

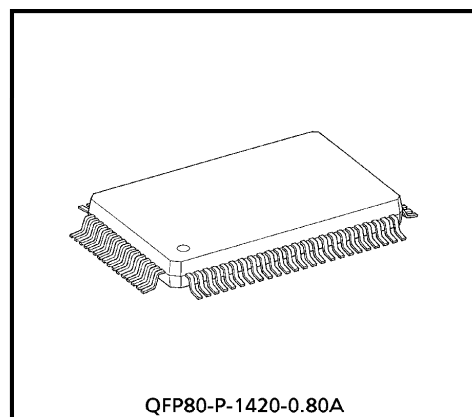
# TC9240F

## AUDIO LCD DRIVER IC

The TC9240F is a driver IC designed for exclusive use for output expansion LCD which is controlled by serial data.

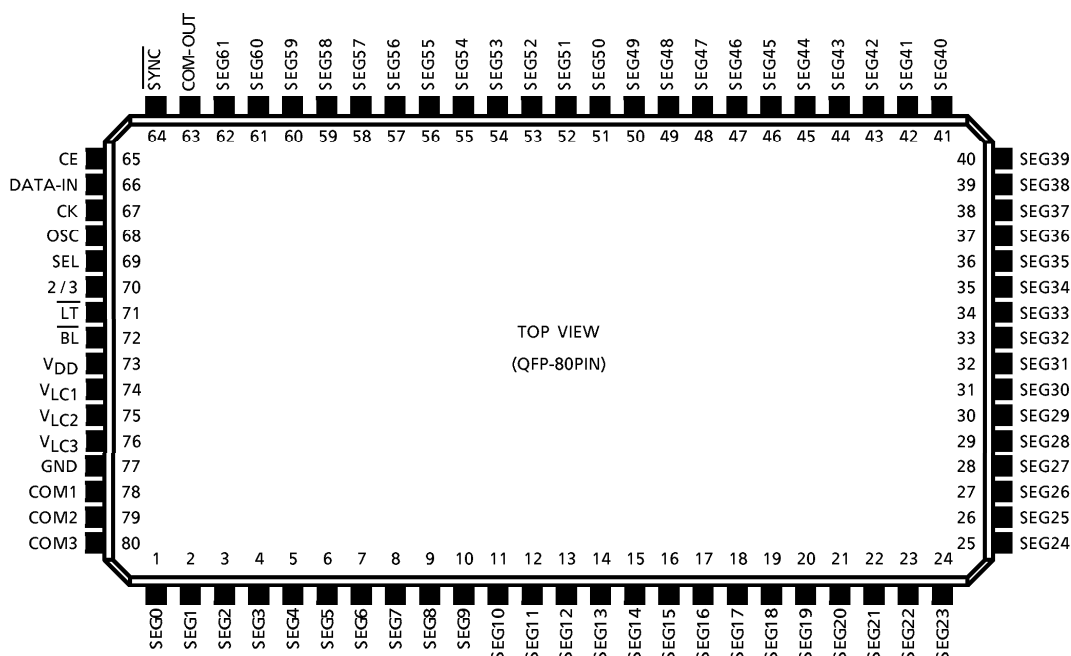
### FEATURES

- 1/2 or 1/3 duty and 1/2 or 1/3 bias can be switched.
- Max. 124 segments can be displayed in the 1/2 duty mode and 186 segments in the 1/3 duty mode.
- Built-in display synchronizing circuit enables display in multi-chip configuration.
- Built-in oscillation circuit with externally connected capacitor and resistor.
- Connected to the controller using the tree-wire system.
- Display data split in 3 segment blocks enables efficient data transfer.



Weight : 1.57g (Typ.)

