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# HN624416 Series

1048576-word  $\times$  16-bit/ 2097152-word  $\times$  8-bit CMOS  
Mask Programmable ROM

# HITACHI

ADE-203-466 (Z)  
Preliminary  
Rev. 0.0  
Nov. 20, 1995

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## Description

The HN624416 is a 16-Mbit CMOS mask-Programmable ROM organized either as 1048576 words by 16 bits or 2097152 words by 8 bits. Realizing low power consumption, this memory is allowed for battery operation. And a high speed access of 100/120 ns (max) is the most suitable to the system using a high speed micro-computer by 16 bits.

## Feature

- Single 5 V supply
- High speed  
Access time: 100/120 ns (max)
- Low power  
Active: 660 mW (max)  
Standby: 165  $\mu$ W (max)
- Byte-wide or word-wide data organization (Switched by BHE terminal)
- Three-state data output for or-tying
- Directly TTL compatible  
All inputs and outputs
- Pin compatible with 8 Mbit Mask ROM (HN62448)

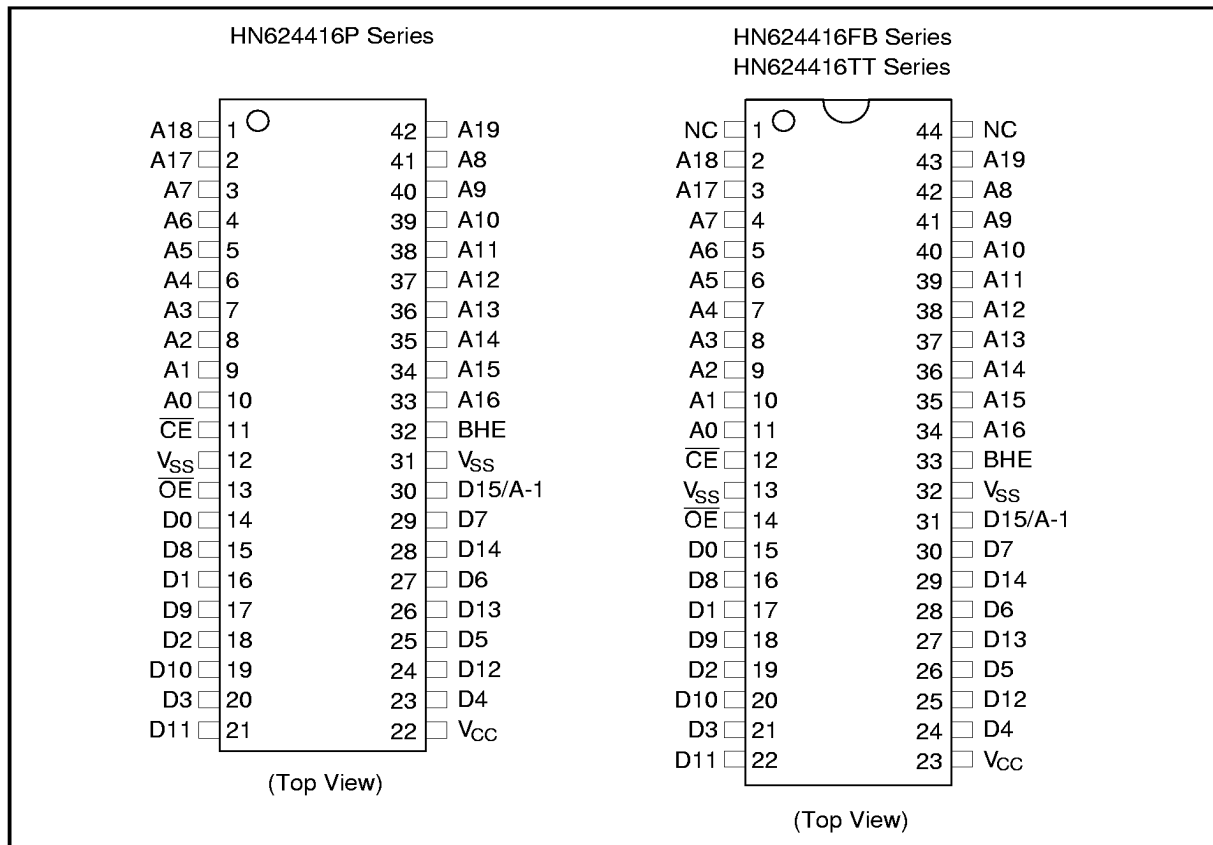
Note: The specifications of this device are subject to change without notice. Please contact your nearest Hitachi's Sales Dept. regarding specifications.

