



### General Description

The MIC2568 dual-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 MIC2568 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 250mA for  $V_{PP}$ . The MIC2568 features well-controlled voltage rise and fall times. Each MIC2568 output voltage is switched by two digital inputs, typically controlled from a separate PC Card logic controller.

The MIC2568 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 MIC2568 is available in 28-pin SSOP and TSSOP packages.

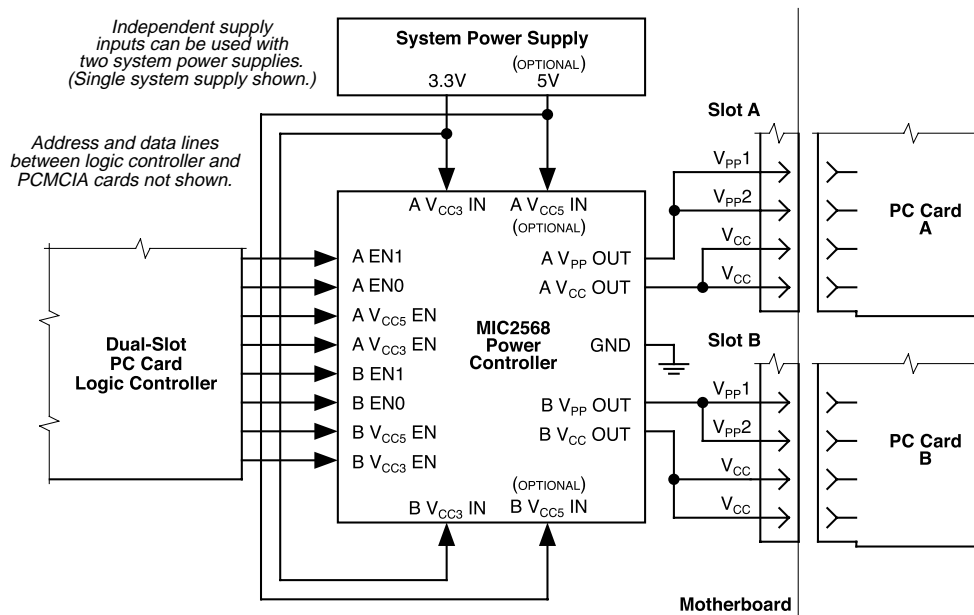
### Features

- Complete single-chip dual-slot power switch
- 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
- > 200mA  $V_{PP}$  output current per slot
- 28-pin SSO and TSSO package
- Pb-free 28-pin SSO package
- UL recognized, file #179633

