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LCD Segment Driver series

# Multifunction Segment Drivers


**BU97930MUV, BU97931FV, BU9798KV, BU9798GUW, BU97500KV**

No.10044EAT04

## ●Description

New released Multi-function type segment drivers support GPO function, LED driving function, static-driving mode, and Blink function that can blink each segment individually.

ROHM Multi-function segment driver series contribute to reduction in cost of system and easy software development.

## ●Features (BU97930MUV, BU97931FV, BU9798KV/GUW)

- 1) LCD drive output
  - Common output : 4, Segment output : 27 (BU97930MUV)
  - Common output : 4, Segment output : 28 (BU97931FV)
  - Common output : 4, Segment output : 49 (BU9798KV/GUW)
- 2) Integrated Display data RAM (DDRAM)
  - RAM: 28\*4 =112 bit (BU97930MUV, BU97931FV)
  - RAM: 49\*4 =196 bit (BU9798KV/GUW)
- 3) 3-wire Serial interface (SD, SCL, CSB)
- 4) Integrated Oscillator circuit
- 5) Integrated LCD Voltage generator circuit
  - Support: 1/3 Bias, 1/3 or 1/4 Duty
  - Support: 1/1 Bias, 1/1Duty (Static Driving)
  - Integrated buffer amp
  - Integrated regulator for LCD drive: 3.2, 3.3, 3.4, 4.4, 4.5, 4.6, 5.0V selectable (BU9798KV/GUW)
- 6) Support Split Supply for Logic (VDD) and LCD (VLCD)
- 7) Integrated LED driver circuit
- 8) Segment terminals operation, segment output mode/GPO output mode selectable
- 9) Segment terminals operation, segment output mode/LED output mode selectable (BU9798KV/GUW)
- 10) Support PWM source select, external clock or internal clock
  - Resolution 8bit mode/12bit mode selectable (BU9798KV/GUW)
  - Resolution 8bit mode (BU97930MUV, BU97931FV)
- 11) Low power consumption design
- 12) Support standby mode
- 13) Integrated Power-On-Reset circuit (POR).
- 14) No external component
- 15) Support Independent blink function
  - Blink frequency 1.6, 2.0, 2.6, 4.0Hz selectable
- 16) Operating power supply : 1.8 ~ 3.6V
- 17) LCD drive power supply : 2.7 ~ 5.5V (BU97930MUV, BU97931FV)
  - : 3.3 ~ 5.5V (BU9798KV/GUW)

### ●Features (BU97500KV)

- 1) LCD drive output:  
Common output : 4, Segment output : 51
- 2) Integrated Display data RAM (DDRAM)  
RAM: 51\*4 =204 bit
- 3) 3-wire Serial interface (SD, SCL, CSB )
- 4) Integrated Oscillator circuit
- 5) Integrated Power supply circuit for LCD driving:  
Support 1/2 and 1/3 Bias  
Support 1/3 and 1/4 Duty  
Integrated Buffer AMP
- 6) Support Split Supply for Logic (VDD) and LCD (VLCD)
- 7) Segment terminals operation, segment output mode/GPO output mode selectable
- 8) Low power consumption design
- 9) Support standby mode
- 10) Integrated Power-on Reset circuit
- 11) No external components
- 12) Operating power supply: VDD = 2.7 ~ 5.5V
- 13) LCD drive power supply: VLCD=4.5 ~ 5.5V

### ●Applications

Telephone, FAX, Portable equipment (POS, ECR, PDA etc.),  
DSC, DVC, Car Audio, Home electrical appliance, Meter equipment, Healthcare equipment etc.

### ●Line up matrix

Parameter	BU97930MUV	BU97931FV	BU9798KV/GUW	BU97500KV
Segment output	27	28	49	52 (1/3Duty) 51 (1/4Duty)
Common output	1 / 3 / 4	1 / 3 / 4	1 / 3 / 4	3 (1/3Duty) 4 (1/4Duty)
Total display dot number	108	112	196	156 (1/3Duty) 204 (1/4Duty)
Adjustable contrast function	-	-	YES	-
Support split voltage supply	YES	YES	YES	YES
Interface	3wireSPI	3wire SPI	3wire SPI	3wire SPI
Package	VQFN040V6060	SSOP-B40	VQFP64 / VBGA063W050	VQFP64

●Absolute maximum ratings (VSS = 0V)

Parameter	BU97930MUV	BU97931FV	BU9798KV /GUW	BU97500KV	Unit	Remarks
Power Supply Voltage1 (VDD)	-0.3 ~ +4.5			-0.5 ~ +7.0	V	Power supply
Power Supply Voltage 2 (VLCD)	-0.5 ~ +7.0				V	LCD drive Voltage
Allowable Loss (Pd)	0.8 <sup>*1</sup>		1.0 <sup>*2</sup> (KV) / 0.8 <sup>*3</sup> (GUW)	1.0 <sup>*2</sup>	W	
Input Voltage Range (VIN)	-0.5 ~ VDD+0.5				V	
Operational Temperature Range (Topr)	-40 ~ +85		-30 ~ +75	-40 ~ +85	°C	
Storage Temperature Range (Tstg)	-55 ~ +125				°C	
Output Current (Iout1)	5			-	mA	SEG output
Output Current (Iout2)	5			-	mA	COM output
Output Current (Iout3)	10			-	mA	GPO output
Output Current (Iout4)	50			-	mA	LED output

- \*1 When use more than Ta=25°C., subtract 8.0mW per degree. (using ROHM standard board) (board size: 74.2mm×74.2mm×1.6mm material: FR4 board copper foil: land pattern only)
- \*2 When use more than Ta=25°C., subtract 10mW per degree. (using ROHM standard board) (board size: 70mm×70mm×1.6mm material: FR4 board copper foil: land pattern only)
- \*3 When use more than Ta=25°C., subtract 8.0mW per degree. (using ROHM standard board) (board size: 114.3mm×76.2mm×1.6mm)

●Recommended operating conditions

(BU9798KV/GUW : Ta=-30 ~ 75°C, VSS = 0V)

(BU97930MUV, BU97931FV, BU97500KV : Ta=-40 ~ 85°C,VSS = 0V)

Parameter	BU97930MUV			BU97931FV			BU9798KV/GUW			BU97500KV <sup>*4</sup>			Unit	Remarks
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
Power Supply Voltage 1 (VDD)	1.8	-	3.6	1.8	-	3.6	1.8	-	3.6	2.7	-	5.5	V	Power supply
Power Supply Voltage 2 (VLCD)	2.7	-	5.5	2.7	-	5.5	3.3	-	5.5	4.5	-	5.5	V	Power supply for LCD
LED Supply Voltage (VLED)	-	-	-	-	-	-	1.0	-	VLCD	-	-	-	V	Power supply for LED
Output Current (Iout4)	-	-	20	-	-	20	-	-	20	-	-	-	mA	Per LED port 1ch
Output Current (Iout4)	-	-	-	-	-	-	-	-	60	-	-	-	mA	Total LED port current

- \*4 The power supply condition shall be met VLCD ≥ VDD.
- This product is not designed against radioactive ray

## ● Electrical Characteristics

&lt;BU97930MUV&gt;

DC characteristics (Ta=-40 ~ 85 °C, VDD=1.8V ~ 3.6V, VLCD=2.7V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
"H" level input voltage	VIH	0.8VDD	-	VDD	V	SD, SCL, CSB, CLKIN, INHb
"L" level input voltage	VIL	VSS	-	0.2VDD	V	SD, SCL, CSB, CLKIN, INHb
Hysteresis width	VH	-	0.2	-	V	SCL, INHb, VDD=3.3V, Ta=25°C
"H" level input current	I <sub>IH1</sub>	-	-	5	μA	SD, SCL, CSB, CLKIN, INHb, VI=3.6V
"L" level input current	I <sub>IL1</sub>	-5	-	-	μA	SD, SCL, CSB, CLKIN, INHb, VI=0V
"H" level output voltage (*2)	VOH1	VLCD -0.4	-	-	V	I <sub>load</sub> =-50μA, VLCD=5.0V SEG0 ~ SEG26
	VOH2	VLCD -0.4	-	-	V	I <sub>load</sub> =-50μA, VLCD=5.0V, COM0 ~ COM3
	VOH3	VLCD -0.6	-	-	V	I <sub>load</sub> =-1mA, VLCD=5.0V, SEG23 ~ SEG26(GPO mode)
"L" level output voltage (*2)	VOL1	-	-	0.4	V	I <sub>load</sub> = 50μA, VLCD=5.0V, SEG0 ~ SEG26
	VOL2	-	-	0.4	V	I <sub>load</sub> = 50μA, VLCD=5.0V, COM0 ~ COM3
	VOL3	-	-	0.5	V	I <sub>load</sub> =1mA, VLCD=5.0V, SEG23 ~ SEG26(GPO mode)
	VOL4	-	0.34	0.5	V	I <sub>load</sub> =20mA, VLCD=5.0V, LED
Current consumption (*1)	I <sub>st</sub> VDD	-	3	10	μA	Input terminal ALL'L', Display off, Oscillation off
	I <sub>st</sub> VLCD	-	0.5	5	μA	Input terminal ALL'L', Display off, Oscillation off
	I <sub>VDD1</sub>	-	8	15	μA	VDD=3.3V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, PWM generate off, All output pin open
	I <sub>VDD2</sub>	-	30	45	μA	VDD=3.3V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, PWM Frequency=500Hz setting, All output pin open
	I <sub>VLCD1</sub>	-	10	15	μA	VDD=5.0V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, LED generate off, All output pin open
	I <sub>VLCD2</sub>	-	30	48	μA	VDD=5.0V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, PWM Frequency=500Hz setting, All output pin open

