



General Description

The MIC2566 single-slot PC Card / CardBus power controller is a V_{CC} and V_{PP} power switch matrix that supports 3.3V and 5V PC Card (PCMCIA) slot power supply pins.

The MIC2566 can switch PC Card slot V_{CC} voltages between 0V (ground), 3.3V and 5.0V and V_{PP} voltages between 0V (ground), 3.3V, 5V, or high impedance at output currents of up to 1A for V_{CC} and 200mA for V_{PP} . The MIC2566 features well-controlled voltage rise and fall times. Each MIC2566 output voltage is switched by two digital inputs, typically controlled from a separate PC Card logic controller.

The MIC2566 is designed for efficient operation. In standby (sleep) mode the device draws very little quiescent current, typically only 0.3 μ A. The power controller includes thermal shutdown and protects itself and its PC Card ports with current limiting. Full cross-conduction lockout protects the system power supplies.

The MIC2566 is available in 14-pin SOP and TSSOP packages.

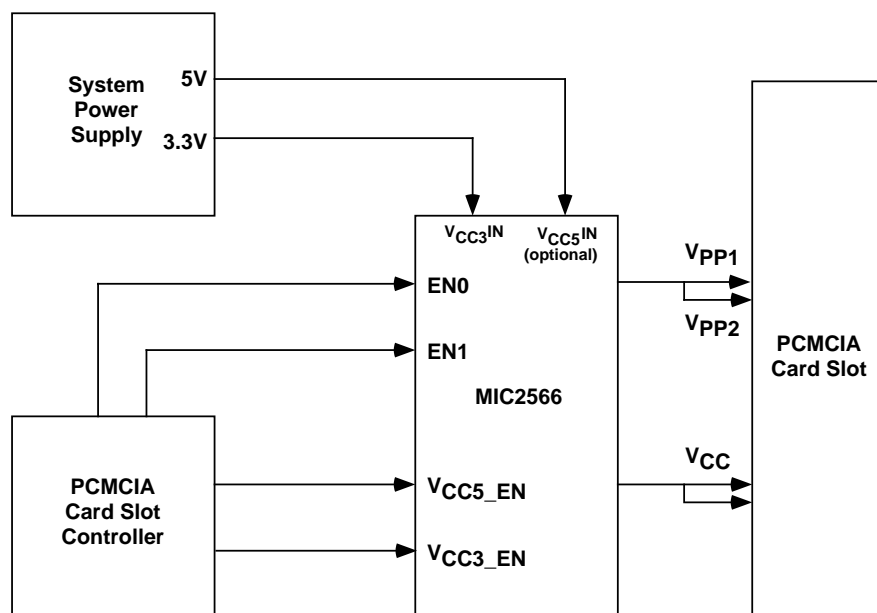
Features

- Complete single-slot power switch solution
- No external components required
- Output current limit and thermal shutdown
- Ultra-low power consumption
- Compatible with standard PC Card logic controllers
- Break-before-make switching (no transients)
- Digital V_{CC} and V_{PP} voltage selection
- > 1A V_{CC} output current per slot
- > 120mA V_{PP} output current per slot
- 14-pin SOP and TSSOP package
- Pb-free SO package
- UL recognized, file #179633

Applications

- Single-slot PC Card power supply voltage switch
- CardBus slot power supply control
- Data collection systems
- Machine control data input systems
- Wireless communications
- Bar code data collection systems
- Instrumentation configuration/datalogging
- Portable and desktop computer docking stations
- Power supply management
- Power analog switching

