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# MSM5299A

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## 80-DOT LCD SEGMENT DRIVER

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### GENERAL DESCRIPTION

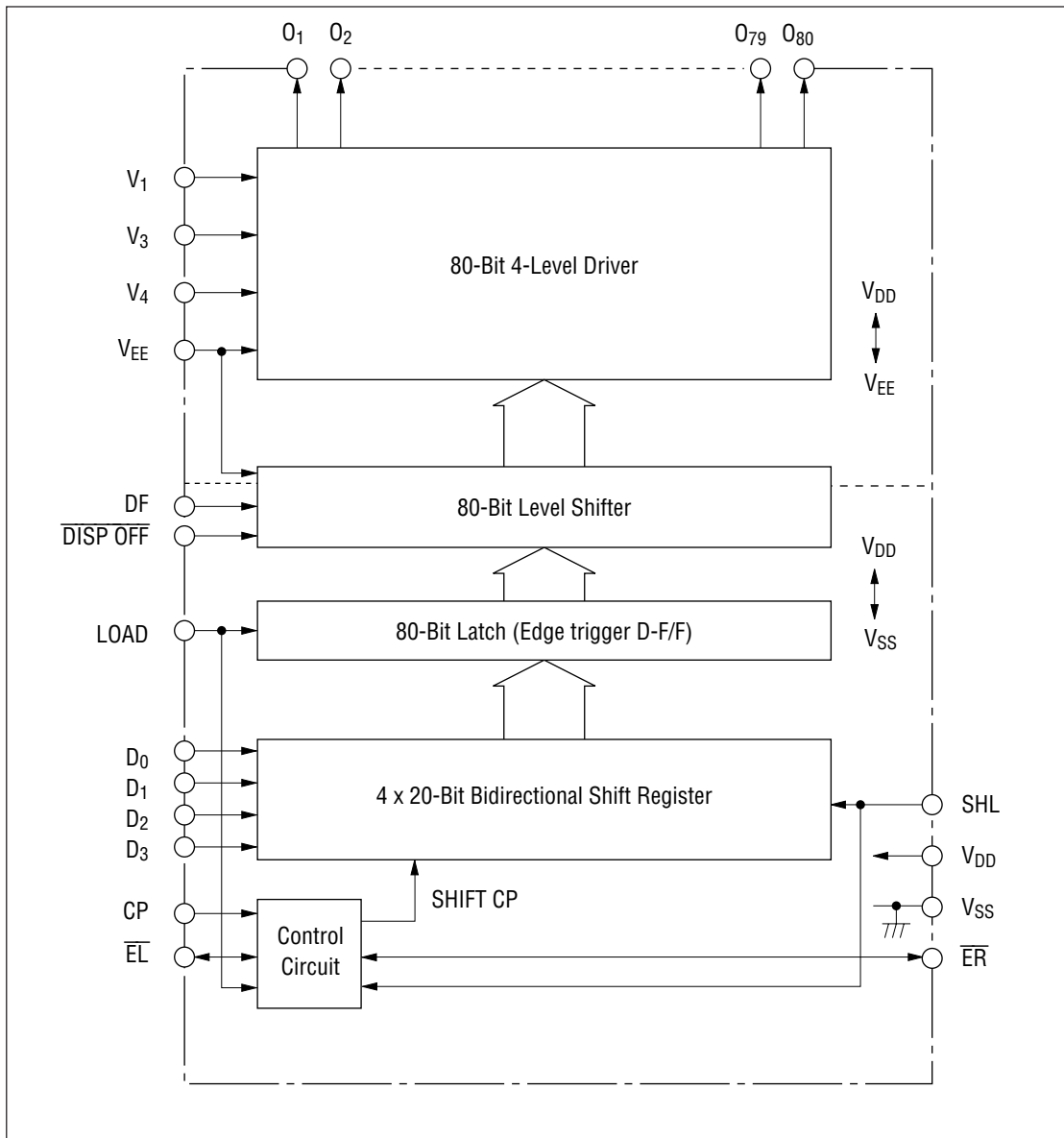
The MSM5299A is a dot matrix LCD segment driver LSI which is fabricated using CMOS low power metal gate technology. This LSI consists of an 80-bit bidirectional shift register, 80-bit latch, 80-bit level shifter and 80-bit 4-level driver.

