

# 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.

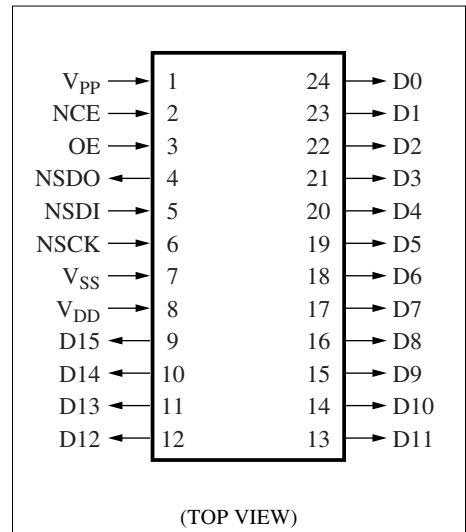
This LSI allows the number of digits displayed to be increased easily by the cascade connection of additional MN12511 LSIs. Also, the MN12511 does not preassign the outputs to digits or segments, so it can be used with a wide range of display types.

### ■ Features

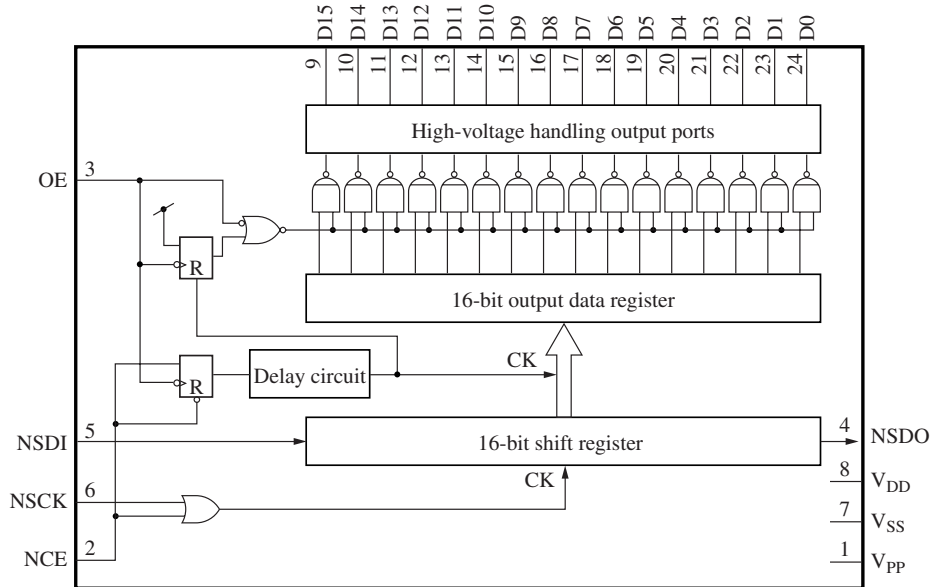
- Sixteen high-voltage handling output ports
  - Number of digit outputs (DGT): 1 to 15 outputs can be arbitrarily assigned
  - Number of segment outputs (SEG): 1 to 15 outputs can be arbitrarily assigned
- FLP display
  - The display mode can be set to any combination of from 1 DGT × 15 SEG to 15 DGT × 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



■ Block Diagram



■ Pin Descriptions

Pin No.	Symbol	I/O	Description
1	V <sub>PP</sub>	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 <sub>SS</sub>	I	Ground (display)
8	V <sub>DD</sub>	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

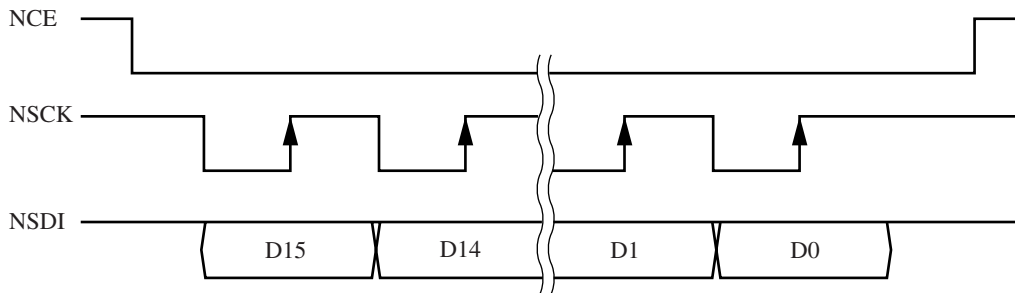
■ Pin Descriptions (continued)

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.



