

## DOT MATRIX LCD 80-OUT SEGMENT DRIVER

### ■ GENERAL DESCRIPTION

The NJU6445 is a 80-out segment driver providing serial input interface for dot matrix LCD.

It is also suitable for the extension driver of LCD controller driver.

It consists of bi-directional shift register, 80-bit latch, and 80-out high voltage LCD drivers.

The bi-directional shift register performs the efficient extension driver allocation according to the number of characters and easy wiring with the LCD panel.

As the 80-driver has 4 level voltage input to drive the LCD, adjustable driving voltage according to the LCD panel can be supplied from the external power source.

### ■ PACKAGE OUTLINE

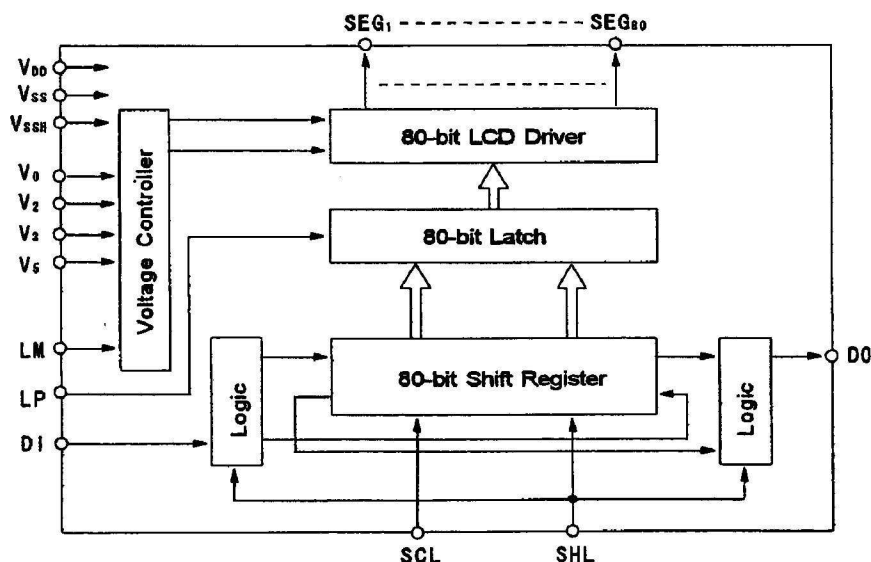


NJU6445C

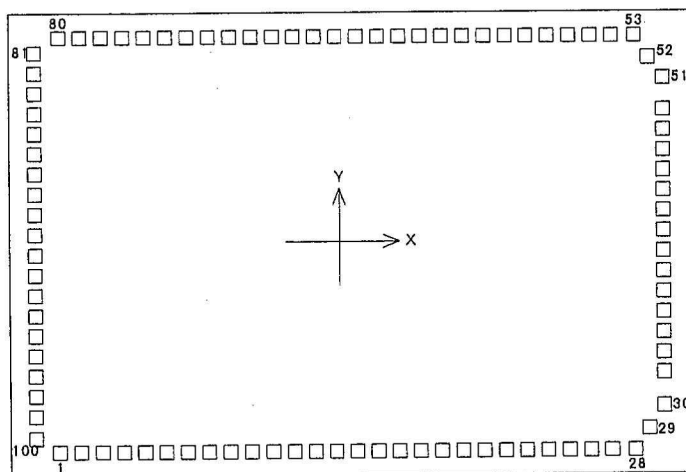
### ■ FEATURES

- 80-out Segment Driver
- 80-bit Shift Register (Bi-directional Shift Register)
- Two of Shift Direction Select Terminal
- Fast Data Transmission (Shift Clock 3.3 MHz)
- External Power Supply for LCD Driving Voltage
- LCD Driving Voltage —  $V_{DD} - 3.0V \sim V_{DD} - 10.0V$
- Operating Voltage —  $5.0V \pm 10\%$
- Package Outline — Chip
- C-MOS Technology

