

# OKI Semiconductor

This version: Nov. 1997  
Previous version: Mar. 1996

## MSM5265

### 80-DOT LCD DRIVER

#### GENERAL DESCRIPTION

The MSM5265 is an LCD driver which can directly drive up to 80 segments in the static display mode and up to 160 segments in the 1/2 duty dynamic display mode.

The MSM5265 is fabricated with low power CMOS metal gate technology. The MSM5265 consists of a 160-stage shift register, 160-bit data latch, 80 pairs of LCD drivers and a common signal generator.

The display data is serially input from the DATA-IN pin to the 160-stage shift register synchronized with the CLOCK pulse. The data is shifted into the 160-bit data latch by the LOAD signal. Then the latched data is directly output to the LCD from the 80 pairs of LCD drivers as a serial output.

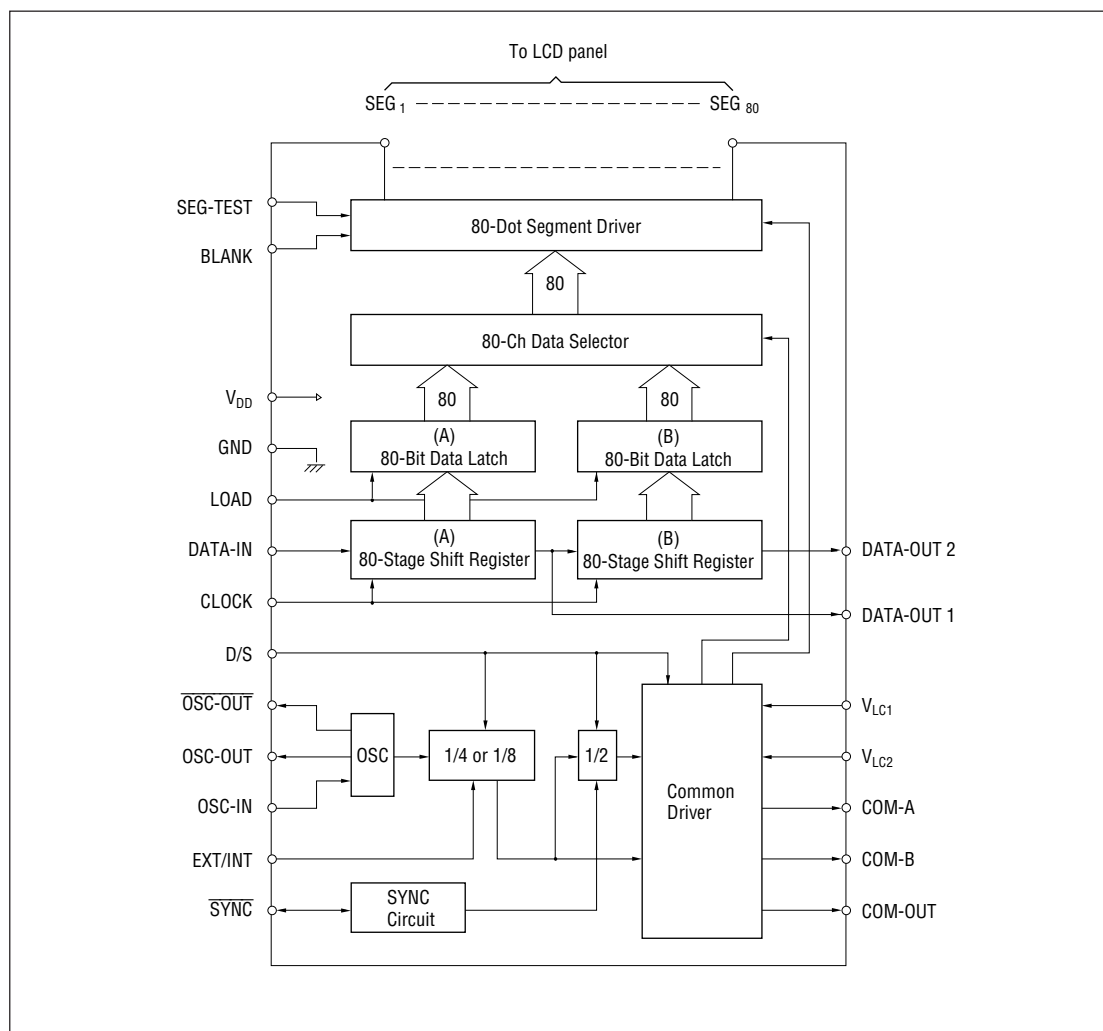
The common signal can be generated by the built-in generator, or externally input. The common synchronization circuit which is used in the dynamic display mode is integrated on the chip.

#### FEATURES

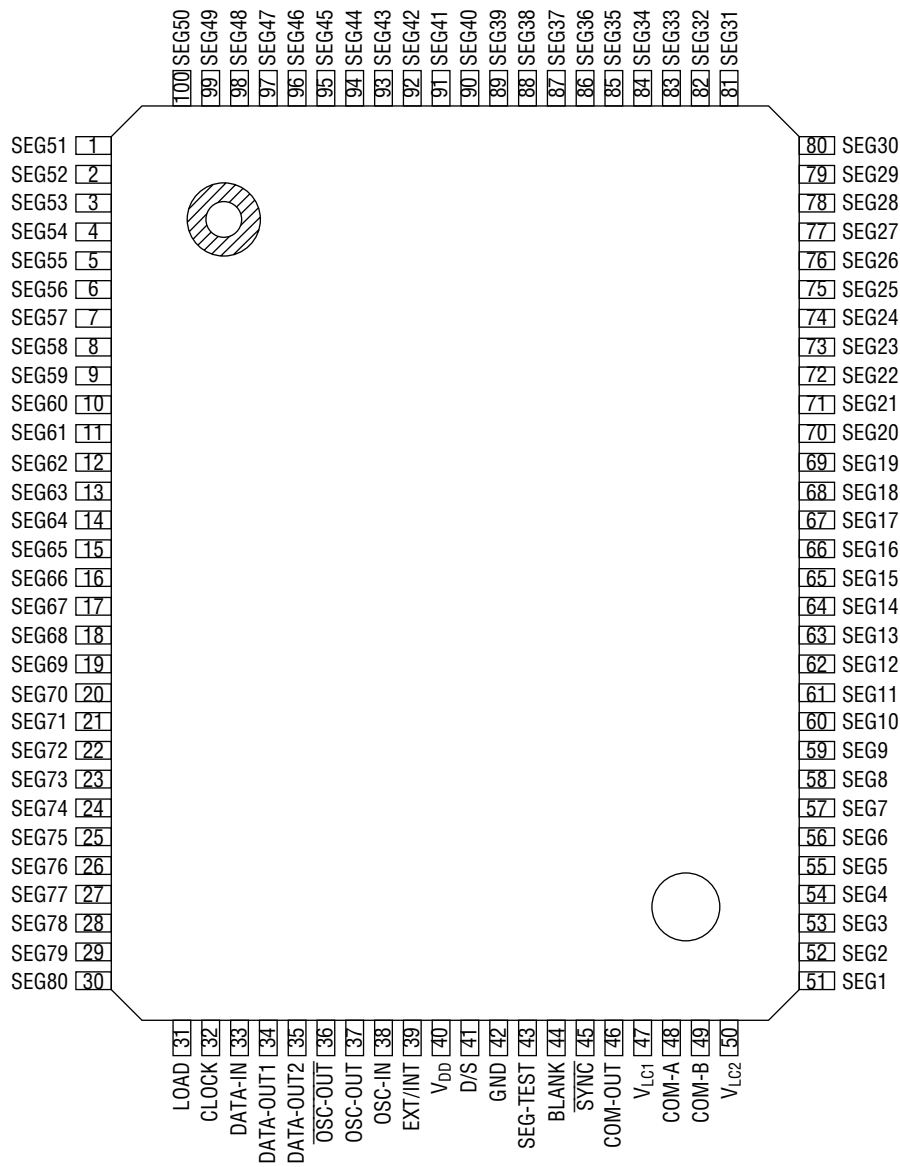
- Supply voltage : 3.0 to 6.0 V
- Drives LCD of up to 80 segments (in the static display mode)
- Drives LCD of up to 160 segments (in the 1/2 duty dynamic display mode)
- Simple interface with microcomputer
- Bit-to-bit correspondence between input data and output data  
H: Display ON    L: Display OFF
- Can be cascade-connected
- Built-in common signal generator
- Can be synchronized with the external common signal
- Testing pins for all-on (SEG-TEST) and all-off (BLANK)
- Applicable as an output expander
- LCD driving voltage can be adjusted by the combination of  $V_{LC1}$  and  $V_{LC2}$
- Package options:
  - 100-pin plastic QFP (QFP100-P-1420-0.65-K) (Product name : MSM5265GS-K)
  - 100-pin plastic QFP (QFP100-P-1420-0.65-BK) (Product name : MSM5265GS-BK)



