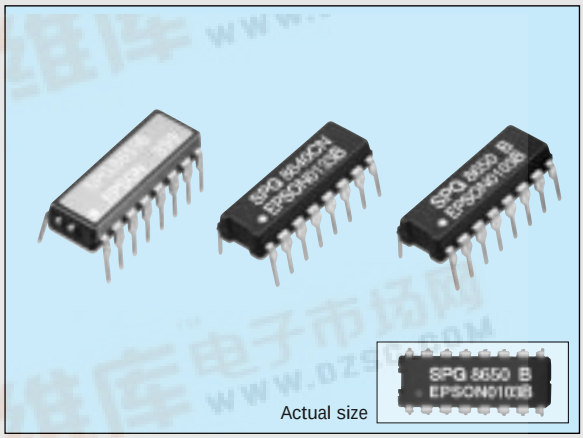
SELECTABLE-OUTPUT CRYSTAL OSCILLATOR

# SPG series

- Capable of selecting 57 varieties of frequency output.
- Low current consumption.
- Easy to mount DIP 16-pin package.




## Specifications (characteristics)

| Item | | Symbol | Specifications | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model name | | | 8640AN | 8640BN | 8640CN | 8650A | 8650B | 8650C | 8650E | 8651A | 8651B | 8651E | |
| Oscillation source frequency | | fo | 600kHz | 1MHz | 768kHz | 60kHz | 100kHz | 96kHz | 32.768kHz | 60kHz | 100kHz | 32.768kHz | For output frequency, refer to the table in the next page |
| Power source voltage | Max. supply voltage | $V_{DD}$-GND | -0.3V to +7.0V | | | | | | | | | | |
| | Operating voltage | $V_{DD}$ | 5.0V±0.5V | | | | | | | | | | |
| Temperature range | Storage temperature | $T_{STG}$ | -55°C to +125°C | | | | | | | -30°C to +80°C | | | |
| | Operating temperature | $T_{OPR}$ | -10°C to +70°C | | | | | | | -10°C to +60°C | | | |
| Soldering condition (lead part) | | $T_{SOL}$ | Under 260°C within 10 sec. | | | | | | | | | | Package should be less than 150°C |
| Frequency tolerance | | Δf/f₀ | ±100ppm | | | ±50ppm | | | | ±5ppm ∗1 | | | $V_{DD}$=5V, Ta=25°C |
| Frequency temperature characteristics | | | +10/-120ppm | | | | | | | | | | $V_{DD}$=5V |
| Frequency voltage characteristics | | | ±20ppm | ±10ppm | ±20ppm | ±10ppm | | | | ±5ppm | | | $V_{DD}$=4.5 to 5.5V |
| Aging | | fa | ±5ppm/year max. | | | | | | | ±3ppm/year max. | | | $V_{DD}$=5V, Ta=25°C, first year |
| Current consumption | | Iop | 1.0mA max. | | 2.0mA max. | 1.5mA max. | 0.5mA max. | | | | | | No load condition |
| Shock resistance | | S.R. | ±5ppm max. | | | ±5ppm max. | | | | ±10ppm max. | | | Three drops on a hard wooden board form 75cm |

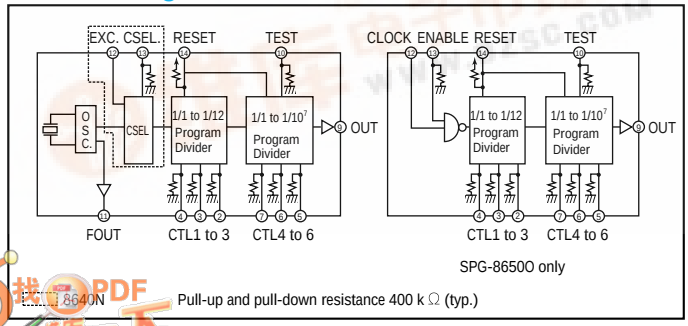
∗1 Frequency tolerance of 8651 system shows the value guaranteed at the time of shipment.

