

# MSM6775

## 1/3, 1/4, 1/5 DUTY LCD DRIVER WITH 5-DOT COMMON DRIVER AND 80-DOT SEGMENT DRIVER

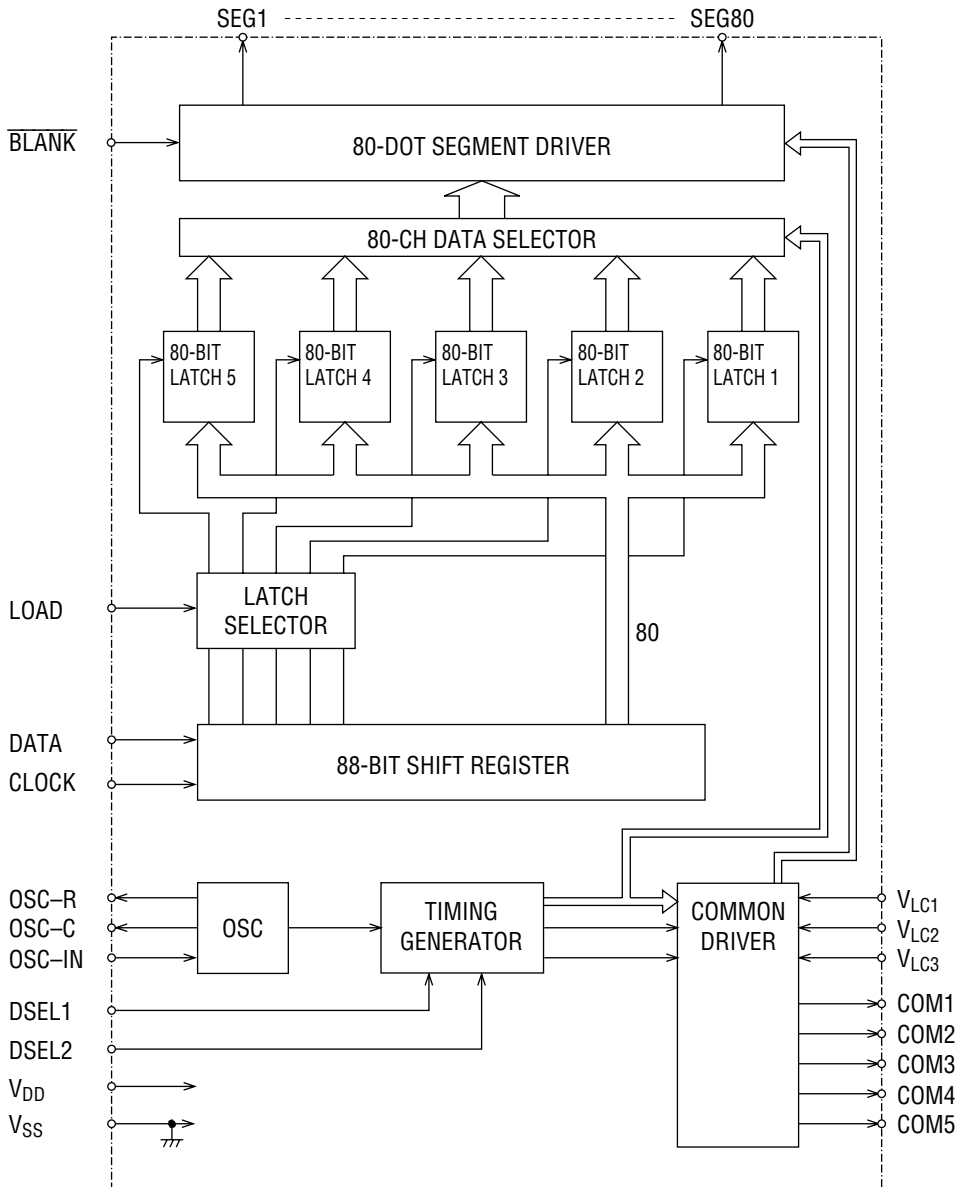
### GENERAL DESCRIPTION

The MSM6775 is an LCD driver for dynamic display providing 3-duty-switchable pins (1/3, 1/4 and 1/5 duty). It can directly drive LCDs of up to 400, 320 and 240 segments when 1/5, 1/4 and 1/3 duty are selected, respectively.