Typical Application

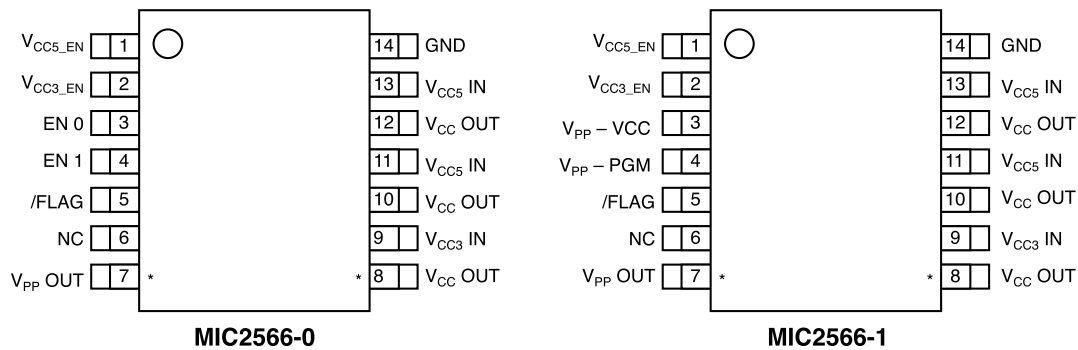


UL Recognized Component

Ordering Information

| Part Number | Operating Temp. Range | Package | Pb-Free |
|--------------|-----------------------|--------------|---------|
| MIC2566-0BM | -40°C to +85°C | 14-pin SOP | |
| MIC2566-1BM | -40°C to +85°C | 14-pin SOP | |
| MIC2566-0YM | -40°C to +85°C | 14-pin SOP | X |
| MIC2566-1YM | -40°C to +85°C | 14-pin SOP | X |
| MIC2566-0BTS | -40°C to +85°C | 14-pin TSSOP | |
| MIC2566-1BTS | -40°C to +85°C | 14-pin TSSOP | |

Pin Configuration



* Denotes pinout differences. Duplicate pins must be connected together for proper operation.
Example: $V_{CC5}IN$ pins 11 & 13 must be externally connected together.

Pin Description

| Pin Number MIC2566-0 | Pin Number MIC2566-1 | Pin Name | Pin Function |
|-------------------------|-------------------------|------------------|---|
| 1 | 1 | $V_{CC5} EN$ | V_{CC} 5V Enable (Input). |
| 2 | 2 | $V_{CC3} EN$ | V_{CC} 3.3V Enable (Input). |
| 3 | | EN0 | Enable 0: Micrel standard logic-control signal. MIC2566-0 only. |
| | 3 | $V_{PP_V_{CC}}$ | $V_{PP_V_{CC}}$ Control: Cirrus Logic logic-controller compatible control signal. MIC2566-1 only. |
| 4 | | EN1 | Enable 1: Micrel standard logic-control signal. MIC2566-0 only. |
| | 4 | V_{PP_PGM} | Program: Cirrus Logic-compatible control signal. MIC2566-1 only. |
| 5 | 5 | /FLAG | Error Flag: This pin requires a pull-up resistor (10k Ω recommended) to $V_{CC3}IN$ or $V_{CC5}IN$. |
| 6 | 6 | NC | Not internally connected. |
| 7 | 7 | $V_{PP} OUT$ | V_{PP} Output: 0V (ground), 3.3V, 5V, or high-impedance output. |
| 9 | 9 | $V_{CC3} IN$ | 3.3V-Nominal Supply Input: Mandatory supply, switchable to V_{CC} and V_{PP} outputs. Also powers MIC2566 internal circuitry. |
| 8, 10, 12 | 8, 10, 12 | $V_{CC} OUT$ | V_{CC} Output: 0V (ground), 3.3V, 5V, or high-impedance output. Pins 8, 10, and 12 must be externally connected. |
| 11, 13 | 11, 13 | $V_{CC5} IN$ | 5V-Nominal Supply Input: Optional supply, switchable to V_{CC} and V_{PP} outputs. Pins 11 and 13 must be externally connected. |
| 14 | 14 | GND | Ground. |

Absolute Maximum Ratings (Note 1)

| | |
|--|----------------------------|
| V_{CC3} IN | +6.0V |
| V_{CC5} IN | +6.0V |
| V_{EN0} , V_{EN1} , V_{CC5EN} , V_{CC3EN} | −0.3V to +6.0V |
| V_{FLAG} | +6.0V |
| V_{PP} OUT | >120mA, Internally Limited |
| V_{CC} OUT | >1A, Internally Limited |
| Power Dissipation at $T_A \leq 25^\circ\text{C}$ (P_D) | Internally Limited |
| Storage Temperature | −65°C to +150°C |
| Lead Temperature (5 sec.) | +260°C |
| ESD Rating, Note 3 | |

Operating Ratings (Note 2)

| | |
|---|----------------|
| V_{CC3} IN | +3.0V to +5.5V |
| V_{CC5} IN | 0V to +5.5V |
| V_{EN0} , V_{EN1} , V_{CC5EN} , V_{CC3EN} | 0V to +5.5V |
| V_{PP} OUT | 0 to 120mA |
| V_{CC} OUT | 0 to 1A |
| Clock Frequency | 0 to 2MHz |
| Ambient Temperature (T_A) | −40°C to +85°C |
| Junction Temperature (T_J) | +125°C |
| Package Thermal Resistance (θ_{JA}) | |
| SOP | 90°C/W |
| TSSOP | 83°C/W |