### Applications

- Dual-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



Dual-Slot PC Card Power Control

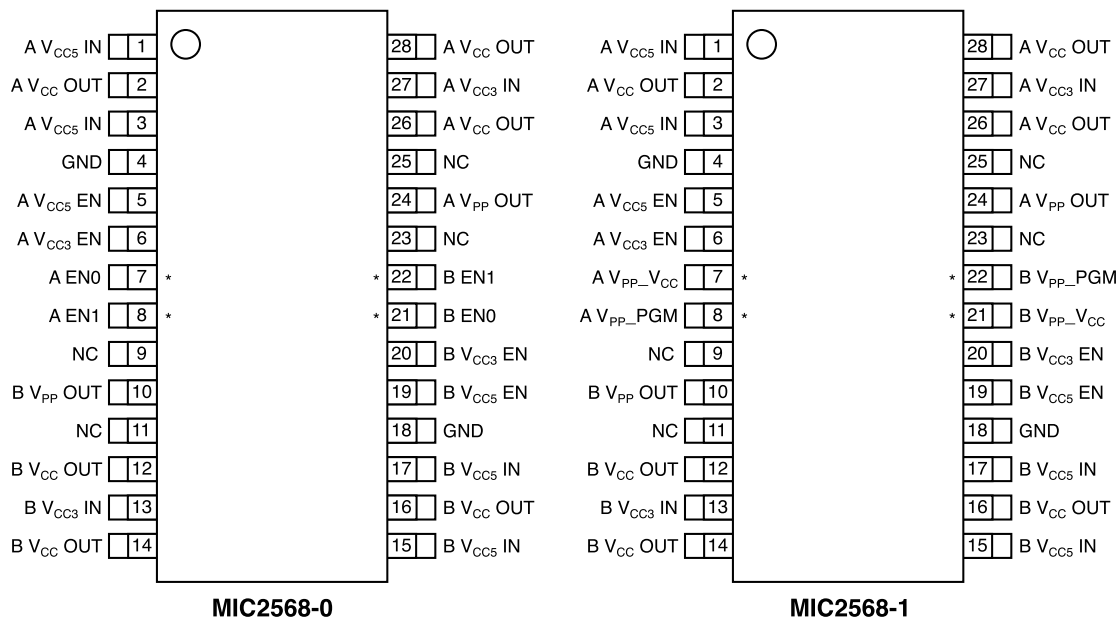


UL Recognized Component

## Ordering Information

Part Number	Operating Temperature Range	Package	Pb-Free
MIC2568-0BSM	-40°C to +85°C	28-pin SSOP	
MIC2568-1BSM	-40°C to +85°C	28-pin SSOP	
MIC2568-0YSM	-40°C to +85°C	28-pin SSOP	X
MIC2568-1YSM	-40°C to +85°C	28-pin SSOP	X
MIC2568-0BTS	-40°C to +85°C	28-pin TSSOP	
MIC2568-1BTS	-40°C to +85°C	28-pin TSSOP	

## Pin Configuration



\* Denotes pinout differences. Duplicate pins must be connected together for proper operation.  
Example: "A V<sub>CC5</sub>IN" pins 1 and 3 must be connected.

## Pin Description

Pin Number MIC2568-0	Pin Number MIC2568-1	Pin Name	Pin Function
1, 3 / 15, 17	1, 3 / 15, 17	A / B V <sub>CC5</sub> IN	5V Nominal Supply Input: Optional supply, switchable to V <sub>CC</sub> and V <sub>PP</sub> outputs.
2,26,28/12,14,16	2,26,28/12,14,16	A / B V <sub>CC</sub> OUT	V <sub>CC</sub> Output: 0V (ground), 3.3V, 5V, or high-impedance output. Pins 2, 26, and 28 must be externally connected. Pins 12, 14, and 16 must be externally connected.
4, 18	4, 18	GND	Ground.
5 / 19	5 / 19	A / B V <sub>CC5</sub> EN	V <sub>CC</sub> 5V Enable (Input).
6 / 20	6 / 20	A / B V <sub>CC3</sub> EN	V <sub>CC</sub> 3.3V Enable (Input).
7 / 21		A / B EN0	Enable 0: Micrel standard logic-control signal. MIC2568-0 only.
	7 / 21	A / B V <sub>PP-VCC</sub>	V <sub>PP-VCC</sub> Control: Cirrus Logic logic-controller compatible control signal. MIC2568-1 only.
8 / 22		A / B EN1	Enable 1: Micrel standard logic-control signal. MIC2568-0 only.
	8 / 22	A / B V <sub>PP-PGM</sub>	Program: Cirrus Logic-compatible control signal. MIC2568-1 only.
24 / 10	24 / 10	A / B V <sub>PP</sub> OUT	V <sub>PP</sub> Output: 0V (ground), 3.3V, 5V, or high-impedance output.
9, 11, 23, 25	9, 11, 23, 25	NC	Not internally connected.
27 / 13	27 / 13	A / B V <sub>CC3</sub> IN	3.3V Nominal Supply Input: Mandatory supply, switchable to V <sub>CC</sub> and V <sub>PP</sub> outputs. Also powers MIC2568 internal circuitry.

**Absolute Maximum Ratings (Note 1)**

$V_{CC5\ IN}$ [5V] Supply Voltage ( $V_{CC5\ IN}$ )	+6V
$V_{CC3\ IN}$ [3.3V] Supply Voltage ( $V_{CC3\ IN}$ )	+6V
Logic Input Voltages ( $V_{CCx\ EN}$ , $V_{ENx}$ )	-0.3V to +6V
Storage Temperature ( $T_S$ )	-65°C to +150°C
Lead Temperature (5 sec.)	260°C

ESD Rating, **Note 3****Operating Ratings (Note 2)**

$V_{CC5\ IN}$ [5V] Supply Voltage ( $V_{CC5\ IN}$ ), <b>Note 5</b>	+4.5V to +5.5V
$V_{CC3\ IN}$ [3.3V] Supply Voltage ( $V_{CC3\ IN}$ ), <b>Note 6</b>	+3.0V to +5.5V
Ambient Temperature Range ( $T_A$ )	-40°C to +85°C
Junction Temperature ( $T_J$ )	Internally Limited
Thermal Resistance	
SSOP ( $\theta_{JA}$ )	84°C/W
TSSOP ( $\theta_{JA}$ )	100°C/W