It receives the display data, which is transferred in 4-bit parallel from a microcomputer or LCD controller LSI such as MSM6255, then outputs the LCD driving waveform to the LCD.

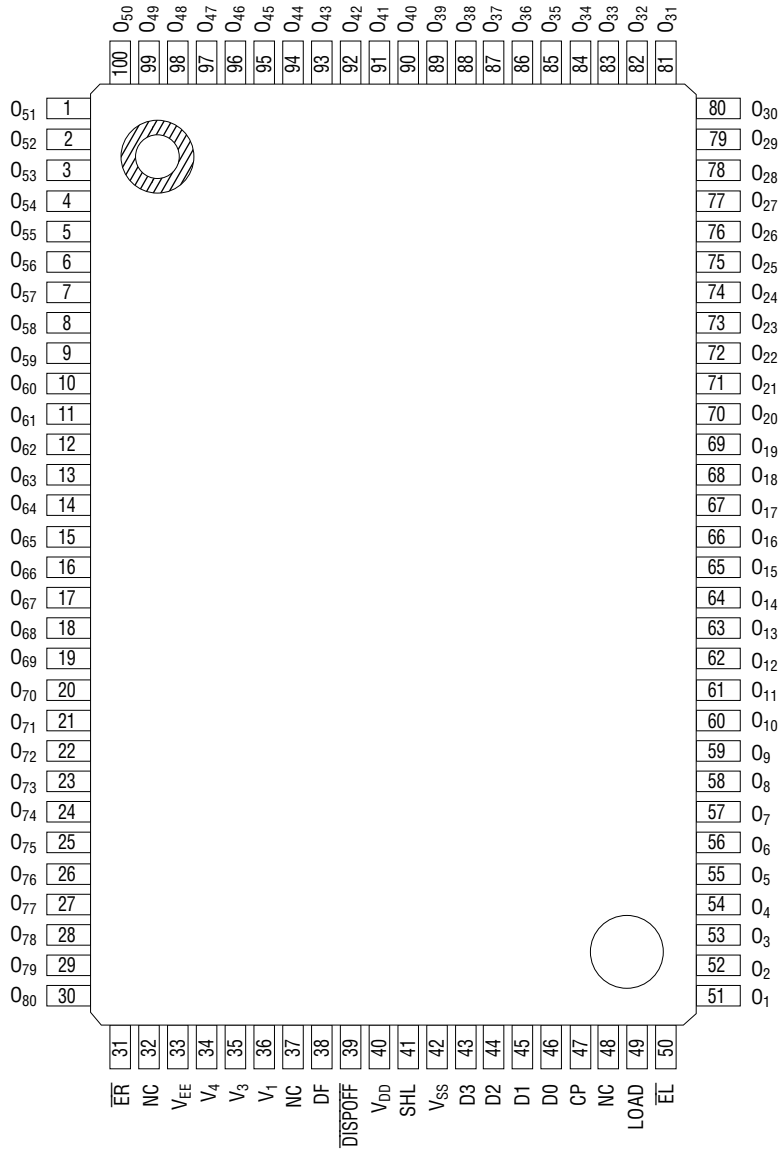
### FEATURES

- Supply voltage : 4.5 to 5.5V
- LCD driving voltage : 8 to 28V
- Applicable LCD duty : 1/64 to 1/256
- LCD Output : 80
- The 4-bit parallel data processing has improved the transfer speed to 1/4 that of the conventional serial transfer, thereby achieving low power consumption
- Can be interfaced with the LCD controller LSI MSM6255
- Applicable common driver : MSM5298A (68 outputs)
- Package options:
  - 100-pin plastic QFP (QFP100-P-1420-0.65-K) (Product name : MSM5299AGS-K)
  - 100-pin plastic QFP (QFP100-P-1420-0.65-BK) (Product name : MSM5299AGS-BK)

**BLOCK DIAGRAM**



**PIN CONFIGURATION (TOP VIEW)**



NC : No connection

**100-Pin Plastic QFP**

Note: The abbreviated part number "M5299A" is imprinted on the package surface.

