

LCD controller driver for dot matrix displays

BU97701 / BU97702

The BU97701 and BU97702 are controller drivers used in dot matrix liquid crystal displays that display English-language characters, Japanese kana characters, and symbols. These products can be controlled by a 4-bit or an 8-bit MPU. All of the functions necessary to drive dot matrix displays are contained on a single chip, enabling liquid crystal displays to be configured with a small number of chips. These products are available in QFP-T80 (BU97701) and SQFP-T80 (BU97702) packages.

●Applications

Liquid crystal display systems for character displays

●Features

- 1) Can accommodate 5×7 and 5×10 dot matrix LCDs.
- 2) Equipped with an internal display data RAM of 80×8 bits; an expansion driver (BU9706KS) can be used to expand the display up to 80 characters.
- 3) Internal display data ROM of 12,000 bits
- 4) Diverse variety of functions includes display clear, cursor home, display on / off, display character blink, display shift, and others.

●Absolute maximum ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Power supply voltage		V _{DD}	− 0.3 ~ + 7.0	V
Power dissipation	BU97701	Pd	900*1	mW
	BU97702		800*2	
Operating temperature		Topr	− 20 ~ + 75	°C
Storage temperature		Tstg	− 55 ~ + 125	°C

*1 Reduced by 9.0mW for each increase in Ta of 1°C over 25°C (QFP-T80).

*2 Reduced by 8.0mW for each increase in Ta of 1°C over 25°C (SQFP-T80).

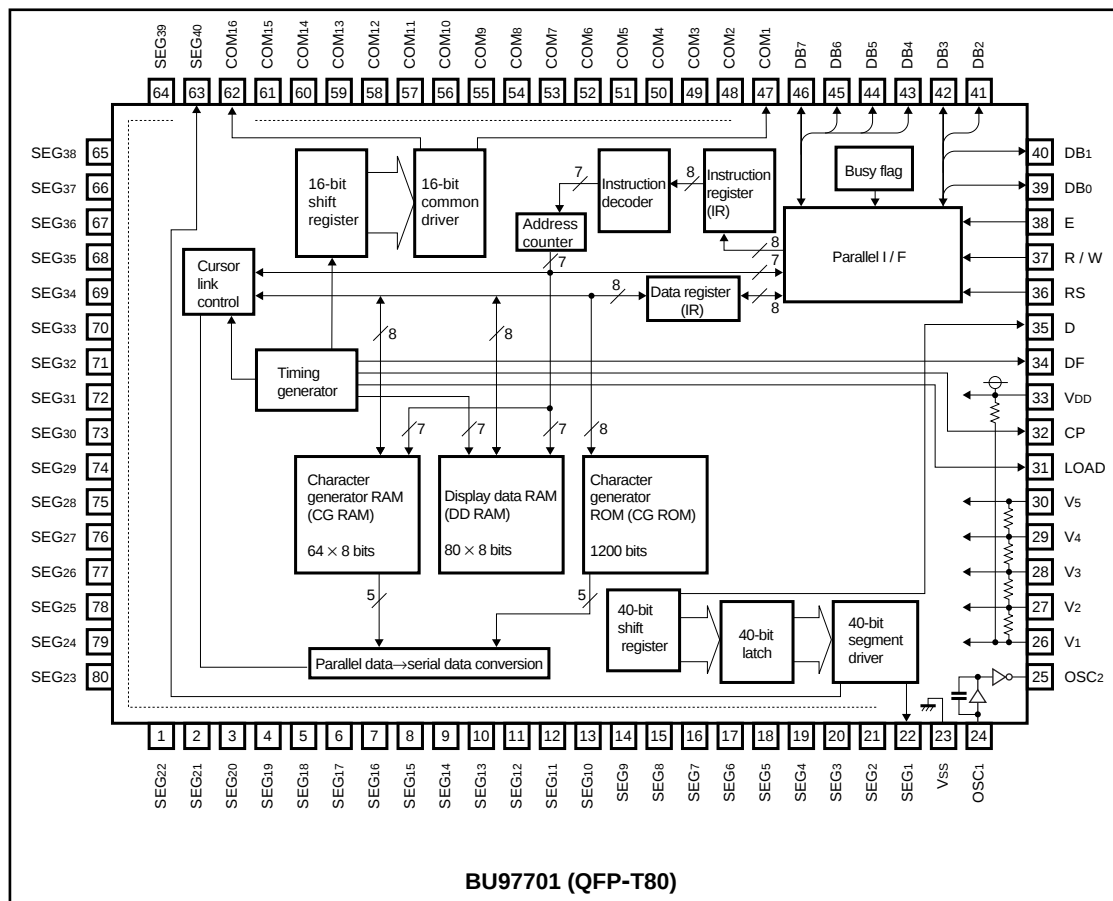
●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V _{DD}	4.5	—	5.5	V

