PCMCIA Switching Matrix with Built-In N-Channel V_{CC} Switch Drivers

FEATURES

- **Output Current Capability: 120mA**
- **External 12V Regulator Can Be Shut Down**
- **Built-In N-Channel V_{CC} Switch Drivers**
- Digital Selection of 0V, V_{CCIN}, VPP_{IN} or Hi-Z
- 3.3V or 5V V_{CC} Supply
- Break-Before-Make Switching
- 0.1µA Quiescent Current in Hi-Z or 0V Mode
- No VPP_{OUT} Overshoot
- Logic Compatible with Standard PCMCIA Controllers

APPLICATIONS

- Notebook Computers
- Palmtop Computers
- Pen-Based Computers
- Handi-Terminals
- Bar-Code Readers

DESCRIPTION

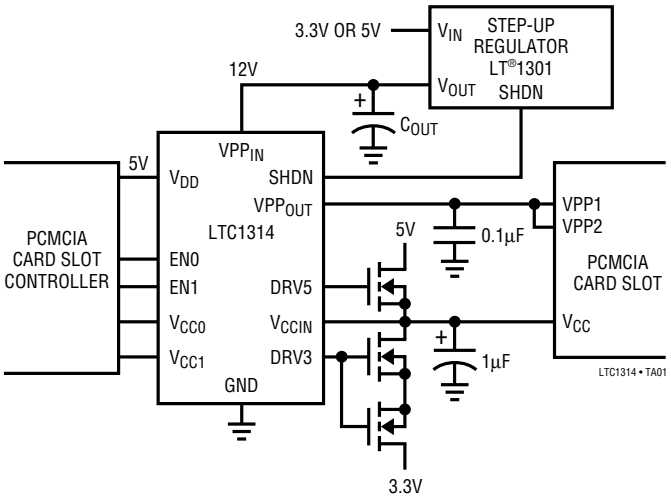
The LTC®1314/LTC1315 provide the power switching necessary to control Personal Computer Memory Card International Association (PCMCIA) Release 2.0 card slots. When used in conjunction with a PC card interface controller, these devices form a complete minimum component count interface for palmtop, pen-based and notebook computers.

The LTC1314/LTC1315 provide 0V, 3.3V, 5V, 12V and Hi-Z power output for flash VPP programming. A built-in charge pump produces 12V of gate drive for inexpensive N-channel 3.3V/5V V_{CC} switching. The 12V regulator can be shut down when 12V is not required at VPP_{OUT}. All digital inputs are TTL compatible and interface directly with industry standard PC card interface controllers.

The LTC1314 is available in 14-pin SO and the LTC1315 in 24-pin SSOP.

TYPICAL APPLICATION

Typical PCMCIA Single Slot Driver



Linear Technology PCMCIA Product Family

DEVICE	DESCRIPTION	PACKAGE
LT1312	SINGLE PCMCIA VPP DRIVER/REGULATOR	8-PIN SO
LT1313	DUAL PCMCIA VPP DRIVER/REGULATOR	16-PIN SO*
LTC®1314	SINGLE PCMCIA SWITCH MATRIX	14-PIN SO
LTC1315	DUAL PCMCIA SWITCH MATRIX	24-PIN SSOP
LTC1470	PROTECTED V_{CC} 5V/3.3V SWITCH MATRIX	8-PIN SO
LTC1472	PROTECTED V_{CC} AND VPP SWITCH MATRIX	16-PIN SO*

*NARROW BODY

LTC1314 Truth Table

EN0	EN1	V_{CC0}	V_{CC1}	VPP_{OUT}	DRV3	DRV5
0	0	X	X	GND	X	X
0	1	X	X	V_{CCIN}	X	X
1	0	X	X	VPP_{IN}	X	X
1	1	X	X	Hi-Z	X	X
X	X	1	0	X	1	0
X	X	0	1	X	0	1
X	X	0	0	X	0	0
X	X	1	1	X	0	0

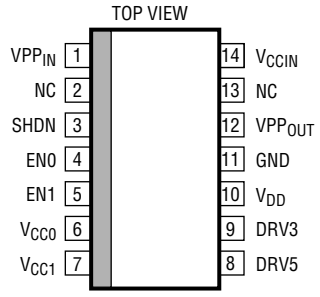
X = DON'T CARE

ABSOLUTE MAXIMUM RATINGS

VPP_{IN} to GND ..... 13.2V to –0.3V
V_{DD} to GND ..... 7V to –0.3V
V_{CCIN} to GND ..... 7V to –0.3V
VPP_{OUT} to GND ..... 13.2V to –0.3V

Digital Input Voltage ..... 7V to –0.3V
Operating Temperature Range ..... 0°C to 70°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec)..... 300°C