**ABSOLUTE MAXIMUM RATINGS**(V<sub>SS</sub>=0V)

Parameter	Symbol	Condition	Rating	Unit
Supply Voltage (1)	V <sub>DD</sub>	T <sub>a</sub> = 25°C	-0.3 to +6	V
Supply Voltage (2)	V <sub>LCD</sub>	T <sub>a</sub> = 25°C, V <sub>DD</sub> - V <sub>EE</sub> <sup>*1</sup>	0 to 30	V
Input Voltage	V <sub>I</sub>	T <sub>a</sub> = 25°C	-0.3 to V <sub>DD</sub> +0.3	V
Storage Temperature	T <sub>STG</sub>	—	-55 to +150	°C

\*1 V<sub>DD</sub> ≥ V<sub>1</sub> > V<sub>3</sub> > V<sub>4</sub> > V<sub>EE</sub>**RECOMMENDED OPERATING CONDITIONS**(V<sub>SS</sub>=0V)

Parameter	Symbol	Condition	Range	Unit
Supply Voltage (1)	V <sub>DD</sub>	—	4.5 to 5.5	V
Supply Voltage (2)	V <sub>LCD</sub>	V <sub>DD</sub> - V <sub>EE</sub> <sup>*1</sup>	8 to 28	V
Operating Temperature	T <sub>op</sub>	—	-20 to +85	°C

\*1 V<sub>DD</sub> ≥ V<sub>1</sub> > V<sub>3</sub> > V<sub>4</sub> > V<sub>EE</sub>

**ELECTRICAL CHARACTERISTICS**

**DC Characteristics**

(V<sub>DD</sub> = 5V ± 10%, T<sub>a</sub> = -20 to +85°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" Input Voltage	V <sub>IH</sub> *1	—	0.8V <sub>DD</sub>	—	V <sub>DD</sub>	V
"L" Input Voltage	V <sub>IL</sub> *1	—	V <sub>SS</sub>	—	0.2V <sub>DD</sub>	V
"H" Input Current	V <sub>IH</sub> *1	V <sub>IH</sub> = V <sub>DD</sub> , V <sub>DD</sub> = 5.5V	—	—	1	μA
"H" Input Current	V <sub>IL</sub> *1	V <sub>IL</sub> = 0V, V <sub>DD</sub> = 5.5V	—	—	-1	μA
"H" Output Voltage	V <sub>OH</sub> *2	I <sub>O</sub> = -0.2mA, V <sub>DD</sub> = 4.5V	V <sub>DD</sub> - 0.4	—	—	V
"L" Output Voltage	V <sub>OL</sub> *2	I <sub>O</sub> = 0.2mA, V <sub>DD</sub> = 4.5V	—	—	0.4	V
ON Resistance	R <sub>ON</sub> *4	V <sub>DD</sub> - V <sub>EE</sub> = 23V *3  V <sub>N</sub> - V <sub>O</sub>   = 0.25V, V <sub>DD</sub> = 4.5V	—	2	4	kΩ
Stand-by Current	I <sub>DDSBY</sub>	f <sub>CP</sub> = 1MHz, V <sub>DD</sub> = 5.5V V <sub>DD</sub> - V <sub>EE</sub> = 26V, No load *5	—	—	200	μA
Supply Current (1)	I <sub>DD1</sub>	f <sub>CP</sub> = 1MHz, V <sub>DD</sub> = 5.5V V <sub>DD</sub> - V <sub>EE</sub> = 26V, No load *6	—	—	3	mA
Supply Current (2)	I <sub>V</sub>	f <sub>CP</sub> = 1MHz, V <sub>DD</sub> = 5.5V V <sub>DD</sub> - V <sub>EE</sub> = 26V, No load *7	—	—	±100	μA
Input Capacitance	C <sub>I</sub>	f = 1MHz	—	5	—	pF

\*1 Applicable to LOAD, CP, D<sub>0</sub> - D<sub>3</sub>,  $\overline{EL}$ ,  $\overline{ER}$ , SHL, DF,  $\overline{DISP\ OFF}$

\*2 Applicable to  $\overline{EL}$ ,  $\overline{ER}$ .

\*3 V<sub>N</sub> = V<sub>DD</sub> to V<sub>EE</sub>, V<sub>4</sub> =  $\frac{13}{15}$  (V<sub>DD</sub> - V<sub>EE</sub>), V<sub>3</sub> =  $\frac{2}{15}$  (V<sub>DD</sub> - V<sub>EE</sub>), V<sub>1</sub> = V<sub>DD</sub>

\*4 Applicable to O<sub>1</sub> to O<sub>80</sub>.

