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TPS2205/TPS2211 PCMCIA Switch Interface to Ricoh Cardbus PCMCIA Controllers

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Contents

List of Figures

List of Tables

TPS2205/TPS2211 PCMCIA Switch Interface to Ricoh Cardbus™ PCMCIA Controllers

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ABSTRACT

This application report explains the similarities and differences between the Texas Instruments TPS2205/TPS2211 PC Card™ Power Interface Switches and the Micrel MIC2563A/MIC2562A devices. The report provides a detailed examination of the parallel interfaces employed by each device. The interface to the Ricoh™ Cardbus PCMCIA is also examined, showing the compatibility with the TPS2205.

Introduction

This application report explains the similarities and differences between the Texas Instruments TPS2205/TPS2211 PC Card™ Power Interface Switches and the Micrel™ MIC2562A/MIC2563A devices. The report provides a detailed examination of the parallel interfaces employed by each device.

The interface to the Ricoh Cardbus PCMCIA is also examined, showing the compatibility with the TPS2205. The Ricoh RB/RL5Cxxx families of controllers are directly compatible.

The TPS2205 PC Card Power Interface Switch provides an integrated power-management solution for two PC Card sockets, and the TPS2211 manages a single socket. The integrated feature sets of the TPS2205 and TPS2211 allow the controlled distribution of 3.3 V, 5 V, and/or 12 V to the card socket(s); the devices are compatible with many of the PCMCIA controllers available. The current- and thermal-limiting features eliminate the need for fuses, providing maintenance-free fault detection, improving reliability, and reducing component count. The TPS2205 and TPS2211 have parallel interfaces.

The closest devices directly competitive with the TPS2205 and TPS2211 are the Micrel MIC2563A and MIC2562A. These devices, although not pin compatible, have a parallel interface similar to the TPS2205 and TPS2211, and they offer similar features. Because the interfaces of these power distribution devices are compatible with the same types of controllers, both devices gluelessly interface to the Ricoh Cardbus PCMCIA controllers, as well as other controllers with a parallel interface.

Figure 1 shows a typical notebook computer application.

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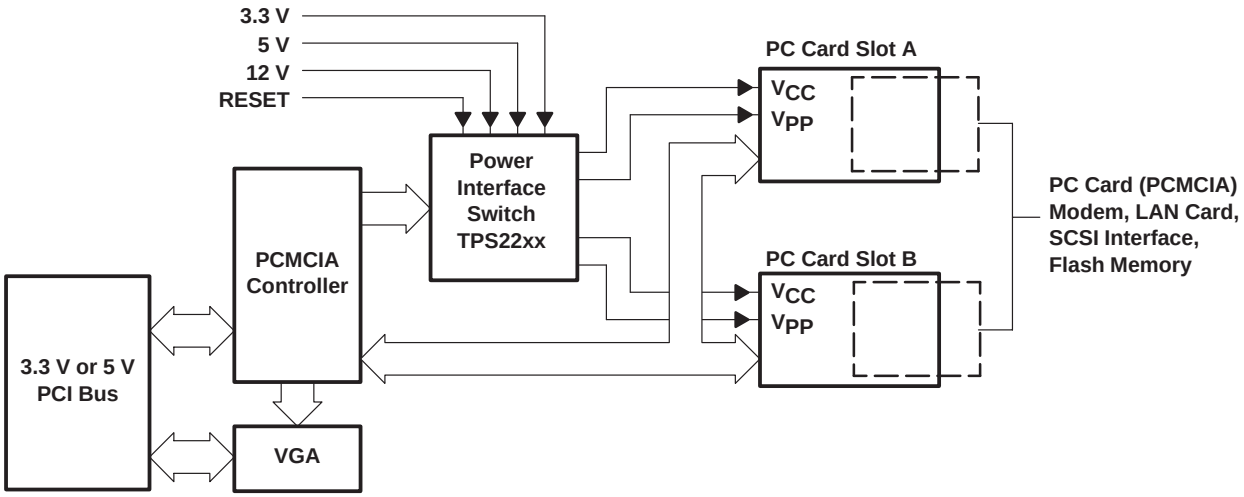

Figure 1. Typical Notebook PC Application

Features and Compatibility

This section lists the features of the TPS22xx devices and describes their compatibility in various applications.