Electrical Characteristics (Note 4)

Specified over operating ambient temperature range of −40°C to +85°C with V_{CC3} IN = 3.3V, V_{CC5} IN = 5.0V, unless otherwise specified.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--|--|--|------------------------|------------|------------------------|--------|
| DIGITAL INPUTS (V_{EN0}, V_{EN1}, V_{CC3EN}, V_{CC5EN}) | | | | | | |
| V_{IH} | Logic 1 Input Voltage | | $0.7 \times V_{CC3IN}$ | | 5.5 | V |
| V_{IL} | Logic 0 Input Voltage | | −0.3 | | $0.3 \times V_{CC3IN}$ | V |
| I_{IN} | Input Current | $0\text{ V} < V_{IN} < 5.5\text{V}$ | | | ±2 | μA |
| V_{PP} OUTPUT | | | | | | |
| $I_{PP\text{ OUT Hi-Z}}$ | High Impedance Output Leakage Current | Shutdown Mode $0 \leq V_{PP\text{ OUT}} \leq 5\text{V}$ | | 1 | 10 | μA |
| I_{PPSC} | Short Circuit Current Limit | $V_{PP\text{ OUT}} = 0\text{V}$ | 0.12 | 0.4 | | A |
| R_O | Switch Resistance | Select $V_{PP\text{ OUT}} = 5\text{V}$ Select $V_{PP\text{ OUT}} = 3.3\text{V}$ $I_{PP\text{ OUT}} = -100\text{mA}$ (Sourcing) | | 1.4 1.5 | 3 4 | Ω Ω |
| R_O | Switch Resistance, Select $V_{PP\text{ OUT}} = 0\text{V}$ | Select $V_{PP\text{ OUT}} = \text{clamped to ground}$ $I_{PP\text{ OUT}} = 50\mu\text{A}$ (Sinking) | | 1300 | 3900 | Ω |
| V_{PP} SWITCHING TIME (See Figure 1) | | | | | | |
| t_1 | Output Turn-On Delay | $V_{PP\text{ OUT}} = \text{Hi-Z to } 10\% \text{ of } 3.3\text{V}$ | | 5 | 50 | μs |
| t_2 | Note 5 | $V_{PP\text{ OUT}} = \text{Hi-Z to } 10\% \text{ of } 5\text{V}$ | | 10 | 50 | μs |
| t_3 | Output Rise Time | $V_{PP\text{ OUT}} = 10\% \text{ to } 90\% \text{ of } 3.3\text{V}$ | 100 | 200 | 800 | μs |
| t_4 | Note 5 | $V_{PP\text{ OUT}} = 10\% \text{ to } 90\% \text{ of } 5\text{V}$ | 100 | 300 | 1000 | μs |
| t_5 | Output Turn-Off Delay Time | $V_{PP\text{ OUT}} = 3.3\text{V to Hi-Z}$ | | 400 | 1000 | ns |
| t_6 | Note 5 | $V_{PP\text{ OUT}} = 5\text{V to Hi-Z}$ | | 400 | 1000 | ns |
| t_7 | Output Turn-Off Fall Time | $V_{PP\text{ OUT}} = 90\% \text{ to } 10\% \text{ of } 3.3\text{V}$ | | 50 | 1000 | ns |
| t_8 | Note 5 | $V_{PP\text{ OUT}} = 90\% \text{ to } 10\% \text{ of } 5\text{V}$ | | 50 | 1000 | ns |
| V_{CC} OUTPUT | | | | | | |
| I_{CCSC} | Short Circuit Current Limit | $V_{CC\text{ OUT}} = 0\text{V}$ | 1 | 1.5 | | A |
| R_O | Switch Resistance | Select $V_{CC\text{ OUT}} = 3.3\text{V}$ $I_{CC\text{ OUT}} = -1\text{A}$ (Sourcing) | | 120 | 180 | mΩ |
| | | Select $V_{CC\text{ OUT}} = 5\text{V}$ $I_{CC\text{ OUT}} = -1\text{A}$ (Sourcing) | | 90 | 135 | mΩ |
| | | Select $V_{CC\text{ OUT}} = \text{clamped to ground}$ $I_{CC\text{ OUT}} = 1\text{mA}$ (Sinking) | | 1800 | 3900 | Ω |

