

1/4 DUTY LCD DRIVER

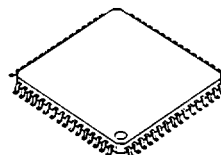
GENERAL DESCRIPTION

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

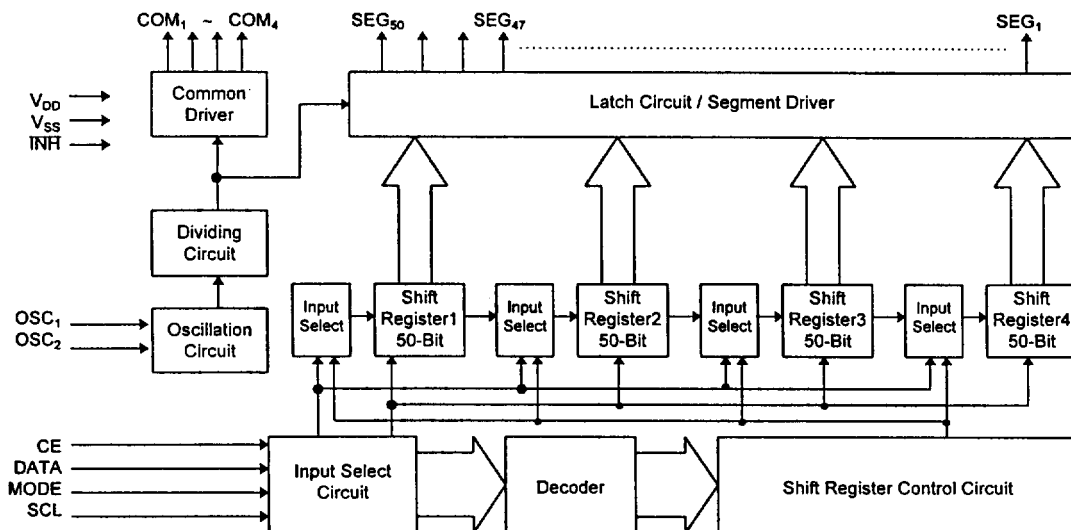


NJU6433F

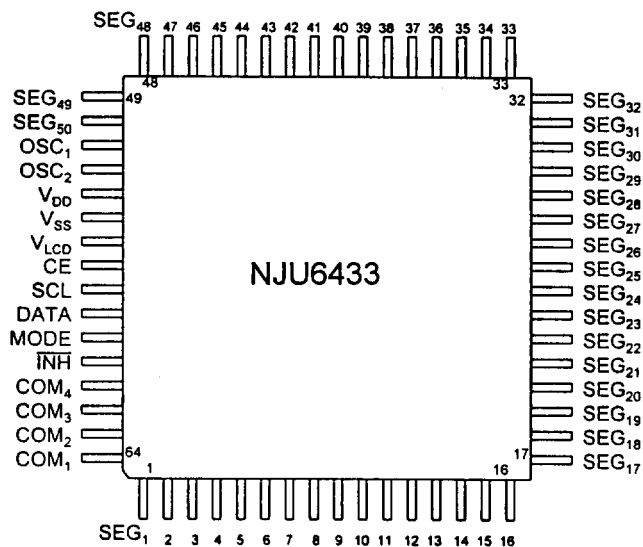
FEATURES

- 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 (TNH Terminal)
- Operating Voltage --- 2.4~5.5V
- LCD Driving Voltage --- 6.5V Max.
- Package Outline --- QFP 64 (D1, G1)
- C-MOS Technology

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	OSC ₁	Oscillation Terminals : External resistance is connected to these terminals.
52	OSC ₂	
53	V _{DD}	Power Supply (+5V)
54	V _{SS}	Power Supply (0V)
55	V _{LCD}	Power Supply for LCD Driving The relation : $ V_{DD} - V_{LCD} \leq 1.3V_{DD}$, $V_{LCD} \geq V_{SS}$ 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	TNH	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