### ■ BLOCK DIAGRAM



## ■ PAD LOCATION



PAD size : 90um × 90um

CHIP size: 3.69 × 2.61mm

## ■ PAD COODINATES

Chip Size 3.69mm × 2.61mm(Chip Center X=0um,Y=0um)

| PAD No. | Terminal | X=(um)  | Y=(um) |
|---------|----------|---------|--------|
| 1       | SEG30    | -1599   | -1183  |
| 2       | SEG29    | -1479   | -1183  |
| 3       | SEG28    | -1359   | -1183  |
| 4       | SEG27    | -1239   | -1183  |
| 5       | SEG26    | -1119   | -1183  |
| 6       | SEG25    | -999    | -1183  |
| 7       | SEG24    | -879    | -1183  |
| 8       | SEG23    | -759    | -1183  |
| 9       | SEG22    | -639    | -1183  |
| 10      | SEG21    | -519    | -1183  |
| 11      | SEG20    | -399    | -1183  |
| 12      | SEG19    | -279    | -1183  |
| 13      | SEG18    | -159    | -1183  |
| 14      | SEG17    | -39     | -1183  |
| 15      | SEG16    | 81      | -1183  |
| 16      | SEG15    | 201     | -1183  |
| 17      | SEG14    | 321     | -1183  |
| 18      | SEG13    | 441     | -1183  |
| 19      | SEG12    | 561     | -1183  |
| 20      | SEG11    | 681     | -1183  |
| 21      | SEG10    | 801     | -1183  |
| 22      | SEG9     | 921     | -1183  |
| 23      | SEG8     | 1041    | -1183  |
| 24      | SEG7     | 1161    | -1183  |
| 25      | SEG6     | 1281    | -1183  |
| 26      | SEG5     | 1401    | -1183  |
| 27      | SEG4     | 1521    | -1183  |
| 28      | SEG3     | 1641    | -1183  |
| 29      | SEG2     | 1683    | -1050  |
| 30      | SEG1     | 1723    | -920   |
| 31      | VSSH     | 1723    | -780   |
| 32      | V5       | 1723    | -660   |
| 33      | V0       | 1723    | -540   |
| 34      | V3       | 1723    | -420   |
| 35      | V2       | 1723    | -300   |
| 36      | VSS      | 1723    | -180   |
| 37      | LP       | 1723    | -60    |
| 38      | NC       | Non-PAD |        |
| 39      | SHL      | 1723    | 60     |
| 40      | SCL      | 1723    | 180    |
| 41      | DI       | 1723    | 300    |
| 42      | DO       | 1723    | 420    |
| 43      | NC       | Non-PAD |        |
| 44      | LM       | 1723    | 540    |
| 45      | NC       | Non-PAD |        |
| 46      | VDD      | 1723    | 660    |
| 47      | NC       | Non-PAD |        |
| 48      | NC       | Non-PAD |        |
| 49      | NC       | Non-PAD |        |
| 50      | DUMMY    | 1723    | 780    |

| PAD No. | Terminal | X=(um) | Y=(um) |
|---------|----------|--------|--------|
| 51      | SEG80    | 1723   | 920    |
| 52      | SEG79    | 1683   | 1050   |
| 53      | SEG78    | 1641   | 1183   |
| 54      | SEG77    | 1521   | 1183   |
| 55      | SEG76    | 1401   | 1183   |
| 56      | SEG75    | 1281   | 1183   |
| 57      | SEG74    | 1161   | 1183   |
| 58      | SEG73    | 1041   | 1183   |
| 59      | SEG72    | 921    | 1183   |
| 60      | SEG71    | 801    | 1183   |
| 61      | SEG70    | 681    | 1183   |
| 62      | SEG69    | 561    | 1183   |
| 63      | SEG68    | 441    | 1183   |
| 64      | SEG67    | 321    | 1183   |
| 65      | SEG66    | 201    | 1183   |
| 66      | SEG65    | 81     | 1183   |
| 67      | SEG64    | -39    | 1183   |
| 68      | SEG63    | -159   | 1183   |
| 69      | SEG62    | -279   | 1183   |
| 70      | SEG61    | -399   | 1183   |
| 71      | SEG60    | -519   | 1183   |
| 72      | SEG59    | -639   | 1183   |
| 73      | SEG58    | -759   | 1183   |
| 74      | SEG57    | -879   | 1183   |
| 75      | SEG56    | -999   | 1183   |
| 76      | SEG55    | -1119  | 1183   |
| 77      | SEG54    | -1239  | 1183   |
| 78      | SEG53    | -1359  | 1183   |
| 79      | SEG52    | -1479  | 1183   |
| 80      | SEG51    | -1599  | 1183   |
| 81      | SEG50    | -1721  | 1140   |
| 82      | SEG49    | -1721  | 1020   |
| 83      | SEG48    | -1721  | 900    |
| 84      | SEG47    | -1721  | 780    |
| 85      | SEG46    | -1721  | 660    |
| 86      | SEG45    | -1721  | 540    |
| 87      | SEG44    | -1721  | 420    |
| 88      | SEG43    | -1721  | 300    |
| 89      | SEG42    | -1721  | 180    |
| 90      | SEG41    | -1721  | 60     |
| 91      | SEG40    | -1721  | -60    |
| 92      | SEG39    | -1721  | -180   |
| 93      | SEG38    | -1721  | -300   |
| 94      | SEG37    | -1721  | -420   |
| 95      | SEG36    | -1721  | -540   |
| 96      | SEG35    | -1721  | -660   |
| 97      | SEG34    | -1721  | -780   |
| 98      | SEG33    | -1721  | -900   |
| 99      | SEG32    | -1721  | -1020  |
| 100     | SEG31    | -1721  | -1140  |