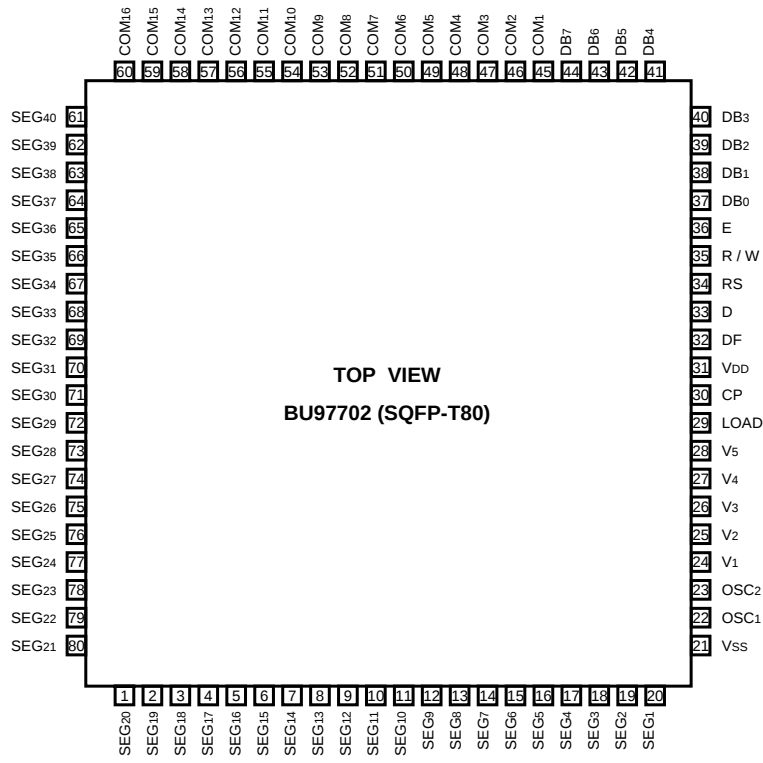
●Model names

Model Number	Built-in font
BU97701-00 / BU97702-00	ROM Ver.00
BU97701-01 / BU97702-01	ROM Ver.01
BU97701-02 / BU97702-02	ROM Ver.02