## HN6224416 Series

### Ordering Information

| Type No.      | Access time | Package                                  |
|---------------|-------------|------------------------------------------|
| HN624416P-10  | 100 ns      | 600 mil 42-pin plastic DIP (DP-42)       |
| HN624416P-12  | 120 ns      |                                          |
| HN624416FB-10 | 100 ns      | 600 mil 44-pin plastic SOP (FP-44D)      |
| HN624416FB-12 | 120 ns      |                                          |
| HN624416TT-10 | 100 ns      | 400 mil 44-pin plastic TSOP II (TTP-44D) |
| HN624416TT-12 | 120 ns      |                                          |

### Pin Arrangement

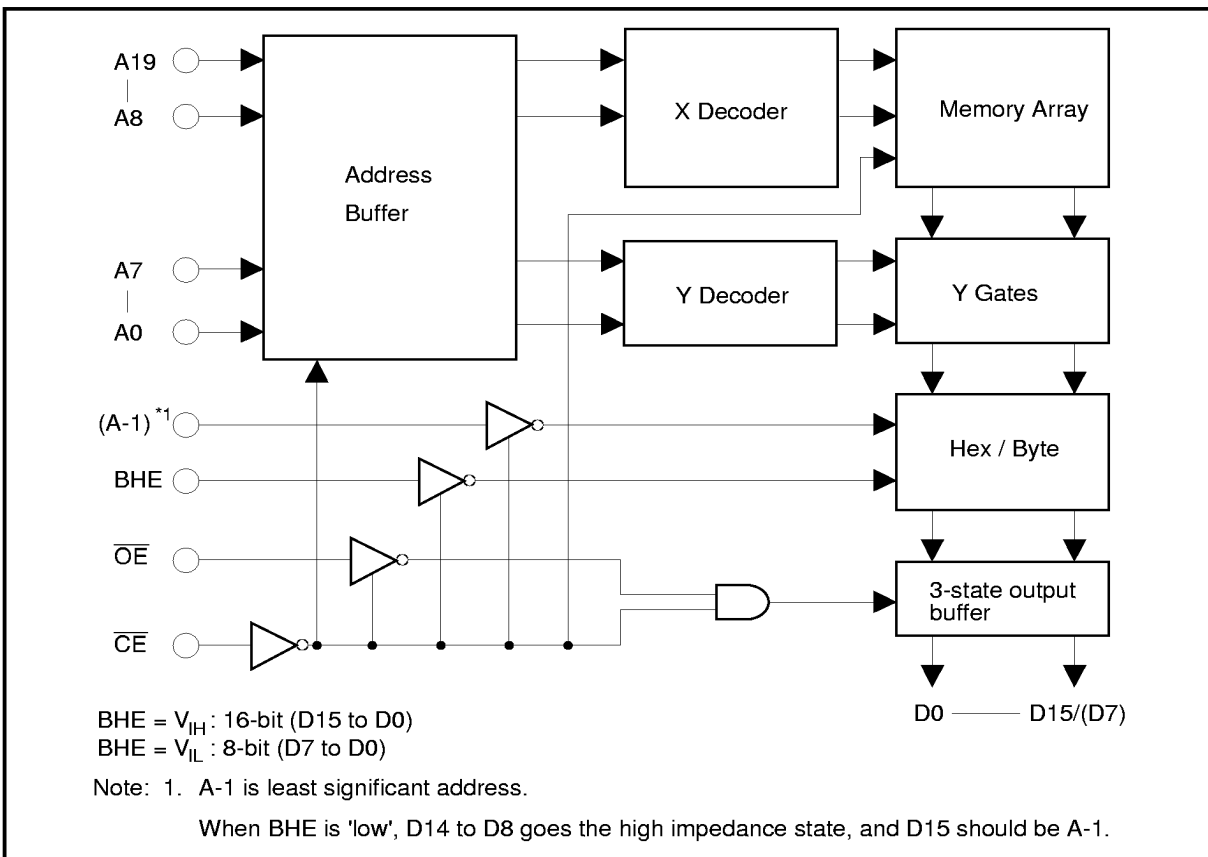


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## Pin Description

| Pin name        | Function                         |
|-----------------|----------------------------------|
| A-1, A0 to A19  | Address inputs                   |
| D0 to D15       | Data outputs                     |
| BHE             | 8/16 bit (byte/word) mode switch |
| $\overline{CE}$ | Chip enable                      |
| $\overline{OE}$ | Output enable                    |
| NC              | No connection                    |
| $V_{CC}$        | Power supply                     |
| $V_{SS}$        | Ground                           |

## Block Diagram



## HN6224416 Series

### Mode Selection

| Mode           | Pin                    |                        |          |          |                     |           |               |     |
|----------------|------------------------|------------------------|----------|----------|---------------------|-----------|---------------|-----|
|                | $\overline{\text{CE}}$ | $\overline{\text{OE}}$ | BHE      | D15/A-1  | Data output         |           | Address input |     |
|                |                        |                        |          |          | D0-D7               | D8-D15    | LSB           | MSB |
| Standby        | H                      | $\times^{*1}$          | $\times$ | $\times$ | High-Z <sup>2</sup> | High-Z    | —             | —   |