## Electric characteristics ($V_{DD}$=5V±0.5V, Ta=-10 to +70°C $C_L \leq$ 15pF)

| Item | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| L. input voltage | $V_{IL}$ | 0 | | 0.8 | V | |
| H. input voltage | $V_{IH}$ | $V_{DD}$-1.0 | | $V_{DD}$ | | |
| L. input current (Reset) | $I_{RL}$ | -30 | | -5 | μA | Reset=GND |
| H input current (Reset) | $I_{RH}$ | | | 0.5 | | Reset=$V_{DD}$ |
| L. input current (input terminal except for Reset) | $I_{IL}$ | -0.5 | | | | |
| H input current (input terminal except for Reset) | $I_{IH}$ | 5 | | 30 | | $I_{OL}$=1.6mA |
| L. output voltage | $V_{OL}$ | | | 0.4 | V | $I_{OH}$= -40μA |
| H. output voltage | $V_{OH}$ | $V_{DD}$-1.0 | | | | $V_{OL}$=0.4V |
| L. output current | $I_{OL}$ | 1.6 | | | mA | $V_{OH}$=$V_{DD}$-1.0V |
| H. output current | $I_{OH}$ | | | -40 | μA | |
| Output rise time | $t_{TLH}$ | | 30 | 60 | ns | |
| Output fall time | $t_{THL}$ | | 25 | 50 | | |
| Duty | | 40 | | 60 | % | Except in the case of 1/3 and 1/5 |
| Min. reset pulse width | $t_{RW}$ | 1.0 | | | μs | |
| Reset delay time | $t_R$ | | | 1.0 | | |
| Reset release synchronous error | $t_E$ | tw-∗1 1/2 to | | tw ∗2 | | |
| External signal input frequency | $F_{IN}$ | | | 1M | Hz | 8640N only |
| External signal input pulse width | $t_{IN}$ | 0.5 | | | μs | |
| Oscillation start up time | $t_{OSC}$ | | 0.2 | 1 | s | ∗3 |

∗1 to=oscillation source cycle. ∗2 tw=1/2 cycle of preset frequency.
∗3 For more than 1ms until $V_{DD}$=0→4.5V. Time at 4.5V is to be 0.

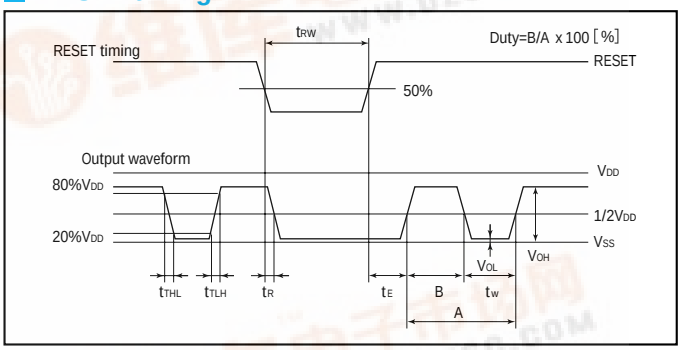
## Block diagram




## Divider IC (without quartz crystal)

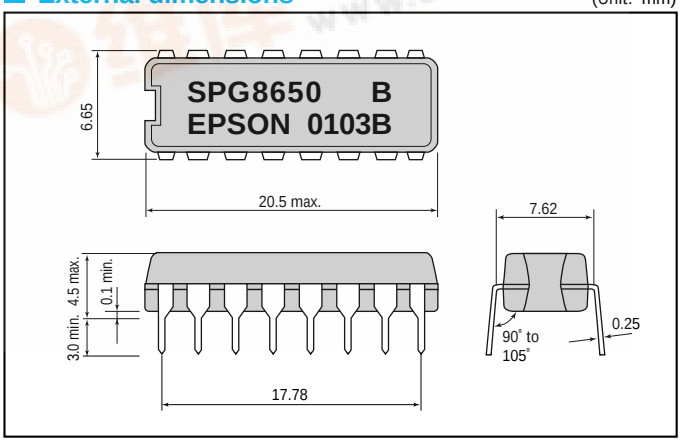
| Item | Symbol | Specifications | Remarks |
|---|---|---|---|
| Model name | | 8650 O | |
| Input clock frequency | | 1 MHz max. | |
| Current consumption | Iop | About 2 mA | No load condition |

