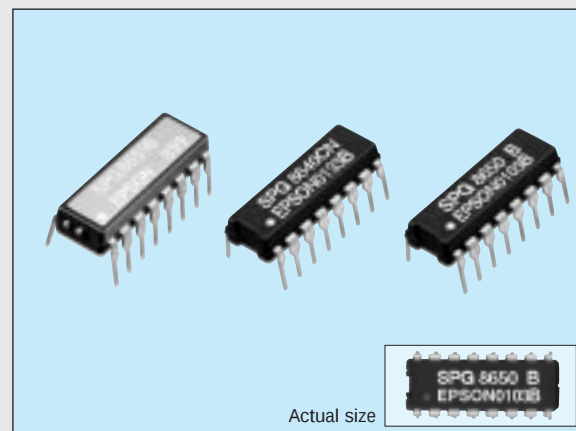


## SELECTABLE-OUTPUT CRYSTAL OSCILLATOR

## 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 | 8650D       | 8650E     | 8651A          | 8651B  | 8651E     |                                                                          |
| Oscillation source frequency          |                       | f <sub>o</sub>       | 600kHz                     | 1MHz       | 768kHz     | 60kHz      | 100kHz | 96kHz | 153.6kHz    | 32.768kHz | 60kHz          | 100kHz | 32.768kHz | For output frequency, refer to the table in the next page                |
| Power source voltage                  | Max. supply voltage   | V <sub>DD</sub> -GND | -0.3V to +7.0V             |            |            |            |        |       |             |           |                |        |           |                                                                          |
|                                       | Operating voltage     | V <sub>DD</sub>      | 5.0V±0.5V                  |            |            |            |        |       |             |           |                |        |           |                                                                          |
| Temperature range                     | Storage temperature   | T <sub>STG</sub>     | -55°C to +125°C            |            |            |            |        |       |             |           | -30°C to +80°C |        |           |                                                                          |
|                                       | Operating temperature | T <sub>OPR</sub>     | -10°C to +70°C             |            |            |            |        |       |             |           | -10°C to +60°C |        |           |                                                                          |
| Soldering condition (lead part)       |                       | T <sub>SOL</sub>     | Under 260°C within 10 sec. |            |            |            |        |       |             |           |                |        |           | Package should be less than 150°C                                        |
| Frequency tolerance                   |                       | Δf/f <sub>o</sub>    | ±100ppm                    |            |            | ±50ppm     |        |       |             |           | ±5ppm #1       |        |           | V <sub>DD</sub> =5V, T <sub>a</sub> =25°C                                |
| Frequency temperature characteristics |                       |                      | +10/-120ppm                |            |            |            |        |       |             |           |                |        |           | V <sub>DD</sub> =5V                                                      |
| Frequency voltage characteristics     |                       |                      | ±20ppm                     | ±10ppm     | ±20ppm     | ±10ppm     |        |       |             |           | ±5ppm          |        |           | V <sub>DD</sub> =4.5 to 5.5V                                             |
| Aging                                 |                       | f <sub>a</sub>       | ±5ppm/year max.            |            |            |            |        |       |             |           |                |        |           | ±3ppm/year max.<br>V <sub>DD</sub> =5V, T <sub>a</sub> =25°C, first year |
| Current consumption                   |                       | I <sub>OP</sub>      | 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 from 75cm                             |

<sup>#1</sup> Frequency tolerance of 8651 system shows the value guaranteed at the time of shipment.