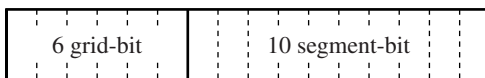
NSDI is acquired on the rising edge of NSCK.  
NSDO is output on the falling edge of NSCK.

• 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)



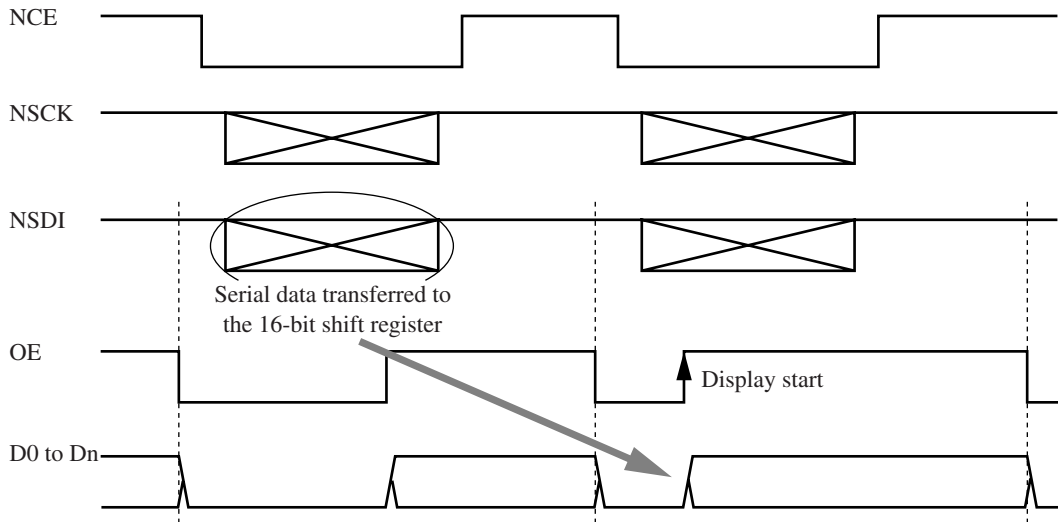
Example: For use with a 15-grid × 11-segment display (Using two MN12511 chips)



Note) \*: Bits marked with an asterisk are unused.

■ Operational Description (continued)

• Display Timing



- 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  $V_{SS} = 0\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C} \pm 2\text{ }^\circ\text{C}$

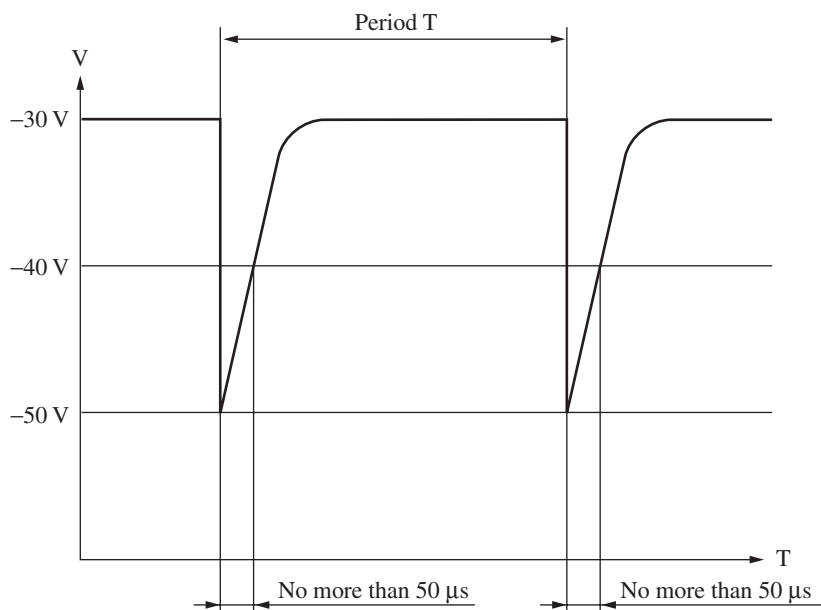
Parameter	Symbol	Rating	Unit
Supply voltage (digital power supply)	$V_{DD}$	- 0.3 to +7.0	V
Supply voltage (High-voltage output power supply)	$V_{PP}$	$V_{DD} - 45$ to $V_{DD} + 0.3$	V
Input voltage	$V_{I1}$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Output voltage	$V_{O1}$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
I/O voltage	$V_{IO1}$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
High-voltage output pin voltage	$V_{IO2}$	- 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	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +125	$^\circ\text{C}$

- 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  $0.1 \mu\text{F}$  between  $V_{\text{DD}}$  and  $V_{\text{SS}}$  as close as possible to the LSI pins.