PACKAGE/ORDER INFORMATION

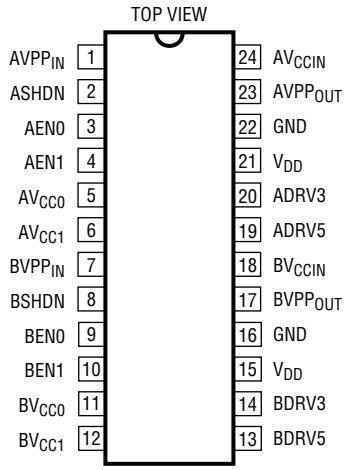


S PACKAGE
14-LEAD PLASTIC SO

T_{JMAX} = 125°C, θ_{JA} = 110°C/W

ORDER PART NUMBER

LTC1314CS



G PACKAGE
24-LEAD PLASTIC SSOP

T_{JMAX} = 125°C, θ_{JA} = 95°C/W

ORDER PART NUMBER

LTC1315CG

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS

V_{DD} = 5V, V_{CCIN} = 5V, VPP_{IN} = 12V, T_A = 25°C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		LTC1314/LTC1315 MIN	TYP	MAX	UNITS
V_{CCIN}	Input Voltage Range		●	3		5.5	V
VPP_{IN}	Input Voltage Range		●	0		12.6	V
V_{DD}	Supply Voltage Range		●	4.5		5.5	V
I_{CC}	V_{CCIN} Supply Current, No Load	VPP_{OUT} = VPP_{IN}, V_{CCIN}, 0V or Hi-Z	●		0.1	1	µA
I_{PP}	VPP_{IN} Supply Current, No Load	VPP_{OUT} = VPP_{IN}, V_{CCIN} VPP_{OUT} = 0V, Hi-Z	● ●		15 0.1	40 1	µA µA
I_{DD}	V_{DD} Supply Current, No Load	VPP_{OUT} = VPP_{IN} or V_{CCIN} VPP_{OUT} = 0V or Hi-Z VPP_{OUT} = 0V or Hi-Z, DRV3 or DRV5 On	● ● ●		60 0.1 85	120 10 200	µA µA µA
I_{IN}	Input Current: EN0, EN1, V_{CC0} or V_{CC1}	0V < V_{IN} < V_{DD}	●			±1	µA
I_{OUT}	High Impedance Output Leakage Current	EN0 = EN1 = 5V, 0V < VPP_{OUT} < 12V	●		0.1	10	µA
R_{ON}	On Resistance, VPP_{OUT} = VPP_{IN} On Resistance, VPP_{OUT} = V_{CCIN} On Resistance, VPP_{OUT} = GND	VPP_{IN} = 12V, I_{LOAD} = 120mA V_{CCIN} = 5V, I_{LOAD} = 5mA V_{DD} = 5V, I_{SINK} = 1mA	● ● ●		0.55 2 100	1.2 5 250	Ω Ω Ω
V_{INH}	Input High Voltage, Digital Inputs		●	2			V
V_{INL}	Input Low Voltage, Digital Inputs		●			0.8	V

ELECTRICAL CHARACTERISTICS

V_{DD} = 5V, V_{CCIN} = 5V, VPP_{IN} = 12V, T_A = 25°C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		LTC1314/LTC1315 MIN	TYP	MAX	UNITS
V_{OH}	SHDN Output High Voltage	VPP_{OUT} = V_{CCIN}, 0V or Hi-Z, I_{LOAD} = 400µA	●	3.5			V
V_{OL}	SHDN Output Low Voltage	VPP_{OUT} = VPP_{IN}, I_{SINK} = 400µA	●			0.4	V
V_G-V_{DD}	Gate Voltage Above Supply	V_{DRV3} or V_{DRV5}	●	6	7	13	V
t_{ON}	Turn-On Time, DRV3 and DRV5	C_{GATE} = 1000pF, Time for V_{GATE} > V_{DD} + 1V		50	150	500	µs
t_{OFF}	Turn-Off Time, DRV3 and DRV5	C_{GATE} = 1000pF, Time for V_{GATE} < 0.5V		3	10	30	µs
t_1	Delay + Rise Time	VPP_{OUT} = GND to V_{CCIN}, VPP_{IN} = 0V, Note 1		5	15	50	µs
t_2	Delay + Rise Time	VPP_{OUT} = GND to VPP_{IN} (Note 1)		5	15	50	µs
t_3	Delay + Rise Time	VPP_{OUT} = V_{CCIN} to VPP_{IN} (Note 1)		5	15	50	µs
t_4	Delay + Fall Time	VPP_{OUT} = VPP_{IN} to V_{CCIN} (Note 3)		2	6	20	µs
t_5	Delay + Fall Time	VPP_{OUT} = VPP_{IN} to GND (Note 2)		15	50	150	µs
t_6	Delay + Fall Time	VPP_{OUT} = V_{CCIN} to GND, VPP_{IN} = 0V (Note 2)		10	25	100	µs
t_7	Output Turn-On Delay	VPP_{OUT} = Hi-Z to VPP_{IN} or V_{CCIN} (Notes 1, 6)		5	15	50	µs

The ● denotes specifications which apply over the full operating temperature range.