Electrical Characteristics (continued)

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|--|--|------------|-------------|--------------|-------|
| V_{CC} SWITCHING TIME (See Figure 2) | | | | | | |
| t ₉ t ₁₀ | Output Turn On Delay Time Note 6 | V _{CC OUT} = 0V to 10% of 3.3V V _{CC OUT} = 0V to 10% of 5.0V | | 200 350 | 1500 3000 | μs |
| t ₁₁ t ₁₂ | Output Rise Time Note 6 | V _{CC OUT} = 10% to 90% of 3.3V V _{CC OUT} = 10% to 90% of 5V | 200 200 | 700 1500 | 2500 6000 | μs |
| t ₁₃ t ₁₄ | Output Turn-Off Delay Notes 6, 7 | V _{CC OUT} = 3.3V V _{CC OUT} = 5V | | 0.65 0.7 | 2 2 | ms |
| t ₁₅ t ₁₆ | Output Fall Time Note 6 | V _{CC OUT} = 90% to 10% of 3.3V V _{CC OUT} = 90% to 10% of 5.0V | 100 100 | 300 600 | 1000 2000 | μs |
| POWER SUPPLY | | | | | | |
| I _{CC5} | V _{CC5 IN} Supply Current (5V) | V _{CC OUT} = 5V or 3.3V, I _{CC OUT} = 0 V _{CC OUT} = 0V (Sleep Mode) | | 8 0.2 | 50 10 | μA |
| I _{CC3} | V _{CC3 IN} Supply Current (3.3V) Note 8 | V _{CC OUT} = 5V or 3.3V, I _{CC OUT} = 0 V _{CC OUT} = 0V (Sleep Mode) | | 40 0.1 | 100 10 | μA |
| V _{CC5} | Operating Input Voltage (5V) | V _{CC5 IN} not required for operation | | 5.0 | 5.5 | V |
| V _{CC3} | Operating Input Voltage (3.3V) | Note 8 | 3.0 | 3.3 | 5.5 | V |
| THERMAL SHUTDOWN | | | | | | |
| T _{SD} | Thermal Shutdown Temperature | | | 130 | | °C |
| FLAG OUTPUT | | | | | | |
| I _{FLAGLK} | Error FLAG Off Current | V _{FLAG} = 5V | | | 4 | μA |
| V _{OL} | FLAG Output Low Voltage | V _{CCx IN} – V _{CC OUT} > 1V 1mA pull-up from FLAG to V _{CCx IN} | | | 0.4 | V |

Note 1. Exceeding the absolute maximum rating may damage the device.

Note 2. The device is not guaranteed to function outside its operating rating.

Note 3. Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF.

Note 4. Specification for packaged product only.

Note 5. R_L = 100Ω connected to ground.

Note 6. R_L = 10Ω connected to ground.

Note 7. Delay from commanding Hi Z or 0V to beginning slope. Does not apply to current limit or overtemperature shutdown conditions.

Note 8. The MIC2566 uses V_{CC3 IN} for operation. For single 5V supply systems, connect 5V to both V_{CC3 IN} and V_{CC5 IN}. See "Applications Information" for further details.