### 2. Operating Conditions at $V_{\text{SS}} = 0$ V, $T_a = -10$ °C to $70$ °C

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

### 3. DC Characteristics at $V_{\text{SS}} = 0$ V, $T_a = -10$ °C to $70$ °C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
1) Supply current						
Operating supply current	$I_{\text{DD}}$		—	3	10	mA
2) Input pins NCE, OE, NSCK, and NSDI (Schmitt inputs)						
High-level input voltage	$V_{\text{IH1}}$		$0.7V_{\text{DD}}$	—	$V_{\text{DD}}$	V
Low-level input voltage	$V_{\text{IL1}}$		$V_{\text{SS}}$	—	$0.2V_{\text{DD}}$	V
Input leakage current	$I_{\text{LK1}}$	$V_{\text{IN}} = 0$ to $5$ V	—	—	$\pm 10$	$\mu\text{A}$
3) The NSDO output pin						
High-level output voltage	$V_{\text{OH1}}$	$I_{\text{OH1}} = -0.5$ mA	4.5	—	—	V
Low-level output voltage	$V_{\text{OL1}}$	$I_{\text{OL2}} = 0.5$ mA	—	—	0.5	V

### ■ Electrical Characteristics (continued)

#### 3. DC Characteristics at $V_{SS} = 0\text{ V}$ , $T_a = -10\text{ °C}$ to $70\text{ °C}$ (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	$V_{DD} = 5\text{ V}$ , $V_{PP} = -30\text{ V}$ , $VOH2 = 3.1\text{ V}$	-8	—	—	mA
		$V_{DD} = 5\text{ V}$ , $V_{PP} = -30\text{ V}$ , $VOH2 = 2.0\text{ V}$	-1.5	—	—	
Output leakage current	ILOL2	$V_{DD} = 5\text{ V}$ , $V_{PP} = -30\text{ V}$ , $VOH2 = -30\text{ V}$ , P ch.-Tr. OFF	—	—	$\pm 10$	$\mu\text{A}$
Pull-down resistor	RINT2	$V_{DD} = 5\text{ V}$ , $V_{PP} = -30\text{ V}$ , $VOH2 = 5\text{ V}$	30	—	250	k $\Omega$
		$V_{DD} = 5\text{ V}$ , $V_{PP} = -30\text{ V}$ , $VOH2 = -15\text{ V}$	30	—	250	

#### 4. AC Characteristics at $V_{SS} = 0\text{ V}$ , $T_a = -10\text{ °C}$ to $70\text{ °C}$

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  $V_{SS} = 0\text{ V}$ ,  $T_a = -10\text{ }^\circ\text{C}$  to  $70\text{ }^\circ\text{C}$  (continued)

