

## 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.

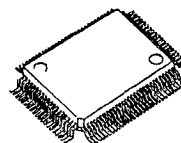
It is also suitable for the extension driver of LCD controller driver.

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



NJU6445F

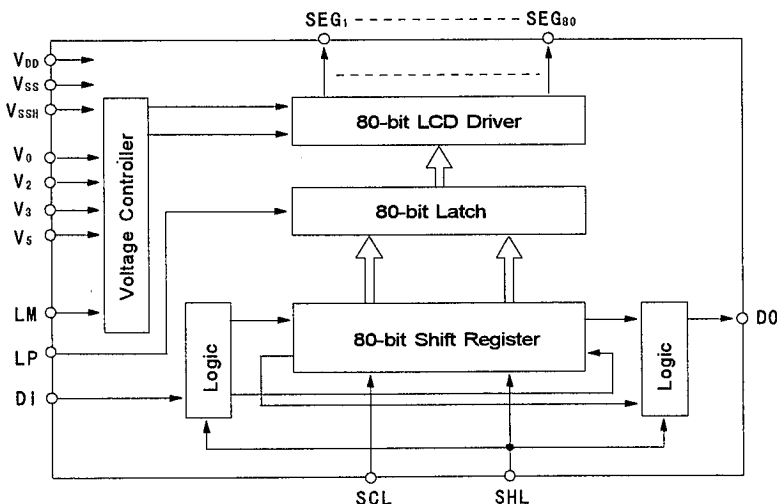


NJU6445C

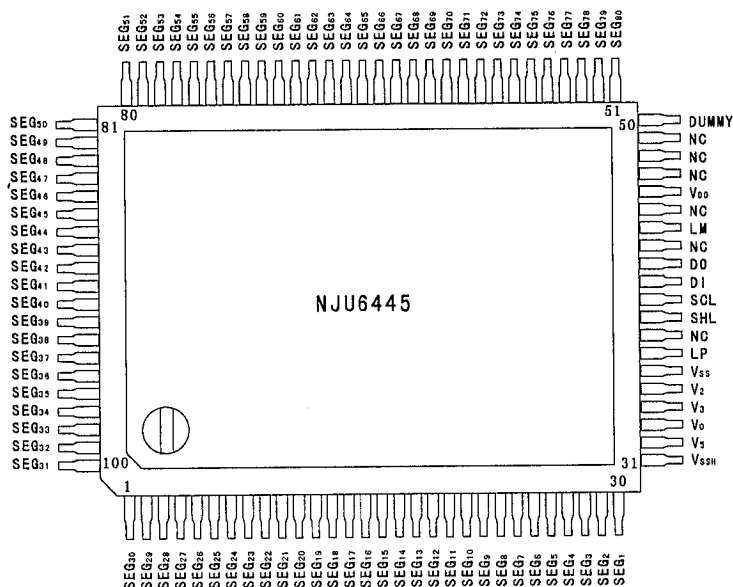
### ■ FEATURES

- 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 --- QFP100/Chip
- C-MOS Technology

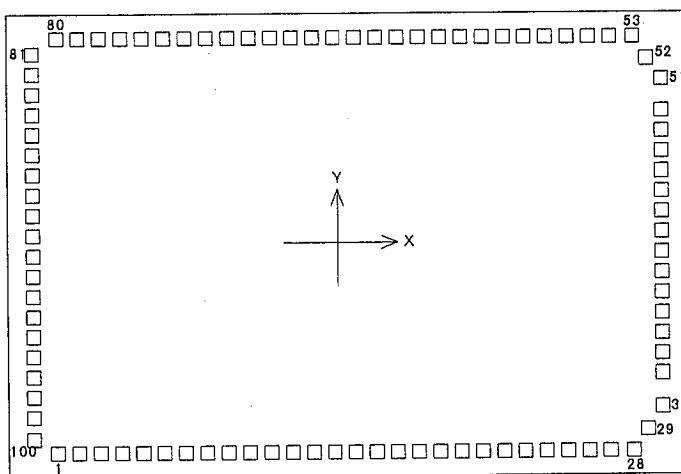
### ■ BLOCK DIAGRAM



## PIN CONFIGURATION



## 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.

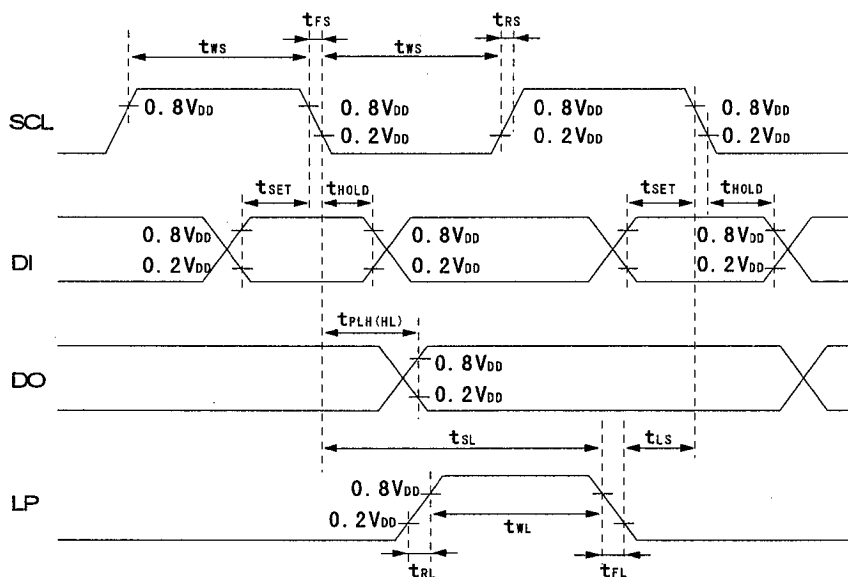
Note 3) Apply to DO terminal.

