

# HD14052B, HD14053B

## Analog Multiplexers/Demultiplexers

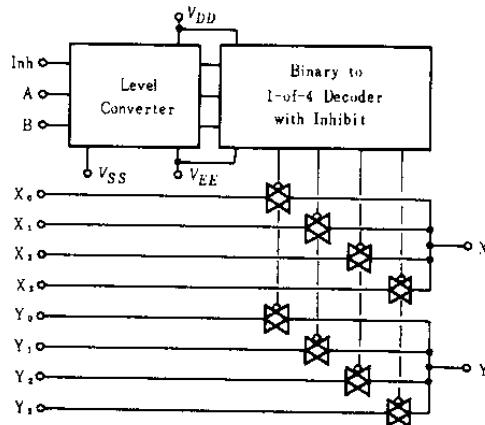
The HD14052B and HD14053B analog multiplexers are digitally controlled analog switches. The HD14052B effectively implements a 2P4T, and the HD14053B a triple SPDT. These devices feature low ON impedance and very low OFF leakage current. Control of analog signals up to the complete supply voltage range can be achieved.

### FEATURES

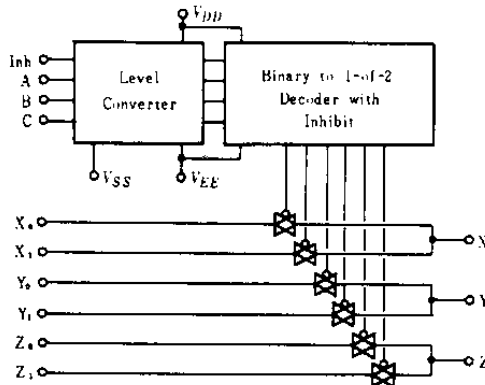
- High On/Off Output Voltage Ratio = 65dB typ.
- Quiescent Current = 5nA/pkg typ. @5V
- Low Crosstalk Between Switches = 80dB typ.
- Supply Voltage Range = 3 to 18V
- Linearized Transfer Characteristics,  $\Delta R_{on} < 60\Omega$  for  $V_{in} = V_{DD}$  to  $V_{EE}$  @15V
- Pin-for-Pin Replacement for CD4052/53 and MC14052B/53B

### BLOCK DIAGRAM

#### HD14052B



#### HD14053B

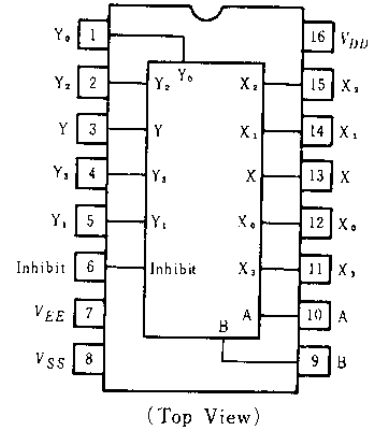


### MAXIMUM RATINGS (Voltages referenced to $V_{SS}$ )

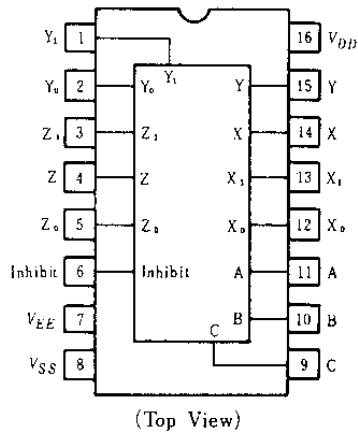
| Characteristic              | Symbol            | Value                            | Unit             |
|-----------------------------|-------------------|----------------------------------|------------------|
| DC Supply Voltage           | $V_{DD} - V_{EE}$ | $-0.5 \sim +18$                  | V <sub>DC</sub>  |
| Control Input Voltage       | $V_{in}$          | $V_{SS} - 0.5 \sim V_{DD} + 0.5$ | V <sub>DC</sub>  |
| Signal Voltage              | $V_{sig}$         | $V_{EE} - 0.5 \sim V_{DD} + 0.5$ | V <sub>P-P</sub> |
| Control Input Current       | $I_{in}$          | $\pm 10$                         | mA               |
| Signal Current              | $I_{sig}$         | 25                               | mA               |
| Operating Temperature Range | $T_A$             | $-40 \sim +85$                   | °C               |
| Storage Temperature Range   | $T_{stg}$         | $-65 \sim +150$                  | °C               |
| Power Dissipation           | $P_D$             | 300                              | mW               |

