1/4 DUTY LCD DRIVER

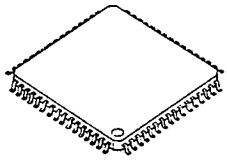
■ GENERAL DESCRIPTION

The NJU6433 is a 1/4 duty LCD driver for segment type LCD panel.

The LCD driver consists of 4-common and 50-segment drives up to 200 segments.

The NJU6433 is useful for the digital tuning system or others segment type display driver.

■ PACKAGE OUTLINE



NJU6433F

■ FEATURES

- 50 Segment Drivers
- Duty Ratio 1/4 (Up to 200-Segments)
- Serial Data Transmission (Shift Clock 2MHz max.)
- Oscillation Circuit On-chip (External Resistance Required)
- Display Off Function ($\overline{INH}$ Terminal)
- Operating Voltage --- 2.4~5.5V
- LCD Driving Voltage --- 6.5V Max.
- Package Outline --- QFP 64 (D1, G1)
- C-MOS Technology

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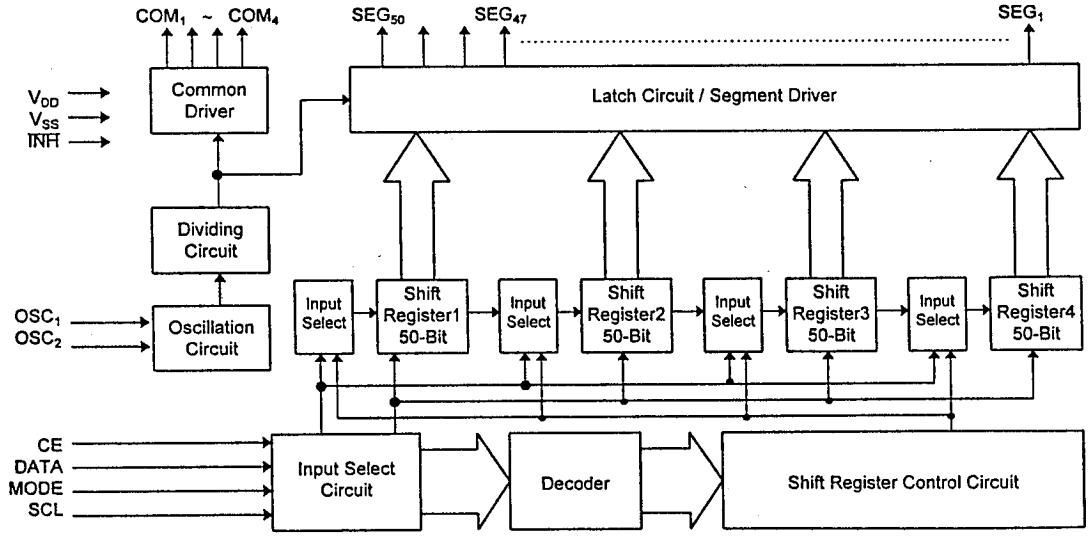
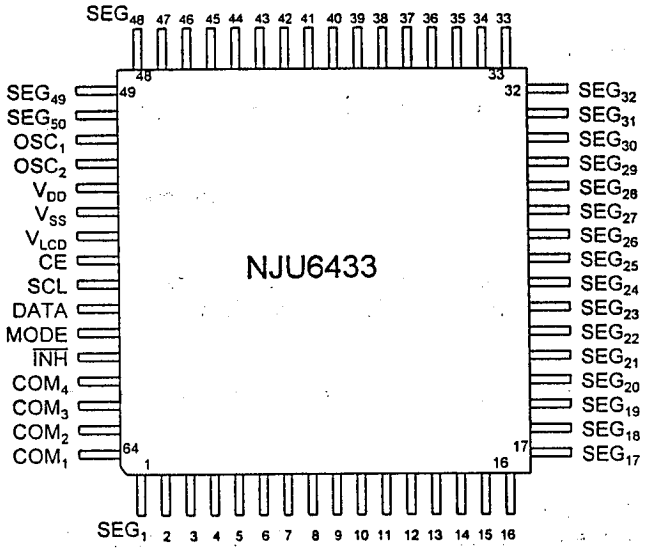
■ BLOCK DIAGRAM



