

Features

- Operating voltage: 4.4V~5.25V
- Compatible with Microsoft Windows 2000 and 5-button Wheel Mouse
- Microsoft 3D Intelli mouse and IBM PS/2 mouse compatible
- Supports 3/5 buttons and Z-axis input
- Z-axis can support two kinds of scroller input (optomechanical and mechanical)
- 3 key or 5 key mode can be selected by package
- Complete Universal Serial Bus specs V2.0 compatibility
- Serial Bus Interface Engine (SIE)
- USB transceiver
- Single chip solution especially for USB mouse function
- HALT function and wake-up feature reduce power consumption
- Plug and Play functions
- Minimal external components
- 6MHz crystal oscillator for system clock
- Interface compliant with ADNS-2051, ADNS-2610 and ADNS-2620
- Pass WHQL, USB-IF and EMC testing
- HT82M23A is pin compatible with HT82M22A
- HT82M23B/HT82M23C is pin compatible with HT82M21A
- HT82M23A: 20-pin DIP/SOP package
HT82M23B/HT82M23C: 18-pin DIP/SOP package

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General Description

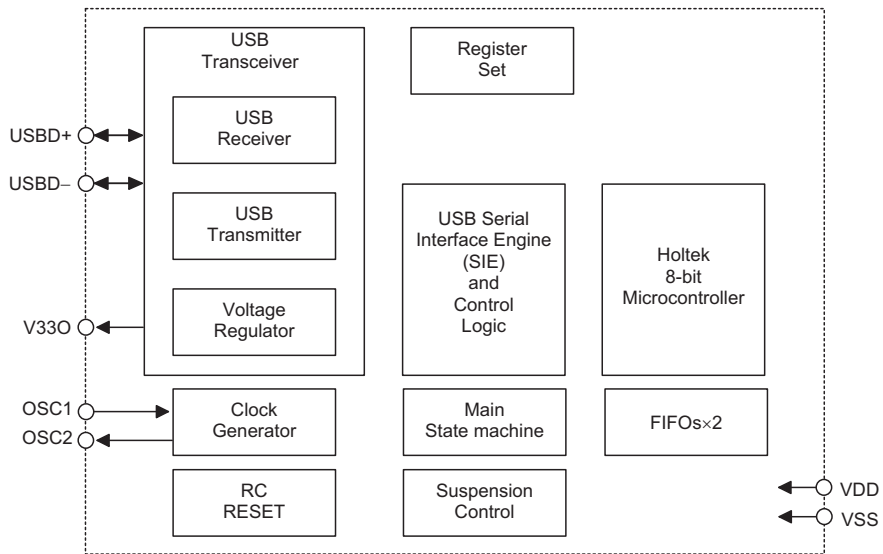
HT82M23A/HT82M23B/HT82M23C is a Plug and Play Windows 2000 and 5-button 3D USB+PS/2 Mouse controller. The HT82M23A/HT82M23B/HT82M23C can support the USB Standard Request as well as HID Class Request version 1.1. It is compatible with Microsoft Intelli 3D or Windows 2000 5 key PS/2 mouse. The Z-axis can support two kinds of scroller input, namely; mechanical and optomechanical. It requires minimal external com-

ponents to implement 3D or Windows 2000 5 key USB plus PS/2 mouse. All its features combined and make up this versatile Holtek 8-bit MCU with an on-chip USB interface logic. The USB is specified by the Universal Serial Bus Specification V2.0.

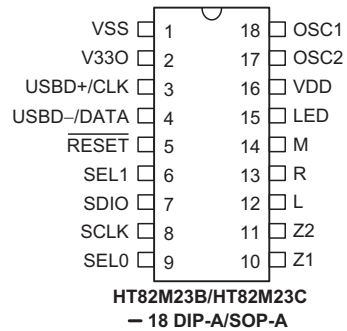
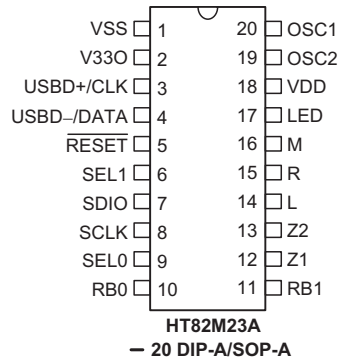
The USB vendor ID for HT82M23A/HT82M23B/HT82M23C is defined as 04D9H, the USB product ID is different by different package