### PIN ARRANGEMENT

#### HD14052B



#### HD14053B

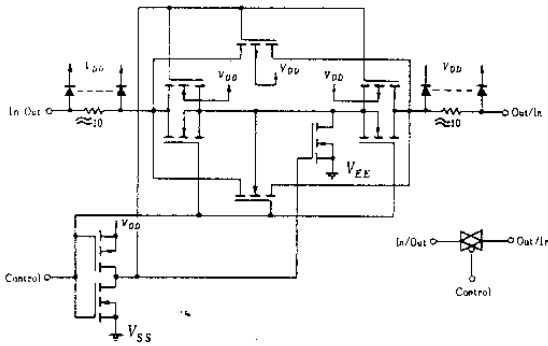


### TRUTH TABLE

| Inhibit | Control Inputs |   |   | ON Switch                     |                |                               |
|---------|----------------|---|---|-------------------------------|----------------|-------------------------------|
|         | C*             | B | A | HD14052B                      | HD14053B       |                               |
| 0       | 0              | 0 | 0 | Y <sub>0</sub> X <sub>0</sub> | Z <sub>0</sub> | Y <sub>0</sub> X <sub>0</sub> |
| 0       | 0              | 0 | 1 | Y <sub>1</sub> X <sub>1</sub> | Z <sub>0</sub> | Y <sub>0</sub> X <sub>1</sub> |
| 0       | 0              | 1 | 0 | Y <sub>2</sub> X <sub>2</sub> | Z <sub>0</sub> | Y <sub>1</sub> X <sub>0</sub> |
| 0       | 0              | 1 | 1 | Y <sub>3</sub> X <sub>3</sub> | Z <sub>0</sub> | Y <sub>1</sub> X <sub>1</sub> |
| 0       | 1              | 0 | 0 |                               | Z <sub>1</sub> | Y <sub>0</sub> X <sub>0</sub> |
| 0       | 1              | 0 | 1 |                               | Z <sub>1</sub> | Y <sub>0</sub> X <sub>1</sub> |
| 0       | 1              | 1 | 0 |                               | Z <sub>1</sub> | Y <sub>1</sub> X <sub>0</sub> |
| 0       | 1              | 1 | 1 |                               | Z <sub>1</sub> | Y <sub>1</sub> X <sub>1</sub> |
| 1       | x              | x | x | —                             |                | —                             |