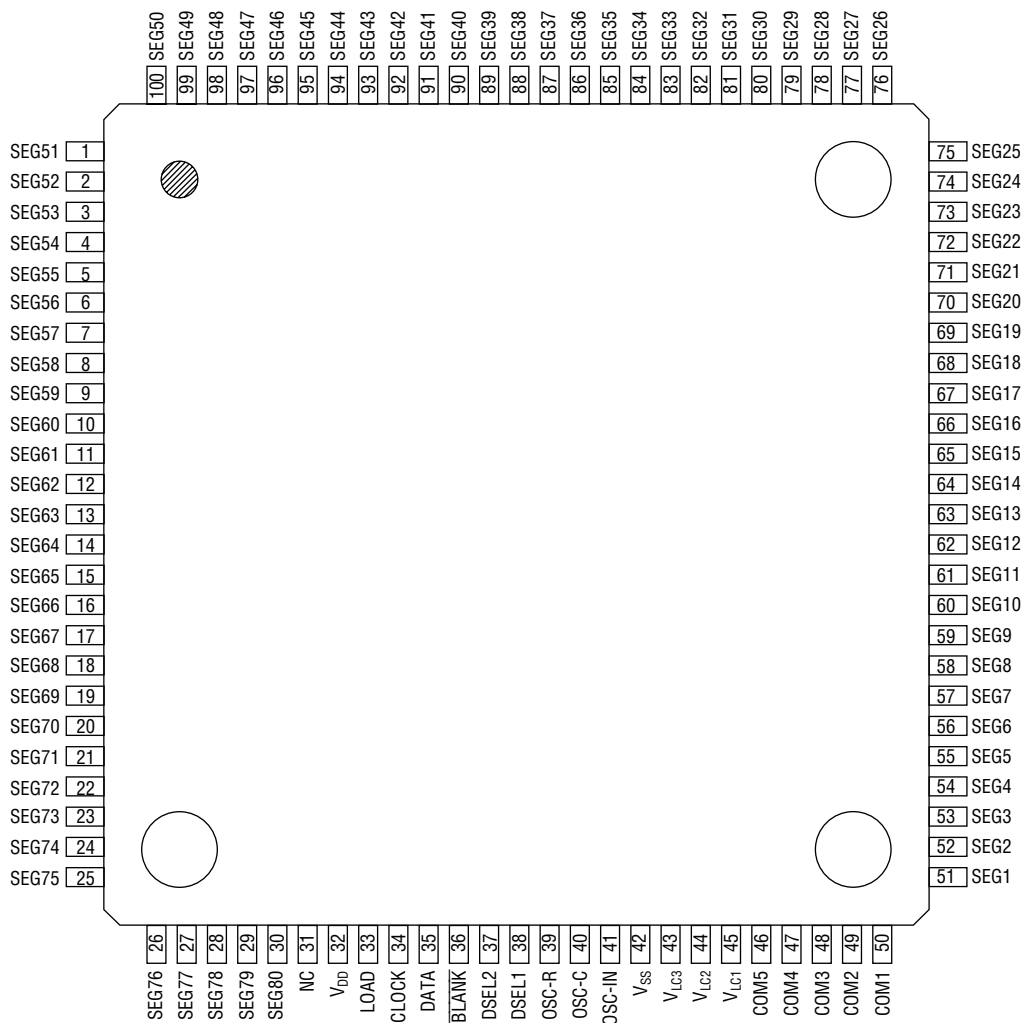
### FEATURES

- Operating range
  - Supply voltage ( $V_{DD}$ ) : 2.7 to 5.5V
  - Operating temperature ( $T_{op}$ ) : -40 to +85°C
  - LCD driving voltage ( $V_{DD}-V_{LC3}$ ) : 3.5 to 5.5V
- Segment output : 80 pins
  - 1/5 duty : Up to 400 segments can be displayed.
  - 1/4 duty : Up to 320 segments can be displayed.
  - 1/3 duty : Up to 240 segments can be displayed.
- Serial transfer clock frequency : 4MHz
- Serial interface with CPU : Through three input pins (DATA, LOAD, and CLOCK)
- One-to-one correspondence between input data and its output
  - When input data is at "H" level : Display goes on.
  - When input data is at "L" level : Display goes off.
- Built-in oscillator circuit for COMMON signals
- The entire display can be turned off. ( $\overline{BLANK}$  pin)
- Package:
  - 100-pin plastic TQFP (TQFP100-P-1414-0.50-K) (Product name : MSM6775TS-K)

