TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T6C61

COLUMN DRIVER FOR A DOT MATRIX LCD

The T6C61 is a 160-channel-output column driver for an STN dot matrix LCD. The T6C61 features a 42-V LCD drive voltage and a 25-MHz maximum operating frequency. The T6C61 is able to drive LCD panels with a duty ratio of up to 1/480. It is recommended for use with the T6C14.

Unit: mm

T6C61	LEAD PITCH	
	IN	OUT
(UAN, 3NS)	0.48	0.08

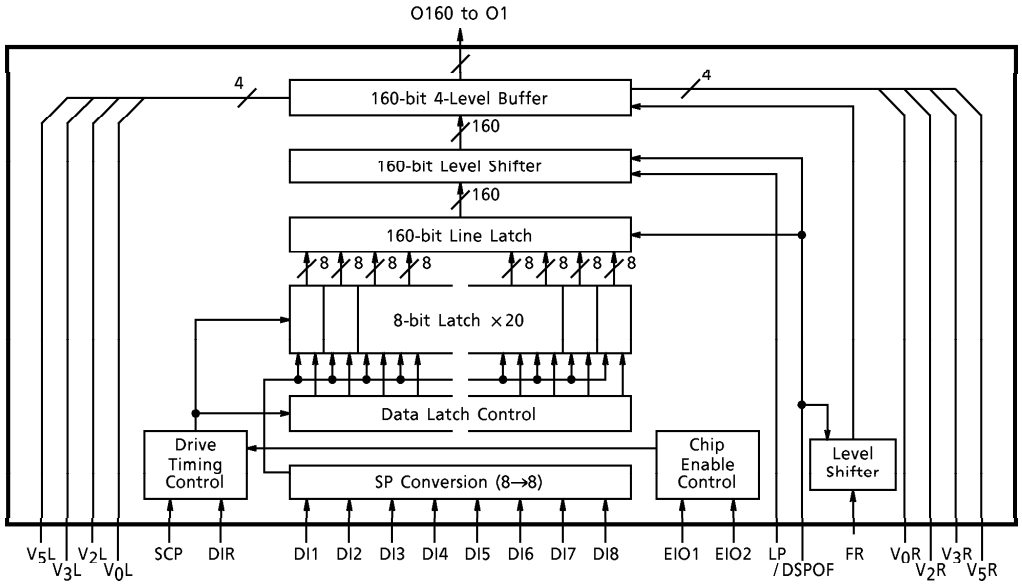
Please contact Toshiba or an authorized Toshiba dealer for information on package dimensions.

TCP (Tape Carrier Package)