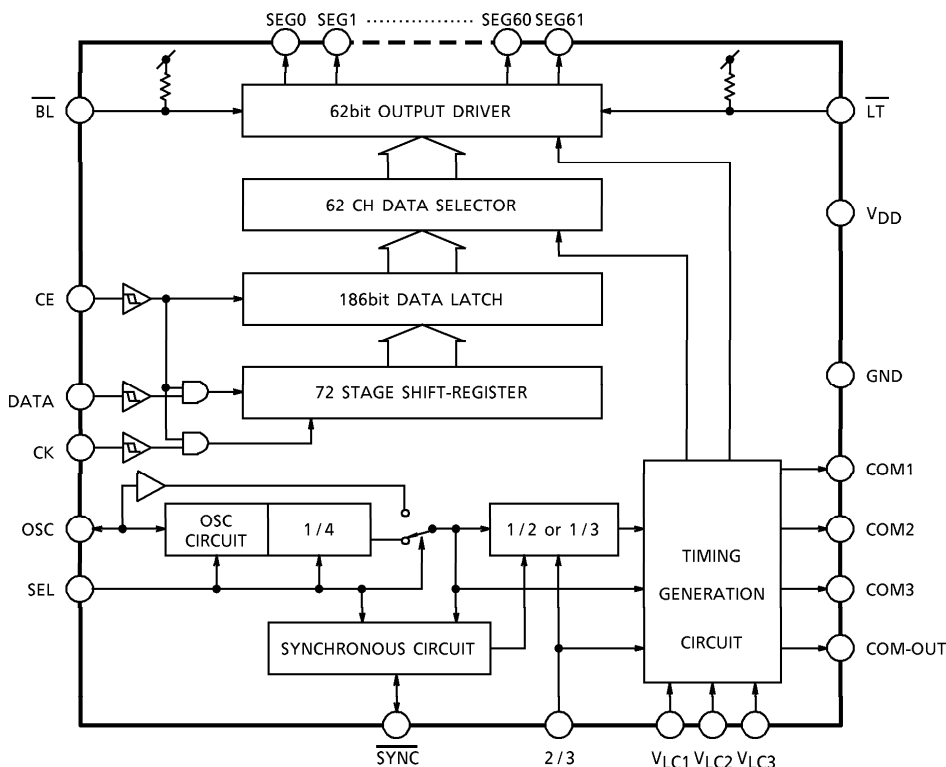
### PIN CONNECTION



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BLOCK DIAGRAM

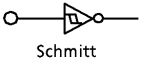
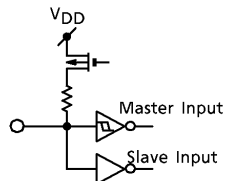
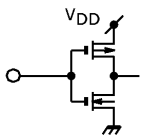
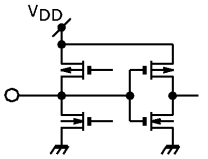
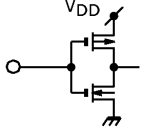
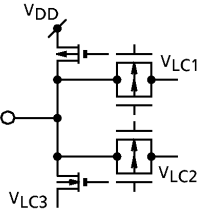
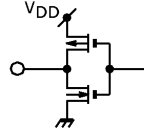


PIN DESCRIPTION

| PIN No.      | SYMBOL             | PIN NAME            | DESCRIPTION  | REMARKS |
|--------------|--------------------|---------------------|--|---------|
| 73           | V <sub>DD</sub>    | Power Supply Pin    | Power Supply Pin (5V±0.5V)   | —       |
| 77           | GND                | GND Pin             |  |         |
| 1<br>5<br>62 | SEG0<br>)<br>SEG61 | Segment Output Pin  | LCD segment drive output pins<br>1/2 or 1/3 duty } can be switched.<br>1/2 or 1/3 bias } |         |
| 72           | BL                 | Blanking Input Pin  | All segments are put in the blanking state when "L" level signal is input.               |         |
| 71           | LT                 | Lamp Test Input Pin | All segments light when "L" level signal is input.                                       |         |