## RESET timing

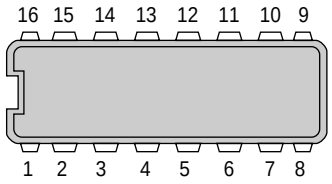



## External dimensions

(Unit: mm)



## Terminal connection




| No. | Pin terminal | No. | Pin terminal |
|---|---|---|---|
| 1 | NC | 16 | $V_{DD}$ |
| 2 | CTL 3 | 15 | NC |
| 3 | CTL 2 | 14 | RESET |
| 4 | CTL 1 | 13 | NC (CSEL) |
| 5 | CTL 6 | 12 | NC (EXC) |
| 6 | CTL 5 | 11 | FOUT |
| 7 | CTL 4 | 10 | TEST |
| 8 | GND | 9 | OUT |

( ) shown 8640N only

For 8650 O
11. NC 12. CLOCK 13. ENABLE

NC: Do not connect to the external terminal.

## Explanation of terminal

(a) CTL 1 to 6 : Programs dividing ratio. (pull-down resistor incorporated.)
(b) OUT : Output frequency preset by CTL1 to 6.
(refer to the procedure for setting output frequency.)
(c) FOUT : Constantly outputs the oscillation source frequency of builtin crystal unit.
(d) RESET : Stops output at RESET= "L".
(pull-up resistor incorporated.)
(e) TEST : Used for the input terminal for testing. When CTL4 is H, output will be 1000 times larger than the preset value at TEST= "H". (pull-down resistor incorporated.)
(f) EXC (8640N only) : Serves as input terminal when using an external clock by changing to the builtin oscillator.
Effective only when CSEL is H.
(g) CSEL (8640N only) : When this terminal is made H, the external clock is selected.
(pull-down resistor incorporated.)

(Note) Treatment of empty terminals. When RESET terminal is not used, this should be connected to $V_{DD}$, and when TEST terminal, CSEL terminal, and CTL 1 to 6 terminals are not used, to GND.

## Explanation of terminal (8650 O)

(a) CLOCK: Clock input (max. 1 MHz) (b) ENABLE: Be sure to connect to $V_{DD}$

## Setting of divider output

| CTL1 | CTL2 | CTL3 | Dividing ratio |
|---|---|---|---|
| 0 | 0 | 0 | 1/1 |
| 0 | 0 | 1 | 1/10 |
| 0 | 1 | 0 | 1/2 |
| 0 | 1 | 1 | 1/3 |
| 1 | 0 | 0 | 1/4 |
| 1 | 0 | 1 | 1/5 |
| 1 | 1 | 0 | 1/6 |
| 1 | 1 | 1 | 1/12 |

| CTL4 | CTL5 | CTL6 | Dividing ratio |
|---|---|---|---|
| 0 | 0 | 0 | 1/1 |
| 0 | 0 | 1 | 1/10 |
| 0 | 1 | 0 | $1/10^2$ |
| 0 | 1 | 1 | $1/10^3$ |
| 1 | 0 | 0 | $1/10^4$ |
| 1 | 0 | 1 | $1/10^5$ |
| 1 | 1 | 0 | $1/10^6$ |
| 1 | 1 | 1 | $1/10^7$ |

0= "L" 1="H"

## Setting of output frequency

### 8640AN

(Unit: Hz)

| Set terminal | | CTL4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CTL5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| CTL1 | CTL2 | CTL3 \ CTL6 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 600k | 60k | 6k | 600 | 60 | 6.0 | 0.6 | 0.06 |
| 0 | 0 | 1 | 60k | 6k | 600 | 60 | 6 | 0.6 | 0.06 | 0.006 |
| 0 | 1 | 0 | 300k | 30k | 3k | 300 | 30 | 3.0 | 0.3 | 0.03 |
| 0 | 1 | 1 | 200k | 20k | 2k | 200 | 20 | 2.0 | 0.2 | 0.02 |
| 1 | 0 | 0 | 150k | 15k | 1.5k | 150 | 15 | 1.5 | 0.15 | 0.015 |
| 1 | 0 | 1 | 120k | 12k | 1.2k | 120 | 12 | 1.2 | 0.12 | 0.012 |
| 1 | 1 | 0 | 100k | 10k | 1k | 100 | 10 | 1.0 | 0.1 | 0.01 |
| 1 | 1 | 1 | 50k | 5k | 500 | 50 | 5 | 0.5 | 0.05 | 0.005 |