Timing Diagram

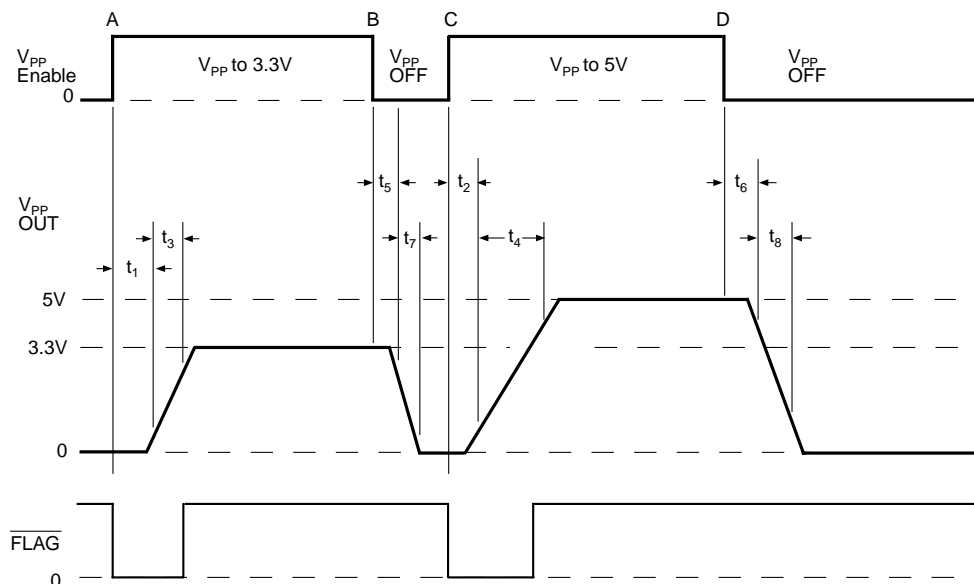


Figure 1. MIC2566 V_{PP} Timing Diagram

Note. V_{PP} Enable is shown generically. Refer to the logic tables on the next page for specific control logic input. At time A, $V_{PP} = 3.3V$. At B, V_{PP} is disabled. At C, V_{PP} is programmed to 5V. At D, V_{PP} is disabled. $R_L = 100\Omega$ for all measurements. Load capacitance is negligible.

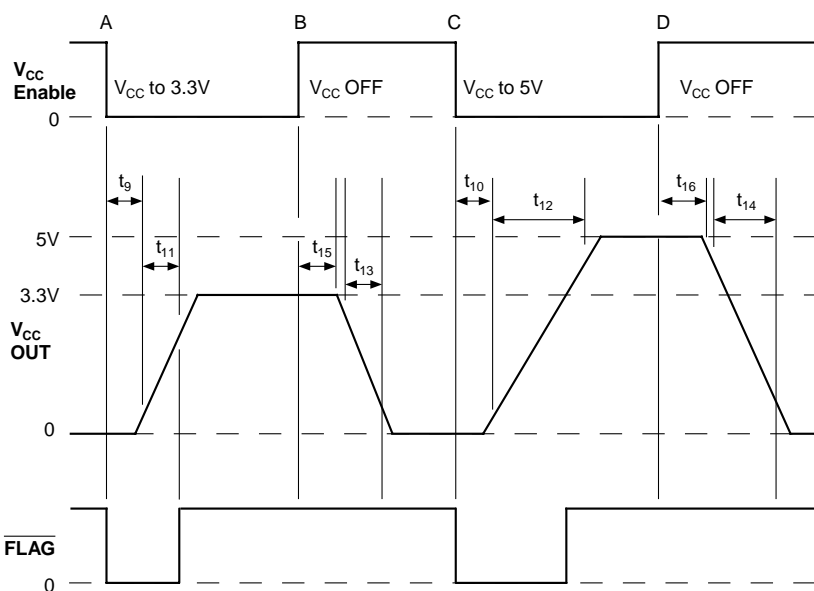


Figure 2. MIC2566 V_{CC} Timing Diagram

Note. V_{CC} Enable is shown generically. Refer to the logic tables on the next page for specific control logic input. At time A, V_{CC} is programmed to 3.3V. At B, V_{CC} is disabled. At C, V_{CC} is programmed to 5V. And at D, V_{CC} is disabled. $R_L = 100\Omega$. FLAG pull-up resistor is $10k\Omega$ to V_{CC3} IN.