Selection Table

| Part No. | Interface | Mode | USB Product ID | Package |
|----------|--------------|--------------|----------------|-----------|
| HT82M23A | USB and PS/2 | Windows 2000 | 048EH | 20DIP/SOP |
| HT82M23B | USB and PS/2 | 3D | 0499H | 18DIP/SOP |
| HT82M23C | USB only | 3D | 0499H | 18DIP/SOP |

Block Diagram


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Pin Assignment


Pin Description

| Pin Name | I/O | Description |
|---------------------|-----|---|
| VSS | — | Negative power supply, ground |
| V330 | O | 3.3V voltage output |
| USBD+/CLK | I/O | USB data plus or PS2 Clock, F/W auto-detect USBD+ for USB, CLK for PS2 |
| USBD-/DATA | I/O | USB data minus or PS2 Data, F/W auto-detect USB- for USB, DATA for PS2 |
| RESET | I | Chip reset input, low active |
| SEL1 SELO | I | Configuration selections SEL1=0: Z-axis is divided by 2 (default) SEL1=1: Z-axis is divided by 4 For ADNS 2051: SEL0=0: 800DPI (default) SEL0=1: 400DPI For ADNS 2610/2620: SEL0=0, 400DPI (default) SEL0=1, 800DPI-by firmware |
| SDIO | I/O | Serial data for Agilent sensor IC SDIO |
| SCLK | I | Serial data for Agilent sensor IC SCLK |
| RB0, RB1 L, R, M | I | Click button detection. Input ports with 30kΩ pull-high resistor. Input ports with pull-high resistor. These pads can function as Left, Right, Middle, B4 and B5 button input lines. |
| Z1, Z2 | I | Z-axis input supports two kinds of scroller input; optomechanical and mechanical. |
| LED | I/O | Drives LED output |
| VDD | — | 5V positive power supply |
| OSC2 | O | 6MHz OSC output |
| OSC1 | I | 6MHz OSC input |

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Absolute Maximum Ratings

| | | | |
|-------------------------|---------------------------------|----------------------------|----------------------------------|
| Supply Voltage | $V_{SS}-0.3V$ to $V_{SS}+6V$ | Storage Temperature | $-50^{\circ}C$ to $125^{\circ}C$ |
| MCU Input Voltage..... | $V_{SS}-0.3V$ to $V_{DD}+0.3V$ | Operating Temperature..... | $-25^{\circ}C$ to $70^{\circ}C$ |
| USB Input Voltage | $V_{SS}-0.3V$ to $V_{330}+0.3V$ | | |

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

D.C. Characteristics

Ta=25°C

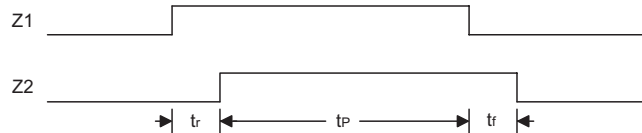
| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit | |
|------------------|---|-----------------|---------------------------------|-----------|------|------|------|----|
| | | V _{DD} | Conditions | | | | | |
| V _{DD} | Operating Voltage | — | — | 4.4 | — | 5.25 | V | |
| I _{DD} | Operating Current (Crystal OSC) | 5V | No load, f _{sys} =6MHz | USB mode | — | 10 | — | mA |
| | | | | PS/2 mode | — | 3 | — | mA |
| I _{SUS} | USB Suspend Mode | 5V | No load, system HALT | | — | — | 250 | μA |
| V _{IL1} | Input Low Voltage (Z1, Z2, L, M, R) | 5V | — | | 0 | — | 1.0 | V |
| V _{IH1} | Input High Voltage (Z1, Z2, L, M, R) | 5V | — | | 3.5 | — | 5 | V |
| V _{IL2} | Input Low Voltage ($\overline{\text{RESET}}$) | 5V | — | | 0 | — | 1.5 | V |
| V _{IH2} | Input High Voltage ($\overline{\text{RESET}}$) | 5V | — | | 3.5 | — | 5 | V |
| V _{POR} | Built-in Power on Reset V _{DD} Detection Voltage | 5V | — | | — | 3.7 | — | V |
| I _{OL} | Sink Current (LED) | 5V | V _{OL} =0.8V | | — | 50 | — | mA |

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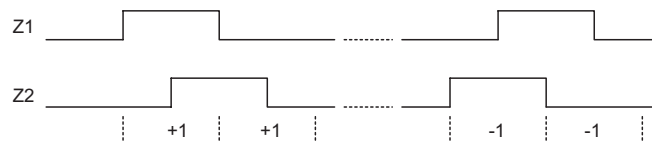
A.C. Characteristics

Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|------------------|----------------------------|-----------------|------------|------|------|------|------|
| | | V _{DD} | Conditions | | | | |
| f _{sys} | System Clock (Crystal OSC) | 5V | — | 0 | 6000 | — | kHz |

 Note: t_{sys}=1/f_{sys}
Timing Diagram
Z-axis Photo-Coupler Crossed Width


Note: For Z-axis tr, tp, tf > 1ms

Z-axis Counting


Functional Description
PS/2 Mouse

- PS/2 status byte
 - ♦ Byte 1
 - Bit 7: Reserved
 - Bit 6: 0=Stream Mode, 1=Remote Mode
 - Bit 5: 0=Disabled, 1=Enabled
 - Bit 4: 0=Scaling 1:1, 1=Scaling 2:1
 - Bit 3: 1=Wrap Mode, 0=Stream or Remote (different from IBM specs.)
 - Bit 2: 1=Left Button Pressed
 - Bit 1: 1=Middle Button Pressed
 - Bit 0: 1=Right Button Pressed
 - ♦ Byte 2
 - Bit 0~7 current resolution setting (Bit 0=LSB)
 - ♦ Byte 3
 - Bit 0~7 current sampling rate (Bit 0=LSB)
- Standard PS/2 data format (HT82M23A/HT82M23B)

| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|----|----|----|----|----|----|----|
| 1st word | YV | XV | YS | XS | 1 | M | R | L |
| 2nd word | X7 | X6 | X5 | X4 | X3 | X2 | X1 | X0 |
| 3rd word | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | Y1 | Y0 |

- Data format for 3D PS/2 (HT82M23A/HT82M23B)

| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|----|----|----|----|----|----|----|
| 1st word | YV | XV | YS | XS | 1 | M | R | L |
| 2nd word | X7 | X6 | X5 | X4 | X3 | X2 | X1 | X0 |
| 3rd word | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | Y1 | Y0 |
| 4th word | Z7 | Z6 | Z5 | Z4 | Z3 | Z2 | Z1 | Z0 |

Note: The X/Y data report is 9-bit 2's complement
The Z data report is 8-bit 2's complement

- Data format for 5-button Wheel Mouse (HT82M23A)

| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|----|-----|-----|----|----|----|----|
| 1st word | 0 | 0 | YS | XS | 1 | M | R | L |
| 2nd word | X7 | X6 | X5 | X4 | X3 | X2 | X1 | X0 |
| 3rd word | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | Y1 | Y0 |
| 4th word | 0 | 0 | RB1 | RB0 | Z3 | Z2 | Z1 | Z0 |

Note: X- movement towards the right is positive, moving towards the left is negative
Y- upward movement is positive, moving down is negative
Z- rolling towards the user is positive, else negative
Button status: 1=pressed, 0=released

- For HT82M23A/HT82M23B, mouse mode changes between Standard and 3D PS/2 mode.
Sending the commands in the following sequence will set the mouse to 3D PS/2 mode.

Command Response From Mouse

| | |
|-----|----------|
| F3h | FAh |
| C8h | FAh |
| F3h | FAh |
| 64h | FAh |
| F3h | FAh |
| 50h | FAh |
| F2h | FAh, 03h |

- For HT82M23A, mouse mode changes between Standard and Windows 2000 PS/2 mode.
Sending the commands in the following sequence will set the mouse to Windows 2000 PS/2 mode.

Command Response From Mouse

| | |
|-----|----------|
| F3h | FAh |
| C8h | FAh |
| F3h | FAh |
| C8h | FAh |
| F3h | FAh |
| 50h | FAh |
| F2h | FAh, 04h |

- ♦ Any time the PC sends a reset "FFh" command to the mouse, it will reset the mouse to Standard PS/2 mode.

After power-on reset is initiated, the mouse is set to Standard PS/2 mode.