TPS2205 Feature Set: (Dual)

- Fully integrated V_{CC} and V_{PP} switching
- Low $r_{DS(on)}$: 140-mΩ 5-V and 110-mΩ 3.3-V V_{CC} switches
- Compatible with controllers from Ricoh, Cirrus™, Intel™, and Texas Instruments Incorporated
- 3.3-V low voltage mode
- 12-V supply not required unless the PC Card uses 12 V for flash programming or other applications
- Short-circuit and thermal protection
- Compatible with 3.3-V, 5-V, and 12-V PC Cards
- Break-before-make switching
- 30-pin SSOP and 32-pin TSSOP packages

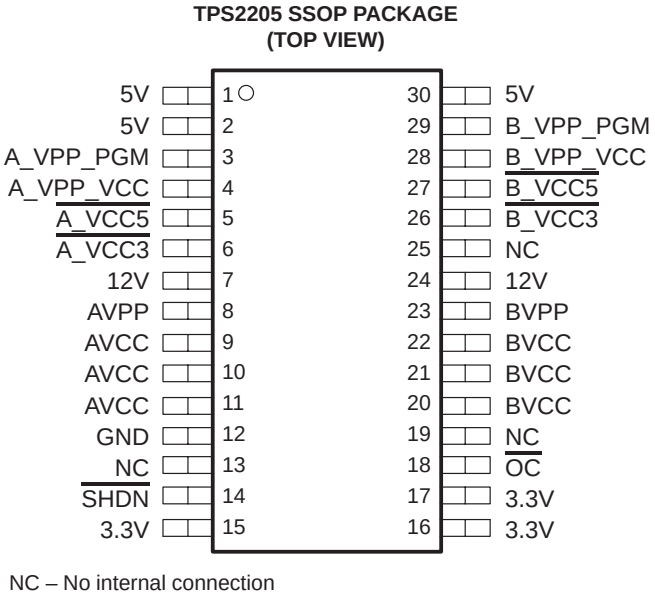

Figure 2. TPS2205 30-Pin SSOP Package

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TPS2211 Feature Set: (Single)

- Fully integrated V_{CC} and V_{PP} switching
- Low $r_{DS(on)}$: 90-mΩ 5-V and 3.3-V V_{CC} switches
- Compatible with industry standard controllers
- 12-V supply not required unless the PC Card uses 12 V for flash programming or other applications
- 3.3-V low voltage mode
- Short-circuit and thermal protection
- Compatible with 3.3-V, 5-V, and 12-V PC Cards
- Break-before-make switching
- 16-pin SSOP package