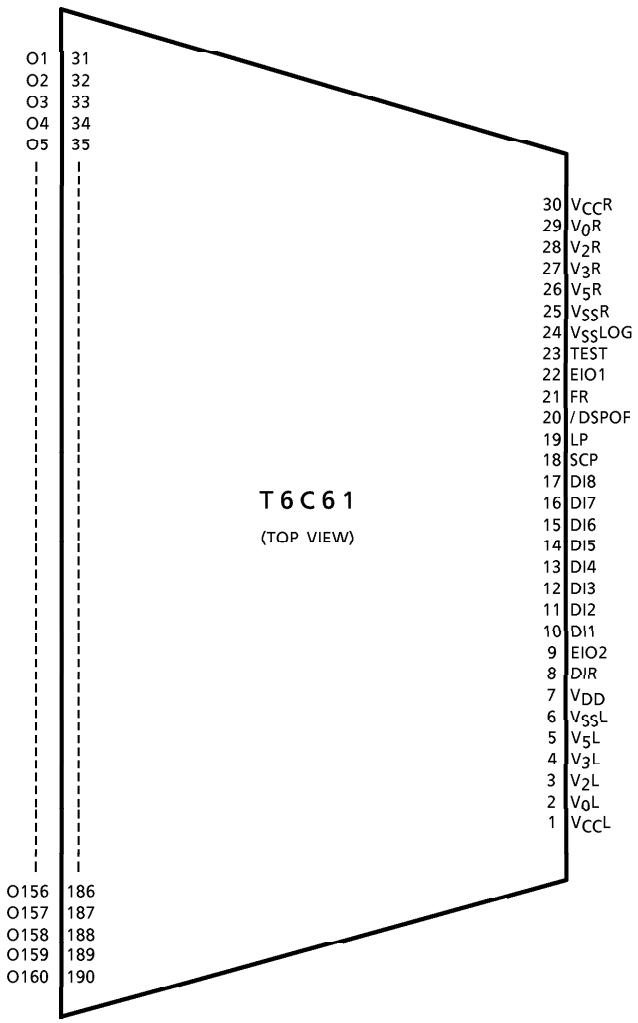
FEATURES

- Display duty application : to 1/480
- LCD drive signal : 160
- Data transfer : 8-bit bidirectional
- Operating frequency : 25MHz (V_{DD} = 4.5V)
  13MHz (V_{DD} = 2.7V)
- LCD drive voltage : 14 to 42V (max 45V)
- Power supply voltage : 2.7 to 5.5V
- Operating temperature : −20 to 75°C
- LCD drive output resistance : 700Ω (typ.), 1200Ω (max) (20V, 1/13 bias)
- Display-off function : When /DSPOF is L, all LCD drive outputs (O1 to O160) remain at the V_5 level.
- Low power consumption : Cascade connection and auto enable transfer functions are available.

BLOCK DIAGRAM



PIN ASSIGNMENT



The above diagram shows the pin configuration of the LSI chip, not that of the tape carrier package.

PIN FUNCTIONS

PIN NAME	I/O	FUNCTIONS	LEVEL
O1 to O160	Output	Output for LCD drive signal	V_0 to V_5
EIO1, EIO2	I/O	Input/output for enable signal DIR selects In or Out. Connect EIO (IN) of 1st LSI to L For a cascade connection, connect EIO (OUT) to EIO (IN) of next LSI.	V_{DD} to V_{SS}
DI1 to DI8	Input	Input for data signal	
DIR	Input	(Direction) Input for data flow direction select	
/DSPOF	Input	(Display Off) /DSPOF = L : Display-off mode, (O1 to O160) remain at the V_5 level. /DSPOF = H : Function mode, (O1 to O160) are operational.	
LP	Input	(Latch Pulse) Input for latch pulse Display data is latched on the falling edge of LP. When EIO (IN) = L, setting $\overline{SCP}$·LP = H enables the 1st LSI.	
FR	Input	(Frame) Input for frame signal	
SCP	Input	(Shift Clock Pulse) Input for shift clock pulse	
TEST	Input	(Test) Test : L or open	
V_{DD}	—	Power supply for internal logic (5V)	—
V_{SS}LOG	—	Power supply for internal logic (0V)	
V_{SS}L·R	—	Power supply for LCD drive circuit	
V_5L·R	—	Power supply for LCD drive circuit	
V_3L·R	—	Power supply for LCD drive circuit	
V_2L·R	—	Power supply for LCD drive circuit	
V_0L·R	—	Power supply for LCD drive circuit	
V_{CC}L·R	—	Power supply for LCD drive circuit	

