



# MIC2566

## Single-Slot PC Card/CardBus Power Controller

Preliminary

### 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 $\mu$ 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.

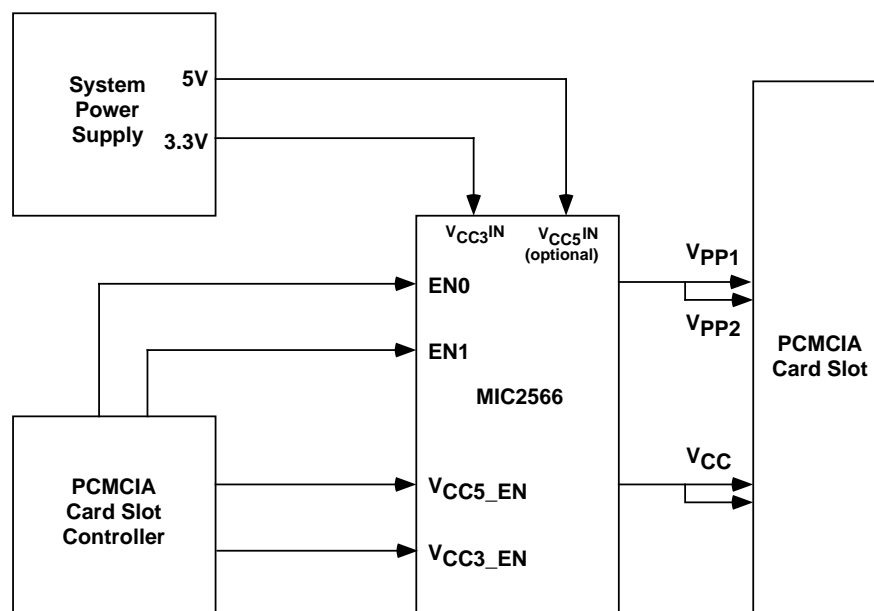
### Features

- 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

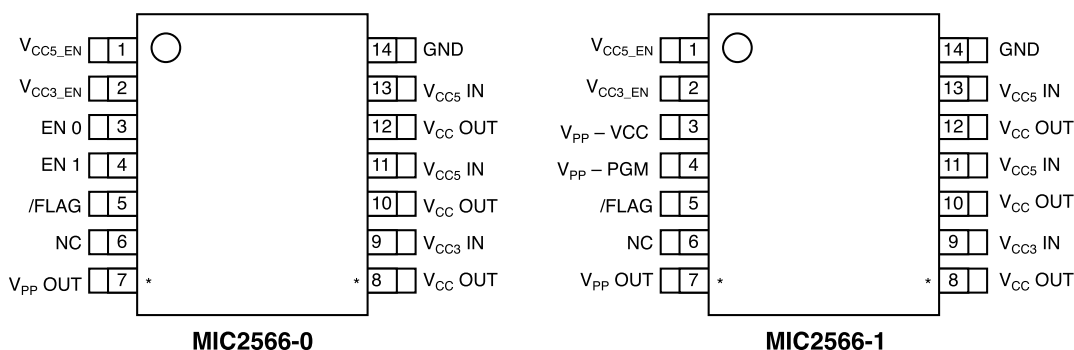


UL Recognized Component

## 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 $\Omega$ 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, <b>Note 3</b>	

