



Dear customers,

About the change in the name such as "Oki Electric Industry Co. Ltd." and "OKI" in documents to OKI Semiconductor Co., Ltd.

The semiconductor business of Oki Electric Industry Co., Ltd. was succeeded to OKI Semiconductor Co., Ltd. on October 1, 2008. Therefore, please accept that although the terms and marks of "Oki Electric Industry Co., Ltd.", "Oki Electric", and "OKI" remain in the documents, they all have been changed to "OKI Semiconductor Co., Ltd.". It is a change of the company name, the company trademark, and the logo, etc. , and NOT a content change in documents.

October 1, 2008
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MSM6775

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

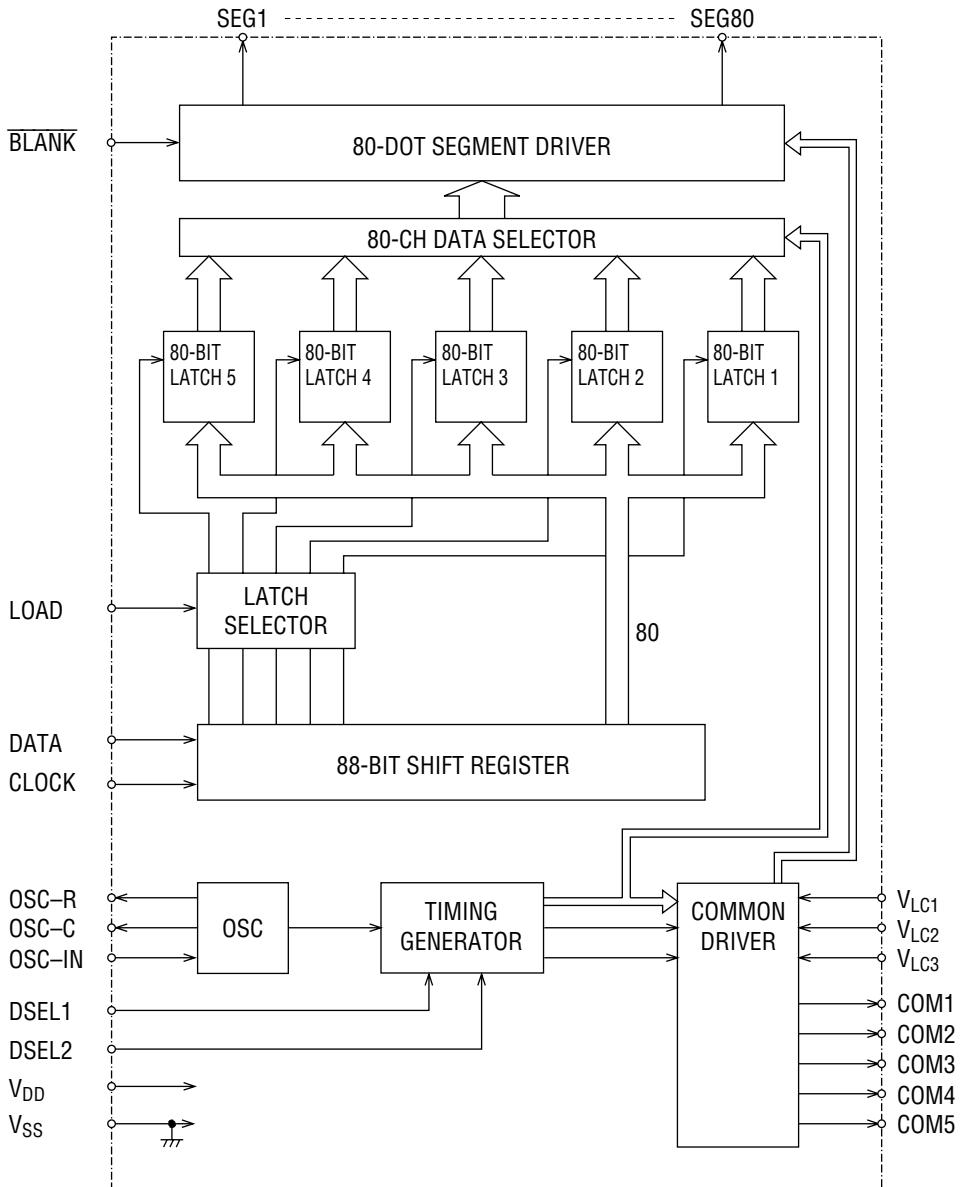
GENERAL DESCRIPTION

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.