Note 1: To 90% of the final value, C_{OUT} = 0.1µF, R_{OUT} = 2.9k.

Note 2: To 10% of the final value, C_{OUT} = 0.1µF, R_{OUT} = 2.9k.

Note 3: To 50% of the initial value, C_{OUT} = 0.1µF, R_{OUT} = 2.9k.

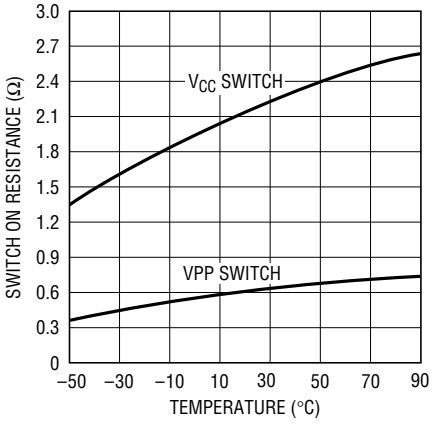
Note 4: Measured current data is per channel.

Note 5: Input logic low equal to 0V, high equal to 5V.

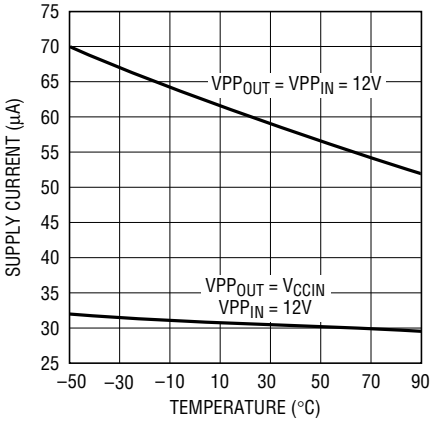
Note 6: VPP_{IN} = 0V when switching from Hi-Z to V_{CCIN}.

TYPICAL PERFORMANCE CHARACTERISTICS

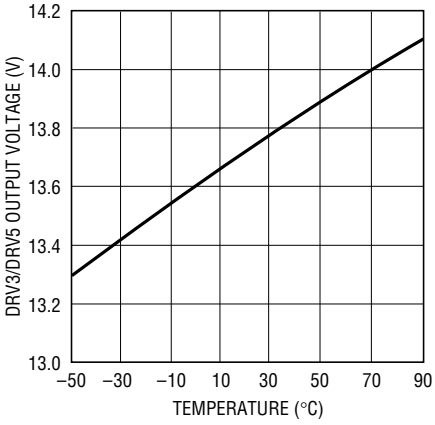
Switch On Resistance vs Temperature



Supply Current vs Temperature

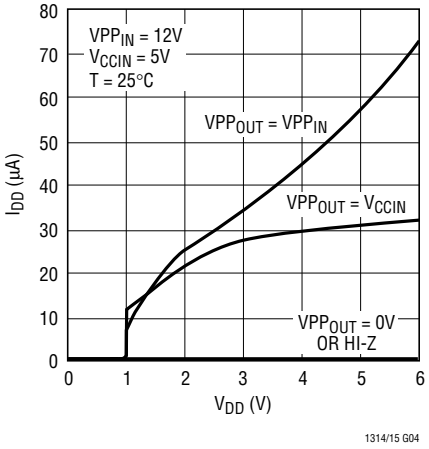


DRV3/DRV5 Output Voltage vs Temperature



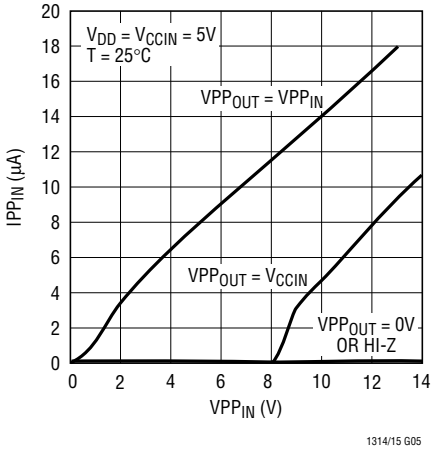
TYPICAL PERFORMANCE CHARACTERISTICS

I_{DD} vs V_{DD}



1314/15 G04

IPP_{IN} vs VPP_{IN}



1314/15 G05

PIN FUNCTIONS

LTC1314

VPP_{IN} (Pin 1): 12V Power Input.