●Block diagram



● Pin assignments

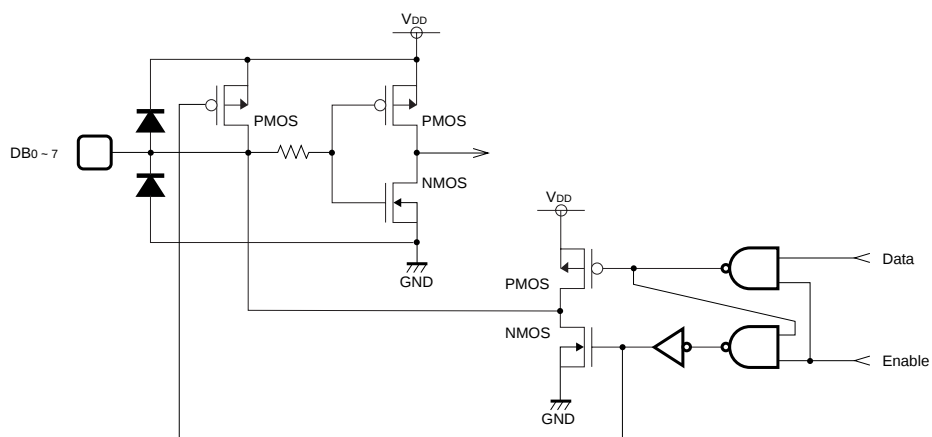
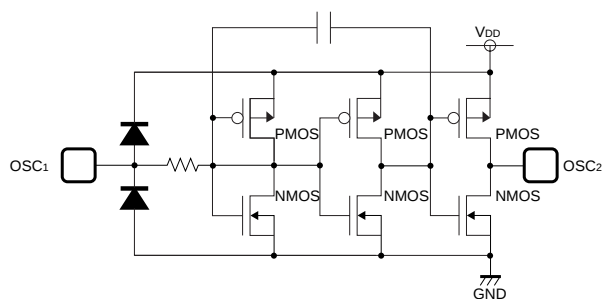
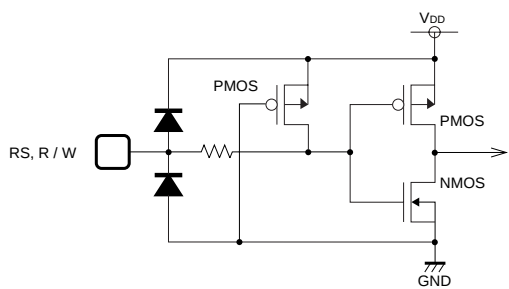
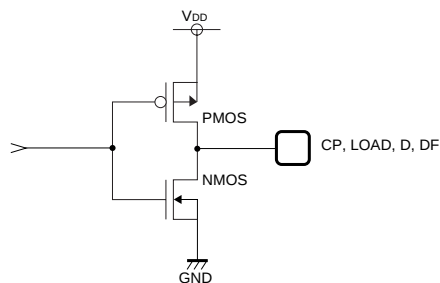
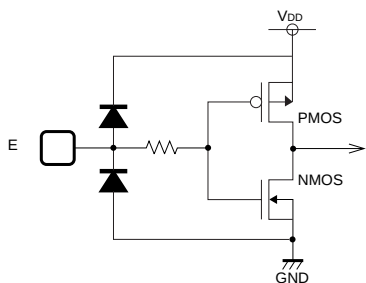


●Pin descriptions

Pin No.	Pin name	Function	
36 (34)	RS	Selects the register used to read / write instructions and data. If RS = 0 and R / W = 0: Instruction register If RS = 0 and R / W = 1: Busy flag and address counter If RS = 1: Data register	
37 (35)	R / W	Signal that selects the read or write operation. This sends and receives data between the BU97701-00 (BU97702) and host computer. R / W = 0: Write R / W = 1: Read	
38 (36)	E	Signal which enables reading / writing.	
39 ~ 42 (37 ~ 40)	DB ₀ ~ DB ₃	Highest four bits of 3-state bi-directional bus. These send and receive data between the BU97701 (BU97702) and host MPU. These are not used with 4-bit operation.	
43 ~ 46 (41 ~ 44)	DB ₄ ~ DB ₇	Lowest four bits of 3-state bi-directional bus. These send and receive data between the BU97701 (BU97702) and host MPU.	
31 (29)	LOAD	Signal output which latches the serial data of the external segment driver.	
32 (30)	CP	Signal output which shifts the serial data of the external segment driver.	
34 (32)	DF	AC signal output of the LCD drive waveform.	
35 (33)	D	Outputs the data corresponding to the character pattern to an external segment register. 0: OFF data 1: ON data	
47 ~ 62 (45 ~ 60)	COM ₁ ~ COM ₁₆	Commons: these are common drive signals. At 1 / 8 duty, COM9 to COM16 are de-selected waveforms. At 1 / 11 duty, COM12 to COM16 are de-selected waveforms.	
22 ~ 1 (20 ~ 1) 80 ~ 63 (80 ~ 61)	SEG ₁ ~ SEG ₄₀	Segments: segment drive signals.	
30 (28)	V ₅	LCD power supply	These must satisfy the following relationship: V _{DD} ≧ V ₁ ≧ V ₂ ≧ V ₃ ≧ V ₄ ≧ V ₅ ≧ V _{SS}
26 ~ 29 (24 ~ 27)	V ₁ ~ V ₄	LCD power supply for external driver.	
33, 23 (31, 21)	V _{DD} , V _{SS}	Power supply pins; V _{DD} = 5.0 ± 10%, V _{SS} = 0V	
24, 25 (22, 23)	OSC ₁ , OSC ₂	When the internal clock is operating, the resistance is connected to these pins. When an external clock is operating, the clock is input to OSC ₁ . (OSC ₂ is open.)	