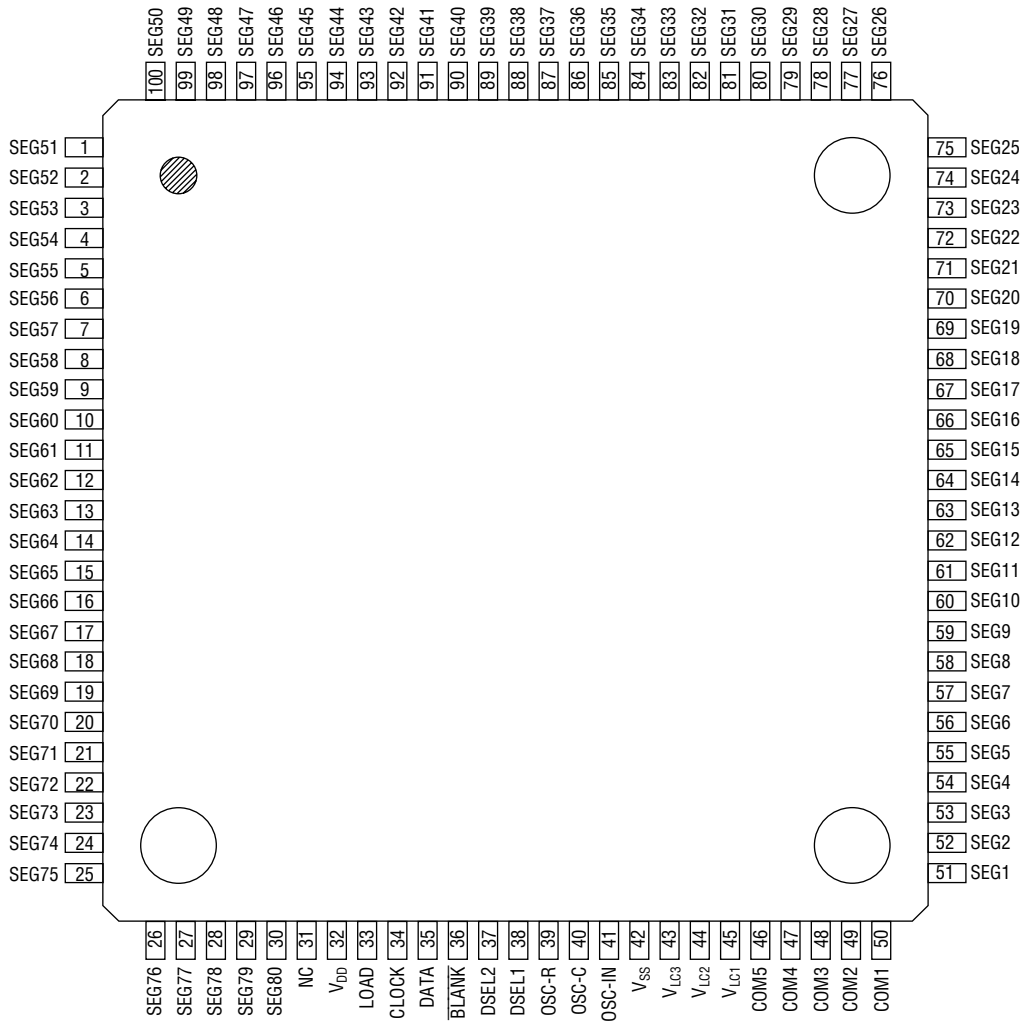
FEATURES

- 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 _{LC1} V _{LC2} V _{LC3}	—	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 _{DD} V _{SS}	—	Supply voltage pin and ground pin.												