| Output disable | L                      | H                      | $\times$ | $\times$ | High-Z              | High-Z    | —             | —   |
| Read (16-bit)  | L                      | L                      | H        | Dout     | D0 to D7            | D8 to D15 | A0            | A19 |
| Read (8-bit)   | L                      | L                      | L        | L        | D0 to D7            | High-Z    | A-1           | A19 |
| Read (8-bit)   | L                      | L                      | L        | H        | D8 to D15           | High-Z    | A-1           | A19 |

Notes: 1.  $\times$ : Don't care.  
2. High-Z: High impedance

### Absolute Maximum Ratings

| Parameter                                  | Symbol                          | Value                         | Unit |
|--------------------------------------------|---------------------------------|-------------------------------|------|
| Supply voltage <sup>*1</sup>               | $V_{\text{CC}}$                 | -0.3 to + 7.0                 | V    |
| All input and output voltage <sup>*1</sup> | $V_{\text{in}}, V_{\text{out}}$ | -0.3 to $V_{\text{CC}} + 0.3$ | V    |
| Operating temperature range                | $T_{\text{opr}}$                | 0 to + 70                     | °C   |
| Storage temperature range                  | $T_{\text{stg}}$                | -55 to + 125                  | °C   |
| Temperature under bias                     | $T_{\text{bias}}$               | -20 to + 85                   | °C   |

Note: 1. With respect to  $V_{\text{SS}}$ .

### Recommended DC Operating Conditions ( $T_a = 0$ to + 70°C)

| Parameter      | Symbol          | Min  | Typ | Max                   | Unit |
|----------------|-----------------|------|-----|-----------------------|------|
| Supply voltage | $V_{\text{CC}}$ | 4.5  | 5.0 | 5.5                   | V    |
|                | $V_{\text{SS}}$ | 0    | 0   | 0                     | V    |
| Input voltage  | $V_{\text{IH}}$ | 2.2  | —   | $V_{\text{CC}} + 0.3$ | V    |
|                | $V_{\text{IL}}$ | -0.3 | —   | 0.8                   | V    |

