



PD6710/PD672X — Two-Pin Detection of Card Operating Voltage

Application Note

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1.0 Introduction

The PD6710 and PD6722 are single-chip PCMCIA interface controllers capable of controlling one or two PCMCIA or compact Flash sockets, respectively. They are designed for use in embedded applications and notebook systems where reduced form factor and low power consumption are critical design objectives.

Current typical application examples include:

- Routers
- Access network servers
- PBXs
- Vending machines
- Portable handheld systems
- Data acquisition systems
- Settop boxes
- Integrated access devices
- DSLAMs
- Terminal servers
- Point of Sale terminals
- Navigation systems
- Measurement equipment

With the PD6710, a complete single-socket PCMCIA solution with power-control circuitry can occupy less than 1.5 square inches (10 square centimeters) of board space. Similarly, with the PD6722, a complete dual-socket PCMCIA solution with power-control circuitry can occupy less than 2 square inches (13 square centimeters) of board space.

The PD67XX controllers are completely compatible with the standards of PCMCIA (Personal Card Memory International Association) Release 2.0 Standard as well as JEIDA (Japan Electronic Industry Development Association) Version 4.1 Standard. The PD67XX controllers also offer special power-saving features such as Automatic Low-power Dynamic Mode and Suspend Mode. Both controllers are true mixed-voltage devices that can operate at +5 volts, +3.3 volts, or a combination of these at various interfaces. The controllers have full internal buffering and require no additional circuitry to interface to the ISA (or ISA-like) Bus or to PCMCIA sockets.

Note: In this document, PD67XX represents both the PD6710 and PD6722.

Other features of the PD67XX controllers are discussed throughout this application note.

2.0 Two-Pin Card Operating Voltage Detection

The PD6710, PD6720, and PD6722 PCMCIA host controllers were initially designed with a single pin for determining a PCMCIA card's operating voltage (V_{CC}) before power is applied to the card. Currently, the PCMCIA committee is in the process of adopting a two-pin card voltage detection mechanism. To accommodate the forthcoming PCMCIA standard, a method has been devised to implement two-pin detection using the existing pins of the PD6710/PD672X PCMCIA host controller.

The method requires a small external hardware modification for the PD672X and some software changes to the algorithm for detection of the card operating voltage. The method uses the 5V_DET pin (the general-purpose input that is used to differentiate between a card's 3.3V and 5V operating voltage) and the -VPP_VALID pin (the general-purpose input that can be used to determine if the 12-volt power supply is stable).

This application note shows how each socket's 5V_DET pin and the chip's -VPP_VALID pin can be used along with a small amount of external logic to implement the forthcoming PCMCIA standard for two-pin detection of the card operating voltage.

2.1 Introduction to Two-Pin Detection of Card Operating Voltage

Recent changes to the PCMCIA specification allow for greater ranges of card operating voltages to accommodate low-power, low-voltage technologies. To prevent damage to low-voltage cards in previously developed systems, the PCMCIA specification defines two types of card and socket keying:

- Sockets keyed to accept 5V cards only (typical PCMCIA socket keying)
- Sockets keyed to accept low-voltage cards (and 5V cards)

The socket and card keying is designed so that typical PCMCIA 5V cards will fit into a low-voltage keyed socket, but low-voltage cards will not fit into 5V-keyed sockets (to prevent damaging a low-voltage-only card in a system designed only for 5V cards).

Table 1. Card Operating Voltage Types Proposed by PCMCIA (Sheet 1 of 2)

Card Voltage Type	Characteristics	Fits in Standard 5V Socket	Fits in Special Low-Voltage Socket	Voltage Sense VS1	Voltage Sense VS2
5V-only	Typical PCMCIA card. Operates at 5V only. Uses traditional 5V card keying.	Yes	Yes	Open	Open
3.3/5V	Can be switched at will between 3.3V and 5V operating voltage without damage. Uses traditional 5V card keying.	Yes	Yes	Tied to ground	Open
3.3V-only	Operates at 3.3V only. Might be damaged if operated at 5V. Available in either traditional 5V card keying or low-voltage keying.	Only if card has 5V keying	Yes	Tied to ground	Open
NOTE:					
1. X.XV indicates an arbitrary low card voltage that can be determined by further card interrogation by Card Services of each card's Card Information Structure (CIS) registers.					