* The 97702 pin numbers are indicated within parentheses.

● Input / output circuits



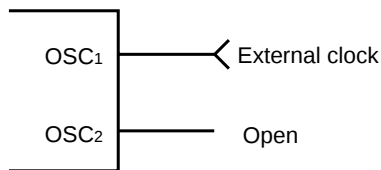
●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{DD} = 5V, V_{SS} = 0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Input high level voltage 1	V _{IH1}	$0.8 \times V_{DD}$	—	V _{DD}	V		Fig.1
Input low level voltage 1	V _{IL1}	0	—	$0.2 \times V_{DD}$	V		Fig.1
Input high level voltage 2	V _{IH2}	2.2	—	—	V		Fig.1
Input low level voltage 2	V _{IL2}	—	—	0.8	V		Fig.1
Output high level voltage 1	V _{OH1}	$V_{DD} - 0.3$	—	—	V	I _{OH} = - 0.625mA	Fig.1
Output low level voltage 1	V _{OL1}	—	—	0.3	V	I _{OL} = 0.625mA	Fig.1
Output high level voltage 2	V _{OH2}	2.4	—	—	V	I _{OH} = - 1.2mA	Fig.1
Output low level voltage 2	V _{OL2}	—	—	0.4	V	I _{OL} = 2.0mA	Fig.1
COM driver ON resistance	R _{COM}	—	—	20	kΩ	I _d = ± 50μA	Fig.1
SEG driver ON resistance	R _{SEG}	—	—	30	kΩ	I _d = ± 50μA	Fig.1
Input current 1	I _{IN1}	- 1	—	1	μA	V _{IN} = 0 ~ V _{DD} Note 1	Fig.1
Input current 2	I _{IN2}	50	125	250	μA	V _{DD} = 5V, V _{IN} = 0V	Fig.1
Current dissipation	I _{DD}	—	350	600	μA	Note 2	Fig.1
External clock operating frequency	f _{IN}	125	250	350	kHz	Note 3	—
External clock duty	f _{Duty}	45	50	55	%	Note 4	—
External clock rise time	t _r	—	—	200	ns	Note 5	—
External clock fall time	t _f	—	—	200	ns	Note 6	—
Internal clock oscillation frequency	f _{OSC}	190	270	350	kHz		Fig.2
Enable cycle time	t _{EC}	500	—	—	ns		Fig.2
Enable pulse width	t _{EP}	220	—	—	ns		Fig.2
Enable rise / fall times	t _{Er} , t _{Ef}	—	—	20	ns		Fig.2
Address setup time	t _{AS}	40	—	—	ns		Fig.2
Address hold time	t _{AH}	10	—	—	ns		Fig.2
Data setup time	t _{DS}	60	—	—	ns		Fig.2
Data hold time (writing)	t _{DH}	10	—	—	ns		Fig.2
Data delay time	t _{DD1}	—	—	250	ns		Fig.2
Data hold time (reading)	t _{OH}	20	—	—	ns		Fig.2
CP cycle time	t _{CC}	1800	—	—	ns		Fig.2
CP pulse time	t _{WH} , t _{WL}	800	—	—	ns		Fig.2
CP rise / fall times	t _{Cr} , t _{Cf}	—	—	100	ns		Fig.2
D delay time	t _{DD2}	—	—	100	ns		Fig.2
LOAD pulse width	t _{WCP}	800	—	—	ns		Fig.2
CP→LOAD time	t _{CL}	125	—	—	ns		Fig.2
LOAD→CP time	t _{LC}	0	—	—	ns		Fig.2
DF delay time	t _{DFD}	- 100	—	100	ns		Fig.2

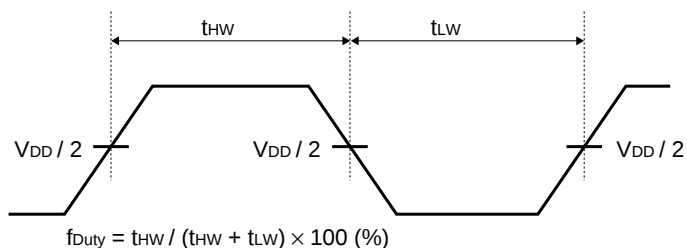
Note 1: Current does not include pull-up MOS current.