\*1 Power save mode 1 and frame inversion setting

\*2 I<sub>load</sub>: In case, load current from only one port

Oscillation Frequency Characteristics (Ta=-40 ~ 85 °C, VDD=1.8V ~ 3.6V, VLCD=2.7V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	MIN	MIN		
Frame frequency 1	fFR1	57.6	64	70.4	Hz	VDD=3.3V, Ta=25°C, fFR=64Hz setting
Frame frequency 2	fFR2	51.2	64	73.0	Hz	VDD=2.5 ~ 3.6V FR=64Hz setting
Frame frequency 3	fFR3	45.0	-	64	Hz	VDD=1.8 ~ 2.5V fFR=64Hz setting

MPU interface Characteristics (Ta=-40 ~ 85 °C, VDD=1.8V ~ 3.6V, VLCD=2.7V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Input rise time	tr	-	-	50	ns	
Input fall time	tf	-	-	50	ns	
SCL cycle time	tSCYC	250	-	-	ns	
"H" SCL pulse width	tSHW	50	-	-	ns	
"L" SCL pulse width	tSLW	50	-	-	ns	
SD setup time	tSDS	50	-	-	ns	
SD hold time	tSDH	50	-	-	ns	
CSB setup time	tCSS	50	-	-	ns	
CSB hold time	tCSH	50	-	-	ns	
"H" CSB pulse width	tCHW	50	-	-	ns	

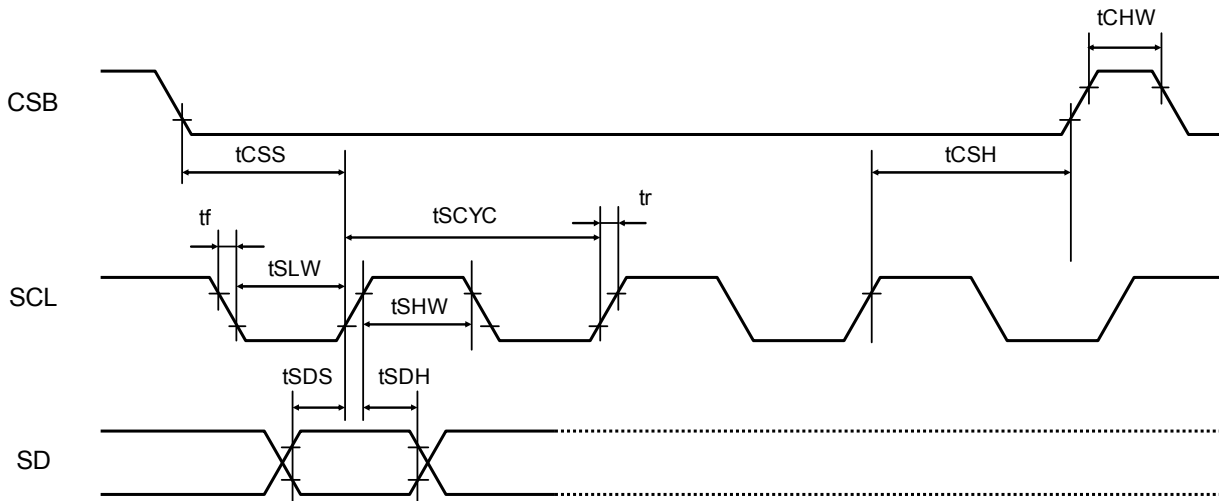


Fig.1 Serial Interface Timing

&lt;BU97931FV&gt;

DC characteristics (Ta=-40 ~ 85 °C, VDD=1.8V ~ 3.6V, VLCD=3.3V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
"H" level input voltage	VIH	0.8VDD	-	VDD	V	SD, SCL, CSB, CLKIN
"L" level input voltage	VIL	VSS	-	0.2VDD	V	SD, SCL, CSB, CLKIN
Hysteresis width	VH	-	0.2	-	V	SCL, VDD=3.3V, Ta=25°C
"H" level input current	I <sub>IH1</sub>	-	-	5	μA	SD, SCL, CSB, CLKIN, VI=3.6V
"L" level input current	I <sub>IL1</sub>	-5	-	-	μA	SD, SCL, CSB, CLKIN, VI=0V
"H" level output voltage <sup>(*2)</sup>	VOH1	VLCD -0.4	-	-	V	Iload=-50μA, VLCD=5.0V SEG0 ~ SEG27
	VOH2	VLCD -0.4	-	-	V	Iload=-50μA, VLCD=5.0V, COM0 ~ COM3
	VOH3	VLCD -0.6	-	-	V	Iload=-1mA, VLCD=5.0V, SEG23 ~ SEG27(GPO mode)
"L" level output voltage <sup>(*2)</sup>	VOL1	-	-	0.4	V	Iload= 50μA, VLCD=5.0V, SEG0 ~ SEG27
	VOL2	-	-	0.4	V	Iload= 50μA, VLCD=5.0V, COM0 ~ COM3
	VOL3	-	-	0.5	V	Iload=1mA, VLCD=5.0V, SEG23 ~ SEG27(GPO mode)
	VOL4	-	0.34	0.5	V	Iload=20mA, VLCD=5.0V, LED
Current consumption <sup>(*1)</sup>	I <sub>stVDD</sub>	-	3	10	μA	Input terminal ALL'L', Display off, Oscillation off
	I <sub>stVLCD</sub>	-	0.5	5	μA	Input terminal ALL'L', Display off, Oscillation off
	I <sub>VDD1</sub>	-	8	15	μA	VDD=3.3V, Ta=25°C, 1/3bias, fFR=64Hz, PWM generate off, All output pin open
	I <sub>VDD2</sub>	-	30	45	μA	VDD=3.3V, Ta=25°C, 1/3bias, fFR=64Hz, PWM Frequency=500Hz setting, All output pin open
	I <sub>VLCD1</sub>	-	10	15	μA	VLCD=5.0V, Ta=25°C, 1/3bias, fFR=64Hz, LED generate off, All output pin open
	I <sub>VLCD2</sub>	-	30	48	μA	VLCD=5.0V, Ta=25°C, 1/3bias, fFR=64Hz, PWM Frequency=500Hz setting, All output pin open

\*1 Power save mode 1 and frame inversion setting

\*2 Iload: In case, load current from only one port

Oscillation Frequency Characteristics (Ta=-40 ~ 85°C, VDD=1.8V ~ 3.6V, VLCD=2.7V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	MIN	MIN		
Frame frequency 1	fFR1	57.6	64	70.4	Hz	VDD=3.3V, Ta=25°C, fFR=64Hz setting
Frame frequency 2	fFR2	51.2	64	73.0	Hz	VDD=2.5 ~ 3.6V fFR=64Hz setting
Frame frequency 3	fFR3	45.0	-	64	Hz	VDD=1.8 ~ 2.5V fFR=64Hz setting

MPU interface Characteristics (Ta=-40 ~ 85°C, VDD=1.8V ~ 3.6V, VLCD=2.7V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Input rise time	tr	-	-	50	ns	
Input fall time	tf	-	-	50	ns	
SCL cycle time	tSCYC	250	-	-	ns	
“H” SCL pulse width	tSHW	50	-	-	ns	
“L” SCL pulse width	tSLW	50	-	-	ns	
SD setup time	tSDS	50	-	-	ns	
SD hold time	tSDH	50	-	-	ns	
CSB setup time	tCSS	50	-	-	ns	
CSB hold time	tCSH	50	-	-	ns	
“H” CSB pulse width	tCHW	50	-	-	ns	