■ PIN CONFIGURATION



■ TERMINAL DESCRIPTION

NO.	SYMBOL	F U N C T I O N
1~50	SEG_1 ~ SEG_{50}	LCD Segment Output Terminals
51 52	OSC_1 OSC_2	Oscillation Terminals : External resistance is connected to these terminals.
53	V_{DD}	Power Supply (+5V)
54	V_{SS}	Power Supply (0V)
55	V_{LCD}	Power Supply for LCD Driving The relation : $\lvert V_{DD} - V_{LCD} \rvert \leqq 1.3V_{DD}$, $V_{LCD} \geqq V_{SS}$ must be maintained.
56	CE	Chip Enable Signal Input Terminal : "H" : LCD display data and mode setting data input "L" : Disable Fall Edge : LCD display data latch
57	SCL	Serial Data Transmission Clock Input Terminal : LCD display and Mode setting data are input synchronized SCL clock signal rise edge.
58	DATA	Serial Data Input Terminal Data input timing : SCL clock rise edge
59	MODE	Data or Mode Select Terminal "H" : Data input mode "L" : LCD display data input mode (refer the mode setting table for mode setting contents)
60	$\overline{INH}$	Display-Off Control Terminal : When display goes to off, the display data in the shift-register is retained. "H" : Display-On "L" : Display-Off
61~64	COM_4~COM_1	LCD Common Output Terminals

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■ FUNCTIONAL DESCRIPTION

(1) Operation of each block

(1-1)Oscillation Circuit :

The oscillation circuit operate by connecting external resistance (capacitance is incorporated).

This circuit provides the clock signal to both common and segment drivers.

(1-2)Divider Circuit

This circuit divides the oscillating signal to generate the common and segment timing.

(1-3)Shift-Register

When the CE terminal is "H" (Enable mode), the display data is transferred to the shift-register synchronized by the shift clock on the SCL terminal.

(1-4)Latch Circuit and Segment Driver

When the CE signal falling, the display data is latched, and the data controls the segment signal of display-on/off.

(2) Data Input Format

(2-1)Input Data Correspond to Segment Status

The "H" input data correspond to segment "ON" and "L" correspond to "OFF".

Data Dxxx	Segment Status
"H"	ON
"L"	OFF

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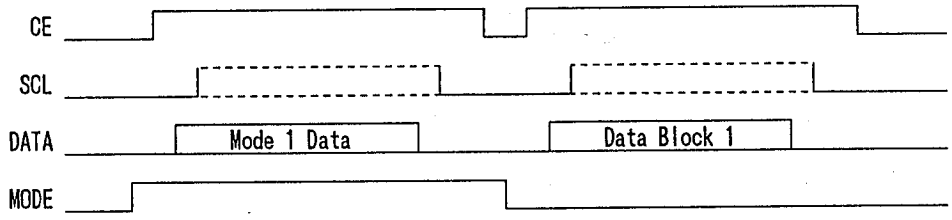
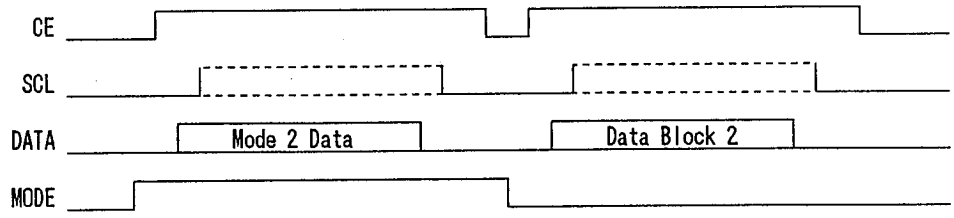
(2-2)Write to Shift-register

Write to shift-register performes Mode setting data writing and LCD display data writing.

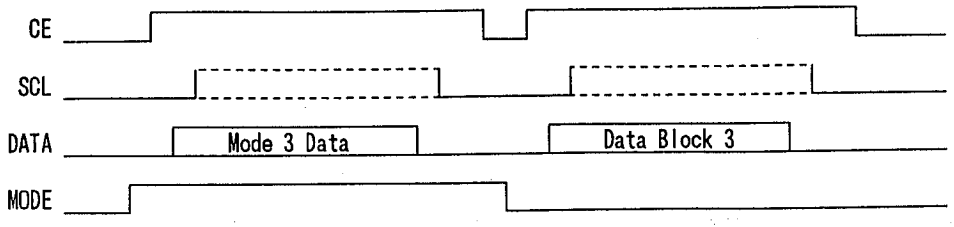
Example 1(Mode 1): Write to Shift-register 1(1 to 50-bit)