**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 ( $\theta_{JA}$ )	
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
<b>DIGITAL INPUTS (<math>V_{EN0}</math>, <math>V_{EN1}</math>, <math>V_{CC3EN}</math>, <math>V_{CC5EN}</math>)</b>						
$V_{IH}$	Logic 1 Input Voltage		$0.7xV_{CC3IN}$		5.5	V
$V_{IL}$	Logic 0 Input Voltage		-0.3		$0.3xV_{CC3IN}$	V
$I_{IN}$	Input Current	$0\text{V} < V_{IN} < 5.5\text{V}$			$\pm 2$	$\mu\text{A}$
<b><math>V_{PP}</math> OUTPUT</b>						
$I_{PP\text{ OUT Hi-Z}}$	High Impedance Output Leakage Current	Shutdown Mode $0 \leq V_{PP\text{ OUT}} \leq 5\text{V}$		1	10	$\mu\text{A}$
$I_{PPSC}$	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	<b>3</b> <b>4</b>	$\Omega$ $\Omega$
$R_O$	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	$\Omega$
<b><math>V_{PP}</math> SWITCHING TIME (See Figure 1)</b>						
$t_1$	Output Turn-On Delay	$V_{PP\text{ OUT}} = \text{Hi-Z to } 10\% \text{ of } 3.3\text{V}$		5	50	$\mu\text{s}$
$t_2$	<b>Note 5</b>	$V_{PP\text{ OUT}} = \text{Hi-Z to } 10\% \text{ of } 5\text{V}$		10	50	$\mu\text{s}$
$t_3$	Output Rise Time	$V_{PP\text{ OUT}} = 10\% \text{ to } 90\% \text{ of } 3.3\text{V}$	100	200	800	$\mu\text{s}$
$t_4$	<b>Note 5</b>	$V_{PP\text{ OUT}} = 10\% \text{ to } 90\% \text{ of } 5\text{V}$	100	300	1000	$\mu\text{s}$
$t_5$	Output Turn-Off Delay Time	$V_{PP\text{ OUT}} = 3.3\text{V to Hi-Z}$		<b>400</b>	1000	ns
$t_6$	<b>Note 5</b>	$V_{PP\text{ OUT}} = 5\text{V to Hi-Z}$		<b>400</b>	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
$t_8$	<b>Note 5</b>	$V_{PP\text{ OUT}} = 90\% \text{ to } 10\% \text{ of } 5\text{V}$		50	1000	ns
<b><math>V_{CC}</math> OUTPUT</b>						
$I_{CCSC}$	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	<b>180</b>	m $\Omega$
		Select $V_{CC\text{ OUT}} = 5\text{V}$ $I_{CC\text{ OUT}} = -1\text{A}$ (Sourcing)		90	<b>135</b>	m $\Omega$
		Select $V_{CC\text{ OUT}} = \text{clamped to ground}$ $I_{CC\text{ OUT}} = 1\text{mA}$ (Sinking)		1800	<b>3900</b>	$\Omega$

## Electrical Characteristics (continued)

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

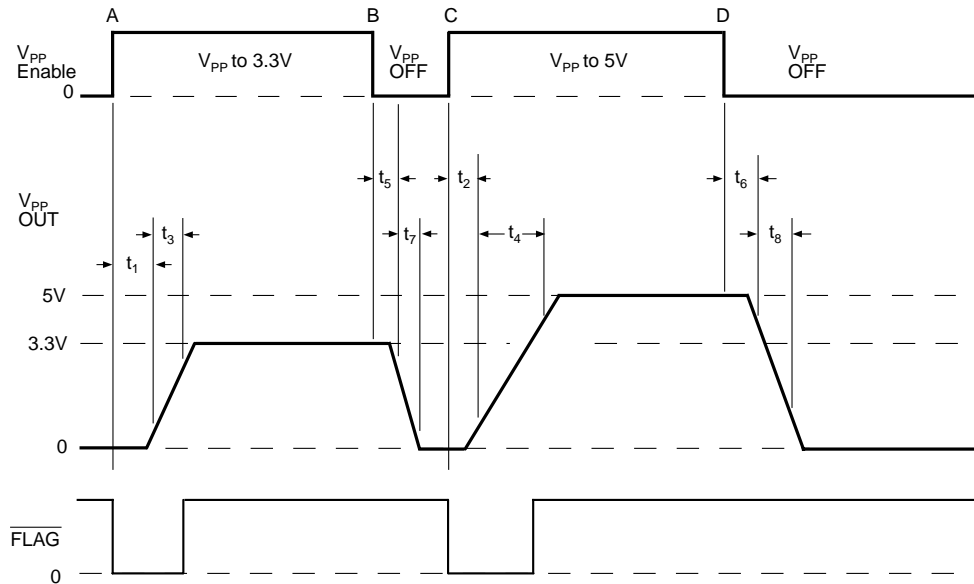
**Note 5.** R<sub>L</sub> = 100Ω connected to ground.