**Electrical Characteristics (Note 4)** $V_{CC3\ IN} = 3.3V$ ,  $V_{CC5\ IN} = 5.0V$ ; specified over operating temperature range of -40°C to +85°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Digital Inputs</b>						
$V_{IH}$	Logic-1 Input Voltage	$V_{CC3\ IN} = 3.0V$ to 5.5V	$0.7V_{CC3\ IN}$		5.5	V
$V_{IL}$	Logic-0 Input Voltage	$V_{CC3\ IN} = 3.0V$ to 5.5V	-0.3		$0.3V_{CC3\ IN}$	V
$I_{IN}$	Input Current	$0V \leq V_{IN} \leq 5.5V$			$\pm 2$	$\mu A$
<b><math>V_{PP}</math> Output</b>						
$I_{PP\ OUT}$ Hi-Z	High Impedance Output Leakage Current	Shutdown mode $0 \leq V_{PP\ OUT} = 0V$		1	10	$\mu A$
$I_{PPSC}$	Short Circuit Current Limit	$V_{PP\ OUT} = 0V$	0.12	0.3		A
$R_O$	Switch Resistance	$V_{PP\ OUT} = 5V$ selected, $I_{PP\ OUT} = -100mA$ (sourcing)		1.4	<b>4</b>	$\Omega$
		$V_{PP\ OUT} = 3.3V$ selected, $I_{PP\ OUT} = -100mA$ (sourcing)		1.5	<b>4</b>	$\Omega$
		$V_{PP\ OUT} = 0V$ [ground] selected, $I_{PP\ OUT} = 50\mu A$ (sinking)		1300	3900	$\Omega$
<b><math>V_{PP}</math> Switching Time (See Figure 1)</b>						
$t_1$	Output Turn-On Delay, <b>Note 7</b>	$V_{PP\ OUT} = \text{Hi-Z to } 10\% \text{ of } 3.3V$		5	50	$\mu s$
$t_2$		$V_{PP\ OUT} = \text{Hi-Z to } 10\% \text{ of } 5V$		10	50	$\mu s$
$t_3$	Output Rise Time, <b>Note 7</b>	$V_{PP\ OUT} = 10\% \text{ to } 90\% \text{ of } 3.3V$	100	200	800	$\mu s$
$t_4$		$V_{PP\ OUT} = 10\% \text{ to } 90\% \text{ of } 5V$	100	300	1000	$\mu s$
$t_5$	Output Turnoff Fall Time, <b>Note 7</b>	$V_{PP\ OUT} = 90\% \text{ to } 10\% \text{ of } 3.3V$		50	1000	ns
$t_6$		$V_{PP\ OUT} = 90\% \text{ to } 10\% \text{ of } 5V$		50	1000	ns
$t_7$	Output Turnoff Delay Time, <b>Notes 7, 8</b>	$V_{PP\ OUT} = 3.3V \text{ to Hi-Z}$		<b>400</b>	1000	ns
$t_8$		$V_{PP\ OUT} = 5V \text{ to Hi-Z}$		<b>400</b>	1000	ns
<b><math>V_{CC}</math> Output</b>						
$I_{CCSC}$	Short Circuit Current Limit	$V_{CC\ OUT} = 0V$ , normal mode, $V_{CC3}$ or $V_{CC5}$ switches	1.0	1.5		A
$R_O$	Switch Resistance	$V_{CC\ OUT} = 3.3V$ selected, $I_{CC\ OUT} = -1A$ (sourcing)		120	<b>180</b>	m $\Omega$
		$V_{CC\ OUT} = 5V$ selected, $I_{CC\ OUT} = -1A$ (sourcing)		90	<b>135</b>	m $\Omega$
		$V_{CC\ OUT} = 0V$ [ground] selected, $I_{CC\ OUT} = 0.1mA$ (sinking)		1800	3900	$\Omega$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>V<sub>CC</sub> Switching Time</b> (See Figure 2)						
t <sub>9</sub>	Output Turn-On Delay Time, <b>Note 9</b>	V <sub>CC OUT</sub> = 0V to 10% of 3.3V		300	1500	μs
t <sub>10</sub>		V <sub>CC OUT</sub> = 0V to 10% of 5.0V		750	3000	μs
t <sub>11</sub>	Output Rise Time, <b>Note 9</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 Fall Time, <b>Note 9</b>	V <sub>CC OUT</sub> = 90% to 10% of 3.3V	100	300	1000	μs
t <sub>14</sub>		V <sub>CC OUT</sub> = 90% to 10% of 5.0V	100	600	2000	μs
t <sub>15</sub>	Output Turnoff Delay, <b>Notes 8, 9</b>	V <sub>CC OUT</sub> = 3.3V		0.65	2	ms
t <sub>16</sub>		V <sub>CC OUT</sub> = 5V		0.7	2	ms
<b>Power Supply</b>						
I <sub>CC5</sub>	V <sub>CC5 IN</sub> Supply Current (5V) <b>Note 5</b>	V <sub>CC OUT</sub> = 5V or 3.3V, I <sub>CC OUT</sub> = 0		8	50	μA
		V <sub>CC OUT</sub> = 0V (sleep mode)		0.2	10	μA
I <sub>CC3</sub>	V <sub>CC3 IN</sub> Supply Current (3.3V) <b>Note 6</b>	V <sub>CC OUT</sub> = 5V or 3.3V, I <sub>CC OUT</sub> = 0		40	100	μA
		V <sub>CC OUT</sub> = 0V (sleep mode)		0.1	10	μA
<b>Thermal Shutdown</b>						
T <sub>SD</sub>	Thermal Shutdown Temperature			140		°C

