NEC

MOS INTEGRATED CIRCUIT

# μPD4992

## 8-Bit Parallel I/O Calendar Clock

The μPD4992 is a CMOS integrated circuit which outputs 8-bit parallel time and calendar data in a system in which a microprocessor is employed. The μPD4992 operates at 32.768 kHz and provides year, month, day of month, day of week, hour, minute, and second data to a system. The μPD4992 internally contains a voltage regulator so that low power consumption operation and high accuracy are realized even if the supply voltage varies. The μPD4992 uses the 8-bit bus to facilitate interfacing with a microprocessor.

### FEATURES:

- Internal counter for time (hour, minute, second), and calendar (leap year, year, month, day of month, day of week)
- Super low power consumption ($I_{DD}$ = 2 μA MAX. at $V_{DD}$ = 2.4 V)
- Automatic determination of leap year, manual setting possible
- 12 hour/24 hour mode selectable
- 8-bit parallel input/output in BCD data format
- 12 kinds of interval timer output (can be used as watchdog timer)
- Internal voltage detection circuit for automatic determination of battery run-down
- High accuracy

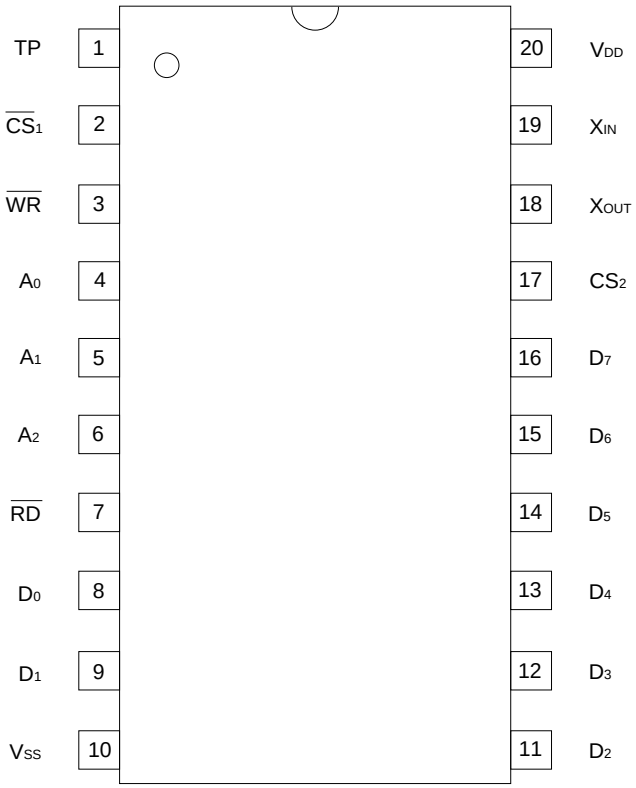
### ORDERING INFORMATION:

| Order Code | Package |
|---|---|
| μPD4992CX | 20-pin plastic DIP (300 mil) |
| μPD4992GS | 20-pin plastic SOP (300 mil) |
| μPD4992GS-T1, T2 | 20-pin plastic SOP (300 mil)<br>Provided on adhesive tape |
| μPD4992GS-E2 | 20-pin plastic SOP (300 mil)<br>Provided on embossed carrier tape |

