

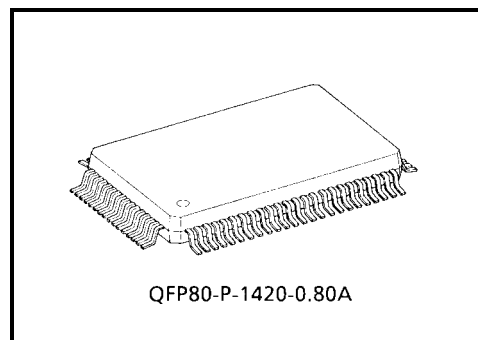
TC9240F

Audio LCD Driver IC

The TC9240F is a driver IC designed for exclusive use for output expansion LCD which is controlled by serial data.

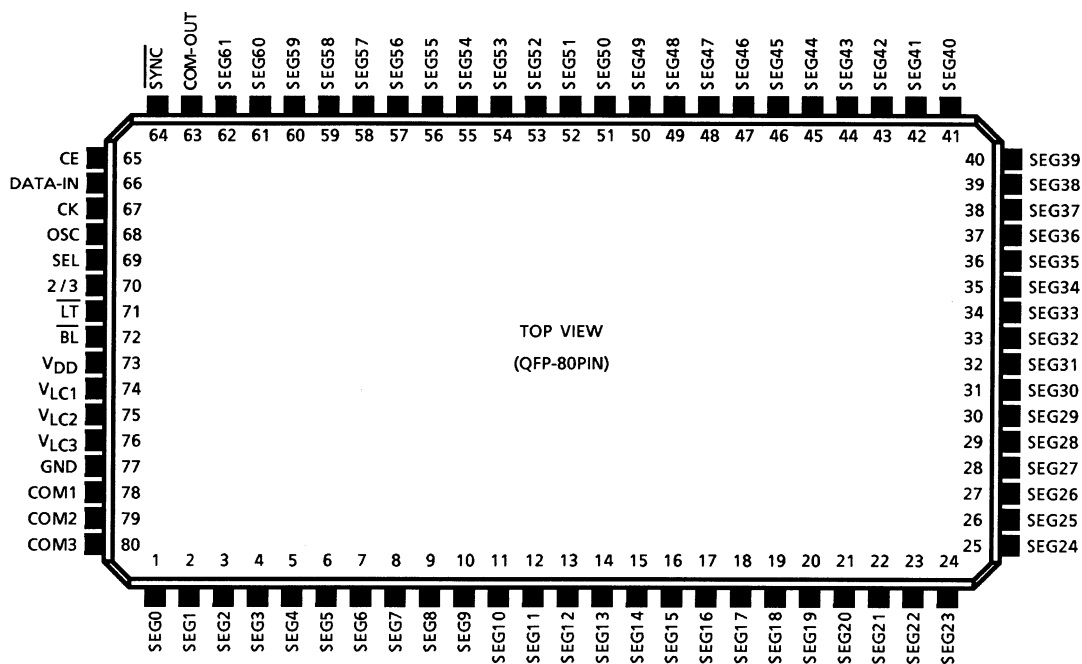
Features

- 1/2 or 1/3 duty and 1/2 or 1/3 bias can be switched.
- Max 124 segments can be displayed in the 1/2 duty mode and 186 segments in the 1/3 duty mode.
- Built-in display synchronizing circuit enables display in multi-chip configuration.
- Built-in oscillation circuit with externally connected capacitor and resistor.
- Connected to the controller using the tree-wire system.
- Display data split in 3 segment blocks enables efficient data transfer.