# ■ TERMINAL DESCRIPTION

| No                   | SYMBOL                                                                                  | FUNCTION                                                                                                                                                                                                                                                                                           |
|----------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 ~ 30<br>51 ~ 100   | SEG <sub>30</sub> ~ SEG <sub>1</sub><br>SEG <sub>80</sub> ~ SEG <sub>31</sub>           | LCD segment driver terminal.<br>Each terminal corresponds to each bit of the shift register                                                                                                                                                                                                        |
| 41                   | DI                                                                                      | Display data input terminal. The DI terminal is fixed as the input regardless of the shift direction.<br>Display data is input synchronizing with the clock signal.                                                                                                                                |
| 42                   | DO                                                                                      | Data output terminal. The DO terminal is fixed as the output regardless of the shift direction.<br>The data is output synchronizing with the clock signal.                                                                                                                                         |
| 40                   | SCL                                                                                     | Shift register clock pulse input terminal.<br>The data is shifted in the shift register by the falling edge of the clock pulse. A data setup time and hold time are required between data input and SCL. Clock pulse rising time and falling time should be set less than 50ns (MAX) respectively. |
| 39                   | SHL                                                                                     | Shift direction select terminal.<br>"H" : Shift direction is from 80th bit to 1st bit.<br>"L" : Shift direction is from 1st bit to 80th bit.<br>The DI and DO terminals are fixed as input and output respectively regardless of this terminal input level.                                        |
| 37                   | LP                                                                                      | Latch pulse input terminal. The data in the shift register is latched to the Latch by this signal.<br>"H" : Data leading, "L" : Data latch                                                                                                                                                         |
| 44                   | LM                                                                                      | Alternate signal input for LCD driving.                                                                                                                                                                                                                                                            |
| 46,36                | V <sub>DD</sub> , V <sub>SS</sub>                                                       | Power supply terminal (connect to the controller's V <sub>DD</sub> terminal)<br>Power supply terminal (connect to the controller's V <sub>SS</sub> terminal)                                                                                                                                       |
| 33,35,34,<br>32,31   | V <sub>0</sub> , V <sub>2</sub> , V <sub>3</sub> ,<br>V <sub>5</sub> , V <sub>SSH</sub> | LCD driving power source input terminals.<br>V <sub>DD</sub> ≥ V <sub>0</sub> ≥ V <sub>2</sub> ≥ V <sub>3</sub> ≥ V <sub>5</sub> ≥ V <sub>SSH</sub>                                                                                                                                                |
| 38,43,45,<br>47 ~ 49 | NC                                                                                      | Non connection. (Normally open)                                                                                                                                                                                                                                                                    |
| 50                   | DUMMY                                                                                   | Dummy PAD                                                                                                                                                                                                                                                                                          |

# ■ FUNCTIONAL DESCRIPTION

## (1) Shift register control

The 80-bit shift register is bi-directional.

