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'Power Management Selection Guide'



updated 2Q '01

(see page 15 for details)

Sine On™

AN ANALOG AND MIXED-SIGNAL PRODUCT CATALOG

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Power Distribution

3Q 2001 Issue 3

Selection Guides

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Power MUX/General Use

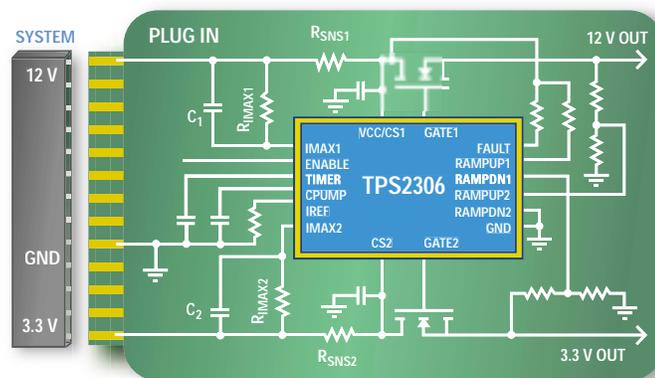
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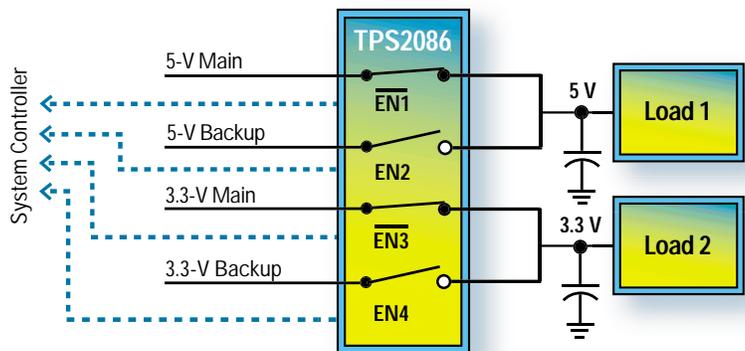
14 Parametric tables



Page **3**

Dual Hot Swap controller with industry's most versatile sequencing ability

[Industry's most complete USB and PCMCIA power switch portfolio. Pages **7** to **13**.]

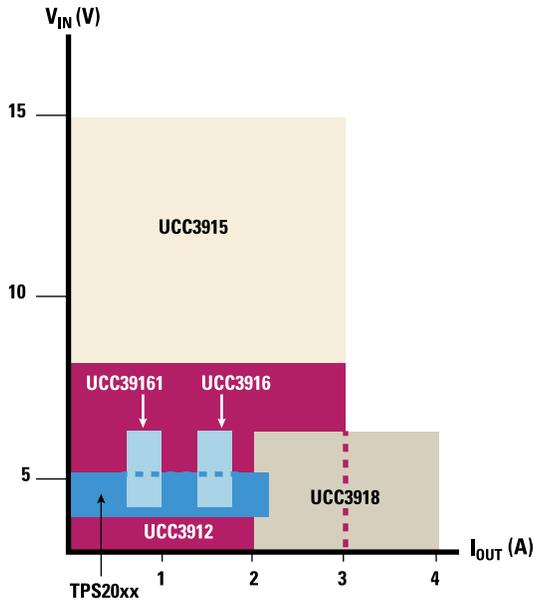


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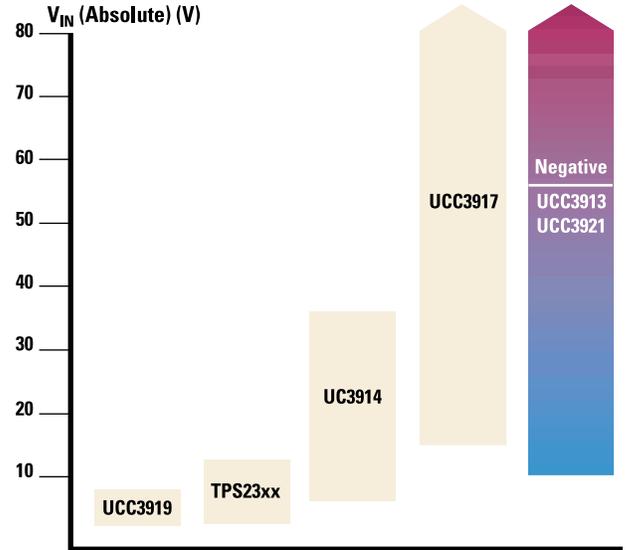
Industry's first true quad 80-mΩ switch IC used as a power MUX

Power Distribution Devices Selection Guides

Hot Swap power switch ICs (integrated power FET)



Hot Swap power controller ICs (external power FET)



USB and Current-Limiting Power Switch ICs

USB and Fault Reporting	Quad USB		TPS2048A/58A	TPS2048/58*		TPS2044/54**			
	Quad Triple USB		TPS2095/6/7	TPS2047A/57A	TPS2047/57*	TPS2044A/54A			
	Dual USB		TPS2046A/56A	TPS2046/56*		TPS2085/6/7			
	Dual Single USB	TPS2020/30*	TPS2090/1/2	TPS2045A/55A	TPS2045/55*	TPS2021/31*	TPS2043/53**		
							TPS2043A/53A		
No Fault Reporting	Single	TPS2010A			TPS2011A	TPS2042/52**			
						TPS2042A/52A	TPS2022/32	TPS2023/33	TPS2024/34
						TPS2080/1/2			
	I_{OS} (A) (min)	0.22	0.3	0.345	0.66	0.7	1.1	1.65	2.2

* Nemko recognized ** UL & Nemko recognized

PCMCIA/CardBus Power Switch Matrix ICs

3.3 V, 5 V, 12 V, V_{PP}	Dual			TPS2226/24	
				TPS2223	
				TPS2214(A)	
				TPS2216(A)	
				TPS2206	
				TPS2205	
	Single	TPS2212		TPS2211(A)	
No V_{PP}	Dual		TPS2044A/54A		
No V_{PP} w/USB	Single		TPS2043A/53A		
V_{PP} , No 12 V	Single		TPS2044A/54A		
	I_{OS} (A) (min)	0.3	0.7	1	

Power MUX ICs

Configuration	Active-low Devices	Active-high Devices	Combo Active-L/H Devices
	TPS2100	TPS2101	
	TPS2102	TPS2103	
	TPS2104	TPS2105	
	TPS2082	TPS2080	TPS2081
	TPS2092	TPS2090	TPS2091
	TPS2087	TPS2085	TPS2086
	TPS2097	TPS2095	TPS2096

Note: Values are typical, unless indicated otherwise.

4-Port USB Hub Power

Controllers		
Device	5-V LDO Controller	Bus Power Mode Indicator
TPS2070	Yes	Active low
TPS2071	Yes	Active high
TPS2074	No	Active low
TPS2075	No	Active high

Hot Swap

OVERVIEW:
Hot Swap Power Managers

Hot Swap power manager ICs allow the insertion and removal of PC boards from active systems, preserving back-plane bus voltage and system data integrity while preventing damage to the hot-swapped board, through features including inrush current control and high-speed short circuit protection. Texas Instruments (TI) offers two types: Hot Swap controllers and Hot Swap switches, for applications including InfiniBand™, 48-V telecom, Universal Serial Bus (USB) and power supply sequencing.

Hot Swap controllers (pages 3 to 6) are for applications with inrush current >4 A. Controllers drive one or more external N-channel MOSFETs.