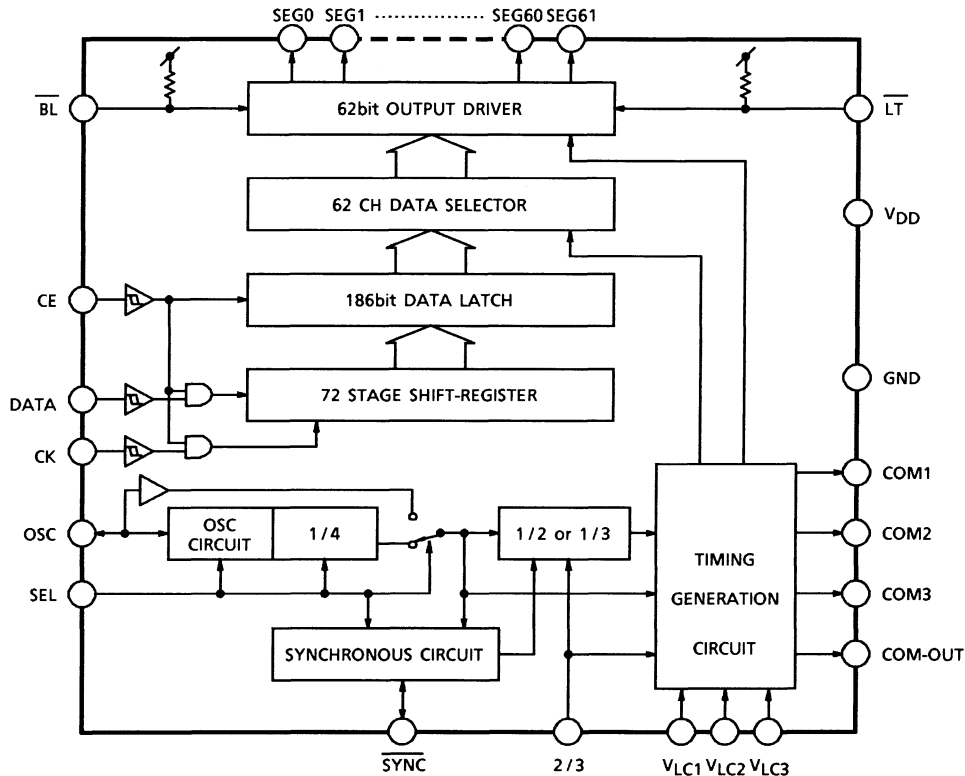


Weight: 1.57 g (typ.)

Pin Assignment (top view)



Block Diagram



Pin Description

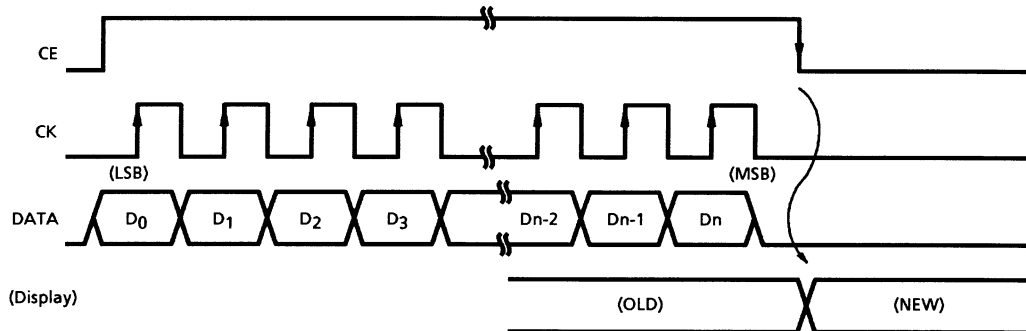
Pin No.	Symbol	Pin Name	Description	Remarks
73	V _{DD}	Power Supply Pin	Power Supply Pin (5 V ± 0.5 V)	—
77	GND	GND Pin		
1~62	SEG0~SEG61	Segment Output Pin	LCD segment drive output pins 1/2 or 1/3 duty } can be switched. 1/2 or 1/3 bias }	
72	BL	Blanking Input Pin	All segments are put in the blanking state when "L" level signal is input.	
71	LT	Lamp Test Input Pin	All segments light when "L" level signal is input.	
65	CE	Chip Select Input Pin	Display data input pins Input data becomes valid only when CE = "H".	
66	DATA	Data Input Pin	Display data is input synchronizing with rise of CK clock.	
67	CK	Clock Input Pin	When CE = "H" changes to CE = "L", data is latched and display is updated.	