Table 1. Card Operating Voltage Types Proposed by PCMCIA (Sheet 2 of 2)

Card Voltage Type	Characteristics	Fits in Standard 5V Socket	Fits in Special Low-Voltage Socket	Voltage Sense VS1	Voltage Sense VS2
X.XV-only ¹	Operates at X.XV arbitrary low voltage. Might be damaged if operated at 3.3V or 5V. Only available in low-voltage card keying.	No	Yes	Open	Tied to ground
X.X/3.3V ¹	Can be switched at will between X.XV and 3.3V operating voltage without damage. Might be damaged if operated at 5V. Available in low-voltage card keying, and possibly 5V keying.	Only if card has 5V keying	Yes	Tied to ground	Tied to ground
X.X/3.3/5V ¹	Can be switched at will between X.XV, 3.3V, and 5V operating voltage without damage. Available in either low-voltage card keying or 5V keying.	Yes	Yes	Tied to ground	Tied to ground
NOTE: 1. X.XV indicates an arbitrary low card voltage that can be determined by further card interrogation by Card Services of each card's Card Information Structure (CIS) registers.					

If the system design requires the ability to detect card types that support X.XV operation, then two-pin detection of the card operating voltage is required. A discussion of how to implement two-pin detection with the PD6710 is presented in [Section 2.2, “Two-Pin Detection for the PD6710” on page 8](#), and [Section 2.3, “Two-Pin Detection for the PD672X” on page 9](#) discusses three possible methods usable with the PD672X.

Note: If only 3.3V, 5V, or 3.3/5V cards are used in the system, then the PD67XX 5V_DET pin, by itself, can distinguish between the possible operating voltages — the designer connects VS1 (pin 43) of each PCMCIA socket to the corresponding 5V_DET pin of the PD6710/PD672X.

The following assumptions were made, and are necessary, to use two-pin detection with a PD6710/PD672X:

1. If low-voltage sockets are used in a system when an X.XV-only card is inserted into a socket, software informs the user that this card type is not supported and requests that the card be removed.

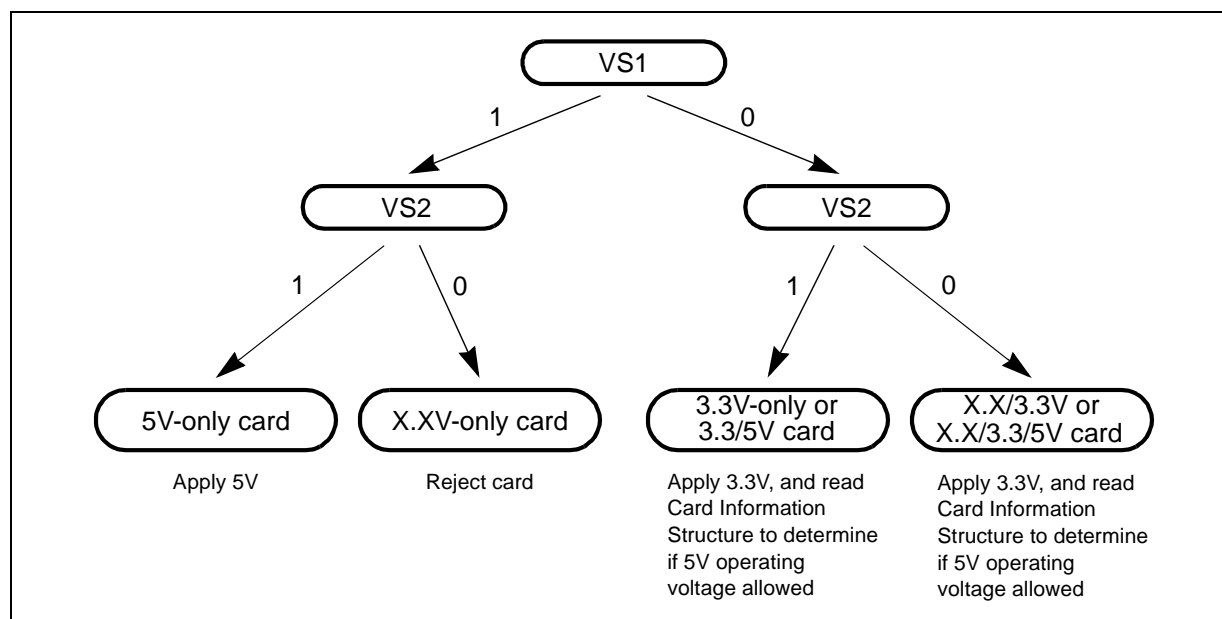
Note: Note again that if 5V-keyed sockets are used, connection of the PD67XX 5V_DET pin(s) to VS1 pin 43 of the PCMCIA socket(s) is all that is needed to detect 3.3V or 5V card operating voltages.