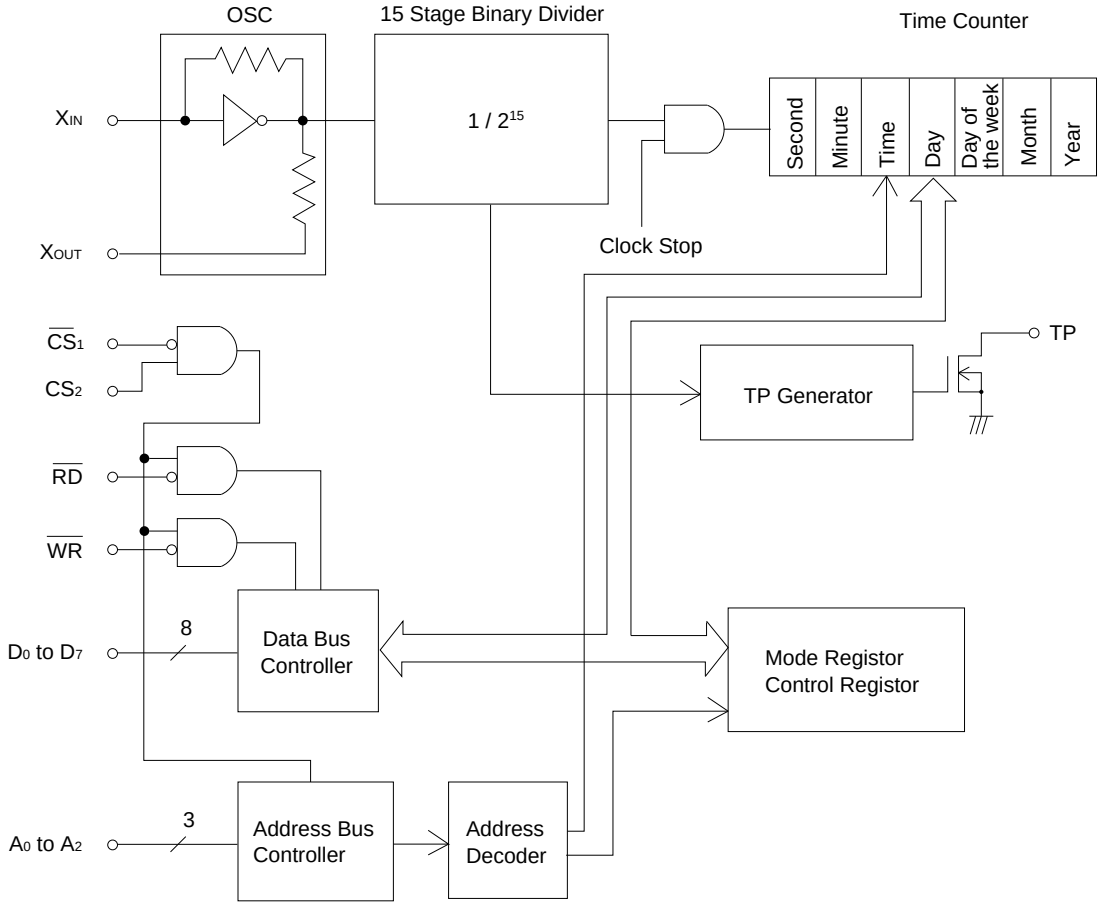


Document No. ID-3084 (1st edition)
(O.D. No. ID-8222)
Date Published March 1997 P
Printed in Japan

## PIN CONFIGURATION




## BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS ($V_{SS}$ = 0 V)

| Item | Symbol | Ratings | Unit |
|---|---|---|---|
| Supply voltage | $V_{DD}$ | –0.3 to 7.0 | V |
| Input voltage range | $V_{IN}$ | –0.3 to $V_{DD}$ + 0.3 | V |
| Output pin withstand voltage | $V_{OUT}$ | 7.0 | V |
| Low level output current (N ch Open Drain) | $I_{OUT}$ | 30 | mA |
| Operating temperature range | $T_{opt}$ | –40 to +85 | °C |
| Storage temperature range | $T_{stg}$ | –65 to +125 | °C |

## ELECTRICAL CHARACTERISTICS

($V_{SS}$ = 0 V, f = 32.768 kHz, $C_G$ = $C_D$ = 20 pF, $C_i$ = 20k ohms, $T_a$ = –40 to +85 °C)

| Item | Symbol | Condition | MIN. | TYP.* | MAX. | Unit |
|---|---|---|---|---|---|---|
| Operating voltage range | $V_{DD}$ | | 2.4 | | 5.5 | V |
| High level input voltage | $V_{IH}$ | | 0.7 $V_{DD}$ | | $V_{DD}$ | V |
| Low level input voltage | $V_{IL}$ | | $V_{SS}$ | | 0.3 $V_{DD}$ | V |
| Supply current | $I_{DD}$ | $V_{DD}$ = 5.5 V, $V_{IN}$ = $V_{SS}$ | | 2 | 6 | μA |
| Supply current | $I_{DD}$ | $V_{DD}$ = 2.4 V, $V_{IN}$ = $V_{SS}$ | | 0.6 | 2 | μA |
| Input leakage current | $I_{LI}$ | $V_{DD}$ = 5.5 V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | $\pm 1 \times 10^{-5}$ | ±1.0 | μA |
| High level output voltage | $V_{OH}$ | $I_{OH}$ = –1.0 mA | 2.4 | 4.3 | | V |
| Low level output voltage | $V_{OL1}$ | $I_{OL}$ = 2.0 mA | | 0.1 | 0.4 | V |
| Low level output voltage | $V_{OL2}$ | $I_{OL}$ = 1.0 mA (N ch Open Drain) | | | 0.4 | V |
| High level leakage current | $I_{LOH}$ | $TP_{out}$ = $V_{DD}$ (N ch Open Drain) | | $4 \times 10^{-5}$ | 1.0 | μA |

