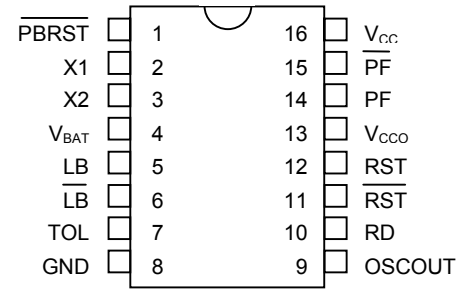
# DS1632

## PC Power-Fail and Reset Controller

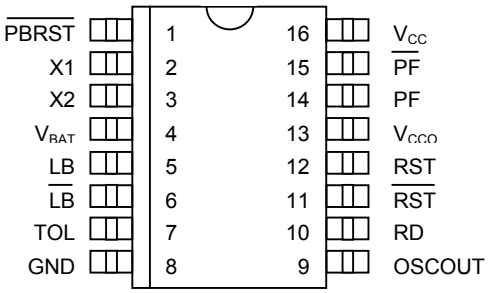
## FEATURES

- Power-fail detector for personal computers and workstations
- Connects directly to popular personal computer chip sets
- On chip 32.768 kHz oscillator for real time clock
- Provides battery backup power to clock chip
- Pushbutton reset input
- Accurate 5% or 10% +5-volt power supply monitoring
- Complementary outputs for reset, power-fail, and low battery
- Provides for reset pulse width of either 95 ms or 190 ms
- Eliminates the need for discrete components
- Low-power CMOS circuitry
- 16-pin DIP or SOIC surface mount package
- 0°C to 70°C operation

## PIN ASSIGNMENT




16-Pin DIP (300-mil)
See Mech. Drawings Section




16-Pin SOIC (300-mil)
See Mech. Drawings Section

## PIN DESCRIPTION

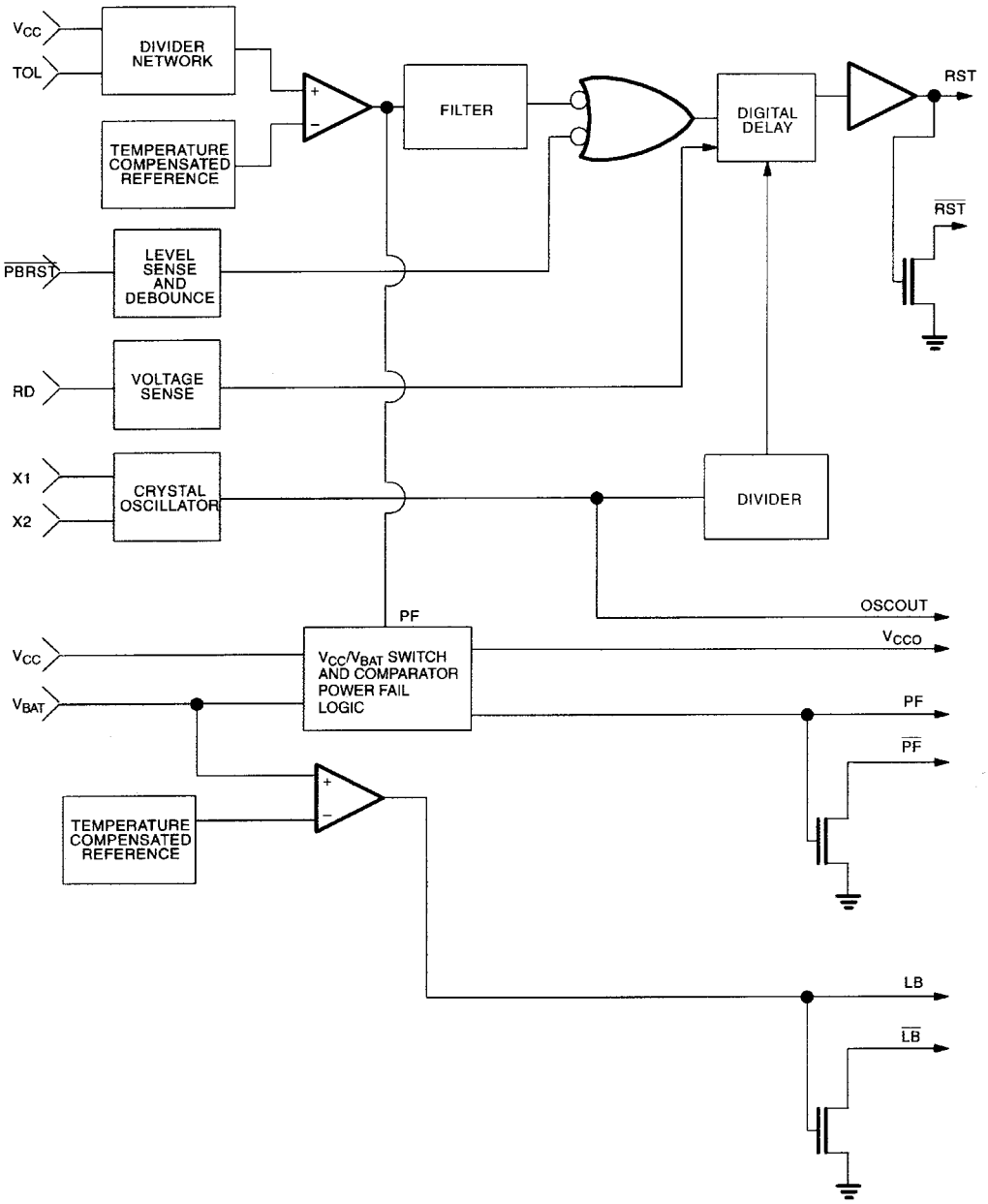
| | |
|---|---|
| $\overline{\text{PBRST}}$ | - Pushbutton Reset Input |
| X1, X2 | - Crystal Inputs |
| $V_{BAT}$ | - Battery Input |
| LB, $\overline{\text{LB}}$ | - Low Battery Outputs |
| RST, $\overline{\text{RST}}$ | - Reset Outputs |
| RD | - Reset Duration |
| TOL | - Selects 5% Or 10% Detection |
| GND | - Ground |
| OSCOUT | - Oscillator Out |
| $V_{CCO}$ | - Switched Power Out |
| PF, $\overline{\text{PF}}$ | - Power-Fail Outputs |
| $V_{CC}$ | - +5-Volt Power In |