Note 2: External resistance oscillation or external clock input- . . . $V_{DD} = 5.0V$, $f_{osc} = f_{cp} = 270kHz$

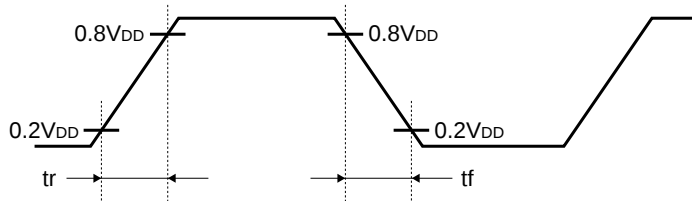
Note 3: External clock operating



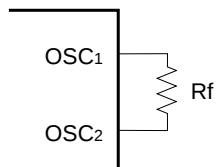
Note 4: Applies to OSC1 pin



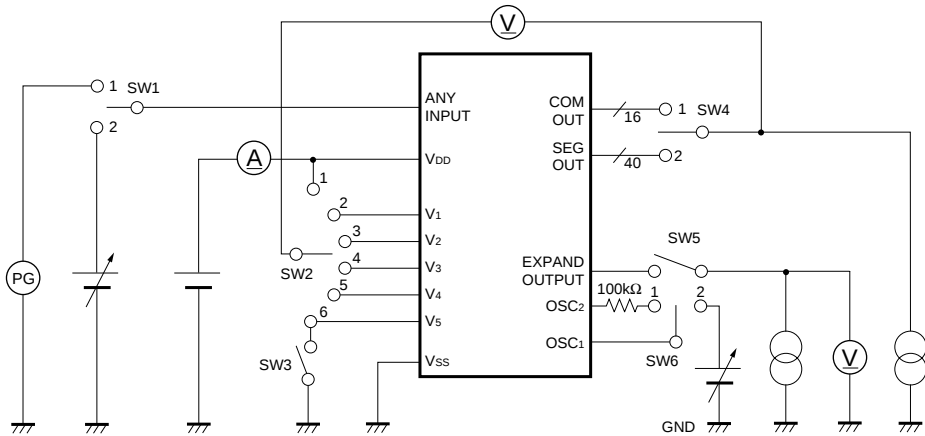
Note 5: Applies to OSC1 pin



Note 6: Internal oscillation caused by external resistance



● Measurement circuits



SW1	1: ON resistance, output voltage measurement	SW3	ON: ON resistance measurement
	2: Input voltage, input current measurement		OFF: Current consumption measurement
SW2	1: ON resistance (in relation to V_{DD}) measurement	SW4	1: ON resistance (COM output) measurement
	2: ON resistance (in relation to V_1) measurement		2: ON resistance (COM output) measurement
	3: ON resistance (in relation to V_2) measurement	SW5	ON: Output voltage measurement
	4: ON resistance (in relation to V_3) measurement		OFF: Current consumption measurement
	5: ON resistance (in relation to V_4) measurement	SW6	1: Current consumption, ON resistance measurement
	6: ON resistance (in relation to V_5) measurement		2: Input voltage measurement