## BLOCK DIAGRAM



PIN CONFIGURATION (TOP VIEW)



100-Pin Plastic QFP

ABSOLUTE MAXIMUM RATINGS

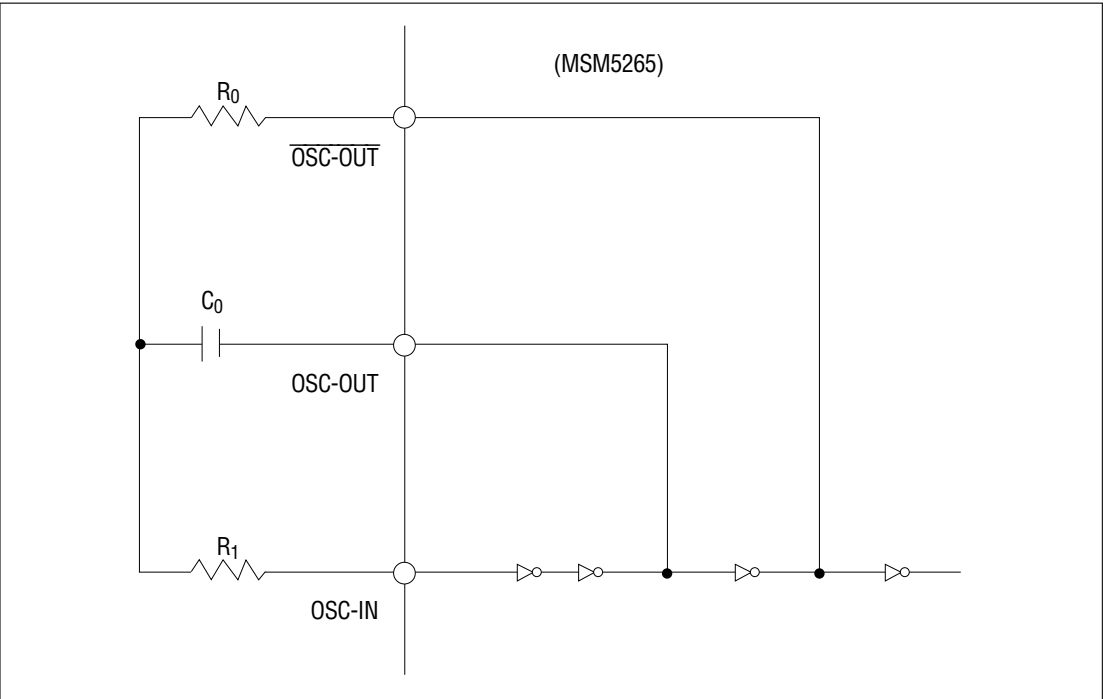
Parameter	Symbol	Condition	Rating	Unit
Supply Voltage	$V_{DD}$	$T_a = 25^{\circ}\text{C}$	-0.3 to +6.5	V
Input Voltage	$V_I$	$T_a = 25^{\circ}\text{C}$	GND-0.3 to $V_{DD} + 0.3$	V
Storage Temperature	$T_{STG}$	—	-55 to +150	$^{\circ}\text{C}$

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Range	Unit
Supply Voltage	$V_{DD}$	—	3 to 6	V
Operating Temperature	$T_{op}$	—	-40 to +85	$^{\circ}\text{C}$
LCD Driving Voltage	$V_{LCD}$	$V_{DD}-V_{LC2}$	3 to $V_{DD}$	V

• Oscillation circuit

Parameter	Symbol	Corresponding pin	Condition	Min.	Typ.	Max.	Unit
Oscillator Resistance	$R_0$	$\overline{\text{OSC-OUT}}$	—	56	100	220	$\text{k}\Omega$
Oscillator Capacitance	$C_0$	OSC-OUT	Film capacitor	0.001	—	0.047	$\mu\text{F}$
Current Limiting Resistance	$R_1$	OSC-IN	$R_1 \geq 10 R_0$	0.56	1	2.2	$\text{M}\Omega$
Common Signal Frequency	$f_{\text{COM}}$	COM-A COM-B	—	25	—	150	Hz



## ELECTRICAL CHARACTERISTICS

## DC Characteristics

(V<sub>DD</sub> = 5.0 V Ta = -40 to +85°C)