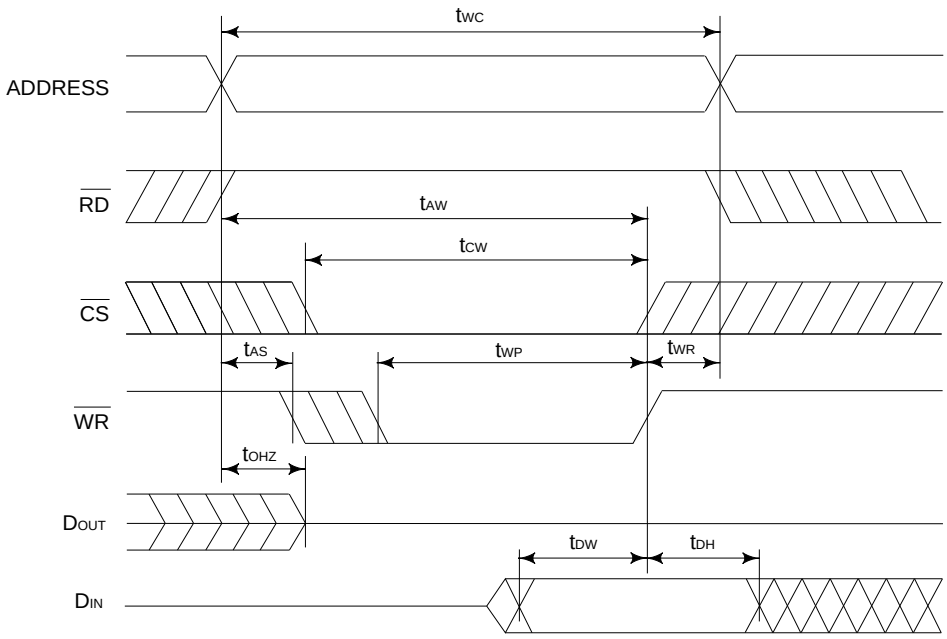
*: Ta = +25 °C

## SWITCHING CHARACTERISTICS

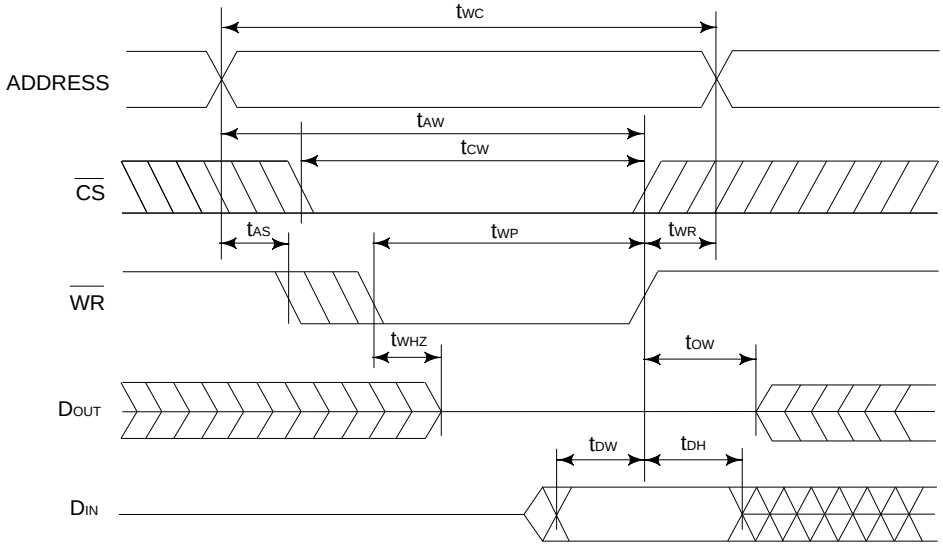
**WRITE CYCLE** (unless otherwise specified $V_{DD}$ = 5 V ± 10 %, $T_a$ = –40 to +85 °C)

| Item | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Cycle time | $t_{WC}$ | | 150 | | | ns |
| $\overline{CS}$-$\overline{WR}$ reset time | $t_{CW}$ | | 120 | | | |
| Address - $\overline{WR}$ reset time | $t_{AW}$ | | 120 | | | |
| Address - $\overline{WR}$ set up time | $t_{AS}$ | | 0 | | | |
| Write pulse width | $t_{WP}$ | | 90 | | | |
| Address hold time | $t_{WR}$ | | 20 | | | |
| Input data set up time | $t_{DW}$ | | 50 | | | |
| Input data hold time | $t_{DH}$ | | 0 | | | |
| $\overline{WR}$ - output floating time | $t_{WHZ}$ | | | | 50 | |

**WRITE CYCLE TIMING WAVEFORMS 1**



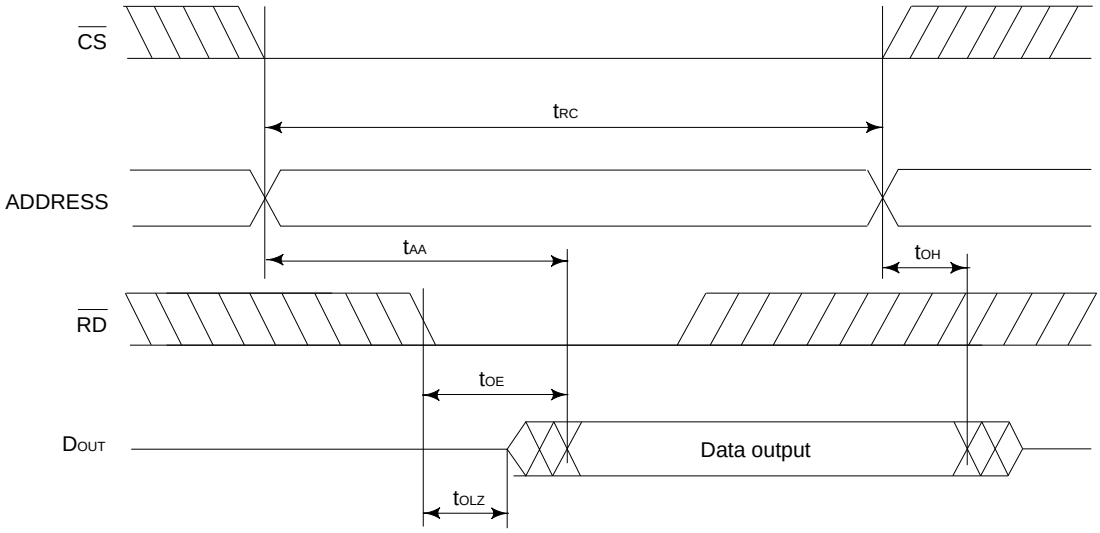

**WRITE CYCLE TIMING WAVEFORMS 2 ($\overline{RD}$ = $V_{IL}$)**



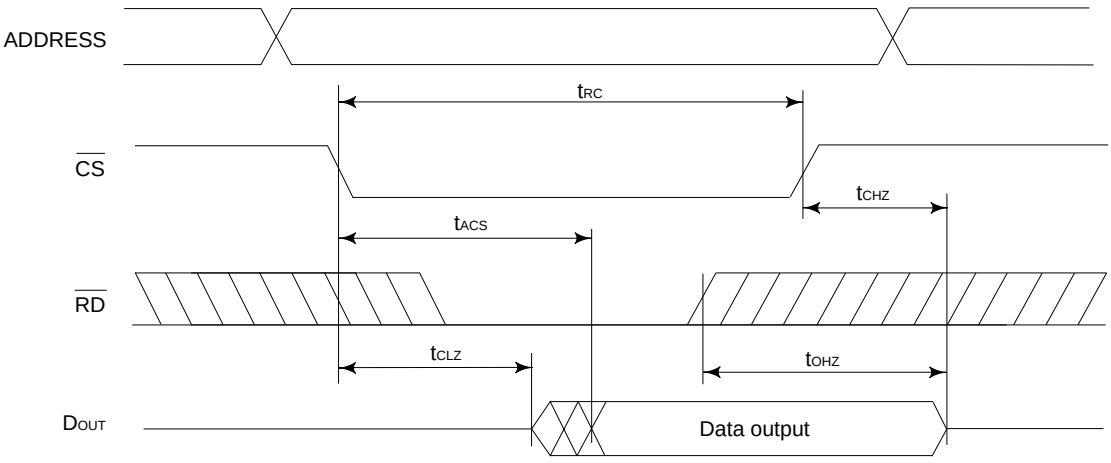
**READ CYCLE** (unless otherwise specified $V_{DD}$ = 5 V ± 10 %, $T_a$ = –40 to +85 °C)