2. The sockets are configured one at a time, and in the order that the PCMCIA cards are inserted.
3. Both sockets in the system are low-voltage-keyed sockets.
4. Power Control register bit 4 is cleared by software to ‘0’ whenever a card is not present in a socket, and it is not set to ‘1’ until after software has determined the card’s initial operating voltage from VS2 and VS1 levels.
5. VS1 and VS2 (pins 43 and 57) of the PCMCIA socket(s) are pulled up to 5 volts.
6. The PD6710/PD672X uses the following truth table:

Table 2. PD6710/PD672X Two-Pin Power Control

VS1 (PCMCIA pin 43)	VS2 (PCMCIA pin 57)	Resulting Action
Low	Low	Apply 3.3V, read CIS to determine if 5V is allowed
Low	High	Apply 3.3V, read CIS to determine if 5V is allowed
High	Low	Reject card
High	High	Apply 5V only

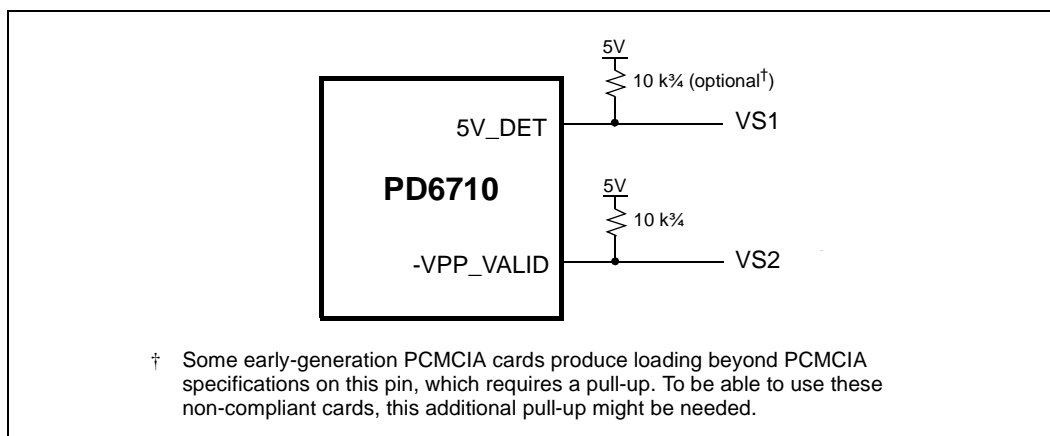
Figure 1. Tree Structure for Voltage Selection with the PD6710/PD672X



2.2 Two-Pin Detection for the PD6710

For the PD6710, the board and software modifications are simple. Connect 5V_DET to VS1 (pin 43 of the PCMCIA socket) and -VPP_VALID to VS2 (pin 57 of the PCMCIA socket).