Fig. 1 DC characteristics measurement circuit

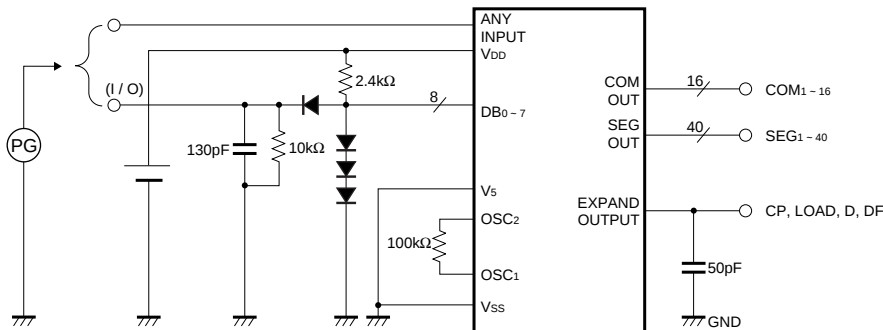


Fig. 2 Switching characteristics measurement circuit

● Timing charts

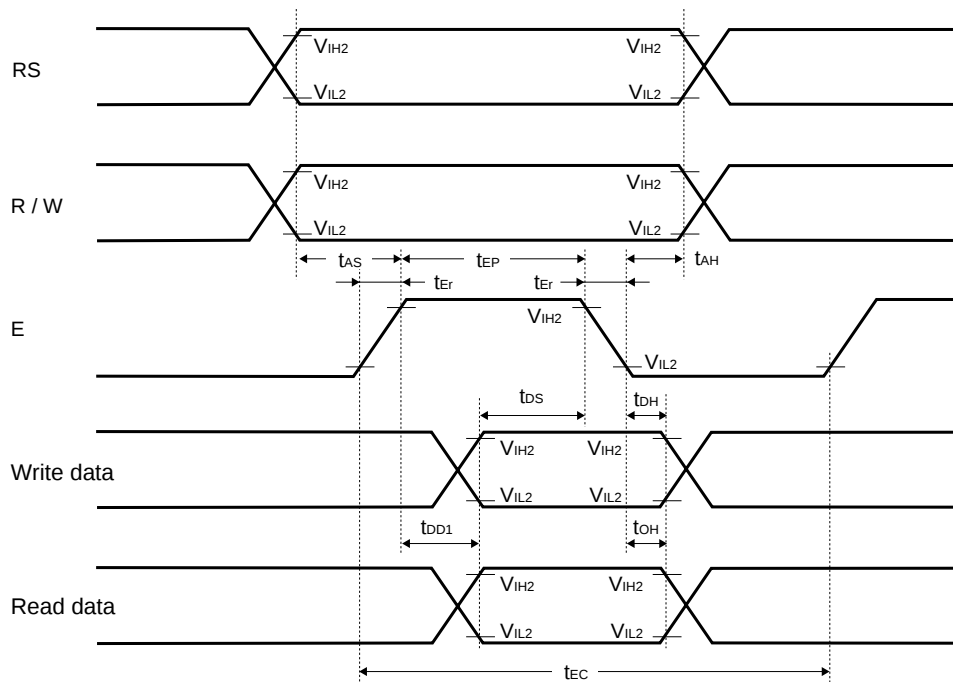


Fig. 3 Bus read / write timing

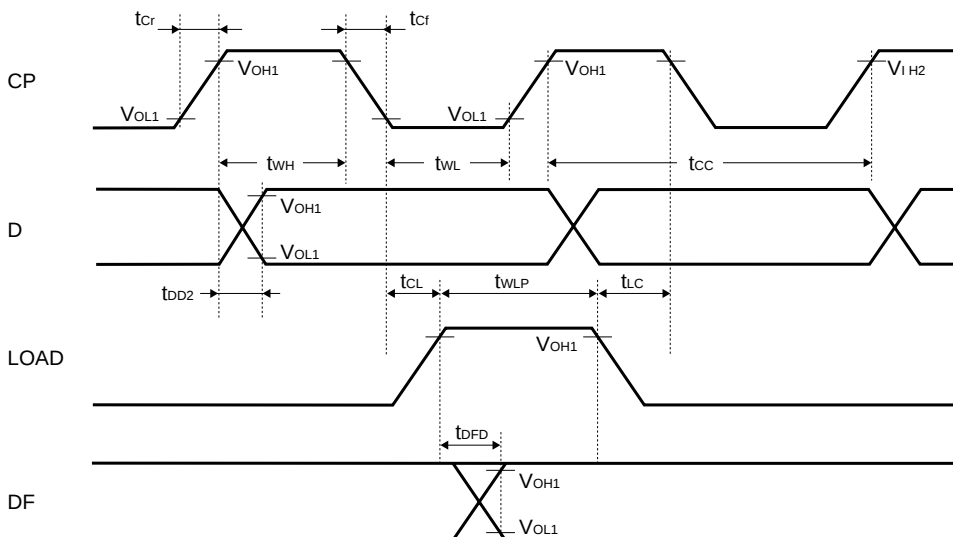


Fig. 4 Output to expansion driver

●Correspondence between character codes and character patterns

Rohm Standard: ROM Ver. 00

Upper bit Lower bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (1)			0	a	P	`	P				—	9	E	o	p
XXXX0001	(2)		!	1	Q	a	9				8	7	+	6	ä	q
XXXX0010	(3)		"	2	B	R	b	r			「	イ	ウ	×	ß	θ
XXXX0011	(4)		#	3	C	S	c	s			」	ウ	テ	E	e	∞
XXXX0100	(5)		\$	4	D	T	d	t			、	工	ト	†	μ	α
XXXX0101	(6)		%	5	E	U	e	u			.	オ	★	1	ε	0
XXXX0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
XXXX0111	(8)		'	7	G	W	g	w			フ	+	ア	ラ	g	π
XXXX1000	(1)		(	8	H	X	h	x			イ	ウ	※	リ	γ	×
