Panasonic

MN12511

Fluorescent Display Tube Driver LSI

■ Overview

The MN12511 is a fluorescent display tube driver LSI. It accepts data for display transferred over a serial interface, generates the digit and/or segment drive signals, and outputs those signals from 16 high-voltage ports.

This LSI allows the number of digits displayed to be increased easily by the cascade connection of additional MN12511 LSIs. Also, the MN12511 does not preassign the outputs to digits or segments, so it can be used with a wide range of display types.

■ Features

- Sixteen high-voltage handling output ports
  Number of digit outputs (DGT): 1 to 15 outputs can be arbitrarily assigned
  Number of segment outputs (SEG): 1 to 15 outputs can be arbitrarily assigned
- FLP display
  - The display mode can be set to any combination of from 1 DGT $\times$ 15 SEG to 15 DGT $\times$ 1 SEG
  - The display on/off state can be controlled from the OE pin.
- Four-wire serial interface (Includes a chip select signal)
  - Built-in shift register
  - The MN12511 can be connected in cascade.
- Supply voltage
  Digital block (V_{DD}): + 4.5 to 5.5 V
  High-voltage (V_{pp}): V_{DD} − 35 V

■ Applications

- Video, audio, and other equipment that uses fluorescent display tubes

V_{PP} →	1		24	→ D0
NCE →	2		23	→ D1
OE →	3		22	→ D2
NSDO ←	4		21	→ D3
NSDI →	5		20	→ D4
NSCK →	6		19	→ D5
V_{SS} →	7		18	→ D6
V_{DD} →	8		17	→ D7
D15 ←	9		16	→ D8
D14 ←	10		15	→ D9
D13 ←	11		14	→ D10
D12 ←	12		13	→ D11

(TOP VIEW)
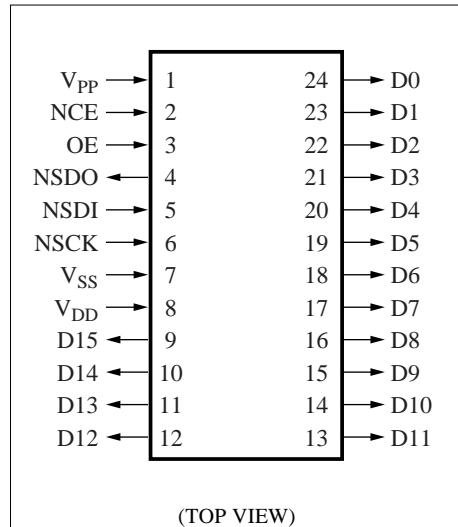
■ Block Diagram
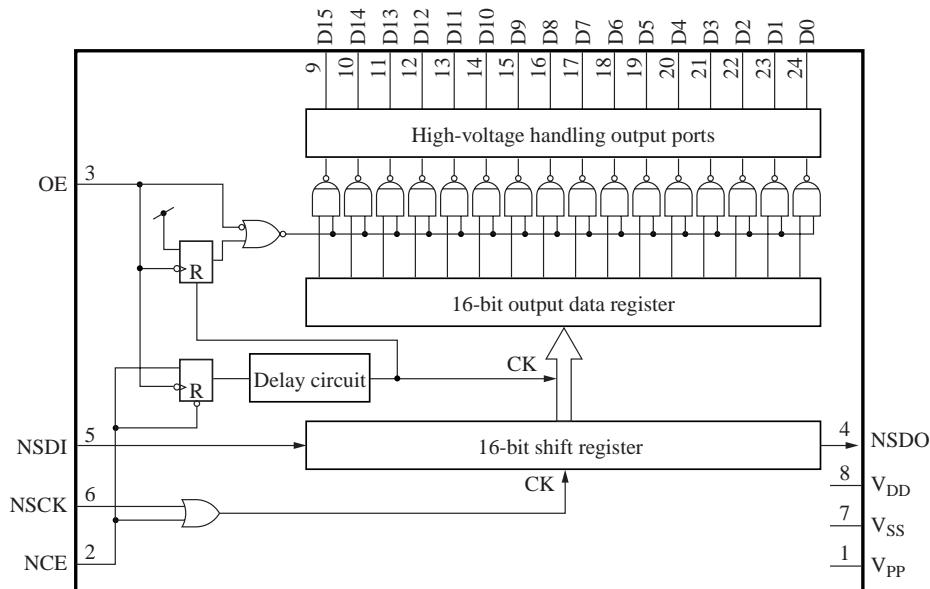
■ Pin Descriptions