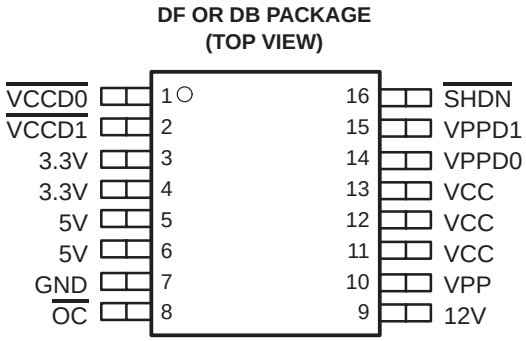


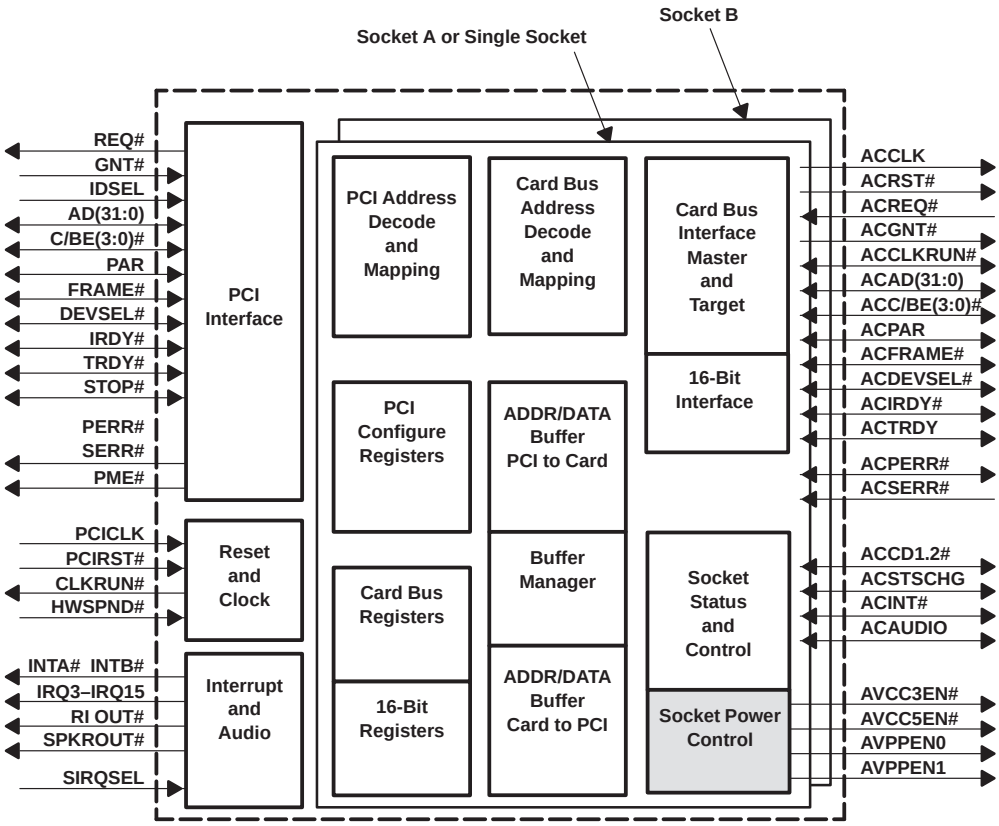
Figure 3. TPS2211 16-Pin SSOP Package

PC Card Power Specification

For PCMCIA cards, system compatibility also means power compatibility. The most current version of the PC Card specification limits the power transfer to the card to 8 of the 68 pins available, consisting of 4 ground, 2 V_{CC}, and 2 V_{PP} pins. On the input side of a PCMCIA power switch, the power interface consists of four voltages; 12 V, 5 V, 3.3 V and ground. These voltages are switched to the V_{CC} and V_{PP} inputs based on the specific need of each individual card plugged into the socket. Typically, ground, 3.3 V, and 5 V are available at the V_{CC} terminals, and ground, 3.3 V, 5 V and 12 V are available at the V_{PP} terminals. Card power is provided by the V_{CC} inputs, and flash memory programming and erase voltages are supplied through the V_{PP} terminals.

Compatibility

The TPS2205 is a backward-compatible upgrade to the Texas Instruments TPS2201. Both devices have the same 8-line parallel interface, but the TPS2205 is a higher performance device. When the TPS2201 was initially released, it brought a new level of integration to the market; the parallel interface became somewhat of a standard for 16-bit PC Card controllers and was also adopted by some of the later cardbus controllers. Whether the TPS2205 is used in conjunction with a Texas Instruments, Ricoh, Cirrus, or O2 Micro controller, the interface is typically glueless. Figure 4 shows the block diagram for the Ricoh controller.



NOTE: A # following a signal name means there is a separate signal for socket A and socket B.

Figure 4. Ricoh Controller Block Diagram

Table 1 lists the V_{CC} interface for the Ricoh RB5C478 controller.

Table 1. V_{CC} Interface for the Ricoh RB5C478

BIT2	BIT1	BIT0	VCC3EN#	VCC5EN#	STATUS
0	0	0	H	H	Set V_{CC} voltage = power off
0	0	1	H	H	Reserved
0	1	0	L	L	Set V_{CC} voltage = 5 V
0	1	1	H	H	Set V_{CC} voltage = 3.3 V
1	0	0	H	H	Reserved
1	0	1	H	H	Reserved
1	1	0	H	H	Reserved
1	1	1	H	H	Reserved

Table 2 lists the V_{PP} interface for the Ricoh RB5C478 controller.

Table 2. V_{PP} Interface for the Ricoh RB5C478

BIT6	BIT5	BIT4	VPP_EN0	VPP_EN1	STATUS
0	0	0	L	L	Set V_{PP} voltage = power off
0	0	1	L	H	Set V_{PP} voltage = 12 V
0	1	0	H	L	Set V_{PP} voltage = 5 V
0	1	1	H	L	Set V_{PP} voltage = 3.3 V
1	0	0	L	L	Reserved
1	0	1	L	L	Reserved
1	1	0	L	L	Reserved
1	1	1	L	L	Reserved

Bit6 through bit0 are power control bits. These bits set the VCC3EN#, VCC5EN#, VPP_EN1, and VPP_EN0 signals to match the level that agrees with the requested voltage output. This logic table is similar to those found in documentation for other PC Card controllers. (Bit3 is reserved as don't care.)