XXXX1001	(2)		)	9	I	Y	i	y			へ	ク	ル		ı	ı
XXXX1010	(3)		*	:	J	Z	j	z			エ	コ	ル		j	≠
XXXX1011	(4)		+	:	K	L	k	l			オ	サ	ヒ	ロ	*	π
XXXX1100	(5)		,	<	L	*	1	1			ホ	シ	フ	フ	⊕	π
XXXX1101	(6)		—	=	M	I	m	ı			ユ	ズ	へ	ロ	⊕	÷
XXXX1110	(7)		.	>	N	^	n	÷			3	E	ホ	°	ñ	
XXXX1111	(8)		/	?	O	_	o	←			ウ	リ	マ	°	ö	■

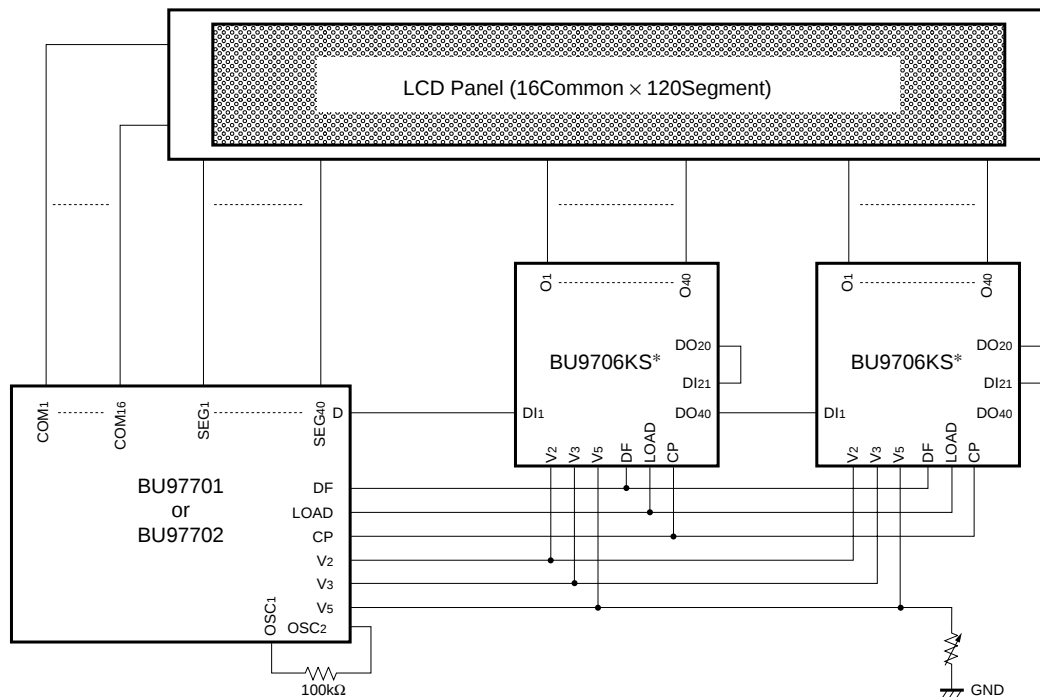
Rohm Standard: ROM Ver. 01

Upper bit Lower bit		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (1)																
XXXX0001	(2)																
XXXX0010	(3)																
XXXX0011	(4)																
XXXX0100	(5)																
XXXX0101	(6)																
XXXX0110	(7)																
XXXX0111	(8)																
XXXX1000	(1)																
XXXX1001	(2)																
XXXX1010	(3)																
XXXX1011	(4)																
XXXX1100	(5)																
XXXX1101	(6)																
XXXX1110	(7)																
XXXX1111	(8)																