Pin No.	Symbol	I/O	Description
1	V_{PP}	I	Pull-down power supply
2	NCE	I	Chip select input
3	OE	I	Display on/off state control input
4	NSDO	O	Serial data output
5	NSDI	I	Serial data input
6	NSCK	I	Serial data clock input
7	V_{SS}	I	Ground (display)
8	V_{DD}	I	Power supply
9	D15	O	High-voltage output 15
10	D14	O	High-voltage output 14
11	D13	O	High-voltage output 13
12	D12	O	High-voltage output 12
13	D11	O	High-voltage output 11
14	D10	O	High-voltage output 10
15	D9	O	High-voltage output 9
16	D8	O	High-voltage output 8
17	D7	O	High-voltage output 7
18	D6	O	High-voltage output 6

■ Pin Descriptions (continued)

Pin No.	Symbol	I/O	Description
19	D5	O	High-voltage output 5
20	D4	O	High-voltage output 4
21	D3	O	High-voltage output 3
22	D2	O	High-voltage output 2
23	D1	O	High-voltage output 1
24	D0	O	High-voltage output 0

■ Operational Description

• Transfer timing

The figure below shows the input timing for the NCE, NSCK, and NSDI pins during data transfers.
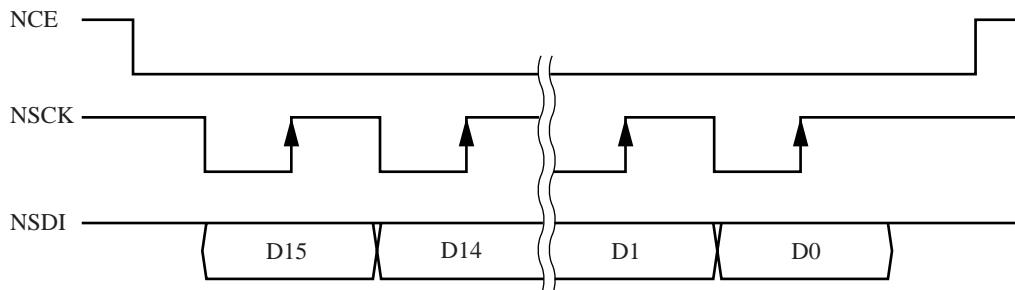

NSDI is acquired on the rising edge of NSCK.
NSDO is output on the falling edge of NSCK.

• Transfer Format

The following transfer formats could be considered as the data format for data transfer from the system microcontroller.

Note that other transfer formats are possible, depending on the requirements of the particular application.

Example: For use with a 6-grid × 10-segment display (Using a single MN12511)

6 grid-bit	10 segment-bit
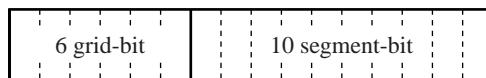
Example: For use with a 15-grid × 11-segment display (Using two MN12511 chips)

*	15 grid-bit	* * * * * *	11 segment-bit
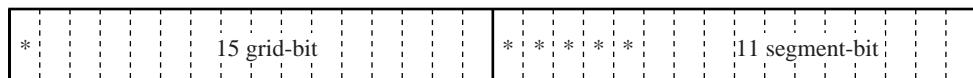
Note) *: Bits marked with an asterisk are unused.

■ Operational Description (continued)

• Display Timing

NCE

NSCK

NSDI

Serial data transferred to
the 16-bit shift register

OE

Display start

D0 to Dn
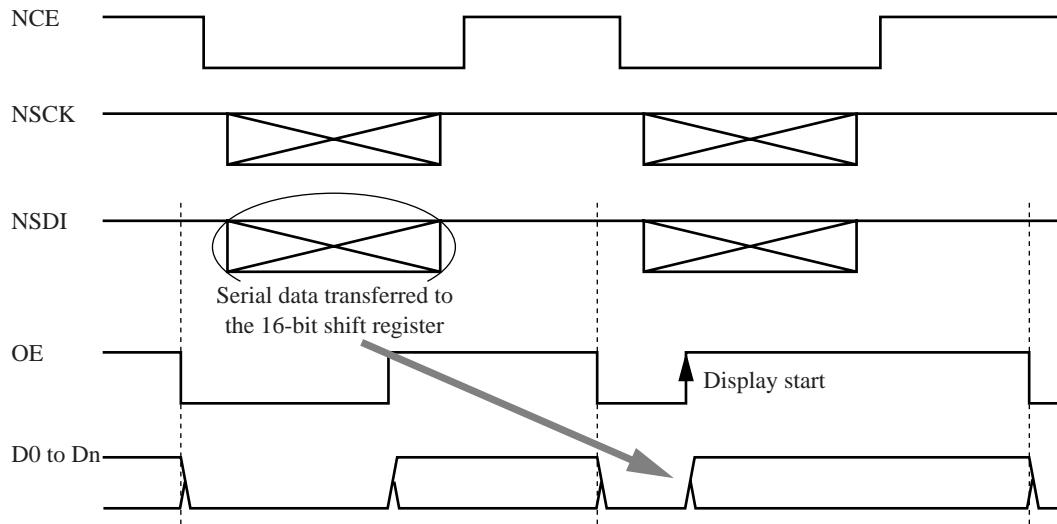
Note) 1. The OE pin should be set low each time the display is changed.