Pin No.	Symbol	Pin Name	Description	Remarks
68	OSC	Oscillation Pin	<p>This pin serves as an oscillator when a capacitor and a resistor are connected externally.</p> <p>In the slave mode, COM-OUT output from the master IC is input to this pin.</p>	
69	SEL	Master/Slave Switching Pin	<p>Master/slave switching input when more than 2 pieces of this IC are used simultaneously.</p> <p>"H" = Master Mode</p> <p>"L" = Slave Mode</p>	
64	$\overline{\text{SYNC}}$	Synchronous Pin	<p>Synchronizing input/output pin when more than 2 pieces of this IC are used simultaneously.</p> <p>Master Mode: Synchronous output</p> <p>Slave Mode: Synchronous input</p>	
70	2/3	Duty Switching Pin	<p>1/2 or 1/3 duty switching input</p> <p>"H" = 1/2 duty mode</p> <p>"L" = 1/3 duty mode</p>	
74	V _{LC1}	Bias Input Pin	LCD drive voltage input pins	—
75	V _{LC2}		Set input voltage to	
76	V _{LC3}		$V_{DD} \geq V_{LC1} \geq V_{LC2} \geq V_{LC3} \geq \text{GND}$	
78	COM1	Common Output Pin	Common pin drive output	
79	COM2		In the 1/2 duty mode, COM3 pin is used in the open state.	
80	COM3			
63	COM-OUT	Common Clock Output Pin	<p>Synchronizing clock output pin</p> <p>Supplies clock to the OSC pin of the slave IC.</p> <p>$f_{\text{COM}} = f_{\text{OSC}}/4$ [Hz]</p>	

Description of Operation

1. Data Input Format

- Display data are input at the following timings:



(display)

- For data length, 48 bits (D₀~D₄₇) are transferred 3 times in the 1/2 duty mode and 72 bits (D₀~D₇₁) 3 times in the 1/3 duty mode
- 3 bits (last 3 bits) from MSB side of data are address data.
(D₄₅~D₄₇ in the 1/2 duty mode, while D₆₉~D₇₁ in the 1/3 duty mode.)
- Data in the 1/2 duty mode (2/3 = "H")

COM1 system data: D ₀ , D ₂ , D ₄ (D ₀ + 2n)	}	n = 0~61
COM2 system data: D ₁ , D ₃ , D ₅ (D ₁ + 2n)		
Address data: "100" = SEG0~SEG20 "010" = SEG21~SEG41 "001" = SEG42~SEG61		
- Data in the 1/3 duty mode (2/3 = "L")

COM1 system data: D ₀ , D ₃ , D ₆ (D ₀ + 3n)	}	n = 0~61
COM2 system data: D ₁ , D ₄ , D ₇ (D ₁ + 3n)		
COM3 system data: D ₂ , D ₅ , D ₈ (D ₂ + 3n)		
Address data: "100" = SEG0~SEG20 "010" = SEG21~SEG41 "001" = SEG42~SEG61		

(1) Data format at 1/3 duty (186 segment)

													Data Address		
D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	~		D ₆₀	D ₆₁	D ₆₂	D ₆₃ ~D ₆₈		D ₆₉	D ₇₀	D ₇₁
S0 C1	S0 C2	S0 C3	S1 C1	S1 C2	S1 C3	}}		S20 C1	S20 C2	S20 C3	(Note 1)	}}	1	0	0
D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	~		D ₆₀	D ₆₁	D ₆₂	D ₆₃ ~D ₆₈		D ₆₉	D ₇₀	D ₇₁
S21 C1	S21 C2	S21 C3	S22 C1	S22 C2	S22 C3	}}		S41 C1	S41 C2	S41 C3	(Note 1)	}}	0	1	0
D ₀	D ₁	D ₂	D ₃	~		D ₅₇	D ₅₈	D ₅₉		D ₆₀ ~D ₆₈		D ₆₉	D ₇₀	D ₇₁	
S42 C1	S42 C2	S42 C3	S43 C1	}}		S61 C1	S61 C2	S61 C3		(Note 1)	}}	0	0	1	