Hot Swap switches (page 6) are for applications with inrush current <4 A. Switches have an integrated power MOSFET. Note that switches for USB, a Hot Swap or “hot-plug” application, are covered in the USB section of this publication.

Dual Hot Swap controller with versatile sequencing control

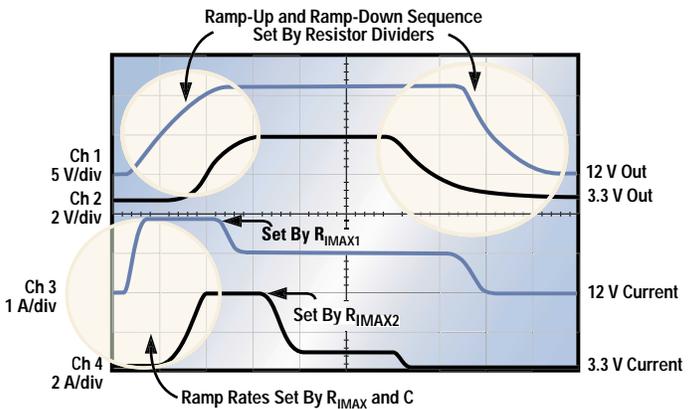
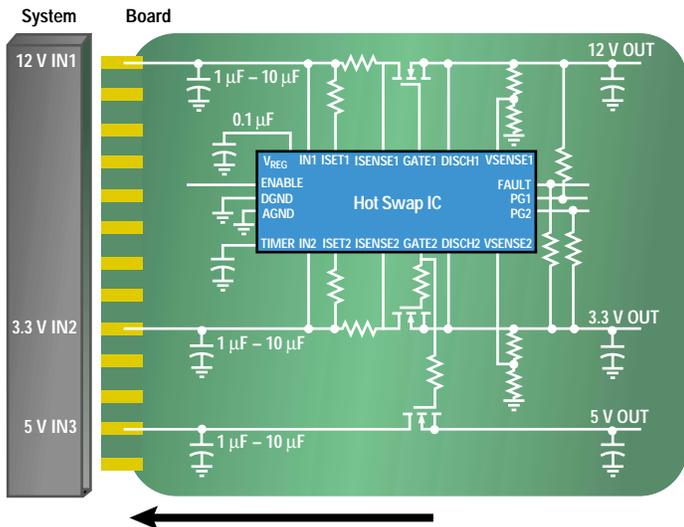
TPS2306

Get samples, datasheets and EVMs at: www.ti.com/sc/device/TPS2306



- Allows Hot Swapping and any sequencing combination desired for dual supplies (sequencing set by resistor dividers)
- Programmable output current ramp rate (di/dt) for inrush current control
- Industry’s lowest insertion loss
- Programmable current limit and circuit-breaker-trip threshold
- Programmable start delay and fault timer for flexible immunity to false fault triggers
- Operating range: 2.75 V to 13.6 V
- Cascadeable for three or more supplies
- Charge pump drives low-cost external NMOS devices
- Packaging: 16-pin SOIC
- Suggested resale price starts at \$3.50 each in quantities of 1,000

TPS2306 in a 3.3-V and 12-V system



➤ Applications include:

- Network switches, routers and hubs
- Fiber-optic applications
- Basestations
- Central office equipment
- DSP applications

Hot Swap

Dual/single Hot Swap controllers with output voltage ramp-rate control

TPS23xx

Get samples, datasheets and EVMs at: www.ti.com/sc/device/partnumber

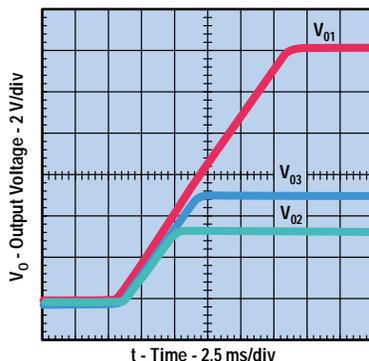
Replace *partnumber* in URL with TPS2300, TPS2301, TPS2310, TPS2311, TPS2320 or TPS2321



- Allows Hot Swapping of dual or single supplies
- Programmable output voltage ramp rate (dv/dt) for inrush current control
- Adjustable circuit-breaker-trip threshold
- Programmable overcurrent transient filter for flexible immunity to false fault triggers
- Power Good reporting options
- Operating range: 3 V to 13 V
- Can support three or more supplies
- Charge pump drives low-cost external NMOS devices
- Packaging: 14-, 16- and 20-pin TSSOP
- Suggested resale price starts at \$2.00 each in quantities of 1,000

Device		Channels	Circuit Breaker Control	Power Good
Enable Low	Enable High			
TPS2300I	TPS2301I	2	Independent	X
TPS2310I	TPS2311I	2	Interdependent	X
TPS2320I	TPS2321I	2	Independent	
TPS2330I	TPS2331I	1	X	X

TPS2301 configured to ramp 3 supply voltage rails



➤ Applications include:

- InfiniBand™
- PCI Hot-Plug
- Data communications
- Manufacturing diagnostic and test systems

Single, positive-voltage Hot Swap controllers with current ramping

UC3914, UCC3917,* UCC3919

Get samples, datasheets and EVMs at: www.ti.com/sc/device/partnumber

Replace *partnumber* in URL with UC3914, UCC3917 or UCC3919

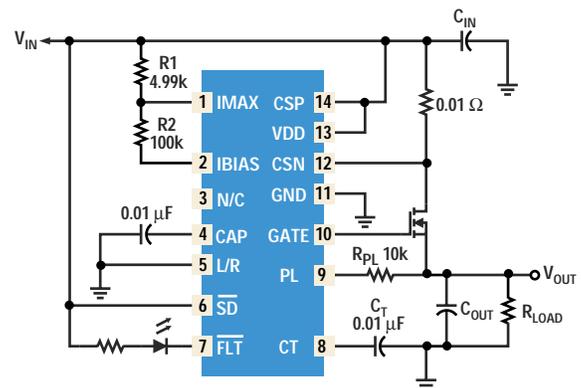


*EVMS available separately.

- Allows Hot Swapping of positive supplies
- Programmable output current ramp rate (di/dt) for inrush current control
- Adjustable current limit and circuit-breaker-trip threshold
- Automatic retry or latch-off-on-fault modes
- Programmable average power limiting
- Programmable start delay and fault timer for flexible immunity to false fault triggers
- Charge pump drives low-cost external NMOS devices
- Fault output indicator
- Packaging: DIP, SOIC and TSSOP
- Suggested resale price starts at \$1.66 each in quantities of 1,000

Device	V _{IN} (V) (min)	V _{IN} (V) (max)	Floating Supply
UC3914	5 V	35 V	
UCC3917	15	9999	X
UCC3919	3	8	

UCC3919 typical application



➤ Applications include:

- 48-V telecom equipment
- Workstations
- Industrial equipment

Hot Swap

Single, negative-voltage Hot Swap controllers with current ramping

UCC3913, UCC3921

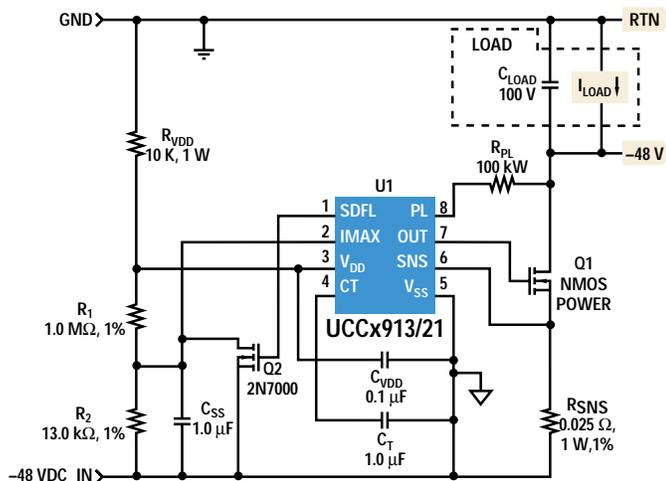
Get samples, datasheets and EVMs at:
www.ti.com/sc/device/UCC3913
www.ti.com/sc/device/UCC3921



- ▶ Allows Hot Swapping of negative supplies
- ▶ Programmable output current ramp rate (di/dt) for inrush current control
- ▶ Adjustable current limit and circuit-breaker-trip threshold
- ▶ Automatic retry or latchable (UCC3921)
- ▶ Programmable average power limiting
- ▶ Programmable start delay and fault timer for flexible immunity to false-fault triggers
- ▶ Charge pump drives low-cost external NMOS devices
- ▶ Fault output indicator
- ▶ Packaging: 8-pin SOIC
- ▶ Suggested resale price starts at \$3.20 each in quantities of 1,000

Device	V _{IN} (V) (min)	V _{IN} (V) (max)
UCC3913	externally limited	-10.5
UCC3921	externally limited	-10.5

UCC3913/21 typical telecom application



- ▶ Applications include:
- - 48-V telecom equipment
 - Network equipment
 - ATM switching equipment

SCSI termpower manager with accurate trip current

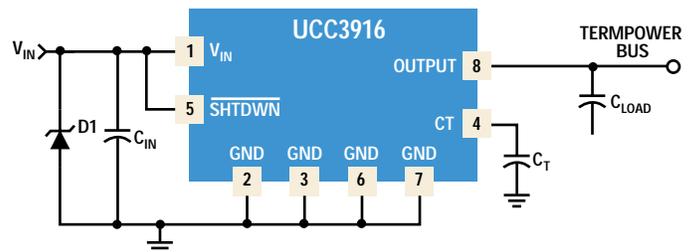
UCC3916

Get samples and datasheets at:
www.ti.com/sc/device/UCC3916



- ▶ SCSI, SCSI-2 and SCSI-3 compliant
- ▶ Accurate 1.65-A trip current and 2.1-A current (max)
- ▶ Integrated power MOSFET; only external component required for operation is timing capacitor
- ▶ Current-limiting and circuit-breaker functions
- ▶ Low sleep-mode current (<5 µA)
- ▶ Automatic retry
- ▶ Average power limiting
- ▶ Thermal shutdown control
- ▶ Programmable start delay and fault timer for flexible immunity to false fault triggers
- ▶ Packaging: 8-pin SOIC and DIP
- ▶ Suggested resale price starts at \$2.26 each in quantities of 1,000

UCC3916 typical application



- ▶ Applications include:
- Servers
 - Workstations
 - RAID
 - SCSI host adapter boards

Hot Swap

Current-limited Hot Swap switch ICs

UCC391X, UCC391X1

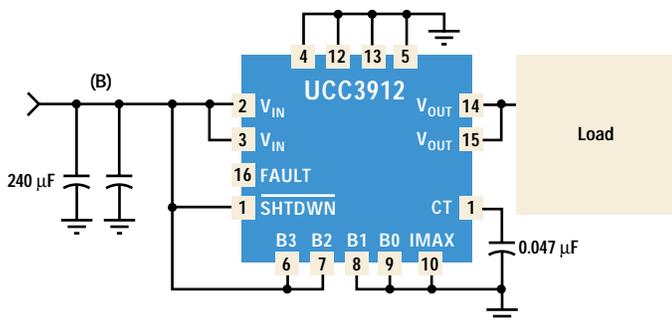
Get samples and datasheets at:
www.ti.com/sc/device/partnumber
 Replace *partnumber* in URL with UCC3912, UCC3915, UCC3918 or UCC39161



- Integrated power MOSFET; only external component required for operation is timing capacitor
- Full-featured to support rigorous requirements of high availability equipment
- Current-limiting and circuit-breaker functions
- Low sleep-mode current
- Automatic retry
- Average power limiting
- Thermal shutdown control
- Programmable start delay and fault timer for flexible immunity to false-fault triggers
- Fault-output indicator
- Packaging: SOIC, TSSOP and PDIP
- Suggested resale price starts at \$3.37 each in quantities of 1,000

Device	V _{IN} (V) (min)	V _{IN} (V) (max)	I Limit (A)
UCC3912	3	8	0 to 3
UCC3915	7	15	0 to 3
UCC39161	4	6	0.6
UCC3918	3	6	0 to 3

UCC3912 typical application



- Applications include:
- Servers
 - Network switches, routers and hubs
 - Basestations
 - Central office equipment

Single Hot Swap switch ICs featuring voltage ramping

TPS201xA, TPS202x, TPS203x

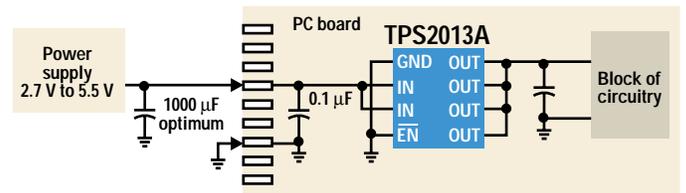
Get samples and datasheets at:
www.ti.com/sc/device/partnumber
 Replace *partnumber* in URL with TPS2010A, TPS2020, or TPS2030



- TPS202x/3x feature fault reporting
- Integrated power MOSFET
- Short-circuit and thermal protection with an over-current logic output
- Operating range: 2.7 V to 5.5 V
- Logic-level enable output
- Controlled switch rise time (6.1 ms) reduces inrush current, making devices suitable for use in hot-swap applications
- Undervoltage lockout
- No drain-to-source back-gate diode, eliminating potential current flow back across device to inputs
- Human-body-model (2 kV) and machine-model (200-V) ESD protection
- Packaging: 8-pin SOIC
- Suggested resale price starts at \$0.96 each in quantities of 1,000

Active Low Enable	Active High Enable	Continuous Current (A)	Current Limit (A) (min)
TPS2010A/20	TPS2030	0.2	0.22
TPS2011A/21	TPS2031	0.6	0.66
TPS2012A/22	TPS2032	1.0	1.1
TPS2013A/23	TPS2033	1.5	1.65
TPS2024	TPS2034	2.0	2.2

TPS2013A used to control inrush current in Hot-Swap application



- Applications include:
- Network equipment
 - ATM switching equipment
 - Industrial equipment

USB

OVERVIEW:
Universal Serial Bus

Power Switch ICs and Complete Hub Power Managers

USB 2.0 offers up to 480-Mbps transmission capability, with both asynchronous and isochronous (real-time) data transmission over a simple and inexpensive four-wire cable. This capability meets the requirements of many peripherals, including keyboards, mice, printers, speakers, scanners and digital-still cameras.