## DESCRIPTION

The DS1632 PC Power-Fail and Reset Controller is designed to do various functions involving battery backup and other functions typically accomplished with discrete components. The DS1632 provides a 32.768 kHz battery-backed crystal oscillator and switched $V_{CC}/V_{BAT}$ power via $V_{CCO}$ for the real time clock function located in accompanying chip sets. In addition, the DS1632 provides for reset on both

power-up and via pushbutton input, power-fail status signals for the processor, and low battery warning signals. The DS1632 is capable of detecting power failure at both the 5% and 10% power supply tolerances, and the reset pulse width can be set for either 95 ms or 190 ms. The device is designed to connect directly to popular laptop and notebook chip sets which eliminates the need for discrete components and reduces cost.

## **BLOCK DIAGRAM** Figure 1




## OPERATION - CRYSTAL OSCILLATOR SECTION

The DS1632 crystal oscillator is designed to be hooked directly to a 32.768 kHz crystal. By using the Daiwa Part No. DT26S, Seiko Part No. DS-VT-200 or equivalent, the oscillator will be accurate enough to run a real time clock to within ±2 minutes per month. If another crystal is to be selected, it should have a specified load capacitance ($C_L$) of 6 pF. The crystal oscillator will run as long as either $V_{CC}$ or $V_{BAT}$ is present, providing that $V_{BAT}$ is greater than 2.3V. The oscillator output provides a rail to rail swing with regards to $V_{CC}$ or $V_{BAT}$, whichever is greater. The crystal oscillator is also used internally as a time base.