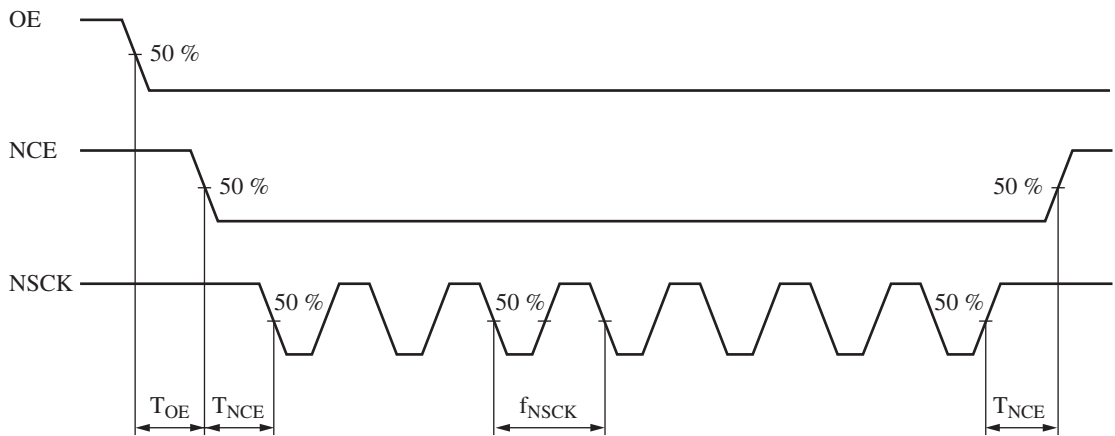


Figure 1 OE, NCE, and NSCK Timing

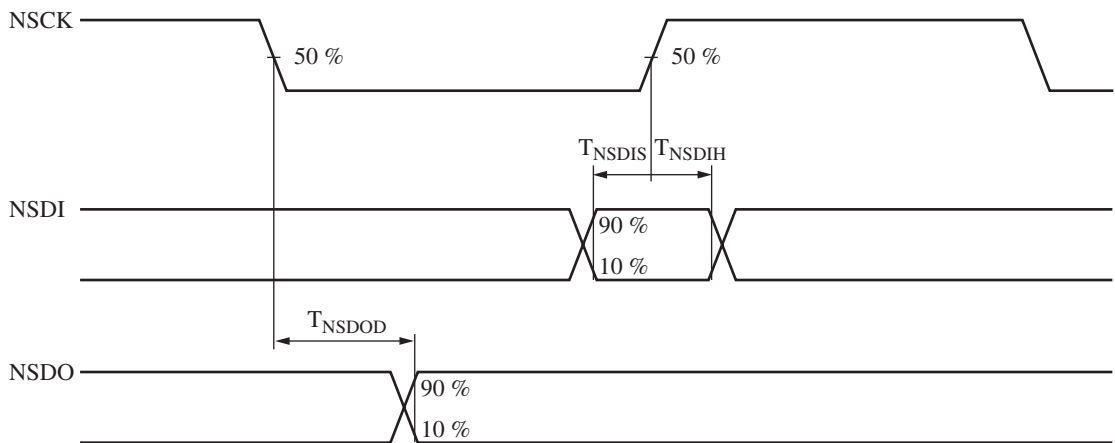
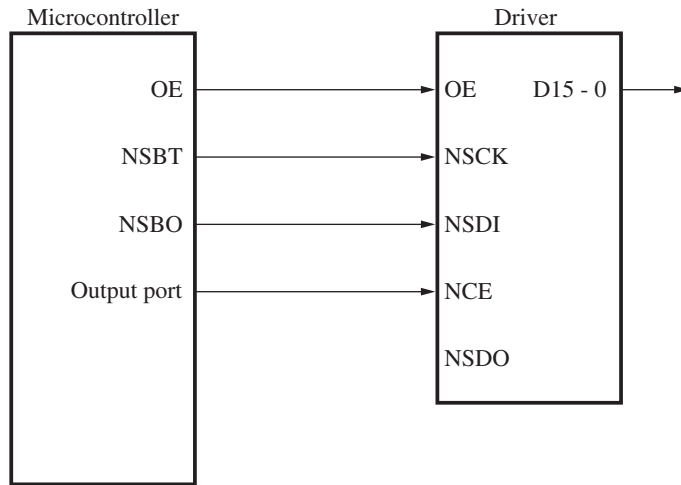