NC (Pin 2): Not Connected.

SHDN (Pin 3): Shutdown Output. When the output is high, the external 12V regulator can be shut down to conserve power consumption.

EN0, EN1 (Pins 4, 5): Logic inputs that control the voltage output on VPP_{OUT}. The input thresholds are compatible with TTL/CMOS levels. Refer to Truth Table.

V_{CC0} (Pin 6): Logic input that controls the state of the MOSFET gate driver DRV3. ESD protection device limits input excursions to 0.6V below ground.

V_{CC1} (Pin 7): Logic input that controls the state of the MOSFET gate driver DRV5. ESD protection device limits input excursions to 0.6V below ground.

DRV5, DRV3 (Pins 8, 9): Gate driver outputs that control the external MOSFETs that switch the V_{CC} pin of card slot to Hi-Z, 3.3V, or 5V.

V_{DD} (Pin 10): Positive Supply, $4.5V \leq V_{DD} \leq 5.5V$. This pin supplies the power to the control logic and the charge pumps and must be continuously powered.

GND (Pin 11): Ground Connection.

VPP_{OUT} (Pin 12): Switched output that provides 0V, 3.3V, 5V, 12V, or Hi-Z to the VPP pin of the card slot. Refer to Truth Table.

NC (Pin 13): Not Connected.

V_{CCIN} (Pin 14): 5V or 3.3V Power Input.

PIN FUNCTIONS

LTC1315

VPP_{IN} (Pins 1, 7): 12V Power Inputs.

SHDN (Pins 2, 8): Shutdown Outputs. When the output is high, the external 12V regulator can be shut down to conserve power consumption.

EN0, EN1 (Pins 3, 4, 9, 10): Logic inputs that control the voltage output on VPP_{OUT}. The input thresholds are compatible with TTL/CMOS levels. Refer to the Truth Table.

V_{CC0} (Pins 5, 11): Logic inputs that control the state of the MOSFET gate driver DRV3. ESD protection device limits input excursions to 0.6V below ground.

V_{CC1} (Pins 6, 12): Logic inputs that control the state of the MOSFET gate driver DRV5. ESD protection device limits input excursions to 0.6V below ground.

DRV5, DRV3 (Pins 13, 14, 19, 20): Gate driver outputs that control the external MOSFETs that switch the V_{CC} pin of card slot to Hi-Z, 3.3V, or 5V.

V_{DD} (Pins 15, 21): Positive Supplies, $4.5V \leq V_{DD} \leq 5.5V$. These pins supply the power to the control logic and the charge pumps and must be continuously powered.

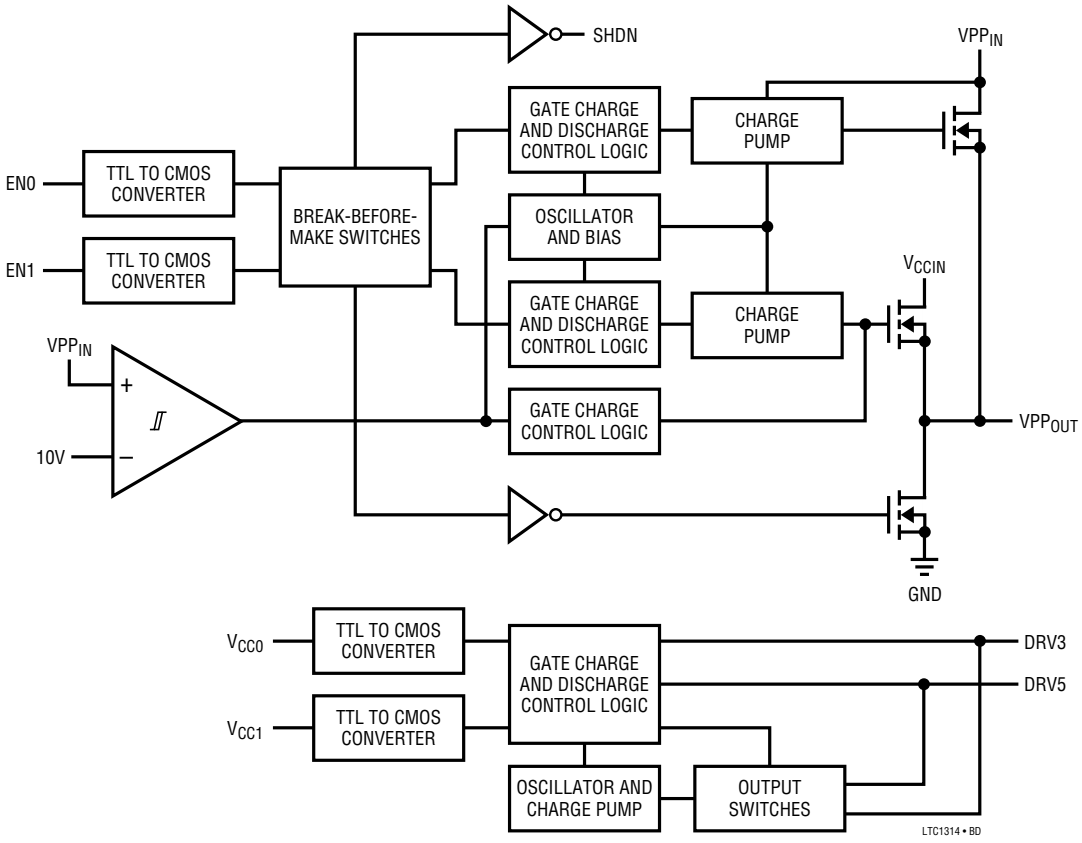
GND (Pins 16, 22): Ground Connections.