## OPERATION – POWER-FAIL, BATTERY BACKUP

The DS1632 provides a switch to direct power from the battery ($V_{BAT}$) or the incoming supply ($V_{CC}$), depending on which is greater. This switch has a voltage drop of less than 0.3 volts. The $V_{CC}$ input is constantly monitored by a precision comparator for an out-of-tolerance condition. When such a condition occurs, the power-fail signals are driven to their active state immediately. The reset signals are also driven active, but this action is delayed by a time determined by the level of the input on the reset duration pin (RD). If RD is tied to ground then reset signals will become active after 9 ms. If RD is tied to $V_{CC}$, then reset signals will become active after 18 ms. Once active, both the reset signals and the power-fail signals will remain active as long as a ($V_{CC}$) out-of-tolerance condition persists. If an out-of-tolerance condition is not long enough to activate the reset signals, then only the power-fail signals would be affected. When power returns to within nominal limits the power-fail signals will return immediately to the inactive state. However, the reset signals remain in the active state for a time which is dependent on the state of the RD pin. If RD is tied to ground, the reset signals will remain active for 95 ms. If RD is tied to $V_{CC}$, then the reset signals will remain active for 190 ms after power is within nominal limits. The delay action on the reset signals allows time for the power supply and microprocessor clock oscillators to stabilize. The tolerance pin (TOL) selects the point at which power-fail detection occurs. With the tolerance pin grounded, power-fail detection occurs in the range of 4.75V to 4.5V. If the tolerance pin is connected to $V_{CC}$, then power-fail detection occurs in the range of 4.5V to 4.25V. During most power supply conditions the $V_{CC}$ input will supply power to all functions within the chip and also to the $V_{CCO}$ pin. The battery pin ($V_{BAT}$) only supplies power when $V_{CC}$ is less than $V_{BAT}$. When $V_{CC}$ is below the level of $V_{BAT}$ only the $V_{CCO}$ and the OSC OUT pin remain powered by $V_{BAT}$. All other outputs will be driven to ground when in a logic low state and will be driven to $V_{CC}$ when in a logic high state. This is done to preserve battery capacity by avoiding battery drain resulting from loads on these outputs. The output ground level will be maintained for all levels of $V_{CC}$, even $V_{CC}$ = GND. However, the output $V_{CC}$ level will be maintained only for $V_{CC} > 2.0V$. Internal battery power consumption is less than 2 μA while $V_{BAT}$ is supplying power. The external load on OSC OUT and $V_{CCO}$ must be added to internal consumption to determine the total load on the battery.

## OPERATION - PUSHBUTTON RESET

The DS1632 provides an input pin for direct connection to a pushbutton. The pushbutton reset input $\overline{\text{PBRST}}$ requires an active low level input. While TTL levels are sufficient to properly activate this input, it has been primarily designed for contact closure. Internally, this input is debounced and timed such that RST and $\overline{\text{RST}}$ signals of 95ms or 190 ms minimum are generated. If RD is tied to ground, then a reset pulse of 95 ms is generated. If RD is tied to $V_{CC}$ then a reset pulse of 190 ms is generated. The delay time is started as the pushbutton reset input is released from low level.

## OPERATION - LOW BATTERY WARNING

The DS1632 provides outputs which warn of a low battery condition. Whenever $V_{CC}$ is within nominal limits, the $V_{BAT}$ input is continuously monitored. If the $V_{BAT}$ input is out of tolerance, the low battery outputs are driven to their active states, and will remain in the active state as long as $V_{CC}$ is within nominal limits or until the battery input is restored to an in limit status. On power-up, if the $V_{BAT}$ input is out of tolerance, the low battery outputs are not guaranteed active until power-fail is deactivated, but guaranteed active prior to reset inactive. When $V_{CC}$ is below the $V_{CC}$ fail trip point both LB and $\overline{\text{LB}}$ will be driven to ground.

For application information, please reference Application Note 64, published separately.

## ABSOLUTE MAXIMUM RATINGS*

| | |
|---|---|
| Voltage on $V_{CC}$ Pin Relative to Ground | -0.5V to +7.0V |
| Voltage on I/O Relative to Ground | -0.5V to $V_{CC}$ + 0.5V |
| Operating Temperature | 0°C to 70°C |
| Storage Temperature | -55°C to +125°C |
| Soldering Temperature | 260°C for 10 seconds |

* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

## RECOMMENDED DC OPERATING CONDITIONS (0°C to 70°C)

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | NOTES |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 4.5 | 5.0 | 5.5 | V | 1 |
| $\overline{\text{PBRST}}$ Input High Level | $V_{IH}$ | 2.0 | | $V_{CC}$+0.3 | V | 1, 3 |
| $\overline{\text{PBRST}}$ Input Low Level | $V_{IL}$ | -0.3 | | +0.8 | V | 1, 3 |
| Battery Supply Voltage | $V_{BAT}$ | 2.3 | 3.0 | 3.5 | V | 1 |