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### DC Characteristics ( $V_{CC} = 5.0 \text{ V} \pm 10\%$ , $V_{SS} = 0 \text{ V}$ , $T_a = 0 \text{ to } +70^\circ\text{C}$ )

| Parameter              |         | Symbol     | Min | Max     | Unit          | Test conditions                                                                         |
|------------------------|---------|------------|-----|---------|---------------|-----------------------------------------------------------------------------------------|
| Supply current         | Active  | $I_{CC}$   | —   | 120/100 | mA            | $V_{CC} = 5.5 \text{ V}$ , $I_{DOUT} = 0 \text{ mA}$ ,<br>$t_{RC} = 100/120 \text{ ns}$ |
|                        | Standby | $I_{SB1}$  | —   | 30      | $\mu\text{A}$ | $V_{CC} = 5.5 \text{ V}$ , $\overline{CE} \geq V_{CC} - 0.2 \text{ V}$                  |
|                        | Standby | $I_{SB2}$  | —   | 3       | mA            | $V_{CC} = 5.5 \text{ V}$ , $\overline{CE} \geq 2.2 \text{ V}$                           |
| Input leakage current  |         | $ I_{IL} $ | —   | 10      | $\mu\text{A}$ | $V_{in} = 0 \text{ to } V_{CC}$                                                         |
| Output leakage current |         | $ I_{OL} $ | —   | 10      | $\mu\text{A}$ | $\overline{CE} = 2.2 \text{ V}$ , $V_{out} = 0 \text{ to } V_{CC}$                      |
| Output voltage         |         | $V_{OH}$   | 2.4 | —       | V             | $I_{OH} = -205 \mu\text{A}$                                                             |
|                        |         | $V_{OL}$   | —   | 0.4     | V             | $I_{OL} = 1.6 \text{ mA}$                                                               |

### Capacitance ( $V_{CC} = 5.0 \text{ V} \pm 10\%$ , $V_{SS} = 0 \text{ V}$ , $T_a = 25^\circ\text{C}$ , $V_{in} = 0 \text{ V}$ , $f = 1 \text{ MHz}$ )

| Parameter                        |  | Symbol    | Min | Max | Unit |
|----------------------------------|--|-----------|-----|-----|------|
| Input capacitance <sup>*1</sup>  |  | $C_{in}$  | —   | 10  | pF   |
| Output capacitance <sup>*1</sup> |  | $C_{out}$ | —   | 15  | pF   |

Note: 1. This parameter is sampled and not 100% tested. D15/A-1 pin is output.

## HN6224416 Series

**AC Characteristics** ( $V_{CC} = 5.0 \text{ V} \pm 10\%$ ,  $V_{SS} = 0 \text{ V}$ ,  $T_a = 0 \text{ to } +70^\circ\text{C}$ )

- Output load: 1TTL +  $C_L = 100 \text{ pF}$  (including jig)
- Input pulse level: 0.45 to 2.4 V
- Input and output timing reference level: 1.5 V
- Input rise and fall time: 5 ns