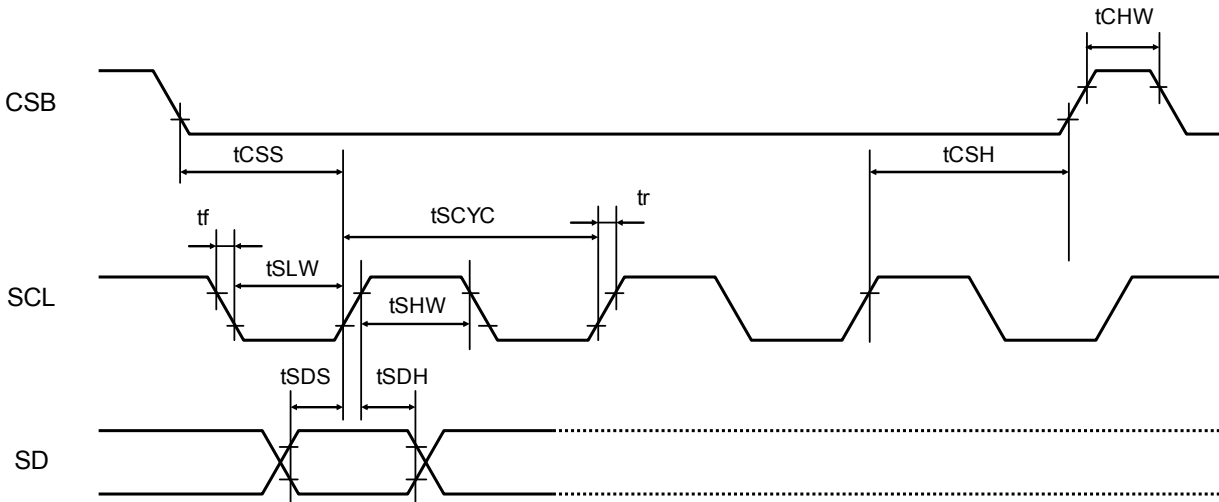


Fig.2 Serial Interface Timing



&lt;BU9798KV/GUW&gt;

DC characteristics (Ta=-30 ~ 75°C, VDD=1.8V ~ 3.6V, VLCD=3.3V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
"H" level input voltage	VIH	0.8VDD	-	VDD	V	SD, SCL, CSB, TEST1,CLKIN, INHb
"L" level input voltage	VIL	VSS	-	0.2VDD	V	SD, SCL, CSB, TEST1,CLKIN, INHb
Hysteresis width	VH	-	0.2	-	V	SCL, INHb, VDD=3.3V, Ta=25°C
"H" level input current	I <sub>IH1</sub>	-	-	5	μA	SD, SCL, CSB, CLKIN, INHb, VI=3.6V
"L" level input current	I <sub>IL1</sub>	-5	-	-	μA	SD, SCL, CSB, CLKIN, INHb, TEST1 VI=0V
"H" level output voltage (*1, *3)	VOH1	VLCD -0.4	-	-	V	I <sub>load</sub> =-50μA, VLCD=5.0V SEG0 ~ SEG48, Unused integrated regulator
	VOH2	VLCD -0.4	-	-	V	I <sub>load</sub> =-50μA, VLCD=5.0V, COM0 ~ COM3, Unused integrated regulator
	VOH3	VLCD -0.6	-	-	V	I <sub>load</sub> =-1mA,VLCD=5.0V, SEG15 ~ SEG45(GPO mode) Unused integrated regulator
	VOH4	VDD -0.6	-	-	V	I <sub>load</sub> =-1mA, VDD=3.0V, PWMOUT
"L" level output voltage (*3)	VOL1	-	-	0.4	V	I <sub>load</sub> =50μA, VLCD=5.0V, SEG0 ~ SEG48
	VOL2	-	-	0.4	V	I <sub>load</sub> =50μA, VLCD=5.0V, COM0 ~ COM3
	VOL3	-	-	0.5	V	I <sub>load</sub> =1mA, VLCD=5.0V, SEG15 ~ SEG45(GPO mode), PWMOUT
	VOL4	-	0.11	0.5	V	I <sub>load</sub> =20mA, VLCD=5.0V, SEG46 ~ 48 (LED drive mode)
Current consumption (*2)	I <sub>stVDD</sub>	-	3	10	μA	Input terminal ALL'L', Display off, Oscillation off
	I <sub>stVLCD</sub>	-	0.5	5	μA	Input terminal ALL'L', Display off, Oscillation off
	I <sub>VDD1</sub>	-	8	15	μA	VDD=3.3V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, PWM generate off, All output pin open
	I <sub>VDD2</sub>	-	90	130	μA	VDD=3.3V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, PWM Frequency=500Hz setting, All output pin open
	I <sub>VLCD1</sub>	-	10	15	μA	VLCD=5.0V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz Unused Integrated regulator, LED generate off, All output pin open
	I <sub>VLCD2</sub>	-	25	40	μA	VLCD=5.0V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz Used Integrated regulator, LED generate off, All output pin open
	I <sub>VLCD3</sub>	-	30	48	μA	VLCD=5.0V, Ta=25°C, 1/3bias, f <sub>FR</sub> =64Hz, Used Integrated regulator, PWM Frequency=500Hz setting, All output pin open

\*1 Integrated regulator using case, please add load regulation value to output voltage listed above.

\*2 Power save mode 1 and frame inversion setting

\*3 I<sub>load</sub>: In case, load current from only one port

Integrated Regulator Characteristics (Ta=-30 ~ 75°C, VDD=1.8V ~ 3.6V, VLCD=3.3V ~ 5.5V, VSS=0)  
(BU9798KV)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Output voltage 1	Vreg1	4.35	4.5	4.65	V	4.5V setting (VLCD=5.5V, Ta=-30 ~ 75°C)
Output voltage 2	Vreg2	4.42	4.5	4.58	V	4.5V setting (VLCD=5.5V, Ta=25°C)
Load regulation (**)	delta Vreg	-	-	0.3	V	Iout = -300µA

(BU9798GUW)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Output voltage 1	Vreg1	4.25	4.5	4.70	V	4.5V setting (VLCD=5.5V, Ta=-30 ~ 75°C)
Output voltage 2	Vreg2	4.38	4.5	4.62	V	4.5V setting (VLCD=5.5V, Ta=25°C)
Load regulation (**)	delta Vreg	-	-	0.3	V	Iout = -300µA

\* In case integrated regulator using, please satisfy condition that Vreg output lower than VLCD - 0.5V.

(\*\*) Load regulation: Vreg block load regulation only. Do not include other block ability.

Oscillation Frequency Characteristics (Ta=-30 ~ 75°C, VDD=1.8V ~ 3.6V, VLCD=3.3V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Frame frequency 1	fFR1	57.6	64	70.4	Hz	VDD=3.3V, Ta=25°C, fFR=64Hz setting
Frame frequency 2	fFR2	51.2	64	73.0	Hz	VDD=2.5 ~ 3.6V fFR=64Hz setting
Frame frequency 3	fFR3	45.0	-	64	Hz	VDD=1.8 ~ 2.5V fFR=64Hz setting
CLKIN Input frequency	fCLK	-	2	4	MHz	

MPU interface Characteristics (Ta=-30 ~ 75°C, VDD=1.8V ~ 3.6V, VLCD=3.3V ~ 5.5V, VSS=0)

Parameter	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Input rise time	tr	-	-	50	ns	
Input fall time	tf	-	-	50	ns	
SCL cycle time	tSCYC	250	-	-	ns	
“H” SCL pulse width	tSHW	50	-	-	ns	
“L” SCL pulse width	tSLW	50	-	-	ns	
SD setup time	tSDS	50	-	-	ns	
SD hold time	tSDH	50	-	-	ns	
CSB setup time	tCSS	50	-	-	ns	
CSB hold time	tCSH	50	-	-	ns	
“H” CSB pulse width	tCHW	50	-	-	ns	

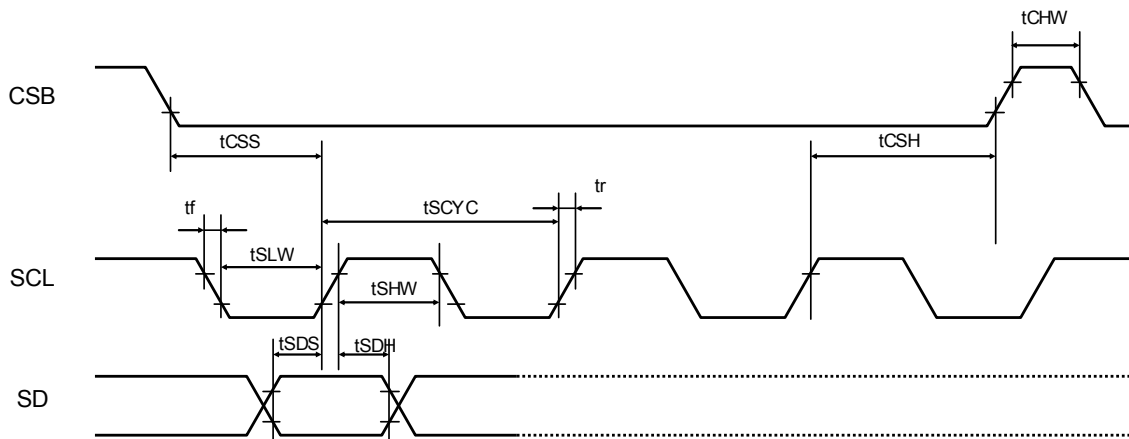


Fig.3 Serial Interface Timing

&lt;BU97500KV&gt;

DC Characteristics (Unless otherwise indicated, VDD=2.7 ~ 5.5V, VLCD=4.5 ~ 5.5V, VSS=0V, Ta=-40 ~ 85°C)