TI offers complete solutions for USB to help simplify design and speed time-to-market. TI's USB power management portfolio includes hub power managers (page 7) and power switch ICs (pages 8 and 9). Additionally, TI provides other USB products such as transient suppressors and low dropout regulators (LDO). For example, the new TPS788xx family of low-noise LDOs, which control inrush current from the USB connection and regulate the output voltage from 2.5 V to 3.3 V, or the TPS2145, which combines an LDO and two power MOSFETs providing inrush current control, output port power limiting and power segmentation.

For further information on these and other TI devices supporting USB, including hub and peripheral controllers, visit: power.ti.com/usbti



USB/General Use

Complete power managers for USB hubs

TPS207x

Get samples, datasheets and EVMs at: www.ti.com/sc/device/partnumber

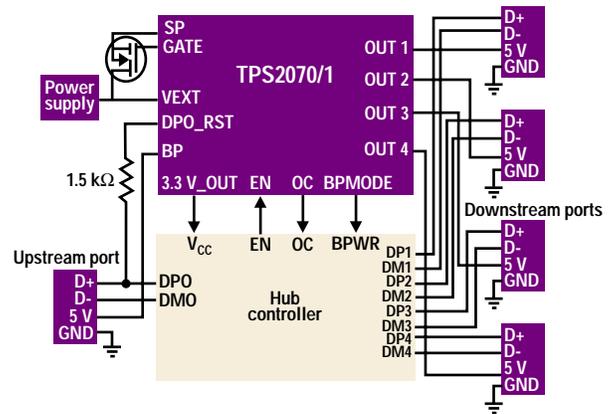
Replace *partnumber* in URL with TPS2070, TPS2071, TPS2074 or TPS2075



- USB 1.1 and 2.0 compliant
- Low $r_{DS(on)}$ protection switches for four ports
- Dual current limits: 120-mA in BP mode; 600-mA in SP mode
- Independent current limiting for each port
- 3.3-V, 100-mA LDO for device controller and functions
- 5-V, 3-A LDO controller for 6-V to 9-V self-power supply
- Operating range: 4.5 V to 5.5 V
- Auto-switching between bus/self-power
- Power Good with adjustable time delay for flexible interface to hub controller
- Available 4-port hub reference design (TPS2071EVM-159) using TUSB2046B device controller with TPS2071
- Packaging: 24- and 32-pin HTSSOP
- Suggested resale price starts at \$2.99 each in quantities of 1,000

Device	5-V LDO Controller	Bus-Power Mode Indicator	Pins	Package
TPS2070	Yes	Active low	32	HTSSOP
TPS2071	Yes	Active high	32	HTSSOP
TPS2074	No	Active low	24	SSOP
TPS2075	No	Active high	24	SSOP

Simplified block diagram for a complete 4-port hub



- Applications include:
- Stand-alone hubs
 - Desktop PCs

USB/General Use

Current-limited, 80-mΩ switch ICs with fault reporting

TPS204xA, TPS205xA

Get samples and datasheets at:

www.ti.com/sc/device/partnumber

Replace *partnumber* in URL with [TPS2041A](#) or [TPS2051A](#)



- Drop-in replacements for TPS204x/5x
- Integrated over-current transient filter (external on TPS204x/5x)
- Independent enable (logic-level) and thermal protection per channel
- Short-circuit protection with over-current logic output
- Operating range: 2.7 V to 5.5 V
- Controlled switch rise time (3 ms) reduces current surges and electromagnetic interference (EMI) concerns
- Undervoltage lockout
- No drain-to-source back-gate diode, eliminating potential current flow back across device to inputs
- USB 1.1 and 2.0 compliant
- Human-body-model (2 kV) and machine-model (200 V) ESD protection
- Packaging: SOIC
- Suggested resale price starts at \$0.67 each in quantities of 1,000

Configuration	Description	Device
	500-mA switch, -EN	TPS2041A
	500-mA switch, +EN	TPS2051A
	250-mA switch, -EN	TPS2045A
	250-mA switch, +EN	TPS2055A
	500-mA switches, -EN	TPS2042A
	500-mA switches, +EN	TPS2052A
	250-mA switches, -EN	TPS2046A
	250-mA switches, +EN	TPS2056A
	500-mA switches, -EN	TPS2043A
	500-mA switches, +EN	TPS2053A
	250-mA switches, -EN	TPS2047A
	250-mA switches, +EN	TPS2057A
	500-mA switches, -EN	TPS2044A
	500-mA switches, +EN	TPS2054A
	250-mA switches, -EN	TPS2048A
	250-mA switches, +EN	TPS2058A

➤ Applications include:

- USB hubs, set-top boxes and desktop PCs
- Internet, audio players and digital-still cameras

Single, current-limited, 33-mΩ switch ICs with fault reporting

TPS202x, TPS203x

Get samples and datasheets at:

www.ti.com/sc/device/partnumber

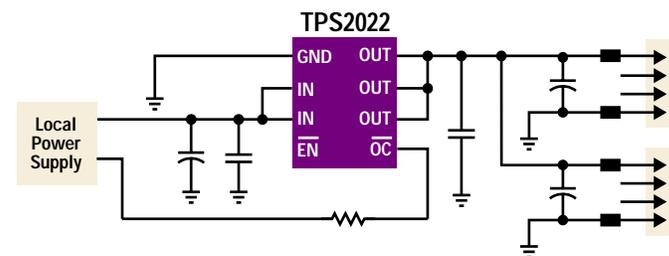
Replace *partnumber* in URL with [TPS2020](#), [TPS2021](#), [TPS2022](#), [TPS2023](#), [TPS2024](#), [TPS2030](#), [TPS2031](#), [TPS2032](#), [TPS2033](#) or [TPS2034](#)



- Good for ganging (switching multiple ports) due to low 33-mΩ $r_{DS(on)}$
- Short-circuit and thermal protection with an over-current logic output
- Operating range: 2.7 V to 5.5 V
- Logic-level enable input
- Controlled switch rise time (6.1 ms) reduces inrush current, making devices suitable for use in Hot-Swap applications
- Under-voltage lockout
- No drain-to-source back-gate diode, eliminating potential current flow back across device to inputs
- USB 1.1 and 2.0 compliant
- Human-body-model (2 kV) and machine-model (200 V) ESD protection
- Packaging: 8-pin SOIC
- Suggested resale price starts at \$1.11 each in quantities of 1,000

Active Low Enable	Active High Enable	Continuous Current (A)	Current Limit (A) (min)
TPS2020	TPS2030	0.2	0.22
TPS2021	TPS2031	0.6	0.66
TPS2022	TPS2032	1.0	1.1
TPS2023	TPS2033	1.5	1.65
TPS2024	TPS2034	2.0	2.2

TPS2022 in a ganged-port protection topology



➤ Applications include:

- USB hubs
- Hot Swap

General Use

Single, current-limited, 33-mΩ switch IC (no fault reporting)

TPS201xA

Get samples and datasheets at: www.ti.com/sc/device/partnumber

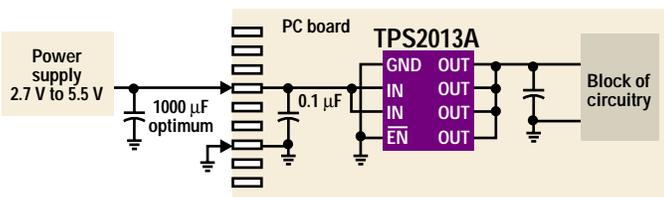
Replace *partnumber* in URL with TPS2010A, TPS2011A, TPS2012A or TPS2013A