### 8640BN

| Set terminal | | CTL4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CTL5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| CTL1 | CTL2 | CTL3 \ CTL6 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1M | 100k | 10k | 1k | 100 | 10 | 1 | 1/10 |
| 0 | 0 | 1 | 100k | 10k | 1k | 100 | 10 | 1 | 1/10 | 1/100 |
| 0 | 1 | 0 | 500k | 50k | 5k | 500 | 50 | 5 | 1/2 | 1/20 |
| 0 | 1 | 1 | 333.3k | 33.3k | 3.3k | 333.3 | 33.3 | 3.33 | 1/3 | 1/30 |
| 1 | 0 | 0 | 250k | 25k | 2.5k | 250 | 25 | 2.5 | 1/4 | 1/40 |
| 1 | 0 | 1 | 200k | 20k | 2k | 200 | 20 | 2 | 1/5 | 1/50 |
| 1 | 1 | 0 | 166.6k | 16.6k | 1.6k | 166.6 | 16.6 | 1.6 | 1/6 | 1/60 |
| 1 | 1 | 1 | 83.3k | 8.3k | 833.3 | 83.3 | 8.3 | 0.83 | 1/12 | 1/120 |

### 8650A 8651A

| Set terminal | | CTL4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CTL5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| CTL1 | CTL2 | CTL3 \ CTL6 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 60k | 6.0k | 600 | 60 | 6.0 | 0.6 | 0.06 | 0.006 |
| 0 | 0 | 1 | 6k | 600 | 60 | 6 | 0.6 | 0.06 | 0.006 | 0.0006 |
| 0 | 1 | 0 | 30k | 3.0k | 300 | 30 | 3.0 | 0.3 | 0.03 | 0.003 |
| 0 | 1 | 1 | 20k | 2.0k | 200 | 20 | 2.0 | 0.2 | 0.02 | 0.002 |
| 1 | 0 | 0 | 15k | 1.5k | 150 | 15 | 1.5 | 0.15 | 0.015 | 0.0015 |
| 1 | 0 | 1 | 12k | 1.2k | 120 | 12 | 1.2 | 0.12 | 0.012 | 0.0012 |
| 1 | 1 | 0 | 10k | 1.0k | 100 | 10 | 1.0 | 0.1 | 0.01 | 0.001 |
| 1 | 1 | 1 | 5k | 500 | 50 | 5 | 0.5 | 0.05 | 0.005 | 0.0005 |

### 8650B 8651B

| Set terminal | | CTL4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CTL5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| CTL1 | CTL2 | CTL3 \ CTL6 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 100k | 10k | 1k | 100 | 10 | 1 | 1/10 | 1/100 |
| 0 | 0 | 1 | 10k | 1k | 100 | 10 | 1 | 1/10 | 1/100 | 1/1000 |
| 0 | 1 | 0 | 50k | 5k | 500 | 50 | 5 | 1/2 | 1/20 | 1/200 |
| 0 | 1 | 1 | 33.3k | 3.3k | 333.3 | 33.3 | 3.33 | 1/3 | 1/30 | 1/300 |
| 1 | 0 | 0 | 25k | 2.5k | 250 | 25 | 2.5 | 1/4 | 1/40 | 1/400 |
| 1 | 0 | 1 | 20k | 2k | 200 | 20 | 2 | 1/5 | 1/50 | 1/500 |
| 1 | 1 | 0 | 16.6k | 1.6k | 166.6 | 16.6 | 1.6 | 1/6 | 1/60 | 1/600 |
| 1 | 1 | 1 | 8.3k | 833.3 | 83.3 | 8.3 | 0.83 | 1/12 | 1/120 | 1/1200 |