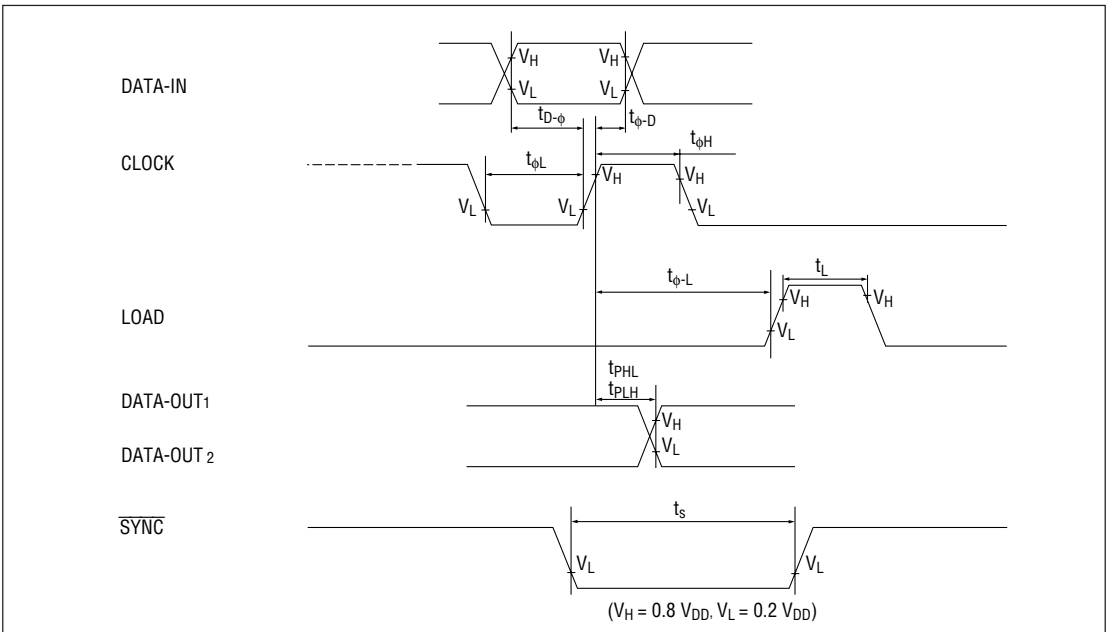
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable pin
"H" Input Voltage	V <sub>IH</sub>	—	36	—	V <sub>DD</sub>	V	SEG-TEST, BLANK, LOAD, DATA-IN, CLOCK, D/S, EXT/INT, OSC-IN
"L" Input Voltage	V <sub>IL</sub>	—	GND	—	1.0	V	
Input Leakage Current	I <sub>IL</sub>	V <sub>I</sub> = 5.0 V/0 V	—	—	±1	μA	
"H" Output Voltage	V <sub>OH</sub>	I <sub>O</sub> = -100 μA	4.5	—	—	V	DATA-OUT1 DATA-OUT2 COM-OUT
		I <sub>O</sub> = -200 μA	4.5	—	—	V	OSC-OUT OSC-OUT
		V <sub>LC1</sub> = 2.5 V, V <sub>LC2</sub> = 0 V I <sub>O</sub> = -30 μA	4.8	—	—	V	SEG <sub>1</sub> -SEG <sub>80</sub>
		V <sub>LC1</sub> = 2.5 V, V <sub>LC2</sub> = 0 V I <sub>O</sub> = -150 μA	4.8	—	—	V	COM-A COM-B
"M" Output Voltage	V <sub>OM</sub>	V <sub>LC1</sub> = 2.5 V, V <sub>LC2</sub> = 0 V I <sub>O</sub> = ±150 μA	2.3	—	2.7	V	COM-A COM-B
"L" Output Voltage	V <sub>OL</sub>	I <sub>O</sub> = 100 μA	—	—	0.5	V	DATA-OUT1 DATA-OUT2 COM-OUT
		I <sub>O</sub> = 200 μA	—	—	0.5	V	OSC-OUT OSC-OUT
		V <sub>LC1</sub> = 2.5 V, V <sub>LC2</sub> = 0 V I <sub>O</sub> = 30 μA	—	—	0.2	V	SEG <sub>1</sub> - SEG <sub>80</sub>
		V <sub>LC1</sub> = 2.5 V, V <sub>LC2</sub> = 0 V I <sub>O</sub> = 150 μA	—	—	0.2	V	COM-A COM-B
		I <sub>O</sub> = 250 μA	—	—	0.8	V	SYNC
Output Leakage Current	I <sub>LO</sub>	V <sub>O</sub> = 5 V when internal Tr is off	—	—	5	μA	SYNC
Segment Output Impedance	R <sub>SEG</sub>	V <sub>LC1</sub> = (5+V <sub>LC2</sub> )/2 V <sub>LC2</sub> = 0 to 2 V	—	—	10	kΩ	SEG <sub>1</sub> - SEG <sub>80</sub>

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable Pin
Common Output Impedance	$R_{COM}$	$V_{LC1} = (5+V_{LC2})/2$ $V_{LC2} = 0 \text{ to } 2 \text{ V}$	—	—	1.5	$k\Omega$	COM-A COM-B
Static Supply Current	$I_{DD1}$	Fix all input levels at either $V_{DD}$ or GND	—	—	100	$\mu\text{A}$	$V_{DD}$
Dynamic Supply Current	$I_{DD2}$	No load. $R_0 = 100 \text{ k}\Omega$ , $C_0 = 0.01 \text{ }\mu\text{F}$ , $R_1 = 1 \text{ M}\Omega$	—	0.12	0.5	$\text{mA}$	

### Switching Characteristics

( $V_{DD} = 3.0 \text{ to } 6.0 \text{ V}$   $T_a = -40 \text{ to } +85^\circ\text{C}$ )

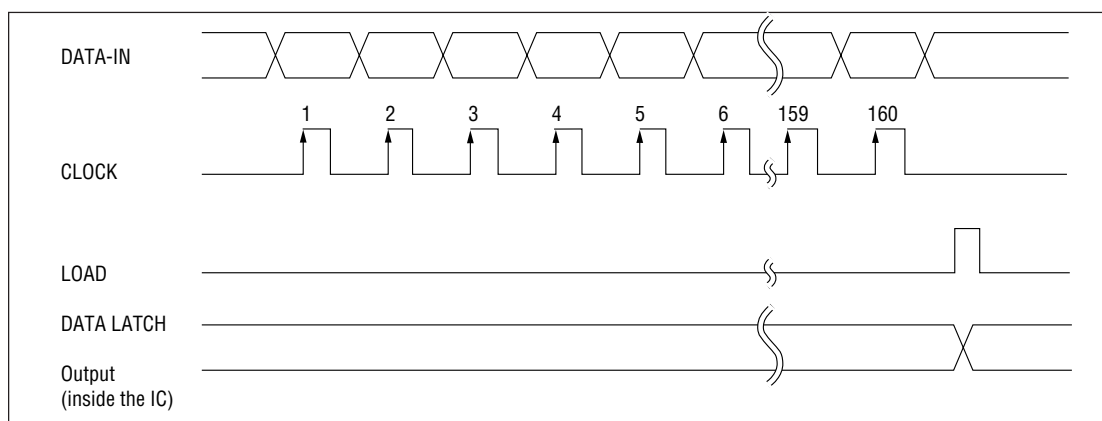
Parameter	Symbol	Condition	Min.	Max.	Unit	Applicable Pin
Clock Frequency	$f_\phi$	—	—	1	$\text{MHz}$	CLOCK
Clock Pulse "H" Time	$t_{\phi H}$	—	0.3	—	$\mu\text{s}$	
Clock Pulse "L" Time	$t_{\phi L}$	—	0.5	—	$\mu\text{s}$	
Data Setup Time	$t_{D-\phi}$	—	0.1	—	$\mu\text{s}$	DATA-IN
Data Hold Time	$t_{\phi-D}$	—	0.1	—	$\mu\text{s}$	CLOCK
"H", "L" Propagation Delay Time	$t_{PHL}$ $t_{PLH}$	Load capacitance of DATA-OUT1, DATA-OUT2: 15 pF	—	0.8	$\mu\text{s}$	DATA-OUT1 DATA-OUT2 CLOCK
LOAD Pulse "H" Time	$t_L$	—	0.2	—	$\mu\text{s}$	LOAD
Clock → LOAD Time	$t_{\phi-L}$	—	0.1	—	$\mu\text{s}$	CLOCK LOAD
OSC-IN Input Frequency	$f_{OSC}$	—	—	5	$\text{kHz}$	OSC-IN
SYNC Pulse "L" Time	$t_s$	—	0.2	—	$\mu\text{s}$	SYNC



## FUNCTIONAL DESCRIPTION

### Operational Description

The MSM5265 consists of a 160-stage shift register, 160-bit data latch, and 80 pairs of LCD drivers. The display data is input from the DATA-IN pin to the 160-stage shift register at the rising edge of the CLOCK pulse and it is shifted to the 160-bit data latch when the LOAD signal is set at "H" level, then it is directly output from the 80 pairs of LCD drivers to the LCD panel. Input the display data in the order of SEG80, SEG79, SEG78, ..., SEG2, SEG1.