The shift direction of shift register is controlled as shown in below:

| Control Terminal | Input | Shift Direction |
|------------------|-------|-----------------|
| SHL              | "H"   | 80 → 1          |
|                  | "L"   | 1 → 80          |

Note) DI and DO terminals are fixed input and output terminal respectively regardless the SHL input level.

## (2) LCD driver output truth table

| Input Data | Selection/<br>Non-selection | LM<br>terminal | Driver Output (SEG1 to SEG80) |
|------------|-----------------------------|----------------|-------------------------------|
| "H"        | Selection                   | "H"            | V5                            |
|            |                             | "L"            | V0                            |
| "L"        | Non-selection               | "H"            | V3                            |
|            |                             | "L"            | V2                            |

# ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER                | SYMBOL                                                                               | RATINGS                                  | UNIT |
|--------------------------|--------------------------------------------------------------------------------------|------------------------------------------|------|
| Supply Voltage(1)        | V <sub>DD</sub>                                                                      | -0.3~+7.0                                | V    |
| Supply Voltage(2) Note1) | V <sub>0</sub> , V <sub>2</sub> , V <sub>3</sub> , V <sub>5</sub> , V <sub>SSH</sub> | V <sub>DD</sub> -11~V <sub>DD</sub> +0.3 | V    |
| Input Voltage            | V <sub>IN</sub>                                                                      | -0.3~V <sub>DD</sub> +0.3                | V    |
| Operating Temperature    | T <sub>opr</sub>                                                                     | -30~+80                                  | °C   |
| Storage Temperature      | T <sub>stg</sub>                                                                     | -55~+150                                 | °C   |

Note 1) The relation : V<sub>DD</sub> ≥ V<sub>0</sub> ≥ V<sub>2</sub> ≥ V<sub>3</sub> ≥ V<sub>5</sub> ≥ V<sub>SSH</sub> must be maintained.

# ELECTRICAL CHARACTERISTICS

## DC Characteristics

(V<sub>DD</sub>=5V ± 10%, Ta=20 ~ +75°C)

| PARAMETER                                | SYMBOL            | CONDITIONS                                                                    | MIN                  | TYP | MAX                 | UNIT |
|------------------------------------------|-------------------|-------------------------------------------------------------------------------|----------------------|-----|---------------------|------|
| Input Voltage Note1)                     | V <sub>IH</sub>   |                                                                               | 0.8V <sub>DD</sub>   |     | V <sub>DD</sub>     | V    |
|                                          | V <sub>IL</sub>   |                                                                               |                      |     | 0.2V <sub>DD</sub>  | V    |
| Input Current Note1)                     | I <sub>IH</sub>   | V <sub>IH</sub> =V <sub>DD</sub>                                              |                      |     | 1                   | μA   |
|                                          | I <sub>IL</sub>   | V <sub>IL</sub> =0V                                                           | -1                   |     |                     | μA   |
| Output Voltage Note2)                    | V <sub>OH</sub>   | I <sub>o</sub> =-40μA                                                         | 4.2                  |     |                     | V    |
|                                          | V <sub>OL</sub>   | I <sub>o</sub> =0.4mA                                                         |                      |     | 0.4                 | V    |
| Driver On-resistance<br>Note3)           | R <sub>ON</sub>   | I <sub>d</sub> =0.05mA                                                        |                      |     | 5                   | kΩ   |
| Operating Current<br>( Logic Part )      | I <sub>SSO</sub>  | (LM,LP)=130us cycle<br>SCL=1.5MHz<br>Every one bit Inverted Data.<br>No Load. |                      | 1.1 | 1.5                 | mA   |
| Operating Current<br>( LCD Driver Part ) | I <sub>SSHO</sub> | (LM,LP)=130us cycle<br>SCL=1.5MHz<br>Every one bit Inverted<br>Data. No Load. |                      | 70  | 100                 | μA   |
| LCD Driving Voltage                      | V <sub>LCD</sub>  | V <sub>SSH</sub> Terminal, V <sub>DD</sub> =5V                                | V <sub>DD</sub> -3.0 |     | V <sub>DD</sub> -10 | V    |

Note 2) Apply to LM, LP, SCL, SHL and DI terminals.