| Item | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Cycle time | $t_{RC}$ | | 150 | | | ns |
| Address access time | $t_{AA}$ | | | | 150 | |
| $\overline{CS}$ - access time | $t_{ACS}$ | | | | 150 | |
| $\overline{RD}$ - output delay time | $t_{OE}$ | | | | 75 | |
| $\overline{RD}$ - output delay time | $t_{OLZ}$ | | 5 | | | |
| $\overline{RD}$ - output delay time | $t_{OHZ}$ | | | | 50 | |
| Output hold time | $t_{OH}$ | | 15 | | | |
| $\overline{CS}$ - output set time | $t_{CLZ}$ | | 10 | | | |
| $\overline{CS}$ - output floating time | $t_{CHZ}$ | | 5 | | | |

**READ CYCLE TIMING WAVEFORMS 1**



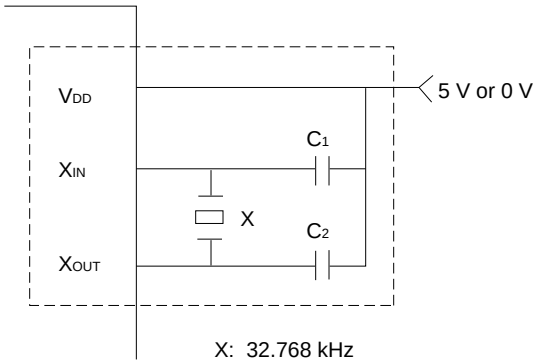

**READ CYCLE TIMING WAVEFORMS 2**



## PIN FUNCTION

| Pin symbol | Pin name | Pin number | Function |
|---|---|---|---|
| $\overline{CS_1}$ | Chip select input | 2 | Internal register can be accessed when $\overline{CS_1}$ = L and $CS_2$ = H |
| $CS_2$ | Chip select input | 17 | |
| $\overline{WR}$ | Write signal input | 3 | Writes the contents of data bus to the register selected by address input at the rising edge |
| $\overline{RD}$ | Read signal input | 7 | Outputs the contents of the register selected by address input to the data bus at the rising edge |
| $D_0$ to $D_7$ | Data input/output | 8, 9, 11 to 16 | Data input/output bus |
| $A_0$ to $A_2$ | Address input | 4 to 6 | Address input to select internal register |
| TP | Timing pulse output | 1 | Interval signal and timing pulse output (N ch open drain output) |
| $X_{IN}$ | Crystal resonator connection pin | 19 | Crystal resonator and capacitor are connected to these pins. |
| $X_{OUT}$ | Crystal resonator connection pin | 18 | |
| $V_{DD}$ | Power supply pin | 20 | 2.4 V to 5.5 V |
| $V_{SS}$ | GND | 10 | Connect to GND |

External components (crystal resonator, capacitors) must be located as close as the IC, and separated as far as from high speed clock wiring.




X: 32.768 kHz
$C_1$, $C_2$: 10 to 30 pF

**REGISTER – ADDRESS CORRESPONDENCE TABLE**

| ADDRESS | | Register contents | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| HEX | BIN | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
| 0H | 000B | 10s second digit | | | | 1s second digit | | | |
| 1H | 001B | 10s minute digit | | | | 1s minute digit | | | |
| 2H | 010B | 12/$\overline{24}$H | $\overline{AM}$/PM | 10s hour digit | | 1s hour digit | | | |
| 3H | 011B | Leap year control | | Leap year counter | | Day of week digit | | | |
| 4H | 100B | 10s day digit | | | | 1s day of month digit | | | |
| 5H | 101B | 10s month digit | | | | 1s month digit | | | |
| 6H | 110B | 10s year digit | | | | 1s year digit | | | |
| 7H | 111B | Mode register | | | | Control register | | | |

$\overline{AM}$/PM flag (R/W) : In 12 hour mode, 0 indicates AM, and 1 indicates PM.
Always 0 in 24 hour mode.

12/$\overline{24}$H flag (R/W) : 0 indicates 24 hour mode, and 1 indicates 12 hour mode.

**LEAP YEAR CONTROL REGISTER (R/W)**

| b7 | b6 | Mode | |
|---|---|---|---|
| 0 | 0 | Leap year effective | Writing to leap year counter disabled |
| 0 | 1 | Leap year effective | Writing to leap year counter enabled |
| 1 | 0 | Leap year invalid | Writing to leap year counter disabled |
| 1 | 1 | Leap year invalid | Writing to leap year counter enabled |

- When the leap year control register is “0X” and the leap year counter is “00” → Leap year (Feb. has 29 days).
- To disable leap year mode, write “10” to the leap year control register (Feb. 28 is followed by Mar. 1).