When the VCC3EN# pin transitions to 0, 3.3 V is applied to the V_{CC} terminals of the PC Card slot. Similarly, when the VCC5EN# pin transitions to 0, 5 V is applied to the V_{CC} terminals of the PC Card slot. Setting both the VCC3EN# and VCC4EN# pins to 1 state simultaneously powers down the card socket. This causes the TPS2205 to place a ground on the card sockets V_{CC} and V_{PP} terminals which will discharge any voltage held in the card's capacitance.

When the VPP_EN0 pin asserts a 1 the V_{CC} output (3.3 V and 5 V) is applied to the V_{PP} terminals of the PC Card slot. Similarly, when the VPP_EN1 pin asserts a 1, 12 V is applied to the V_{PP} terminals of the PC Card slot. Care must be taken with this controller to assure that VPP_EN0 and VPP_EN1 do not transition to 1 simultaneously, as that is an undefined state; the TPS2205 handles this by placing the V_{PP} switches in a Hi-Z state. This effectively protects the card from having the wrong voltage applied.

Figure 5 shows a typical TPS2205 application with the Ricoh RB5C478 controller.

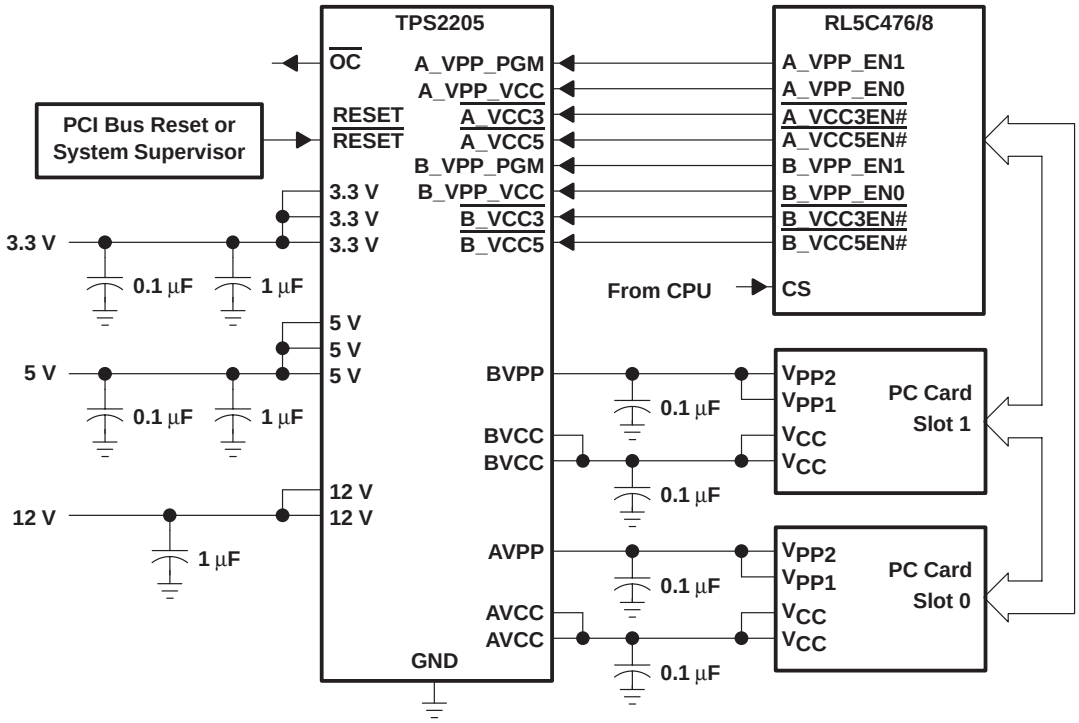


Figure 5. TPS2205 and Ricoh RB5C478 Application

The TPS2211 is a high performance single socket version of the TPS2205. With a lower $r_{DS(on)}$ but similar switching characteristics, the TPS2211 is ideal for limited-power single-socket applications. The parallel interface of the TPS2211 interfaces gluelessly to the Ricoh single slot Cardbus PCMCIA controllers, similar to the way the TPS2205 interfaces to the dual socket controllers.

Competitiveness

Although there are many PCMCIA power distribution switches available, the only truly competitive parallel interface switch in this application is the Micrel MIC2563A. Tables 3 and 4 show that the MIC2563A and TPS2205 interface signal names and functionality are very similar. (Signals shown have independent outputs for socket A and socket B.)

Table 3 shows the interface for a single socket of the TPS2205.