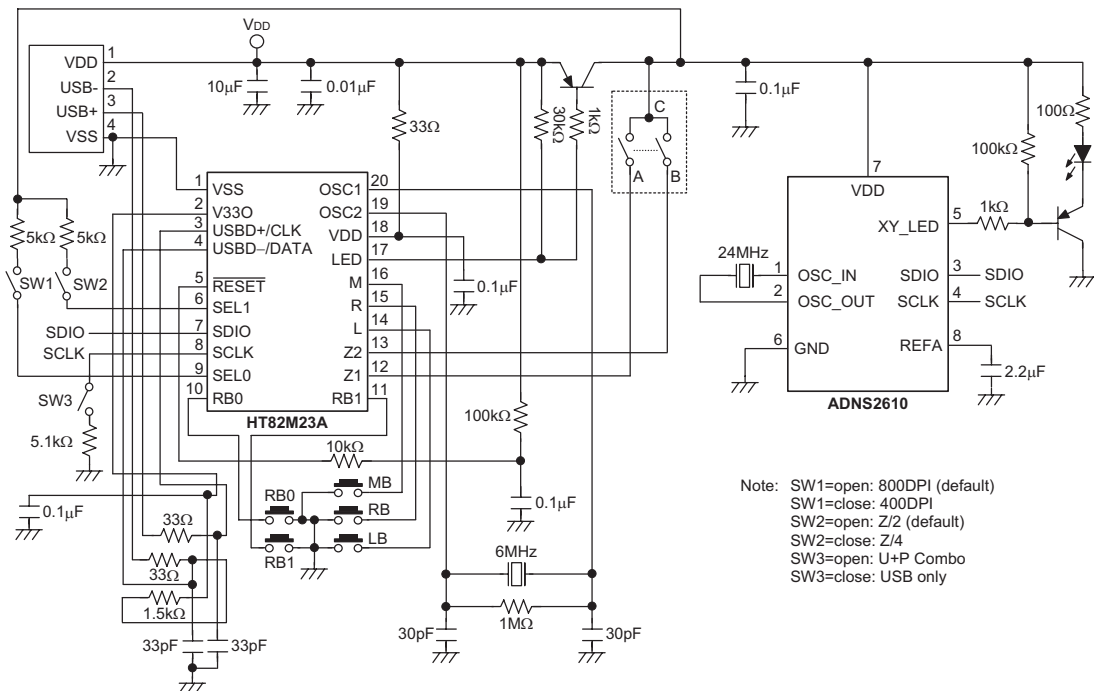
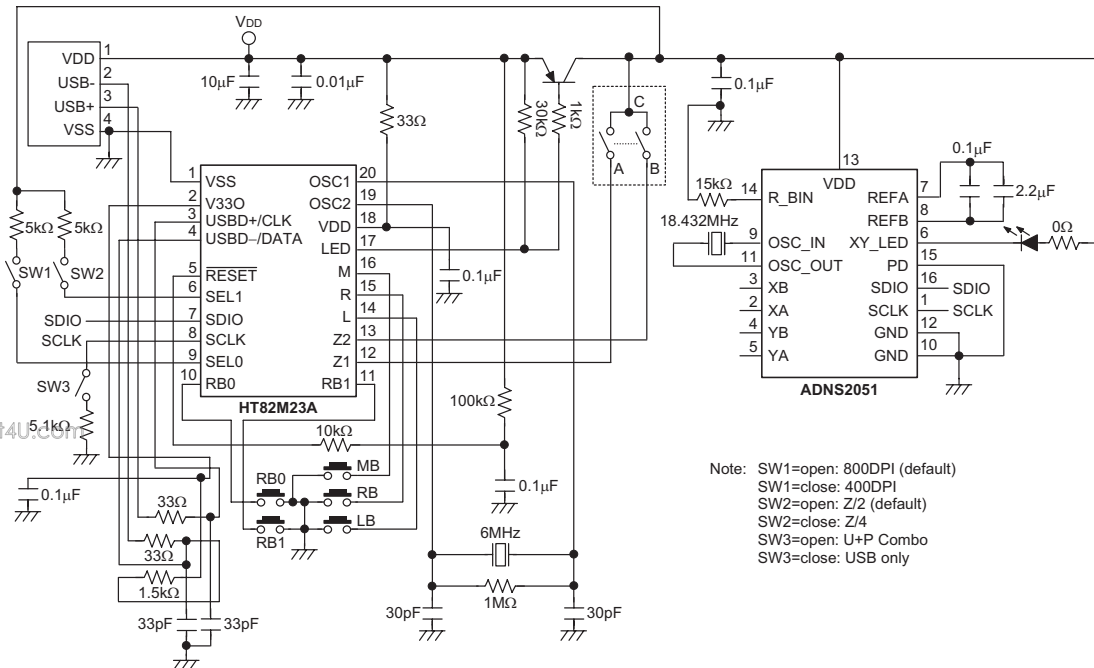
- USB mouse data format for 3D mod (HT82M23A/HT82M23B/HT82M23C)

| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|----|----|----|----|----|----|----|
| 1st word | 0 | 0 | 0 | 0 | 0 | M | R | L |
| 2nd word | X7 | X6 | X5 | X4 | X3 | X2 | X1 | X0 |
| 3rd word | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | Y1 | Y0 |
| 4th word | Z7 | Z6 | Z5 | Z4 | Z3 | Z2 | Z1 | Z0 |