### 8650E 8651E

| Set terminal | | CTL4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CTL5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| CTL1 | CTL2 | CTL3 \ CTL6 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 32768 | 3276.8 | 327.68 | 32.768 | 3.276 | 0.3276 | 0.03276 | 0.00327 |
| 0 | 0 | 1 | 3276.8 | 327.68 | 32.768 | 3.276 | 0.327 | 0.0327 | 0.00327 | 0.00032 |
| 0 | 1 | 0 | 16384 | 1638.4 | 163.84 | 16.384 | 1.638 | 0.1638 | 0.01638 | 0.00163 |
| 0 | 1 | 1 | 10922.6 | 1092.26 | 109.226 | 10.922 | 1.092 | 0.1092 | 0.01092 | 0.00109 |
| 1 | 0 | 0 | 8192 | 819.2 | 81.92 | 8.192 | 0.819 | 0.0819 | 0.00819 | 0.00081 |
| 1 | 0 | 1 | 6553.6 | 655.36 | 65.536 | 6.553 | 0.655 | 0.0655 | 0.00655 | 0.00065 |
| 1 | 1 | 0 | 5461.3 | 546.13 | 54.613 | 5.461 | 0.546 | 0.0546 | 0.00546 | 0.00054 |
| 1 | 1 | 1 | 2730.6 | 273.06 | 27.306 | 2.730 | 0.273 | 0.0273 | 0.00273 | 0.00027 |

Note: Lower digits are omitted.

## Baud rate generator

### 8640CN

| CTL1 | CTL2 | CTL3 | CTL4 | CTL5 | CTL6 | Output frequency | Baud rate output example (fo/16) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 768 kHz | 48000bits/sec. |
| 1 | 0 | 1 | 0 | 0 | 0 | 153.6 | 9600 |
| 0 | 0 | 1 | 0 | 0 | 0 | 76.8 | 4800 |
| 0 | 1 | 0 | 0 | 0 | 1 | 38.4 | 2400 |
| 1 | 0 | 0 | 0 | 0 | 1 | 19.2 | 1200 |

### 8650C

| CTL1 | CTL2 | CTL3 | CTL4 | CTL5 | CTL6 | Output frequency | Baud rate output example (to/16) |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 96.0 kHz | 6000bits/sec. |
| 1 | 0 | 1 | 0 | 0 | 0 | 19.2 | 1200 |
| 0 | 0 | 1 | 0 | 0 | 0 | 9.6 | 600 |
| 0 | 1 | 0 | 0 | 0 | 1 | 4.8 | 300 |
| 0 | 1 | 1 | 0 | 0 | 1 | 3.2 | 200 |
| 1 | 0 | 0 | 0 | 0 | 1 | 2.4 | 150 |
| 1 | 1 | 0 | 0 | 0 | 1 | 1.6 | 100 |
| 1 | 1 | 1 | 0 | 0 | 1 | 0.8 | 50 |

# THE CRYSTALMASTER

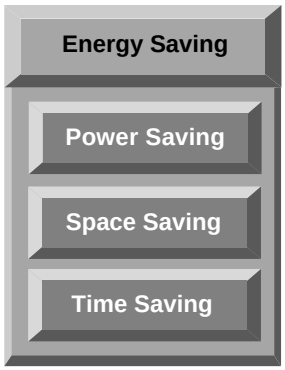
# ENERGY SAVING EPSON

EPSON offers effective savings to its customers through a wide range of electronic devices, such as semiconductors, liquid crystal display (LCD) modules, and crystal devices. These savings are achieved through a sophisticated melding of three different efficiency technologies.

Power saving technology provides low power consumption at low voltages.

Space saving technology provides further reductions in product size and weight through super-precise processing and high-density assembly technology.

Time saving technology shortens the time required for design and development on the customer side and shortens delivery times.





Our concept of Energy Saving technology conserves resources by blending the essence of these three efficiency technologies. The essence of these technologies is represented in each of the products that we provide to our customers.

In the industrial sector, leading priorities include measures to counter the greenhouse effect by reducing CO2, measures to preserve the global environment, and the development of energy-efficient products. Environmental problems are of global concern, and although the contribution of energy-saving technology developed by EPSON may appear insignificant, we seek to contribute to the development of energy-saving products by our customers through the utilization of our electronic devices. EPSON is committed to the conservation of energy, both for the sake of people and of the planet on which we live.

**SEIKO EPSON CORP. QUARTZ DEVICE DIVISION acquired ISO9001 and ISO14001 certification by B.V.Q.I. (Bureau Veritas Quality International) .**

**ISO9001 in October, 1992.**

**ISO14001 in November,1997.**