ABSOLUTE MAXIMUM RATINGS

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

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	$^{\circ}C$	—

Oscillator Circuit

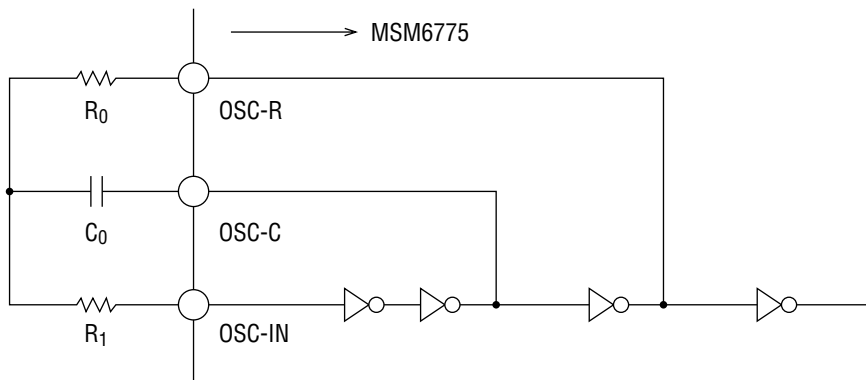
Parameter	Symbol	Condition	Min	Max	Unit	Applicable pin
Oscillation Resistance	R_0	—	20	120	$k\Omega$	OSC-R
Oscillation Capacitance	C_0	—	0.00047	0.01	μF	OSC-C
Current Limiting Resistance	R_1	—	62	360	$k\Omega$	OSC-IN
COMMON Signal Frequency	f_{COM}	—	25	250	Hz	COM1 to COM5

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	$k\Omega$	OSC-R
Oscillation Capacitance	C_0	0.001	0.001	0.001	μF	OSC-C
Current Limiting Resistance	R_1	220	160	130	$k\Omega$	OSC-IN