Parameters	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
"H" Input Voltage	VIH	0.7VDD	-	VDD	V	SD, SCL, CSB, RESB, OSC
"L" Input Voltage	VIL	VSS	-	0.3VDD	V	SD, SCL, CSB, RESB, OSC
"H" Input Current	IIH			5.0	μA	SD,SCL,CSB,RESB, OSC VI=5.5V
"L" Input Current	IIL	-5.0			μA	SD,SCL,CSB,RESB, OSC VI=0V
"H" Level Output Voltage	VOH1	VLCD -1.0			V	P1 ~ P4, Io=1mA
	VOH2	VLCD -1.0				S1 ~ S52, Io=20μA
	VOH3	VLCD -1.0				COM1 ~ COM4, Io=100μA
"L" Level Output Voltage	VOL1	-	-	1.0	V	P1 ~ P4, Io=1mA
	VOL2	-	-	1.0		S1 ~ S52, Io=20μA
	VOL3	-	-	1.0		COM1 ~ COM4, Io=100μA
LCD Bias Voltage	VMID1	1/2VLCD -1.0	-	1/2VLCD +1.0	V	S1 ~ S52 1/2 Bias, Io=±100μA
	VMID2	1/2VLCD -1.0	-	1/2VLCD +1.0		COM1 ~ COM4 1/2 Bias, Io=±100μA
	VMID3	2/3VLCD -1.0	-	2/3VLCD +1.0		S1 ~ S52 1/3 Bias, Io=±20μA
	VMID4	1/3VLCD -1.0	-	1/3VLCD +1.0		S1 ~ S52 1/3 Bias, Io=±20μA
	VMID5	2/3VLCD -1.0	-	2/3VLCD +1.0		COM1 ~ COM4 1/3Bias, Io=±100μA
	VMID6	1/3VLCD -1.0	-	1/3VLCD +1.0		COM1 ~ COM4 1/3 Bias, Io=±100μA
Current consumption	IstVDD	-	1	5	μA	Input Pin ALL "L" Display off, Disable oscillator
	IstVLCD	-	1	5		Input Pin ALL "L" Display off, Disable oscillator
	ILCD1	-	2	10		VDD=VLCD=5.0V Output unloaded fFR=80Hz
	ILCD2	-	40	95		VDD=VLCD=5.0V Output unloaded 1/2 Bias, fFR=80Hz
	ILCD3	-	65	140		VDD=VLCD=5.0V Output unloaded 1/3 Bias, fFR=80Hz

Oscillation Characteristics (Ta=-40 ~ 85°C, VDD=2.7 ~ 5.5V, VLCD=4.5 ~ 5.5V, VSS=0V)

Parameters	Symbol	Limits			Unit	Conditions
		MIN	TYP	MAX		
Frame Frequency	fCLK	56	80	104	Hz	fFR = 80Hz setting, 1/4 Duty setting

MPU interface Characteristics (Ta=-40 ~ 85°C, VDD=2.7V ~ 5.5V, VLCD=4.5 ~ 5.5V, VSS=0V)

Parameters	Symbol	Limits			Unit	Conditions
		MIN.	TYP.	MAX.		
Input Rise Time	tr	-	-	80	ns	
Input Fall Time	tf	-	-	80	ns	
SCL Cycle Time	tSCYC	400	-	-	ns	
"H" SCL Pulse Width	tSHW	100	-	-	ns	
"L" SCL Pulse Width	tSLW	100	-	-	ns	
SD Setup Time	tSDS	20	-	-	ns	
SD Hold Time	tSDH	20	-	-	ns	
CSB Setup Time	tCSS	50	-	-	ns	
CSB Hold Time	tCSH	50	-	-	ns	
"H" CSB Pulse Time	tCHW	50	-	-	ns	

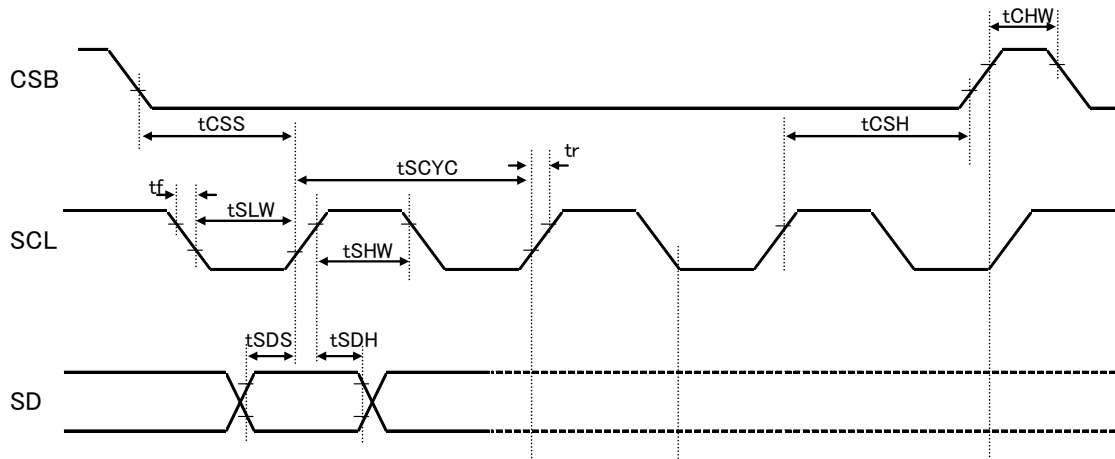


Fig.4 Serial interface Timing

●Block diagrams / Pin arrangement / Terminal description

<BU97930MUV>

●Block diagrams

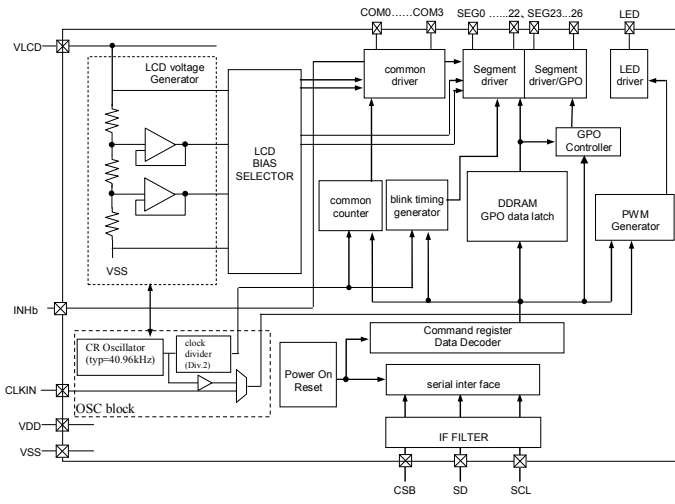


Fig.5 Block Diagram (BU97930MUV)

●Pin arrangement

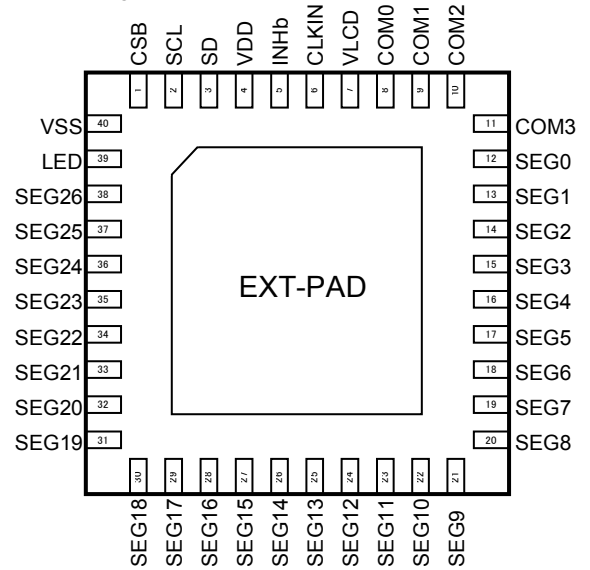


Fig.6 Pin Arrangement (BU97930MUV)

●Terminal description

Terminal	Terminal number	I/O	unused case	Function
CSB	1	I	VDD	Chip select: "L" active
SCL	2	I	VSS	Serial data transfer clock
SD	3	I	VSS	Input serial data
VDD	4	-	-	Power supply for LOGIC
CLKIN	6	I	OPEN / VSS	External clock input terminal (for display/PWM using selectable) Support Hi-Z input mode at internal clock mode
VSS	40	-	-	GND
VLCD	7	-	-	Power supply for LCD
INHb	5	I	VDD	Display turning on/off select terminal H: turning on display, L: turning off display  INHb = "L": All SEG/COM terminal : output VSS level GPO terminal : output VSS level LED drive terminal : output Hi-Z
COM0 ~ 3	8-11	O	OPEN	COMMON output for LCD
SEG0 ~ 22	12-34	O	OPEN	SEGMENT output for LCD
SEG23 ~ 26	35-38	O	OPEN	SEGMENT output for LCD/GPO
LED	39	O	OPEN	LED driver output
EXT-PAD	-	-	VSS	substrate