**Note 6.** R<sub>L</sub> = 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.

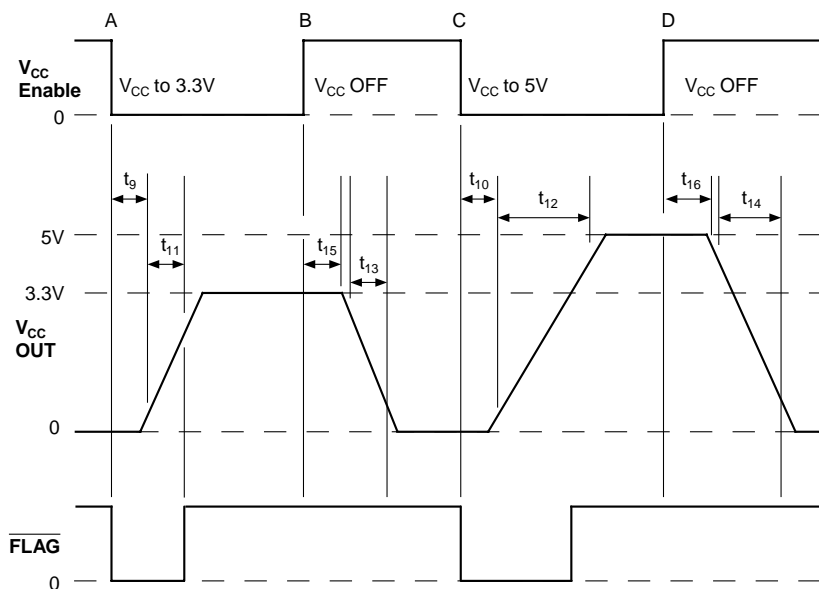
**Note 8.** The MIC2566 uses V<sub>CC3 IN</sub> for operation. For single 5V supply systems, connect 5V to both V<sub>CC3 IN</sub> and V<sub>CC5 IN</sub>. See "Applications Information" for further details.

## 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  $V_{CC3 IN}$ .

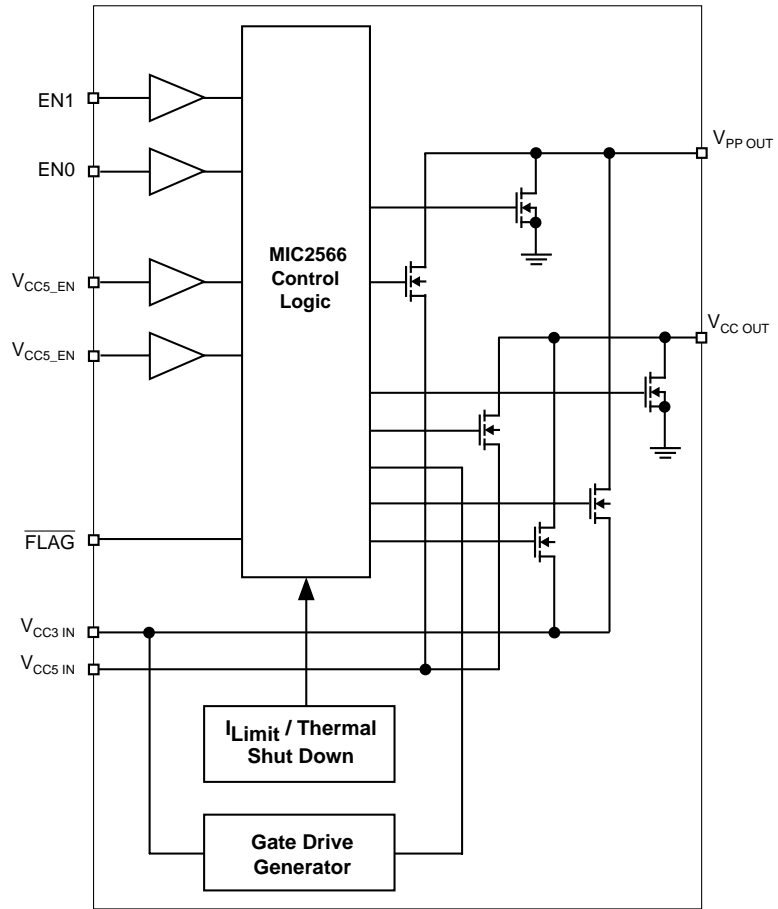
**MIC2566-0 Control Logic Table**

V <sub>CC5</sub> EN	V <sub>CC3</sub> EN	EN1	EN0	V <sub>CC</sub> OUT	V <sub>PP</sub> 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 <sub>CC5</sub> EN	V <sub>CC3</sub> EN	V <sub>PP</sub> PGM	V <sub>PP</sub> VCC	V <sub>CC</sub> OUT	V <sub>PP</sub> 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  $1\mu\text{F}$  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  $0.01\mu\text{F}$  to  $0.1\mu\text{F}$  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  $3.3\text{V} \pm 0.3\text{V}$  or  $5.0\text{V} \pm 5\%$ . 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.