**MODE REGISTER (R/W)**

| HEX | BIN | Mode |
|---|---|---|
| 0H | 0000B | Outputs TP2048 Hz |
| 1H | 0001B | Outputs TP1024 Hz |
| 2H | 0010B | Outputs TP256 Hz |
| 3H | 0011B | Outputs TP64 Hz |
| 4H | 0100B | Outputs INT1/2048s |
| 5H | 0101B | Outputs INT1/1024s |
| 6H | 0110B | Outputs INT1/256s |
| 7H | 0111B | Outputs INT1/64s |
| 8H | 1000B | Outputs INT1s |
| 9H | 1001B | Outputs INT10s |
| AH | 1010B | Outputs INT60s |
| BH | 1011B | Outputs BUSY signal |
| CH | 1100B | Test mode 1 |
| DH | 1101B | Test mode 2 |
| EH | 1110B | Test mode 3 |
| FH | 1111B | Test mode 4 |

**CONTROL REGISTER**

| Access mode | b3 | b2 | b1 | b0 |
|---|---|---|---|---|
| When writing | 0 | CLK adjust | Reset | CLK stop |
| | | 0: NOP | 0: NOP | 0: CLK start |
| | | 1: CLK adjust | 1: Reset | 1: CLK stop |
| | 1 | TP enable*1 | INT reset | INT stop |
| | | 0: TP = ENABLE | 0: NOP | 0: INT start |
| | | 1: TP = DISABLE | 1: Reset | 1: INT stop |
| When reading | * (Don't care) | TP flag | OSC flag*2 | BUSY flag*3 |
| | | 0: TP = Z | 0: No oscillation | 0: OFF |
| | | 1: TP = L | 1: Oscillation | 1: ON |

***1** : When TP enable is 1 (TP = DISABLE), the TP pin becomes high impedance (actually a high level because a pull up resistor is connected to the TP pin).
But TP flag is not DISABLE in this case.

***2** : If the OSC flag becomes 0 by oscillation stop, the OSC flag remains to be 0 when oscillation is resumed. To set OSC flag to 1 again, execute CLK reset (if the OSC flag still remains to be 0, oscillation has not been started again).
Upon initial power application of the μPD4992, 0 is set to the OSC flag.

***3** : The BUSY flag is "1" when the time counter of the μPD4992 is operating (when read is disabled).

**Table 1 Time Counter Data**

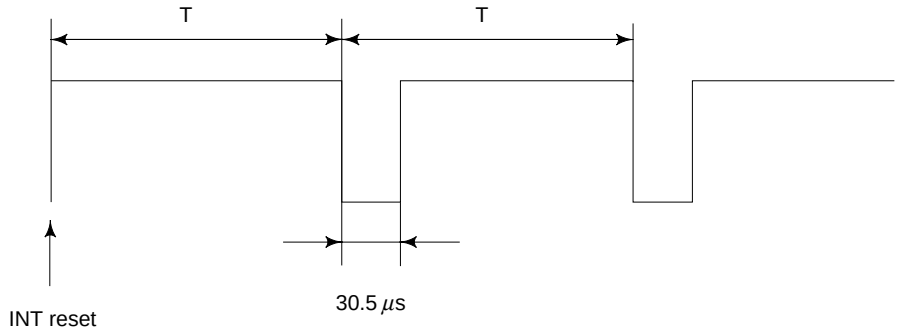
| TIME COUNTER | DATA | TIME COUNTER | DATA |
|---|---|---|---|
| 1s second digit | 0-9 | 1s day of month digit | 0-9 |
| 10s seocnd digit | 0-5 | 10s day of month digit | 0-3 |
| 1s minute digit | 0-9 | 1s month digit | 0-9 |
| 10s minute digit | 0-5 | 10s month digit | 0-1 |
| 1s hour digit | 0-9 | 1s year digit | 0-9 |
| 10s hour digit | 0-5 | 10s year digit | 0-9 |
| Day of week digit | 0-6 | | |

**Table 2 Hour Counter Data**

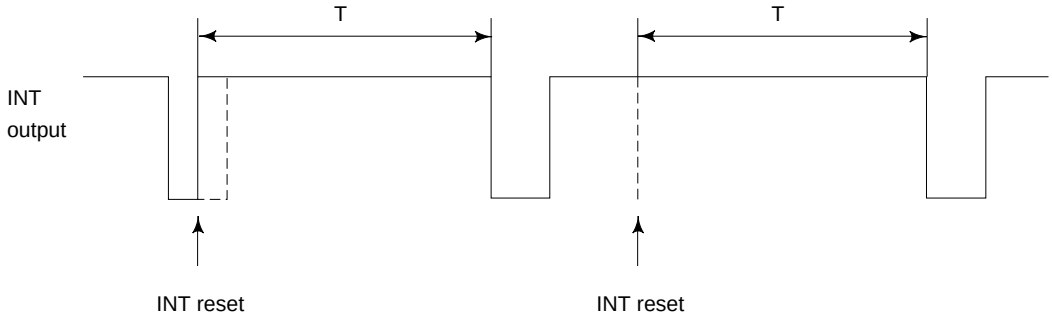
| Hour | 24 hour mode | 12 hour mode | Hour | 24 hour mode | 12 hour mode |
|---|---|---|---|---|---|
| AM 1 o'clock | 01H | 81H | PM 1 o'clock | 13H | C1H |
| AM 2 o'clock | 02H | 82H | PM 2 o'clock | 14H | C2H |
| AM 3 o'clock | 03H | 83H | PM 3 o'clock | 15H | C3H |
| AM 4 o'clock | 04H | 84H | PM 4 o'clock | 16H | C4H |
| AM 5 o'clock | 05H | 85H | PM 5 o'clock | 17H | C5H |
| AM 6 o'clock | 06H | 86H | PM 6 o'clock | 18H | C6H |
| AM 7 o'clock | 07H | 87H | PM 7 o'clock | 19H | C7H |
| AM 8 o'clock | 08H | 88H | PM 8 o'clock | 20H | C8H |
| AM 9 o'clock | 09H | 89H | PM 9 o'clock | 21H | C9H |
| AM 10 o'clock | 10H | 90H | PM 10 o'clock | 22H | D0H |
| AM 11 o'clock | 11H | 91H | PM 11 o'clock | 23H | D1H |
| PM 12 o'clock | 12H | D2H | AM 12 o'clock | 00H | 92H |