**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.

**Note 4.** Specification for packaged product only.

**Note 5.** V<sub>CC5 IN</sub> is not required for operation.

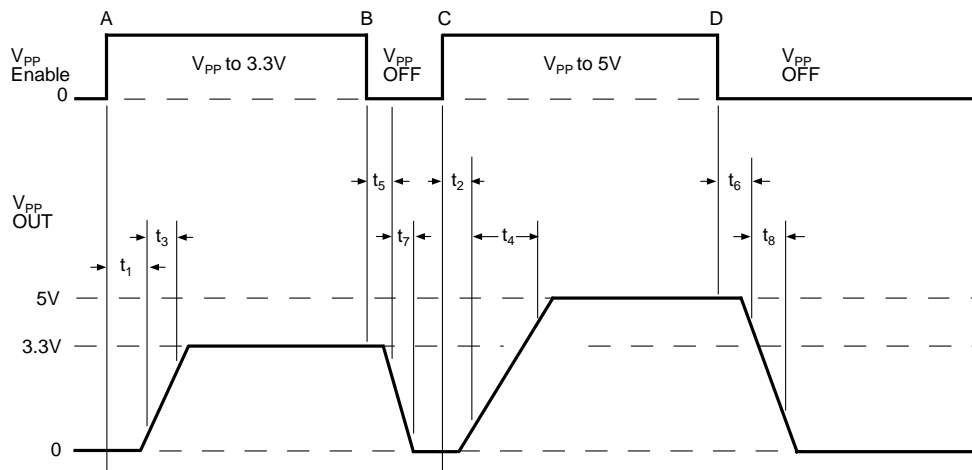
**Note 6.** V<sub>CC3 IN</sub> powers all internal logic, bias, and drive circuitry, and is required for operation.

**Note 7.** R<sub>L</sub> = 1kΩ connected to ground.

**Note 8.** Measurement is from the Hi-Z- or 0V-state command to the beginning of the slope. Measurement does not apply when device is in current limit or thermal shutdown.