**BLOCK DIAGRAM**



**PIN CONFIGURATION (TOP VIEW)**



NC : No connection

**100-Pin Plastic TQFP**

## PIN DESCRIPTIONS

Symbol	Type	Description												
OSC-IN OSC-C OSC-R	I O O	Pins for oscillation. The oscillator circuit is configured by externally connecting two resistors and a capacitor. Make the wiring length as short as possible, because the resistor connected to the OSC-IN pin has a higher value and the circuit is susceptible to external noise.												
DATA	I	Serial data input pin. The display goes on when input data is at "H" level, and it goes off when input data is at "L" level.												
CLOCK	I	Shift clock input pin. Data from the DATA pin is transferred in synchronization with the rising edge of the shift clock. (Built-in Schmitt circuit is used.)												
LOAD	I	Load signal input pin. Serially input data is transferred to the 80-bit latch at "H" level of this load signal, then held at "L" level.												
<u>BLANK</u>	I	Input pin that turns off all segments. The entire display goes off when "L" level is applied to this pin. The display returns to the previous state when "H" level is applied.												
DSEL1 DSEL2	I I	Input pins to select 1/3, 1/4, or 1/5 duty. Following shows how each duty is selected. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>DSEL2</th> <th>DSEL1</th> <th>Duty selected</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>1/3</td> </tr> <tr> <td>L</td> <td>H</td> <td>1/4</td> </tr> <tr> <td>H</td> <td>X</td> <td>1/5</td> </tr> </tbody> </table> <p style="text-align: center;">X: Don't care</p>	DSEL2	DSEL1	Duty selected	L	L	1/3	L	H	1/4	H	X	1/5
DSEL2	DSEL1	Duty selected												
L	L	1/3												
L	H	1/4												
H	X	1/5												
COM1 to COM5	O	Display output pins for LCD. These pins are connected to the COMMON side on the LCD panel.												
SEG1 to SEG80	O	Display output pins for LCD. These pins are connected to the SEGMENT side on the LCD panel. For the correspondence between the output of these pins and input data, see Section, "Data Structure".												
V <sub>LC1</sub> V <sub>LC2</sub> V <sub>LC3</sub>	—	Bias pins for LCD drive. Through these pins, bias voltages for the LCD are externally supplied. The bias potential must meet the following condition: $V_{DD} > V_{LC1} \geq V_{LC2} > V_{LC3}$												
V <sub>DD</sub> V <sub>SS</sub>	—	Supply voltage pin and ground pin.												

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Supply Voltage	$V_{DD}$	$T_a=25^{\circ}\text{C}$	-0.3 to +6.0	V
Input Voltage	$V_I$	$T_a=25^{\circ}\text{C}$	-0.3 to $V_{DD}+0.3$	V
Storage Temperature	$T_{STG}$	—	-55 to +150	$^{\circ}\text{C}$

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Range	Unit	Applicable pin
Supply Voltage	$V_{DD}$	—	2.7 to 5.5	V	$V_{DD}$
LCD Driving Voltage	$V_{DD} - V_{LC3}$	—	3.5 to 5.5	V	$V_{DD}, V_{LC1}, V_{LC2}, V_{LC3}$
Operating Temperature	$T_{op}$	—	-40 to +85	$^{\circ}\text{C}$	—

## Oscillator Circuit

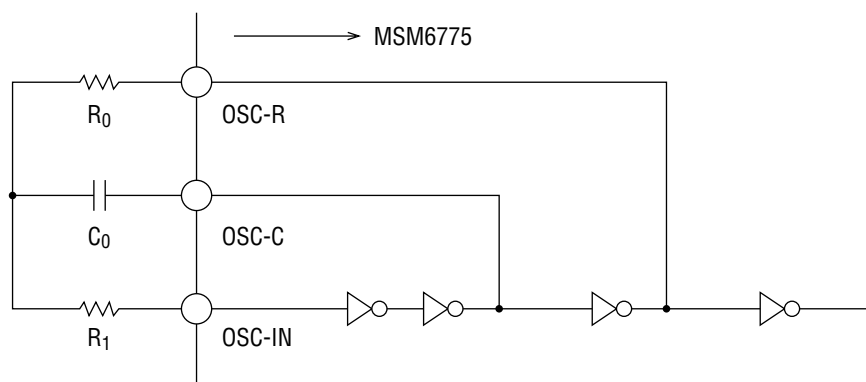
Parameter	Symbol	Condition	Min	Max	Unit	Applicable pin
Oscillation Resistance	$R_0$	—	20	120	$\text{k}\Omega$	OSC-R
Oscillation Capacitance	$C_0$	—	0.00047	0.01	$\mu\text{F}$	OSC-C
Current Limiting Resistance	$R_1$	—	62	360	$\text{k}\Omega$	OSC-IN
COMMON Signal Frequency	$f_{COM}$	—	25	250	Hz	COM1 to COM5

Note: See Section, "Reference Data," for the resistor and capacitor values in the table.

## RC Values in Oscillator Circuit

Parameter	Symbol	1/3 duty	1/4 duty	1/5 duty	Unit	Applicable pin
Oscillation Resistance	$R_0$	68	51	43	$\text{k}\Omega$	OSC-R
Oscillation Capacitance	$C_0$	0.001	0.001	0.001	$\mu\text{F}$	OSC-C
Current Limiting Resistance	$R_1$	220	160	130	$\text{k}\Omega$	OSC-IN

Example of an oscillator circuit



## ELECTRICAL CHARACTERISTICS

## DC Characteristics

(V<sub>DD</sub>=2.7 to 5.5V, T<sub>a</sub>=-40 to +85°C)