Example of an oscillator circuit



ELECTRICAL CHARACTERISTICS

DC Characteristics

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

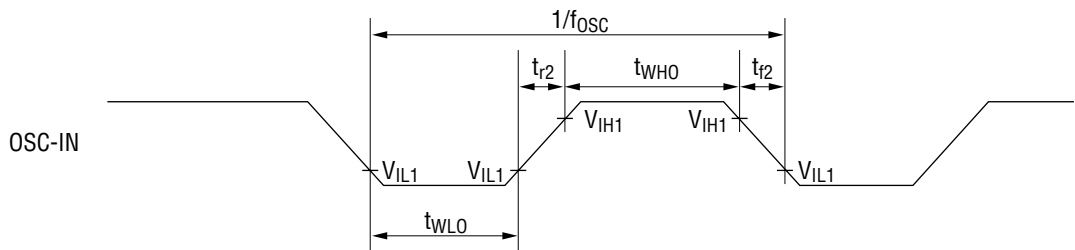
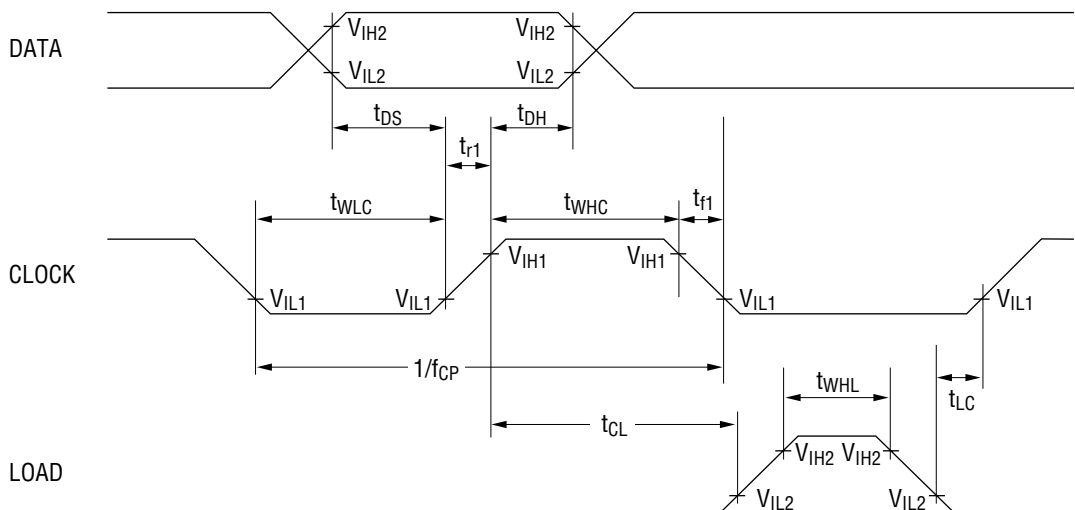
Parameter	Symbol	Condition	Min	Max	Unit	
"H" Input Voltage 1	V_{IH1}		$0.85V_{DD}$	V_{DD}	V	
"L" Input Voltage 1	V_{IL1}		V_{SS}	$0.15V_{DD}$	V	
"H" Input Voltage 2	V_{IH2}		$0.8V_{DD}$	V_{DD}	V	
"L" Input Voltage 2	V_{IL2}		V_{SS}	$0.2V_{DD}$	V	
"H" Input Current	V_{IH}	$V_{DD}=5.5V, V_I=V_{DD}$	—	10	μA	
"L" Input Current	V_{IL}	$V_{DD}=5.5V, V_I=0V$	—	-10	μA	
COMMON Output Voltage	V_{OC0}	$V_{DD}=4.0V$ *4	$I_O=-100\mu A$	$V_{DD}-1$	—	V
	V_{OC1}		$I_O=\pm 100\mu A$ *6	$V_{LC1}-1$	$V_{LC1}+1$	V
	V_{OC2}		$I_O=\pm 100\mu A$ *7	$V_{LC2}-1$	$V_{LC2}+1$	V
	V_{OC3}		$I_O=+100\mu A$ *8	—	$V_{LC3}+1$	V
Segment Output Voltage	V_{OS0}	$V_{DD}=4.0V$ *5	$I_O=-10\mu A$	$V_{DD}-1$	—	V
	V_{OS1}		$I_O=\pm 10\mu A$ *6	$V_{LC1}-1$	$V_{LC1}+1$	V
	V_{OS2}		$I_O=\pm 10\mu A$ *7	$V_{LC2}-1$	$V_{LC2}+1$	V
	V_{OS3}		$I_O=+10\mu A$ *8	—	$V_{LC3}-1$	V
Supply Current	I_{DD}	$V_{DD}=5.0V$, 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 $V_{LC1}=3.0V$
- *7 $V_{LC2}=2.0V$
- *8 $V_{LC3}=1.0V$
- *9 $R_0=51k\Omega$ $R_1=160k\Omega$ $C_0=0.001\mu F$

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
Data Hold Time	t_{DH}	—	50	—	ns	CLOCK
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	—	μs	
OSC-IN "L" Time	t_{WLO}	—	20	—	μs	
Rise Time, Fall Time	t_{r2}, t_{f2}	—	—	100	ns	