- Short-circuit and thermal protection with an over-current logic output
- Operating range: 2.7 V to 5.5 V
- Logic-level enable input
- Controlled switch rise time (6.1 ms) reduces inrush current, making devices suitable for use in hot-swap applications
- Under-voltage lockout
- No drain-to-source back-gate diode, eliminating potential current flow back across device to inputs
- Human-body-model (2 kV) and machine-model (200 V) ESD protection
- Packaging: 8-pin SOIC and 14-pin TSSOP
- Suggested resale price starts at \$0.96 each in quantities of 1,000

Active-low Enable	Current Limit (A) (min)
TPS2010A	0.22
TPS2011A	0.66
TPS2012A	1.1
TPS2013A	1.65

TPS2013A used to control inrush current in Hot-Swap applications



➤ Applications include:

- Disk drives (limit peak current at platter spin-up)
- Provide maintenance-free fuse
- Reduce average power consumption
- Simple hot swap power management

Power MUX/General Use

Industry's first true quad 80-mΩ switch ICs allow power MUXing

TPS208x, TPS209x

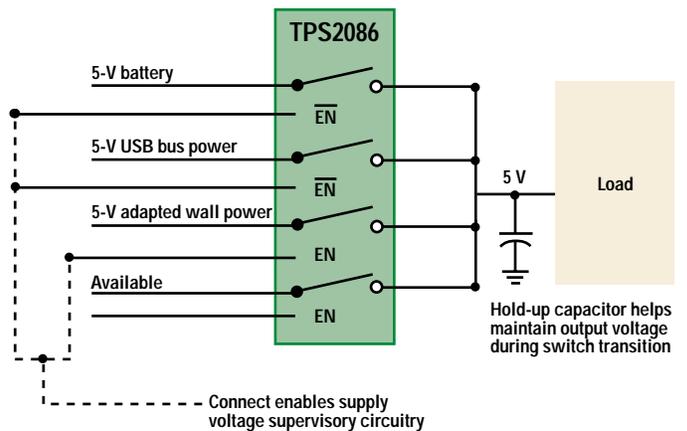
Get samples and datasheets at: www.ti.com/sc/device/partnumber

Replace *partnumber* in URL with TPS2080, TPS2081, TPS2082, TPS2085, TPS2086, TPS2087, TPS2090, TPS2091, TPS2092, TPS2095, TPS2096 or TPS2097



- Design flexibility:
 - Duals, 2 inputs/outputs
 - Quads, 4 inputs/outputs
- Short-circuit and thermal protection
- Operating range: 2.7 V to 5.5 V
- Current limits:
 - 700 mA (min) (TPS208x)
 - 300 mA (min) (TPS209x)
- CMOS- and TTL-compatible enables for each channel:
 - Active-high (TPS2080/90/85/95)
 - Combination (TPS2081/91/86/96)
 - Active-low (TPS2082/92/87/97)
- Controlled switch rise time (2.5 ms) reduces current surges
- Under-voltage lockout
- No drain-to-source back-gate diode, eliminating potential current flow back across device to inputs
- Packaging: 8- and 16-pin SOIC
- Suggested resale price starts at \$1.40 each in quantities of 1,000

TPS2086 used as a power MUX



➤ Applications include:

- Switch between power rails (power muxing)
- Memory card sockets

Power MUX

Power MUX ICs allow seamless transitions from main power to battery

TPS210x

Get samples and datasheets at:

www.ti.com/sc/device/partnumber

Replace *partnumber* in URL with TPS2100, TPS2101, TPS2102, TPS2103, TPS2104 or TPS2105

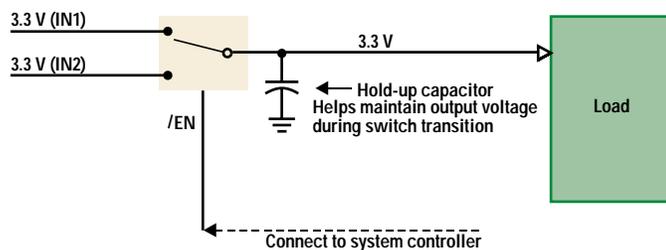


- Seamless 4- μ s transition from IN1 to IN2
- IN1: 500-mA rating 250-m Ω $r_{DS(on)}$
- IN2: 100-mA rating 1.3-m Ω $r_{DS(on)}$ (TPS2102/3/4/5)
- IN2: 100-mA rating 1.3-m Ω $r_{DS(on)}$ (TPS2100/1)
- Input voltage range: 2.7 V to 4 V (TPS2100/1/2/3)
- Input voltage range: 2.7 V to 5.5 V (TPS2104/5)
- No drain-to-source back-gate diode, eliminating potential current flow back across device to inputs
- Packaging: available in space-saving SOT-23
- Suggested resale price starts at \$0.69 each in quantities of 1,000

TPS2100/02/04 Truth Table			
VIN1	VIN2	/EN	OUT
0 V	0 V	XX	GND
3.3 V	N/A	L	VIN1
3.3 V	0 V	H	VIN2
N/A	3.3 V	H	VIN2

TPS2101/03/05 Truth Table			
VIN1	VIN2	EN	OUT
0 V	0 V	XX	GND
3.3 V	N/A	H	VIN1
3.3 V	0 V	L	VIN2
N/A	3.3 V	L	VIN2

TPS210x allows IN2 battery power to be selected when IN1 main power is not available



➤ Applications include:

- Wireless phones
- PDAs
- Calculators

PCMCIA

OVERVIEW:
PCMCIA/CardBus Power-Switch Matrix ICs

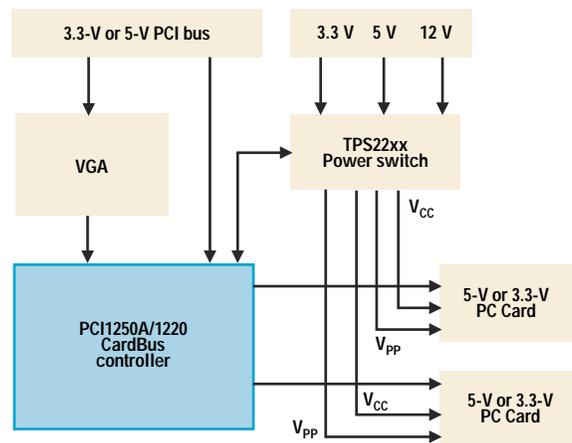
PCMCIA/CardBus is a PCI-based interface allowing modular expandability, typically in a notebook computer environment. A standard PC Card implementation, as shown in the graphic, requires switching ground, 3.3 V and 5 V to the V_{CC} input; while ground, 3.3 V, 5 V and 12 V switch to the V_{PP} input. TI's TPS22xx series includes power-switch matrix ICs for dual-socket as well as single-socket standard implementations.

Some new applications, such as personal digital assistants (PDAs), no longer require 12 V or V_{PP} . TPS2044A or TPS2054A could be used in these instances instead of TPS22xx, as shown in the PDA PCMCIA section starting on page 12.

TPS2043A and TPS2053A are showcased on page 13. These devices are suitable for applications involving a single PC Card and a single USB port.