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

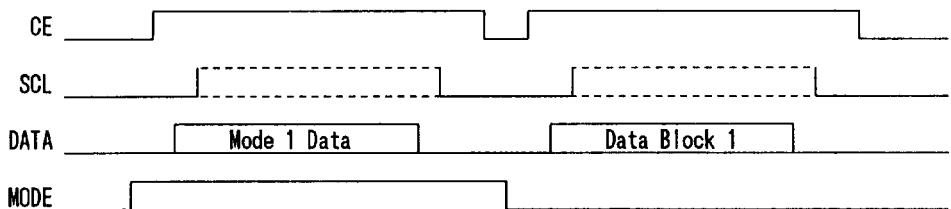
The "H" input data correspond to segment "ON" and "L" correspond to "OFF".

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

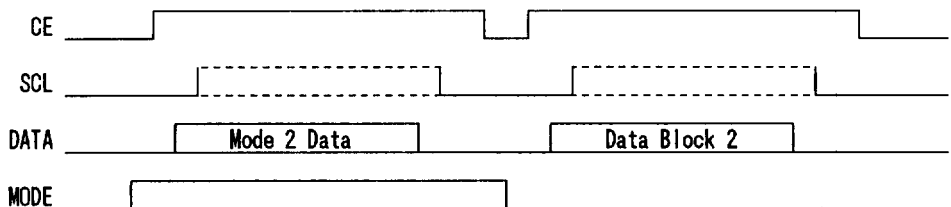
(2-2) Write to Shift-register

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

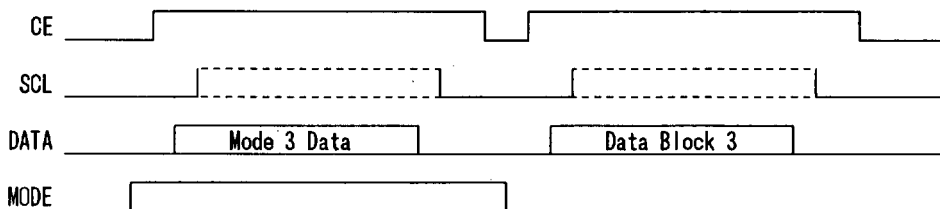
Example 1 (Mode 1): Write to Shift-register 1 (1 to 50-bit)



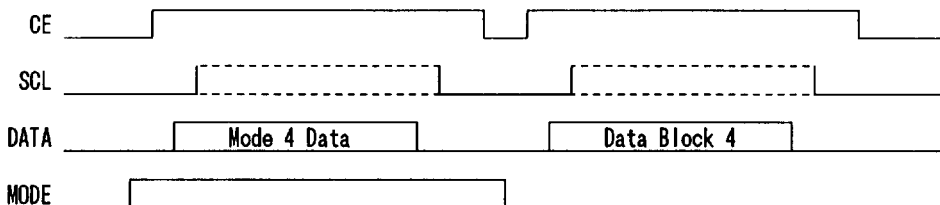
Example 2 (Mode 2): Write to Shift-register 2 (51 to 100-bit)



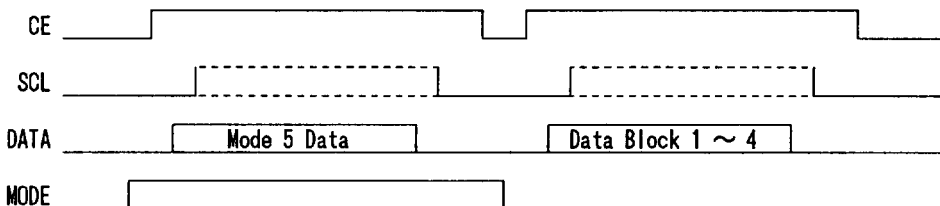
Example 3(Mode 3): Write to Shift-register 3(101 to 150-bit)



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)