Parameter	Symbol	Condition	Min	Max	Unit	
"H" Input Voltage 1	V <sub>IH1</sub>		0.85V <sub>DD</sub>	V <sub>DD</sub>	V	
"L" Input Voltage 1	V <sub>IL1</sub>		V <sub>SS</sub>	0.15V <sub>DD</sub>	V	
"H" Input Voltage 2	V <sub>IH2</sub>		0.8V <sub>DD</sub>	V <sub>DD</sub>	V	
"L" Input Voltage 2	V <sub>IL2</sub>		V <sub>SS</sub>	0.2V <sub>DD</sub>	V	
"H" Input Current	V <sub>IH</sub>	V <sub>DD</sub> =5.5V, V <sub>I</sub> =V <sub>DD</sub>	—	10	μA	
"L" Input Current	V <sub>IL</sub>	V <sub>DD</sub> =5.5V, V <sub>I</sub> =0V	—	-10	μA	
COMMON Output Voltage	V <sub>OC0</sub>	V <sub>DD</sub> =4.0V *4	I <sub>O</sub> =-100μA	V <sub>DD</sub> -1	—	V
	V <sub>OC1</sub>		I <sub>O</sub> =±100μA *6	V <sub>LC1</sub> -1	V <sub>LC1</sub> +1	V
	V <sub>OC2</sub>		I <sub>O</sub> =±100μA *7	V <sub>LC2</sub> -1	V <sub>LC2</sub> +1	V
	V <sub>OC3</sub>		I <sub>O</sub> =+100μA *8	—	V <sub>LC3</sub> +1	V
Segment Output Voltage	V <sub>OS0</sub>	V <sub>DD</sub> =4.0V *5	I <sub>O</sub> =-10μA	V <sub>DD</sub> -1	—	V
	V <sub>OS1</sub>		I <sub>O</sub> =±10μA *6	V <sub>LC1</sub> -1	V <sub>LC1</sub> +1	V
	V <sub>OS2</sub>		I <sub>O</sub> =±10μA *7	V <sub>LC2</sub> -1	V <sub>LC2</sub> +1	V
	V <sub>OS3</sub>		I <sub>O</sub> =+10μA *8	—	V <sub>LC3</sub> -1	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> =5.0V, no load	—	0.5	mA	

\*1 Applies to the CLOCK and OSC-IN.

\*2 Applies to all input pins excluding the CLOCK and OSC-IN.

\*3 Applies to all input pins.

\*4 Applies to COM1 to COM5.

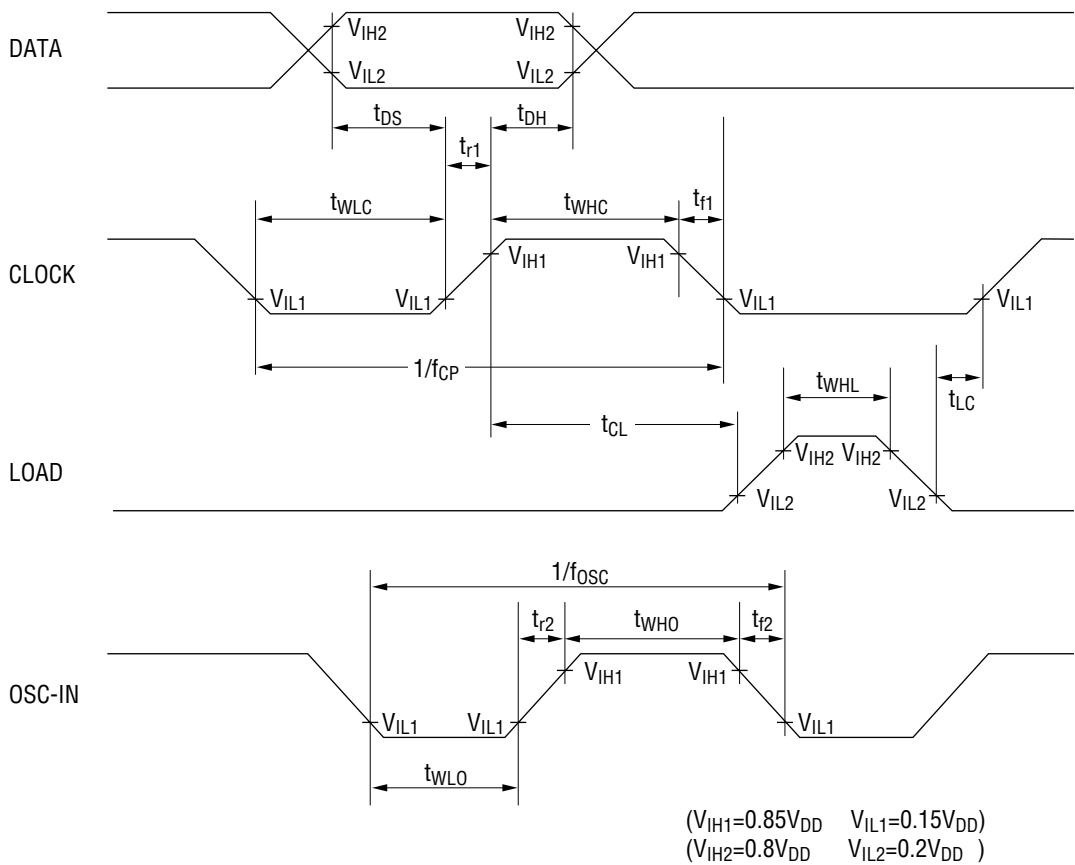
\*5 Applies to SEG1 to SEG80.