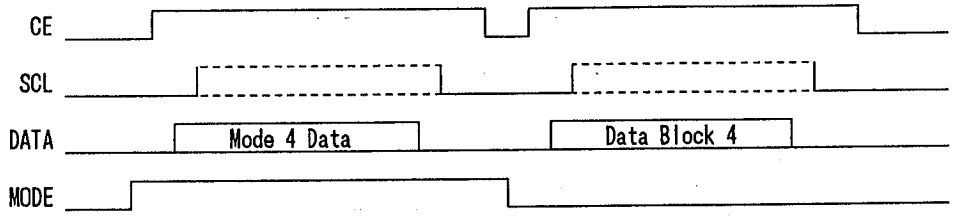
Example 2(Mode 2): Write to Shift-register 2(51 to 100-bit)



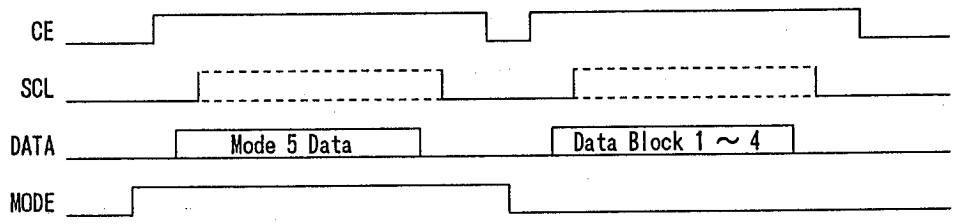
Example 3(Mode 3): Write to Shift-register 3(101 to 150-bit)



Example 4(Mode 4): Write to Shift-register 4(151 to 200-bit)



Example 5(Mode 5): Write to Shift-register 5(1 to 200-bit)



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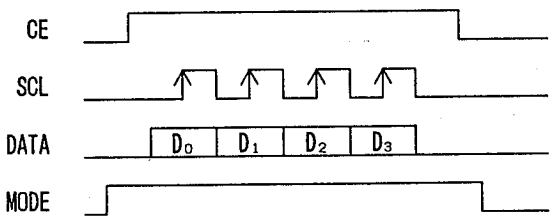
(2-3)Mode Setting

Transferd register selection and all clear of the shift register are performed by writing 4-bit code shown below to the decoder in CE ="H" and MODE ="H" state.

< Input Timing Chart >



< Mode Setting Table >

CE Terminal	MODE Terminal	DATA Terminal D_3 D_2 D_1 D_0	MODE # Data (HEX)	Mode Set Up
"H"	"H"	0 0 0 1	(01_H)	Select the shift-register 1
		0 0 1 0	(02_H)	Select the shift-register 2
		0 0 1 1	(03_H)	Select the shift-register 3
		0 1 0 0	(04_H)	Select the shift-register 4
		0 1 0 1	(05_H)	Select the all shift-register (1 to 4)
		1 1 1 1	($0F_H$)	All shift-register is "L"

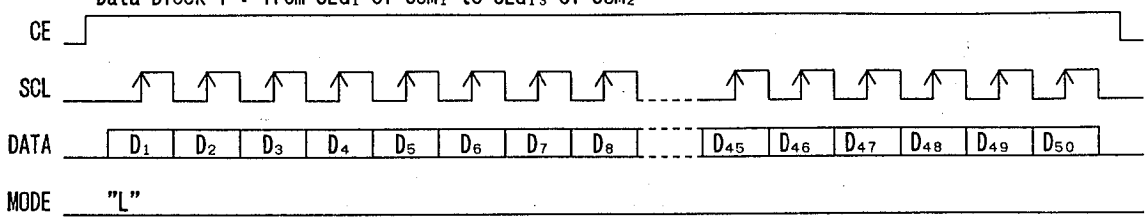
Note) The internal decoder is data through type. Therefore, the 8 bits data also can write though only 4 bits data from the CE falling are validated.