### Pin Functional Description

#### • OSC-IN, OSC-OUT, OSC-OUT

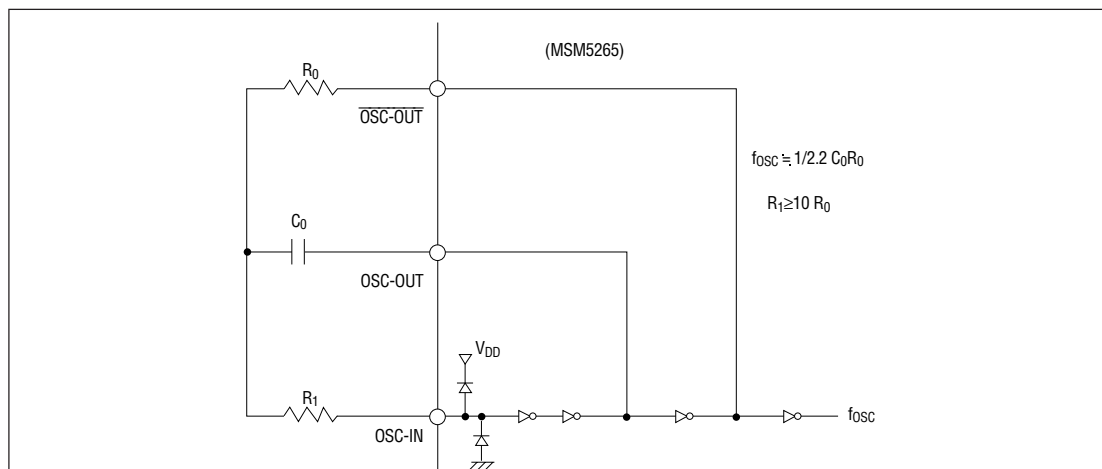
As shown in the figure below, by connecting the external resistors  $R_0$ ,  $R_1$  and external capacitor  $C_0$  with OSC-IN, OSC-OUT and  $\overline{\text{OSC-OUT}}$  respectively, an oscillating circuit to generate the common signal is formed.

This frequency is divided into either 1/8 or 1/4 by the internal dividing circuit. The 1/8 divided frequency is used in the static display mode, while the 1/4 divided frequency is used as the common signal in the 1/2 duty dynamic display mode which is output from the COM-OUT pin. (EXT/INT should be set at low level.)

The resistor  $R_1$  is used to limit the current on the OSC-IN pin's protecting diodes. The value of the  $R_1$  should be more than 10 times that of  $R_0$ .

When the external common signal is used, the EXT/INT pin should be set at high level and the external common signal should be input from the OSC-IN pin.

Keep the wiring between the OSC-IN pin and  $R_1$  as short as possible, because the OSC-IN pin becomes susceptible to external noise if the value of  $R_1$  is large.



- **D/S**

When this pin is set at high level, the MSM5265 operates in the 1/2 duty dynamic display mode, the MSM5265 operates in the static display mode when this pin is set at low level.

- **EXT/INT**

When the external common signal is used, fix this pin at high level and input the external common signal from the OSC-IN pin. The input common signal is used as the internal common signal and is output from the COM-OUT pin through the buffer. When the built-in common signal generator is used, fix this pin at low level. When the MSM5265 is used as an output expander, fix this pin at high level and the OSC-IN pin at low level. The output logic can be reversed in respect to the input data by setting OSC-IN to "H" level.

- **COM-OUT**

When two or more MSM5265s are connected in series (cascade connection), this pin should be connected with all of the slave MSM5265's OSC-IN pins.

- **SYNC**

This pin is an input/output pin which is used when two or more MSM5265s are connected in series (cascade connection) in the 1/2 duty dynamic display mode. All of the involved MSM5265's SYNC pins should be connected by the same line and they should be pulled up with a common resistor, which makes a phase level of all involved MSM5265's COM-A and COM-B pins equal. When a single MSM5265 is used in the dynamic display mode, SYNC should be pulled up with a resistor.

Connect this pin to GND if any of the following conditions is true:

- the MSM5265 is operated in the static display mode
- two or more MSM5265 devices are cascade connected
- a single MSM5265 device is used
- the MSM5265 is used as an output expander

- **DATA-IN, CLOCK**

The display data is serially input from the DATA-IN pin to the 160-stage shift register at the rising edge of the CLOCK pulse. The high level of the display data is used to turn the display on, while low level of the display data is used to turn off the display.

- **DATA-OUT1**

The 80th stage of the shift register contents is output from this pin.

When two or more MSM5265s are connected in series (cascade connection) in the static display mode, this pin should be connected to the next MSM5265's DATA-IN pin.

- **DATA-OUT2**

The 160th stage of the shift register contents is output from this pin.

When two or more MSM5265s are connected in series (cascade connection) in the 1/2 duty dynamic display mode, this pin should be connected to the next MSM5265's DATA-IN pin.

- **LOAD**

The signal for latching the shift register contents is input from this pin.

When LOAD pin is set at high level, the shift register contents are shifted to the 80 sets of LCD drivers. When this pin is set at low level, the last display data is held which was transferred to the 80 sets of LCD drivers when LOAD pin was set at high level.



- **V<sub>LC2</sub>**

Supply voltage pin for the 80 sets of LCD drivers. The input level to this pin should be the low level output voltage of segment outputs (SEG<sub>1</sub> to SEG<sub>80</sub>) and common outputs (COM-A, COM-B).

In this case, the high level of segment outputs and common outputs is the V<sub>DD</sub> level, while low level of segment outputs and common outputs is V<sub>LC2</sub> level. V<sub>LC2</sub> should be set at higher level than ground level.

- **V<sub>LC1</sub>**

Supply voltage pin for the middle level voltage of the common outputs. The input level of this pin is the middle level output voltage of the common outputs (COM-A, COM-B) in the 1/2 duty dynamic display mode.

The value of V<sub>LC1</sub> is calculated by the following formula:

$$V_{LC1} = (V_{DD} + V_{LC2})/2$$

In the static display mode, this pin should be open.

- **COM-A, COM-B**

LCD driving common signals are output from these pins. These pins should be connected to the common side of the LCD panel.

- In the static display mode

A pulse in phase with the COM-OUT output is output from both COM-A and COM-B. In this case, the high level is V<sub>DD</sub>, and the low level is V<sub>LC2</sub>.

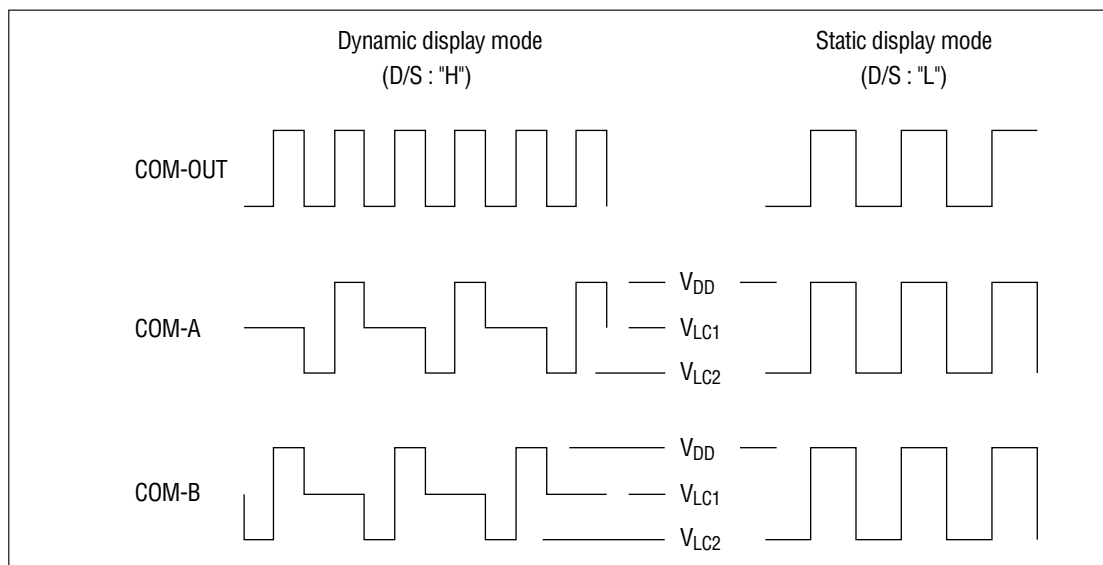
- In the 1/2 duty dynamic display mode

The COM-A and COM-B output signals are alternately changed within each COM-OUT output cycle, resulting in alternate repetition of select and non-select modes.