- Data format for Windows 2000 mode (HT82M23A)

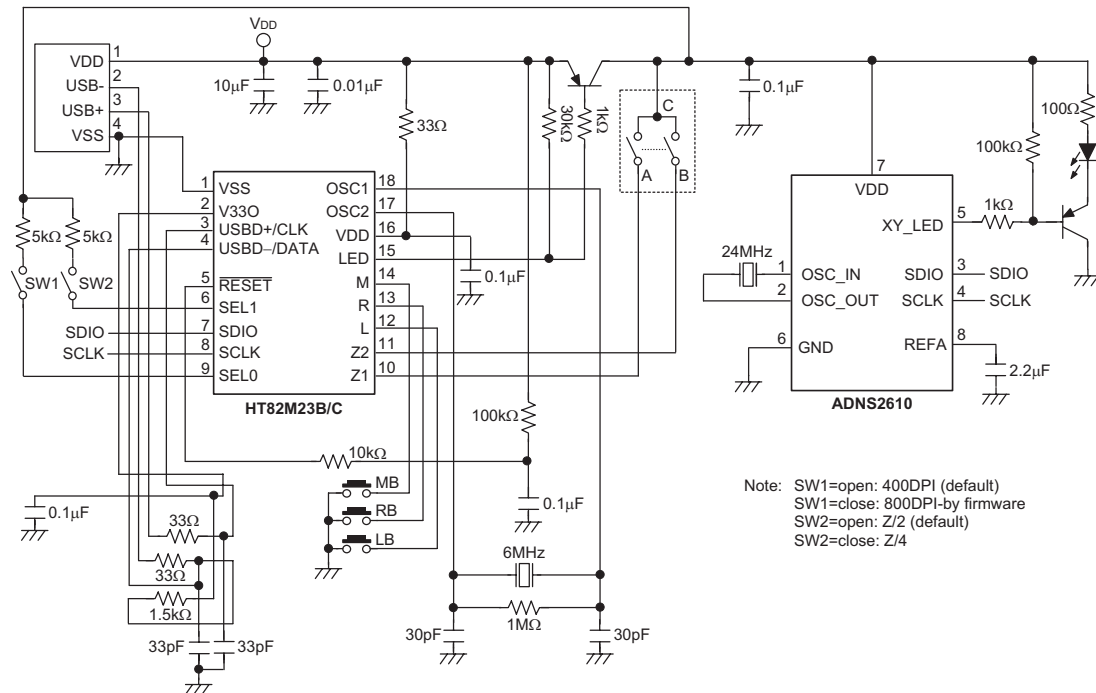
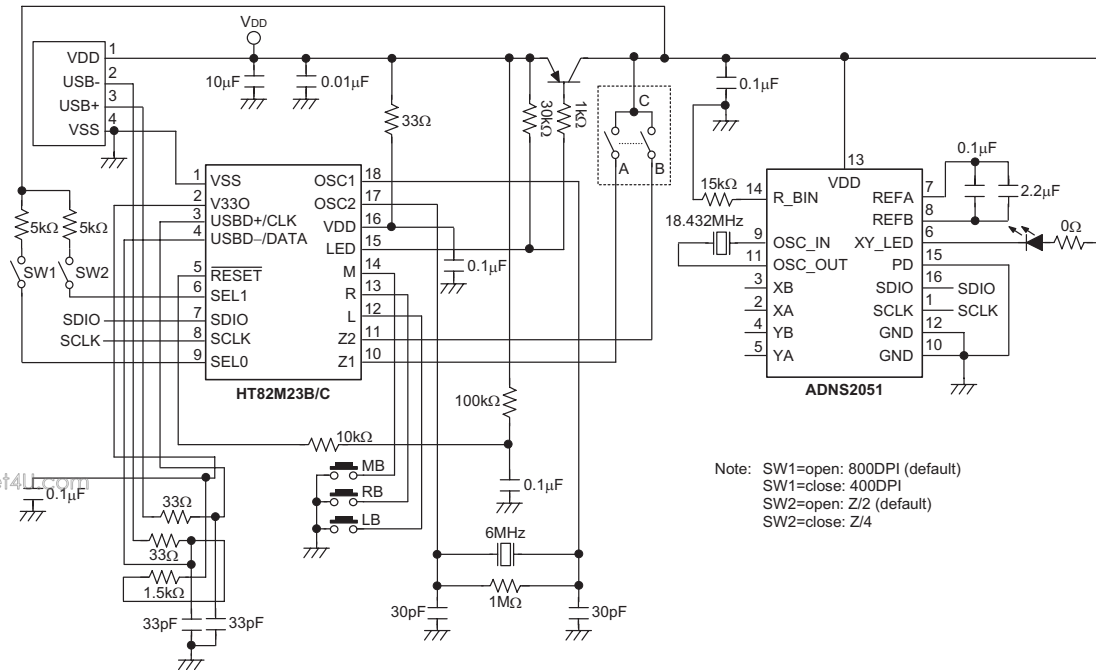
| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|----|----|-----|-----|----|----|----|
| 1st word | 0 | 0 | 0 | RB1 | RB1 | M | R | L |
| 2nd word | X7 | X6 | X5 | X4 | X3 | X2 | X1 | X0 |
| 3rd word | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | Y1 | Y0 |
| 4th word | Z7 | Z6 | Z5 | Z4 | Z3 | Z2 | Z1 | Z0 |

