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**MSM5299C**

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**80-DOT LCD SEGMENT DRIVER**

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**GENERAL DESCRIPTION**

The MSM5299C 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 4-bit parallel display data transferred from a microcomputer or an LCD controller LSI such as MSM6255, then outputs the LCD driving waveform to the LCD.

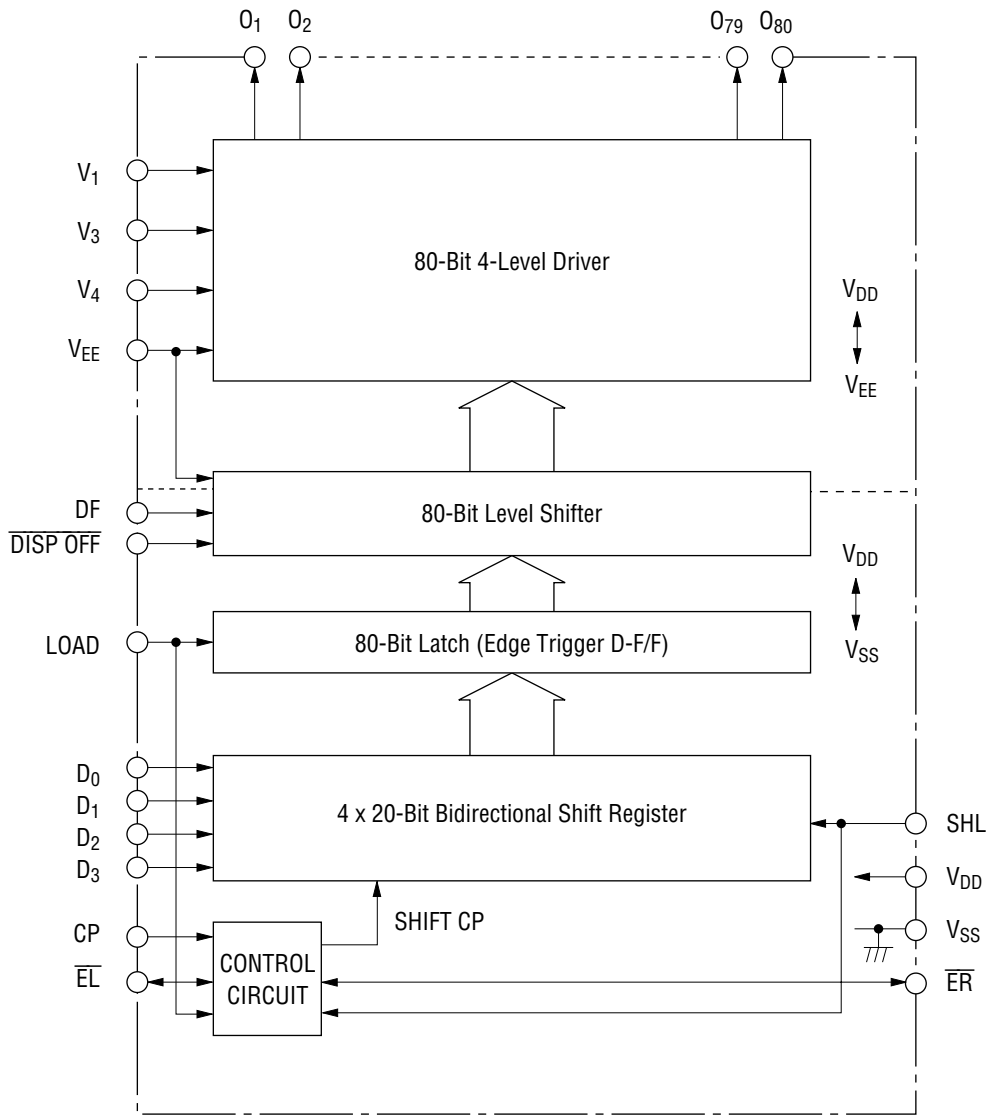
This LSI is improved with respect to timing between load and clock in the switching characteristics of MSM5299A. ( $t_{LC} = 200\text{ns} \rightarrow 63\text{ns}$ )

However, note that the timing regulations for the load signal leading edge are added.