VPP_{OUT} (Pins 17, 23): Switched outputs that provide 0V, 3.3V, 5V, 12V, or Hi-Z to the VPP pin of the card slot. Refer to the Truth Table.

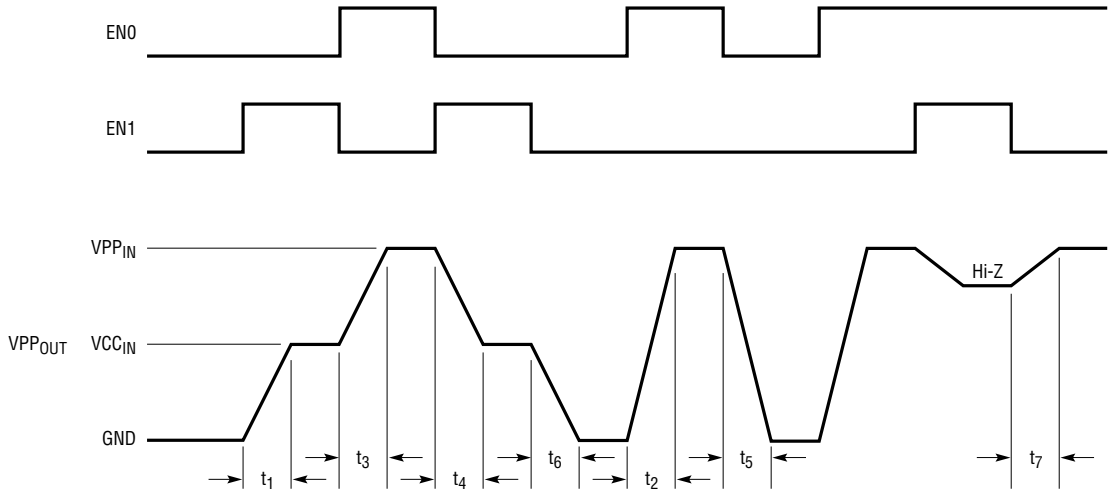
V_{CCIN} (Pins 18, 24): 5V or 3.3V Power Inputs.

BLOCK DIAGRAM

LTC1314 or 1/2 LTC1315



SWITCHING TIME WAVEFORMS



NOTE: 1μF CAPACITOR CONNECTED ON BOTH VPP_{IN} AND V_{CCIN} PINS AT TIMING TEST

LTC1314 • SW

APPLICATIONS INFORMATION

PCMCIA VPP control is easily accomplished using the LTC1314 or LTC1315 switching matrix. Two control bits (LTC1314) or four control bits (LTC1315) determine the output voltage and standby/operate mode conditions. Output voltages of 0V, V_{CCIN} (3.3V or 5V), VPP_{IN}, or a high impedance state are available. When either the high impedance or low voltage (0V) conditions are selected, the device switches into "sleep" mode and draws 0.1μA of current from the V_{DD} supply.

The LTC1314/LTC1315 are low resistance power MOSFET switching matrices that operate from the computer system main power supply. Device power is obtained from V_{DD}, which is 5V ±0.5V. The gate drives for the NFETs (both internal and external) are derived from internal charge pumps, therefore VPP_{IN} is only required when it's switched to VPP_{OUT}. Internal break-before-make switches determine the output voltage and device mode.