Note: X- movement towards the right is positive, moving towards the left is negative
Y- upward movement is negative, moving down is positive
Z- rolling towards the user is negative, else positive
Button status: 1=pressed, 0=released

Application Circuits
HT82M23A Application Circuit is for Reference Only


Note: Layout 0.1μF capacitor, 33Ω resistor and 0.01μF capacitor as close to VDD pin as possible.

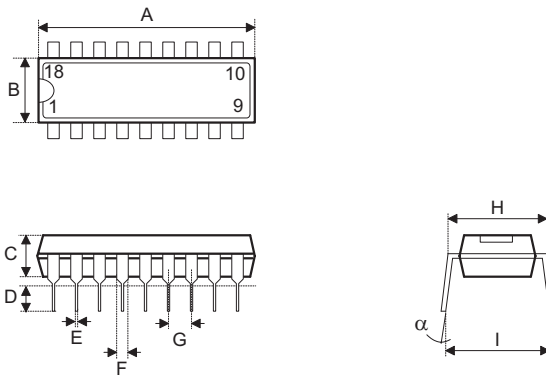
HT82M23B/HT82M23C Application Circuit is for Reference Only



Note: Layout 0.1μF capacitor, 33Ω resistor and 0.01μF capacitor as close to VDD pin as possible.

Package Information

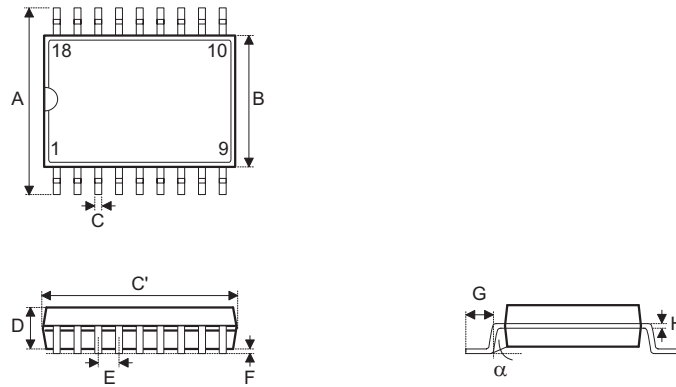
18-pin DIP (300mil) Outline Dimensions



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| Symbol | Dimensions in mil | | |
|----------|-------------------|------|------|
| | Min. | Nom. | Max. |
| A | 895 | — | 915 |
| B | 240 | — | 260 |
| C | 125 | — | 135 |
| D | 125 | — | 145 |
| E | 16 | — | 20 |
| F | 50 | — | 70 |
| G | — | 100 | — |
| H | 295 | — | 315 |
| I | 335 | — | 375 |
| α | 0° | — | 15° |