\* Not applicable for HD14053B  
x = Don't Care

SWITCH CIRCUIT SCHEMATIC



ELECTRICAL CHARACTERISTICS

| Characteristic                          | Symbol           | V <sub>DD</sub> (V) | Test Conditions   | -40°C |      | 25°C |       |      | 85°C |      | Unit |
|---|------------------|---------------------|---|-------|------|------|-------|------|------|------|------|
|   |                  |                     |   | min   | max  | min  | typ   | max  | min  | max  |      |
| Input Voltage                           | V <sub>IL</sub>  | 5.0                 | R <sub>L</sub> =10 kΩ, V <sub>O</sub> =0.5V                       | —     | 1.5  | —    | 2.25  | 1.5  | —    | 1.5  | V    |
|   |                  | 10                  | SW入力 = V <sub>DD</sub> , V <sub>O</sub> =1.0V                     | —     | 3.0  | —    | 4.50  | 3.0  | —    | 3.0  |      |
|   |                  | 15                  | V <sub>EE</sub> =V <sub>SS</sub> , V <sub>O</sub> =1.5V           | —     | 4.0  | —    | 6.75  | 4.0  | —    | 4.0  |      |
|   | V <sub>IH</sub>  | 5.0                 | R <sub>L</sub> =10 kΩ, V <sub>O</sub> =4.0V                       | 3.5   | —    | 3.5  | 2.75  | —    | 3.5  | —    | V    |
|   |                  | 10                  | SW入力 = V <sub>DD</sub> , V <sub>O</sub> =9.0V                     | 7.0   | —    | 7.0  | 5.50  | —    | 7.0  | —    |      |
|   |                  | 15                  | V <sub>EE</sub> =V <sub>SS</sub> , V <sub>O</sub> =13.5V          | 11.0  | —    | 11.0 | 8.25  | —    | 11.0 | —    |      |
| Input Current(Control, Inhibit)         |                  | I <sub>in</sub>     | 15  |       | —    | —    | —     | 10   | —    | —    | pA   |
| Input Capacitance                       | Control, Inhibit | C <sub>in</sub>     | V <sub>in</sub> =0  | —     | —    | —    | 5.0   | —    | —    | —    | pF   |
|   | Switch Inputs    |                     |   | —     | —    | —    | 10    | —    | —    | —    | —    |
| Output Capacitance                      | HD14052B         | C <sub>out</sub>    | 10  | —     | —    | —    | 32    | —    | —    | —    | pF   |
|   | HD14053B         |                     |   | —     | —    | —    | 17    | —    | —    | —    |      |
| Feedthrough Capacitance                 | HD14052B         | C <sub>in-out</sub> | 10  | —     | —    | —    | 0.12  | —    | —    | —    | pF   |
|   | HD14053B         |                     |   | —     | —    | —    | 0.10  | —    | —    | —    |      |
| Quiescent Current                       | I <sub>DD</sub>  | 5.0                 | Zero Signal, per Package  | —     | 20   | —    | 0.005 | 20   | —    | 150  | μA   |
|   |                  | 10                  |   | —     | 40   | —    | 0.010 | 40   | —    | 300  |      |
|   |                  | 15                  |   | —     | 80   | —    | 0.015 | 80   | —    | 600  |      |
| Total Supply Current*                   | I <sub>T</sub>   | 5.0                 | Dynamic + I <sub>DD</sub> , T <sub>a</sub> =25°C per Gate, f=1kHz | —     | —    | —    | 0.075 | —    | —    | —    | μA   |
|   |                  | 10                  |   | —     | —    | —    | 0.210 | —    | —    | —    |      |
|   |                  | 15                  |   | —     | —    | —    | 0.375 | —    | —    | —    |      |
| ON Resistance                           | R <sub>ON</sub>  | 5.0                 |   | —     | 880  | —    | 250   | 1050 | —    | 1200 | Ω    |
|   |                  | 10                  |   | —     | 450  | —    | 120   | 500  | —    | 520  |      |
|   |                  | 15                  |   | —     | 250  | —    | 80    | 280  | —    | 300  |      |
| ΔON Resistance Between Any Two Channels | ΔR <sub>ON</sub> | 5.0                 | Two Channels  | —     | —    | —    | 25    | —    | —    | —    | Ω    |
|   |                  | 10                  |   | —     | —    | —    | 10    | —    | —    | —    |      |
|   |                  | 15                  |   | —     | —    | —    | 5.0   | —    | —    | —    |      |
| OFF Channel Leakage Current             | Each Channel     |                     | 15  | —     | 1000 | —    | ±0.01 | 1000 | —    | 3000 | nA   |
|   | All Channels OFF | HD14052B            |   | —     | 1000 | —    | ±0.04 | 1000 | —    | 3000 |      |
|   |                  | HD14053B            |   | —     | 1000 | —    | ±0.02 | 1000 | —    | 3000 |      |

\* To calculate total supply current at frequency other than 1kHz.

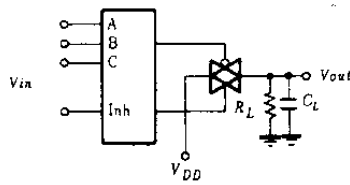
@V<sub>DD</sub>=5.0V, I<sub>T</sub>=(0.075μA/kHz)f+I<sub>DD</sub>, @V<sub>DD</sub>=10V, I<sub>T</sub>=(0.210μA/kHz)f+I<sub>DD</sub>, @V<sub>DD</sub>=15V, I<sub>T</sub>=(0.375μA/kHz)f+I<sub>DD</sub>

■ SWITCHING CHARACTERISTICS ( $C_L=50\text{pF}$ ,  $T_a=25^\circ\text{C}$ )