**TYPICAL INT CONTROL EXAMPLES (mode register: INT output mode)**

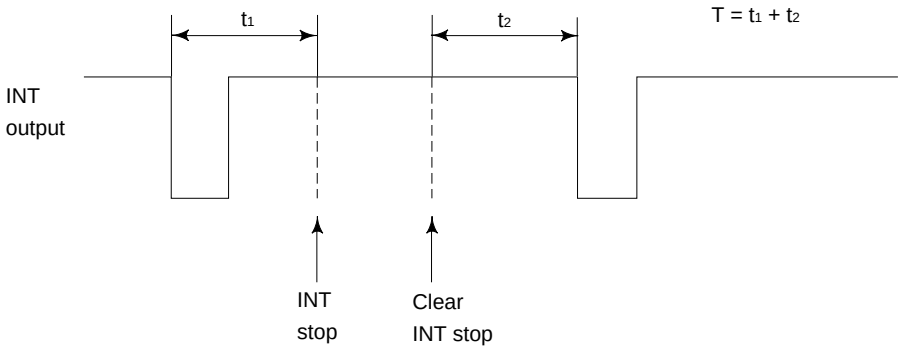
**(1) Use of INT reset (example 1)**



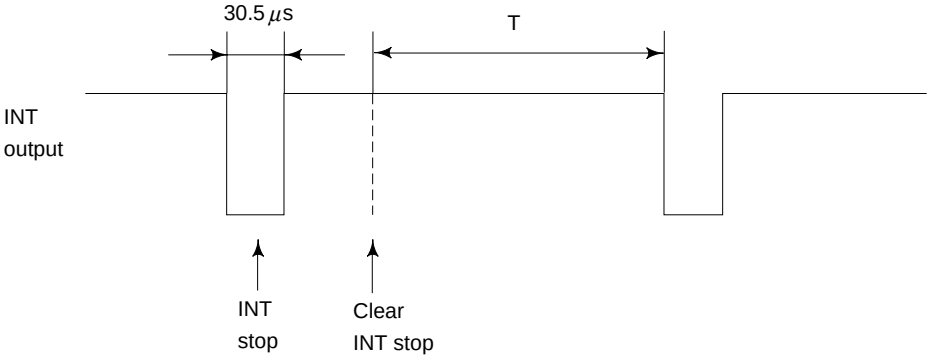

**(2) Use of INT reset (example 2)**



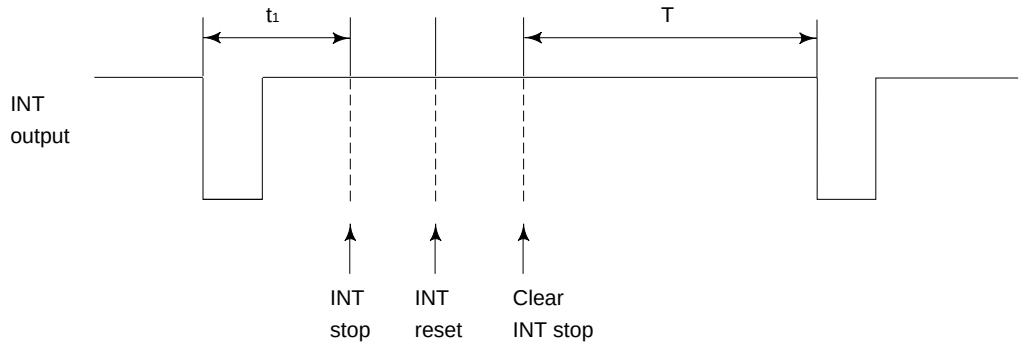

**(3) Use of INT stop (example 1)**



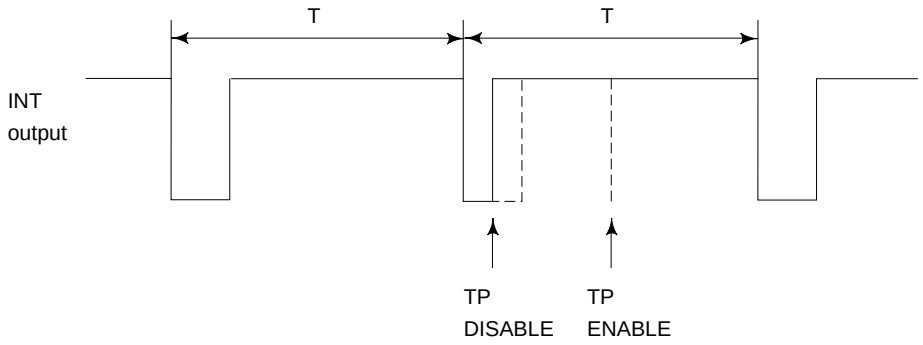

**(4) Use of INT stop (example 2)**



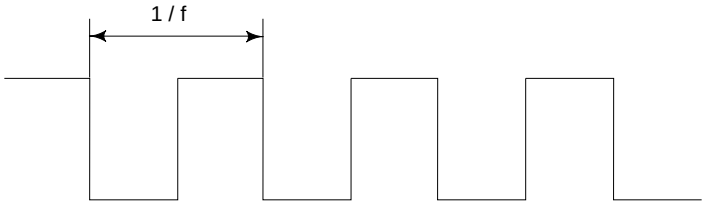
**(5) Use of INT reset, INT stop**




**(6) Use of TP enable**

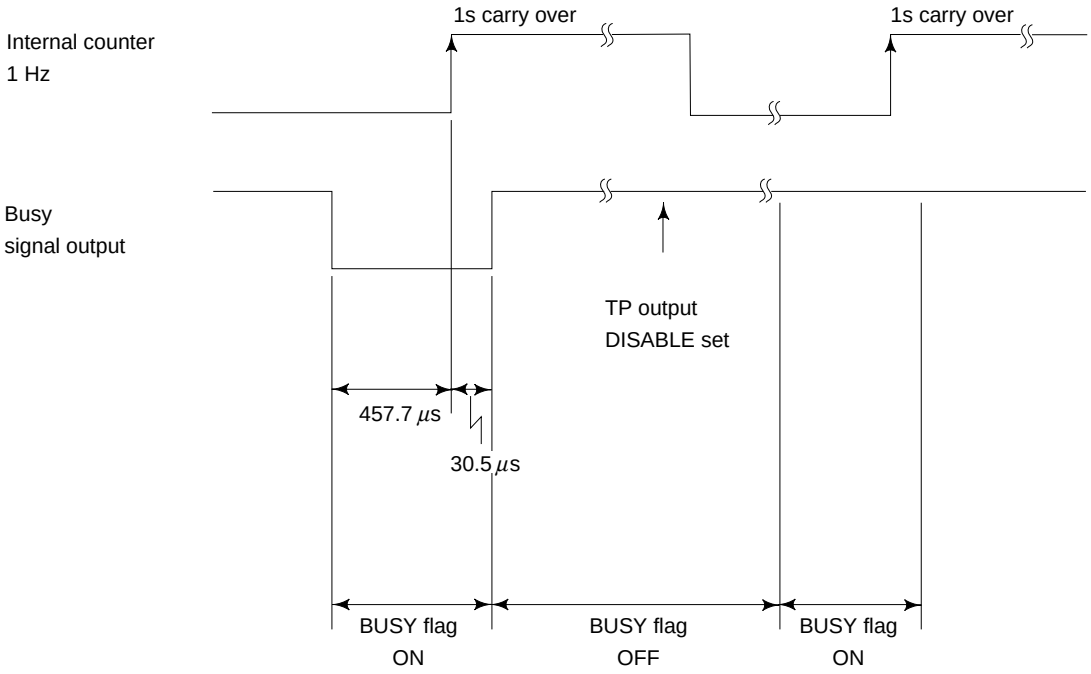