<BU97931FV>

●Block diagrams

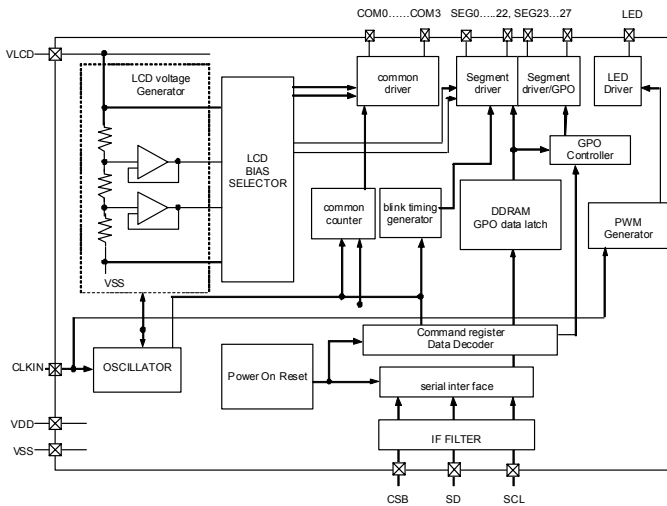


Fig.7 Block Diagram (BU97931FV)

●Pin arrangement

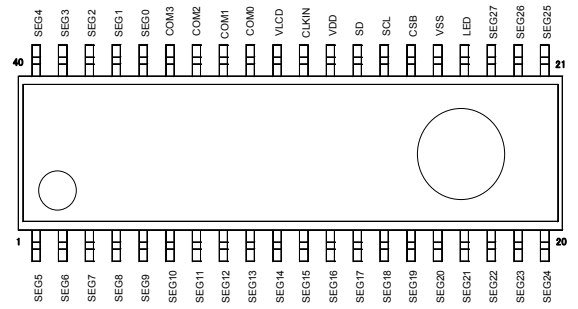


Fig.8 Pin Arrangement (BU97931FV)

●Terminal description

Terminal	Terminal number	I/O	unused case	Function
CSB	26	I	VDD	Chip select: "L" active
SCL	27	I	VSS	Serial data transfer clock
SD	28	I	VSS	Input serial data
VDD	29	-	-	Power supply for LOGIC
CLKIN	30	I	OPEN / VSS	External clock input terminal (for display/PWM using selectable) Support Hi-Z input mode at internal clock mode
VSS	25	-	-	GND
VLCD	31	-	-	Power supply for LCD
COM0 ~ 3	32-35	O	OPEN	COMMON output for LCD
SEG0 ~ 22	36-40 1-18	O	OPEN	SEGMENT output for LCD
SEG23 ~ 27	19-23	O	OPEN	SEGMENT output for LCD/GPO
LED	24	O	OPEN	LED driver output

<BU9798KV>

●Block diagrams

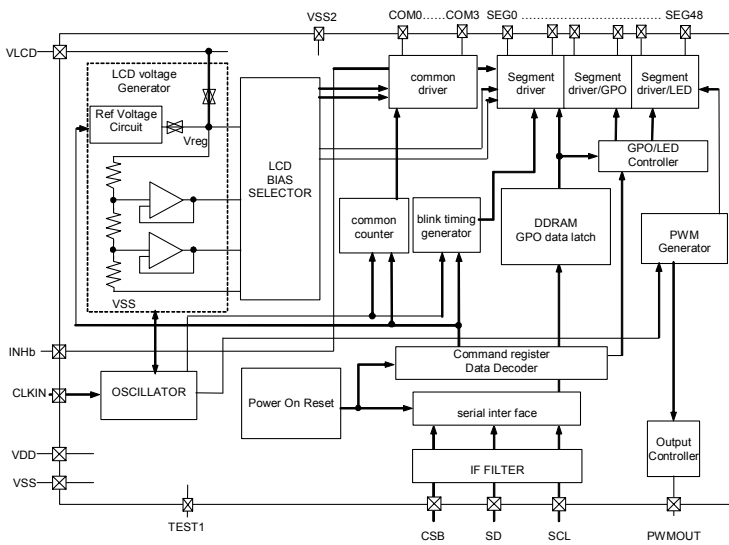


Fig.9 Block Diagram (BU9798KV)

●Pin arrangement

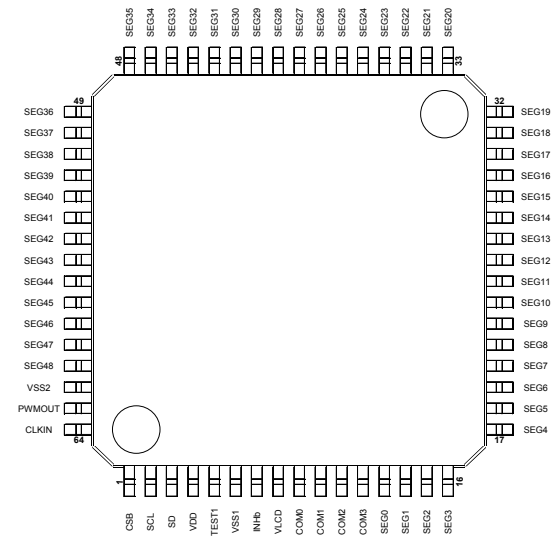


Fig.10 Pin Arrangement (BU9798KV)

●Terminal description

Terminal	Terminal number	I/O	unused case	Function
CSB	1	I	VDD	Chip select: "L" active
SCL	2	I	VSS	Serial data transfer clock
SD	3	I	VSS	Input serial data
VDD	4	-	-	Power supply for LOGIC
CLKIN	64	I	OPEN / VSS	External clock input terminal (for display/PWM using selectable) Support Hi-Z input mode at internal clock mode
TEST1	5	I	-	TEST terminal (Please connect VSS terminal)
VSS1	6	-	-	GND
VLCD	8	-	-	Power supply for LCD
INHb	7	I	VDD	Display turning on/off select terminal H: turning on display, L: turning off display INHb = "L": All SEG/COM terminal : output VSS level GPO terminal : output VSS level LED drive terminal : output Hi-Z
PWMOUT	63	O	OPEN	PWM output for LED2 group
COM0 ~ 3	9-12	O	OPEN	COMMON output for LCD
SEG0 ~ 14	13-27	O	OPEN	SEGMENT output for LCD
SEG15 ~ 45	28-58	O	OPEN	SEGMENT output for LCD/GPO
SEG46 ~ 48	59-61	O	OPEN	SEGMENT output for LCD/LED driver
VSS2	62	-	GND	GND (for SEG46-48 / LED driver)

<BU9798GUW>  
 ●Block diagrams

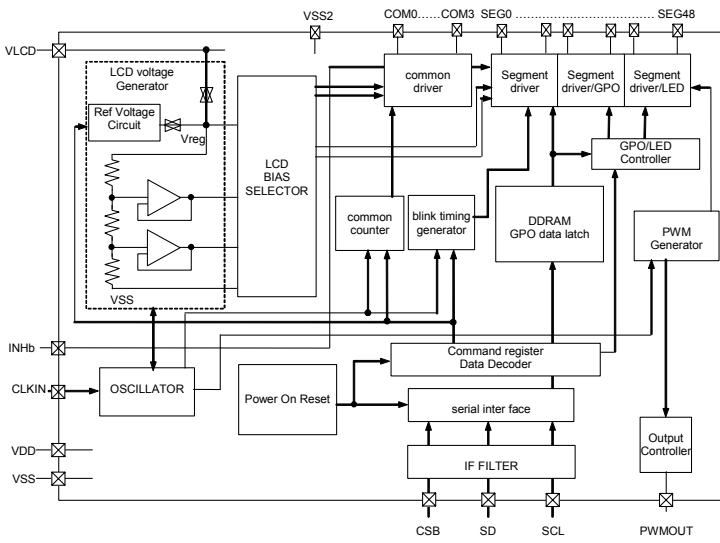


Fig.11 Block Diagram (BU9798GUW)

●Pin arrangement

	1	2	3	4	5	6	7	8
H	SEG 4	SEG 5	SEG 9	SEG 11	SEG 14	SEG 16	SEG 18	SEG 20
G	SEG 2	SEG 3	SEG 7	SEG 8	SEG 12	SEG 17	SEG 19	SEG 21
F	SEG 0	SEG 1	SEG 6	SEG 10	SEG 13	SEG 22	SEG 23	SEG 25
E	COM 2	COM 0	COM 1	COM 3	SEG 15	SEG 26	SEG 24	SEG 27
D	VLCD	VDD	INHb	SEG 47	SEG 31	SEG 29	SEG 28	SEG 30
C	VSS1	SDA	SCL	SEG 45	SEG 42	SEG 38	SEG 33	SEG 32
B	(NC)	CLK IN	VSS2	SEG 44	SEG 40	SEG 39	SEG 35	SEG 34
A	CSB	PWM OUT	SEG 48	SEG 46	SEG 43	SEG 41	SEG 37	SEG 36