2. If the fluorescent display control input (OE) is set low during a serial data transfer, the MN12511 will detect an incorrect transfer and output the V_{PP} level from all the high-voltage output ports.

■ Electrical Characteristics

1. Absolute Maximum Ratings at V_{SS} = 0 V, T_a = 25 °C±2 °C

Parameter	Symbol	Rating	Unit
Supply voltage (digital power supply)	V_{DD}	− 0.3 to +7.0	V
Supply voltage (High-voltage output power supply)	V_{PP}	V_{DD}− 45 to V_{DD}+0.3	V
Input voltage	VI1	V_{SS}− 0.3 to V_{DD}+0.3	V
Output voltage	VO1	V_{SS}− 0.3 to V_{DD}+0.3	V
I/O voltage	VIO1	V_{SS}− 0.3 to V_{DD}+0.3	V
High-voltage output pin voltage	VIO2	− 40 to V_{DD}+0.3	V
Normal pin peak output current	IOH(peak)	−10	mA
	IOL(peak)	30	
Normal pin average output current	IOH(ave)	−5	mA
	IOL(ave)	15	
High-voltage output pin output current	IOH	−30	mA
Allowable power dissipation	PT	300	mW
Operating temperature	T_{opr}	−10 to +70	°C
Storage temperature	T_{stg}	−55 to +125	°C

Note) 1. These values are limiting values under which the device will not be destroyed. Operation is not guaranteed within these ranges.

2. These values are limiting values such that the device will not be destroyed if voltages within these ranges are applied to the pins. Operation is not guaranteed within these ranges.

3. Applies to any 100 ms period.

■ Electrical Characteristics (continued)

Note) (continued)

4. The rating for capacitance coupled spike noise that exceeds the absolute maximum rating of −40 V and that occurs at most once in any of the display cycles is defined as shown below.
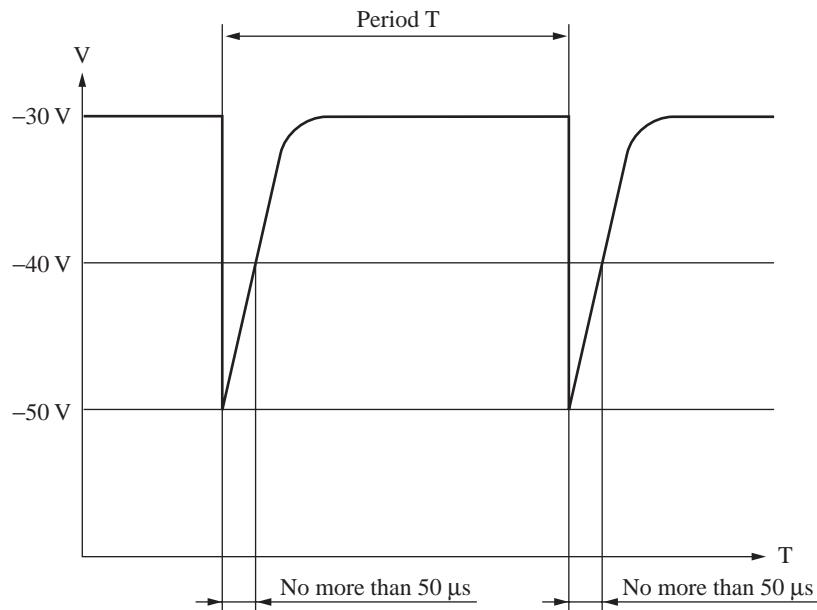
5. Insert a capacitor of at least 0.1 μF between V_{DD} and V_{SS} as close as possible to the LSI pins.