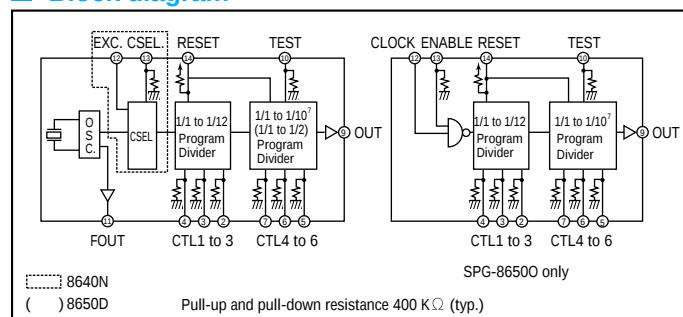
Electric characteristics ( $V_{DD}=5V \pm 0.5V, T_a=-10 \text{ to } 70^\circ\text{C}, C_L \leq 15\text{pF}$ )

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

<sup>#1</sup> to=oscillation source cycle. <sup>#2</sup>  $t_{RW}=1/2$  cycle of preset frequency.

<sup>#3</sup> For more than 1ms until  $V_{DD}=0.4-5V$ . Time at 4.5V is to be 0.

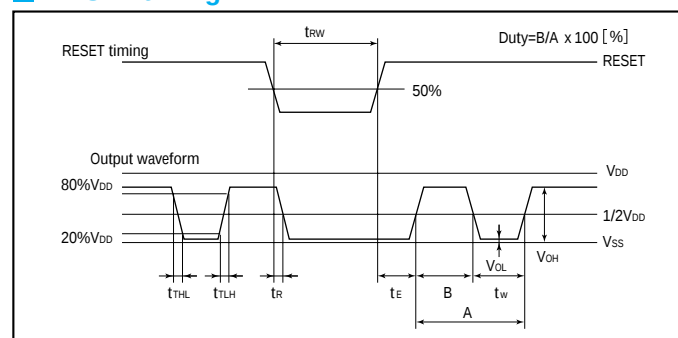
## Block diagram



## Divider IC (without quartz crystal)

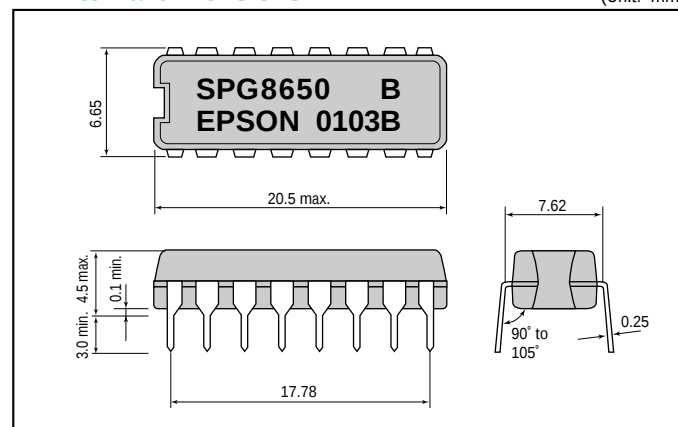
| Item                  | Symbol   | Specifications | Remarks           |
|-----------------------|----------|----------------|-------------------|
| Model name            |          | 8650 O         |                   |
| Input clock frequency |          | 1 MHz max.     |                   |
| Current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

## RESET timing



## External dimensions

(Unit: mm)



## 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 (1/1)                            |
| 0    | 0    | 1    | 1/10           | 0    | 0    | 1    | 1/10 (1/2)                           |
| 0    | 1    | 0    | 1/2            | 0    | 1    | 0    | 1/10 <sup>2</sup> (1/2) <sup>2</sup> |
| 0    | 1    | 1    | 1/3            | 0    | 1    | 1    | 1/10 <sup>3</sup> (1/2) <sup>3</sup> |
| 1    | 0    | 0    | 1/4            | 1    | 0    | 0    | 1/10 <sup>4</sup> (1/2) <sup>4</sup> |
| 1    | 0    | 1    | 1/5            | 1    | 0    | 1    | 1/10 <sup>5</sup> (1/2) <sup>5</sup> |
| 1    | 1    | 0    | 1/6            | 1    | 1    | 0    | 1/10 <sup>6</sup> (1/2) <sup>6</sup> |
| 1    | 1    | 1    | 1/12           | 1    | 1    | 1    | 1/10 <sup>7</sup> (1/2) <sup>7</sup> |