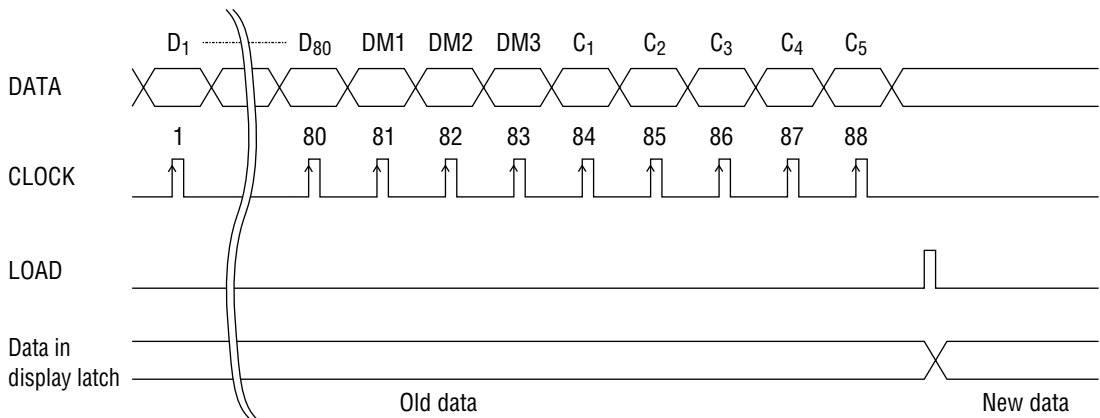


($V_{IH1}=0.85V_{DD}$ $V_{IL1}=0.15V_{DD}$)
 ($V_{IH2}=0.8V_{DD}$ $V_{IL2}=0.2V_{DD}$)

FUNCTIONAL DESCRIPTION

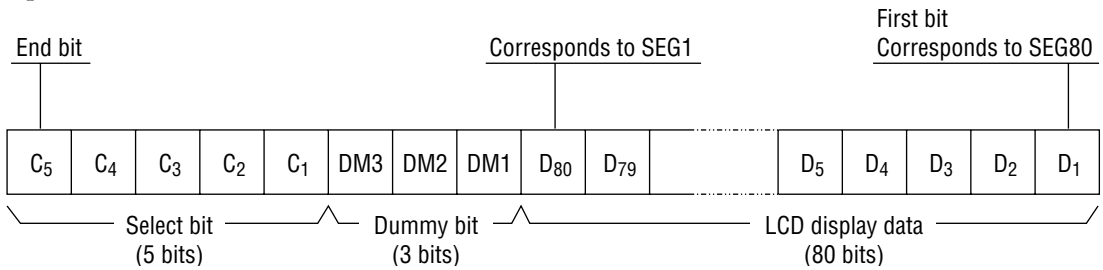
Operation

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

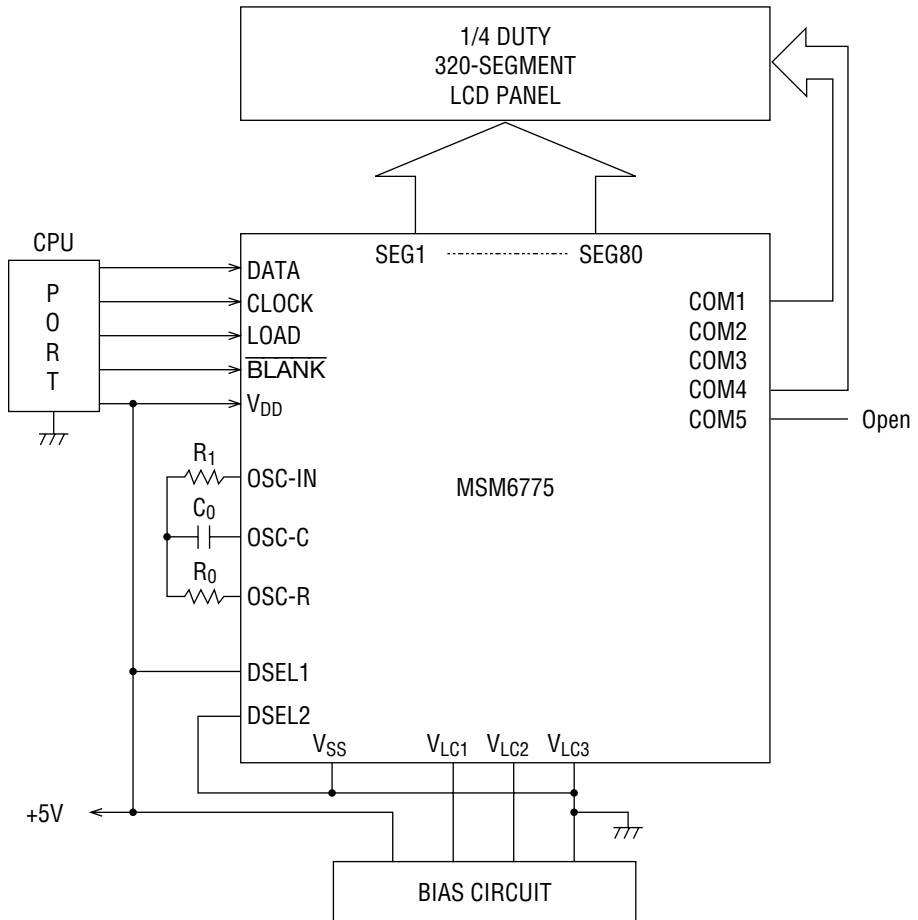
C ₅	C ₄	C ₃	C ₂	C ₁	Description
0	0	0	0	1	Display data corresponding to COM1
0	0	0	1	0	Display data corresponding to COM2
0	0	1	0	0	Display data corresponding to COM3
0	1	0	0	0	Display data corresponding to COM4
1	0	0	0	0	Display data corresponding to COM5