Note 1: 1 or 0

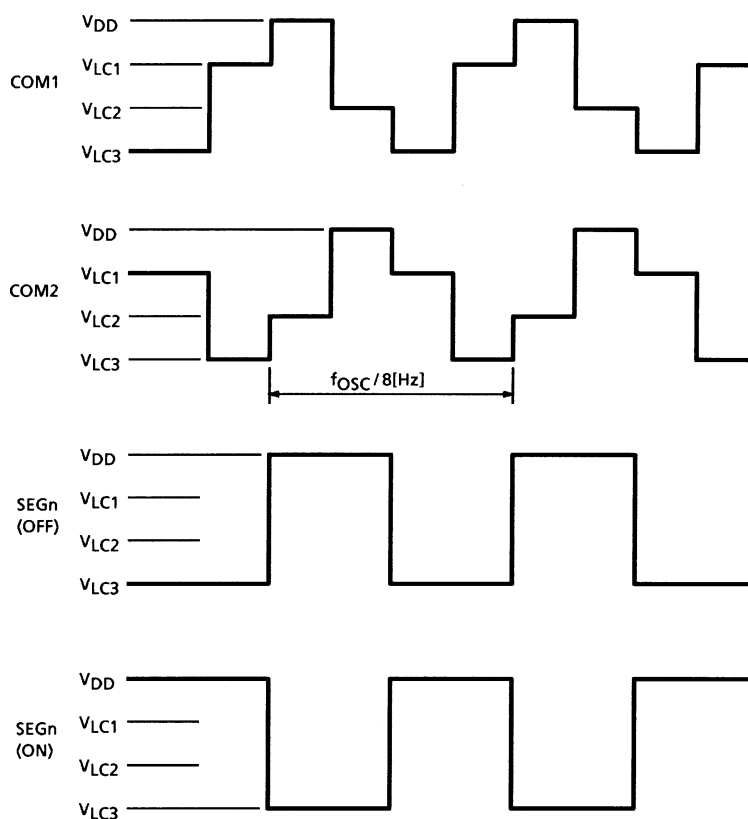
(2) Data format at 1/2 duty (124 segment)

													Data Address		
D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	~		D ₃₉	D ₄₀	D ₄₁	D ₄₂ ~D ₄₄		D ₄₅	D ₄₆	D ₄₇
S0 C1	S0 C2	S1 C1	S1 C2	S2 C1	S2 C2	}}		S19 C1	S20 C1	S20 C2	(Note 1)	}}	1	0	0
D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	~		D ₃₉	D ₄₀	D ₄₁	D ₄₂ ~D ₄₄		D ₄₅	D ₄₆	D ₄₇
S21 C1	S21 C2	S22 C1	S22 C2	S23 C1	S23 C2	}}		S40 C2	S41 C1	S41 C2	(Note 1)	}}	0	1	0
D ₀	D ₁	D ₂	D ₃	~		D ₃₇	D ₃₈	D ₃₉		D ₄₀ ~D ₄₄		D ₄₅	D ₄₆	D ₄₇	
S42 C1	S42 C2	S43 C1	S43 C2	}}		S60 C2	S61 C1	S61 C2		(Note 1)	}}	0	0	1	

Note 1: 1 or 0

2. LCD Display Timings

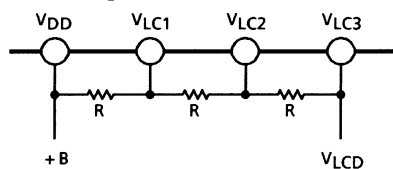
(1) 1/2 duty mode (2/3 = "H")



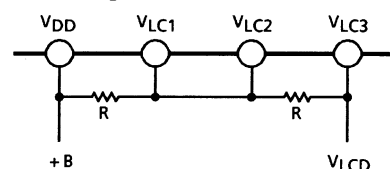
Note 2: When used in the 1/2 bias, supply bias by connecting V_{LC2} pin and V_{LC3} pin.

(this also applies to the 1/3 duty mode.)