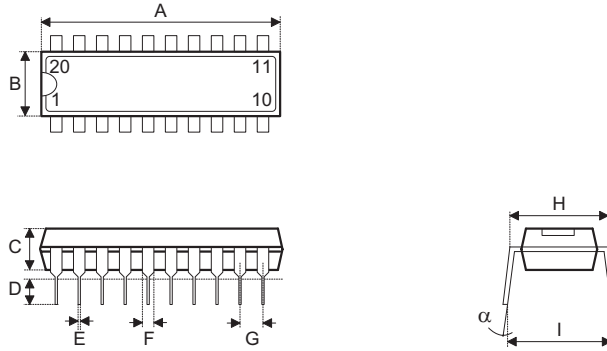
18-pin SOP (300mil) Outline Dimensions



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| Symbol | Dimensions in mil | | |
|--------|-------------------|------|------|
| | Min. | Nom. | Max. |
| A | 394 | — | 419 |
| B | 290 | — | 300 |
| C | 14 | — | 20 |
| C' | 447 | — | 460 |
| D | 92 | — | 104 |
| E | — | 50 | — |
| F | 4 | — | — |
| G | 32 | — | 38 |
| H | 4 | — | 12 |
| α | 0° | — | 10° |

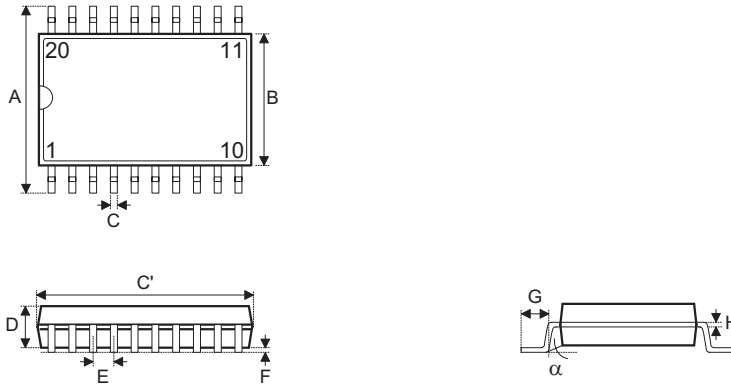
20-pin DIP (300mil) Outline Dimensions



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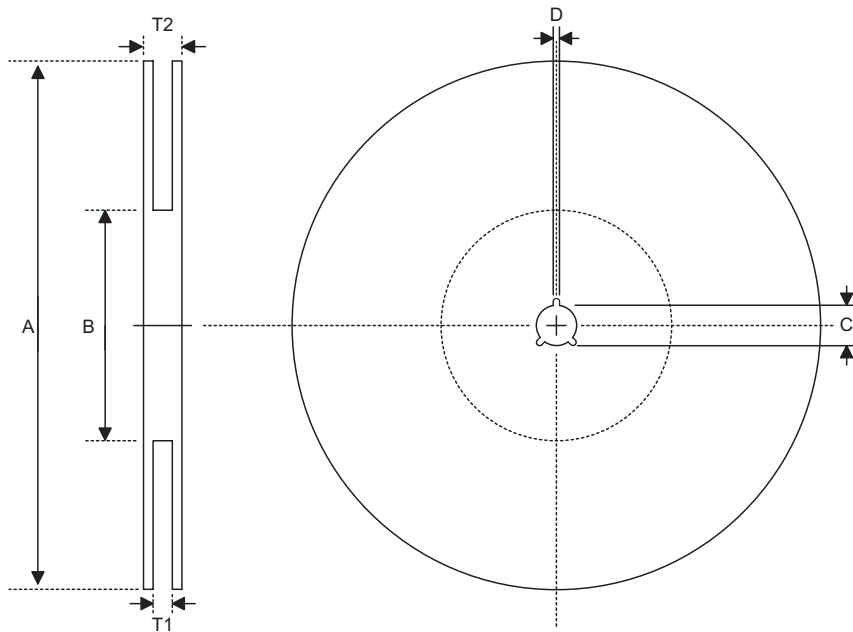
| Symbol | Dimensions in mil | | |
|----------|-------------------|------|------|
| | Min. | Nom. | Max. |
| A | 1020 | — | 1045 |
| B | 240 | — | 260 |
| C | 125 | — | 135 |
| D | 125 | — | 145 |
| E | 16 | — | 20 |
| F | 50 | — | 70 |
| G | — | 100 | — |
| H | 295 | — | 315 |
| I | 335 | — | 375 |
| α | 0° | — | 15° |