\*6 V<sub>LC1</sub>=3.0V\*7 V<sub>LC2</sub>=2.0V\*8 V<sub>LC3</sub>=1.0V\*9 R<sub>0</sub>=51kΩ R<sub>1</sub>=160kΩ C<sub>0</sub>=0.001μF

**AC Characteristics**

( $V_{DD}=2.7$  to  $5.5V$ ,  $T_a=-40$  to  $+85^{\circ}C$ )

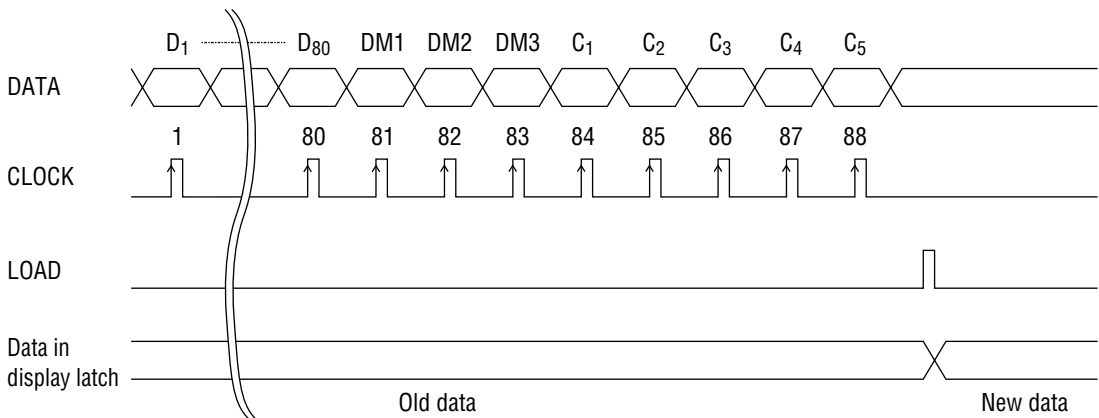
Parameter	Symbol	Condition	Min	Max	Unit	Applicable pin
Clock Frequency	$f_{CP}$	—	—	4.0	MHz	CLOCK
Clock "H" Time	$t_{WHC}$	—	70	—	ns	
Clock "L" Time	$t_{WLC}$	—	70	—	ns	
Data Set-up Time	$t_{DS}$	—	50	—	ns	DATA CLOCK
Data Hold Time	$t_{DH}$	—	50	—	ns	
Load "H" Time	$t_{WHL}$	—	100	—	ns	LOAD
Clock-to-load Time	$t_{CL}$	—	100	—	ns	CLOCK
Load-to-clock Time	$t_{LC}$	—	100	—	ns	LOAD
Rise time, Fall Time	$t_{r1}, t_{f1}$	—	—	50	ns	CLOCK
OSC-IN Input Frequency	$f_{osc}$	—	—	20	kHz	OSC-IN
OSC-IN "H" Time	$t_{WHO}$	—	20	—	$\mu s$	
OSC-IN "L" Time	$t_{WLO}$	—	20	—	$\mu s$	
Rise Time, Fall Time	$t_{r2}, t_{f2}$	—	—	100	ns	



## FUNCTIONAL DESCRIPTION

### Operation

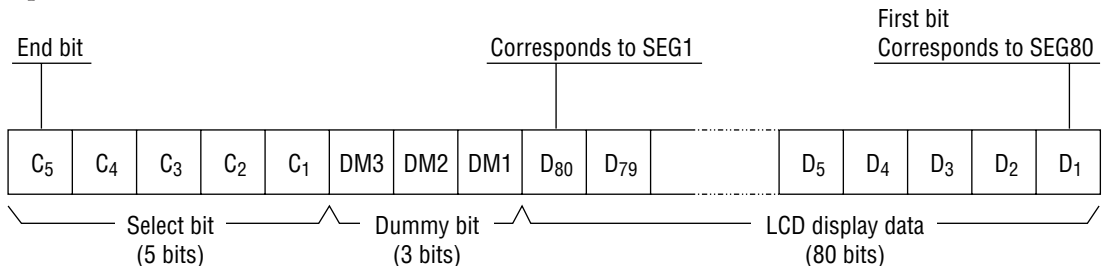
As shown in "Data Structure" (next section), the display data consists of the data field corresponding to the output for turning the segments on or off and the select field that selects the input block of data. Data input to the DATA pin is loaded into the 88-bit shift register at the rising edge of the CLOCK signal, transferred to the 80-bit latch while the load signal is at "H" level, and then output via the 80-dot segment driver.