RELATION BETWEEN FR, DATA INPUT AND OUTPUT LEVEL

FR	DATA INPUT (DI1~DI8)	/DSPOF	OUTPUT LEVEL
H	L	H	V_2
H	H	H	V_0
L	L	H	V_3
L	H	H	V_5
*	*	L	V_5

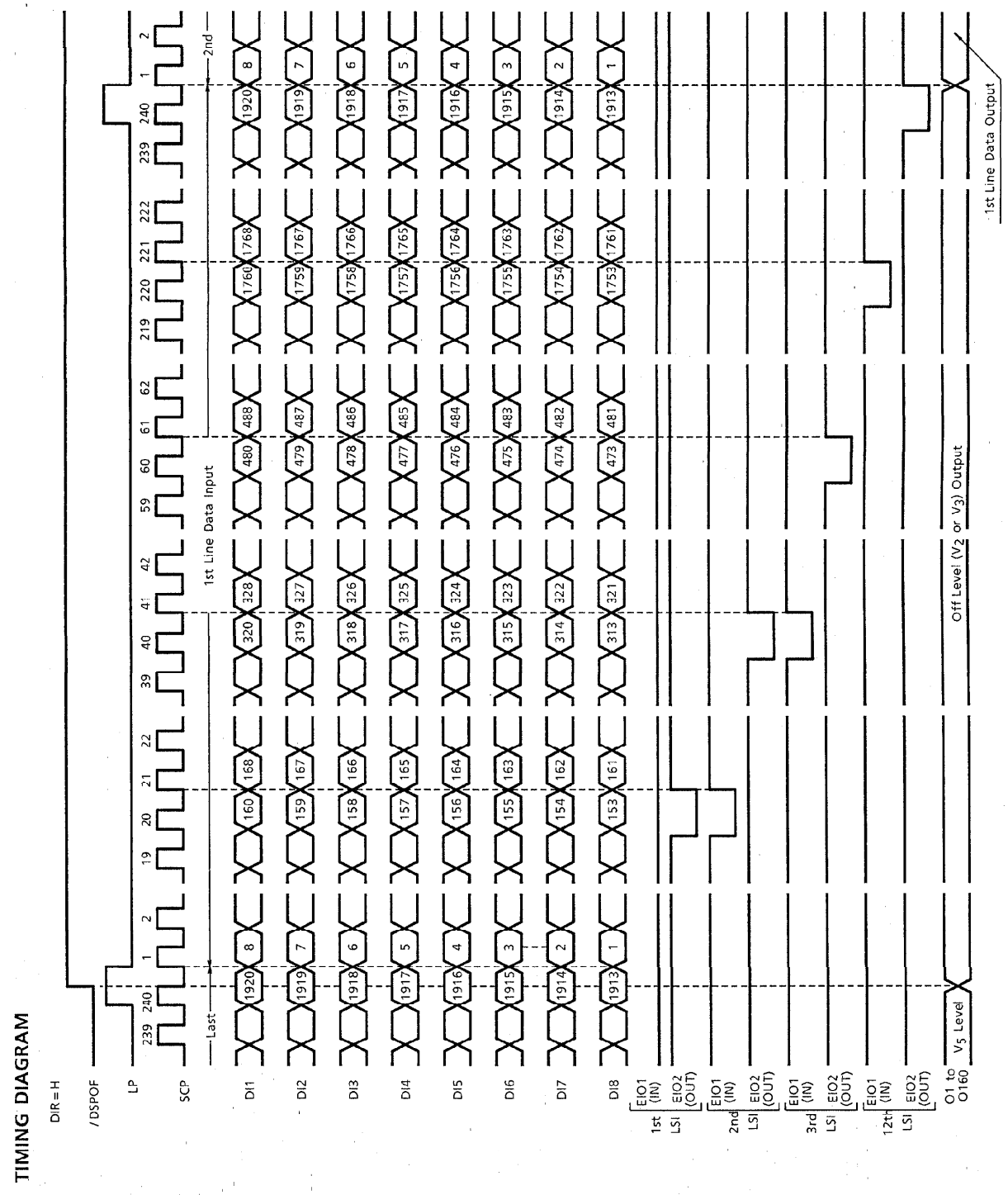
* Don't Care

DATA INPUT FORMAT

DIR	ENABLE PIN		(*1)	INPUT DATA LINE AND OUTPUT BUFFERS							
	EIO1	EIO2		DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8
H	IN	OUT	L	O160	O159	O158	O157	O156	O155	O154	O153
			F	O8	O7	O6	O5	O4	O3	O2	O1
L	OUT	IN	L	O1	O2	O3	O4	O5	O6	O7	O8
			F	O153	O154	O155	O156	O157	O158	O159	O160

(*1) L : LAST DATA F : FIRST DATA

TIMING DIAGRAM



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ABSOLUTE MAXIMUM RATINGS

(Ensure that the following conditions are maintained, $V_{CC} \geqq V_0 \geqq V_2 \geqq V_3 \geqq V_5 \geqq V_{SS}$)

ITEM	SYMBOL	PIN NAME	RATING	UNIT
Supply Voltage 1	V_{DD}	V_{DD}	−0.3 to 6.5	V
Supply Voltage 2	V_{CC}	V_{CC}L/R	−0.3 to 45.0	V
Supply Voltage 3	V_0, V_2	V_0L/R, V_2L/R	−0.3 to V_{CC}+0.3	V
Supply Voltage 4	V_3, V_5	V_3L/R, V_5L/R	−0.3 to V_{CC}+0.3	V
Input Voltage	V_{IN}	(*2)	−0.3 to V_{DD}+0.3	V
Operating Temperature	T_{opr}	—	−20 to 75	°C
Storage Temperature	T_{stg}	—	−40 to 125	°C