TI is a total solution provider for CardBus. For information on TI CardBus controllers, visit power.ti.com/pcicardbus

Typical CardBus application



PCMCIA

Serial-interface power-switch matrix ICs for standard dual-sockets

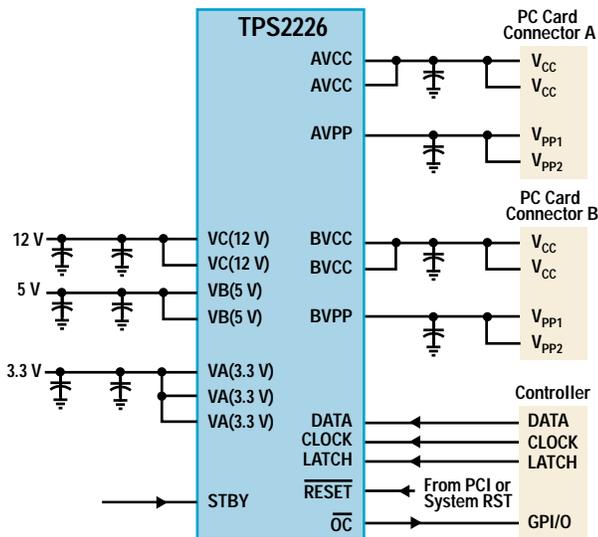
TPS2224, TPS2226

Get samples and datasheets at:
www.ti.com/sc/device/TPS2224
www.ti.com/sc/device/TPS2226



- Drop-in replacements:
 - TPS2224 (for TPS2214 or TPS2214A)
 - TPS2226 (for TPS2202A, TPS2206 or TPS2216/16A)
- Fully integrated and independent V_{CC} and V_{PP} switching
- 3.3-V, 5-V and/or 12-V power distribution
- Low r_{DS(on)} (85-mΩ V_{CC} switch)
- Internal power-on reset
- Short-circuit and thermal protection
- Quiescent current: 140 μA (typical)
- 12-V and 5-V supplies not required for operation
- Packaging: 30-pin SSOP (TPS2226), 24-pin SSOP and 24-pin HTSSOP (TPS2224)
- Suggested resale price starts at \$2.95 each in quantities of 1,000

TPS2226 in standard, dual-socket CardBus application with 3.3-V, 5-V, and 12-V power distribution



- Applications include:
- Notebook and desktop PCs
 - Set-top boxes
 - Telecom PBX

Parallel-interface power-switch matrix IC for standard dual-sockets

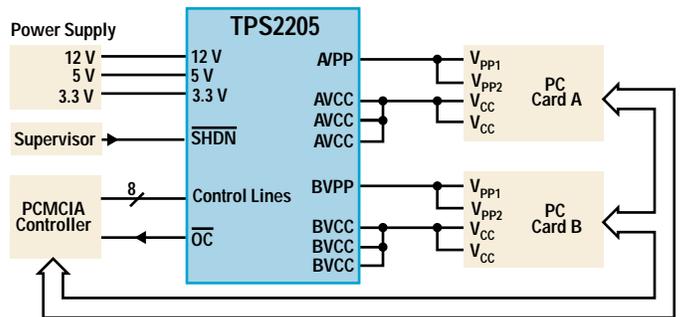
TPS2205

Get samples and datasheets at:
www.ti.com/sc/device/TPS2205



- Compatible with industry standard CardBus controllers
- Fully integrated V_{CC} and V_{PP} switching
- 3.3-V, 5-V and/or 12-V power distribution
- Low r_{DS(on)} (100-mΩ V_{CC} switch)
- Internal power-on reset
- Short-circuit and thermal protection
- Quiescent current: 117 μA (typ)
- 12-V supply not required for operation
- Packaging: 30-pin SSOP and 32-pin TSSOP
- Suggested resale price starts at \$2.95 each in quantities of 1,000

TPS2205 in a standard, dual-socket application



- Applications include:
- Notebook and desktop PCs
 - Set-top boxes
 - Telecom PBX

PCMCIA

Power-switch matrix IC for standard single-sockets

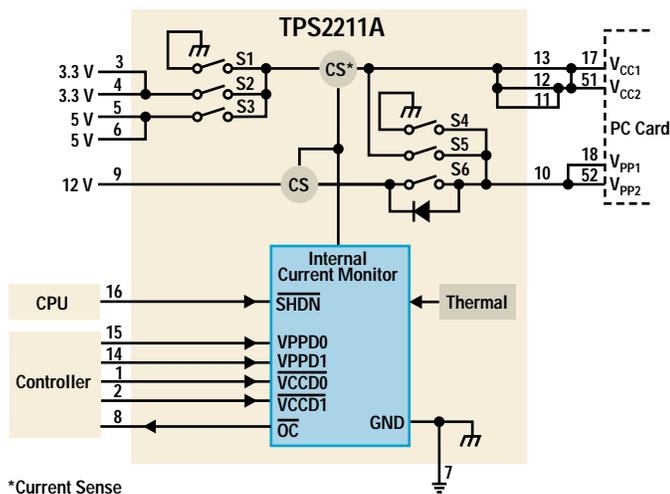
TPS2211A

Get samples and datasheets at:
www.ti.com/sc/device/TPS2211A



- Drop-in replacement for TPS2211
- 1.6-A V_{CC} current limit (typical)
- Four-line parallel microcontroller interface
- Fully integrated V_{CC} and V_{PP} switching
- 3.3-V, 5-V and/or 12-V power distribution
- Low $r_{DS(on)}$: 70-m Ω V_{CC} switch
- Internal power-on reset
- Short-circuit and thermal protection
- 12-V supply not required for operation
- Packaging: 16-pin SSOP
- Suggested resale price starts at \$1.59 each in quantities of 1,000

TPS2211A in a standard, single-socket CardBus application



*Current Sense

➤ Applications include:

- Notebook and desktop PCs
- Set-top boxes
- PDAs
- Printers
- Test equipment
- Web pads

Power-switch matrix IC for PDA/ low-power, single-sockets

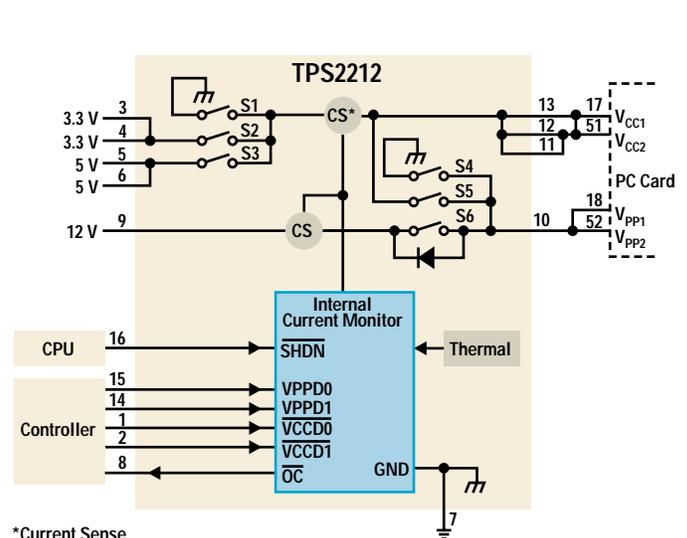
TPS2212

Get samples and datasheets at:
www.ti.com/sc/device/TPS2212



- 450-mA V_{CC} current limit (typical)
- Four-line parallel microcontroller interface
- Fully integrated V_{CC} and V_{PP} switching
- 3.3-V, 5-V and/or 12-V power distribution
- 160-m Ω V_{CC} switch
- Internal power-on reset
- Short-circuit and thermal protection
- 12-V supply not required for operation
- Packaging: 16-pin SSOP
- Suggested resale price starts at \$1.54 each in quantities of 1,000