Flash Memory Card VPP Power Considerations

PCMCIA compatible flash memory cards require tight regulation of the 12V VPP programming supply to ensure that the internal flash memory circuits are never subjected to damaging conditions. Flash memory circuits are typically rated with an absolute maximum of 13.5V and VPP must be maintained at 12V ±5% under all possible load conditions during erase and program cycles. Undervoltage can decrease specified flash memory reliability and overvoltage can damage the device.

V_{CC} Switch Driver and VPP Switch Matrix

Figures 1 and 2 show the approach that is very space and power efficient. The LTC1314/LTC1315 used in conjunction with the LT1301 DC/DC converter, provide complete power management for a PCMCIA card slot. The LTC1314/LTC1315 and LT1301 combination provides a highly efficient, minimal parts count solution. These circuits are especially good for applications that are adding a PCMCIA socket to existing systems that currently have only 5V or 3.3V available.

The LTC1314 drives three N-channel (LTC1315 six N-channel) MOSFETs that provide V_{CC} pin power switching. On-chip charge pumps provide the necessary voltage to fully enhance the switches. With the charge pumps on-chip, the MOSFET drive is available without the need for a 12V supply. The LTC1314/LTC1315 provide a natural break-before-make action and smooth transitions due to

APPLICATIONS INFORMATION

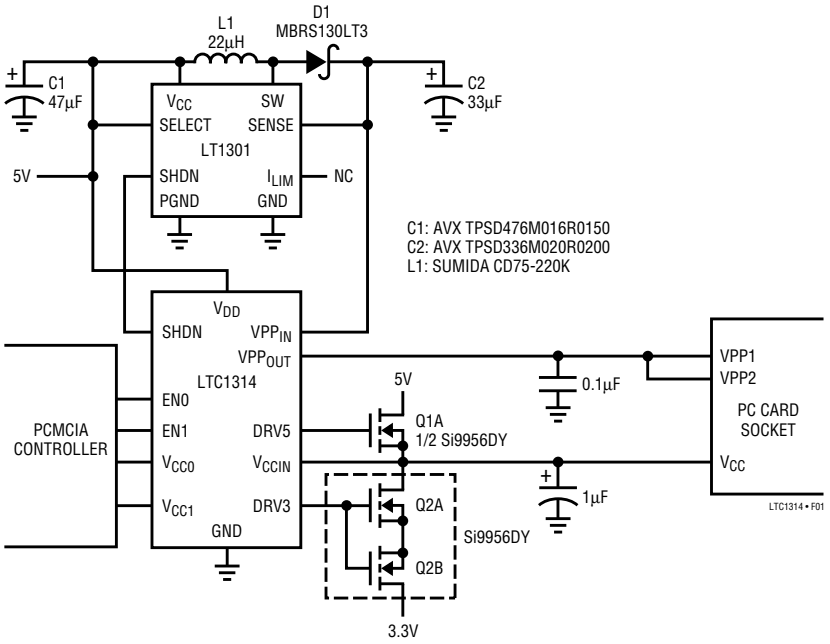


Figure 1. LTC1314 Switch Matrix with the LT1301 Boost Regulator

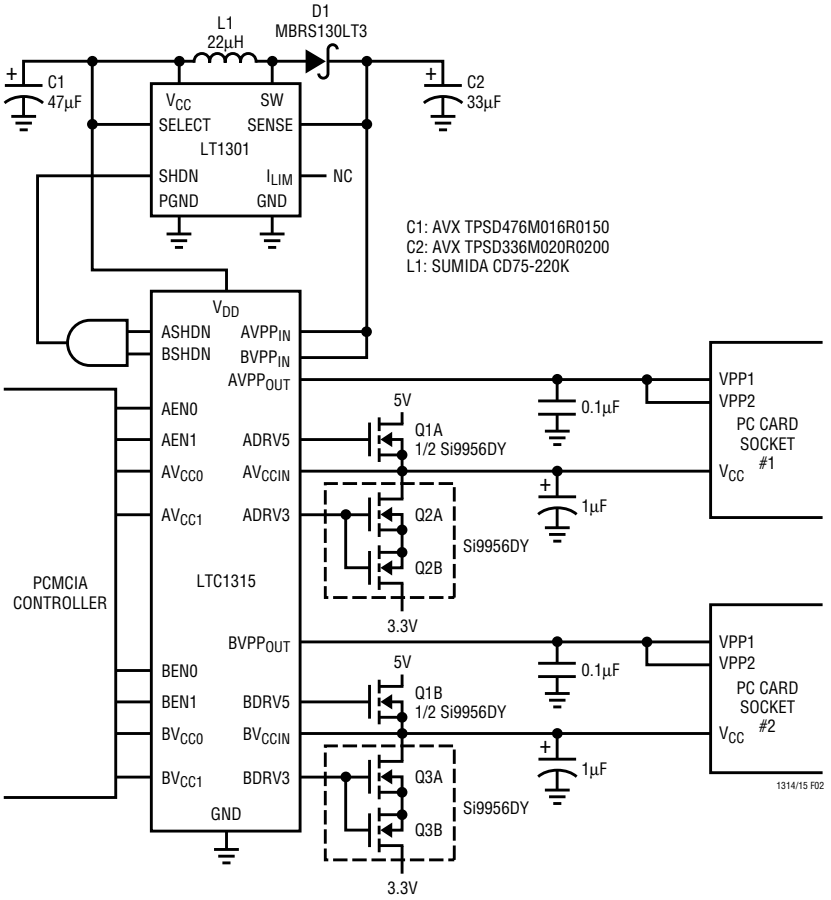


Figure 2. Typical Two-Socket Application Using the LTC1315 and the LT1301

APPLICATIONS INFORMATION