## Data Structure

### Input data



### Correspondence between select bits and COM1 to COM5

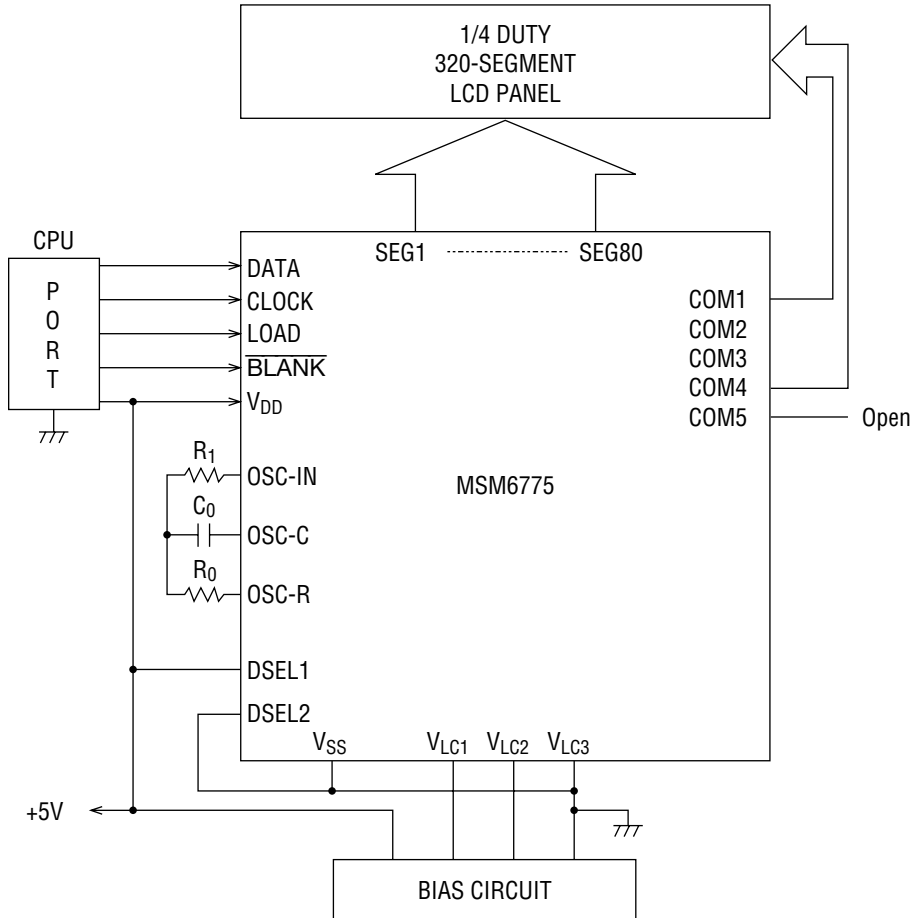
C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	Description
0	0	0	0	1	Display data corresponding to COM1
0	0	0	1	0	Display data corresponding to COM2
0	0	1	0	0	Display data corresponding to COM3
0	1	0	0	0	Display data corresponding to COM4
1	0	0	0	0	Display data corresponding to COM5

- Notes:
1. Arbitrary data can be set for the dummy bits.
  2. Select bits C<sub>1</sub> to C<sub>5</sub> select 80-bit latches that correspond to COM1 to COM5, respectively. Therefore, if "1" is set for more than one select bit, data is set to all the corresponding 80-bit latches.

#### Example:

If "1" is set to all the select bits C<sub>1</sub> to C<sub>5</sub>, the display data of D<sub>1</sub> to D<sub>80</sub> is set to all the 80-bit latches that correspond to COM1 to COM5.

**APPLICATION CIRCUITS**  
(For 1/4 duty)



**REFERENCE DATA**

The data shown in this section is for reference (a metal film resistor and a film capacitor are used). Resistor and capacitor values must be determined based on experiments.