**Note 9.** R<sub>L</sub> = 10Ω connected to ground.

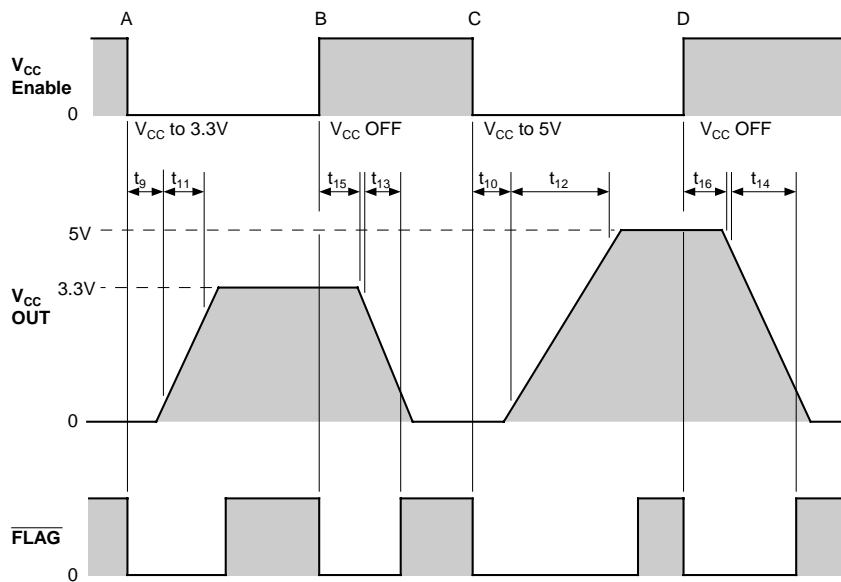
## Output Timing Diagrams



**Figure 1.  $V_{PP}$  Timing Diagram**

$V_{PP\ EN}$  is shown generically.  $R_L = 100\Omega$ . Load capacitance is negligible. Refer to “MIC2568-0 Logic Table” for specific control logic input.

At time **A**)  $V_{PP} = 3.3V$ , **B**)  $V_{PP}$  is disabled, **C**)  $V_{PP}$  is programmed to 5V, **D**)  $V_{PP}$  is disabled.



**Figure 2.  $V_{CC}$  Timing Diagram**

$V_{CC\ EN}$  is shown generically.  $R_L = 10\Omega$ . Refer to “MIC2568-0 Logic Table” for specific control logic input.

At time **A**)  $V_{CC}$  is programmed to 3.3V, **B**)  $V_{CC}$  is disabled, **C**)  $V_{CC}$  is programmed to 5V, **D**)  $V_{CC}$  is disabled.

**MIC2568-0 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	0V*	Hi-Z
0	0	0	1	0V*	Hi-Z
0	0	1	0	0V*	Hi-Z
0	0	1	1	0V*	0V*
0	1	0	0	3.3V	Hi-Z
0	1	0	1	3.3V	3.3V
0	1	1	0	3.3V	Hi-Z
0	1	1	1	3.3V	0V*
1	0	0	0	5V	Hi-Z
1	0	0	1	5V	5V
1	0	1	0	5V	Hi-Z
1	0	1	1	5V	0V*
1	1	0	0	3.3V	Hi-Z
1	1	0	1	3.3V	3.3V
1	1	1	0	3.3V	5V
1	1	1	1	3.3V	0V*