| Parameter                             | Symbol    | HN624416-10 |     | HN624416-12 |     | Unit | Note |
|---------------------------------------|-----------|-------------|-----|-------------|-----|------|------|
|                                       |           | Min         | Max | Min         | Max |      |      |
| Read cycle time                       | $t_{RC}$  | 100         | —   | 120         | —   | ns   |      |
| Address access time                   | $t_{AA}$  | —           | 100 | —           | 120 | ns   |      |
| $\overline{CE}$ access time           | $t_{ACE}$ | —           | 100 | —           | 120 | ns   |      |
| $\overline{OE}$ access time           | $t_{OE}$  | —           | 40  | —           | 50  | ns   |      |
| BHE access time                       | $t_{BHE}$ | —           | 100 | —           | 120 | ns   |      |
| Output hold time from address change  | $t_{DHA}$ | 5           | —   | 5           | —   | ns   |      |
| Output hold time from $\overline{CE}$ | $t_{DHC}$ | 0           | —   | 0           | —   | ns   |      |
| Output hold time from $\overline{OE}$ | $t_{DHO}$ | 0           | —   | 0           | —   | ns   |      |
| Output hold time from BHE             | $t_{DHB}$ | 0           | —   | 0           | —   | ns   |      |
| $\overline{CE}$ to output in high-Z   | $t_{CHZ}$ | —           | 30  | —           | 30  | ns   | 1    |
| $\overline{OE}$ to output in high-Z   | $t_{OHZ}$ | —           | 30  | —           | 30  | ns   | 1    |
| BHE to output in high-Z               | $t_{BHZ}$ | —           | 30  | —           | 30  | ns   | 1    |
| $\overline{CE}$ to output in low-Z    | $t_{CLZ}$ | 5           | —   | 5           | —   | ns   |      |
| $\overline{OE}$ to output in low-Z    | $t_{OLZ}$ | 5           | —   | 5           | —   | ns   |      |
| BHE to output in low-Z                | $t_{BLZ}$ | 5           | —   | 5           | —   | ns   |      |

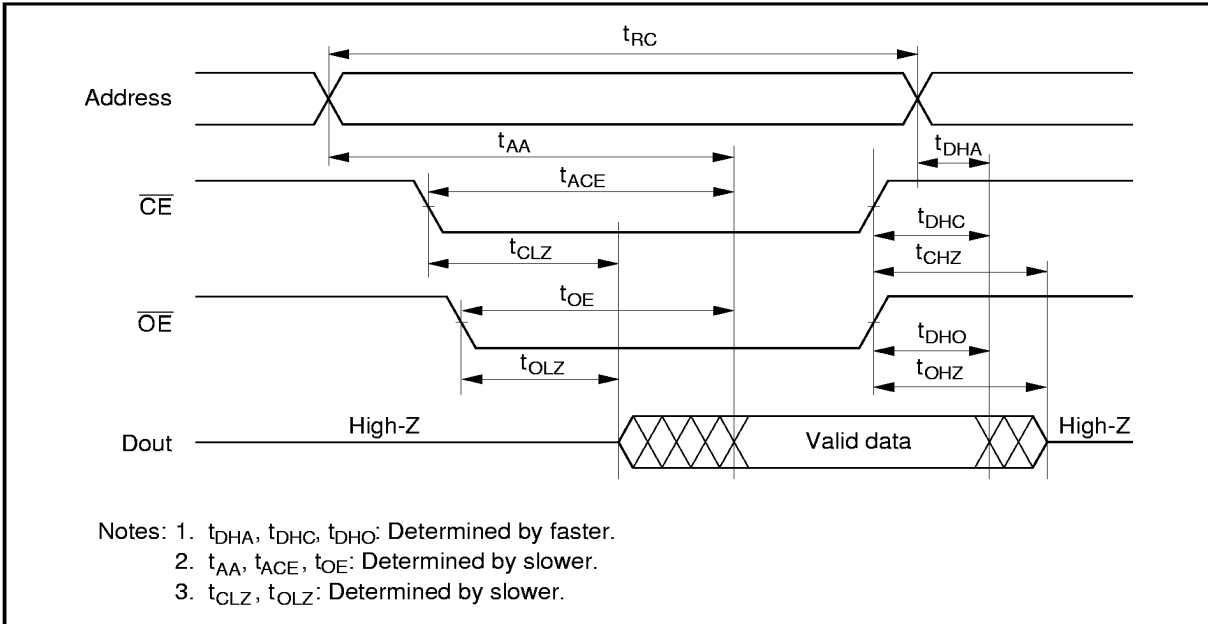
Note: 1.  $t_{CHZ}$ ,  $t_{OHZ}$  and  $t_{BHZ}$  are defined as the time at which the output achieves the open circuit conditions and are not referred to output voltage levels.