(2-4)Block Data and Whole Data transfer

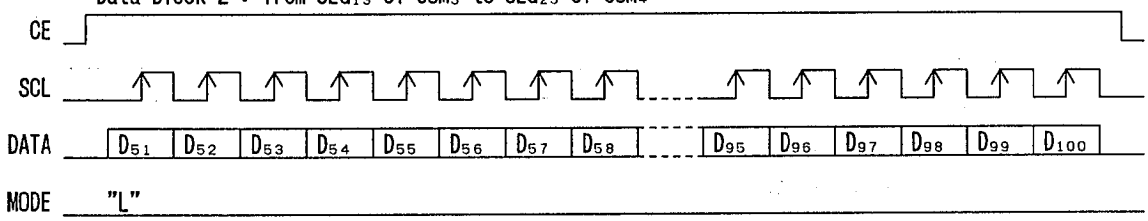
a.Block Data(50-bit) transfer

In this mode, each 50 bits data block send to the each register.

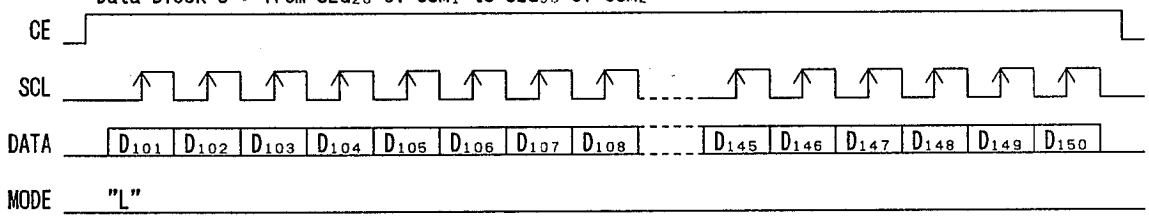
Data Block 1 : from SEG_1 of COM_1 to SEG_{13} of COM_2



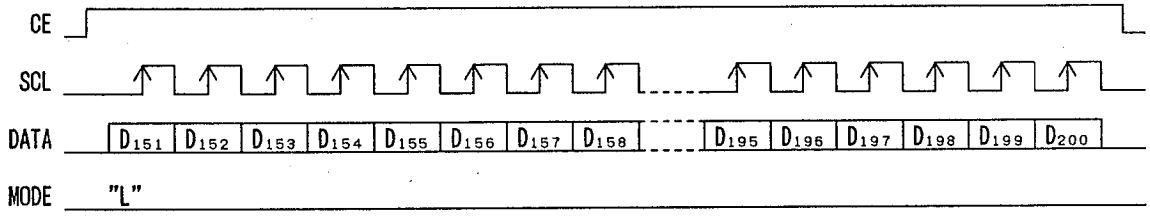
Data Block 2 : from SEG_{13} of COM_3 to SEG_{25} of COM_4