**TP OUTPUT (mode register: TP output mode)**




50 % duty continuous output

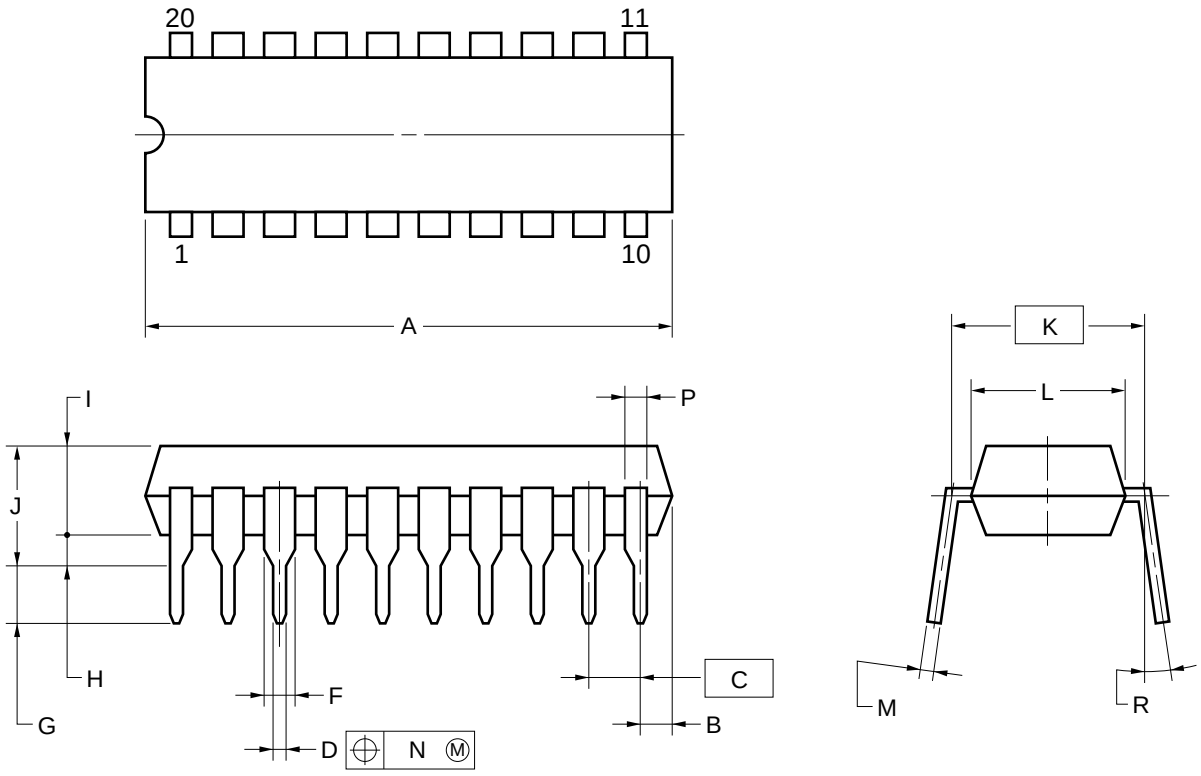
**BUSY SIGNAL**




The time and calendar data read out when BUSY signal is being output may not be correct. This is because, the internal time counter is operating. Therefore, accessing must be disabled during this period or the data must be read out twice and checked by the software. (Reading data during BUSY period has not effect on the contents of the internal counter.)