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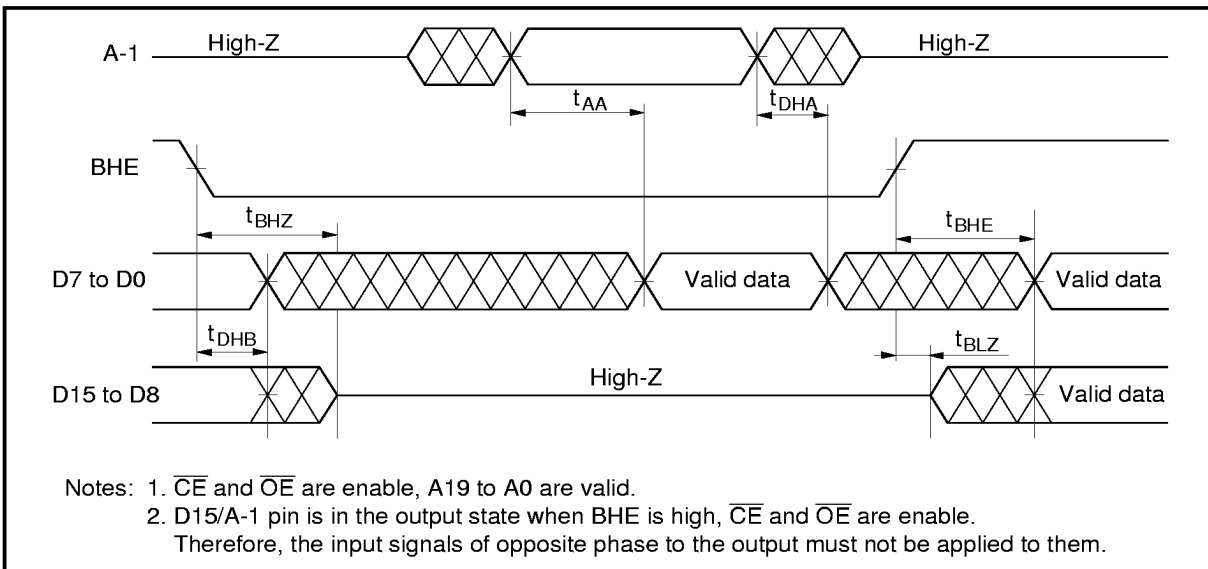
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## Timing Waveforms

Word Mode (BHE = 'V<sub>IH</sub>') or Byte Mode (BHE = 'V<sub>IL</sub>')