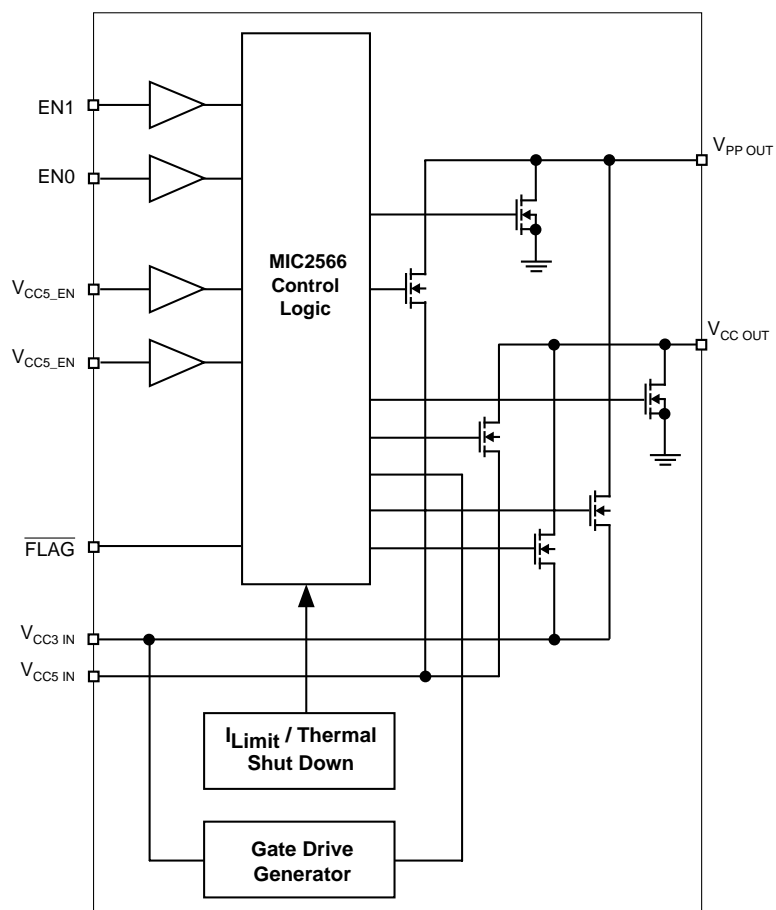
MIC2566-0 Control Logic Table

| V _{CC5} EN | V _{CC3} EN | EN1 | EN0 | V _{CC} OUT | V _{PP} OUT |
|---------------------|---------------------|-----|-----|---------------------|---------------------|
| 0 | 0 | 0 | 0 | Clamped to Ground | High Z |
| 0 | 0 | 0 | 1 | Clamped to Ground | High Z |
| 0 | 0 | 1 | 0 | Clamped to Ground | High Z |
| 0 | 0 | 1 | 1 | Clamped to Ground | Clamped to Ground |
| 0 | 1 | 0 | 0 | 3.3 | High Z |
| 0 | 1 | 0 | 1 | 3.3 | 3.3 |
| 0 | 1 | 1 | 0 | 3.3 | High Z |
| 0 | 1 | 1 | 1 | 3.3 | Clamped to Ground |
| 1 | 0 | 0 | 0 | 5 | High Z |
| 1 | 0 | 0 | 1 | 5 | 5 |
| 1 | 0 | 1 | 0 | 5 | High Z |
| 1 | 0 | 1 | 1 | 5 | Clamped to Ground |
| 1 | 1 | 0 | 0 | 3.3 | High Z |
| 1 | 1 | 0 | 1 | 3.3 | 3.3 |
| 1 | 1 | 1 | 0 | 3.3 | 5 |
| 1 | 1 | 1 | 1 | 3.3 | Clamped to Ground |

MIC2566-1 Control Logic**(Compatible with Cirrus Logic CL-PD6710 & PD672x-Series Controllers)**

| V _{CC5} EN | V _{CC3} EN | V _{PP} PGM | V _{PP} VCC | V _{CC} OUT | V _{PP} OUT |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| 0 | 0 | 0 | 0 | Clamped to Ground | Clamped to Ground |
| 0 | 0 | 0 | 1 | Clamped to Ground | High Z |
| 0 | 0 | 1 | 0 | Clamped to Ground | High Z |
| 0 | 0 | 1 | 1 | Clamped to Ground | High Z |
| 0 | 1 | 0 | 0 | 5 | Clamped to Ground |
| 0 | 1 | 0 | 1 | 5 | 5 |
| 0 | 1 | 1 | 0 | 5 | High Z |
| 0 | 1 | 1 | 1 | 5 | High Z |
| 1 | 0 | 0 | 0 | 3.3 | Clamped to Ground |
| 1 | 0 | 0 | 1 | 3.3 | 3.3 |
| 1 | 0 | 1 | 0 | 3.3 | High Z |
| 1 | 0 | 1 | 1 | 3.3 | High Z |
| 1 | 1 | 0 | 0 | Clamped to Ground | Clamped to Ground |
| 1 | 1 | 0 | 1 | Clamped to Ground | High Z |
| 1 | 1 | 1 | 0 | Clamped to Ground | High Z |
| 1 | 1 | 1 | 1 | Clamped to Ground | High Z |

Functional Diagram



Applications Information

PC Card V_{CC} and V_{PP} control is easily accomplished using the MIC2566 PC Card/CardBus Slot V_{CC} and V_{PP} Power Controller IC. Four control bits determine $V_{CC\ OUT}$ and $V_{PP\ OUT}$ voltage and standby/operate mode condition. V_{CC} outputs of 3.3V and 5V at the maximum allowable PC Card current are supported. $V_{PP\ OUT}$ output voltages of V_{CC} (3.3V or 5V), 0V or a high impedance state are available. When the V_{CC} clamped to ground condition is selected, the device switches into "sleep" mode and draws only nanoamperes of leakage current. An error flag alerts the user if the output voltage is too low because of overtemperature or overcurrent faults. Protection from hot switching is provided which prevents feedback from the $V_{CC\ OUT}$ (from 5V to 3.3V, for example) by locking out the low voltage switch until the initial switch's gate voltage drops below the desired lower V_{CC} .