Rohm Standard: ROM Ver. 02

Upper bit Lower bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
XXXX0000	CGRAM (1)			0	Q	P	`	P	T	*		—	9	E	o	p
XXXX0001	(2)	±	!	1	A	O	a	9	—	E	9	7	*	4	ä	q
XXXX0010	(3)	≥	"	2	B	R	b	r	=	T	T	イ	ウ	×	P	θ
XXXX0011	(4)	≤	#	3	C	S	c	s	=	B	J	ウ	テ	エ	ε	∞
XXXX0100	(5)	J	\$	4	D	T	d	t	E	*	\	I	ト	†	μ	Ω
XXXX0101	(6)	J	%	5	E	U	e	u	5	+	=	オ	ナ	1	ε	0
XXXX0110	(7)	!!	8	6	F	V	f	v	*	+	ヲ	カ	ニ	ヨ	p	Σ
XXXX0111	(8)	×	'	7	G	W	g	w	t	1	ア	*	ア	ラ	g	π
XXXX1000	(1)	#	(	8	H	X	h	x	A	T	イ	ウ	*	リ	5	×
XXXX1001	(2)	#	)	9	I	Y	i	y	9	*	→	↑	ル	リ	γ	
XXXX1010	(3)	II	*	#	J	Z	j	z	+	*	エ	コ	ハ	ル	j	*
XXXX1011	(4)	III	+	:	K	L	k	l	(	E	火	*	サ	ヒ	0	*
XXXX1100	(5)	△	,	<	L	*	1	1	生	*	ホ	シ	フ	フ	Φ	π
XXXX1101	(6)	9	—	=	M	I	m	)	*	*	ユ	ズ	ハ	コ	ト	÷
XXXX1110	(7)	↑	.	>	N	^	n	÷	A	金	3	ヒ	ホ	°	π	
XXXX1111	(8)	↓	/	?	0	—	o	+	E	1	ウ	ソ	マ	"	ö	

●Application circuit



* The BU9706KS is a segment expansion LSI.

Fig. 5

●Electrical characteristic curves

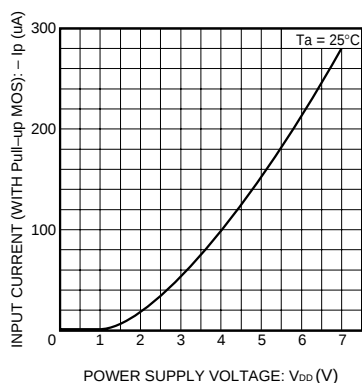


Fig. 6 Input current vs. power supply voltage

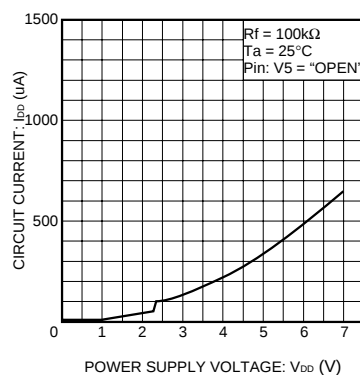
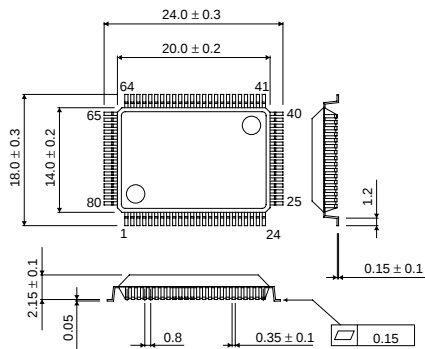


Fig. 7 Current consumption vs. power supply voltage

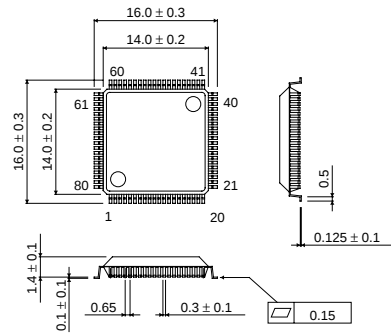
● External dimensions (Units: mm)

BU97701



QFP-T80

BU97702



SQFP-T80