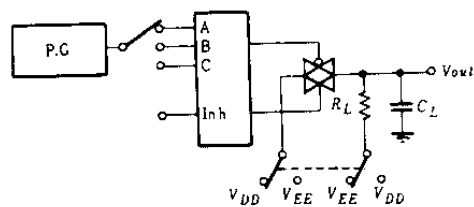
| Characteristic            |                               | Symbol   | $V_{DD}-V_{SS}$ (V) | Test Conditions  | typ  | max  | Unit |      |    |
|---------------------------|-------------------------------|----------|---------------------|--|------|------|------|------|----|
| Propagation Delay Time    | Switch Input to Switch Output | HD14052B | 5.0                 | $R_L=10\text{k}\Omega$   | 30   | 75   | ns   |      |    |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
|                           |                               | HD14053B | 5.0                 |  |      |      |      | 25   | 65 |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
|                           | Control Input to Output       | HD14052B | $t_{PLH}$           |  | 5.0  | 1400 |      | 2000 |    |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
|                           |                               | HD14053B | $t_{PHL}$           |  | 5.0  | 1400 |      | 2000 |    |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
| Output Enable Time        | HD14052B                      | $t_{ZH}$ | 5.0                 | $R_L=10\text{k}\Omega$   | 950  | 2375 | ns   |      |    |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
|                           | HD14053B                      | $t_{ZL}$ | 5.0                 |  | 325  | 800  |      |      |    |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
| Output Disable Time       | HD14052B                      | $t_{HZ}$ | 5.0                 | 1000   | 2500 |      |      |      |    |
|                           |                               |          | 10                  |  |      |      |      |      |    |
|                           |                               |          | 15                  |  |      |      |      |      |    |
| HD14053B                  | $t_{LZ}$                      | 5.0      | 350                 | 875  |      |      |      |      |    |
|                           |                               | 10       |                     |  |      |      |      |      |    |
|                           |                               | 15       |                     |  |      |      |      |      |    |
| Sine Wave(Distortion)     |                               |          | 10                  | $R_L=1\text{k}\Omega$ , $f=1\text{kHz}$  | 0.04 | —    | %    |      |    |
| Bandwidth                 | HD14052B                      | BW       | 10                  | $R_L=1\text{k}\Omega$ , $V_{in}=1/2(V_{DD}-V_{SS})$ P-P,<br>$20\log_{10} \frac{V_{out}}{V_{in}} = -3\text{dB}$         | 30   | —    | MHz  |      |    |
|                           | HD14053B                      |          | 55                  |  |      |      |      |      |    |
| Feedthrough               | HD14052B                      |          | 10                  | $R_L=1\text{k}\Omega$ , $20\log_{10} \frac{V_{out}}{V_{in}} = -50\text{dB}$  | 3.5  | —    | MHz  |      |    |
|                           | HD14053B                      | 3.0      |                     |  |      |      |      |      |    |
| Channel Separation        |                               |          | 10                  | $R_L=1\text{k}\Omega$ , $V_{in}=1/2(V_{DD}-V_{SS})$ P-P,<br>$20\log_{10} \frac{V_{out(B)}}{V_{out(A)}} = -50\text{dB}$ | 3.0  | —    | MHz  |      |    |
| Feedthrough Control       |                               |          | 10                  | $R_1=1\text{k}\Omega$ , $R_L=10\text{k}\Omega$ ,<br>Control, Inhibit $t_r=t_f=20\text{ns}$                             | 30   | —    | mV   |      |    |
| Maximum Control Frequency |                               |          | 10                  | $R_L=1\text{k}\Omega$ , $V_{out}=1/2V_{in}$  | 10   | —    | MHz  |      |    |