Data Block 3 : from SEG_{26} of COM_1 to SEG_{38} of COM_2

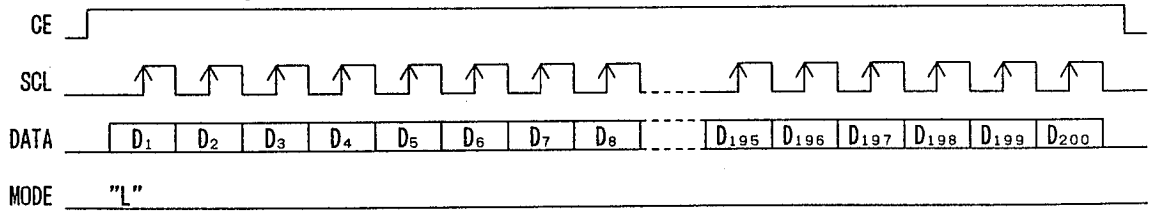


Data Block 4 : from SEG_{38} of COM_3 to SEG_{50} of COM_4



b.Whole Data(200-bit) transfer

from shift-register 1 to shift-register 4



(2-5)Display Data Correspond to Segment and Common Terminals

Mode	Data	Segment	COM_1	COM_2	COM_3	COM_4	Data Block
Mode 1	D_1 D_2 D_3 D_4	SEG_1	○	○	○	○	Data Block 1
	D_5 D_6 D_7 D_8	SEG_2	○	○	○	○	
	⋮	⋮	⋮	⋮	⋮	⋮	
	D_{45} D_{46} D_{47} D_{48}	SEG_{12}	○	○	○	○	
	D_{49} D_{50}	SEG_{13}	○	○			
Mode 2	D_{51} D_{52}	SEG_{13}			○	○	Data Block 2
	D_{53} D_{54} D_{55} D_{56}	SEG_{14}	○	○	○	○	
	⋮	⋮	⋮	⋮	⋮	⋮	
	D_{97} D_{98} D_{99} D_{100}	SEG_{25}	○	○	○	○	
Mode 3	D_{101} D_{102} D_{103} D_{104}	SEG_{26}	○	○	○	○	Data Block 3
	D_{105} D_{106} D_{107} D_{108}	SEG_{27}	○	○	○	○	
	⋮	⋮	⋮	⋮	⋮	⋮	
	D_{145} D_{146} D_{147} D_{148}	SEG_{37}	○	○	○	○	
	D_{149} D_{150}	SEG_{38}	○	○			
Mode 4	D_{151} D_{152}	SEG_{38}			○	○	Data Block 4
	D_{153} D_{154} D_{155} D_{156}	SEG_{39}	○	○	○	○	
	⋮	⋮	⋮	⋮	⋮	⋮	
	D_{197} D_{198} D_{199} D_{200}	SEG_{50}	○	○	○	○	

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■ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNIT
Operating Voltage (1)		V_{DD}	- 0.3 ~ + 7.0	V
Operating Voltage (2)	Note 1)	V_{LCD}	V_{DD} - 6.5 ~ V_{SS}	V
Input Voltage (1)	Note 2)	$V_{I(1)}$	- 0.3 ~ + 7.0	V
Input Voltage (2)	Note 3)	$V_{I(2)}$	- 0.3 ~ V_{DD}+0.3	V
Output Voltage	Note 3)	V_O	- 0.3 ~ V_{DD}+0.3	V
Output Current (1)	Note 4)	$I_{O(1)}$	100	μA
Output Current (2)	Note 5)	$I_{O(2)}$	1.0	mA
Power Dissipation		P_D	300	mW
Operating Temperature		Topr	- 30 ~ + 85	℃
Storage Temperature		Tstg	- 40 ~ + 125	℃

Note 1) $|V_{DD} - V_{LCD}| \leqq 1.3V_{DD}$, $V_{LCD} \geqq V_{SS}$
Note 2) CE, SCL, DATA, MODE, $\overline{INH}$ Terminals
Note 3) OSC_1, OSC_2 Terminals
Note 4) SEG_1 ~ SEG_{50} Terminals
Note 5) COM_1 ~ COM_4 Terminals

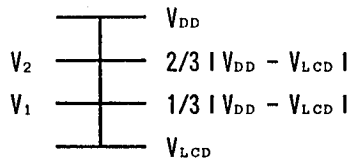
■ ELECTRICAL CHARACTERISTICS

· DC Characteristics

(Ta=25℃, V_{DD}=5.0V, V_{SS}=0V, V_{LCD}=V_{DD}-6.5V)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Operating Voltage (1)	V_{DD}	V_{DD} Terminal		2.4	5.0	5.5	V
Operating Voltage (2)	V_{LCD}	V_{LCD} Terminal Note 6)		V_{SS}		V_{DD}-6.5	V
"H" Input Voltage	V_{IH}	CE,SCL,DATA,MODE,		0.7V_{DD}		V_{DD}	V
"L" Input Voltage	V_{IL}	$\overline{INH}$ Terminals		V_{SS}		0.3V_{DD}	V
"H" Input Current	I_{IH}	CE,SCL,DATA,MODE,	V_I=V_{DD}			5.0	μA
"L" Input Current	I_{IL}	$\overline{INH}$ Terminals	V_I=V_{SS}			5.0	μA
"H" Output Voltage (1)	$V_{OH(1)}$	SEG_1~SEG_{50}	I_O=-10μA	V_{DD}-1.0			V
"L" Output Voltage (1)	$V_{OL(1)}$		I_O=+10μA			V_{LCD}+1.0	V
Middle Level Voltage 1/3 (1)	$V_{MS1/3}$	SEG_1~SEG_{50}	I_O=±10μA	V_1-1.0	V_1	V_1+1.0	V
Middle Level Voltage 2/3 (1)	$V_{MS2/3}$	Note 7)	I_O=±10μA	V_2-1.0	V_2	V_2+1.0	V
"H" Output Voltage (2)	$V_{OH(2)}$	COM_1~COM_4	I_O=-100μA	V_{DD}-0.6			V
"L" Output Voltage (2)	$V_{OL(2)}$		I_O=+100μA			V_{LCD}-0.6	V
Middle Level Voltage 1/3 (2)	$V_{MC1/3}$	COM_1~COM_4	I_O=±100μA	V_1-0.6	V_1	V_1+0.6	V
Middle Level Voltage 2/3 (2)	$V_{MC2/3}$	Note 7)	I_O=±100μA	V_2-0.6	V_2	V_2+0.6	V
Oscillating Frequency Range	f_{osc}	OSC_1, OSC_2 Terminals		25		200	kHz
Oscillating Frequency	f_{osc}		R=140kΩ	115	130	145	kHz
Operating Current (1)	I_{DD}	V_{DD} Terminal			50	80	μA
Operating Current (2)	I_{LCD}	V_{LCD} Terminal			15	25	μA
Hysteresis Voltage	V_H	CE,SCL,DATA,MODE, $\overline{INH}$ Terminals		0.3			V