20-pin SOP (300mil) Outline Dimensions



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| Symbol | Dimensions in mil | | |
|----------|-------------------|------|------|
| | Min. | Nom. | Max. |
| A | 394 | — | 419 |
| B | 290 | — | 300 |
| C | 14 | — | 20 |
| C' | 490 | — | 510 |
| D | 92 | — | 104 |
| E | — | 50 | — |
| F | 4 | — | — |
| G | 32 | — | 38 |
| H | 4 | — | 12 |
| α | 0° | — | 10° |

Product Tape and Reel Specifications
Reel Dimensions


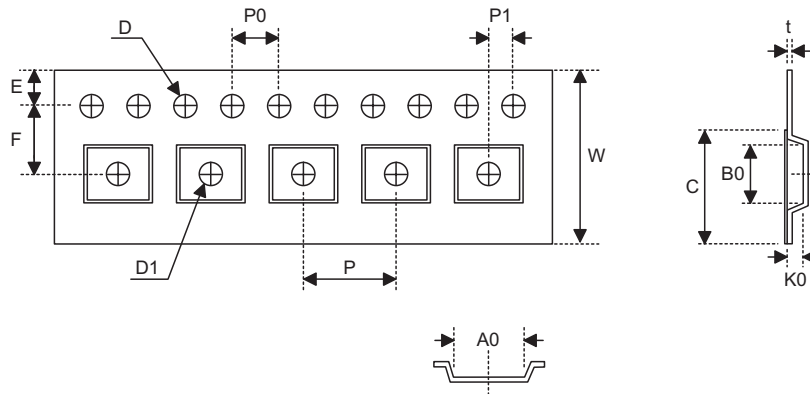
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SOP 18W

| Symbol | Description | Dimensions in mm |
|--------|-----------------------|------------------|
| A | Reel Outer Diameter | 330±1.0 |
| B | Reel Inner Diameter | 62±1.5 |
| C | Spindle Hole Diameter | 13.0+0.5 -0.2 |
| D | Key Slit Width | 2.0±0.5 |
| T1 | Space Between Flange | 24.8+0.3 -0.2 |
| T2 | Reel Thickness | 30.2±0.2 |

SOP 20W

| Symbol | Description | Dimensions in mm |
|--------|-----------------------|------------------|
| A | Reel Outer Diameter | 330±1.0 |
| B | Reel Inner Diameter | 62±1.5 |
| C | Spindle Hole Diameter | 13.0+0.5 -0.2 |
| D | Key Slit Width | 2.0±0.5 |
| T1 | Space Between Flange | 24.8+0.3 -0.2 |
| T2 | Reel Thickness | 30.2±0.2 |

Carrier Tape Dimensions

SOP 18W

| Symbol | Description | Dimensions in mm |
|--------|--|------------------|
| W | Carrier Tape Width | 24.0+0.3 -0.1 |
| P | Cavity Pitch | 16.0±0.1 |
| E | Perforation Position | 1.75±0.1 |
| F | Cavity to Perforation (Width Direction) | 11.5±0.1 |
| D | Perforation Diameter | 1.5±0.1 |
| D1 | Cavity Hole Diameter | 1.5+0.25 |
| P0 | Perforation Pitch | 4.0±0.1 |
| P1 | Cavity to Perforation (Length Direction) | 2.0±0.1 |
| A0 | Cavity Length | 10.9±0.1 |
| B0 | Cavity Width | 12.0±0.1 |
| K0 | Cavity Depth | 2.8±0.1 |
| t | Carrier Tape Thickness | 0.3±0.05 |
| C | Cover Tape Width | 21.3 |

SOP 20W

| Symbol | Description | Dimensions in mm |
|--------|--|------------------|
| W | Carrier Tape Width | 24.0+0.3 -0.1 |
| P | Cavity Pitch | 12.0±0.1 |
| E | Perforation Position | 1.75±0.1 |
| F | Cavity to Perforation (Width Direction) | 11.5±0.1 |
| D | Perforation Diameter | 1.5±0.1 |
| D1 | Cavity Hole Diameter | 1.5+0.25 |
| P0 | Perforation Pitch | 4.0±0.1 |
| P1 | Cavity to Perforation (Length Direction) | 2.0±0.1 |
| A0 | Cavity Length | 10.8±0.1 |
| B0 | Cavity Width | 13.3±0.1 |
| K0 | Cavity Depth | 3.2±0.1 |
| t | Carrier Tape Thickness | 0.3±0.05 |
| C | Cover Tape Width | 21.3 |

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