\*5 Display data 1010 .....f<sub>DF</sub> = 40 Hz, Current from V<sub>DD</sub> to V<sub>SS</sub> when the display data is not processing.

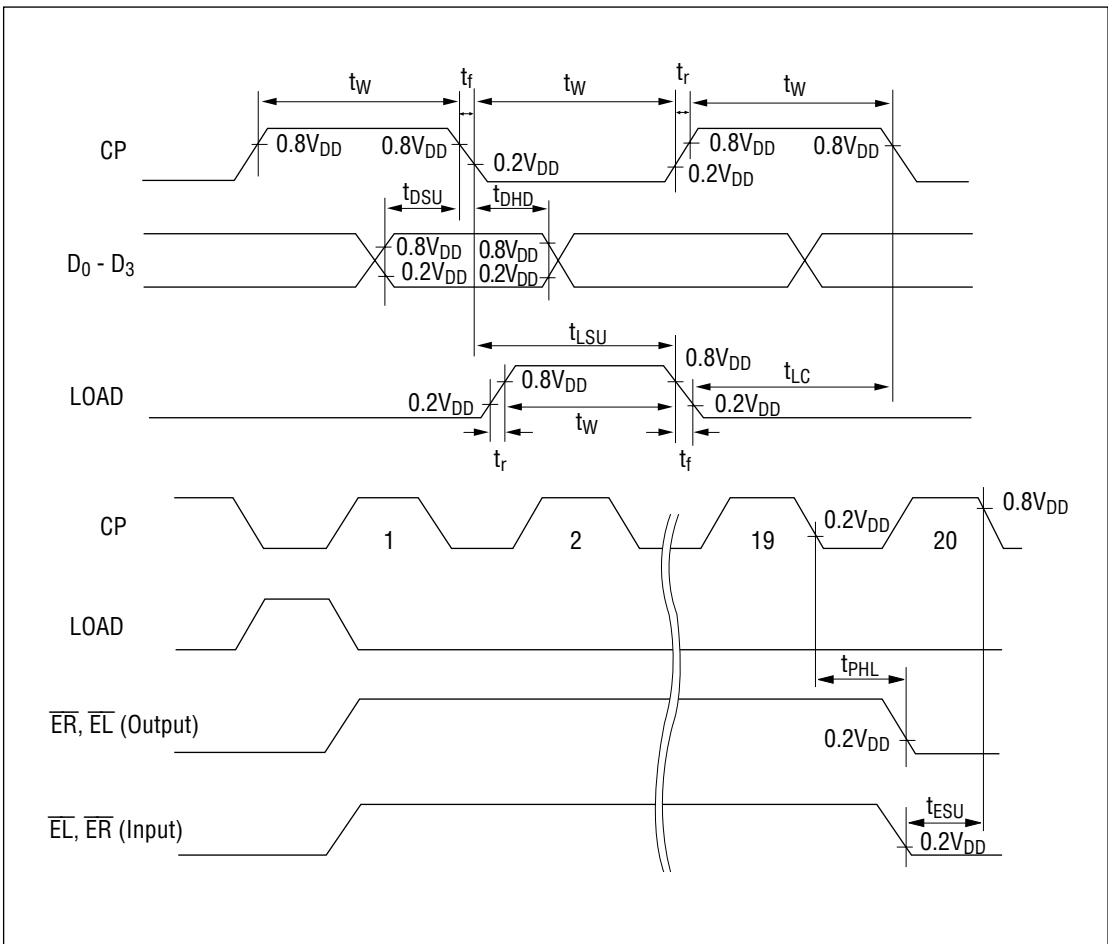
\*6 Display data 1010 .....f<sub>DF</sub> = 40 Hz, Current from V<sub>DD</sub> to V<sub>SS</sub> when the display data is processing.

\*7 Display data 1010 .....f<sub>DF</sub> = 40 Hz, Current on V<sub>1</sub>, V<sub>3</sub> and V<sub>4</sub>.