Note 6) The relation: $|V_{DD} - V_{LCD}| \leqq 1.3V_{DD}$, $V_{LCD} \leqq V_{SS}$ must be maintained.
Note 7) $V_1=1/3\,|V_{DD} - V_{LCD}|$, $V_2=2/3\,|V_{DD} - V_{LCD}|$

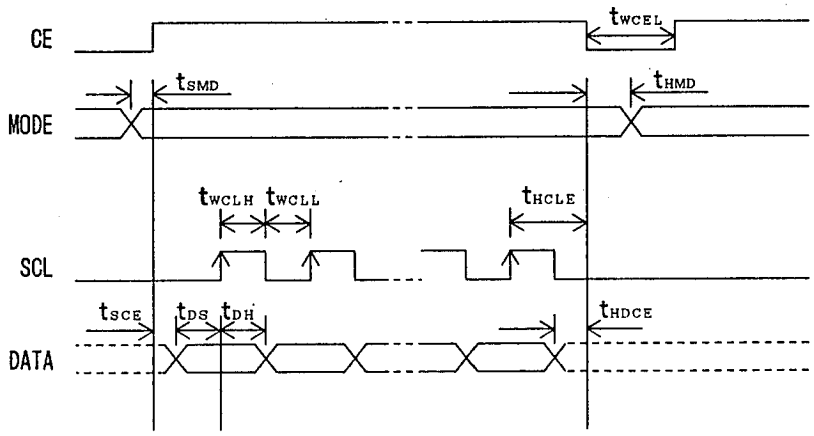


- **AC Characteristics**

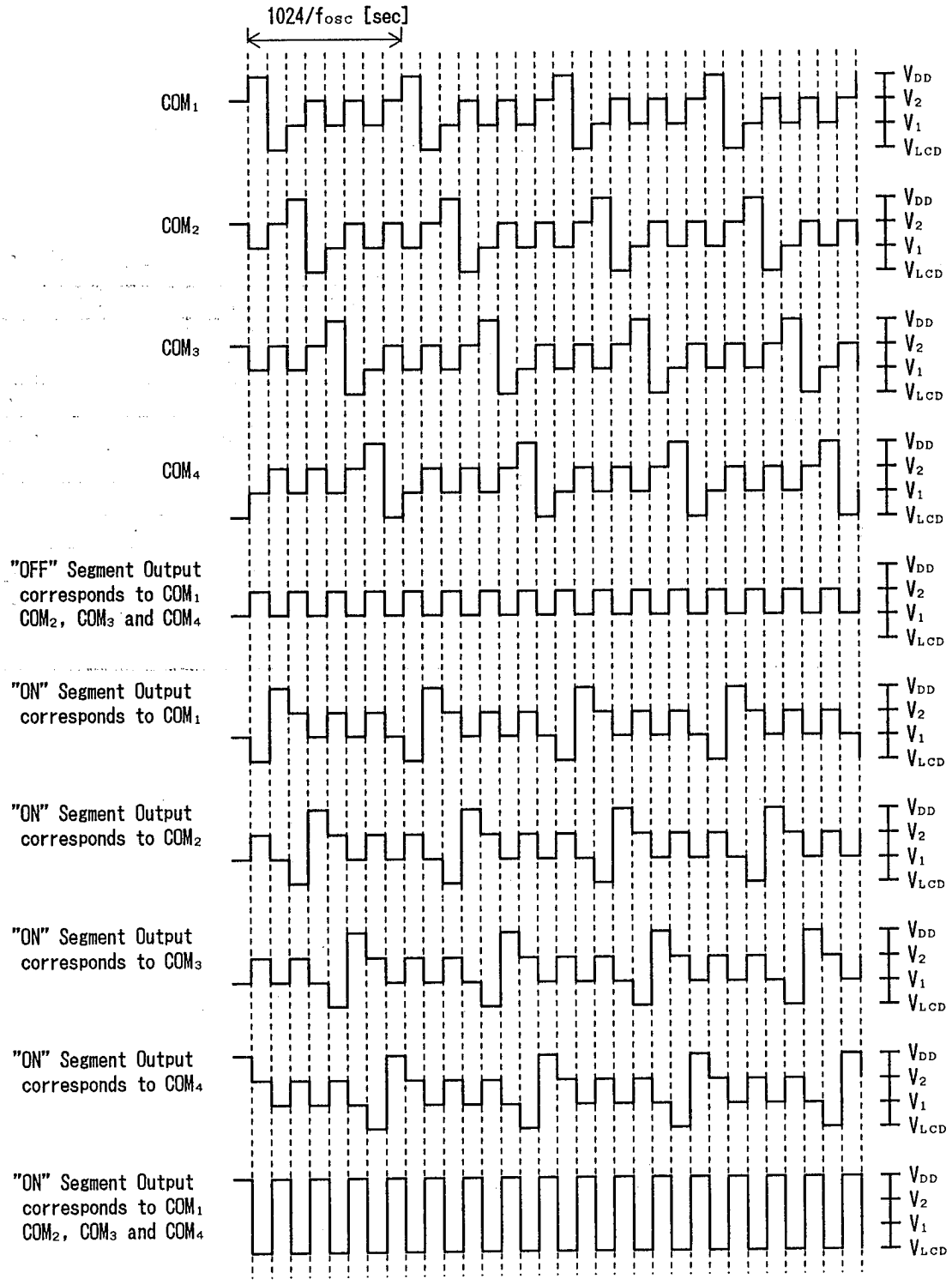
(Ta=25℃, V_{DD}=5.0V, V_{SS}=0V, $V_{LCD}=V_{DD}$-6.5V)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
"L" Clock Pulse Width	t_{WCLL}	SCL Terminal	0.25			μs
"H" Clock Pulse Width	t_{WCLH}		0.25			μs
Data Set-up Time	t_{DS}	SCL, DATA Terminals	0.25			μs
Data Hold Time	t_{DH}		0.25			μs
CE Set-up Time	t_{SCE}	CE, DATA Terminals	1.0			μs
CE Hold Time (1)	t_{HDCE}		1.0			μs
CE Hold Time (2)	t_{HCLE}	CE, SCL Terminals	1.25			μs