Use the following expression to convert oscillation frequency to COMMON frame frequency (or vice versa):

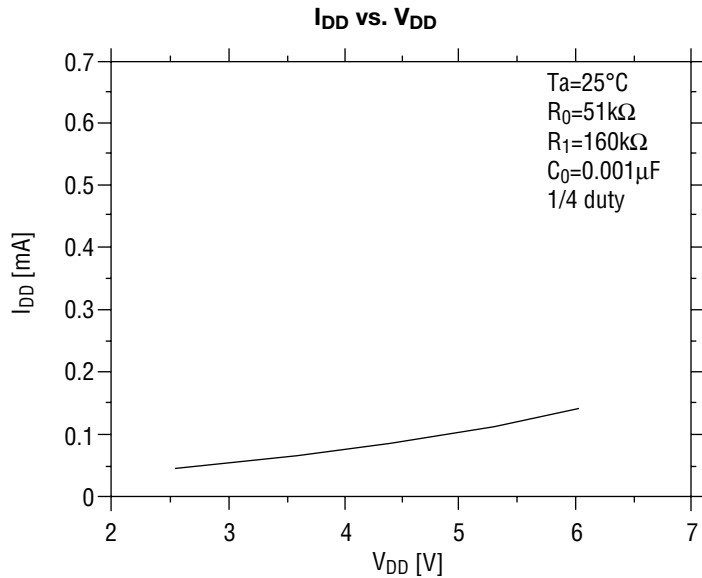
$$f_{COM}=f_{OSC} \times \text{Duty}/16$$

$f_{COM}$  : COMMON frame frequency

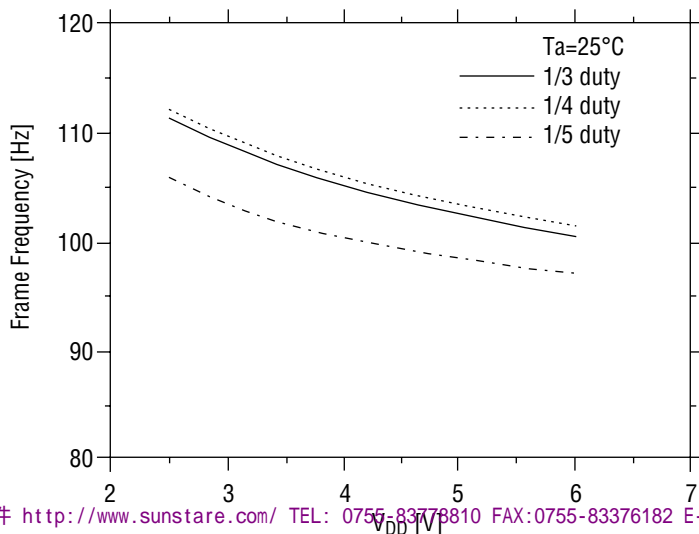
$f_{OSC}$  : Oscillation frequency

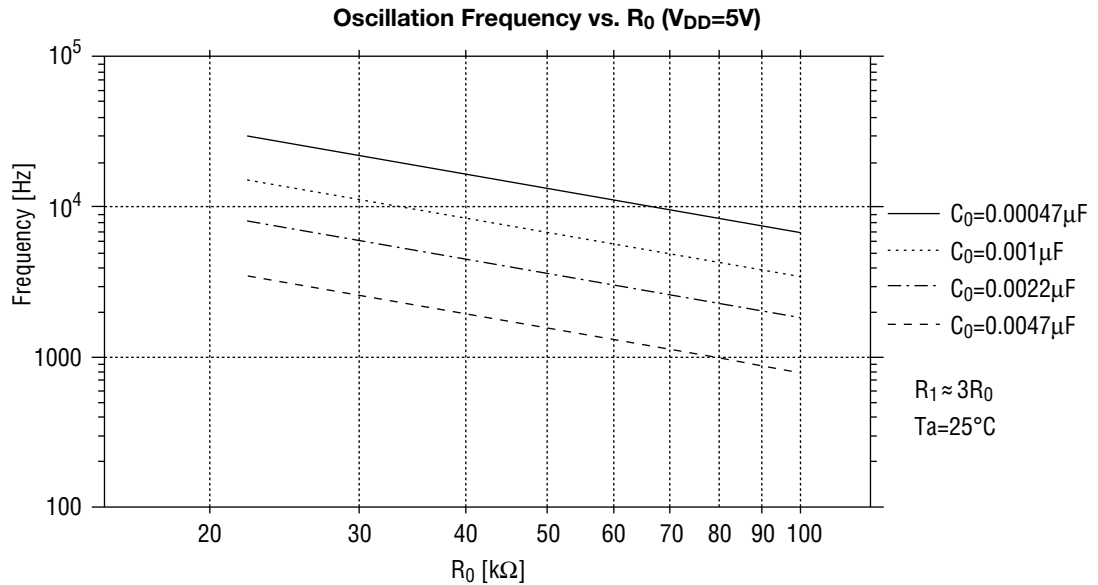
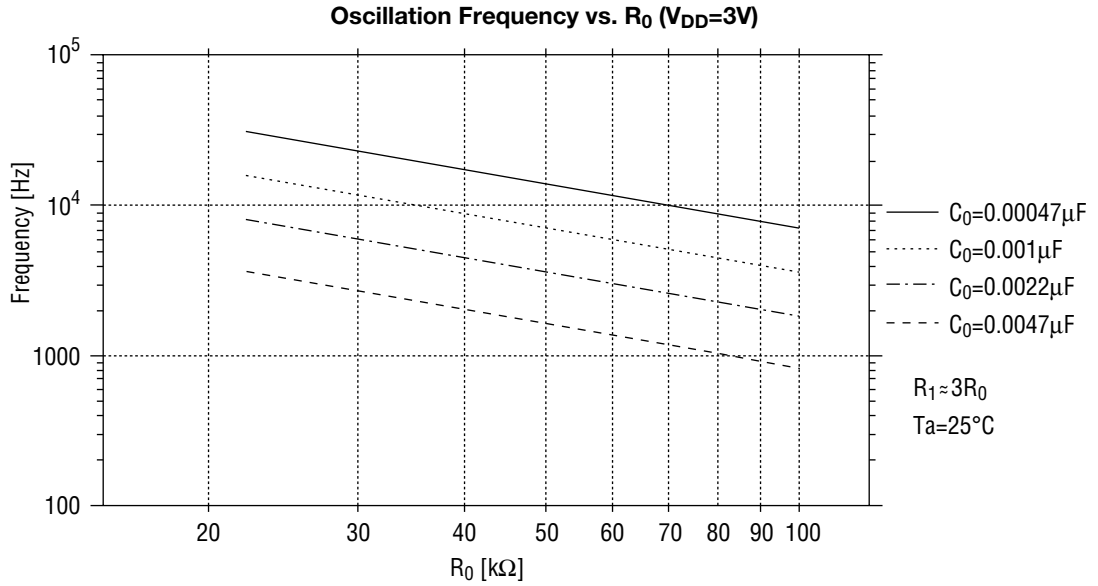
Duty : e.g., 1/4 for 1/4 duty