(*2) SCP, FR, LP, DIR, EIO1, EIO2, DI1 to DI8, /DSPOF, TEST

ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

(Unless otherwise noted, V_{SS} = 0V, V_{DD} = 2.7 to 5.5V, V_{CC} = 14 to 42V, Ta = – 20 to 75°C)

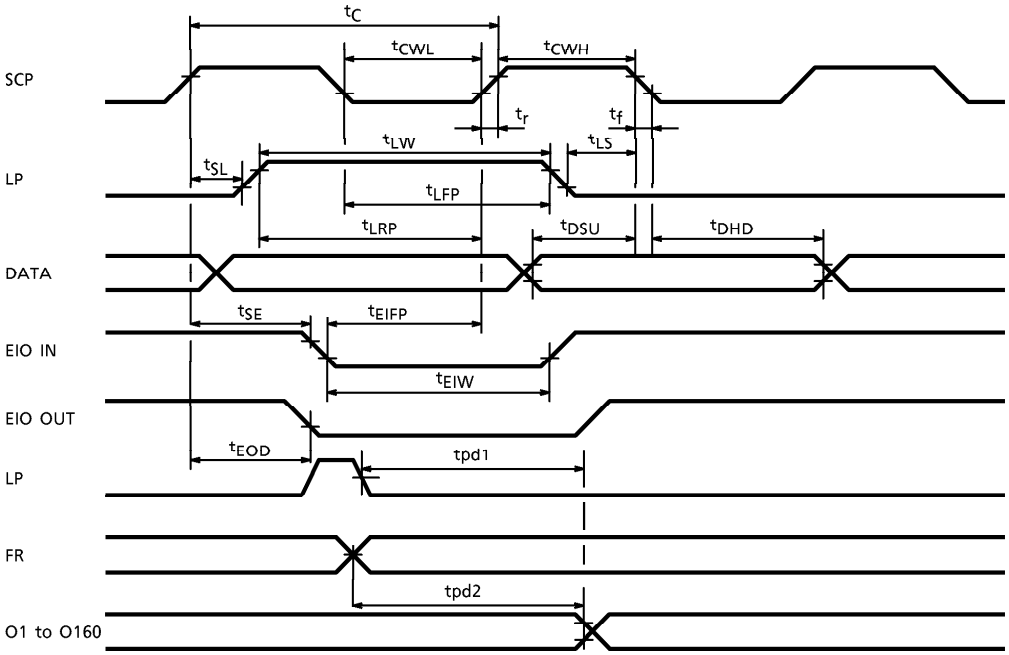
ITEM		SYMBOL	TEST CIR-CUIT	TEST CONDITIONS			MIN	TYP.	MAX	UNIT	PIN NAME
Supply Voltage 1		V_{DD}	—	—			2.7	5.0	5.5	V	V_{DD}
Supply Voltage 2		V_{CC}	—	—			14	—	42		V_{CC}L / R
Input Voltage	H Level	V_{IH}	—	—			0.8 V_{DD}	—	V_{DD}		SCP, FR, LP, DIR, EIO1, EIO2, DI1 to DI8, / DSPOF, TEST
	L Level	V_{IL}		—			0	—	0.2 V_{DD}		
Output Voltage	H Level	V_{OH}	—	I_{OH} = – 0.5mA			V_{DD} – 0.5	—	V_{DD}		EIO1, EIO2
	L Level	V_{OL}		I_{OL} = 0.5mA			0	—	0.5		
Output Resistance	H Level	R_{OH}	—	$V_{OUT} = V_0 - 0.5V$	(*3)		—	700	1200	Ω	O1 to O160
	M Level	R_{OM}		$V_{OUT} = V_2 \pm 0.5V$	(*3)		—	700	1200		
				$V_{OUT} = V_3 \pm 0.5V$	(*3)		—	700	1200		
	L Level	R_{OL}		$V_{OUT} = V_5 + 0.5V$	(*3)		—	700	1200		
Input Current		I_{IL}	—	V_{DD}	V_{CC}	CONDITION	– 10	—	10	μA	V_0L / R V_2L / R V_3L / R V_5L / R
				5.0	42	Standby					
Current Consumption		I_{DD} Ope	—	5.0	20	Function (*4)	—	—	5.0	mA	V_{DD}
				2.7	20		—	—	2.5		
		I_{DD} St / by		5.0	20	Function (*5)	—	—	2.0		
				2.7	20		—	—	1.0		
		I_{CC} Leak		5.0	42	Standby	– 10	—	10	μA	V_{CC}L / R