Table 3. TPS2205 Interface

CONTROL SIGNALS				SWITCH OUTPUT SETTING	
VCC5	**VCC3**	**VPP_PGM**	**VPP_VCC**	**V_{CC}**	**V_{PP}**
0	0	0	0	Ground	Ground
0	0	0	1	Ground	Ground
0	0	1	0	Ground	12 V
0	0	1	1	Ground	Hi-Z
0	1	0	0	5 V	Ground
0	1	0	1	5 V	5 V
0	1	1	0	5 V	12 V
0	1	1	1	5 V	Hi-Z
1	0	0	0	3.3 V	Ground
1	0	0	1	3.3 V	3.3 V
1	0	1	0	3.3 V	12 V
1	0	1	1	3.3 V	Hi-Z
1	1	0	0	Ground	Ground
1	1	0	1	Ground	Ground
1	1	1	0	Ground	12 V
1	1	1	1	Ground	Hi-Z

Table 4 shows the interface for a single socket of the MIC2563A.

Table 4. MIC2563A Interface

CONTROL SIGNALS				SWITCH OUTPUT SETTING	
VCC5_EN	VCC3_EN	VPP_PGM	VPP_VCC	V_{CC}	V_{PP}
0	0	0	0	Ground	Ground
0	0	0	1	Ground	Hi-Z
0	0	1	0	Ground	Hi-Z
0	0	1	1	Ground	Hi-Z
0	1	0	0	5 V	Ground
0	1	0	1	5 V	5 V
0	1	1	0	5 V	12 V
0	1	1	1	5 V	Hi-Z
1	0	0	0	3.3 V	Ground
1	0	0	1	3.3 V	3.3 V
1	0	1	0	3.3 V	12 V
1	0	1	1	3.3 V	Hi-Z
1	1	0	0	Ground	Ground
1	1	0	1	Ground	Hi-Z
1	1	1	0	Ground	Hi-Z
1	1	1	1	Ground	Hi-Z

The tables show some minor differences in the way the switches respond to the same input signals in the V_{PP} output column, but these typically deal with Hi-Z and/or grounding selections and do not diminish the performance of either switch in any way.

Although the controller manages the PC Card socket power, the software implementation in socket services is what actually controls the power that is applied to the PC Card socket. This means that the power control registers in card and socket services must be programmed individually for each platform, taking the following three questions into consideration. The first is what voltages does the host platform actually support; the second is what voltages can the switching matrix for the socket handle; and the third is how exactly the switch and controller switch the voltages. The table that is generated with this information is shown as a template in the current PC Card specification. Voltages and switch settings that are not defined in the specification do not, and typically are not, implemented in any platforms. This all goes to supporting the conformity of the interface from platform to platform. Table 5 compares the features of the TPS2205 and the MIC2563A.

Table 5. Feature Comparison: MIC2563A vs TPS2205

PARAMETER		TPS2205			MIC2563			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
Switch resistance	V_{CC} = 5 V			140		70	100	mΩ
	V_{CC} = 3.3 V			110		100	140	
	V_{PP} = 12 V			1		0.6	1	Ω
	V_{PP} = 5 V			6		1.8	2.5	
	V_{PP} = 3.3 V			6		3.3	5	
Supply current	Total		131	150		48	154	μA
	Shutdown						4	
V_{CC} switching times	Turn-on delay		6.6			0.75	3	ms
	Turn-off delay		25			2.4	8	
	Rise time		1.2			0.7	2.5	
	Fall time		10			0.6	2	

The table shows some of the more critical specifications for devices used in this application, and from a specification perspective the devices fare equally well. Since the devices have compatible interfaces and similar specifications in the critical areas, the differentiation for selection comes from the feature set.

Both the TPS2205 and MIC2563A can be placed in a low-current mode by switching the outputs of the switches to Hi-Z. The TPS2205 augments this function by adding an additional shutdown function (pin 14). When this pin is taken low, the device goes into a low-current operation, placing the outputs in Hi-Z. The benefit of this additional state is that the controller is not required to write to the device, and the switch settings can be held for the next power-up sequence.

The TPS2205 sources power from either the 3.3-V or 5-V switch inputs, basically providing an ORing circuit and selecting the larger of the two voltages applied. The device will function normally with either voltage connected to its assigned input pins. The MIC2563A can not be used in this fashion. It sources power from only the VCC3_IN pins, and cannot power itself from the 5-V input. In an application where the power supply optimizes itself by shutting down the power rails that are not in use, the MIC2563A would not function if the 3.3-V input were removed.

Summary

The TPS2205 and TPS2211 PC Card Power Interface Switches are the obvious best design choices based on performance, compatibility, and features.