■ DC CHARACTERISTIC TEST CIRCUIT

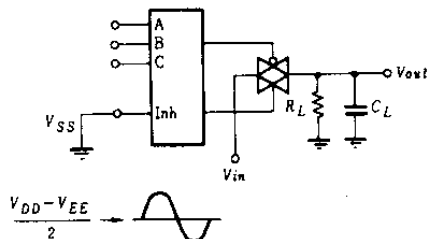
1. Input Voltage



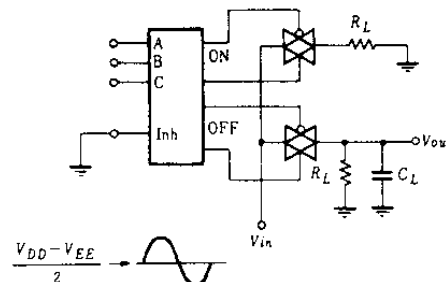
2. Propagation Delay Time



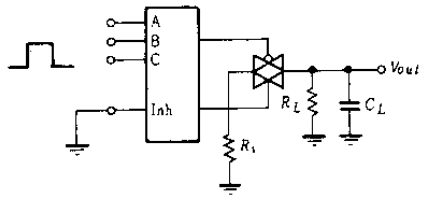
3. Bandwidth, Feedthrough



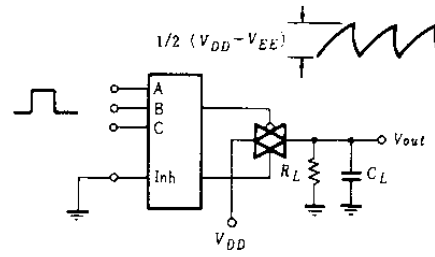
4. Crosstalk



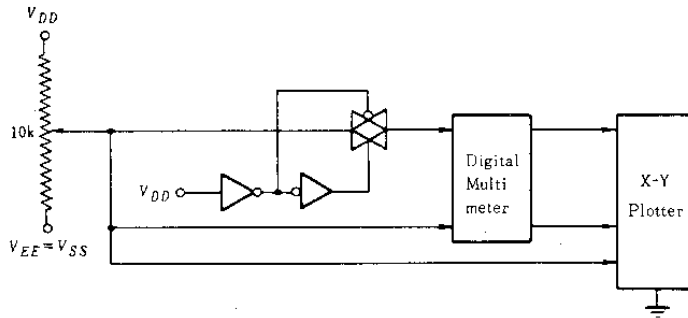
5. Feedthrough



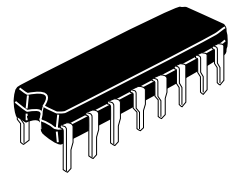
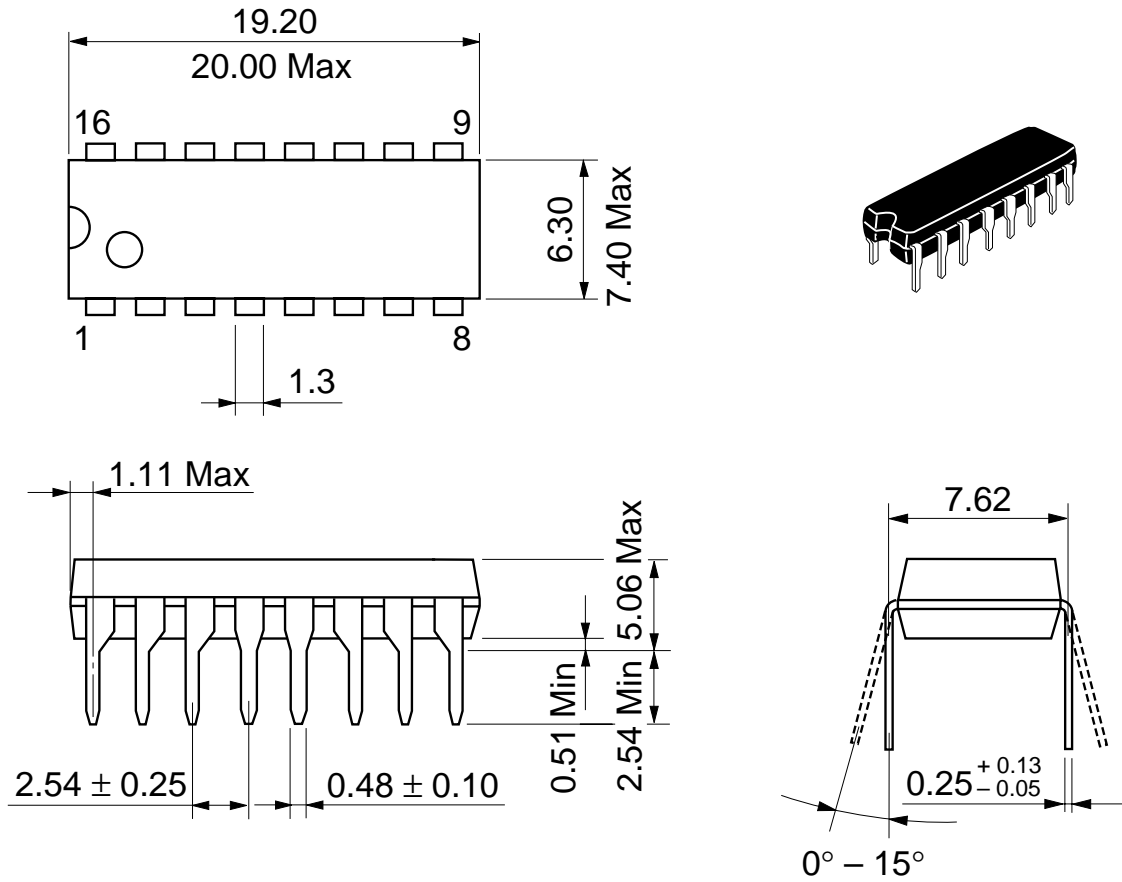
6. Maximum Control Frequency