The MIC2566 operates from the computer system main power supply. Device logic and internal MOSFET drive is generated internally by charge pump voltage multipliers powered from $V_{CC3\ IN}$. Switching speeds are carefully controlled to prevent damage to sensitive loads and meet all PC Card Specification speed requirements.

Supply Bypassing

External capacitors are not required for operation. The MIC2566 is a switch and has no stability problems. For best results however, bypass $V_{CC3\ IN}$ and $V_{CC5\ IN}$ inputs with 1 μ F capacitors to improve output ripple. As all internal device logic and comparison functions are powered from the $V_{CC3\ IN}$ line, the power supply quality of this line is the most important, and a bypass capacitor may be necessary for some layouts. Both $V_{CC\ OUT}$ and $V_{PP\ OUT}$ pins may use 0.01 μ F to 0.1 μ F capacitors for noise reduction and electrostatic discharge (ESD) damage prevention. Larger values of output capacitors are not necessary.

PC Card Slot Implementation

The MIC2566 is designed for PC Card applications, including the CardBus option, that do not require a 12V bias. One MIC2566 is required for each PC Card slot.

When a memory card is initially inserted, it should receive V_{CC} — either $3.3V \pm 0.3V$ or $5.0V \pm 5\%$. The initial voltage is determined by a combination of mechanical socket "keys" and voltage sense pins. The card sends a handshaking data

stream to the controller, which then determines whether or not this card requires V_{PP} and if the card is designed for dual V_{CC} . If the card is compatible with and desires a different V_{CC} level, the controller commands this change by disabling V_{CC} , waiting at least 100ms, and then re-enabling the other V_{CC} voltage.

V_{CC} switches are turned ON and OFF slowly. If commanded to immediately switch from one V_{CC} to the other (without turning OFF and waiting 100ms first), enhancement of the second switch begins after the first is OFF, realizing break-before-make protection. V_{PP} switches are turned ON slowly and OFF quickly, which also prevents cross conduction.

If no card is inserted or the system is in sleep mode, the slot logic controller outputs a ($V_{CC3\ IN}$, $V_{CC5\ IN}$) = (0,0) to the MIC2566, which shuts down V_{CC} . This also places the switch into a high impedance output shutdown (sleep) mode, where current consumption drops to nearly zero, with only tiny CMOS leakage currents flowing.

Internal device control logic and MOSFET drive and bias voltage is powered from $V_{CC3\ IN}$. The high voltage bias is generated by an internal charge pump quadrupler. Systems without 3.3V may connect $V_{CC3\ IN}$ to 5V. Input logic threshold voltages are compatible with common PC Card logic controllers using either 3.3V or 5V supplies.

Figure 3 shows MIC2566 configuration for situations where only a single +5V V_{CC} is available.

Output Current and Protection

MIC2566 output switches are capable of passing the maximum current needed by any PC Card. For system and card protection, output currents are internally limited. For full system protection, long term (millisecond or longer) output short circuits invoke overtemperature shutdown, protecting the MIC2566, the system power supplies, the card socket pins, and the PC Card. A final protective feature is the error FLAG, which signals the PC Card slot logic controller when a fault condition exists, allowing the controller to notify the user that the card inserted has a problem. The open-drain FLAG monitors the voltage level on both $V_{CC\ OUT}$ and $V_{PP\ OUT}$ and activates (pulls low) when either output is 1V below its programmed level or an overtemperature fault exists.

This FLAG signals output voltage transitions as well as fault conditions. Refer to Figures 1 and 2 for details.