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

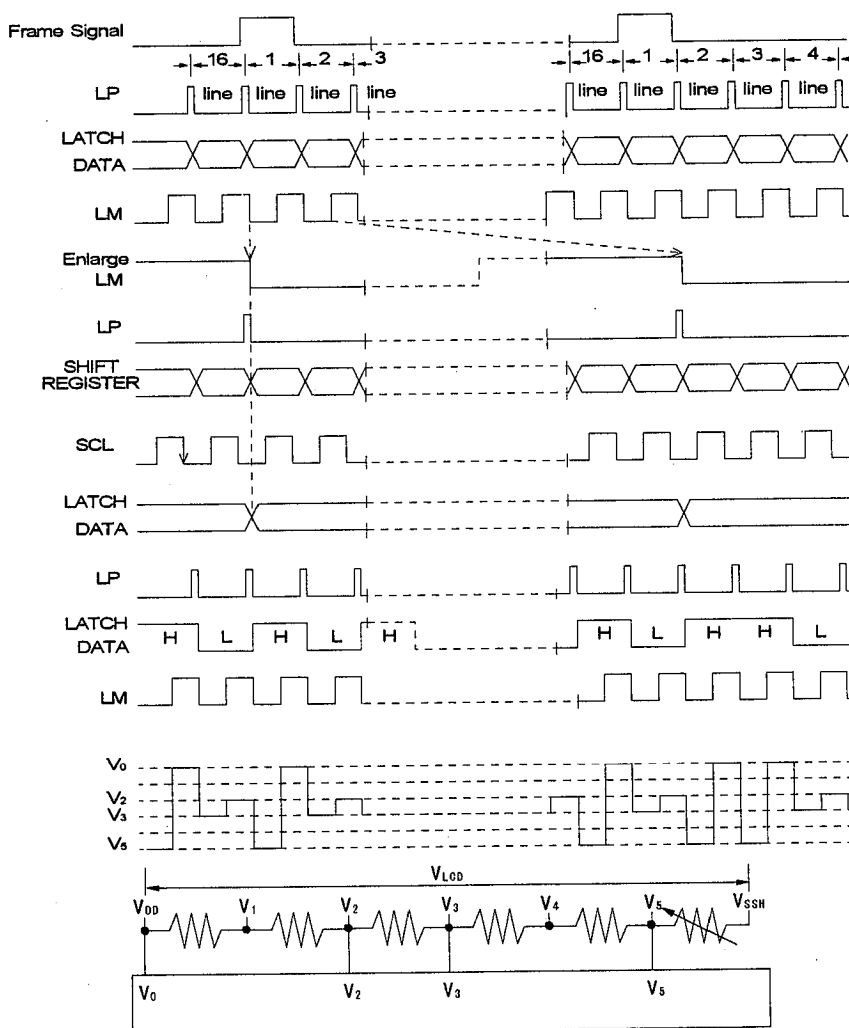
## AC Characteristics

| 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   |

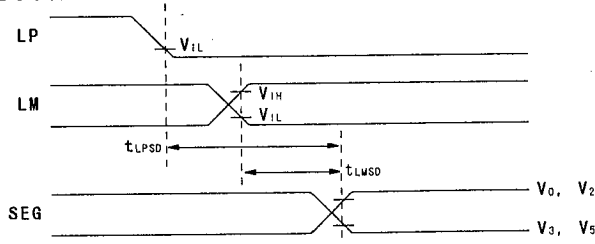
## ■ AC CHARACTERISTICS TIMING CHART



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



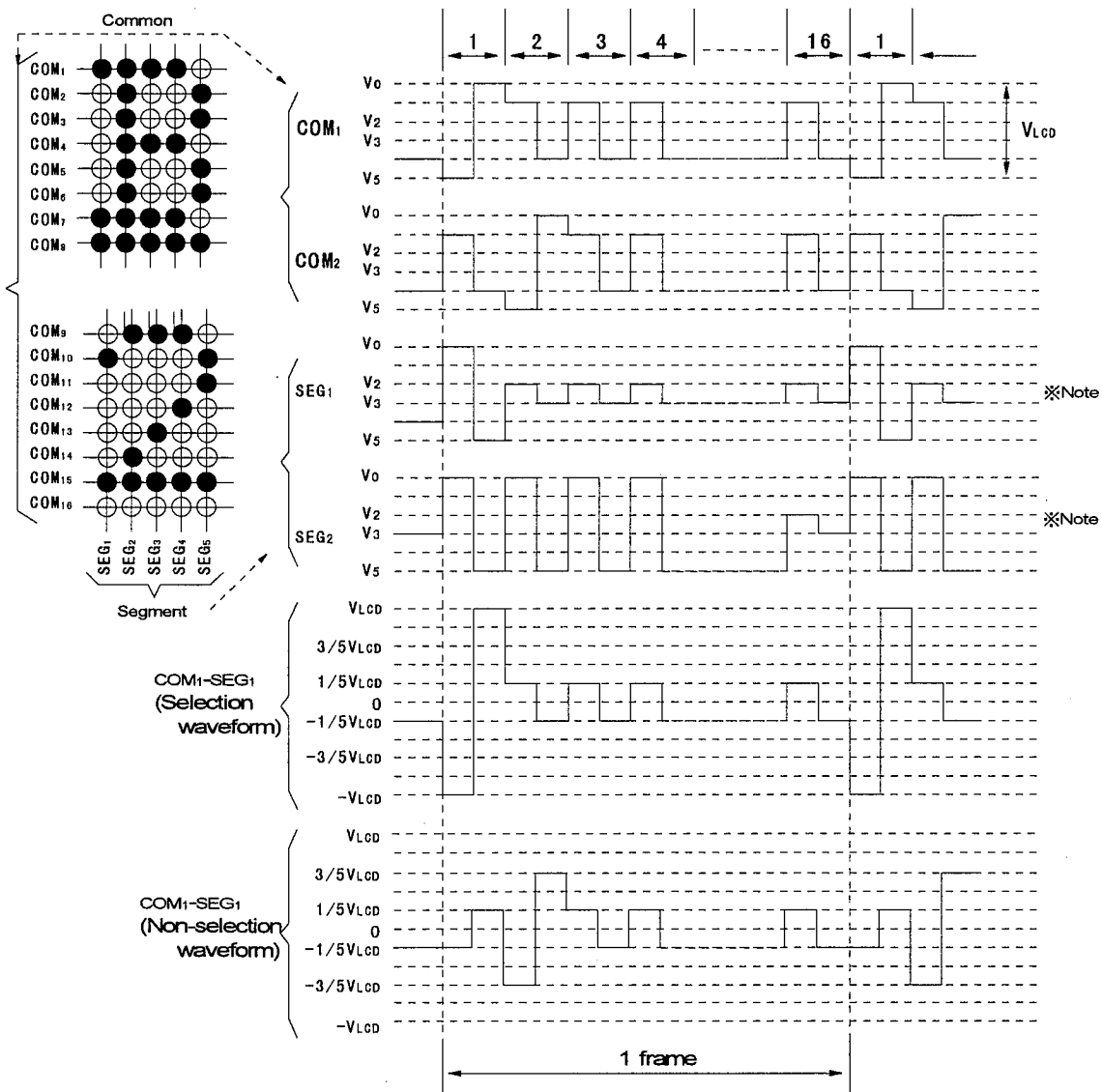
## ■ SEGMENT SIGNAL OUTPUT TIMING



| PARAMETER                | SYMBOL            | CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------|-------------------|------------|-----|-----|-----|------|
| LP-SEG Output Delay Time | t <sub>LPSD</sub> | CL=100pF   | -   | -   | 4.5 | us   |
| LM-SEG Output Delay Time | t <sub>LMSD</sub> | CL=100pF   | -   | -   | 4.5 | us   |

# LCD DRIVING WAVEFORM EXAMPLE

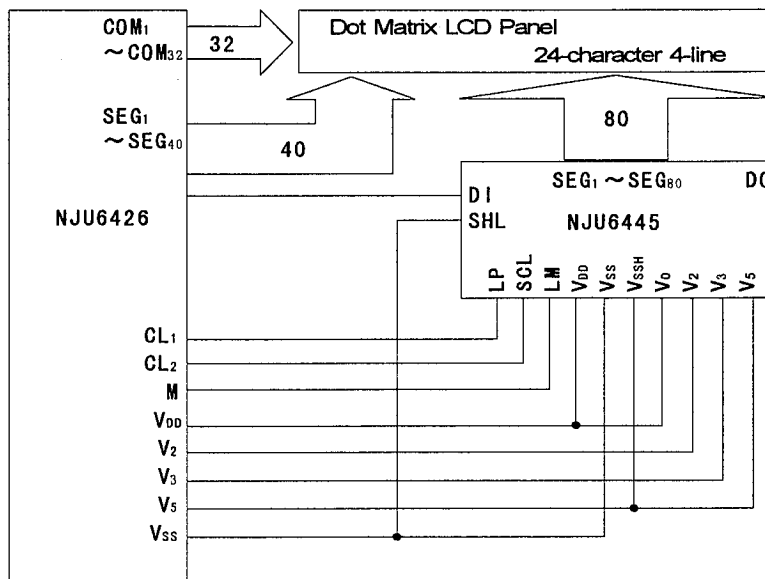
1/5 Bias, 1/16 Duty Ratio



※ 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]**

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.