In the select mode, a signal in phase with the COM-OUT signal is output at "H" (V<sub>DD</sub>) and "L" (V<sub>LC2</sub>).

In the non-select mode, a voltage is output at "M" (V<sub>LC1</sub>). In the select mode of COM-A (non-select mode of COM-B), signals that correspond to the 1st- to 80th-bit data of the data latch are output to the segment outputs.

In the select mode of COM-B (non-select mode of COM-A), signals that correspond to the 81st- to 160th-bit data of the data latch are output to the segment outputs.



- **SEG<sub>1</sub> to SEG<sub>80</sub>**

LCD segment driving signals are output from these pins and they should be connected to the segment side of the LCD panel.

"H" level :  $V_{DD}$ , "L" level :  $V_{LC2}$

- In the static display mode

The nth-bit data of the data latch (A) corresponds to the SEG n. The data of the data latch (B) is invalid .

A signal out of phase with the COM-OUT signal is output to the segment outputs when the display is turned on, while a signal in phase with it is output when the display is turned off.

- In the 1/2 duty dynamic display mode

Output of the SEG n corresponds to as follows.

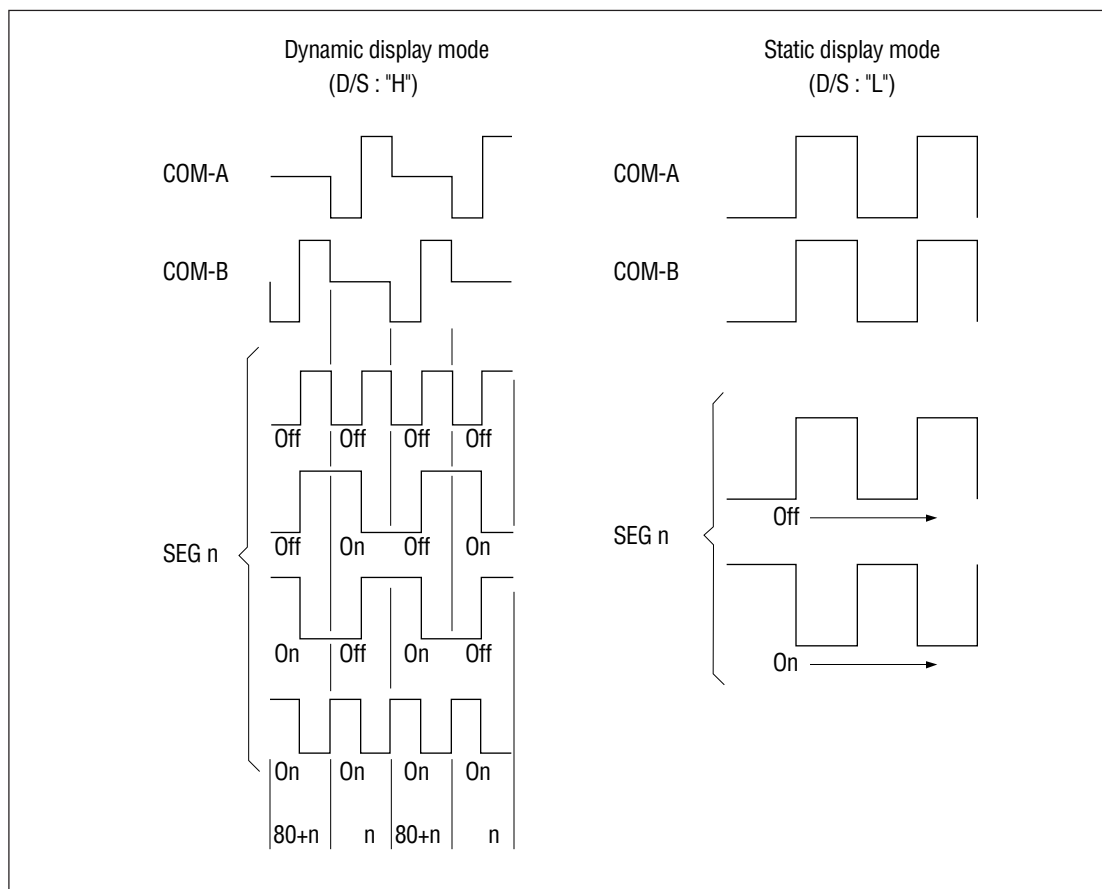
When COM-A is in select mode:

nth-bit data of the data latch (A)

When COM-B is in select mode:

nth-bit data of the data latch (B)

When the display is turned on, a signal out of phase with the common signal corresponding to the data is output, while a signal in phase with the common signal is output when the display is turned off.



- **SEG-TEST**

This pin is used to test the segment outputs (SEG<sub>1</sub> to SEG<sub>80</sub>). All displays are turned on when this pin is set to high level. The display returns to the condition before the pin was set to high level. When this pin is at high level, the input on the BLANK pin is disabled.

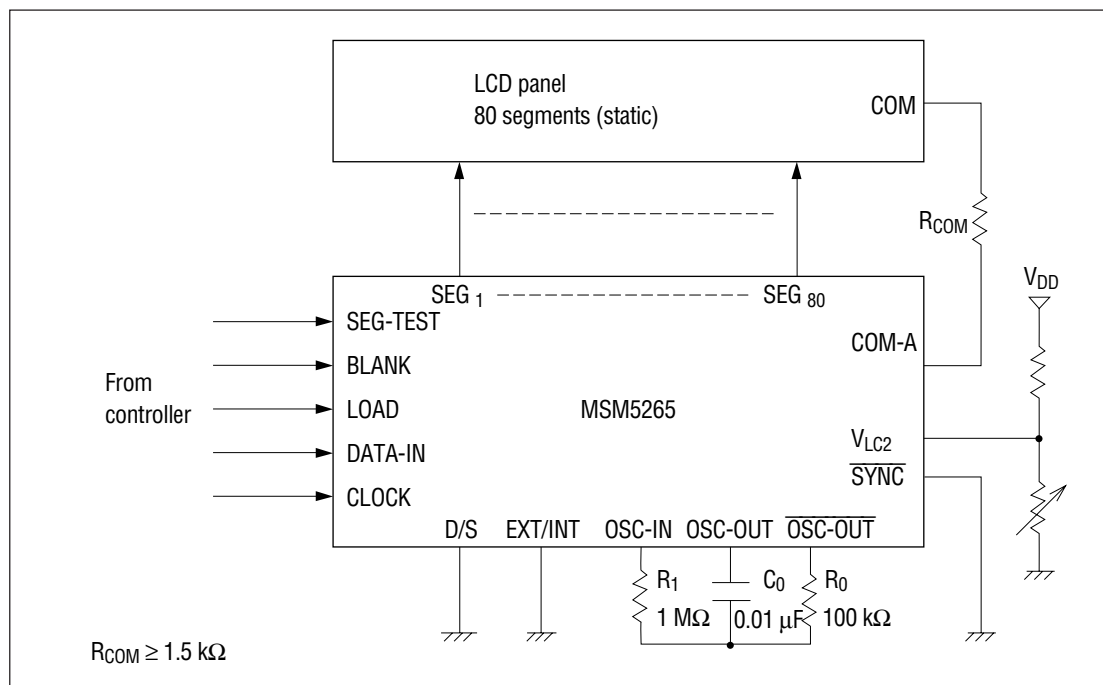
- **BLANK**

This pin is also used to test the segment outputs (SEG<sub>1</sub> to SEG<sub>80</sub>). All displays are turned off when this pin is set to high level. The display returns to the condition before the pin was set to high level.