Switching Characteristics

( $V_{DD} = 5V \pm 10\%$ ,  $T_a = -20$  to  $+75^\circ C$ ,  $C_L = 15pF$ )

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock Frequency	$f_{CP}$	DUTY=50%	—	—	3.4	MHz
Clock, Load Pulse Width	$t_W$	—	100	—	—	ns
Clock Pulse Rise/Fall Time	$t_r, t_f$	—	—	—	50	ns
Data Set-up Time	$t_{DSU}$	—	50	—	—	ns
Data Hold Time	$t_{DHD}$	—	80	—	—	ns
Load Set-up Time	$t_{LSU}$	—	90	—	—	ns
Load → Clock Time	$t_{LC}$	—	200	—	—	ns
Propagation Delay Time	$t_{PHL}$	—	—	—	224	ns
$\overline{ER}, \overline{EL}$ Set-up Time	$t_{ESU}$	—	70	—	—	ns



## FUNCTIONAL DESCRIPTION

### Pin Functional Description

- $\overline{ER}$ ,  $\overline{EL}$

Pin	Input/Output	SHL	Description
$\overline{ER}$	Input	L	Input pin to ENABLE F/F of MSM5299A.
$\overline{EL}$	Output		Output pin of ENABLE F/F. $\overline{EL}$ is connected to next MSM5299A's $\overline{ER}$ when MSM5299As are connected in series (cascade connection).
$\overline{EL}$	Input	H	Input pin to ENABLE F/F of MSM5299A.
$\overline{ER}$	Output		Output pin of ENABLE F/F. $\overline{ER}$ is connected to next MSM5299A's $\overline{EL}$ when MSM5299As are connected in series (cascade connection).

When single MSM5299A is used,  $\overline{ER}$  ( $\overline{EL}$ ) should be set at "L" level.

When a cascade connection is required, set the  $\overline{ER}$  ( $\overline{EL}$ ) pin of the first MSM5299A at "L" level and connect the  $\overline{EL}$  ( $\overline{ER}$ ) pin of the first MSM5299A to the  $\overline{ER}$  ( $\overline{EL}$ ) pin of the second MSM5299A, then connect the  $\overline{EL}$  ( $\overline{ER}$ ) pin of the second MSM5299A to the  $\overline{ER}$  ( $\overline{EL}$ ) pin of the third MSM5299A.

- **CP**

Clock pulse input pin for the 4-bit parallel shift register. The data is shifted to 4 × 20-bit shift register at the falling edge of the clock pulse. The clock pulse is activated when the ENABLE F/F is set and is deactivated when the ENABLE F/F is not set.

- **SHL**

Input pin to switch the input or output of pins  $\overline{ER}$  and  $\overline{EL}$ , and the shift direction of the 4-bit parallel bidirectional shift register.

The shift direction of the 4-bit parallel data, the correspondence of the data  $D_0$  to  $D_3$  to the driver outputs  $O_1$  to  $O_{80}$ , and the input and output state of pins  $\overline{ER}$  and  $\overline{EL}$  are shown in the table below.

SHL	$\overline{ER}$	$\overline{EL}$	Shift direction
L	Input	Output	$D_0 \rightarrow O_1 \rightarrow O_5 \rightarrow \dots \rightarrow O_{77}$
			$D_1 \rightarrow O_2 \rightarrow O_6 \rightarrow \dots \rightarrow O_{78}$
			$D_2 \rightarrow O_3 \rightarrow O_7 \rightarrow \dots \rightarrow O_{79}$
			$D_3 \rightarrow O_4 \rightarrow O_8 \rightarrow \dots \rightarrow O_{80}$
H	Output	Input	$D_0 \rightarrow O_{80} \rightarrow O_{76} \rightarrow \dots \rightarrow O_4$
			$D_1 \rightarrow O_{79} \rightarrow O_{75} \rightarrow \dots \rightarrow O_3$
			$D_2 \rightarrow O_{78} \rightarrow O_{74} \rightarrow \dots \rightarrow O_2$
			$D_3 \rightarrow O_{77} \rightarrow O_{73} \rightarrow \dots \rightarrow O_1$

↑  
end data
↑  
start data

- **D<sub>0</sub>, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>**

Display data input pins for 4 × 20-bit shift register. The display data is clocked into the shift register at the falling edge of the clock pulse. The combinations of D<sub>0</sub> to D<sub>3</sub> level, DF signal level, display data output level and the display on the LCD panel are described on the table below.