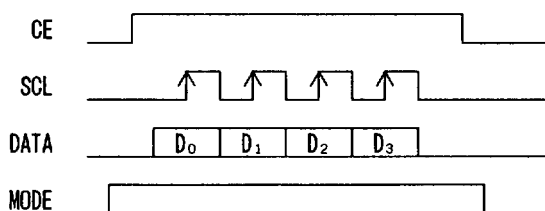


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(2-3) Mode Setting

Transfer 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	MODE # Data	Mode Set Up
		D ₃ D ₂ D ₁ D ₀ (HEX)		
"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"

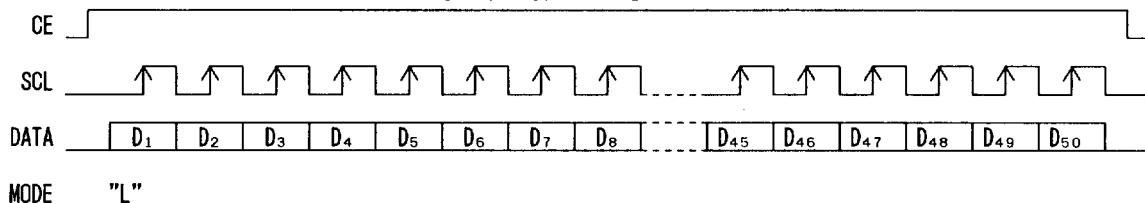
Note) The internal decoder is data through type. Therefore, the 8 bits data also can write though only 4 bits data from the CE falling are validated.

(2-4)Block Data and Whole Data transfer

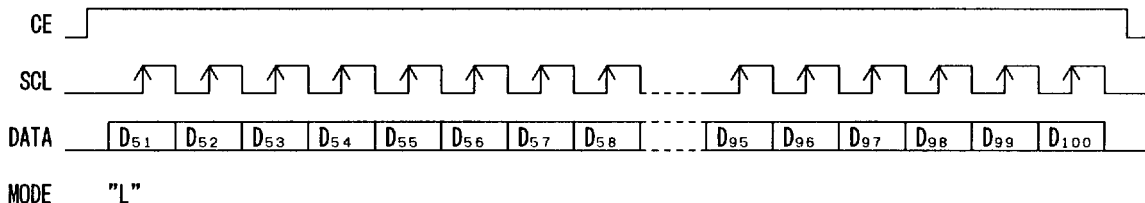
a.Block Data(50-bit) transfer

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

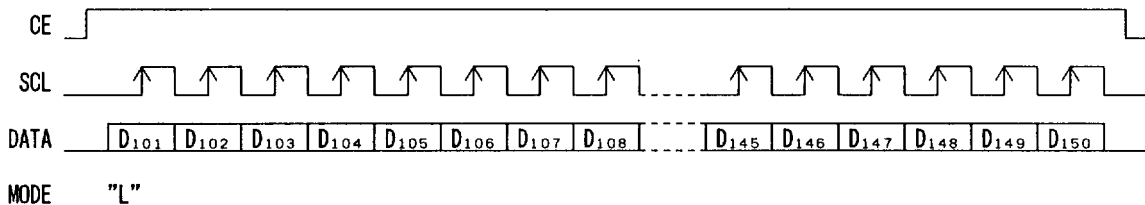
Data Block 1 : from SEG₁ of COM₁ to SEG₁₃ of COM₂



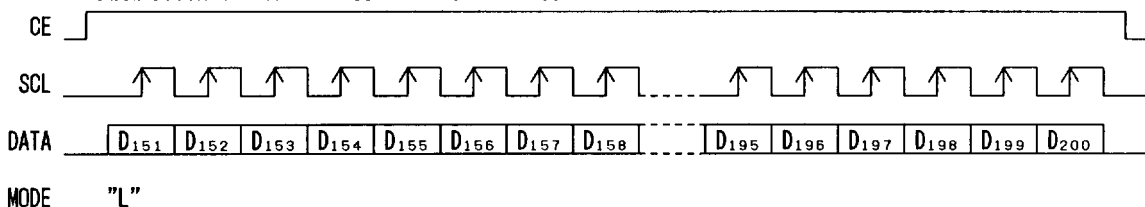
Data Block 2 : from SEG₁₃ of COM₃ to SEG₂₅ of COM₄