Figure 2. Hardware Connections for the PD6710



The system PCMCIA software needs to be reconfigured for how the -VPP_VALID pin is to be used. The three possibilities are programming voltage supply monitoring, VS2 input for two-pin voltage detection, or general-purpose system input.

If -VPP_VALID is used as VS2 for the two-pin detection, then software modification requires Card Services to read the appropriate register bits, Misc Control 1 register (index 16h) bit 0 and Interface Status register (index 1h) bit 7, when a card status-change interrupt is generated. From the status of the VS1 and VS2 signals from the card, the appropriate voltage can then be applied to the socket by programming Misc Control 1 register bit 1, or software should notify the user that the X.XV-only card type is not supported.

Table 3. Software Actions for the PD6710 Two-Pin Power Control

Interface Status Register Bit 7: V _{PP} Valid (Inverted VS2 Level)	Misc Control 1 Register Bit 0: 5V Detect (VS1 Level)	Interpretation	Action
0	0	3.3V-only or 3.3/5V card	Set Misc Control 1 register bit 1 to '1' for 3.3V or, if allowed, '0' for 5V.
0	1	5V-only card	Set Misc Control 1 register bit 1 to '0' for 5V
1	0	X.X/3.3V or X.X/3.3/5V card	Set Misc Control 1 register bit 1 to '1' for 3.3V or, if allowed, '0' for 5V.
1	1	X.XV-only card	Reject card: Power Control register bit 4 must be set to '0'.

2.3 Two-Pin Detection for the PD672X

For the PD672X, the hardware modifications are simple but the software requirements are more complex. The reason is that, when used for VS2 sensing, there is only one -VPP_VALID pin per chip that must be shared between two sockets. There are three possible power-up configurations that the system must accommodate.

1. The system is powered up without any cards, and after power up a card is inserted in one of the sockets.

2. The system is powered up with a card in one socket, and after power up a second card is installed in the other socket.
3. The system is powered up with cards in both sockets.

The following subsections present three ways that the hardware can be modified to provide a PD672X with the capability of two-pin voltage detection.

The system PCMCIA software needs to be reconfigured for how the -VPP_VALID pin is to be used. The three possibilities are programming voltage supply monitoring, VS2 input for two-pin voltage detection, or general-purpose system input.

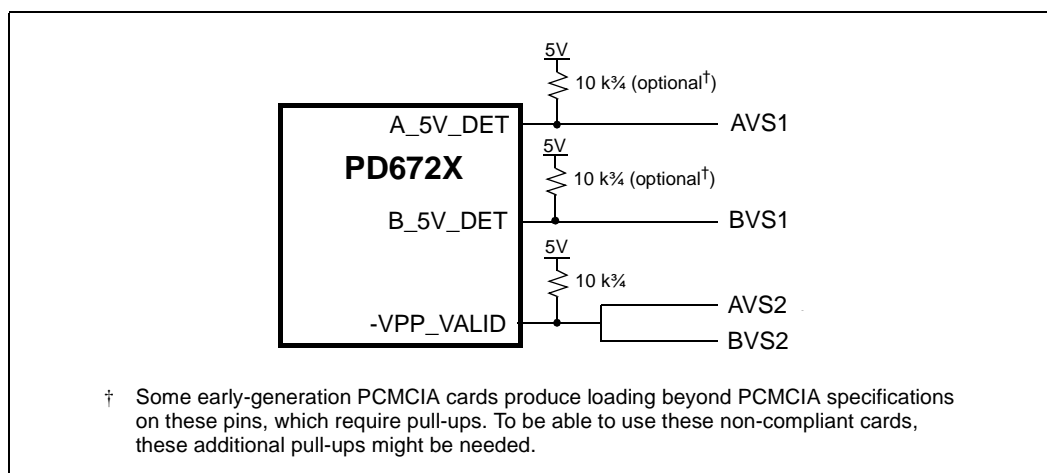
If -VPP_VALID is used as VS2 for the two-pin detection, then software modification requires Card Services to look at the appropriate register bits, Misc Control 1 register (index 16h/56h) bit 0 and Interface Status register (index 1h) bit 7, when a card status-change interrupt is generated. From the status of the VS1 and VS2 signals from the card, the appropriate voltage can then be applied to the socket by programming Misc Control 1 register bit 1, or software should notify the user that the X.XV-only card type is not supported.