- Notes:
1. Arbitrary data can be set for the dummy bits.
 2. Select bits C₁ to C₅ 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 C₁ to C₅, the display data of D₁ to D₈₀ 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):

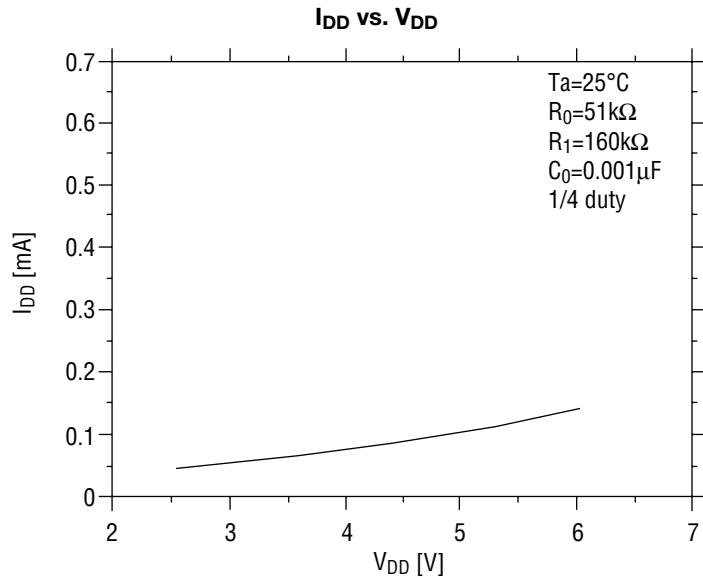
$$f_{COM} = f_{OSC} \times \text{Duty} / 16$$