Data Block 3 : from SEG₂₆ of COM₁ to SEG₃₈ of COM₂

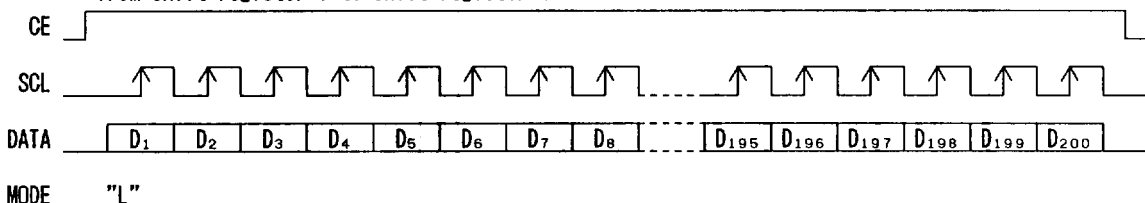


Data Block 4 : from SEG₃₈ of COM₃ to SEG₅₀ of COM₄



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	○	○	○	○	

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Operating Voltage (1)	V_{DD}	- 0.3 ~ + 7.0	V
Operating Voltage (2) Note 1)	V_{LCD}	$V_{DD} - 6.5 \sim V_{SS}$	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	T_{opr}	- 30 ~ + 85	$^{\circ}C$
Storage Temperature	T_{stg}	- 40 ~ + 125	$^{\circ}C$

Note 1) $1V_{DD} - V_{LCD} \leq 1.3V_{DD}$, $V_{LCD} \leq V_{SS}$

Note 2) CE, SCL, DATA, MODE, $\overline{TNH}$ Terminals

Note 3) OSC₁, OSC₂ Terminals

Note 4) SEG₁ ~ SEG₅₀ Terminals

Note 5) COM₁ ~ COM₄ Terminals

ELECTRICAL CHARACTERISTICS

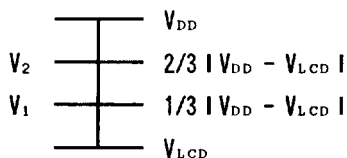
DC Characteristics

($T_a=25^{\circ}C$, $V_{DD}=5.0V$, $V_{SS}=0V$, $V_{LCD}=V_{DD}-6.5V$)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage (1)	V_{DD}	V_{DD} Terminal	2.4		5.5	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}	$\overline{TNH}$ 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}	$\overline{TNH}$ Terminals $V_I=V_{SS}$			5.0	μA
"H" Output Voltage (1)	$V_{OH(1)}$	SEG ₁ ~ SEG ₅₀ $I_o=-10\mu A$	$V_{DD}-1.0$			V
"L" Output Voltage (1)	$V_{OL(1)}$	$I_o=+10\mu A$			$V_{LCD}+1.0$	V
Middle Level Voltage 1/3 (1)	$V_{MS1/3}$	SEG ₁ ~ SEG ₅₀ $I_o=\pm 10\mu A$	$V_1-1.0$	V_1	$V_1+1.0$	V
Middle Level Voltage 2/3 (1)	$V_{MS2/3}$	Note 7) $I_o=\pm 10\mu A$	$V_2-1.0$	V_2	$V_2+1.0$	V
"H" Output Voltage (2)	$V_{OH(2)}$	COM ₁ ~ COM ₄ $I_o=-100\mu A$	$V_{DD}-0.6$			V
"L" Output Voltage (2)	$V_{OL(2)}$	$I_o=+100\mu A$			$V_{LCD}-0.6$	V
Middle Level Voltage 1/3 (2)	$V_{MC1/3}$	COM ₁ ~ COM ₄ $I_o=\pm 100\mu A$	$V_1-0.6$	V_1	$V_1+0.6$	V
Middle Level Voltage 2/3 (2)	$V_{MC2/3}$	Note 7) $I_o=\pm 100\mu A$	$V_2-0.6$	V_2	$V_2+0.6$	V
Oscillating Frequency Range	f_{osc}	OSC ₁ , OSC ₂ Terminals	25		200	kHz
Oscillating Frequency	f_{osc}	$R=140k\Omega$	115	130	145	kHz
Operating Current (1)	I_{DD}	V_{DD} Terminal		50	80	μA
Operating Current (2)	I_{LCD}	V_{LCD} Terminal		15		μA
Hysteresis Voltage	V_H	CE, SCL, DATA, MODE, $\overline{TNH}$ Terminals	0.3			V