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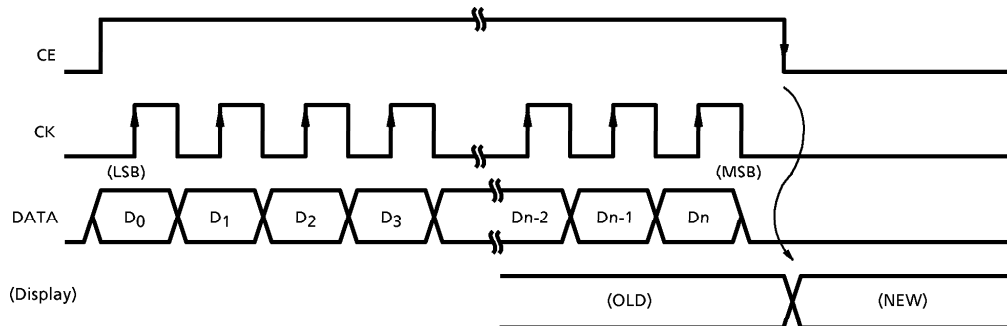
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| PIN No. | SYMBOL                   | PIN NAME                   | DESCRIPTION   | REMARKS   |
|---------|--------------------------|----------------------------|---|---|
| 65      | CE                       | Chip Select Input Pin      | Display data input pins<br>Input data becomes valid only when CE = "H".<br>Display data is input synchronizing with rise of CK clock.<br>When CE = "H" changes to CE = "L", data is latched and display is updated. |    |
| 66      | DATA                     | Data Input Pin             |   |   |
| 67      | CK                       | Clock Input Pin            |   |   |
| 68      | OSC                      | Oscillation Pin            | This pin serves as an oscillator when a capacitor and a resistor are connected externally.<br>In the slave mode, COM-OUT output from the master IC is input to this pin.  |    |
| 69      | SEL                      | Master/Slave Switching Pin | Master/slave switching input when more than 2 pieces of this IC are used simultaneously.<br>"H" = Master Mode<br>"L" = Slave Mode   |    |
| 64      | $\overline{\text{SYNC}}$ | Synchronous Pin            | Synchronizing input/output pin when more than 2 pieces of this IC are used simultaneously.<br>Master Mode : Synchronous output<br>Slave Mode : Synchronous input  |   |
| 70      | 2/3                      | Duty Switching Pin         | 1/2 or 1/3 duty switching input<br>"H" = 1/2 duty mode<br>"L" = 1/3 duty mode   |  |
| 74      | V <sub>LC1</sub>         | Bias Input Pin             | LCD drive voltage input pins<br>Set input voltage to<br>$V_{DD} \geq V_{LC1} \geq V_{LC2} \geq V_{LC3} \geq GND$  | —   |
| 75      | V <sub>LC2</sub>         |                            |   |   |
| 76      | V <sub>LC3</sub>         |                            |   |   |
| 78      | COM1                     | Common Output Pin          | Common pin drive output<br>In the 1/2 duty mode, COM3 pin is used in the open state.  |  |
| 79      | COM2                     |                            |   |   |
| 80      | COM3                     |                            |   |   |
| 63      | COM-OUT                  | Common Clock Output Pin    | Synchronizing clock output pin<br>Supplies clock to the OSC pin of the slave IC.<br>$f_{\text{COM}} = f_{\text{OSC}} / 4[\text{Hz}]$  |  |

**DESCRIPTION OF OPERATION**

1. Data Input Format

- Display data are input at the following timings:



(Display)

- For data length, 48 bits ( $D_0 \sim D_{47}$ ) are transferred 3 times in the 1/2 duty mode and 72 bits ( $D_0 \sim D_{71}$ ) 3 times in the 1/3 duty mode
- 3 bits (last 3 bits) from MSB side of data are address data.  
( $D_{45} \sim D_{47}$  in the 1/2 duty mode, while  $D_{69} \sim D_{71}$  in the 1/3 duty mode.)
- Data in the 1/2 duty mode ( $2/3 = "H"$ )
 

|                  |                                    |                   |
|------------------|------------------------------------|-------------------|
| COM1 system data | : $D_0, D_2, D_4 \dots (D_0 + 2n)$ | } $n = 0 \sim 61$ |
| COM2 system data | : $D_1, D_3, D_5 \dots (D_1 + 2n)$ |                   |
| Address data     | : "100" = SEG0~SEG20               |                   |
|                  | : "010" = SEG21~SEG41              |                   |
|                  | : "001" = SEG42~SEG61              |                   |
- Data in the 1/3 duty mode ( $2/3 = "L"$ )
 

|                  |                                    |                   |
|------------------|------------------------------------|-------------------|
| COM1 system data | : $D_0, D_3, D_6 \dots (D_0 + 3n)$ | } $n = 0 \sim 61$ |
| COM2 system data | : $D_1, D_4, D_7 \dots (D_1 + 3n)$ |                   |
| COM3 system data | : $D_2, D_5, D_8 \dots (D_2 + 3n)$ |                   |
| Address data     | : "100" = SEG0~SEG20               |                   |
|                  | : "010" = SEG21~SEG41              |                   |
|                  | : "001" = SEG42~SEG61              |                   |