**OUTLINE DRAWING**

## 20PIN PLASTIC DIP (300 mil)




**NOTES**

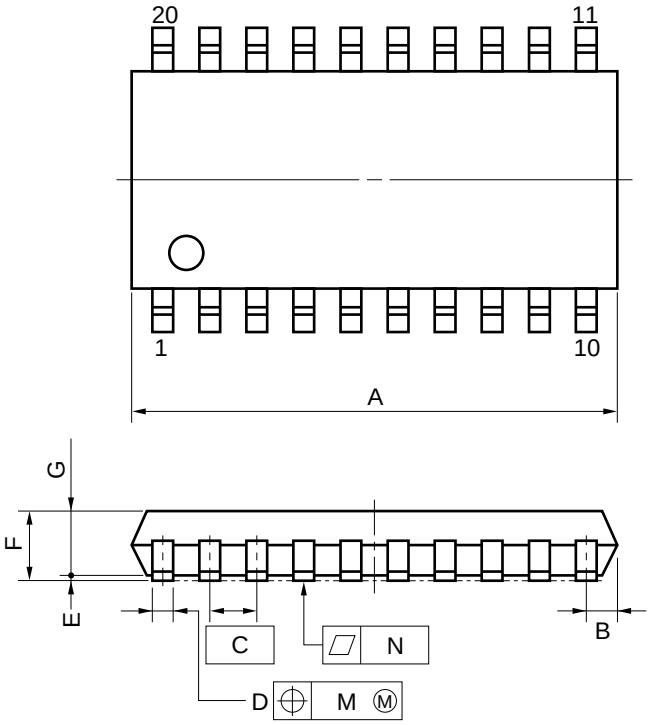
1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.

2) Item "K" to center of leads when formed parallel.

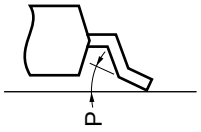
| ITEM | MILLIMETERS | INCHES |
|---|---|---|
| A | 25.40 MAX. | 1.000 MAX. |
| B | 1.27 MAX. | 0.050 MAX. |
| C | 2.54 (T.P.) | 0.100 (T.P.) |
| D | $0.50\pm0.10$ | $0.020^{+0.004}_{-0.005}$ |
| F | 1.1 MIN. | 0.043 MIN. |
| G | 3.5±0.3 | 0.138±0.012 |
| H | 0.51 MIN. | 0.020 MIN. |
| I | 4.31 MAX. | 0.170 MAX. |
| J | 5.08 MAX. | 0.200 MAX. |
| K | 7.62 (T.P.) | 0.300 (T.P.) |
| L | 6.4 | 0.252 |
| M | $0.25^{+0.10}_{-0.05}$ | $0.010^{+0.004}_{-0.003}$ |
| N | 0.25 | 0.01 |
| P | 0.9 MIN. | 0.035 MIN. |
| R | 0~15° | 0~15° |

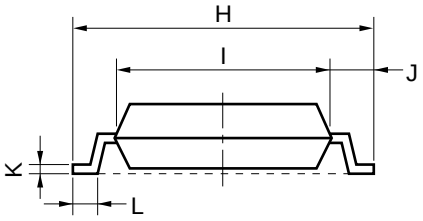
**P20C-100-300A,C-1**

## 20 PIN PLASTIC SOP (300 mil)




detail of lead end




**NOTE**

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

| ITEM | MILLIMETERS | INCHES |
|---|---|---|
| A | 13.00 MAX. | 0.512 MAX. |
| B | 0.78 MAX. | 0.031 MAX. |
| C | 1.27 (T.P.) | 0.050 (T.P.) |
| D | $0.40^{+0.10}_{-0.05}$ | $0.016^{+0.004}_{-0.003}$ |
| E | 0.1±0.1 | 0.004±0.004 |
| F | 1.8 MAX. | 0.071 MAX. |
| G | 1.55 | 0.061 |
| H | 7.7±0.3 | 0.303±0.012 |
| I | 5.6 | 0.220 |
| J | 1.1 | 0.043 |
| K | $0.20^{+0.10}_{-0.05}$ | $0.008^{+0.004}_{-0.002}$ |
| L | 0.6±0.2 | $0.024^{+0.008}_{-0.009}$ |
| M | 0.12 | 0.005 |
| N | 0.10 | 0.004 |
| P | $3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$ | $3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$ |

**P20GM-50-300B, C-4**

## RECOMMENDED SOLDERING CONDITIONS

The following conditions (see table below) must be met when soldering this product.

Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

### TYPES OF SURFACE MOUNT DEVICE

μPD4992GS

| Soldering process | Soldering condition | Symbol |
|---|---|---|
| Infrared ray reflow | Peak package's surface temperature: 235 °C or below,<br>Reflow time: 30 seconds or below (210 °C or higher),<br>Number of reflow process: 2,<br>Exposure limit*: None | IR35-00-2 |
| VPS | Peak package's surface temperature: 215 °C or below,<br>Reflow time: 40 seconds or below (200 °C or higher),<br>Number of reflow process: 2,<br>Exposure limit*: None | VP15-00-2 |
| Wave soldering | Solder temperature: 260 °C or below,<br>Flow time: 10 seconds or below,<br>Number of flow process: 1,<br>Exposure limit*: None | WS60-00-1 |
| Partial heating method | Terminal temperature: 300 °C or below,<br>Flow time: 10 seconds or below,<br>Exposure limit*: None | |

*: Exposure limit before soldering after dry-pack package is opened.
Storage conditions: 25 °C and relative humidity at 65 % or less.

**Note**: Do not apply more than a single process at once, except for "Partial heating method".

### TYPE OF THROUGH HOLE MOUNT DEVICE

μPD4992CX

| Soldering process | Soldering conditions |
|---|---|
| Wave soldering | Solder temperature: 260 °C or below,<br>Flow time: 10 seconds or below. |

**[MEMO]**