0= "L" 1="H"

( ) 8650D

## 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    | 1     |
| CTL1         | CTL2 | CTL3 | CTL6 | 0   | 1    | 0   | 1  | 0    | 1     |
| 0            | 0    | 0    | 600K | 60K | 6K   | 600 | 60 | 6.0  | 0.06  |
| 0            | 0    | 1    | 60K  | 6K  | 600  | 60  | 6  | 0.06 | 0.006 |
| 0            | 1    | 0    | 300K | 30K | 3K   | 300 | 30 | 0.3  | 0.03  |
| 0            | 1    | 1    | 200K | 20K | 2K   | 200 | 20 | 0.2  | 0.02  |
| 1            | 0    | 0    | 150K | 15K | 1.5K | 150 | 15 | 0.15 | 0.015 |
| 1            | 0    | 1    | 120K | 12K | 1.2K | 120 | 12 | 0.12 | 0.012 |
| 1            | 1    | 0    | 100K | 10K | 1K   | 100 | 10 | 0.1  | 0.01  |
| 1            | 1    | 1    | 50K  | 5K  | 500  | 50  | 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    | 1     |
| CTL1         | CTL2 | CTL3 | CTL6   | 0     | 1     | 0     | 1    | 0    | 1     |
| 0            | 0    | 0    | 1M     | 100K  | 10K   | 1K    | 100  | 10   | 1/10  |
| 0            | 0    | 1    | 100K   | 10K   | 1K    | 100   | 10   | 1    | 1/100 |
| 0            | 1    | 0    | 500K   | 50K   | 5K    | 500   | 50   | 5    | 1/2   |
| 0            | 1    | 1    | 333.3K | 33.3K | 3.3K  | 333.3 | 33.3 | 3.33 | 1/3   |
| 1            | 0    | 0    | 250K   | 25K   | 2.5K  | 250   | 25   | 2.5  | 1/4   |
| 1            | 0    | 1    | 200K   | 20K   | 2K    | 200   | 20   | 2    | 1/5   |
| 1            | 1    | 0    | 166.6K | 16.6K | 1.6K  | 166.6 | 16.6 | 1.6  | 1/6   |
| 1            | 1    | 1    | 83.3K  | 8.3K  | 833.3 | 83.3  | 8.3  | 0.83 | 1/12  |

## 8650A 8651A

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

## 8650B 8651B

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

## 8650E 8651E

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

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          | 4800bits/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                               |

### 8650D

| CTL1 | CTL2 | CTL3 | CTL4 | CTL5 | CTL6 | Output frequency | Baud rate output example (to/16) |
|------|------|------|------|------|------|------------------|----------------------------------|
| 0    | 0    | 0    | 0    | 0    | 0    | 153.6 kHz        | 9600bits/sec.                    |
| 0    | 0    | 0    | 0    | 0    | 1    | 76.8             | 4800                             |
| 0    | 0    | 0    | 0    | 1    | 0    | 38.4             | 2400                             |
| 0    | 0    | 0    | 0    | 1    | 1    | 19.2             | 1200                             |
| 0    | 0    | 0    | 1    | 0    | 0    | 9.6              | 600                              |
| 0    | 0    | 0    | 1    | 0    | 1    | 4.8              | 300                              |
| 0    | 1    | 1    | 1    | 0    | 0    | 3.2              | 200                              |
| 0    | 0    | 0    | 1    | 1    | 0    | 2.4              | 150                              |
| 1    | 1    | 0    | 1    | 0    | 0    | 1.6              | 100                              |
| 0    | 0    | 0    | 1    | 1    | 1    | 1.2              | 75                               |
| 1    | 1    | 1    | 1    | 0    | 0    | 0.8              | 50                               |