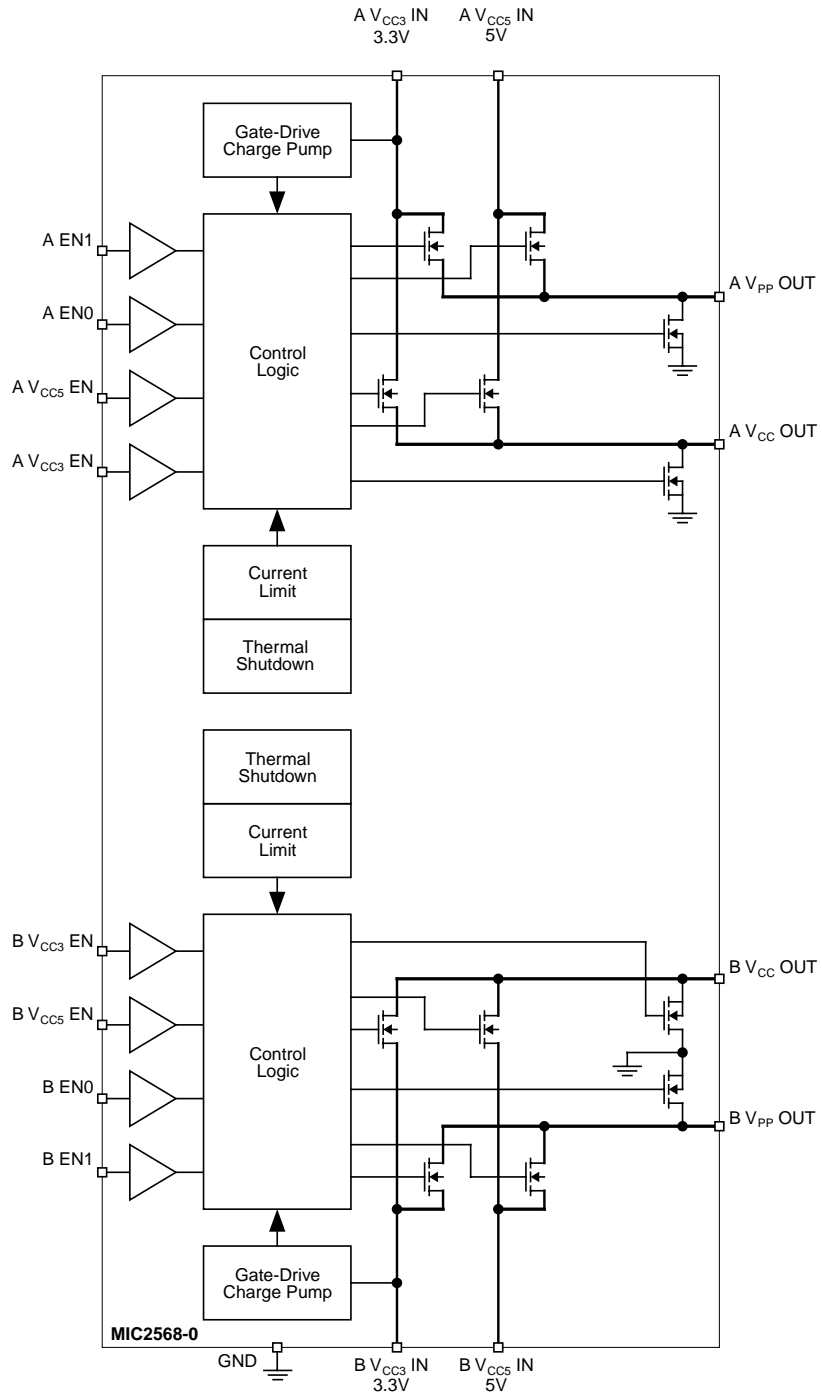
**MIC2568-1 Logic Table**

MIC2568-1 control logic is compatible with the Cirrus Logic CL-PD6710 and CL-PD672x-series logic controllers.

V <sub>CC5</sub> EN	V <sub>CC3</sub> EN	V <sub>PP</sub> -PGM	V <sub>PP</sub> -V <sub>CC</sub>	V <sub>CC</sub> OUT	V <sub>PP</sub> OUT
0	0	0	0	0V*	0V*
0	0	0	1	0V*	Hi-Z
0	0	1	0	0V*	Hi-Z
0	0	1	1	0V*	Hi-Z
0	1	0	0	5V	0V*
0	1	0	1	5V	5V
0	1	1	0	5V	Hi-Z
0	1	1	1	5V	Hi-Z
1	0	0	0	3.3V	0V*
1	0	0	1	3.3V	3.3V
1	0	1	0	3.3V	Hi-Z
1	0	1	1	3.3V	Hi-Z
1	1	0	0	0V*	0V*
1	1	0	1	0V*	Hi-Z
1	1	1	0	0V*	Hi-Z
1	1	1	1	0V*	Hi-Z

\* clamped to ground

# Functional Diagram



## Applications Information

PC Card power control for two sockets is easily accomplished using the Micrel MIC2568 PC Card/CardBus Slot Power Controller IC.

### Output Voltage Selection

Four control bits per socket determine  $V_{CC}$  and  $V_{PP}$  output voltages and standby- or operate-mode conditions. Input logic threshold voltages are compatible with common PC Card logic controllers using either 3.3V or 5V supplies.

The  $V_{CC}$  outputs can be individually switched between 0V (ground) or 3.3V and 5V at the maximum allowable PC Card current. The  $V_{PP}$  outputs can be individually switched between 0V (ground), 3.3V or 5V ( $V_{CC3}$  or  $V_{CC5}$  voltages), or high impedance. When  $V_{CC} = 0V$  (ground) is selected, the MIC2568 goes into sleep mode and draws only nanoamperes of leakage current.

Switching speeds are controlled to prevent damage to sensitive loads and meet all PC Card Specification timing requirements.  $V_{CC}$  switches are turned on and off slowly. If commanded to switch directly from one  $V_{CC}$  to the other (without first turning off and waiting 100ms), enhancement of the second switch begins only after the first is off (break-before-make protection).

### Supply Input

The MIC2568 itself is powered from the  $V_{CC3}$  IN pin (3.3V-nominal supply input). Bias its internal MOSFETs is generated by a charge pump quadrupler. Refer to "5V-Only  $V_{CC}$  Application" and Figure 4 for information on using the MIC2568 without a 3.3V supply.

### Output Current and Protection

The MIC2568 meets or exceeds all PCMCIA current specifications. Its 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 output short circuits (millisecond or longer) invoke overtemperature shutdown, protecting the MIC2568, system power supplies, card socket pins, and PC Card.