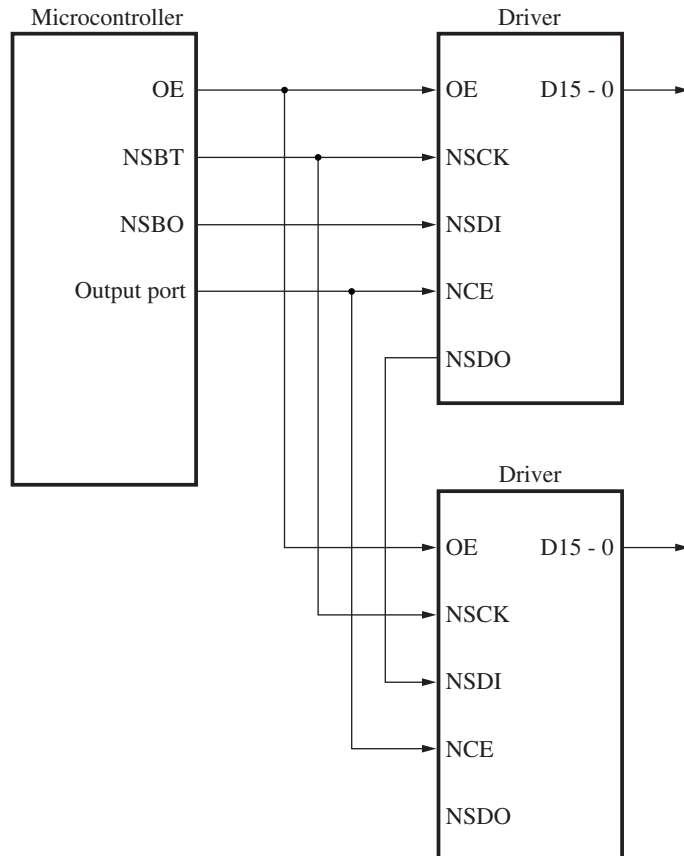
Figure 2 NSCK, NSDI, and NSDO Timing

■ Sample Application Systems

- When one driver LSI is used



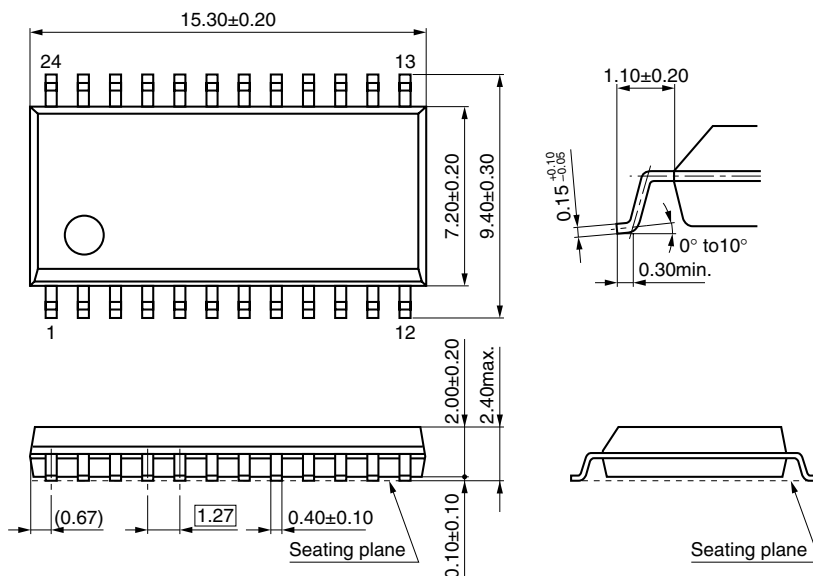
- When two driver LSIs are used





■ Package Dimensions (Unit : mm)

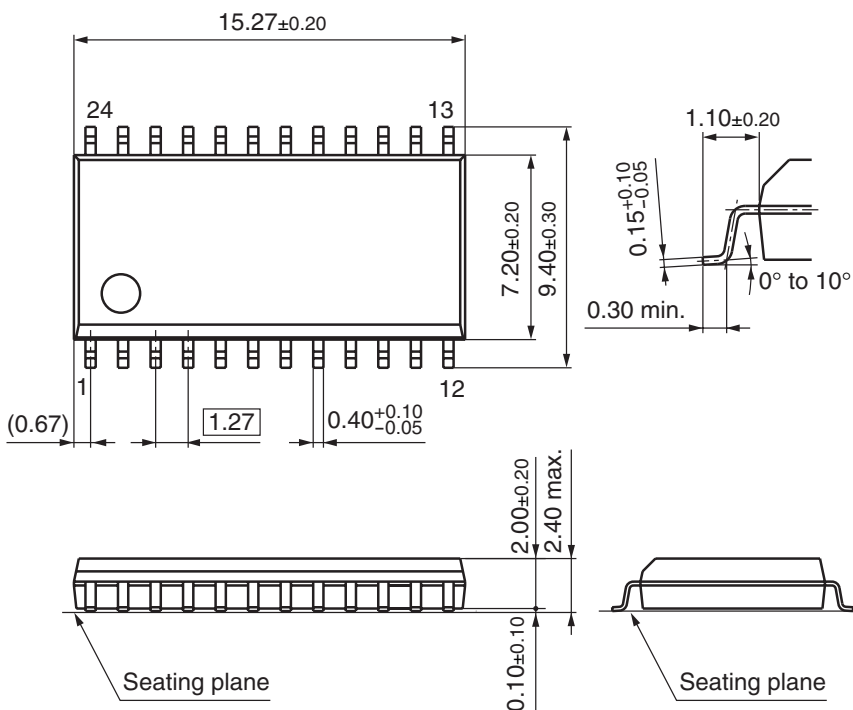
- SOP024-P-0375



Note) The package of this product will be changed to the following lead-free type (SOP024-P-0375B).

■ New Package Dimensions (Unit: mm)

- SOP024-P-0375B (Lead-free package)



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