2.3.1 PD672X Method 1

Method 1 Hardware

- No external components (shared VS2 pins)
- Connections:
 - Connect A_5V_DET to AVS1 (pin 43 of PCMCIA socket 0).
 - Connect B_5V_DET to BVS1 (pin 43 of PCMCIA socket 1).
 - Connect -VPP_VALID to AVS2 and BVS2 (pin 57 of both PCMCIA sockets).

Figure 3. Method 1 Hardware Connections for the PD672X



Handling of Power-Up Situations

1. **The system is powered up without any cards, and after power up a card is inserted into one of the sockets:** In this situation, since there is only one card being inserted into the socket,

the VS1 and VS2 signals can be read and the voltage configured accordingly, or the card is rejected.

2. **The system is powered up with a card in one socket, and after power up a second card is installed in the other socket:** There are two situations when the second card inserted cannot be configured:

When a card is initially in socket 0:

Cases 4 and 12 (Table 4) — the card inserted into socket 1 will be rejected.

When a card is initially in socket 1:

Cases 13 and 15 (Table 4) — the card inserted into socket 0 will be rejected.

3. **The system is powered up with cards in both sockets:** There are two situations when both cards cannot be configured:

Cases 4 and 12 (Table 4) — socket 1 card is rejected. The operator is given instructions on how to sequence card seating to determine card voltages and which cards are supportable.

Cases 13 and 15 (Table 4) — socket 0 card is rejected. The operator is given instructions on how to sequence card seating to determine card voltages and which cards are supportable.

Method 1 Software

Table 4. Method 1 Truth Table

Case	Actual values at socket				Actual values read by software using Method 1 with a shared VS2 signal from the PCMCIA sockets		
	Card in Socket 0		Card in Socket 1		PD672X		
	VS1	VS2	VS1	VS2	A_5V_DET	B_5V_DET	-VPP_VALID ¹
1	Low	Low	Low	Low	0	0	0
2	Low	Low	Low	High	0	0	0
3	Low	Low	High	Low	0	1	0
4	Low	Low	High	High	0	1	0
5	Low	High	Low	Low	0	0	0
6	Low	High	Low	High	0	0	1
7	Low	High	High	Low	0	1	0
8	Low	High	High	High	0	1	1
9	High	Low	Low	Low	1	0	0
10	High	Low	Low	High	1	0	0
11	High	Low	High	Low	1	1	0
12	High	Low	High	High	1	1	0
13	High	High	Low	Low	1	0	0
14	High	High	Low	High	1	0	1
15	High	High	High	Low	1	1	0
16	High	High	High	High	1	1	1

NOTE:
1. -VPP_VALID value is that sensed at the pin.

False Reading	If actual values read are affected by the other card type, card can still be powered up at its alternate operating voltage without damage.
Problem Case	If actual values read are affected by the other card type, card could be damage if powered up. Issue message to reinsert cards.
Reject	Card type not is supported (X.XV-only type). Do not apply card power.