Note 6) The relation: $|V_{DD} - V_{LCD}| \leq 1.3V_{DD}$, $V_{LCD} \leq V_{SS}$ must be maintained.

Note 7) $V_1 = 1/3 |V_{DD} - V_{LCD}|$, $V_2 = 2/3 |V_{DD} - V_{LCD}|$



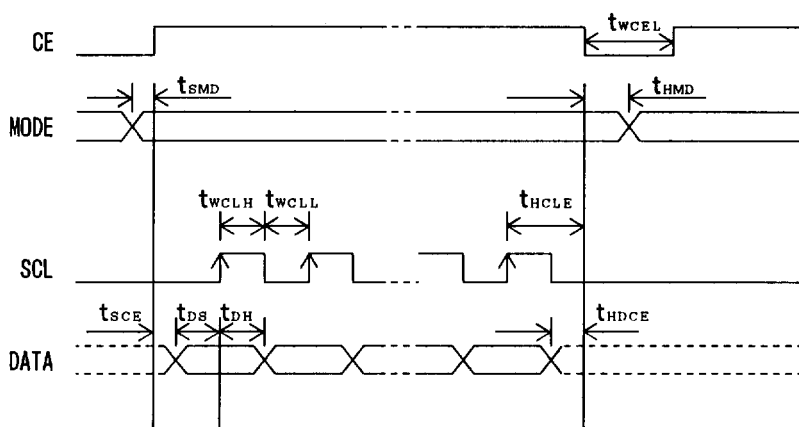
AC Characteristics

($T_a = 25^\circ\text{C}$, $V_{DD} = 5.0\text{V}$, $V_{SS} = 0\text{V}$, $V_{LCD} = V_{DD} - 6.5\text{V}$)