f_{COM} : COMMON frame frequency

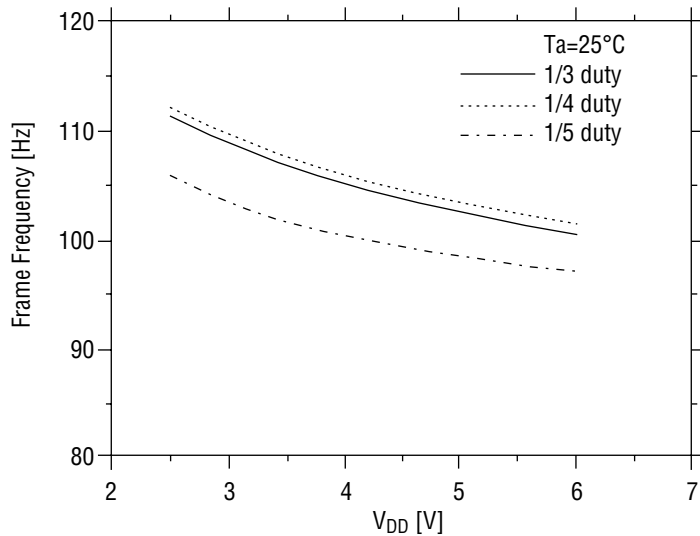
f_{OSC} : Oscillation frequency

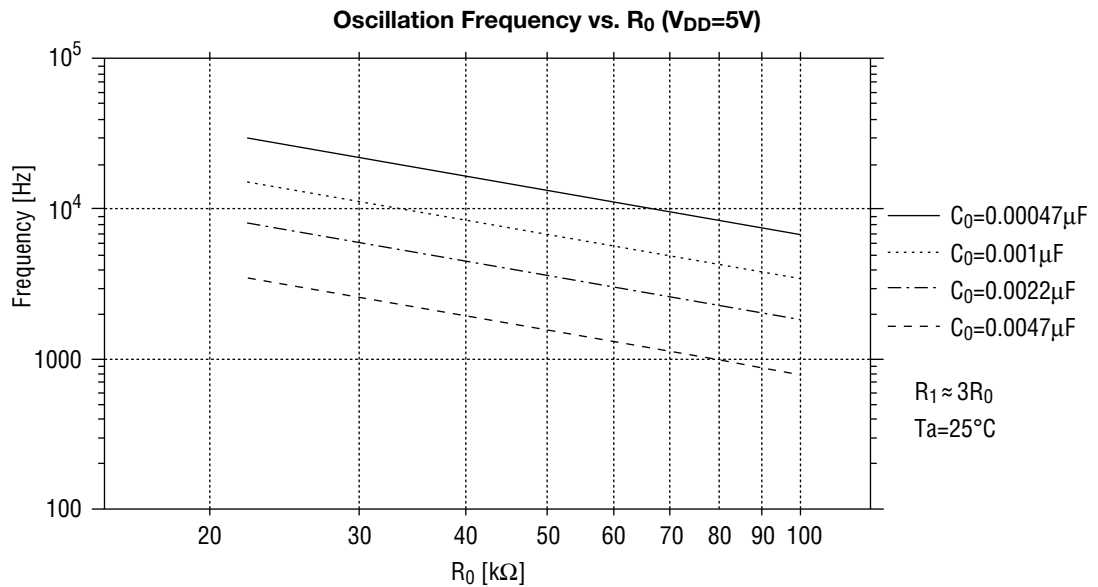
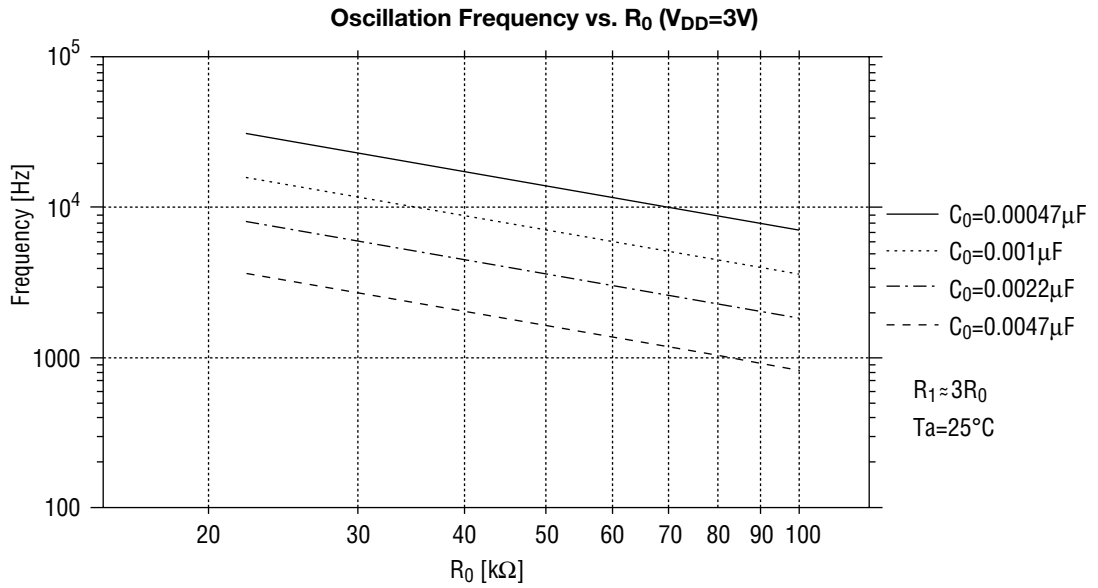
Duty : e.g., 1/4 for 1/4 duty