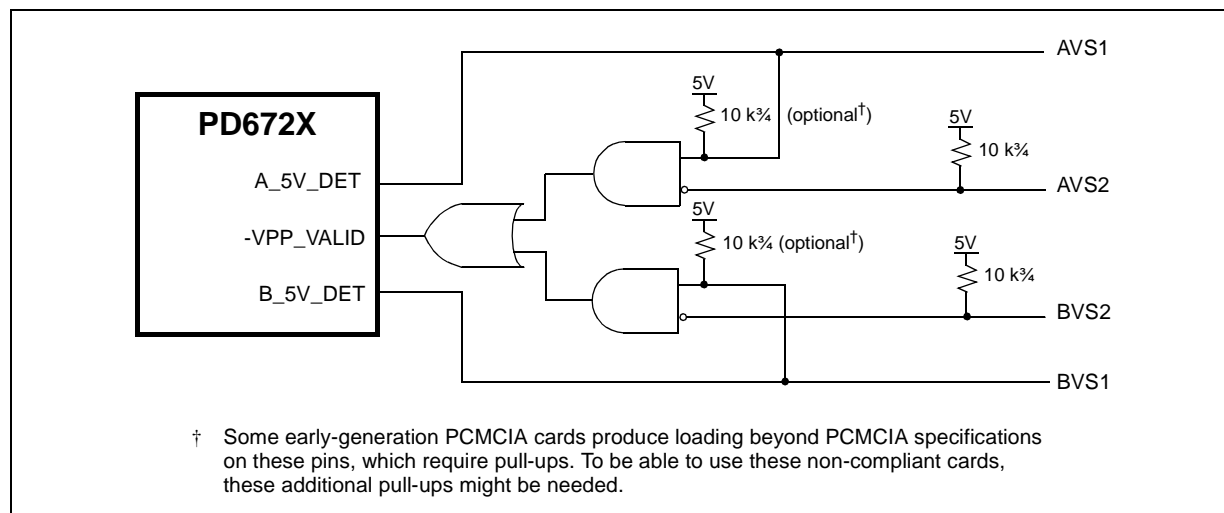
2.3.2 PD672X Method 2

Method 2 Hardware

- External components:
 - 1 external PAL or discrete logic gates

This decoding logic allows the software to determine if an X.XV-only card is in the socket.

Figure 4. Method 2 Hardware Connections for the PD672X



- Connections:
 - Connect A_5V_DET to AVS1 (pin 43 of socket 0) and corresponding PAL or discrete gates input.
 - Connect B_5V_DET to BVS1 (pin 43 of socket 1) and corresponding PAL or discrete gates input.
 - Connect AVS2 and BVS2 (pin 57 of both sockets) to the PAL inputs pins as shown.
 - Connect -VPP_VALID to the PAL output pin.

Handling of Power-Up Situations

- The system is powered up without any cards, and after power up a card is inserted into one of the sockets:** In this situation, since there is only one card being inserted into the socket,

the VS1 and VS2 signals can be read and the voltage configured accordingly, or the card is rejected.

2. **The system is powered up with a card in one socket, and after power up a second card is installed in the other socket:** There are two situations when the second card inserted cannot be configured. The first is when a card is initially in socket 0 — in case 12 (Table 4) the card inserted into socket 1 will be rejected. The second situation is when a card is initially in socket 1 — in case 15 (Table 4) the card inserted into socket 0 will be rejected.

3. **The system is powered up with cards in both sockets:** There are two situations when both cards cannot be configured:

Case 12 (Table 4) — socket 1 card is rejected. The operator is given instructions on how to sequence card seating to determine card voltages and which cards are supportable.

Case 15 (Table 4) — socket 0 card is rejected. The operator is given instructions on how to sequence card seating to determine card voltages and which cards are supportable.

Method 2 Software

Table 5. Method 2 Truth Table

Case	Actual values at socket				Actual values read by software using Method 2 with external decode circuit to determine if an X.XV-only card is in the socket		
	Card in Socket 0		Card in Socket 1		PD672X		
	VS1	VS2	VS1	VS2	A_5V_DET	B_5V_DET	-VPP_VALID ¹
1	Low	Low	Low	Low	0	0	0
2	Low	Low	Low	High	0	0	0
3	Low	Low	High	Low	0	1	1
4	Low	Low	High	High	0	1	0
5	Low	High	Low	Low	0	0	0
6	Low	High	Low	High	0	0	0
7	Low	High	High	Low	0	1	1
8	Low	High	High	High	0	1	0
9	High	Low	Low	Low	1	0	1
10	High	Low	Low	High	1	0	1
11	High	Low	High	Low	1	1	1
12	High	Low	High	High	1	1	1
13	High	High	Low	Low	1	0	0
14	High	High	Low	High	1	0	0
15	High	High	High	Low	1	1	1
16	High	High	High	High	1	1	0

NOTE:
1. -VPP_VALID value is that sensed at the pin.