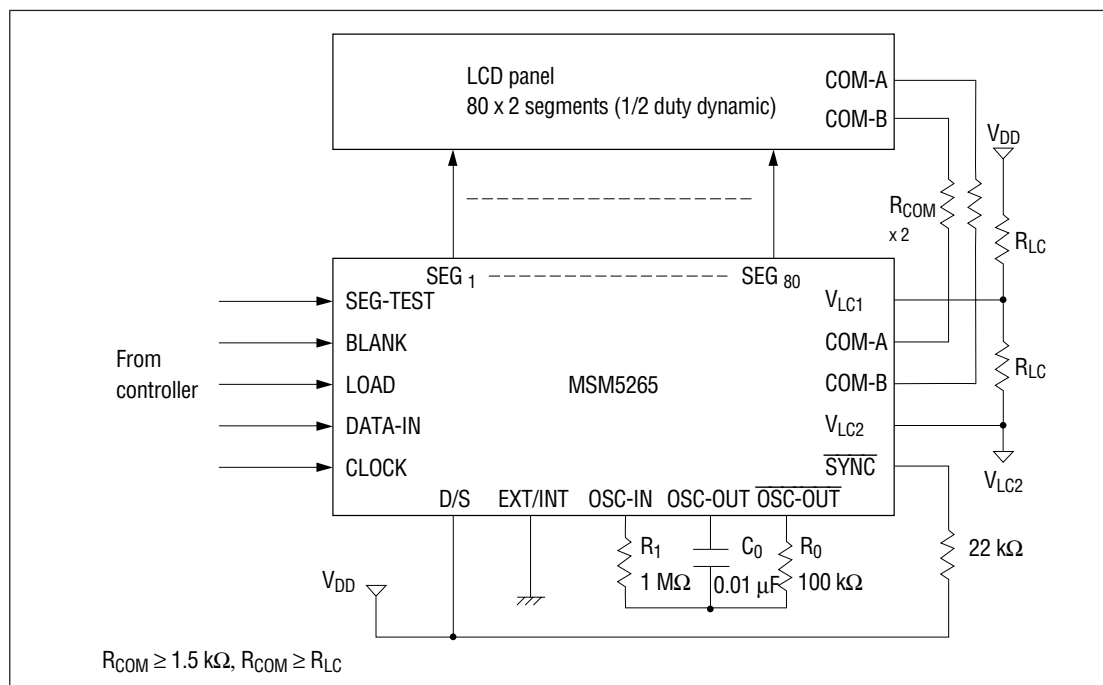
When SEG-TEST pin is at high level, the input on this pin is disabled.

## APPLICATION CIRCUITS

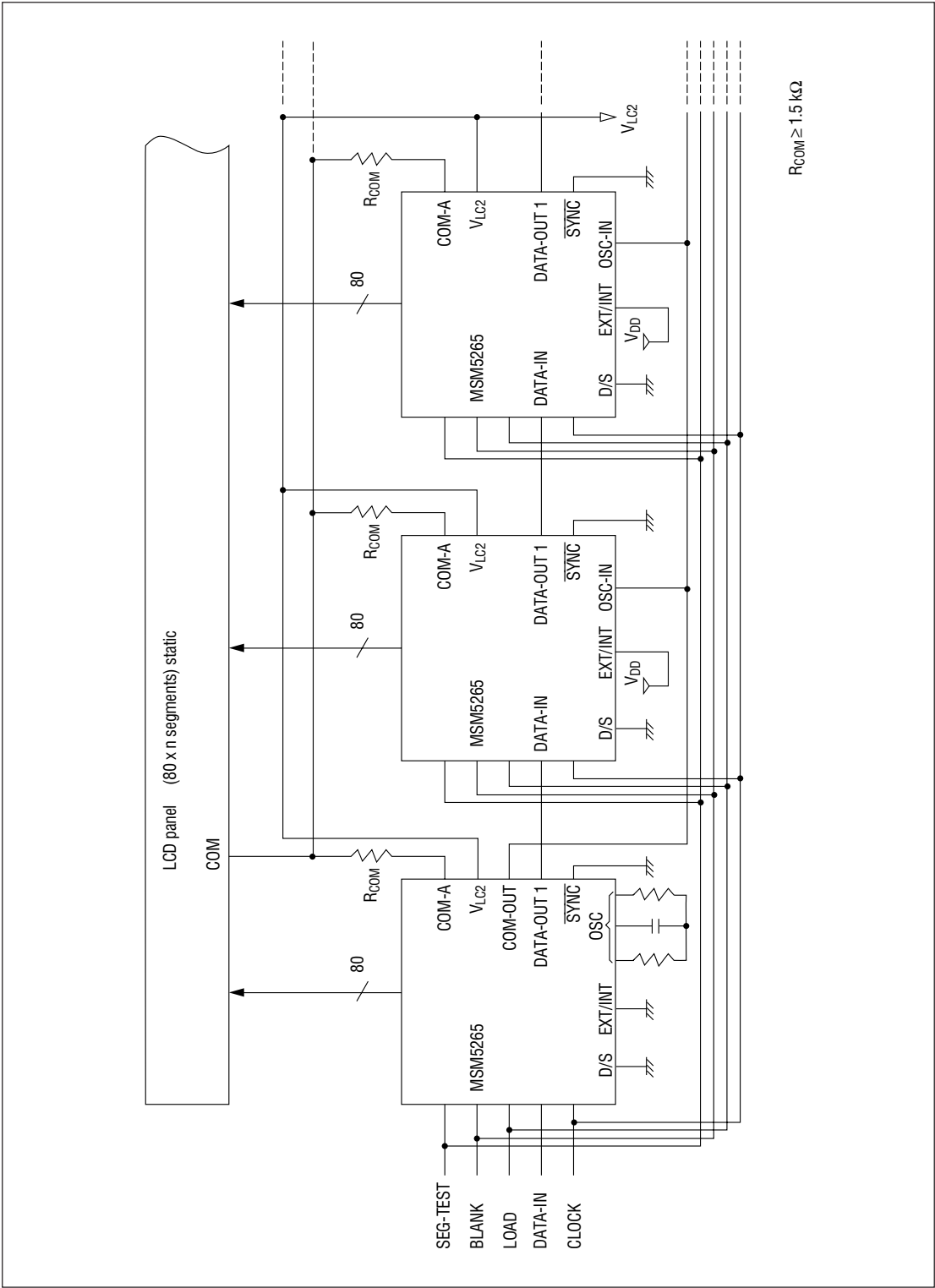
## 1) Single MSM5265 operation in the static display mode



