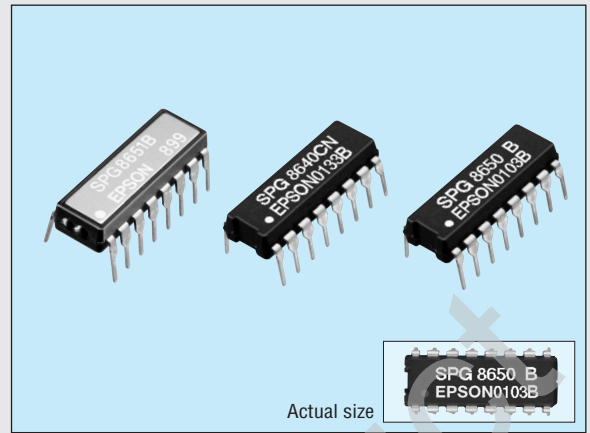


SELECTABLE-OUTPUT CRYSTAL OSCILLATOR

# 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          | $f_o$                 | 600 kHz                                  | 1 MHz                   | 768 kHz                 | 60 kHz                      | 100 kHz | 96 kHz | 32.768 kHz                   | 60 kHz                                  | 100 kHz | 32.768 kHz                                     | For output frequency, refer to the table in the next page |                  |
| Power source voltage                  | Max. supply voltage   | $V_{DD-GND}$                             |                         |                         |                             |         |        |                              |   |         |  | -0.3 V to +7.0 V  |                  |
|                                       | Operating voltage     | $V_{DD}$                                 |                         |                         |                             |         |        |                              |   |         |  | 5.0 V $\pm$ 0.5 V   |                  |
| 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 s                |                         |                         |                             |         |        |                              |   |         |  | Package should be less than +150 °C                       |                  |
| Frequency tolerance                   | $\Delta f/f_o$        | $\pm 100 \times 10^{-6}$                 |                         |                         | $\pm 50 \times 10^{-6}$     |         |        | $\pm 5 \times 10^{-6} *1$    |   |         | $V_{DD}=5 V, T_a=+25 °C$                       |   |                  |
| Frequency temperature characteristics |                       | $+10/-120 \times 10^{-6}$                |                         |                         |                             |         |        |                              |   |         |  | $V_{DD}=5 V$  |                  |
| Frequency voltage characteristics     |                       | $\pm 20 \times 10^{-6}$                  | $\pm 10 \times 10^{-6}$ | $\pm 20 \times 10^{-6}$ | $\pm 10 \times 10^{-6}$     |         |        | $\pm 5 \times 10^{-6}$       |   |         | $V_{DD}=4.5$ to $5.5 V$                        |   |                  |
| Aging                                 | $f_a$                 | $\pm 5 \times 10^{-6}/\text{year Max.}$  |                         |                         |                             |         |        |                              | $\pm 3 \times 10^{-6}/\text{year Max.}$ |         |  | $V_{DD}=5 V, T_a=+25 °C, \text{first year}$               |                  |
| Current consumption                   | $I_{OP}$              | 1.0 mA Max.                              | 2.0 mA Max.             | 1.5 mA Max.             | 0.5 mA Max.                 |         |        |                              |   |         | No load condition                              |   |                  |
| Shock resistance                      | S.R.                  | $\pm 5 \times 10^{-8}$ Max.(From 500 mm) |                         |                         | $\pm 5 \times 10^{-8}$ Max. |         |        | $\pm 10 \times 10^{-8}$ Max. |   |         | Three drops on a hard wooden board form 750 mm |   |                  |

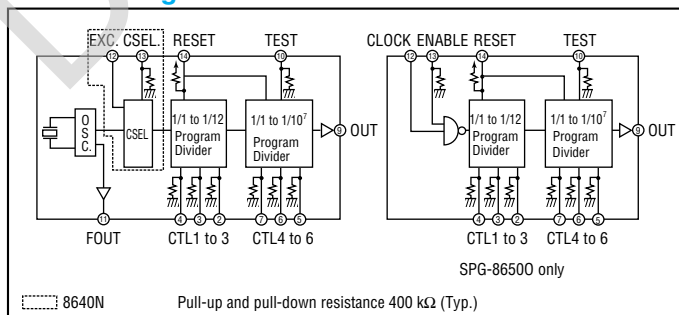
\*1 Frequency tolerance of 8651 system shows the value guaranteed at the time of shipment.

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

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

\* 1  $t_o$ =oscillation source cycle. \* 2  $t_w=1/2$  cycle of preset frequency.  
 \* 3 For more than 1 ms until  $V_{DD}=0 \rightarrow 4.5 V$ . Time at 4.5 V is to be 0.