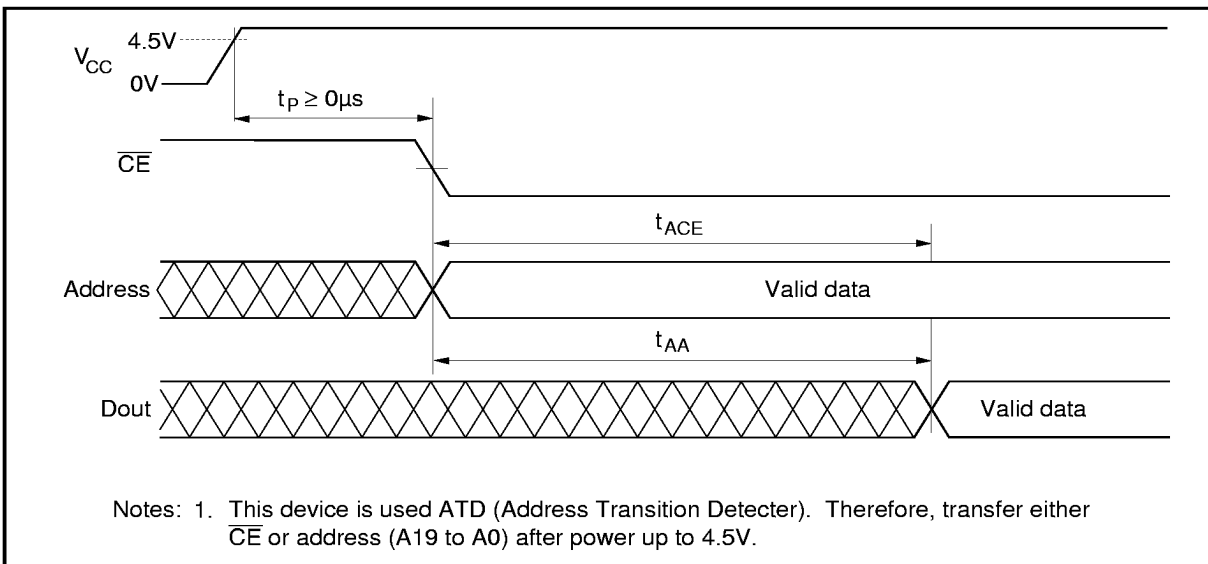


## Word Mode, Byte Mode Switch



## HN6224416 Series

### Power Up Sequence



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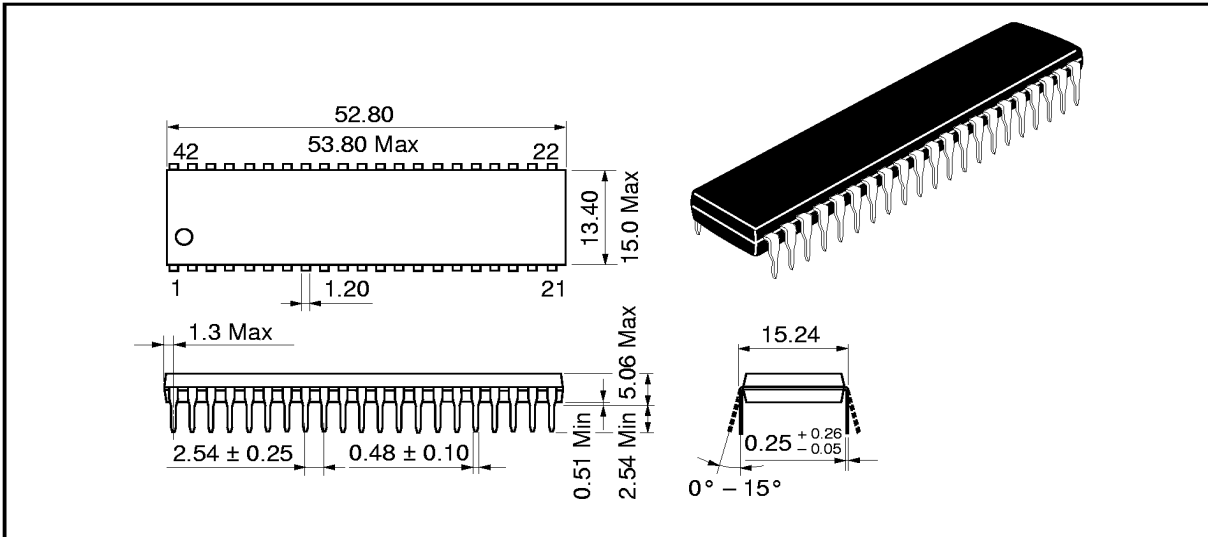