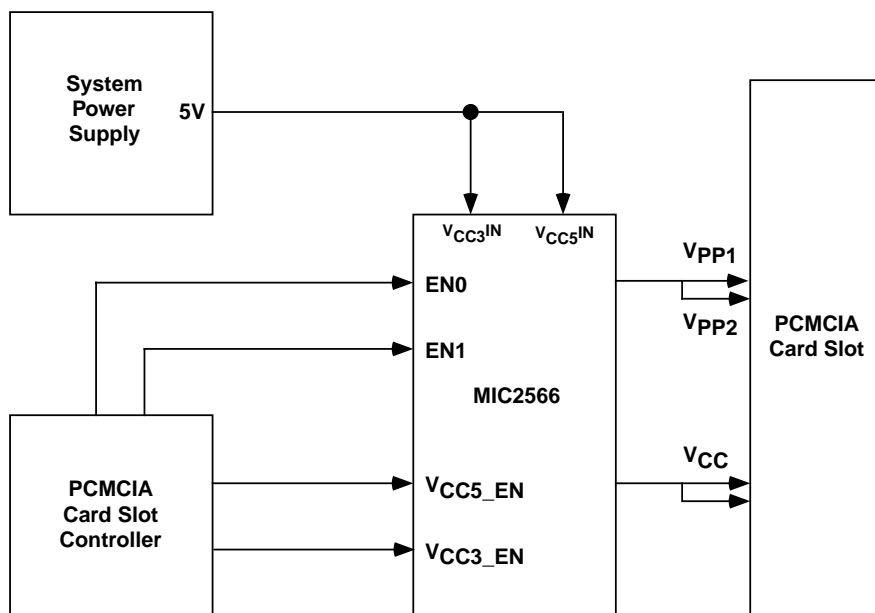
Figure 3 shows MIC2566 configuration for situations where only a single +5V  $V_{CC}$  is available.

### 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.

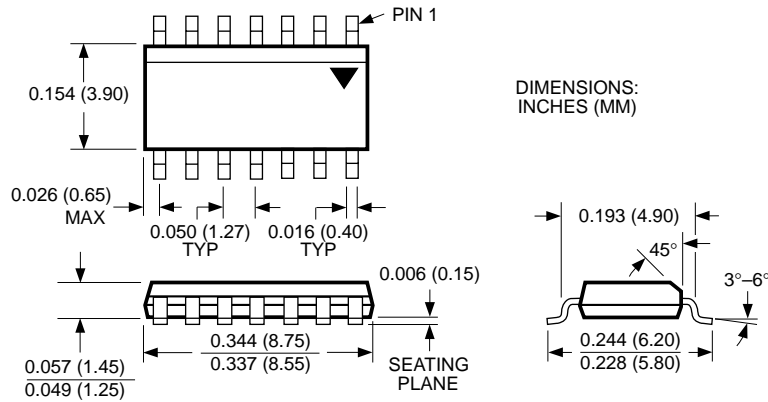




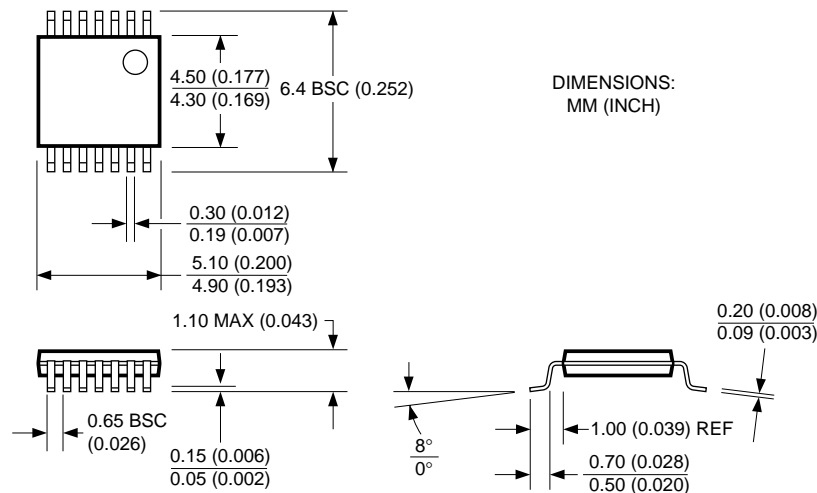
**Figure 3. PC Card Slot Power Control Application Without an Available 3.3V  $V_{CC}$**

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

**MICREL, INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA**

TEL + 1 (408) 944-0800 FAX + 1 (408) 944-0970 WEB <http://www.micrel.com>

The information furnished by Micrel in this datasheet is believed to be accurate and reliable. However, no responsibility is assumed by Micrel for its use. Micrel reserves the right to change circuitry and specifications at any time without notification to the customer.

Micrel Products are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of a product can reasonably be expected to result in personal injury. Life support devices or systems are devices or systems that (a) are intended for surgical implant into the body or (b) support or sustain life, and whose failure to perform can be reasonably expected to result in a significant injury to the user. A Purchaser's use or sale of Micrel Products for use in life support appliances, devices or systems is at Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

© 2003 Micrel, Incorporated.