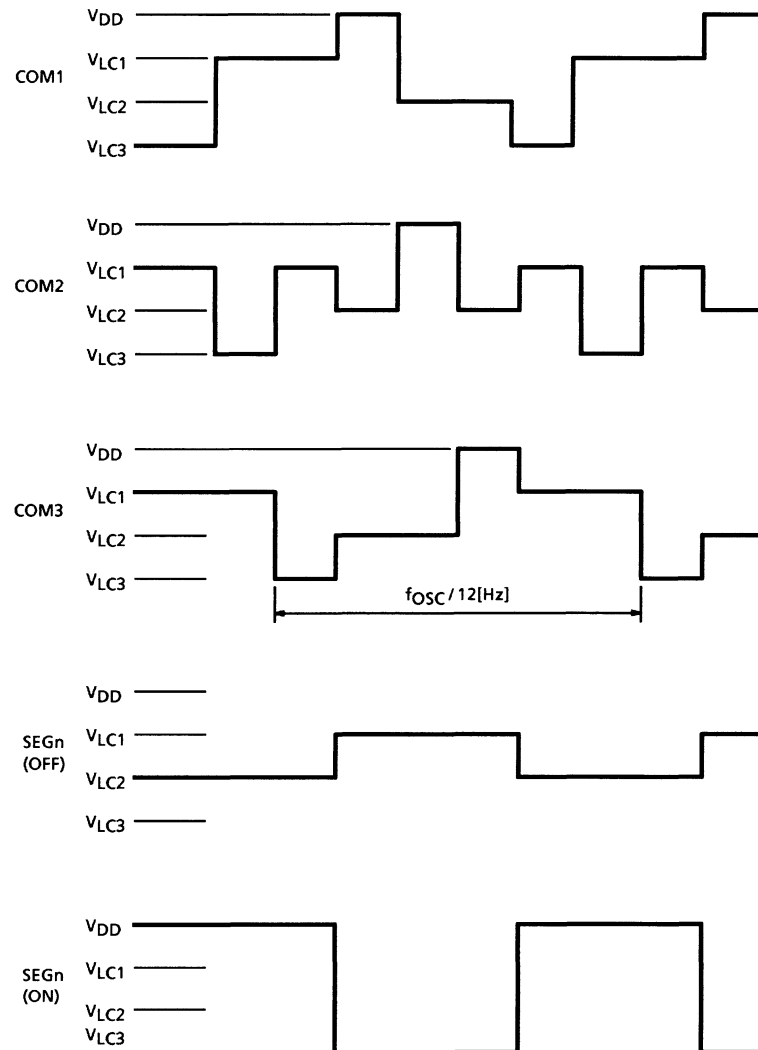
- 1/3 bias operation



- 1/2 bias operation



(2) 1/3 duty mode (2/3 = "L")



3. Oscillation Circuit

When a resistor and a capacitor are connected to the OSC pin and oscillation circuit is composed and common signal is generated.

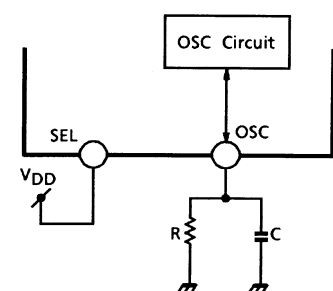
1/4 division of oscillation frequency becomes common frequency.

Capacitor (C) and resistor (R) are connected as shown in the right-side figure and the oscillation frequency is expressed by the following expression:

$$f_{OSC} \approx 1.44/C \cdot R \quad (T_a = 25^\circ C, V_{DD} = 5 V)$$

For instance, when $C = 0.012 \mu F$, and $R = 150 k\Omega$, f_{OSC} will be about 800 Hz and common frequency will be 200 Hz. Use the external resistor at 12~220 k Ω .

However, there is no restriction for the external capacitor C.



4. In Case of Using More than 2

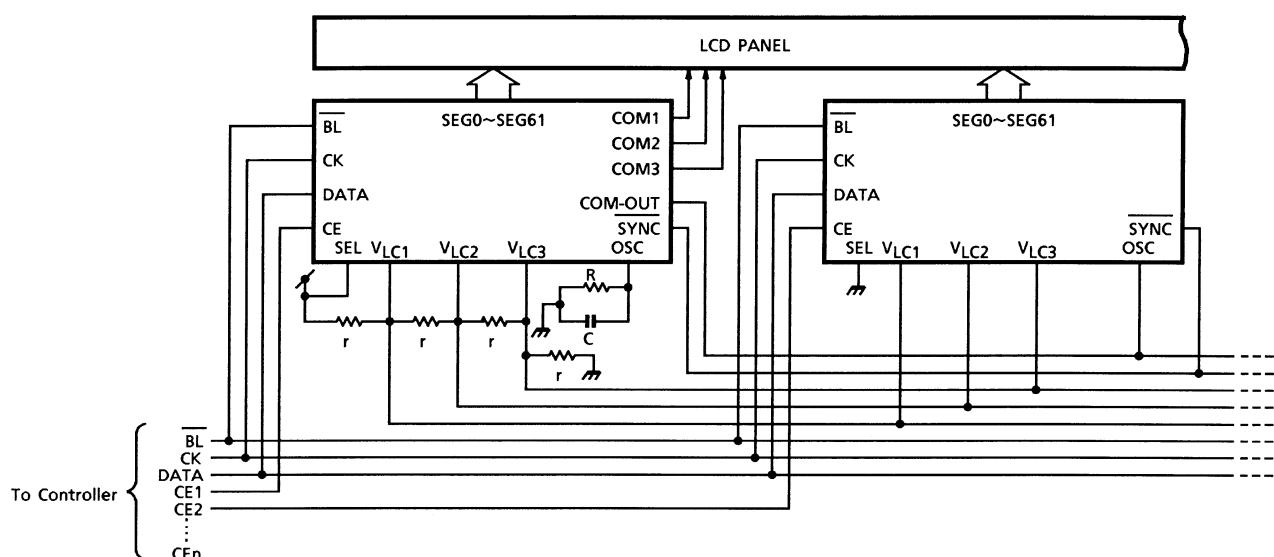
When more than 2 TC9240F are used simultaneously, common frequency is generated using one IC in the master mode.