1) Data Format at 1/3 Duty (186 Segment)

|                |                |                |                |                |                 |                 |                 |                                  |                 |                                  |                 |                 |                 |
|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|----------------------------------|-----------------|----------------------------------|-----------------|-----------------|-----------------|
| D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> | D <sub>5</sub>  | ~               | D <sub>60</sub> | D <sub>61</sub>                  | D <sub>62</sub> | D <sub>63</sub> ~D <sub>68</sub> | Data Address    |                 |                 |
| S0 C1          | S0 C2          | S0 C3          | S1 C1          | S1 C2          | S1 C3           | }}              | S20 C1          | S20 C2                           | S20 C3          | ※                                | 1               | 0               | 0               |
| D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> | D <sub>5</sub>  | ~               | D <sub>60</sub> | D <sub>61</sub>                  | D <sub>62</sub> | D <sub>63</sub> ~D <sub>68</sub> | D <sub>69</sub> | D <sub>70</sub> | D <sub>71</sub> |
| S21 C1         | S21 C2         | S21 C3         | S22 C1         | S22 C2         | S22 C3          | }}              | S41 C1          | S41 C2                           | S41 C3          | ※                                | 0               | 1               | 0               |
| D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | ~              | D <sub>57</sub> | D <sub>58</sub> | D <sub>59</sub> | D <sub>60</sub> ~D <sub>68</sub> |                 |                                  | D <sub>69</sub> | D <sub>70</sub> | D <sub>71</sub> |
| S42 C1         | S42 C2         | S42 C3         | S43 C1         | }}             | S61 C1          | S61 C2          | S61 C3          | ※                                |                 |                                  | 0               | 0               | 1               |

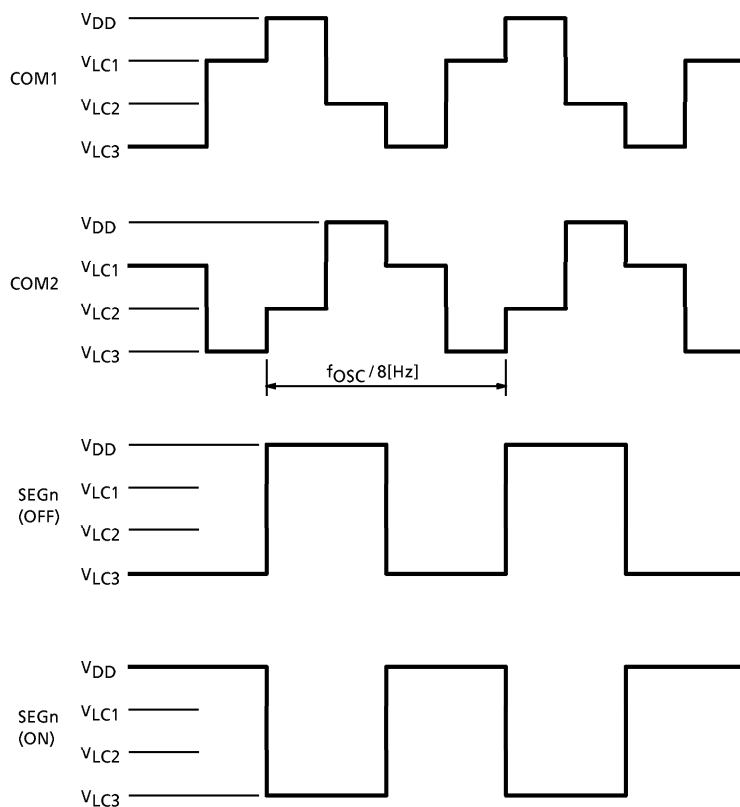
2) Data Format at 1/2 Duty (124 Segment)

|                |                |                |                |                |                 |                 |                 |                                  |                 |                                  |                 |                 |                 |
|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|----------------------------------|-----------------|----------------------------------|-----------------|-----------------|-----------------|
| D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> | D <sub>5</sub>  | ~               | D <sub>39</sub> | D <sub>40</sub>                  | D <sub>41</sub> | D <sub>42</sub> ~D <sub>44</sub> | Data Address    |                 |                 |
| S0 C1          | S0 C2          | S1 C1          | S1 C2          | S2 C1          | S2 C2           | }}              | S19 C1          | S20 C1                           | S20 C2          | ※                                | 1               | 0               | 0               |
| D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> | D <sub>5</sub>  | ~               | D <sub>39</sub> | D <sub>40</sub>                  | D <sub>41</sub> | D <sub>42</sub> ~D <sub>44</sub> | D <sub>45</sub> | D <sub>46</sub> | D <sub>47</sub> |
| S21 C1         | S21 C2         | S22 C1         | S22 C2         | S23 C1         | S23 C2          | }}              | S40 C2          | S41 C1                           | S41 C2          | ※                                | 0               | 1               | 0               |
| D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | ~              | D <sub>37</sub> | D <sub>38</sub> | D <sub>39</sub> | D <sub>40</sub> ~D <sub>44</sub> |                 |                                  | D <sub>45</sub> | D <sub>46</sub> | D <sub>47</sub> |
| S42 C1         | S42 C2         | S43 C1         | S43 C2         | }}             | S60 C2          | S61 C1          | S61 C2          | ※                                |                 |                                  | 0               | 0               | 1               |