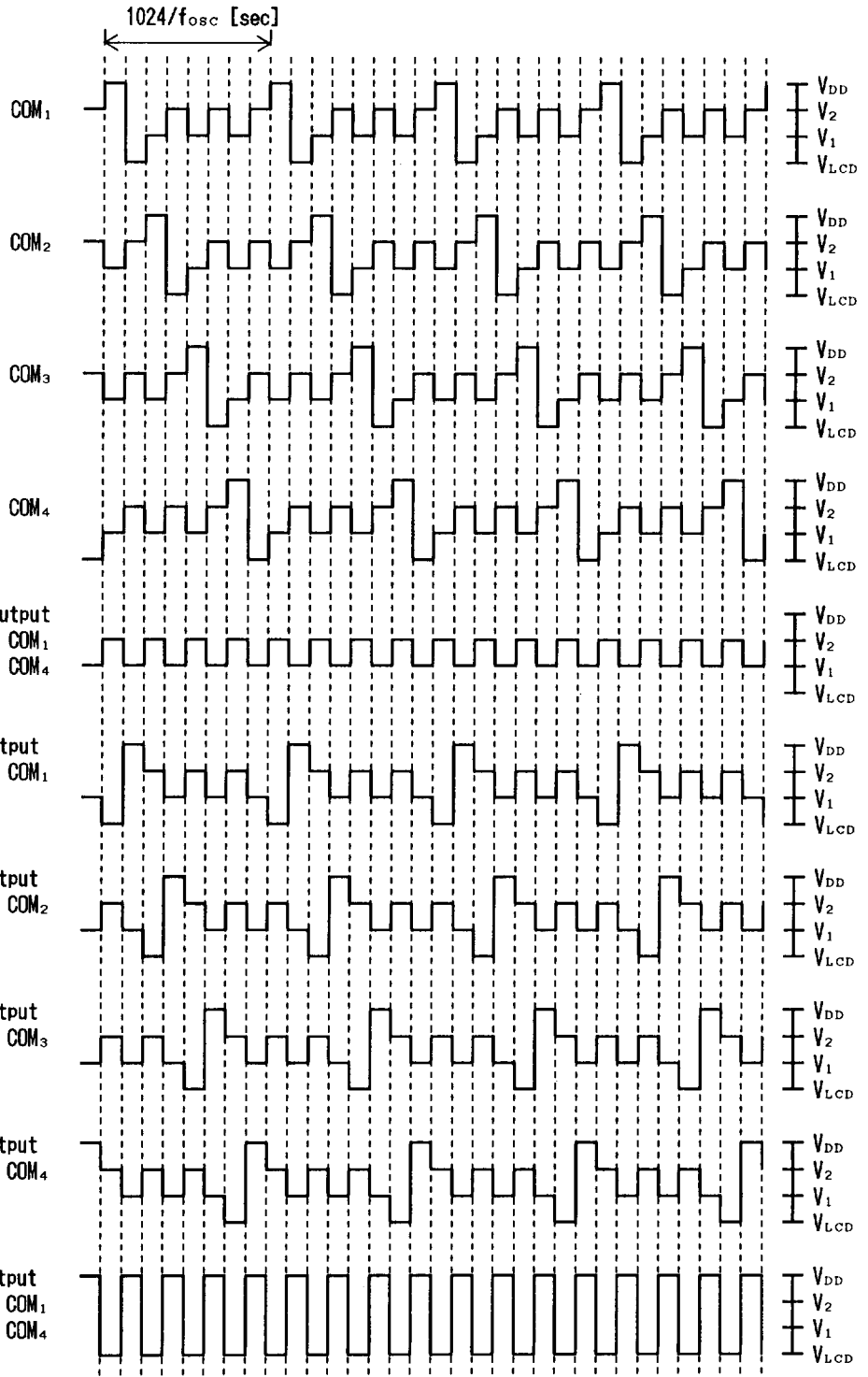
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
"L" Clock Pulse Width	t_{WCLL}	SCL Terminal	0.25			μs
"H" Clock Pulse Width	t_{WCLH}		0.25			μs
Data Set-up Time	t_{DS}	SCL, DATA Terminals	0.25			μs
Data Hold Time	t_{DH}		0.25			μs
CE Set-up Time	t_{SCE}	CE, DATA Terminals	1.0			μs
CE Hold Time (1)	t_{HDCE}		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

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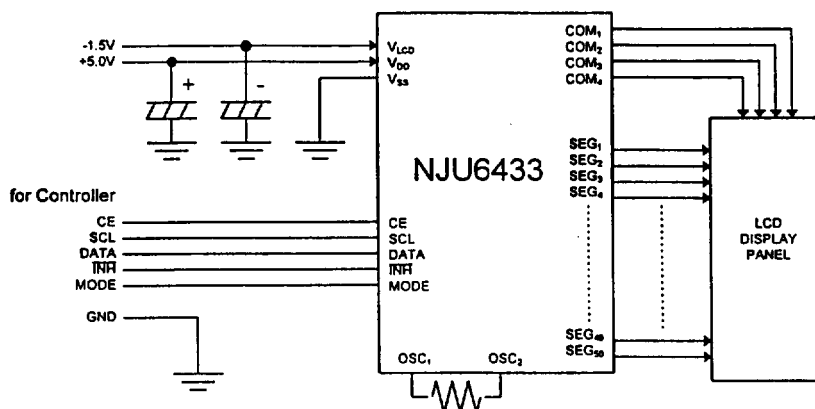
Input Timing Characteristics



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 $\overline{\text{INH}}$ 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.