### Bypass Capacitors

Both  $V_{CC3}$  IN and  $V_{CC5}$  IN pins should be bypassed with 1 $\mu$ F low-ESR surface-mount ceramic capacitors mounted near the MIC2568 chip.

Both  $V_{CC}$  OUT and  $V_{PP}$  OUT pins may use 0.01 $\mu$ F to 0.1 $\mu$ F capacitors for noise reduction and to reduce the chance of (electrostatic discharge) ESD damage.

### PC Card Slot Implementation

The MIC2568 is designed for PC Card applications, including the CardBus option, that do not require a 12V supply.

When a memory card is initially inserted, it must receive a  $V_{CC}$  voltage (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. Each card sends handshaking data to the logic controller which determines whether that card requires a  $V_{PP}$  voltage and whether the card is designed for dual  $V_{CC}$  voltages. If the card is compatible with, and requests, a different  $V_{CC}$  level, the controller disables  $V_{CC}$ , waits at least 100ms, and then enables the new  $V_{CC}$  voltage.

If no card is inserted, or the system is in sleep mode, the logic controller outputs a ( $V_{CC3}$  EN,  $V_{CC5}$  EN) = (0, 0) to the MIC2568, which shuts down  $V_{CC}$ . This also places the switch into its high-impedance output sleep mode.

### Basic $V_{PP}$ and $V_{CC}$ Switch Application

Refer to Figure 3. A single system power supply feeds both slot-A and slot-B supply inputs. Although the PC Card specification defines two  $V_{PP}$  outputs ( $V_{PP}$  1 and  $V_{PP}$  2) per card, they are usually connected together.

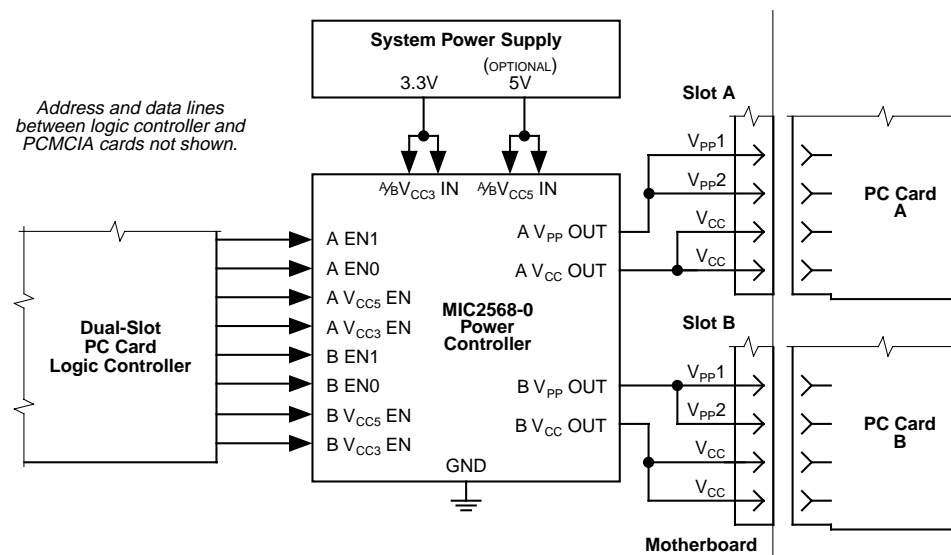


Figure 3. Basic  $V_{PP}$  and  $V_{CC}$  Switch



### 5V-Only V<sub>CC</sub> Application

To use the MIC2568 in applications where only a single 5V V<sub>CC</sub> is available (no 3.3V V<sub>CC</sub>), connect V<sub>CC5</sub> (5V supply) to the V<sub>CC3</sub> IN pin. Refer to Figure 4. In this configuration, V<sub>CC</sub> OUT will be 5V when either V<sub>CC3</sub> switch or V<sub>CC5</sub> switch is enabled.