<b>D<sub>0</sub> to D<sub>3</sub></b>	<b>DF</b>	<b>Display data output level</b>	<b>Display on the LCD</b>
L	L	Nonselect level (V <sub>3</sub> )	OFF
H	L	Select level (V <sub>1</sub> )	ON
L	H	Nonselect level (V <sub>4</sub> )	OFF
H	H	Select level (V <sub>EE</sub> )	ON

- **LOAD**

The signal for latching the shift register contents is input to this pin. The display data stored in the shift register is latched at the falling edge of the load pulse.

- **DF**

Synchronous signal input pin for alternate signal for LCD driving.

- **V<sub>DD</sub>, V<sub>SS</sub>**

Supply voltage pins, V<sub>DD</sub> should be 4.5 to 5.5V. V<sub>SS</sub> is a ground pin (V<sub>SS</sub> = 0V)

- **V<sub>1</sub>, V<sub>3</sub>, V<sub>4</sub>, V<sub>EE</sub>**

Bias supply voltage pin to drive the LCD. Use an external bias voltage supply for driving the LCD.



- O<sub>1</sub> - O<sub>80</sub>**  
 Display data output pins, which correspond to the respective latch contents. One of V<sub>1</sub>, V<sub>3</sub>, V<sub>4</sub> and V<sub>EE</sub> is selected as a display driving voltage source according to the combination of the latched data level and DF signal. Refer to the Truth Table.  
 The outputs O<sub>1</sub> to O<sub>80</sub> are connected to the segment side of the LCD panel.
- DISP OFF**  
 Input pin to control outputs of O<sub>1</sub> to O<sub>80</sub>. V<sub>1</sub> level is output from O<sub>1</sub> to O<sub>80</sub> pins during "L" level input. Refer to the Truth Table.

**Truth Table**

DF	Latched data	DISP OFF	LCD driver output (O <sub>1</sub> - O <sub>80</sub> )
L	L	H	V <sub>3</sub>
L	H	H	V <sub>1</sub>
H	L	H	V <sub>4</sub>
H	H	H	V <sub>EE</sub>
X	X	L	V <sub>1</sub>

X : Don't care

**NOTES ON USE**

Note the following when turning power on and off:

The LCD drivers of this IC require a high voltage. For this reason, if a high voltage is applied to the LCD drivers with the logic power supply floating, excess current flows. This may damage the IC. Be sure to carry out the following power-on and power-off sequences:

When turning power on:

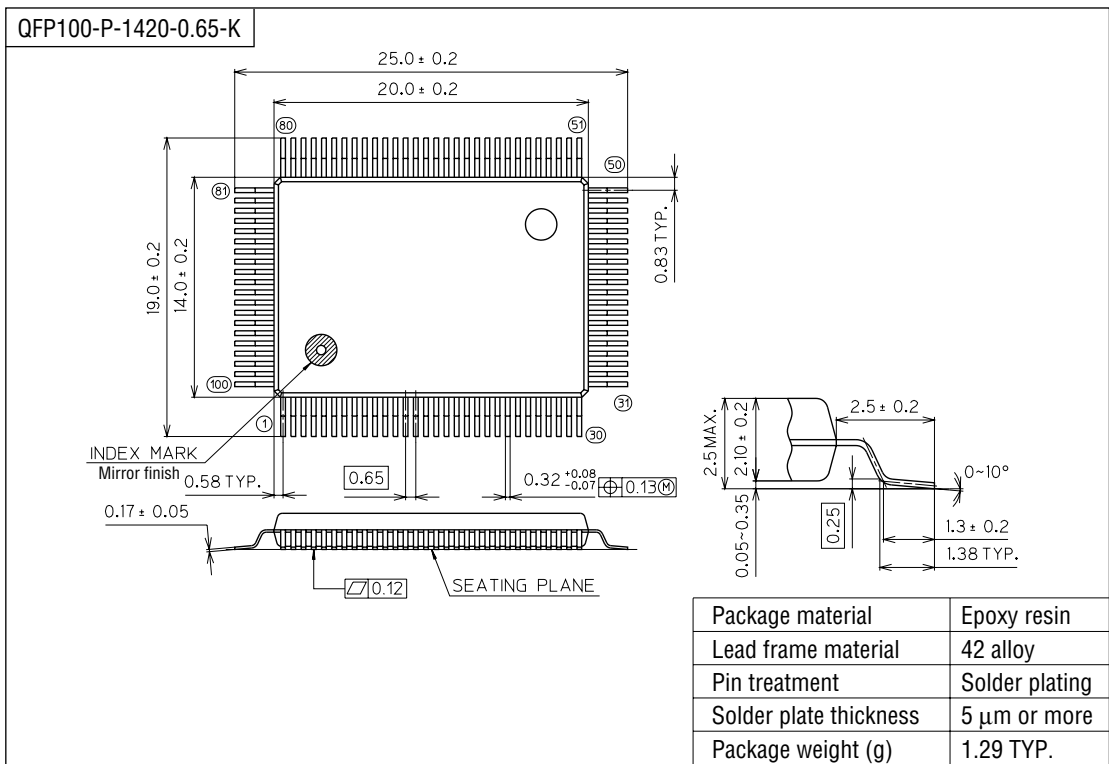
First V<sub>DD</sub> ON, next V<sub>EE</sub>, V<sub>4</sub>, V<sub>3</sub>, V<sub>1</sub> ON. Or both ON at the same time.