Note) ※ : 1 or 0

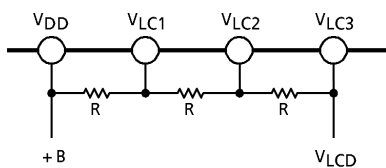
2. LCD Display Timings

1) 1/2 Duty Mode (2/3 = "H")

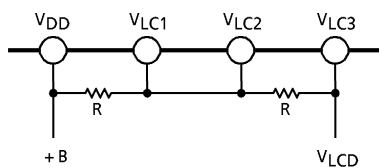


(Note) When used in the 1/2 bias, supply bias by connecting VLC2 pin and VLC3 pin. (This also applies to the 1/3 duty mode.)

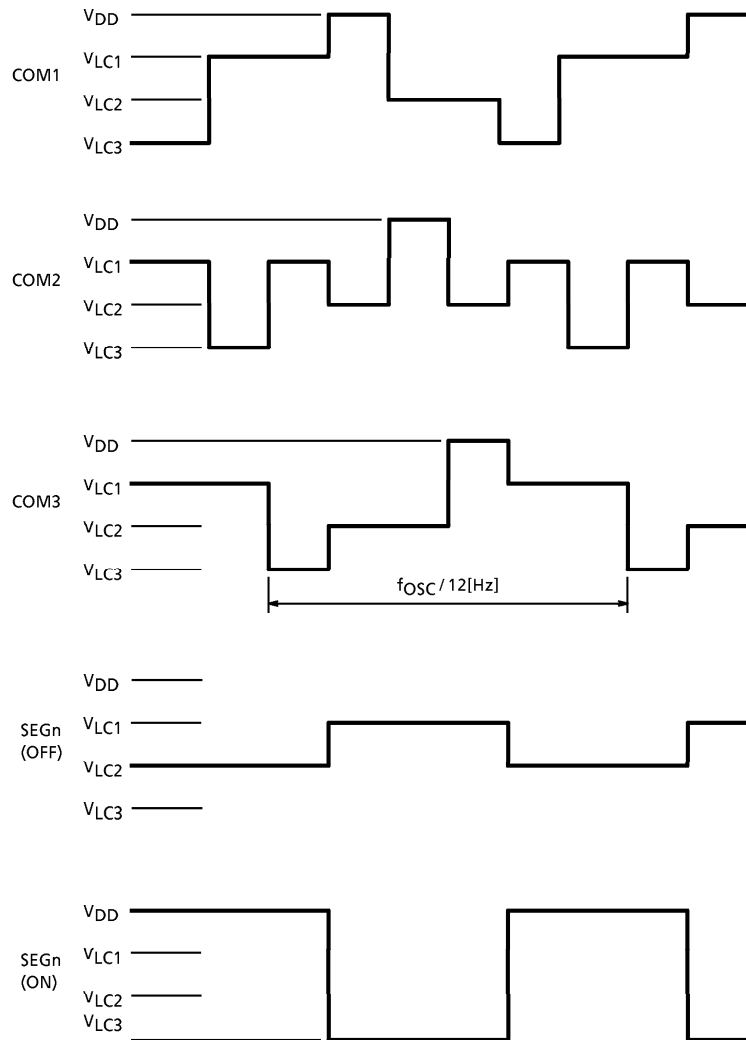
• 1/3 Bias Operation



• 1/2 Bias Operation



2) 1/3 Duty Mode (2/3 = "L")



**3. Oscillation Circuit**

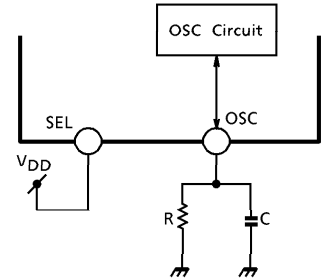
When a resistor and a capacitor are connected to the OSC pin and oscillation circuit is composed and common signal is generated.