TPS2212 in a low-power, single-socket CardBus application



*Current Sense

➤ Applications include:

- PDAs and other hand-held computers
- Mini-computers
- Printers

PCMCIA

Industry's first 3.3 V and 5 V only PCMCIA power-switch matrix IC

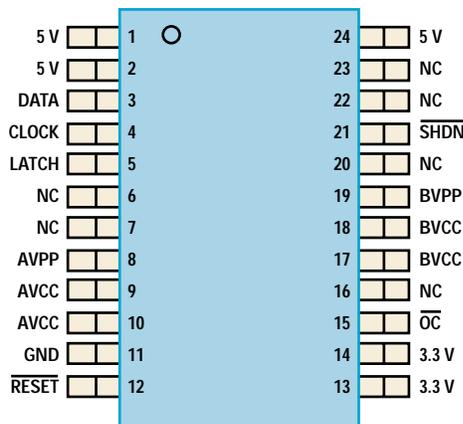
TPS2223

Get samples, datasheets and EVMs at: www.ti.com/sc/docs/products/analog/TPS2223



- Fully integrated and independent V_{CC} and V_{PP} switching for 3.3 V and 5 V (no 12 V)
- Supports dual-socket applications
- 3-wire serial interface
- Low $r_{DS(on)}$ (85 m Ω V_{CC} switch)
- Internal power-on reset
- Short-circuit and thermal protection
- Quiescent current: 140 μ A (typical)
- 5-V supply not required for operation
- Packaging: 24-pin HTSSOP and SSOP
- Suggested resale price starts at \$2.85 each in quantities of 1,000

TPS2223 pin-out is same as TPS2224, simplifying migration away from 12 V



NC - No internal connection

➤ Applications include:

- SmartCard applications including set-top boxes, PDAs and digital cameras
- PC Card/CardBus applications including notebooks and desktop PCs

Power-switch ICs for PC Card/CardBus applications not using 12 V or V_{pp}

TPS2044A/54A, TPS2043A/53A

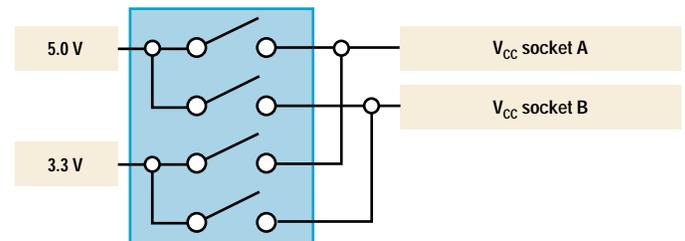
Get samples and datasheets at: www.ti.com/sc/device/partnumber

Replace *partnumber* in URL with TPS2044A, TPS2054A, TPS2043A or TPS2053A

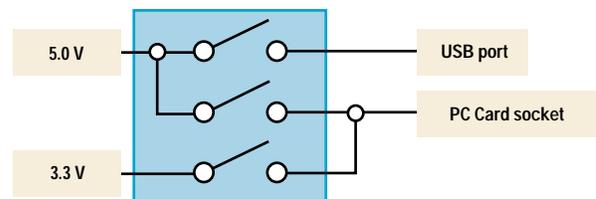


- Power distribution: 3.3 V and 5 V
- Supports single-socket applications with V_{PP} , but no 12-V supply; dual-socket applications not using V_{PP} (TPS2044A/54A)
- Supports a single USB port and a single-socket PC Card not using V_{PP} (TPS2043A/53A)
- Low $r_{DS(on)}$: 80-m Ω V_{CC} switch
- Short-circuit and thermal protection
- Active-low enable (TPS2044A/43A)
- Active-high enable (TPS2054A/53A)
- Packaging: 16-pin SOIC
- Suggested resale price starts at \$1.25 each in quantities of 1,000

TPS2044A/54A in a dual-socket CardBus application not requiring 12-V power distribution



TPS2043A/53A in an application requiring 5 V for USB port and 3.3 V/5 V for single PC Card



➤ Applications include:

- PDAs
- Mini-computers

Parametric Tables

Current-Limited Power Distribution Switch ICs for USB and General-Purpose Applications

Device	Number of FETs	I _{OS} (A) (min)	r _{DS(on)} (mΩ)	V _{IN} Range (V)	Supply Current (μA)	OC Logic Output	OT Logic Output	Enable	Predecessor	Price (1K)
TPS2010A	1	0.22	33	2.7–5.5	73	No	No	L	TPS2010	\$0.96
TPS2011A	1	0.66	33	2.7–5.5	73	No	No	L	TPS2011	\$0.96
TPS2012A	1	1.1	33	2.7–5.5	73	No	No	L	TPS2012	\$0.96
TPS2013A	1	1.65	33	2.7–5.5	73	No	No	L	TPS2013	\$0.96
TPS2020/30	1	0.22	33	2.7–5.5	73	Yes	Yes	L/H	-	\$1.11
TPS2021/31	1	0.66	33	2.7–5.5	73	Yes	Yes	L/H	TPS2014	\$1.11
TPS2022/32	1	1.1	33	2.7–5.5	73	Yes	Yes	L/H	TPS2015	\$1.11
TPS2023/33	1	1.65	33	2.7–5.5	73	Yes	Yes	L/H	-	\$1.11
TPS2024/34	1	2.2	33	2.7–5.5	73	Yes	Yes	L/H	-	\$1.11
TPS2041A/51A	1	0.7	80	2.7–5.5	80	Yes	Yes	L/H	TPS2041/51	\$0.67
TPS2042A/52A	2	0.7 ea	80	2.7–5.5	80	Each	Yes	L/H	TPS2042/52	\$0.86
TPS2043A/53A	3	0.7 ea	80	2.7–5.5	160	Each	Yes	L/H	TPS2043/53	\$1.25
TPS2044A/54A	4	0.7 ea	80	2.7–5.5	160	Each	Yes	L/H	TPS2044/54	\$1.61
TPS2045A/55A	1	0.3	80	2.7–5.5	80	Yes	Yes	L/H	TPS2045/55	\$0.66
TPS2046A/56A	2	0.3 ea	80	2.7–5.5	80	Each	Yes	L/H	TPS2046/56	\$0.86
TPS2047A/57A	3	0.3 ea	80	2.7–5.5	160	Each	Yes	L/H	TPS2047/57	\$1.25
TPS2048A/58A	4	0.3 ea	80	2.7–5.5	160	Each	Yes	L/H	TPS2048/58	\$1.61
TPS2080	2	0.7 ea	80	2.7–5.5	85	Yes	Yes	2H	-	\$1.40
TPS2081	2	0.7 ea	80	2.7–5.5	85	Yes	Yes	1L/1H	-	\$1.40
TPS2082	2	0.7 ea	80	2.7–5.5	85	Yes	Yes	2L	-	\$1.40
TPS2085	4	0.7 ea	80	2.7–5.5	85	Yes	Yes	4H	-	\$2.36
TPS2086	4	0.7 ea	80	2.7–5.5	85	Yes	Yes	2L/2H	-	\$2.36
TPS2087	4	0.7 ea	80	2.7–5.5	85	Yes	Yes	4L	-	\$2.36
TPS2090	2	0.3 ea	80	2.7–5.5	85	Yes	Yes	2H	-	\$1.40
TPS2091	2	0.3 ea	80	2.7–5.5	85	Yes	Yes	1L/1H	-	\$1.40
TPS2092	2	0.3 ea	80	2.7–5.5	85	Yes	Yes	2L	-	\$1.40
TPS2095	4	0.3 ea	80	2.7–5.5	85	Yes	Yes	4H	-	\$2.36
TPS2096	4	0.3 ea	80	2.7–5.5	85	Yes	Yes	2L/2H	-	\$2.36
TPS2097	4	0.3 ea	80	2.7–5.5	85	Yes	Yes	4L	-	\$2.36