When turning power off:

First V<sub>EE</sub>, V<sub>4</sub>, V<sub>3</sub>, V<sub>1</sub> OFF, next V<sub>DD</sub> OFF. Or both OFF at the same time.

**PACKAGE DIMENSIONS**

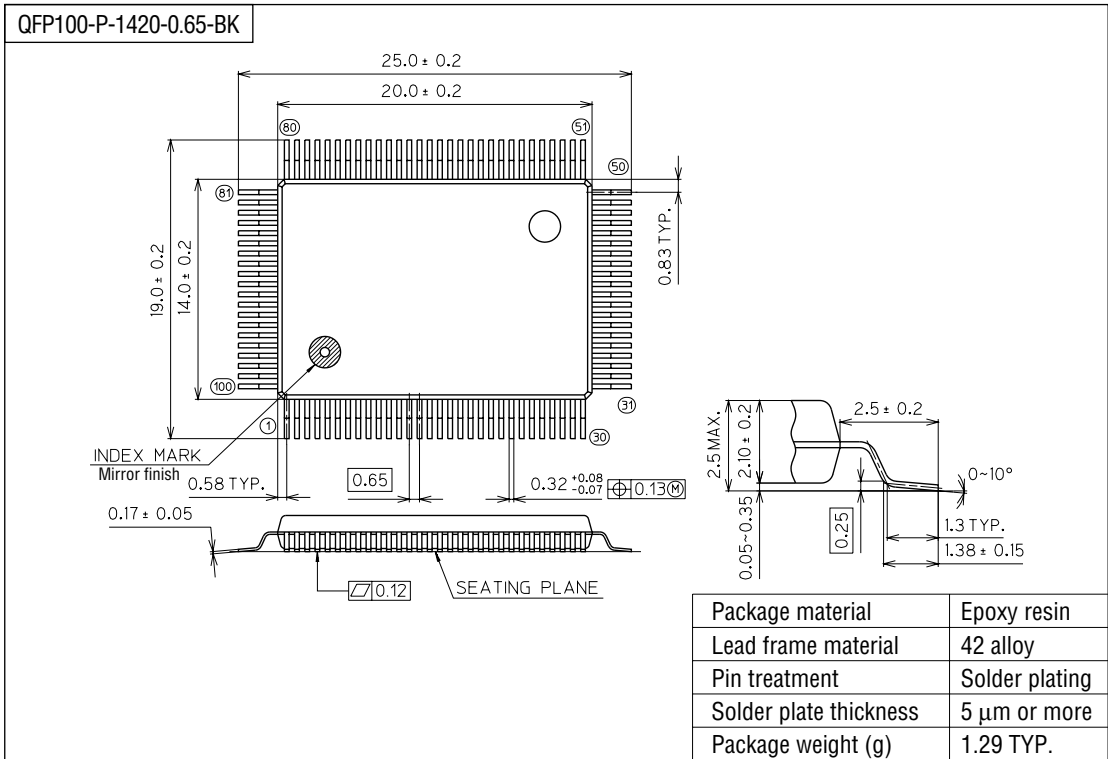
(Unit : mm)



**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)



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