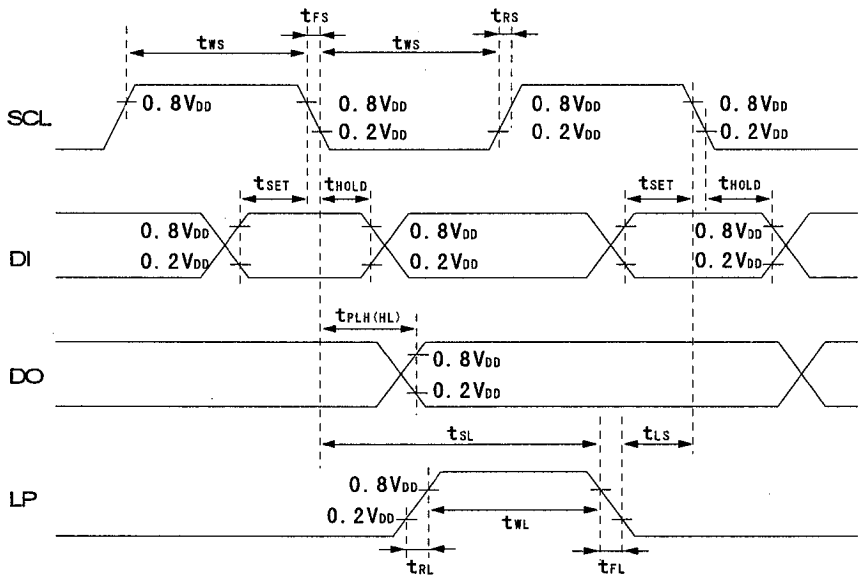
Note 3) Apply to DO terminal.

Note 4) Apply to SEG<sub>1</sub>~SEG<sub>80</sub> terminals.