## DC ELECTRICAL CHARACTERISTICS (0°C to 70°C; $V_{CC}$=4.5 to 5.5V)

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | NOTES |
|---|---|---|---|---|---|---|
| Output Current @ 2.4V | $I_{OH}$ | 1 | | | mA | 5, 7 |
| Output Current @ 0.4V | $I_{OL}$ | 4 | | | mA | 7 |
| Output Voltage @ -500 µA | $V_{OH}$ | $V_{CC}$-0.5V | $V_{CC}$-0.1V | | V | 1, 6 |
| Low Level @ RST | $V_{OL}$ | | | 0.4 | V | 1 |
| Operating Current | $I_{CC}$ | | 0.5 | 2.0 | mA | 2 |
| $V_{CC}$ Trip Point (TOL=GND) | $V_{CCTP}$ | 4.50 | 4.62 | 4.75 | V | 1 |
| $V_{CC}$ Trip Point (TOL=$V_{CC}$) | $V_{CCTP}$ | 4.25 | 4.37 | 4.50 | V | 1 |
| Battery Fail Trip Point | $V_{BATTP}$ | 2.30 | 2.45 | 2.55 | V | 1 |
| Supply Voltage Output | $V_{CCO}$ | $V_{CC}$-0.3 | | | V | |
| Supply Current Output | $I_{CCO1}$ | | | 100 | mA | 4 |

## DC ELECTRICAL CHARACTERISTICS (0°C; $V_{CC}$=<$V_{BAT}$)

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | NOTES |
|---|---|---|---|---|---|---|
| Battery Current | $I_{BAT}$ | | | 2 | µA | |
| Battery Backup Current | $I_{CCO2}$ | | | 500 | µA | 4 |

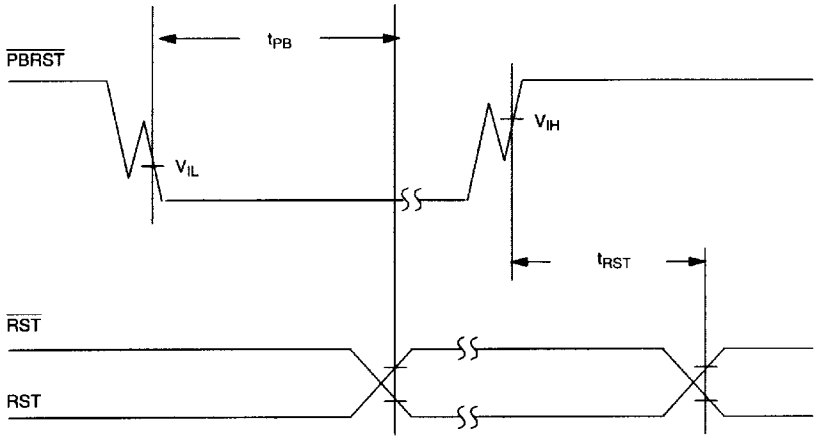
## CAPACITANCE ($t_A$=25°C)

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | NOTES |
|---|---|---|---|---|---|---|
| Input Capacitance | $C_{IN}$ | | | 5 | pF | |
| Output Capacitance | $C_{OUT}$ | | | 7 | pF | |

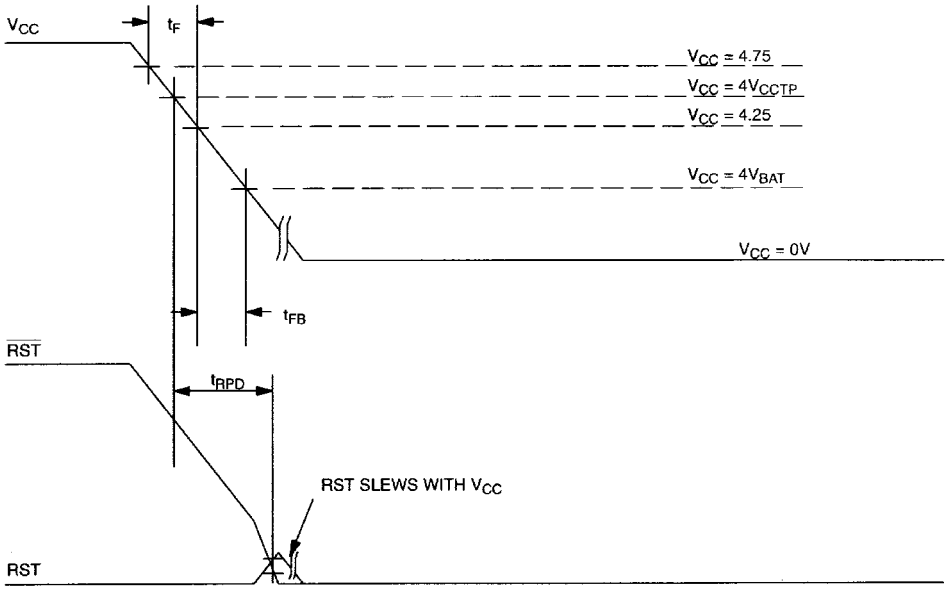
## AC ELECTRICAL CHARACTERISTICS (0°C to 70°C; $V_{CC}$=5V ± 10%)