the asymmetrical turn-on and turn-off of the MOSFETs. The LT1301 switching regulator is in shutdown mode and consumes only 10μA until the VPP pins require 12V.

The VPP switching is accomplished by a combination of the LTC1314/LTC1315 and LT1301. The LT1301 is in shutdown mode to conserve power until the VPP pins require 12V. When the VPP pins require 12V, the LT1301 is activated and the LTC1314/LTC1315's internal switches route the VPP_{IN} pin to the VPP_{OUT} pin. The LT1301 is capable of delivering 12V at 120mA maintaining high efficiency. The LTC1314/LTC1315's break-before-make and slope-controlled switching will ensure that the output voltage transition will be smooth, of moderate slope, and without overshoot. This is critical for flash memory products to prevent damaging parts from overshoot and ringing exceeding the 13.5V device limit.

With Higher Voltage Supplies Available

Often systems have an available supply voltage greater than 12V. The LTC1314/LTC1315 can be used in conjunction with an LT1121 linear regulator to supply the PC card socket with all necessary voltages. Figures 3 and 4 show these circuits. The LTC1314/LTC1315 enable the LT1121 linear regulator only when 12V is required at the VPP pins. In all other modes the LT1121 is in shutdown mode and consumes only 16μA. The LT1121 also provides thermal shutdown and current limiting features to protect the socket, the card and the system regulator.

Supply Bypassing

For best results, bypass V_{CCIN} and VPP_{IN} at their inputs with 1μF capacitors. VPP_{OUT} should have a 0.01μF to 0.1μF capacitor for noise reduction and electrostatic discharge (ESD) damage prevention. Larger values of output capacitor will create large current spikes during transitions, requiring larger bypass capacitors on the V_{CCIN} and VPP_{IN} pins.