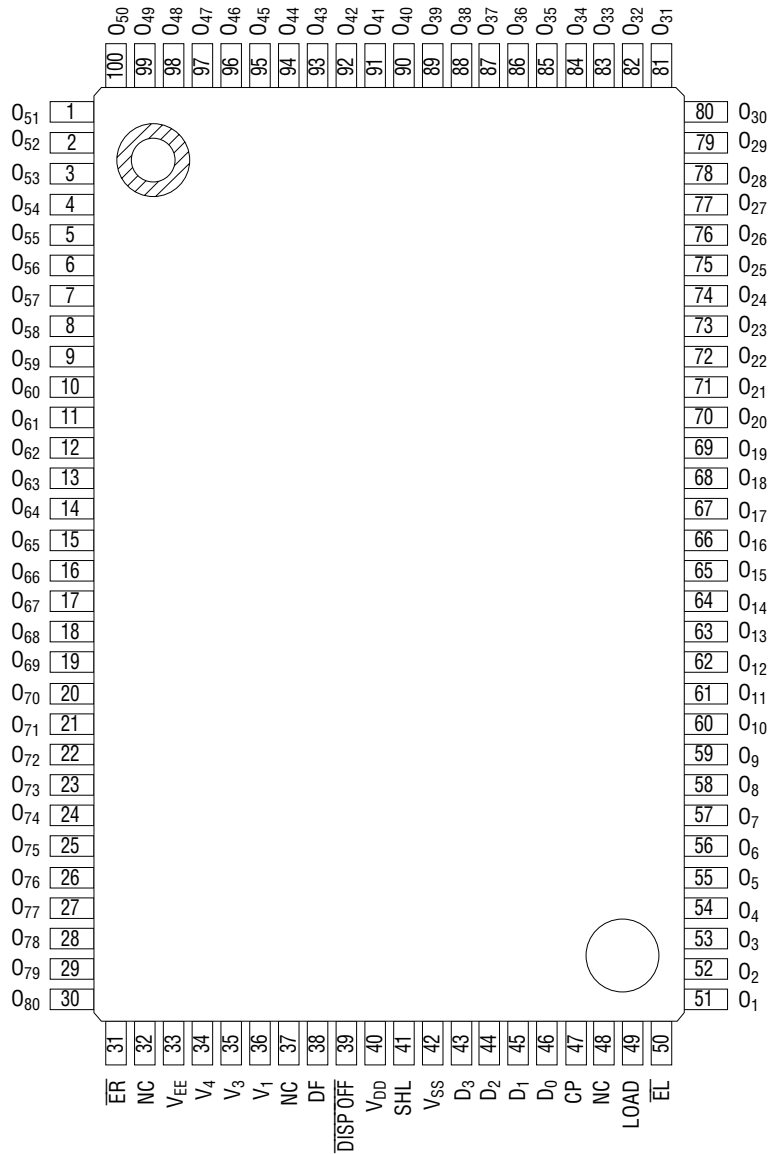
**FEATURES**

- Logic supply voltage : 4.5 to 5.5V
- LCD driving voltage : 8 to 28V
- Applicable LCD duty : 1/64 to 1/256
- LCD Output : 80
- 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 : MSM5299CGS-K)
  - 100-pin plastic QFP (QFP100-P-1420-0.65-BK) (Product name : MSM5299CGS-BK)

**BLOCK DIAGRAM**



**PIN CONFIGURATION (TOP VIEW)**



NC : No connection

**100-Pin Plastic QFP**

Note : The abbreviated part number "M5299C" 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> *1	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> *1	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> <sup>*1</sup>	—	0.8V <sub>DD</sub>	—	V <sub>DD</sub>	V
"L" Input Voltage	V <sub>IL</sub> <sup>*1</sup>	—	V <sub>SS</sub>	—	0.2V <sub>DD</sub>	V
"H" Input Current	I <sub>IH</sub> <sup>*1</sup>	V <sub>IH</sub> = V <sub>DD</sub> , V <sub>DD</sub> = 5.5V	—	—	1	μA
"L" Input Current	I <sub>IL</sub> <sup>*1</sup>	V <sub>IL</sub> = 0V, V <sub>DD</sub> = 5.5V	—	—	-1	μA
"H" Output Voltage	V <sub>OH</sub> <sup>*2</sup>	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> <sup>*2</sup>	I <sub>O</sub> = 0.2mA, V <sub>DD</sub> = 4.5V	—	—	0.4	V
ON Resistance	R <sub>ON</sub> <sup>*4</sup>	V <sub>DD</sub> - V <sub>EE</sub> = 23V  V <sub>N</sub> - V <sub>O</sub>   = 0.25V, V <sub>DD</sub> = 4.5V	—	—	4	kΩ
Stand-by Current	I <sub>DDBY</sub>	f <sub>CP</sub> = 1MHz, V <sub>DD</sub> = 5.5V V <sub>DD</sub> - V <sub>EE</sub> = 26V, no load	—	—	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	—	—	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	—	—	±100	μA
Input Capacitance	C <sub>I</sub>	f = 1MHz	—	5	—	pF