7. RON

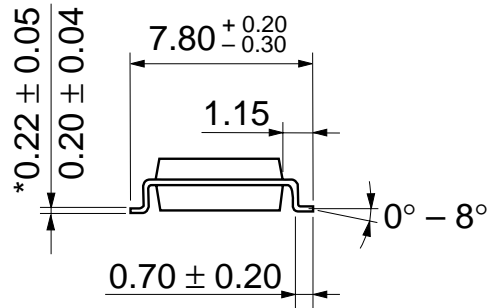
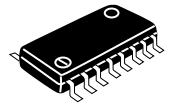
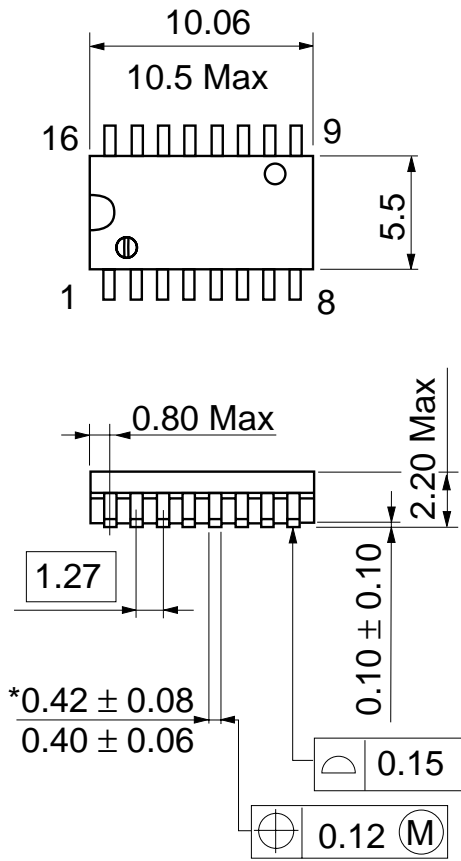


Unit: mm



|                          |          |
|--------------------------|----------|
| Hitachi Code             | DP-16    |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 1.07 g   |

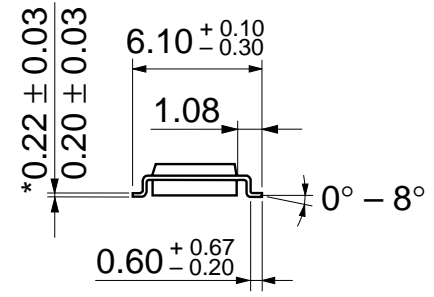
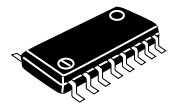
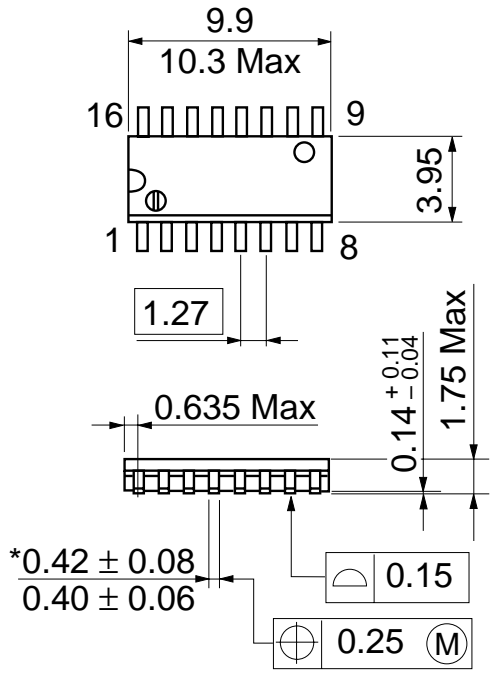
Unit: mm



\*Dimension including the plating thickness  
Base material dimension

|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-16DA  |
| JEDEC                    | —        |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.24 g   |

Unit: mm



\*Dimension including the plating thickness  
 Base material dimension

|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-16DN  |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.15 g   |

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