## HN6224416 Series

### Package Dimensions

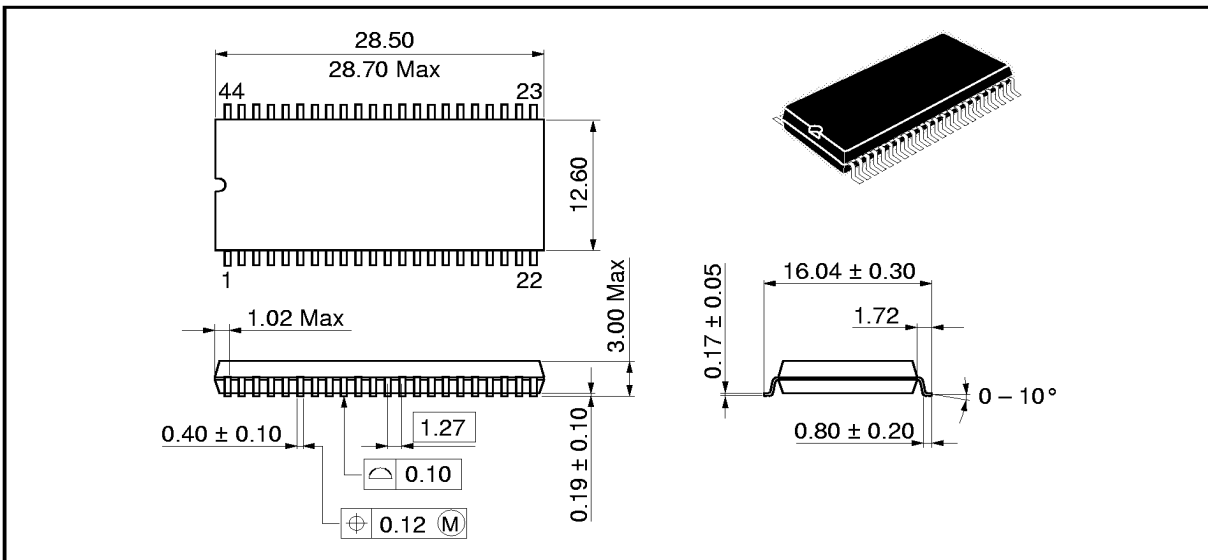
HN624416P Series (DP-42)

Unit: mm



HN624416FB Series (FP-44D)

Unit: mm



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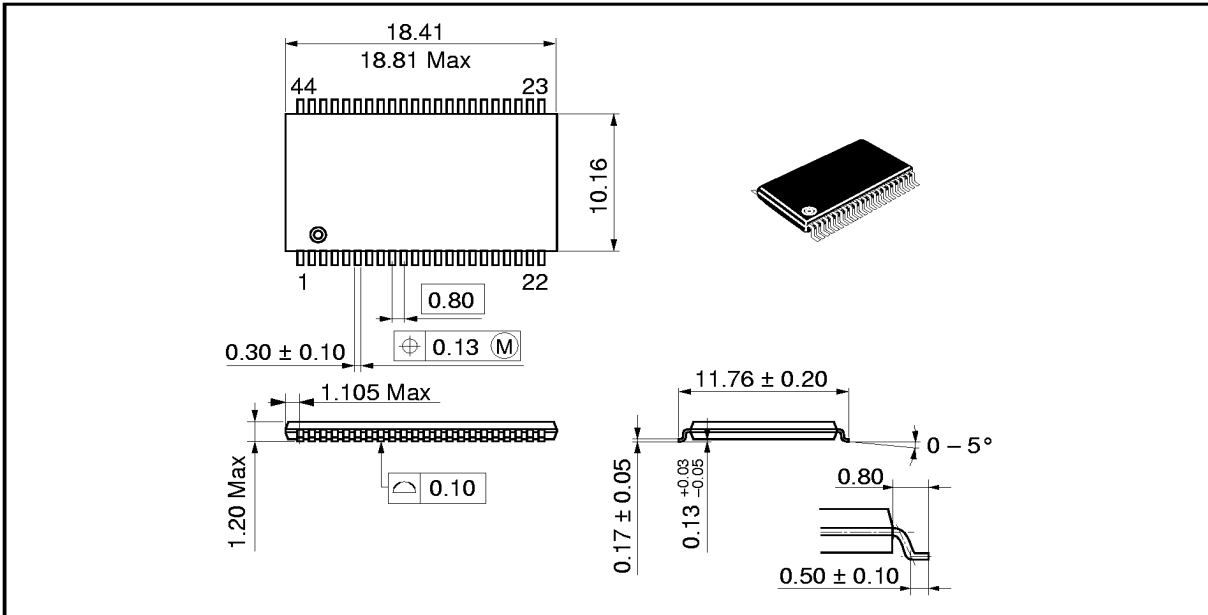
## HN6224416 Series

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### Package Dimensions (cont)

HN624416TT Series (TTP-44D)

Unit: mm



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