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



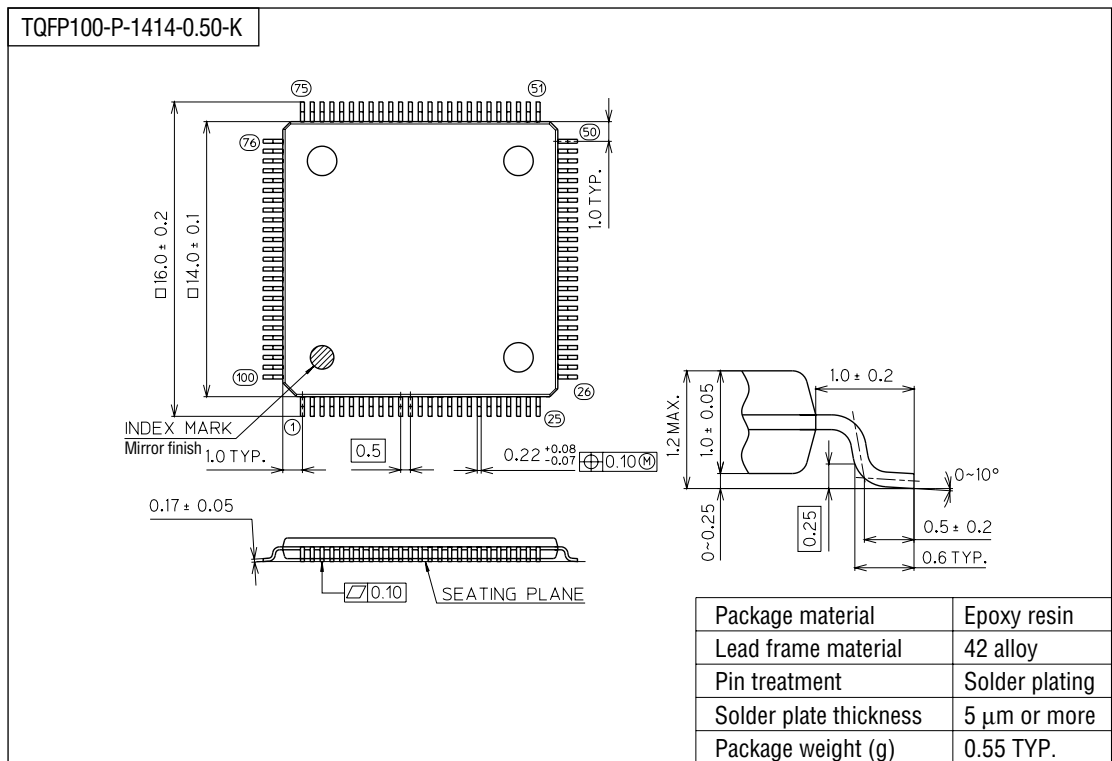
COMMON Frame Frequency vs. V_{DD}
 (The resistor and capacitor values used are their recommended values.)





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).