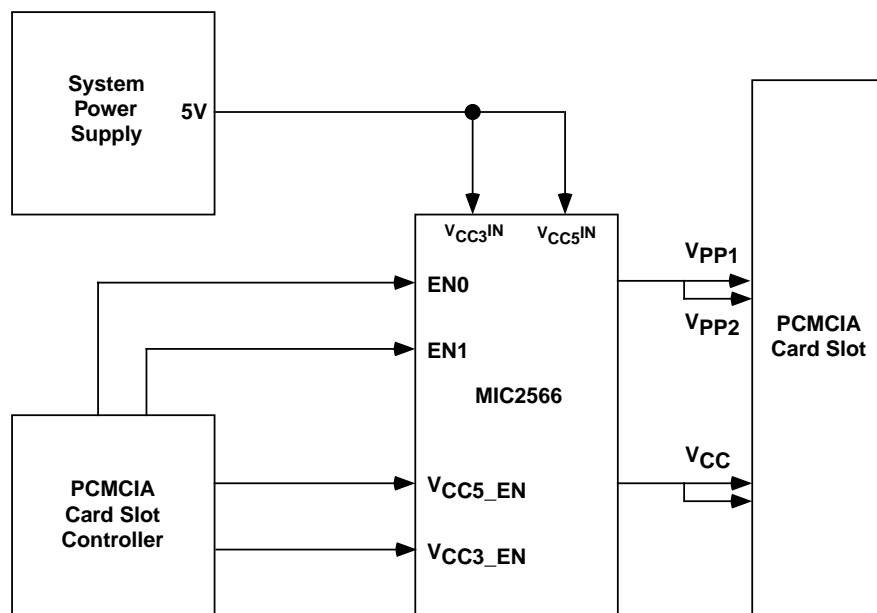
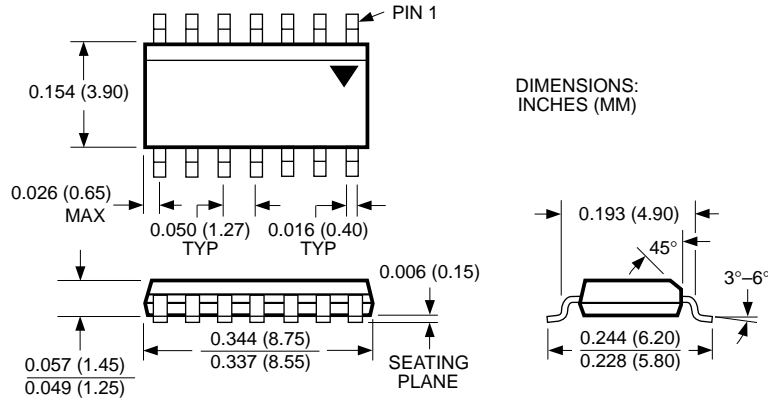


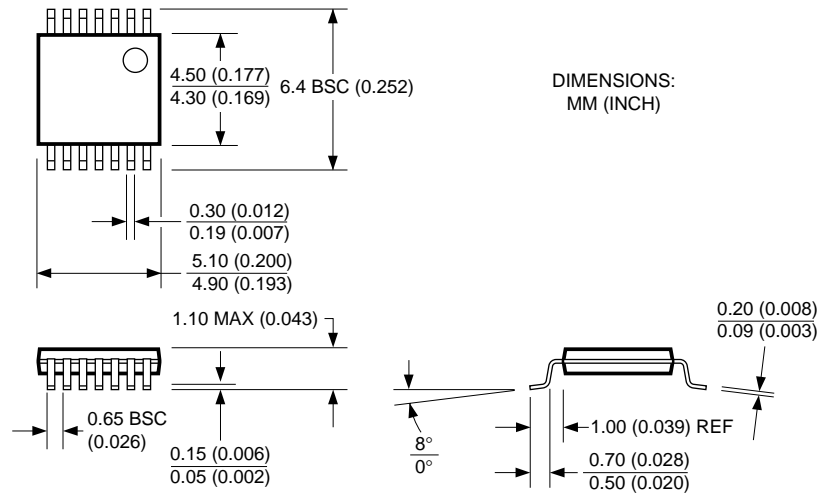
Figure 3. PC Card Slot Power Control Application Without an Available 3.3V V_{CC}

Note that $V_{CC3\ IN}$ and $V_{CC5\ IN}$ are driven together. The MIC2566 is powered by the $V_{CC3\ IN}$ line. In this configuration, $V_{CC\ OUT}$ will be 5V when either V_{CC3} or V_{CC5} is enabled from the logic table. Take advantage of the lower switch resistance of the V_{CC5} switch by using the V_{CC5_EN} control as your main V_{CC} switch.

Package Information



14-Pin SOP



14-Pin TSSOP

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