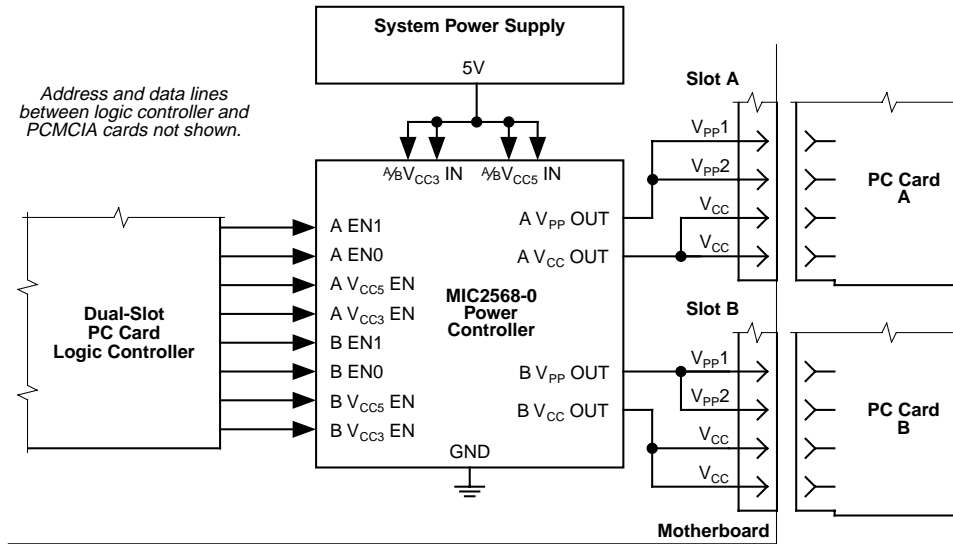
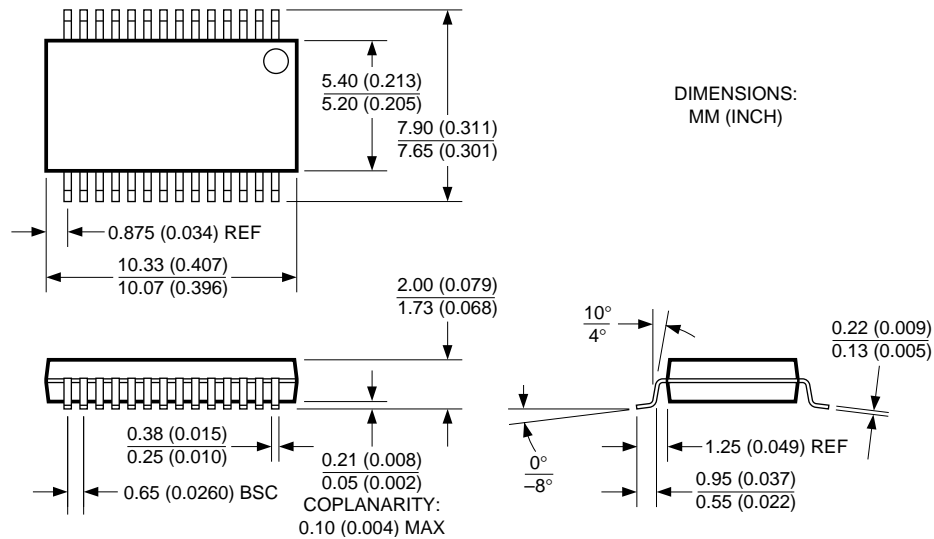
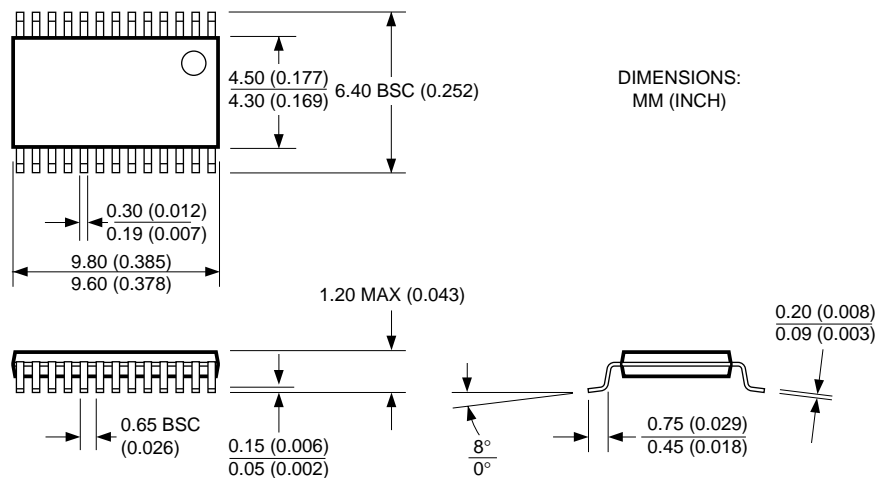


Figure 4. 5V-Only V<sub>CC</sub> Application

## Package Information



**28-Pin SSOP (SM)**



**28-Pin TSSOP (TS)**

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