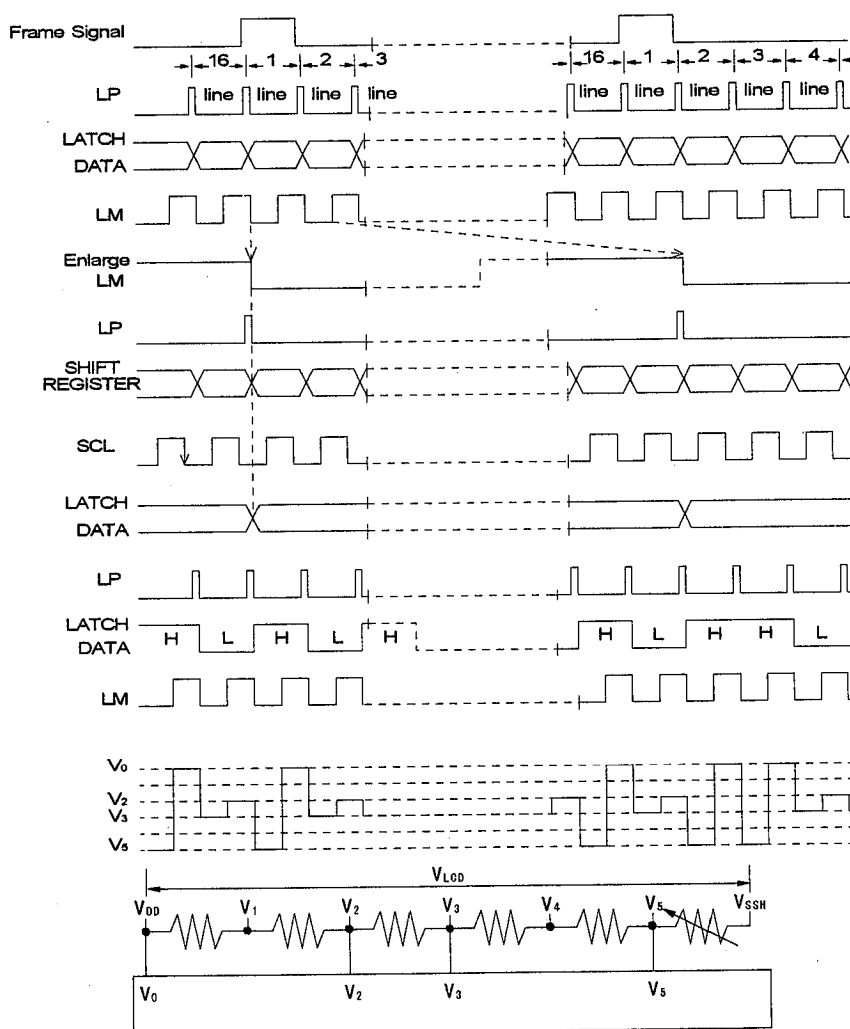
AC Characteristics

| PARAMETER                   | SYMBOL           | CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------------------|------------------|------------|-----|-----|-----|------|
| Propagation Delay Time      | $t_{PLH(HL)}$    |            | -   | -   | 250 | ns   |
| Maximum Operating Frequency | $f_{SCL}$        | Duty=50%   | 3.3 | -   | -   | MHz  |
| SCL Pulse Width             | $t_{WS}$         |            | 125 | -   | -   | ns   |
| LP Pulse Width              | $t_{WL}$         |            | 125 | -   | -   | ns   |
| Set Up Time                 | $t_{SET}$        |            | 50  | -   | -   | ns   |
| SCL → LP Time               | $t_{SL}$         |            | 250 | -   | -   | ns   |
| LP → SCL Time               | $t_{LS}$         |            | 0   | -   | -   | ns   |
| Data Hold Time              | $t_{HOLD}$       |            | 50  | -   | -   | ns   |
| SCL Rise, Fall Time         | $t_{RS}, t_{FS}$ |            | -   | -   | 50  | ns   |
| LP Rise, Fall Time          | $t_{RL}, t_{FL}$ |            | -   | -   | 1   | us   |