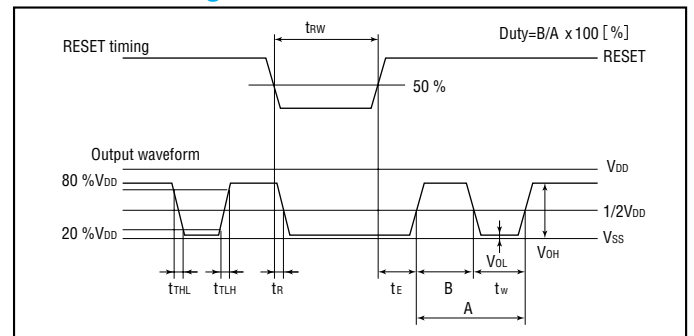
## Block diagram



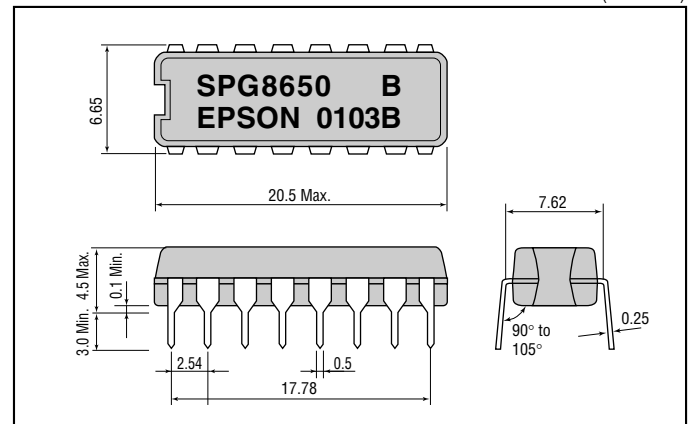
## Divider IC (without quartz crystal)

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

## RESET timing



## External dimensions



**Terminal connection**

| No. | Pin terminal | No. | Pin terminal    |
|-----|--------------|-----|-----------------|
| 1   | NC           | 16  | V <sub>DD</sub> |
| 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<sub>DD</sub>, 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<sub>DD</sub>

**Setting of divider output**

| CTL1 | CTL2 | CTL3 | Dividing ratio | CTL4 | CTL5 | CTL6 | Dividing ratio    |
|------|------|------|----------------|------|------|------|-------------------|
| 0    | 0    | 0    | 1/1            | 0    | 0    | 0    | 1/1               |
| 0    | 0    | 1    | 1/10           | 0    | 0    | 1    | 1/10              |
| 0    | 1    | 0    | 1/2            | 0    | 1    | 0    | 1/10 <sup>2</sup> |
| 0    | 1    | 1    | 1/3            | 0    | 1    | 1    | 1/10 <sup>3</sup> |
| 1    | 0    | 0    | 1/4            | 1    | 0    | 0    | 1/10 <sup>4</sup> |
| 1    | 0    | 1    | 1/5            | 1    | 0    | 1    | 1/10 <sup>5</sup> |
| 1    | 1    | 0    | 1/6            | 1    | 1    | 0    | 1/10 <sup>6</sup> |
| 1    | 1    | 1    | 1/12           | 1    | 1    | 1    | 1/10 <sup>7</sup> |

0= "L" 1="H"

**Setting of output frequency**

**8640AN**

(Unit: Hz)

| Set terminal | CTL4 | CTL5 | CTL3 | CTL6 | CTL1 | CTL2 | Output frequency | Baud rate output example (to/16) |
|--------------|------|------|------|------|------|------|------------------|----------------------------------|
| 0            | 0    | 0    | 0    | 0    | 1    | 1    | 1                | 1                                |
| 0            | 0    | 1    | 1    | 0    | 0    | 1    | 1                | 1                                |
| 0            | 0    | 0    | 0    | 1    | 0    | 1    | 0                | 1                                |
| 0            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 0.06                             |
| 0            | 0    | 1    | 0    | 0    | 0    | 1    | 0                | 0.006                            |
| 0            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 0.03                             |
| 0            | 1    | 1    | 0    | 0    | 0    | 1    | 0                | 0.02                             |
| 1            | 0    | 0    | 0    | 0    | 0    | 0    | 0                | 0.015                            |
| 1            | 0    | 1    | 0    | 0    | 0    | 1    | 0                | 0.012                            |
| 1            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 0.01                             |
| 1            | 1    | 1    | 0    | 0    | 0    | 1    | 0                | 0.005                            |