Fig.12 Pin Arrangement (BU9798GUW)

●Terminal description

Terminal	I/O	Unused case	Function
CSB	I	VDD	Chip select: "L" active
SCL	I	VSS	Serial data transfer clock
SD	I	VSS	Input serial data
VDD	-	-	Power supply for LOGIC
CLKIN	I	OPEN / VSS	External clock input terminal (for display/PWM using selectable) Support Hi-Z input mode at internal clock mode
VSS1	-	-	GND
VLCD	-	-	Power supply for LCD
INHb	I	VDD	Display turning on/off select terminal H: turning on display, L: turning off display INHb = "L": All SEG/COM terminal : output VSS level GPO terminal : output VSS level LED drive terminal : output Hi-Z
PWMOUT	O	OPEN	PWM output for LED2 group
COM0 ~ 3	O	OPEN	COMMON output for LCD
SEG0 ~ 14	O	OPEN	SEGMENT output for LCD
SEG15 ~ 45	O	OPEN	SEGMENT output for LCD/GPO
SEG46 ~ 48	O	OPEN	SEGMENT output for LCD/LED driver
VSS2	-	GND	GND (for SEG46-48 / LED driver)



<BU97500KV>

●Block diagrams

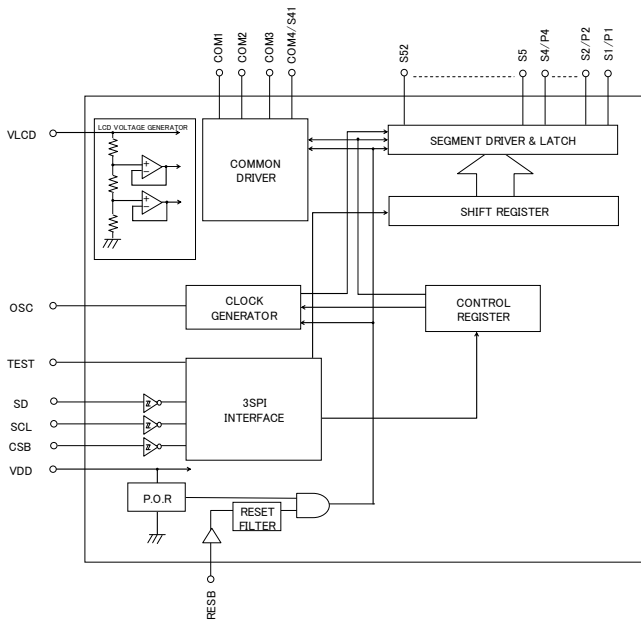


Fig.13 Block Diagram (BU97500KV)

●Pin arrangement

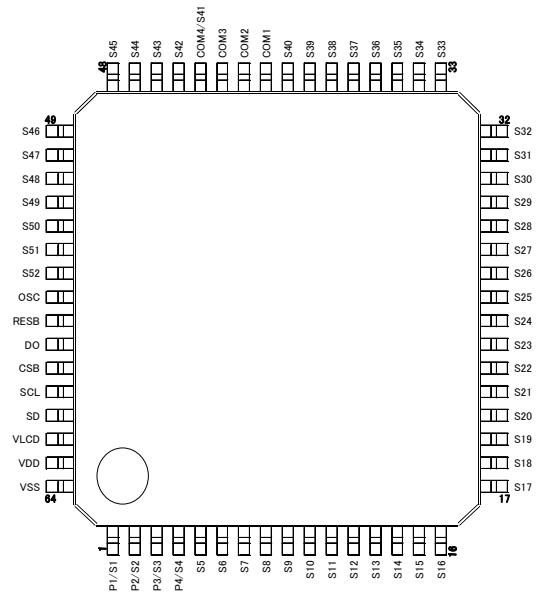


Fig.14 Pin Arrangement (BU97500KV)

●Terminal description

Terminal	Terminal No.	I/O	Unused case	Function
CSB	59	I	VDD	Chip select : "L" active
SCL	60	I	VSS	Serial data transfer clock
SD	61	I	VSS	Input Serial data
VDD	63	-	-	Power Supply for the logic
OSC	56	I/O	OPEN / VSS	External clock input terminal Supported Hi-Z input if the internal clock mode.
VSS	64	-	-	GND
VLCD	62	-	-	Power Supply for the LCD driver
COM1 ~ 3	41-43	O	OPEN	COMMON output for LCD driving
COM4/S41	44	O	OPEN	COMMON / SEGMENT output for LCD driving Assigned as SEGMENT output if 1/3Duty mode.
S1/P1 ~ S4/P4	1-4	O	OPEN	SEGMENT output for LCD driving / General Purpose output
S5 ~ S40 S42 ~ S52	5-40 45-55	O	OPEN	SEGMENT output for LCD driving
RESB	57	I	VDD	Reset Input: RESB="L" : Display is disabled RESB="H" : Display is controllable NOTE) 3-SPI is NOT available if RESET is "L".
DO	58	O	OPEN	Output for manufacturing test:

● I/O equivalent circuit

<BU97930MUV>

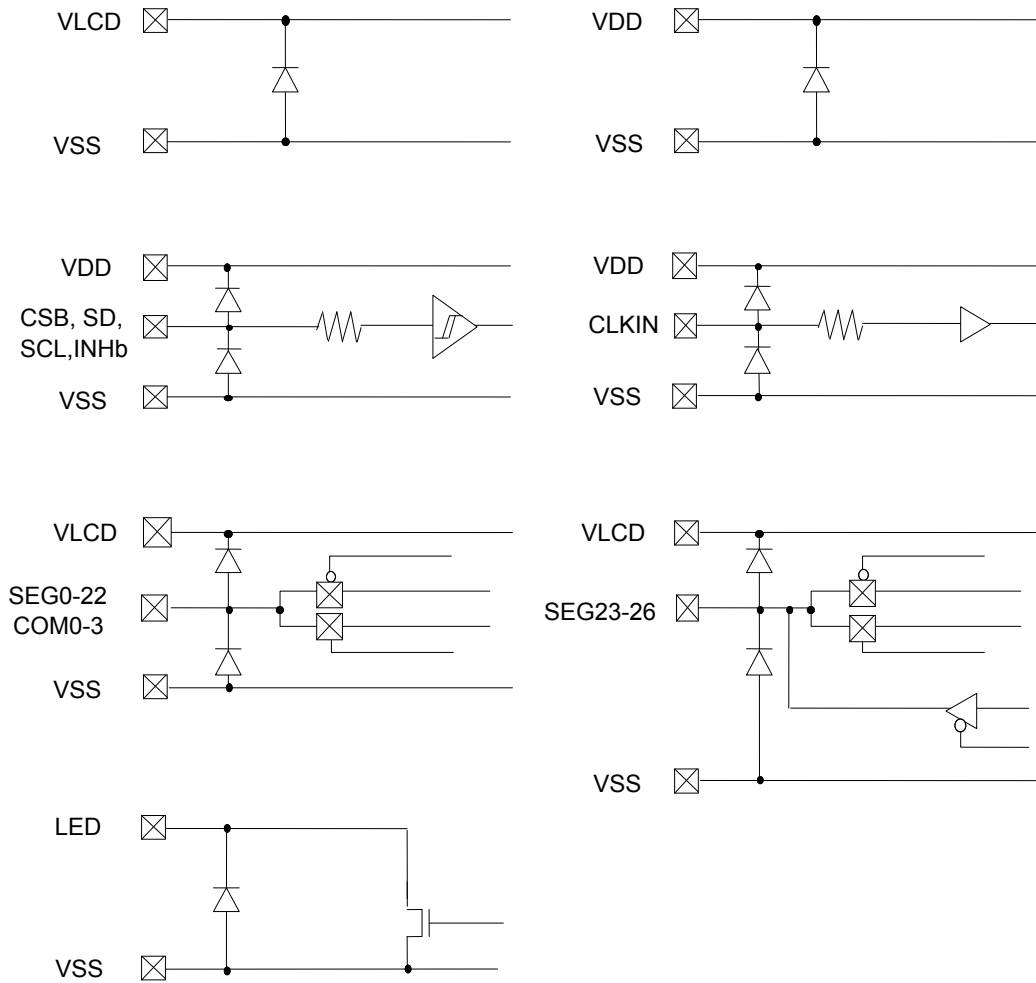


Fig.15 I/O equivalent circuit

<BU97931FV>

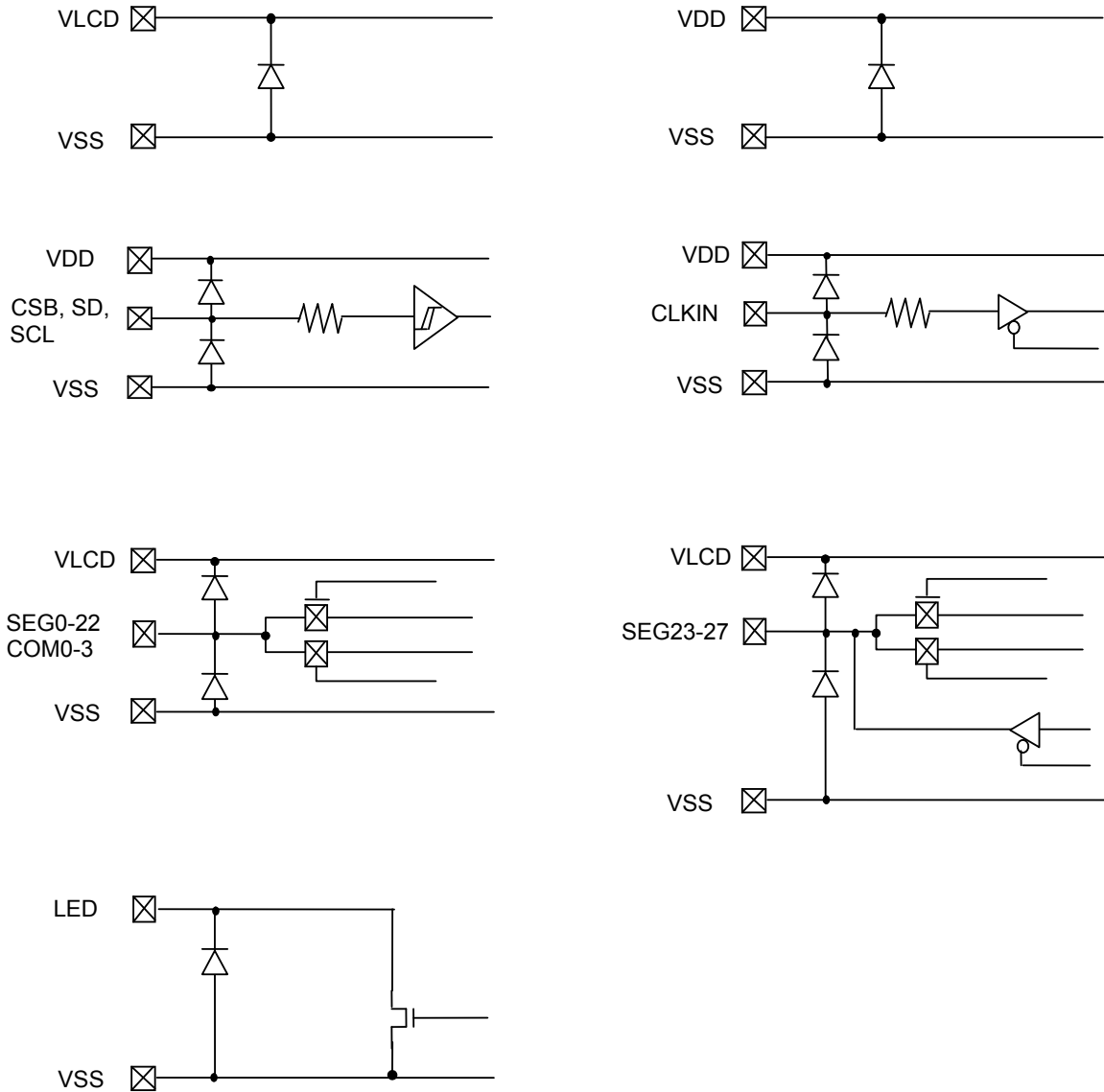


Fig.16 I/O equivalent circuit

<BU9798KV>

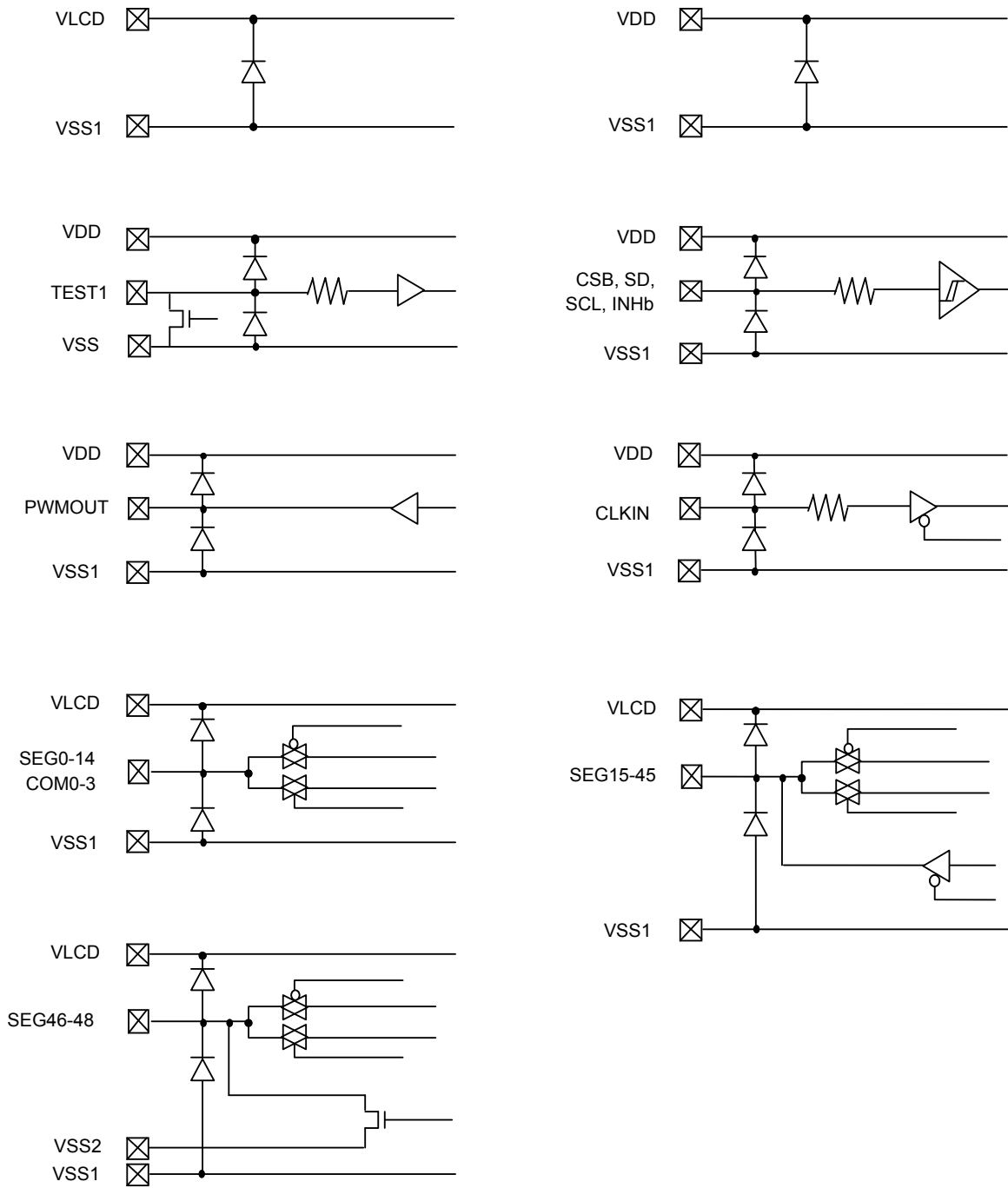


Fig.17 I/O equivalent circuit

<BU9798GUW>

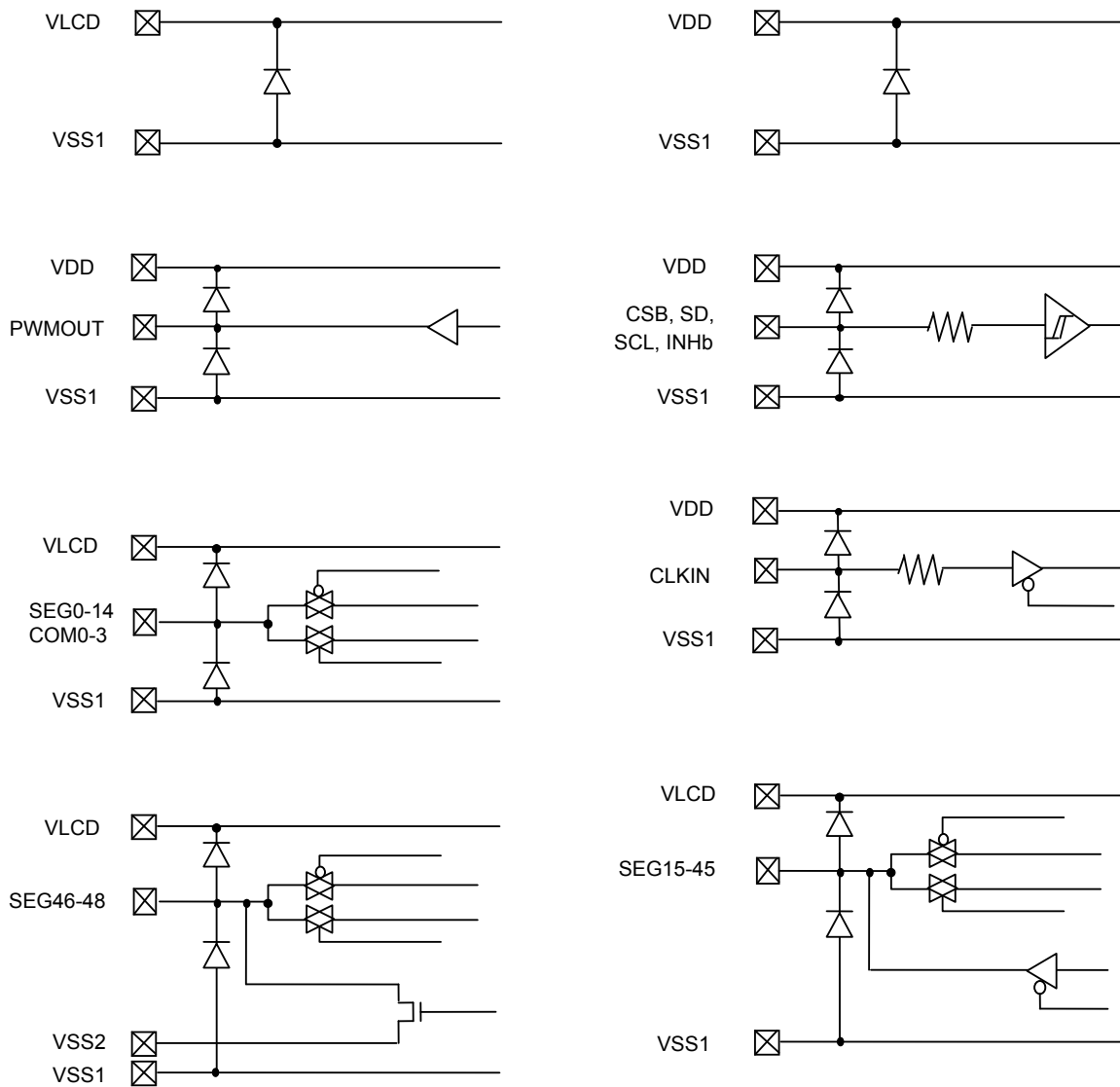


Fig.18 I/O equivalent circuit

<BU97500KV>

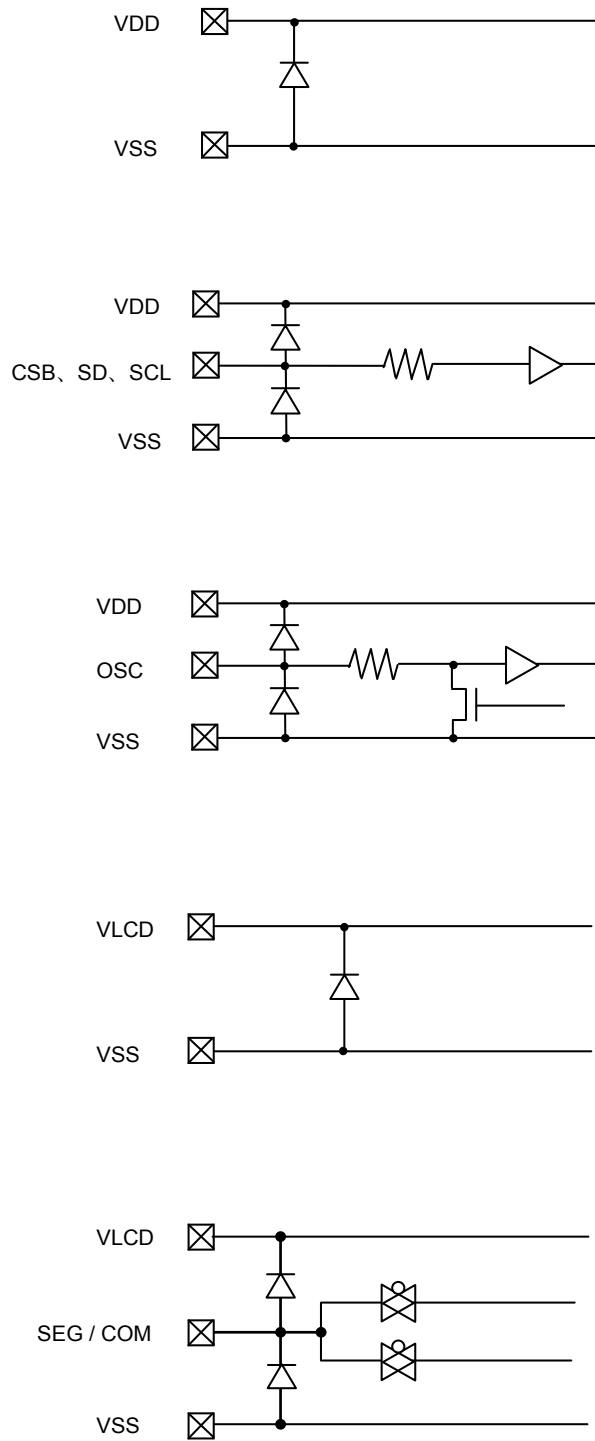
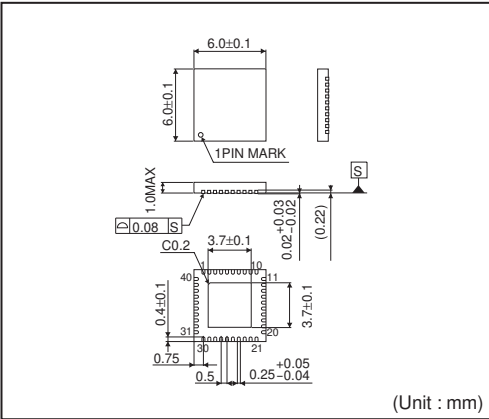


Fig.19 I/O equivalent circuit

●Ordering part number

B	U	9	7	9	3	0	M	U	V	-	E	2
Part No.		Part No.					Package			Packaging and forming specification		
		BU97930 BU97931 BU9798 BU97500					MUV : VQFN040V6060 FV : SSOP-B40 KV : VQFP64 GUW : VBGA063W050			E2: Embossed tape and reel		

VQFN040V6060

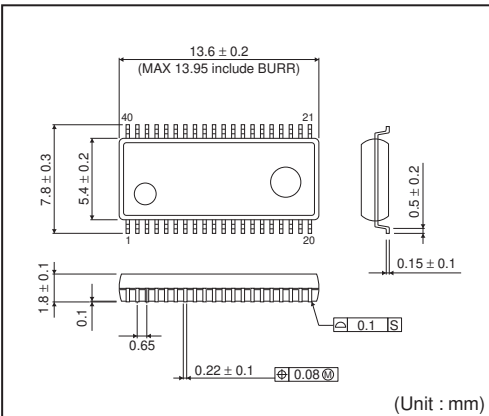