PCMCIA Power Switch Matrix ICs

Device	Interface	Number of Ports	3.3-V r _{DS(on)} (mΩ)	r _{DS(on)} (mΩ) Typ	I _{OS} (A) (min)	Predecessor	Price (1K)
TPS2224	3-line Serial	2	85	95	1	TPS2214, TPS2214A	\$2.95
TPS2226	3-line Serial	2	85	95	1	TPS2206, TPS2216/16A	\$2.95
TPS2223	3-line Serial	2	85	95	1	-	\$2.85
TPS2214A	3-line Serial	2	60	140	1	TPS2214	\$3.10
TPS2216A	3-line Serial	2	60	140	1	TPS2206, TPS2216	\$3.10
TPS2205	8-line Parallel	2	70	100	1	TPS2201	\$2.95
TPS2211A	4-line Parallel	1	70	57	1	TPS2211	\$1.59
TPS2212	4-line Parallel	1	160	160	0.3	-	\$1.54
TPS2043A or 53A	Parallel	1	80	80	0.7	TPS2043, TPS2053	\$1.25
TPS2044A or 54A	Parallel	1 or 2	80	80	0.7	TPS2044, TPS2054	\$1.61

Power Mux ICs*

Device	Number of Inputs	IN1 r _{DS(on)} (mΩ)	IN2 r _{DS(on)} (on) (Ω)	IN1 Output Current (mA)	IN2 Output Current (mA)	IN1 Supply Current (μA)	IN2 Supply Current (μA)	IN1, IN2 Input Voltage Range (V)	Transition Time		Enable	Price (1K)
									IN1 to IN2 (μs)	IN2 to IN1 (ms)		
TPS2100	2	250	1.3	500	10	10	0.75	2.7 to 4.0	4	0.9	L	\$0.69
TPS2101	2	250	1.3	500	10	10	0.75	2.7 to 4.0	4	0.9	H	\$0.69
TPS2102	2	250	1.3	500	100	14	0.75	2.7 to 4.0	3	0.7	L	\$0.71
TPS2103	2	250	1.3	500	100	14	0.75	2.7 to 4.0	3	0.7	H	\$0.71
TPS2104	2	250	1.3	500	100	18	0.75	2.7 to 5.5	3	0.7	L	\$0.94
TPS2105	2	250	1.3	500	100	18	0.75	2.7 to 5.5	3	0.7	H	\$0.94

* TPS208x and TPS209x shown in the "Current-Limited Power Distribution Switch ICs for USB and General-Purpose Applications" table (top of page) can be used as Power MUX ICs.

For technical support and literature, see back cover.

Parametric Tables

USB Hub Power Managers

Device	# of FETs	$r_{DS(on)}$ per FET (m Ω) (typ)	Current Limit (min) (A)	V_{IN} min (V)	V_{IN} max (V)	Over-Current Reporting	Over-Temp Reporting	Enable	BPMODE Indicator	5-V, 3-A LDO Controller	3.3-V, 100-mA LDO	Price (1K)
TPS2070	8	560 BP, 107 SP	0.12 BP, 0.6 SP	4.5	5.5	Yes	Yes	L	L	Yes	Yes	\$3.70
TPS2071	8	560 BP, 107 SP	0.12 BP, 0.6 SP	4.5	5.5	Yes	Yes	L	H	Yes	Yes	\$3.70
TPS2074	8	500 BP, 100 SP	0.12 BP, 0.6 SP	4.5	5.5	Yes	Yes	L	L	No	Yes	\$2.99
TPS2075	8	560 BP, 100 SP	0.12 BP, 0.6 SP	4.5	5.5	Yes	Yes	L	H	No	Yes	\$2.99

Hot Swap Power Controllers

Device	Attributes	V_{IN} Range (V)	Fault Reporting	Average Power Limiting	Supply Current (mA)	Enable / Shutdown	Price (1K)
UCC3921	Negative floating, di/dt control	< -10.5	Yes	Yes	1	SH: Active-High	\$1.37
UCC3919	Single, di/dt control	3 to 8	Yes	Yes	1	SH: Active-Low	\$2.15
UCC3917	Positive floating, di/dt control	> 15	Yes	Yes	5	SH: Active-Low	\$1.66
UCC3913	Negative floating, di/dt control	< -10.5	Yes	Yes	1	SH: Active-High	\$1.37
UC3914	Single, high voltage, di/dt control	5 to 35	Yes	Yes	8	SH: Active-Low	\$4.35
TPS2331	Single, dv/dt control	3 to 13	Yes	No	0.5	EN: Active-High	\$2.00
TPS2330	Single, dv/dt control	3 to 13	Yes	No	0.5	EN: Active-Low	\$2.00
TPS2321	Dual, dv/dt control	3 to 13 / 3 to 5.5	No	No	0.5	EN: Active-High	\$2.76
TPS2320	Dual, dv/dt control	3 to 13 / 3 to 5.5	No	No	0.5	EN: Active-Low	\$2.76
TPS2311	Dual, dv/dt control	3 to 13 / 3 to 5.5	Yes	No	0.5	EN: Active-High	\$3.50
TPS2310	Dual, dv/dt control	3 to 13 / 3 to 5.5	Yes	No	0.5	EN: Active-Low	\$3.50
TPS2301	Dual, dv/dt control	3 to 13 / 3 to 5.5	Yes	No	0.5	EN: Active-High	\$3.50
TPS2300	Dual, dv/dt control	3 to 13 / 3 to 5.5	Yes	No	0.5	EN: Active-Low	\$3.50
TPS2306	Dual, di/dt control, sequencing	2.75 to 13.6	Yes	No	2	EN: Active-High	\$3.50

Hot Swap Power Switches

Device	Attributes	V_{IN} Range (V)	Current Limit (A) (min)	$r_{DS(on)}$ (m Ω)	Programmable Fault Threshold	Automatic Retry Mode	Supply Current (mA)	Enable / Shutdown	Price (1K)
UCC3918	Single, low $r_{DS(on)}$, di/dt control	3 to 6	0 to 4	75	Yes	Yes	1	SH: Active-Low	\$3.06
UCC39161	Single, fixed low current, di/dt control	4 to 6	0.6	220	No	Yes	1	SH: Active-Low	\$2.66
UCC3916	Single, fixed low current, SCSI, di/dt control	4 to 6	1.65	220	No	Yes	1	SH: Active-Low	\$2.26
UCC3915	Single, di/dt control	7 to 15	0 to 3	150	Yes	Yes	1	SH: Active-Low	\$3.44
UCC3912	Single, di/dt control	3 to 8	0 to 3	150	Yes	Yes	1	SH: Active-Low	\$3.37
TPS20xx	Singles to quads, dv/dt control	2.7 to 5.5	0.22 to 2.2	33 to 80	No	No	< 1	EN: High or Low	\$1.11

Note: Values are typical, unless indicated otherwise.

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