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNITS | NOTES |
|---|---|---|---|---|---|---|
| $\overline{PBRST}$ = $V_{IL}$ | $t_{PB}$ | $t_{RPD}$ | | | ms | |
| Reset Pulse Width | $t_{RST}$ | 95 | | 105 | ms | RD=GND |
| Reset Pulse Width | $t_{RST}$ | 190 | | 210 | ms | RD=$V_{CC}$ |
| Reset Active on Power-Up | $t_{RPU}$ | 95 | | 105 | ms | RD=GND |
| Reset Active on Power-Up | $t_{RPU}$ | 190 | | 210 | ms | RD=$V_{CC}$ |
| Reset Active on Power-Down | $t_{RPD}$ | 9 | | 11 | ms | RD=GND |
| Reset Active on Power-Down | $t_{RPD}$ | 18 | | 22 | ms | RD=$V_{CC}$ |
| $V_{CC}$ Slew Rate Power-Down | $t_F$ | 300 | | | µs | |
| $V_{CC}$ Slew Rate Power-Down | $t_{FB}$ | 10 | | | µs | |
| $V_{CC}$ Slew Rate Power-Up | $t_R$ | 10 | | | µs | |

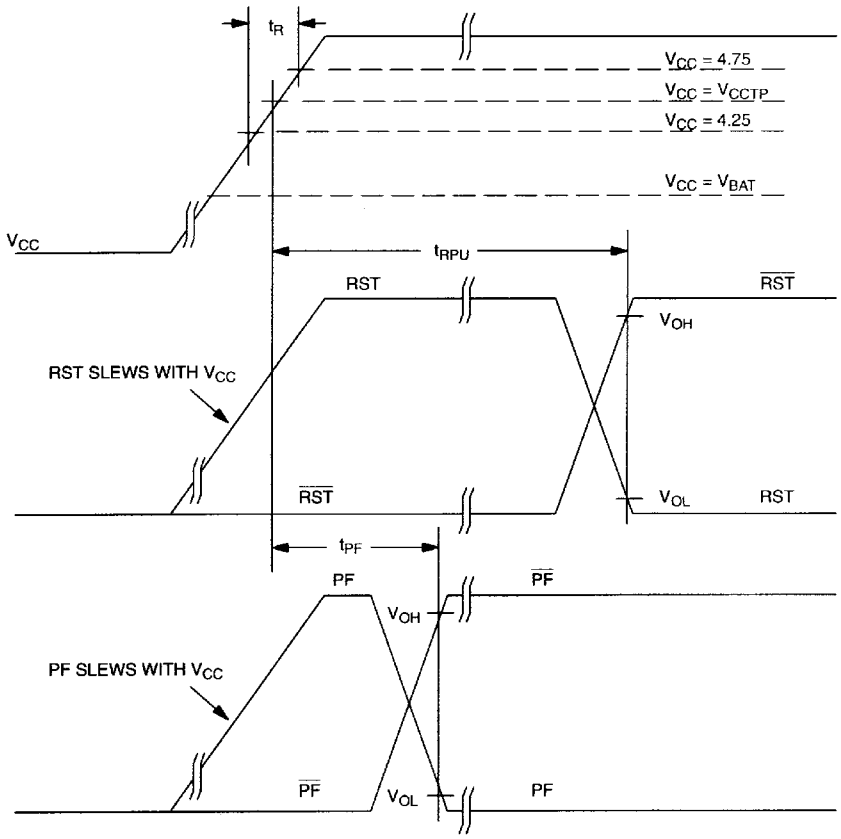
## TIMING DIAGRAM: PUSHBUTTON RESET




## TIMING DIAGRAM: POWER-DOWN



## TIMING DIAGRAM: POWER-UP




## NOTES:

1. All voltages are referenced to ground.
2. Measured with outputs open.
3. The $\overline{\text{PBRST}}$ input has an internal pull-up of 10kΩ to $V_{CC}$.
4. Supply current output is specified with 0.3V drop from $V_{BAT}$ or $V_{CC}$.
5. $\overline{\text{RST}}$, $\overline{\text{PF}}$, and $\overline{\text{LB}}$ are open-drain outputs.
6. RST and PF remain within 0.5 volts of $V_{CC}$ on power down until $V_{CC}$ drops below 2.0V.
7. Sink and source currents apply to all outputs except OSC OUT which has a drive capability of sourcing 500 µA at $V_{OH} = V_{CCO}$ - 0.5V and sinking 1 mA at $V_{OL}$ = 0.5 V.