1/4 division of oscillation frequency becomes common frequency. Capacitor (C) and resistor (R) are connected as shown in the right-side figure and the oscillation frequency is expressed by the following expression :

$$f_{OSC} \approx 1.44 / C \cdot R \quad (T_a = 25^\circ C, V_{DD} = 5V)$$

For instance, when  $C = 0.012 \mu F$ , and  $R = 150k\Omega$ ,  $f_{OSC}$  will be about 800Hz and common frequency will be 200Hz. Use the external resistor at 12~220kΩ.

However, there is no restriction for the external capacitor C.



**4. In Case of Using More Than 2**

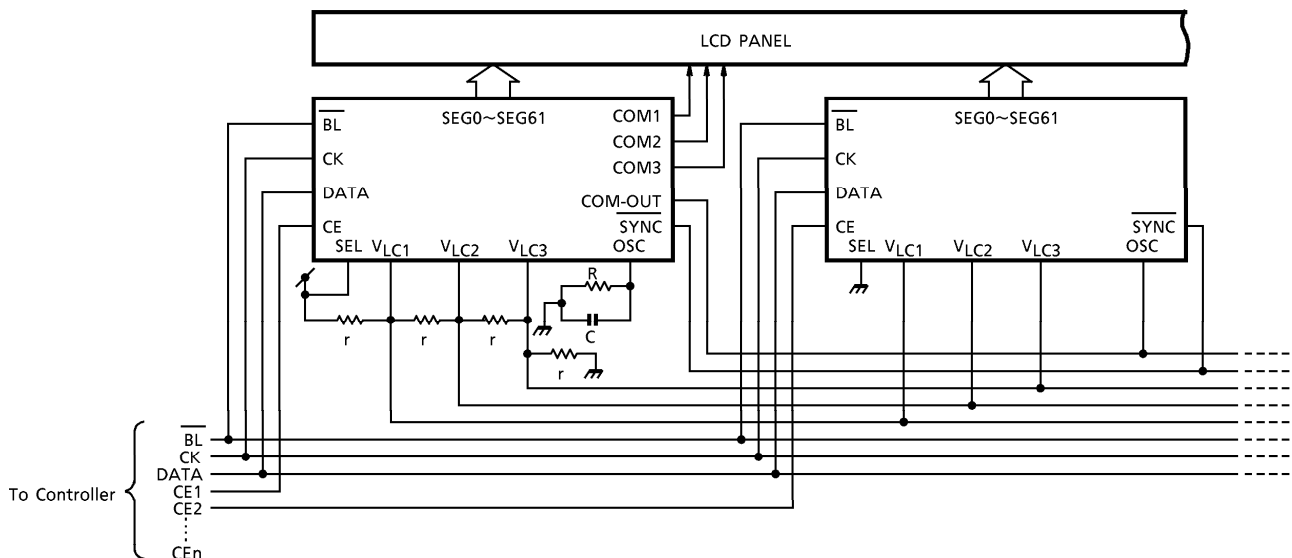
When more than 2 TC9240F are used simultaneously, common frequency is generated using one IC in the master mode.

As a result, the slave mode IC performs the simultaneous operation.

**1) Processing of Pins at Simultaneous Operation**

| PIN NAME | PIN No. | MASTER MODE IN               | SLAVE MODE IC                  |
|----------|---------|------------------------------|--------------------------------|
| SEL      | 68      | "H" (V <sub>DD</sub> ) Level | "L" (GND) Level                |
| OSC      | 75      | Connect External C&R         | Connect to Master IC : COM-OUT |
| SYNC     | 64      | Generate SYNC Output         | Connect to Master IC : SYNC    |
| COM-OUT  | 63      | Connect to Slave IC : OSC    | Open (unused)                  |
| COM1     | 78      | Connect to COM Pin of LCD    | Open (unused)                  |
| COM2     | 79      |                              |                                |
| COM3     | 80      |                              |                                |