(*3) V_{CC} = 20V, 1 / 13 bias

(*4) f_{scp} = 13MHz, f_{LP} = 54kHz, f_{FR} = 13.5kHz, f_{EIO} = 650kHz
Data Format : every bit inverted, while internal data receiver is operating

(*5) f_{scp} = 13MHz, f_{LP} = 54kHz, f_{FR} = 13.5kHz
Data Format : every bit inverted, while internal data receiver is sleeping

AC CHARACTERISTICS



TEST CONDITIONS (1) (V_{SS} = 0V, V_{DD} = 4.5 to 5.5V, V_{CC} = 14 to 42V, Ta = – 20 to 75°C)

ITEM	SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Clock Cycle	t_C	—	40	—	—	ns
SCP Pulse Width	t_{CWH}	—	15	—	—	
	t_{CWL}	—	15	—	—	
Data Set-Up Time	t_{DSU}	—	10	—	—	
Data Hold Time	t_{DHD}	—	10	—	—	
SCP Rise / Fall Time	t_r, t_f	—	—	—	(*6)	
LP Rise Time	t_{LRP}	—	15	—	—	
LP Fall Time	t_{LFP}	—	10	—	—	
LP Pulse Width	t_{LW}	—	10	—	—	
SCP-to-LP Delay Time	t_{SL}	—	5	—	—	
LP-to-SCP Delay Time	t_{LS}	—	10	—	—	
EIO-IN Rise Time	t_{EIFP}	—	20	—	—	
EIO-IN Pulse Width	t_{EIW}	—	10	—	—	
SCP-to-EIO Delay Time	t_{SE}	—	5	—	—	
EIO-OUT Delay Time	t_{EOD}	(*7)	—	—	20	
Output Delay Time 1 (LP→OUT)	t_{pd1}	—	—	—	400	
Output Delay Time 2 (FR→OUT)	t_{pd2}	—	—	—	400	
Output Delay Time Variation	(*8)	—	—	0	30	

(*6) t_r, $t_f \leqq (t_C - t_{CWH} - t_{CWL}) / 2$ and t_r, $t_f \leqq 50$ns (*7) C_L = 10pF

(*8) Variation in t_{pd1} and t_{pd2}

TEST CONDITIONS (2) (V_{SS} = 0V, V_{DD} = 2.7 to 4.5V, V_{CC} = 14 to 42V, Ta = – 20 to 75°C)

ITEM	SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Clock Cycle	t_C	—	76	—	—	ns
SCP Pulse Width	t_{CWH}	—	30	—	—	
	t_{CWL}	—	30	—	—	
Data Set-up Time	t_{DSU}	—	28	—	—	
Data Hold Time	t_{DHD}	—	28	—	—	
SCP Rise / Fall Time	t_r, t_f	—	—	—	(*9)	
LP Rise Time	t_{LRP}	—	28	—	—	
LP Fall Time	t_{LFP}	—	28	—	—	
LP Pulse Width	t_{LW}	—	28	—	—	
SCP-to-LP Delay Time	t_{SL}	—	5	—	—	
LP-to-SCP Delay Time	t_{LS}	—	10	—	—	
EIO-IN Rise Time	t_{EIFP}	—	40	—	—	
EIO-IN Pulse Width	t_{EIW}	—	28	—	—	
SCP-to-EIO Delay Time	t_{SE}	—	5	—	—	
EIO-OUT Delay Time	t_{EOD}	(*10)	—	—	35	
Output Delay Time 1 (LP→OUT)	t_{pd1}	—	—	—	500	
Output Delay Time 2 (FR→OUT)	t_{pd2}	—	—	—	500	
Output Delay Time Variation	(*11)	—	—	0	50	

(*9) t_r, $t_f \leqq (t_C - t_{CWH} - t_{CWL}) / 2$ and t_r, $t_f \leqq 50$ns
(*10) C_L = 10pF
(*11) Variation in t_{pd1} and t_{pd2}

NOTE

Insert the bypass capacitor (0.1μF) between V_{DD} and V_{SS}, and between V_{CC} and V_{SS} to decrease power supply noise.
Place the bypass capacitor as close to the LSI as possible.