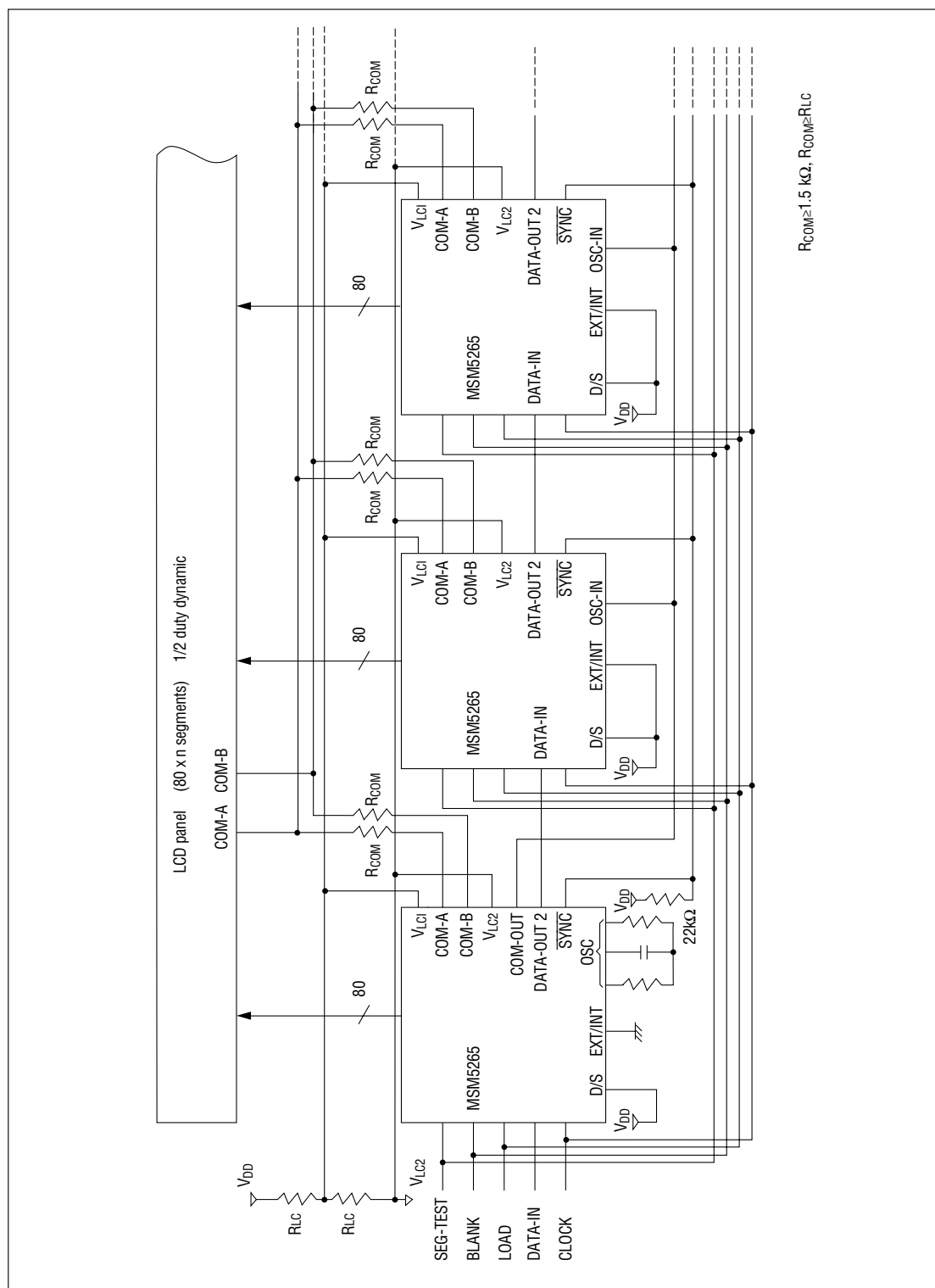
## 2) Single MSM5265 operation in the 1/2 duty dynamic display mode



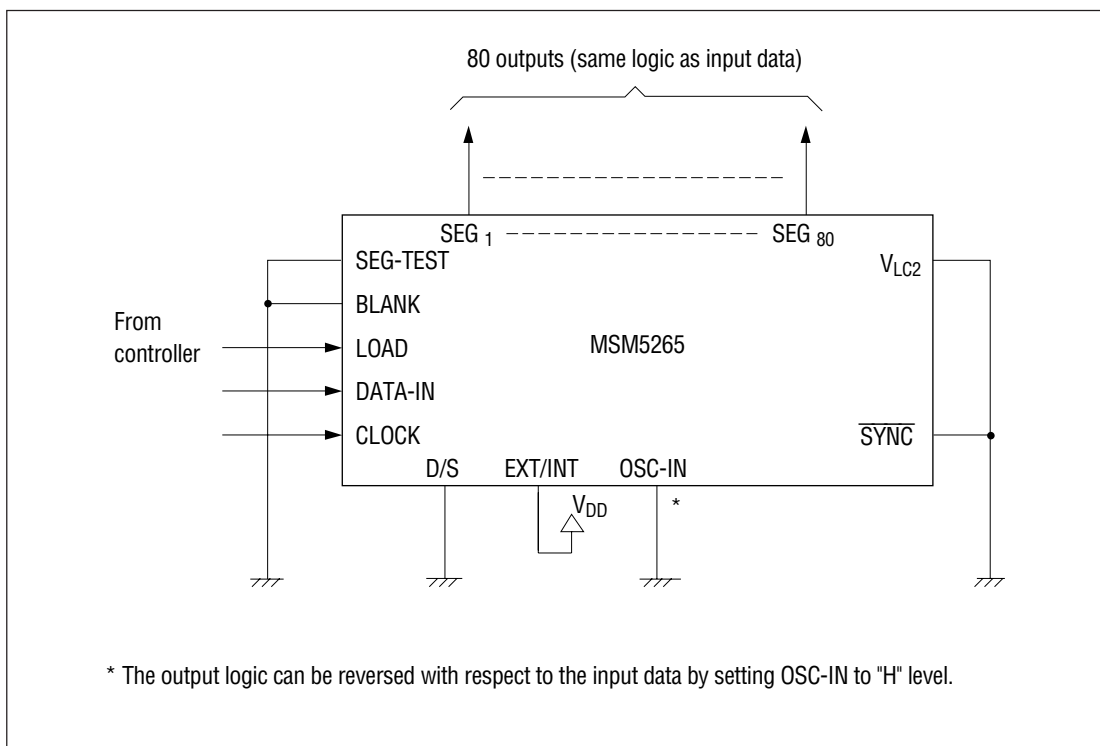
3) Cascade connections for MSM5265s in the static display mode