2. Operating Conditions at V_{SS} = 0 V, T_a = −10 °C to 70 °C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		4.5	5.0	5.5	V
	V_{PP}	Potential difference between V_{DD} and V_{PP}.	—	—	35	

3. DC Characteristics at V_{SS} = 0 V, T_a = −10 °C to 70 °C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
1) Supply current						
Operating supply current	I_{DD}		—	3	10	mA
2) Input pins NCE, OE, NSCK, and NSDI (Schmitt inputs)						
High-level input voltage	VIH1		$0.7V_{DD}$	—	V_{DD}	V
Low-level input voltage	VIL1		V_{SS}	—	$0.2V_{DD}$	V
Input leakage current	ILK1	VIN = 0 to 5 V	—	—	±10	μA
3) The NSDO output pin						
High-level output voltage	VOH1	IOH1 = − 0.5 mA	4.5	—	—	V
Low-level output voltage	VOL1	IOL2 = 0.5 mA	—	—	0.5	V

■ Electrical Characteristics (continued)

3. DC Characteristics at V_{SS} = 0 V, T_a = −10 °C to 70 °C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
4) High-voltage output pins D15 to 0 (P-channel open drain, built-in pull-down resistors)						
Output current	IOH2	V_{DD} = 5 V, V_{PP} = −30 V, VOH2 = 3.1 V	−8	—	—	mA
		V_{DD} = 5 V, V_{PP} = −30 V, VOH2 = 2.0 V	−1.5	—	—	
Output leakage current	ILOL2	V_{DD} = 5 V, V_{PP} = −30 V, VOH2 = −30 V, P ch.–Tr. OFF	—	—	±10	μA
Pull-down resistor	RINT2	V_{DD} = 5 V, V_{PP} = −30 V, VOH2 = 5 V	30	—	250	kΩ
		V_{DD} = 5 V, V_{PP} = −30 V, VOH2 = −15 V	30	—	250	

4. AC Characteristics at V_{SS} = 0 V, T_a = −10 °C to 70 °C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Serial clock frequency (NSCK)	f_{NSCK}	Figure 1	—	—	1	MHz
NCE interval (OE → NCE)	T_{OE}	Figure 1	100	—	—	ns
NSCK interval (NCE → NSCK)	T_{NCE}	Figure 1	100	—	—	ns
Serial input setup time (NSDI)	T_{NSDIS}	Figure 2	100	—	—	ns
Serial input hold time (NSDI)	T_{NSDIH}	Figure 2	100	—	—	ns
Serial output delay time (NSDO)	T_{NSDOD}	Figure 2	—	—	100	ns

■ Electrical Characteristics (continued)

4. AC Characteristics at V_{SS} = 0 V, T_a = −10 °C to 70 °C (continued)
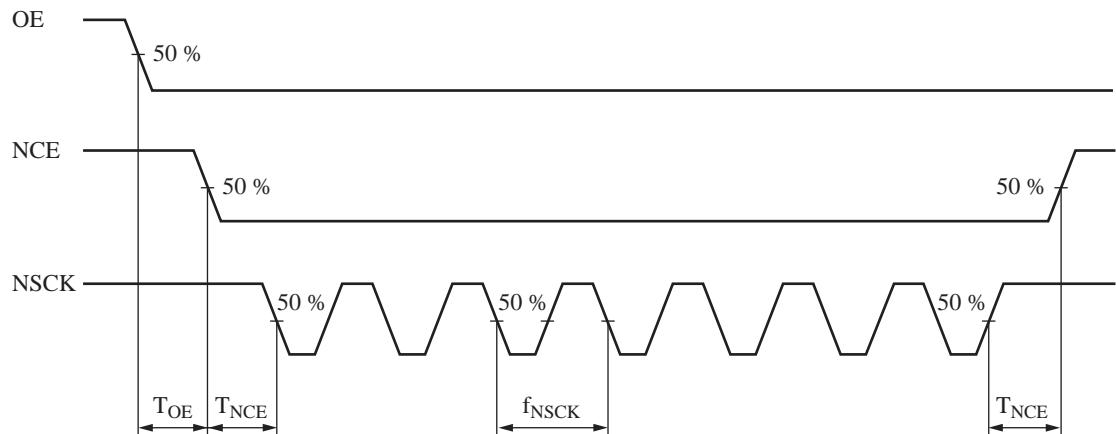
Figure 1   OE, NCE, and NSCK Timing
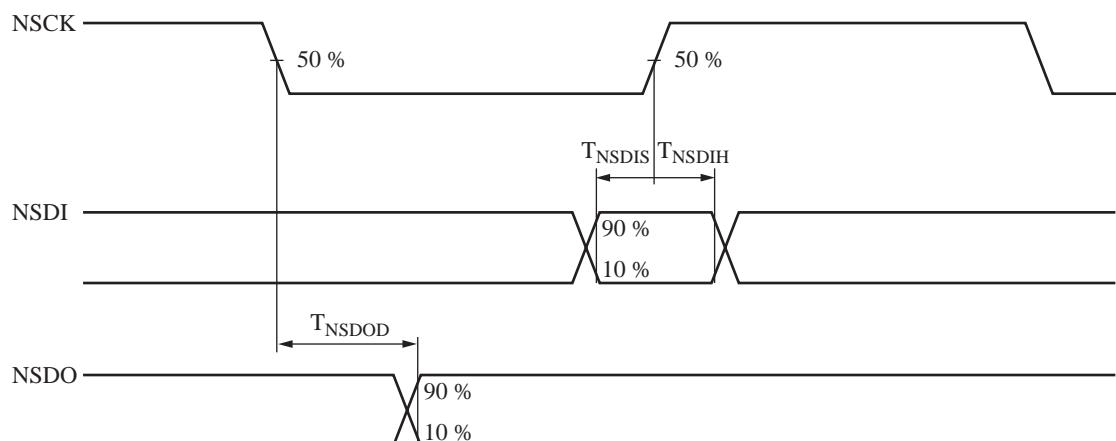
Figure 2   NSCK, NSDI, and NSDO Timing