Mode Set-up Time	t_{SMD}	CE, MODE Terminals	0.25			μs
Mode Hold Time	t_{HMD}		0.25			μs
"L" Chip Enable Pulse Width	t_{WCEL}	CE Terminal	4.0			μs

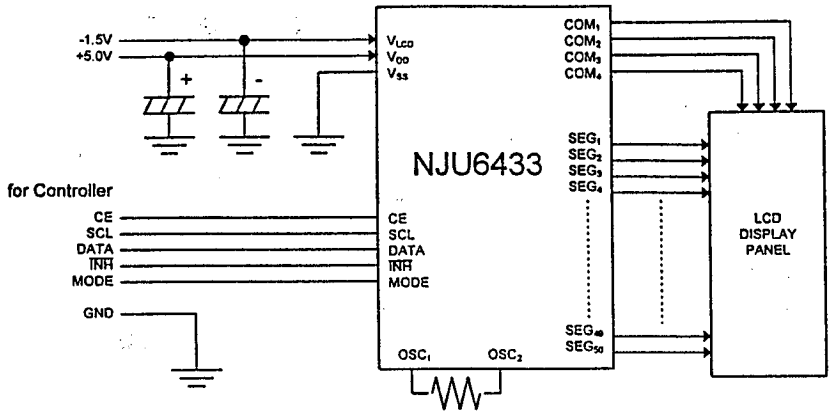
- **Input Timing Characteristics**



■ LCD Driving Waveform(1/4DUTY・1/3BIAS)



■ APPLICATION CIRCUIT



(Note) The internal display data is undefined when V_{DD} is just turned on.
To avoid the meaningless display, please keep the $\overline{INH}$ terminal at "L" until proper display data has been transferred.
In order to set the initial condition, 200-bit blank data or the first 200-bit data to be displayed should be transferred.

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MEMO