**8640BN**

| Set terminal | CTL4 | CTL5 | CTL3 | CTL6 | CTL1 | CTL2 | Output frequency | Baud rate output example (to/16) |
|--------------|------|------|------|------|------|------|------------------|----------------------------------|
| 0            | 0    | 0    | 0    | 0    | 1    | 1    | 1                | 1                                |
| 0            | 0    | 1    | 1    | 0    | 0    | 0    | 1                | 1                                |
| 0            | 0    | 0    | 0    | 1    | 0    | 1    | 0                | 1                                |
| 0            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 1/10                             |
| 0            | 0    | 1    | 0    | 0    | 0    | 1    | 0                | 1/100                            |
| 0            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 1/20                             |
| 0            | 1    | 1    | 0    | 0    | 0    | 1    | 0                | 1/30                             |
| 1            | 0    | 0    | 0    | 0    | 0    | 0    | 0                | 1/40                             |
| 1            | 0    | 1    | 0    | 0    | 0    | 1    | 0                | 1/50                             |
| 1            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 1/60                             |
| 1            | 1    | 1    | 0    | 0    | 0    | 1    | 0                | 1/120                            |

**8650A 8651A**

| Set terminal | CTL4 | CTL5 | CTL3 | CTL6 | CTL1 | CTL2 | Output frequency | Baud rate output example (to/16) |
|--------------|------|------|------|------|------|------|------------------|----------------------------------|
| 0            | 0    | 0    | 0    | 0    | 1    | 1    | 1                | 1                                |
| 0            | 0    | 1    | 1    | 0    | 0    | 0    | 1                | 1                                |
| 0            | 0    | 0    | 0    | 1    | 0    | 1    | 0                | 1                                |
| 0            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 0.006                            |
| 0            | 0    | 1    | 0    | 0    | 0    | 1    | 0                | 0.006                            |
| 0            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 0.03                             |
| 0            | 1    | 1    | 0    | 0    | 0    | 0    | 0                | 0.02                             |
| 1            | 0    | 0    | 0    | 0    | 0    | 0    | 0                | 0.015                            |
| 1            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 0.012                            |
| 1            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 0.01                             |
| 1            | 1    | 1    | 0    | 0    | 0    | 0    | 0                | 0.005                            |

**8650B 8651B**

| Set terminal | CTL4 | CTL5 | CTL3 | CTL6 | CTL1 | CTL2 | Output frequency | Baud rate output example (to/16) |
|--------------|------|------|------|------|------|------|------------------|----------------------------------|
| 0            | 0    | 0    | 0    | 0    | 1    | 1    | 1                | 1                                |
| 0            | 0    | 1    | 1    | 0    | 0    | 0    | 1                | 1                                |
| 0            | 0    | 0    | 0    | 1    | 0    | 1    | 0                | 1                                |
| 0            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 1/100                            |
| 0            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 1/1000                           |
| 0            | 1    | 0    | 0    | 0    | 0    | 1    | 0                | 1/200                            |
| 0            | 1    | 1    | 0    | 0    | 0    | 0    | 0                | 1/300                            |
| 1            | 0    | 0    | 0    | 0    | 0    | 0    | 0                | 1/400                            |
| 1            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 1/500                            |
| 1            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 1/600                            |
| 1            | 1    | 1    | 0    | 0    | 0    | 0    | 0                | 1/1200                           |

**8650E 8651E**

| Set terminal | CTL4 | CTL5 | CTL3 | CTL6 | CTL1 | CTL2 | Output frequency | Baud rate output example (to/16) |
|--------------|------|------|------|------|------|------|------------------|----------------------------------|
| 0            | 0    | 0    | 0    | 0    | 1    | 1    | 1                | 1                                |
| 0            | 0    | 1    | 1    | 0    | 0    | 0    | 1                | 1                                |
| 0            | 0    | 0    | 0    | 1    | 0    | 1    | 0                | 1                                |
| 0            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 0.00327                          |
| 0            | 0    | 1    | 0    | 0    | 0    | 1    | 0                | 0.0032                           |
| 0            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 0.01638                          |
| 0            | 1    | 1    | 0    | 0    | 0    | 0    | 0                | 0.01092                          |
| 1            | 0    | 0    | 0    | 0    | 0    | 0    | 0                | 0.0819                           |
| 1            | 0    | 1    | 0    | 0    | 0    | 0    | 0                | 0.0655                           |
| 1            | 1    | 0    | 0    | 0    | 0    | 0    | 0                | 0.0546                           |
| 1            | 1    | 1    | 0    | 0    | 0    | 0    | 0                | 0.0273                           |

Note: Lower digits are omitted.

**Baud rate generator**

**8640CN**

| CTL1 | CTL2 | CTL3 | CTL4 | CTL5 | CTL6 | Output frequency | Baud rate output example (to/16) |
|------|------|------|------|------|------|------------------|----------------------------------|
| 0    | 0    | 0    | 0    | 0    | 0    | 768 kHz          | 48000 bits/s                     |
| 1    | 0    | 0    | 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         | 6000 bits/s                      |
| 1    | 0    | 0    | 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                               |