#### 4) Cascade connections for MSM5265s in the 1/2 duty dynamic display mode

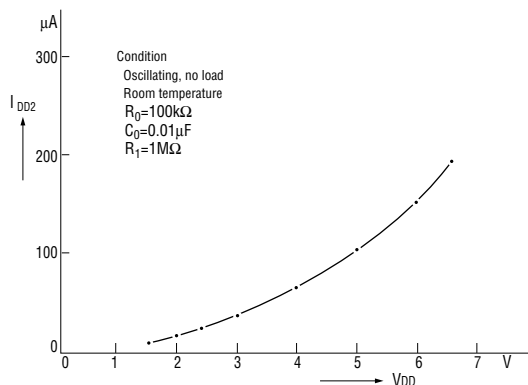


## 5) Output-expander

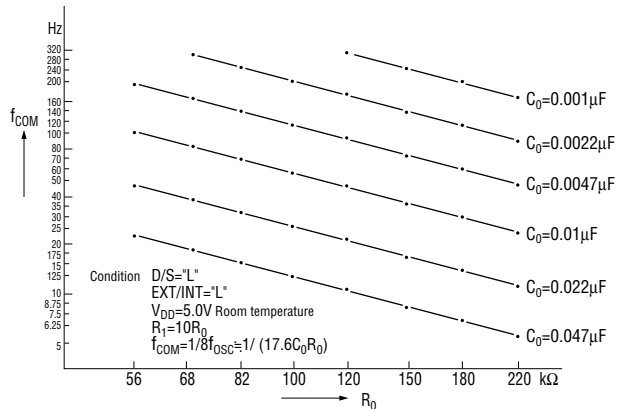


## REFERENCE DATA

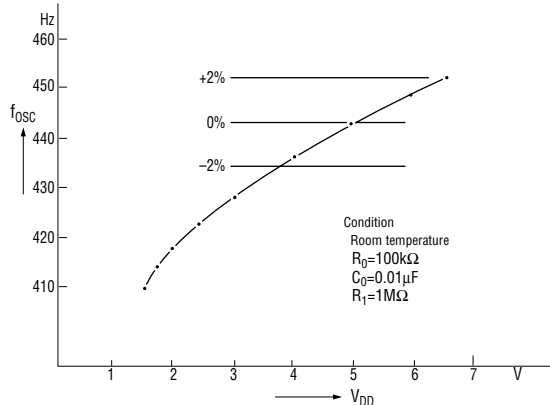
### $I_{DD2}$ vs. $V_{DD}$



### $f_{COM}$ vs. $R_0$ , $C_0$



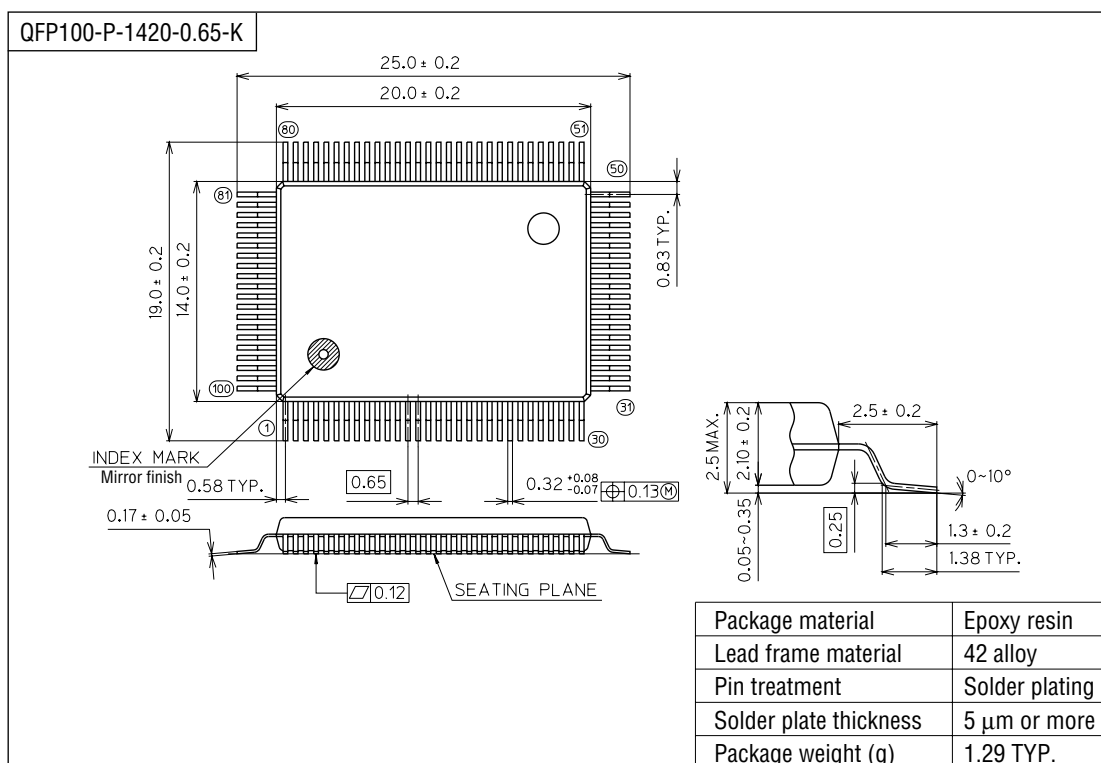
### $f_{OSC}$ vs. $V_{DD}$





## PACKAGE DIMENSIONS

(Unit : mm)

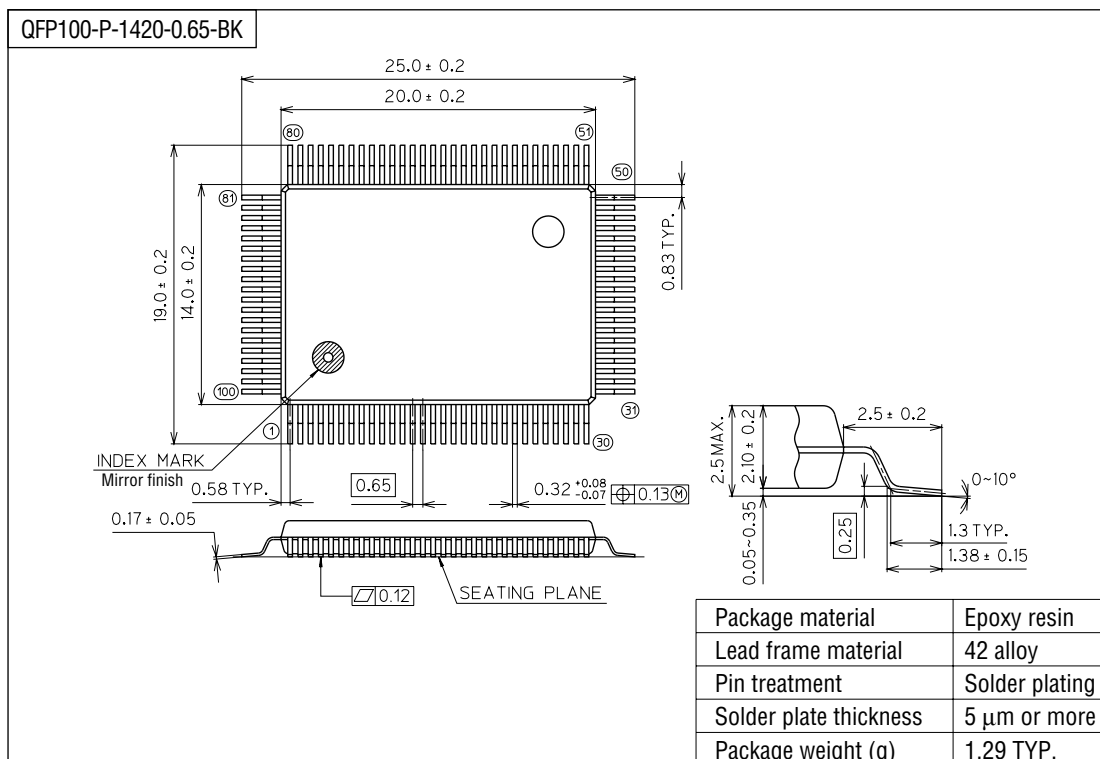


## Notes for Mounting the Surface Mount Type Package

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).

(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).