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

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

\*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>DD</sub> = V<sub>1</sub>

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

\*5 Display data 1010, f<sub>DF</sub> = 40 Hz, current that flows from V<sub>DD</sub> to V<sub>SS</sub> when the display data is not clocked in.

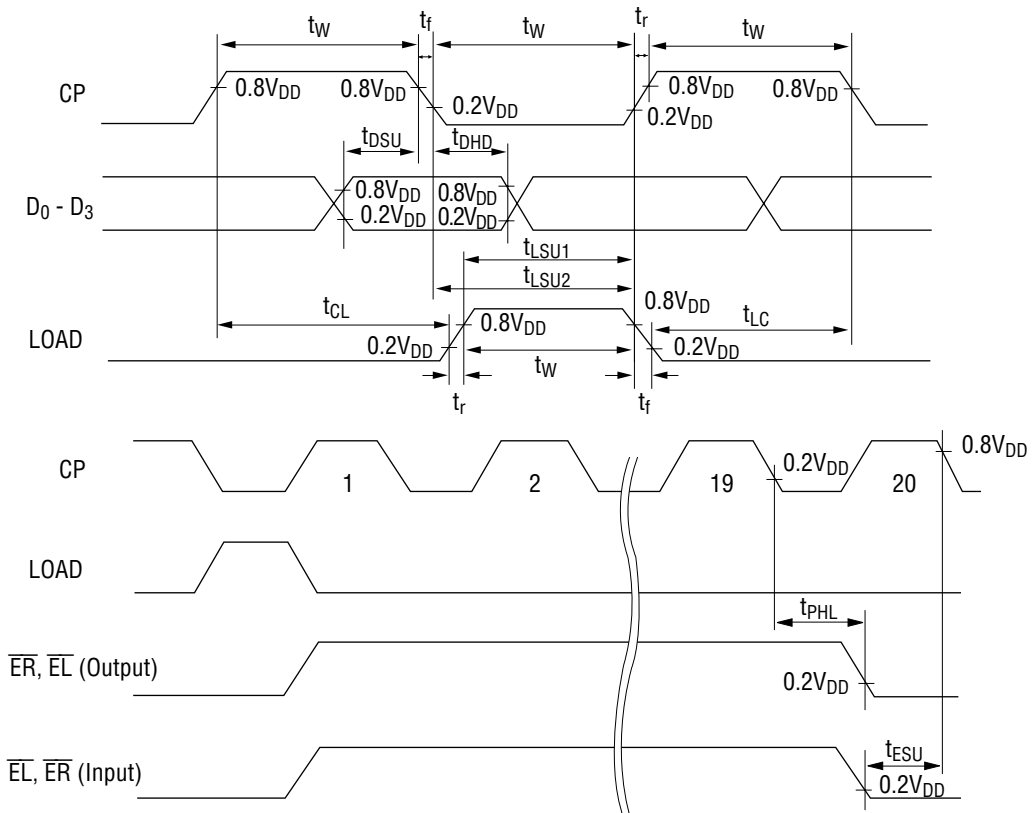
\*6 Display data 1010, f<sub>DF</sub> = 40 Hz, current that flows from V<sub>DD</sub> to V<sub>SS</sub> when the display data is clocked in.

\*7 Display data 1010, f<sub>DF</sub> = 40 Hz, current that flows to each of the V<sub>1</sub>, V<sub>3</sub> and V<sub>4</sub> pins.