<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1 pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

\*Order quantity needs to be multiple of the minimum quantity.

SSOP-B40

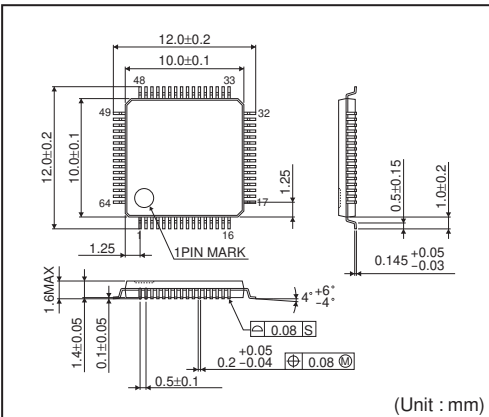


<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1 pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

\*Order quantity needs to be multiple of the minimum quantity.

VQFP64

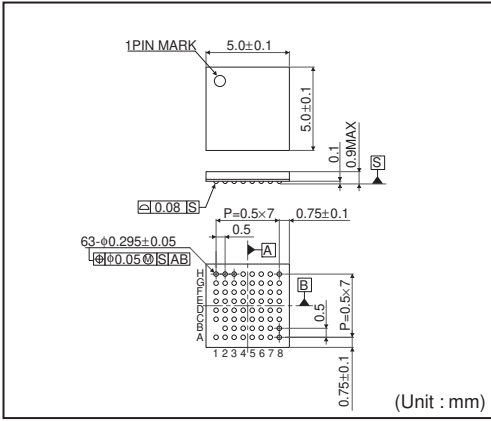


<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	1000pcs
Direction of feed	E2 (The direction is the 1 pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

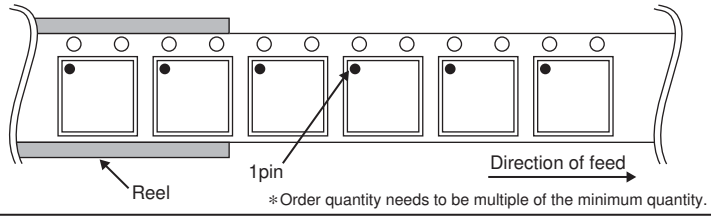
\*Order quantity needs to be multiple of the minimum quantity.

**VBGA063W050**



<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1 pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand )





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