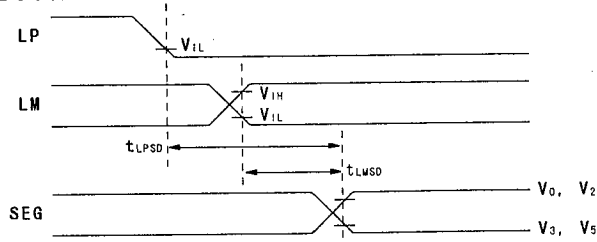
■ AC CHARACTERISTICS TIMING CHART



**■TIMING CHART**  
1/5 Bias, 1/16 Duty Ratio



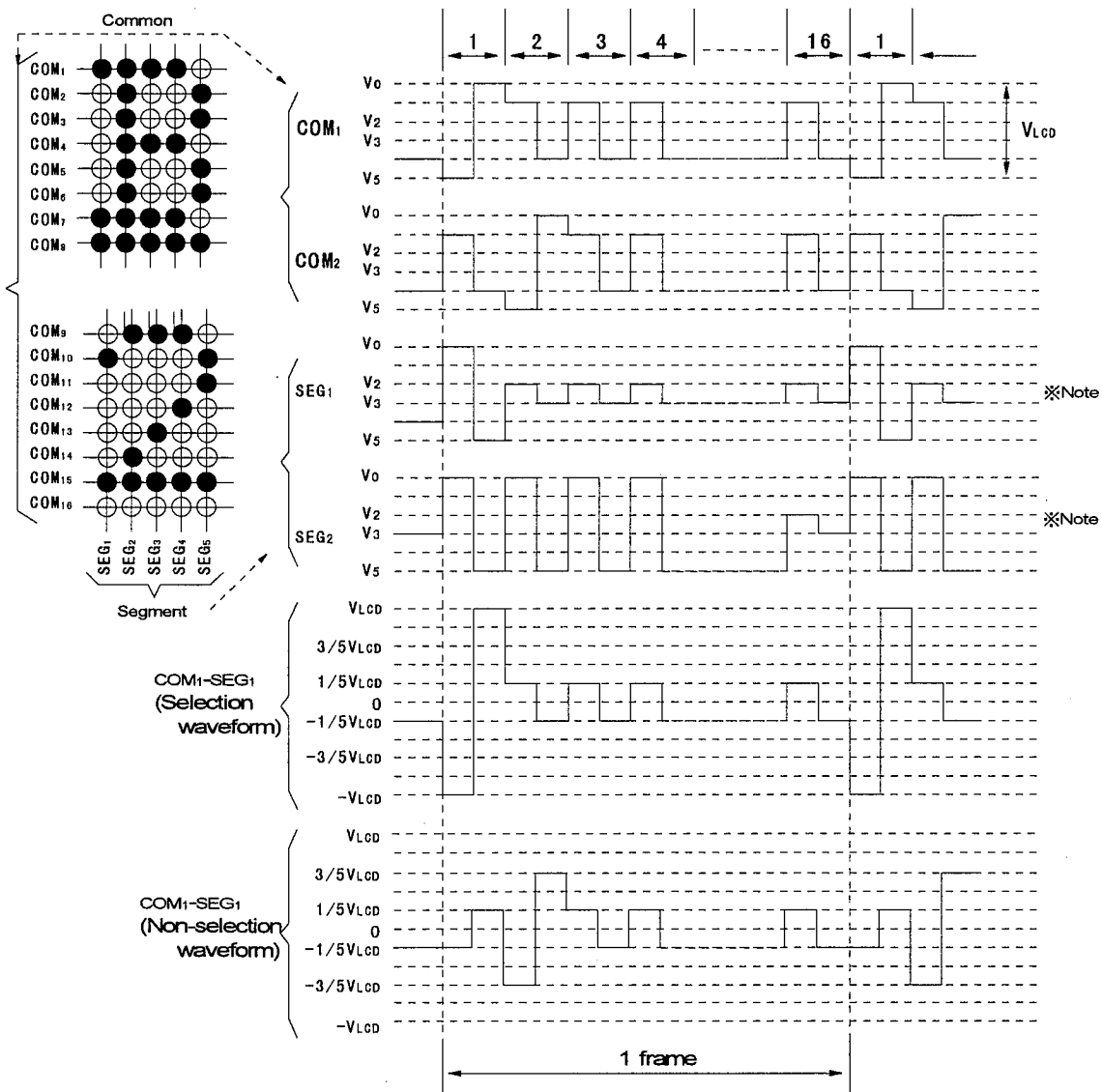
## ■ SEGMENT SIGNAL OUTPUT TIMING



| PARAMETER                | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------|--------|------------|-----|-----|-----|------|
| LP-SEG Output Delay Time | tLPSD  | CL=100pF   | -   | -   | 4.5 | us   |
| LM-SEG Output Delay Time | tLMSD  | CL=100pF   | -   | -   | 4.5 | us   |

## ■ LCD DRIVING WAVEFORM EXAMPLE

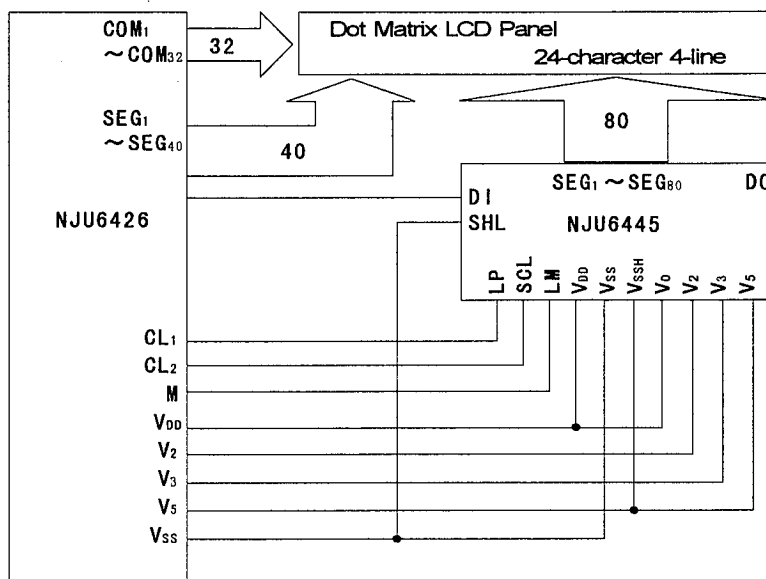
1/5 Bias, 1/16 Duty Ratio



※ Note : In case of V<sub>0</sub> terminal connected to the V<sub>DD</sub>.

## ■ APPLICATION CIRCUIT

24-character 4-line Display Example (NJU6426 + NJU6445)



## MEMO

**[CAUTION]**

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