■ Sample Application Systems

• When one driver LSI is used
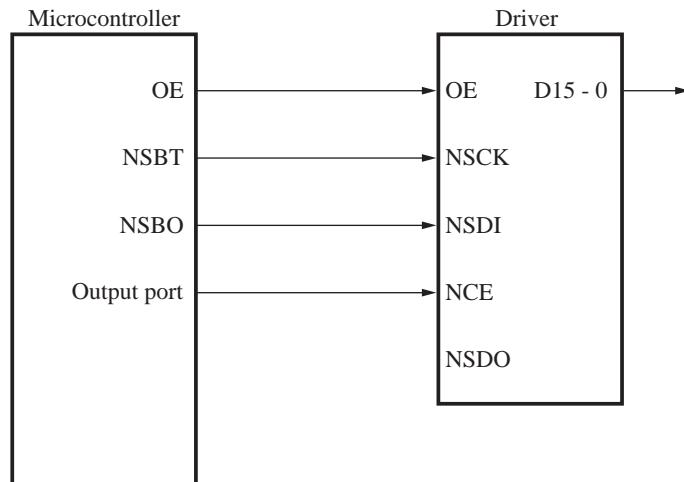
• When two driver LSIs are used
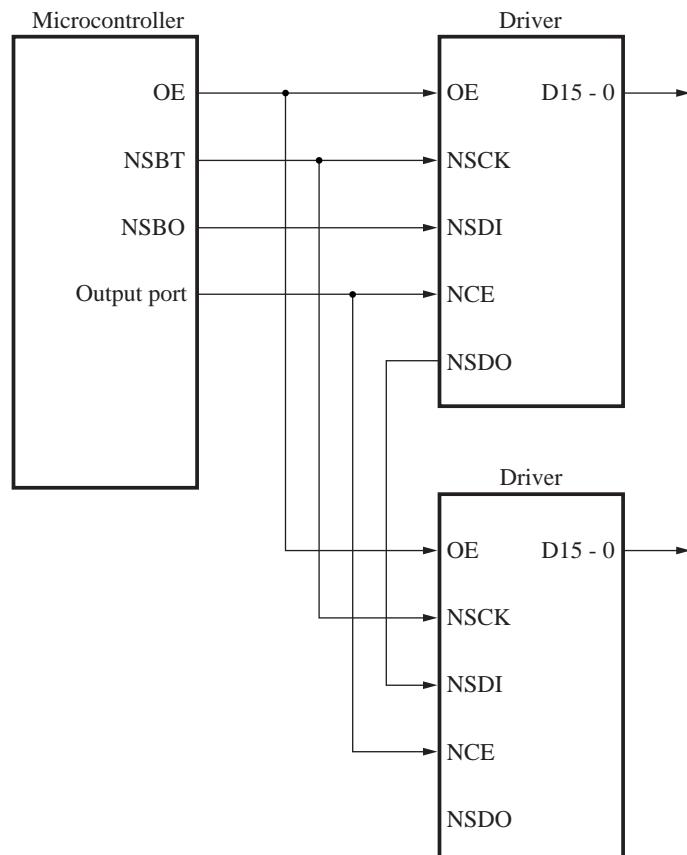
■ Package Dimensions (Unit : mm)

• SOP024-P-0375

15.30±0.20

24   13

7.20±0.20

9.40±0.30

1   12

1.10±0.20

0.15 $^{+0.10}_{-0.05}$

0 to 10°

0.30min.

2.00±0.20

2.40max.

0.10±0.10

(0.67)   1.27   0.40±0.10

Seating plane

Seating plane