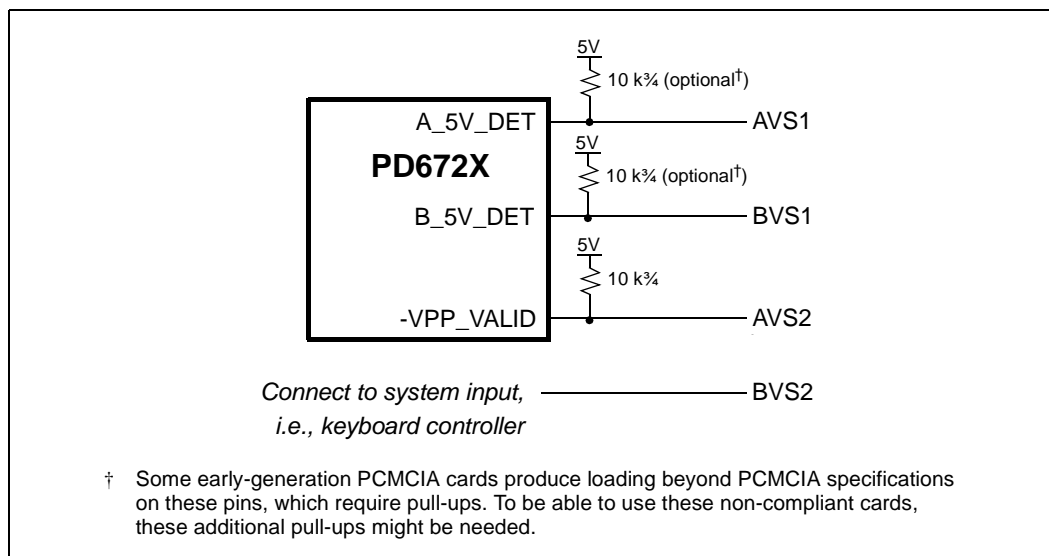
Problem Case	If actual values read are affected by the other card type, card could be damage if powered up. Issue message to reinsert cards.
Reject	Card type not is supported (X.XV-only type). Do not apply card power.

2.3.3 PD672X Method 3

Method 3 Hardware

- No added external components
 - Connections:
 - Connect A_5V_DET to AVS1 (pin 43 of PCMCIA socket 0).
 - Connect B_5V_DET to BVS1 (pin 43 of PCMCIA socket 1).
 - Connect -VPP_VALID to AVS2 (pin 57 of PCMCIA socket 0).
 - Connect a system input such as keyboard controller to BVS2 (pin 57 of PCMCIA socket 1).

Figure 5. Method 3 Hardware Connections for the PD672X



Method 3 Software

Software needs to be reconfigured for how the BVS2 pin is connected to the system.

For two-pin voltage detection of socket 0, the software will read the appropriate register bits, Misc Control 1 register (index 16h) bit 0 and Interface Status register (index 1h) bit 7, when a card status-change interrupt is generated. From the status of the VS1 and VS2 signals from the card, the appropriate voltage can then be applied to the socket by programming Misc Control 1 register bit 1, or software should notify the user that the X.XV-only card type is not supported.



For two-pin voltage detection of socket 1, the software will read the appropriate register bit, Misc Control 1 register (index 56h) bit 0, and a system input that stores the state of VS2 when a card status-change interrupt is generated. From the status of the VS1 and VS2 signals from the card, the appropriate voltage can then be applied to the socket by programming Misc Control 1 register bit 1, or software should notify the user that the X.XV-only card type is not supported.

Alternatively, if there are two free system inputs, both the AVS2 and BVS2 pins could be connected to these inputs and -VPP_VALID used as its normal function.