As a result, the slave mode IC performs the simultaneous operation.

(1) Processing of pins at simultaneous operation

Pin Name	PIN No.	Master Mode IN	Slave Mode IC
SEL	68	"H" (V_{DD}) Level	"L" (GND) Level
OSC	75	Connect External C&R	Connect to Master IC: COM-OUT
SYNC	64	Generate SYNC Output	Connect to Master IC: SYNC
COM-OUT	63	Connect to Slave IC: OSC	Open (unused)
COM1	78	Connect to COM Pin of LCD	Open (unused)
COM2	79		
COM3	80		

(2) Example of application circuit synchronizing operation



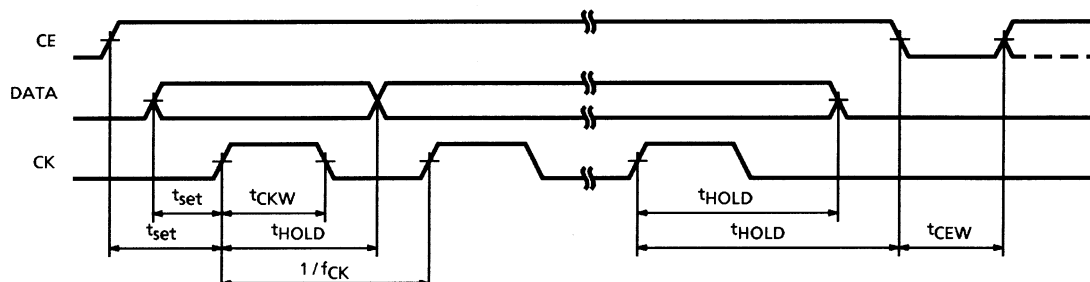
Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	V _{DD}	-0.3~7.0	V
Input voltage	V _{IN}	-0.3~V _{DD} + 0.3	V
Power dissipation	P _D	300	mW
Operating temperature	T _{opr}	-40~85	°C
Storage temperature	T _{stg}	-65~150	°C

Electrical Characteristics (unless otherwise specified, V_{DD} = 4.5~5.5 V, Ta = -40~85°C)

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Operating supply voltage		V _{DD}	—	—		4.5	5.0	5.5	V
Operating supply current		I _{DD}	—	f _{OSC} = 1.2 kHz, No load, V _{DD} = 5 V		—	0.3	1.0	mA
Input voltage	“H” level	V _{IH}	—	All input pins		V _{DD} × 0.7	~	V _{DD}	V
	“L” level	V _{IL}				GND	~	V _{DD} × 0.3	
Input current	“H” level	I _{IH}	—	CMOS input pins, V _{DD} = 5 V	V _{IH} = V _{DD}	−2	—	2	μA
	“L” level	I _{IL}			V _{IL} = GND	−2	—	2	
Pull-up resistance		R _{UP}	—	BL , LT pins, V _{DD} = 5 V, Ta = 25°C		50	100	200	kΩ
Output resistance	Segment	R _{seg}	—	SEG0~SEG61 Output pins	V _{LC1} = V _{LC2} = 1/2V _{DD}	—	0.6	3.0	kΩ
	Common	R _{COM}		COM1~COM3 Output pins	V _{LC3} = GND V _{DD} = 5 V	—	0.5	3.0	
Output current	“H” level	I _{OH}	—	SYNC , COM-OUT	V _{OH} = 4.5 V	−0.2	−0.8	—	mA
	“L” level	I _{OL}		Output pins, V _{DD} = 5 V	V _{OL} = 0.5 V	0.2	1.0	—	
Oscillation frequency		f _{OSC}	—	OSC Pin Operation Frequency		—	1.2	50	kHz
Max clock frequency		f _{CK}	—	Refer to the timing chart as below.		0	~	2.0	MHz
Clock pulse width		t _{CKW}				250	—	—	ns
Data set time		t _{set}				250	—	—	ns
Data hold time		t _{HOLD}				250	—	—	ns
CE pulse width		t _{CEW}				250	—	—	ns