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 Setup Time	$t_{DSU}$	—	50	—	—	ns
Data Hold Time	$t_{DHD}$	—	80	—	—	ns
Clock → Load Time	$t_{CL}$	—	63	—	—	ns
Load Setup Time	$t_{LSU1}$	—	90	—	—	ns
Load Setup Time	$t_{LSU2}$	—	90	—	—	ns
Load → Clock Time	$t_{LC}$	—	63	—	—	ns
Propagation Delay Time	$t_{PHL}$	—	—	—	224	ns
$\overline{ER}, \overline{EL}$ Setup 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 MSM5299C.
$\overline{EL}$	Output		Output pin of ENABLE F/F. $\overline{EL}$ is connected to next MSM5299C's $\overline{ER}$ when MSM5299Cs are connected in series (cascade connection).
$\overline{EL}$	Input	H	Input pin to ENABLE F/F of MSM5299C.
$\overline{ER}$	Output		Output pin of ENABLE F/F. $\overline{ER}$ is connected to next MSM5299C's $\overline{EL}$ when MSM5299Cs are connected in series (cascade connection).

When a single MSM5299C device is used,  $\overline{ER}$  ( $\overline{EL}$ ) should be set at "L" level.

When a cascade connection is required, set the first MSM5299C's  $\overline{ER}$  ( $\overline{EL}$ ) pin at "L" level and connect the next MSM5299C's  $\overline{EL}$  ( $\overline{ER}$ ) pin to the further next MSM5299C's  $\overline{ER}$  ( $\overline{EL}$ ) pin.

- **CP**

Clock pulse input pin for the 4-bit parallel shift register. The data is shifted to the 4-bit parallel shift register at the falling edge of the clock pulse.

- **SHL**

$\overline{ER}$  and  $\overline{EL}$  can be used as either an input pin or an output pin based on the H/L condition of SHL. The shift direction of each data ( $D_0$  to  $D_3$ ), the Input/Output condition of  $\overline{ER}$  and  $\overline{EL}$  and the H/L condition of SHL are described 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 these pins. The combinations of D<sub>0</sub> to D<sub>3</sub>, DF signal level, display data output level and the display on the LCD panel are described in the table below.

<b>D<sub>0</sub> - D<sub>3</sub></b>	<b>DF</b>	<b>Liquid crystal drive output</b>	<b>Liquid crystal display</b>
L	L	Non-select level (V <sub>3</sub> )	OFF
H	L	Select level (V <sub>1</sub> )	ON
L	H	Non-select 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**

Alternate signal input pin for LCD driving. Frame inversion signal is input to this pin.

- **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. Bias voltage to drive the LCD is supplied from an external source.



- **O<sub>1</sub> to 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 based on 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 for controlling the 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	Driver output level (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>

### 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 :

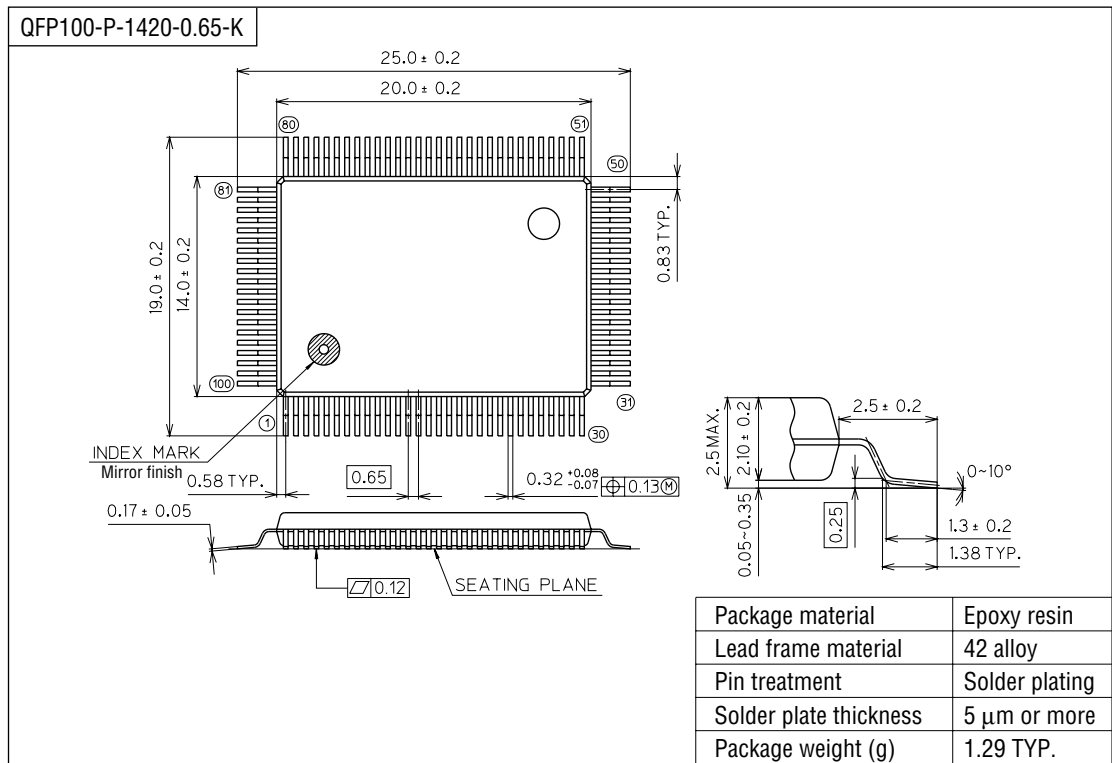
First V<sub>DD</sub> ON, next V<sub>EE</sub>, V<sub>4</sub>, V<sub>3</sub>, V<sub>1</sub> ON. Or both ON at the same time.