For example, if  $f_{COM}=100\text{Hz}$  at 1/5 duty, the oscillation frequency is  $f_{OSC}=8000\text{Hz}$ .



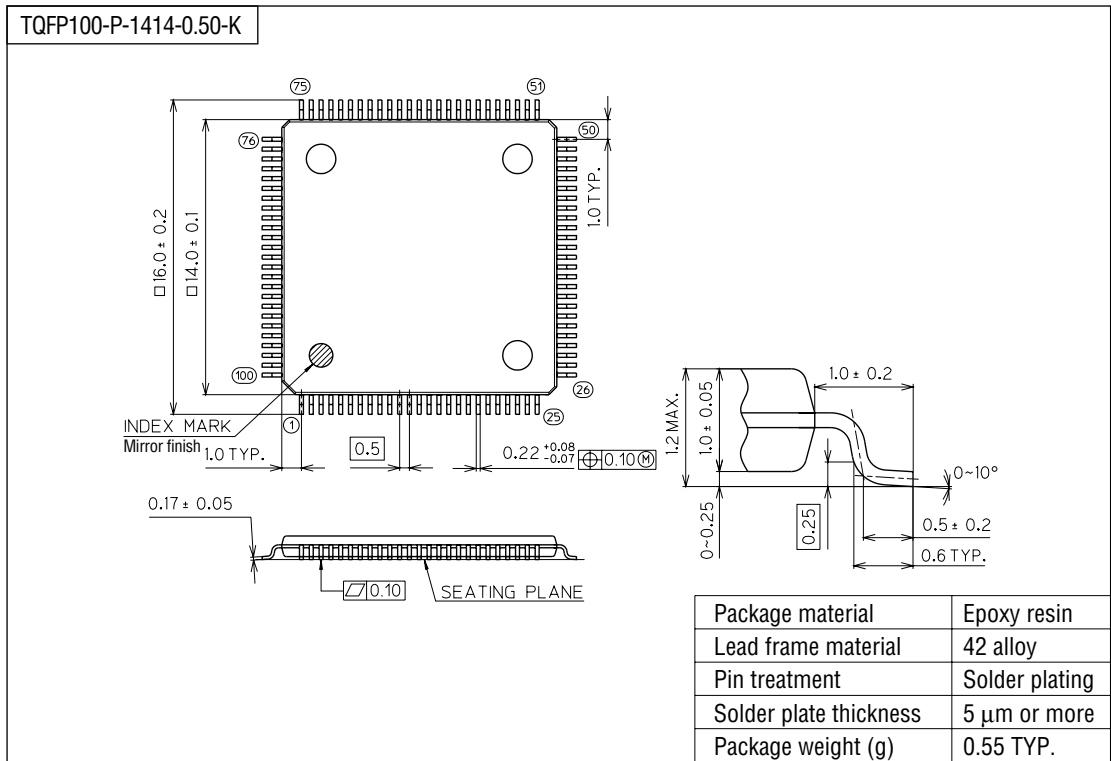
**COMMON Frame Frequency vs.  $V_{DD}$**   
 (The resistor and capacitor values used are their recommended values.)





**PACKAGE DIMENSIONS**

(Unit : mm)



**Notes for Mounting the Surface Mount Type Package**

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).