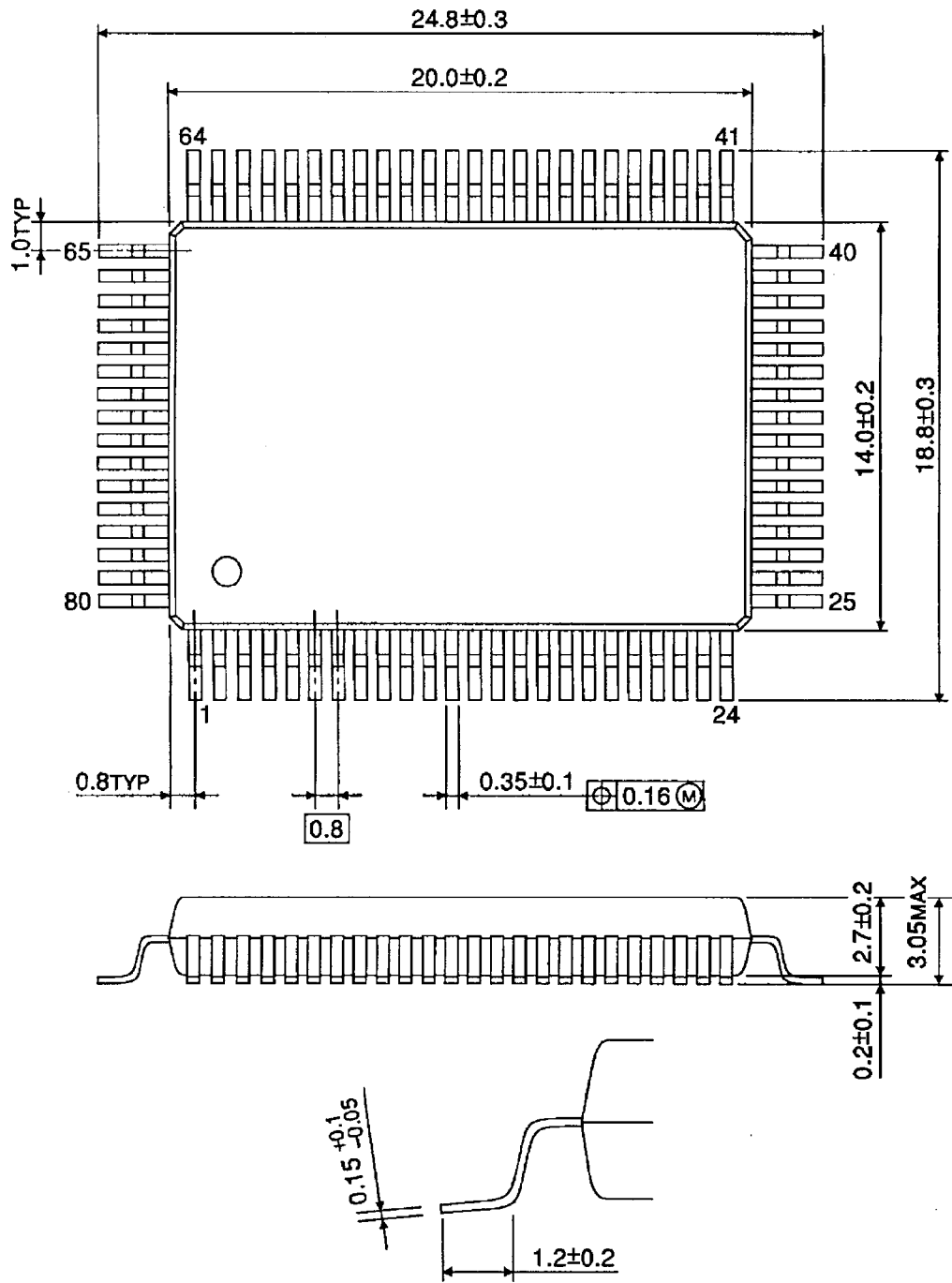
CE, CK, DATA Timing



Package Dimensions

QFP80-P-1420-0.80A

Unit : mm



Weight: 1.57 g (typ.)

RESTRICTIONS ON PRODUCT USE

030519EBA

- The information contained herein is subject to change without notice.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.