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

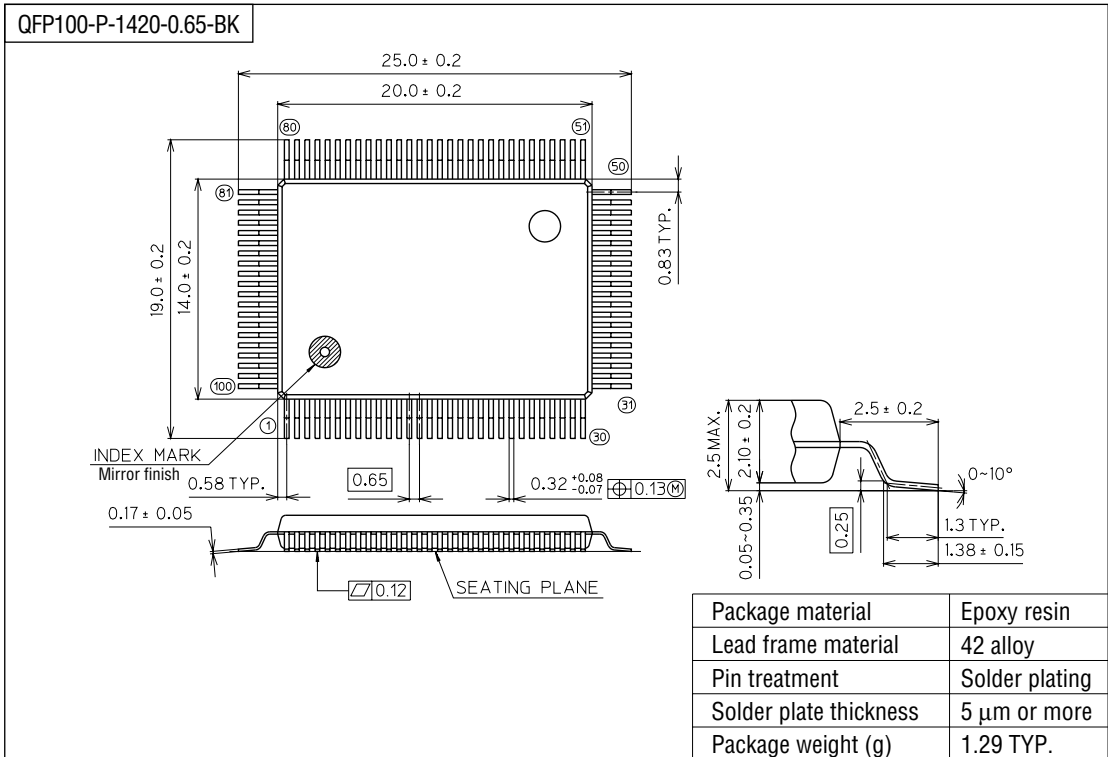
(Unit : mm)



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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