**2) Example of Application Circuit Synchronizing Operation**





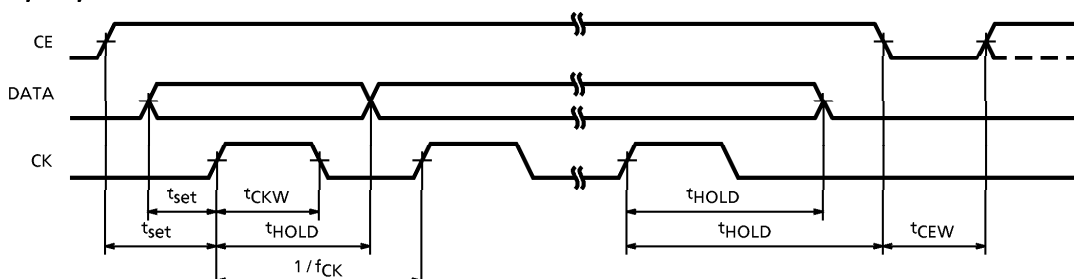
**MAXIMUM RATINGS (Ta = 25°C)**

| CHARACTERISTIC        | SYMBOL           | RATING                     | UNIT |
|-----------------------|------------------|----------------------------|------|
| Supply Voltage        | V <sub>DD</sub>  | -0.3~7.0                   | V    |
| Input Voltage         | V <sub>IN</sub>  | -0.3~V <sub>DD</sub> + 0.3 | V    |
| Power Dissipation     | P <sub>D</sub>   | 300                        | mW   |
| Operating Temperature | T <sub>opr</sub> | -40~85                     | °C   |
| Storage Temperature   | T <sub>stg</sub> | -65~150                    | °C   |

**ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V<sub>DD</sub> = 4.5~5.5V, Ta = -40~85°C)**

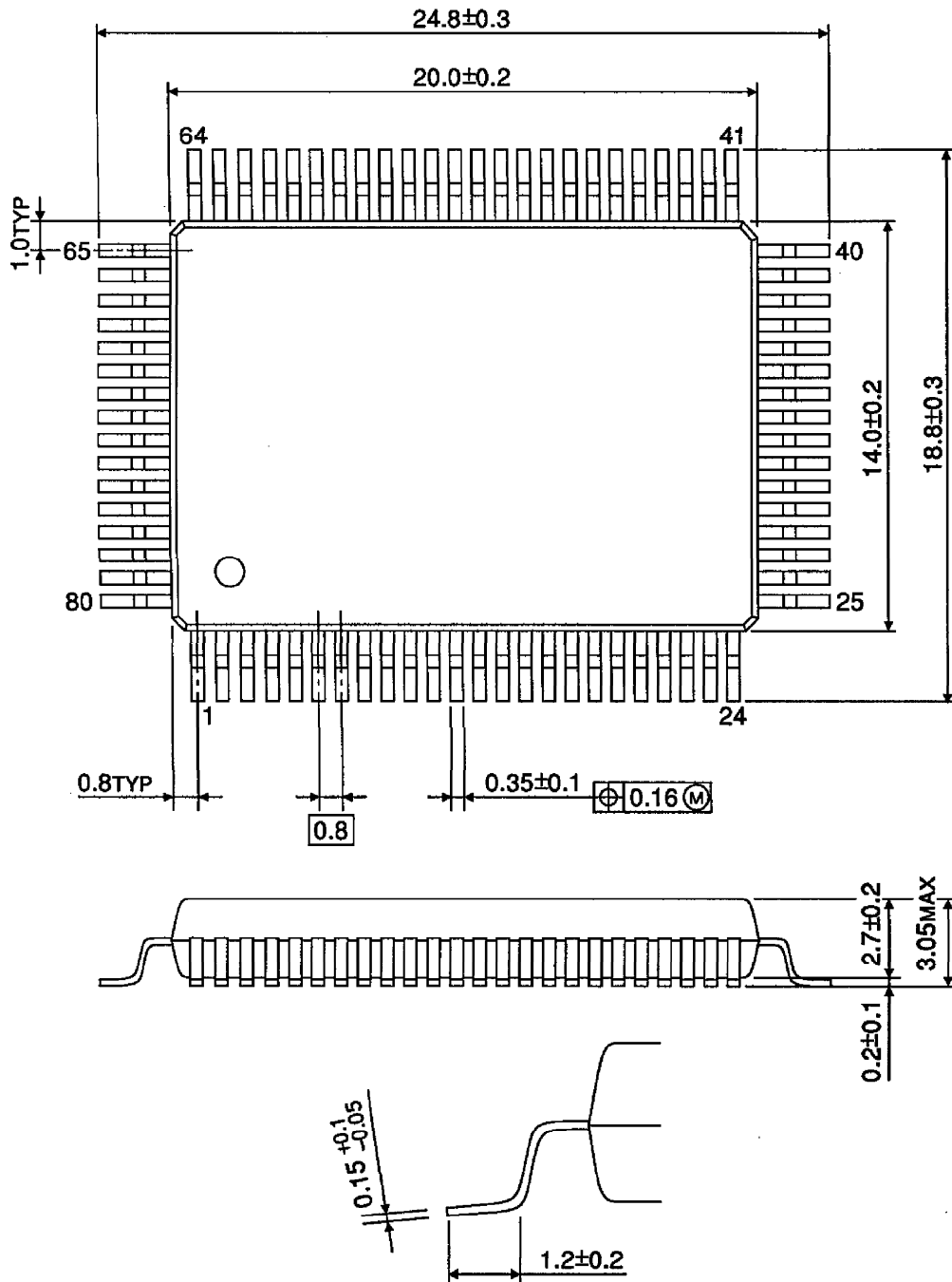
| CHARACTERISTIC           | SYMBOL            | TEST CIR-CUIT    | TEST CONDITION   | MIN.   | TYP. | MAX.                  | UNIT |
|--------------------------|-------------------|------------------|--|--|------|-----------------------|------|
| Operating Supply Voltage | V <sub>DD</sub>   | —                | —  | 4.5  | 5.0  | 5.5                   | V    |
| Operating Supply Current | I <sub>DD</sub>   | —                | f <sub>OSC</sub> = 1.2kHz, No load, V <sub>DD</sub> = 5V | —  | 0.3  | 1.0                   | mA   |
| Input Voltage            | "H" Level         | V <sub>IH</sub>  | All input pins   | V <sub>DD</sub> × 0.7                                    | ~    | V <sub>DD</sub>       | V    |
|                          | "L" Level         | V <sub>IL</sub>  |  | GND  | ~    | V <sub>DD</sub> × 0.3 |      |
| Input Current            | "H" Level         | I <sub>IH</sub>  | CMOS input pins, V <sub>DD</sub> = 5V                    | V <sub>IH</sub> = V <sub>DD</sub>                        | —    | 2                     | μA   |
|                          | "L" Level         | I <sub>IL</sub>  |  | V <sub>IL</sub> = GND                                    | -2   | —                     |      |
| Pull-up Resistance       | R <sub>UP</sub>   | —                | BL, LT pins, V <sub>DD</sub> = 5V, Ta = 25°C             | 50   | 100  | 200                   | kΩ   |
| Output Resistance        | Segment           | R <sub>seg</sub> | SEG0~SEG61 Output pins                                   | V <sub>LC1</sub> = V <sub>LC2</sub> = 1/2V <sub>DD</sub> | —    | 0.6                   | kΩ   |
|                          | Common            | R <sub>COM</sub> | COM1~COM3 Output pins                                    | V <sub>LC3</sub> = GND, V <sub>DD</sub> = 5V             | —    | 0.5                   |      |
| Output Current           | "H" Level         | I <sub>OH</sub>  | SYNC, COM-OUT Output pins, V <sub>DD</sub> = 5V          | V <sub>OH</sub> = 4.5V                                   | -0.2 | -0.8                  | mA   |
|                          | "L" Level         | I <sub>OL</sub>  |  | V <sub>OL</sub> = 0.5V                                   | 0.2  | 1.0                   |      |
| Oscillation Frequency    | f <sub>OSC</sub>  | —                | OSC Pin Operation Frequency                              | —  | 1.2  | 50                    | kHz  |
| Max. Clock Frequency     | f <sub>CK</sub>   | —                | Refer to the timing chart as below.                      | 0  | ~    | 2.0                   | MHz  |
| Clock Pulse Width        | t <sub>CKW</sub>  |                  |  | 250  | —    | —                     |      |
| Data Set Time            | t <sub>set</sub>  |                  |  | 250  | —    | —                     |      |
| Data Hold Time           | t <sub>HOLD</sub> |                  |  | 250  | —    | —                     |      |
| CE Pulse Width           | t <sub>CEW</sub>  |                  |  | 250  | —    | —                     |      |

**CE, CK, DATA TIMING**



**OUTLINE DRAWING**  
QFP80-P-1420-0.80A

Unit : mm



Weight : 1.57g (Typ.)