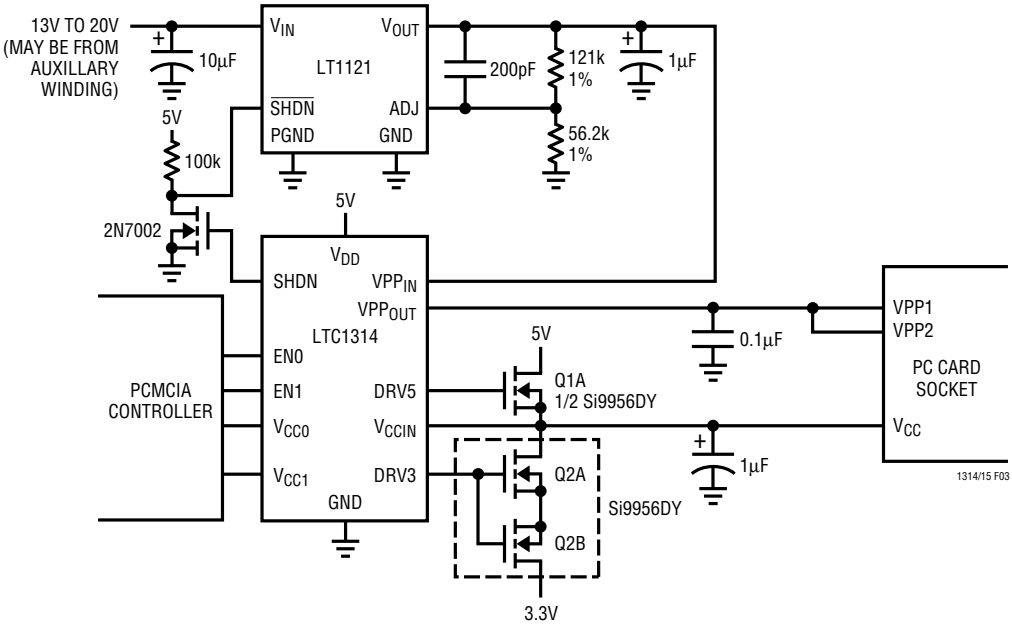


Figure 3. LTC1314 with the LT1121 Linear Regulator

APPLICATIONS INFORMATION

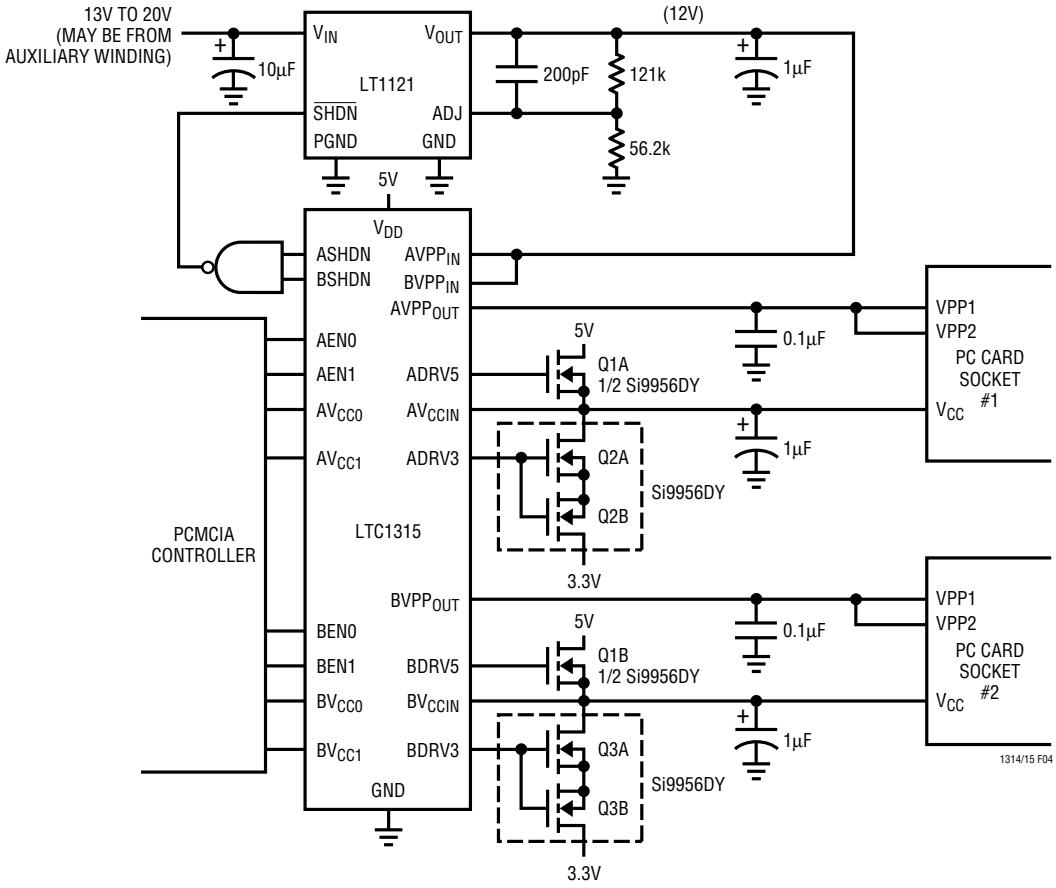
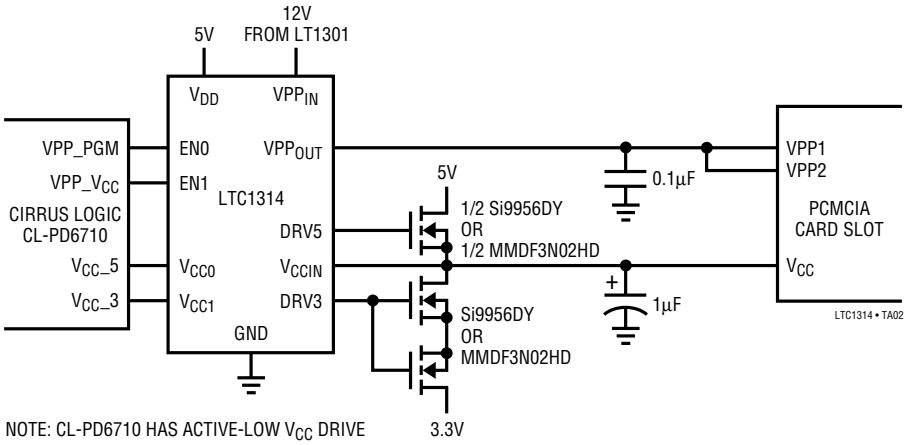


Figure 4. Typical Two-Socket Application Using the LTC1315 and the LT1121

TYPICAL APPLICATIONS

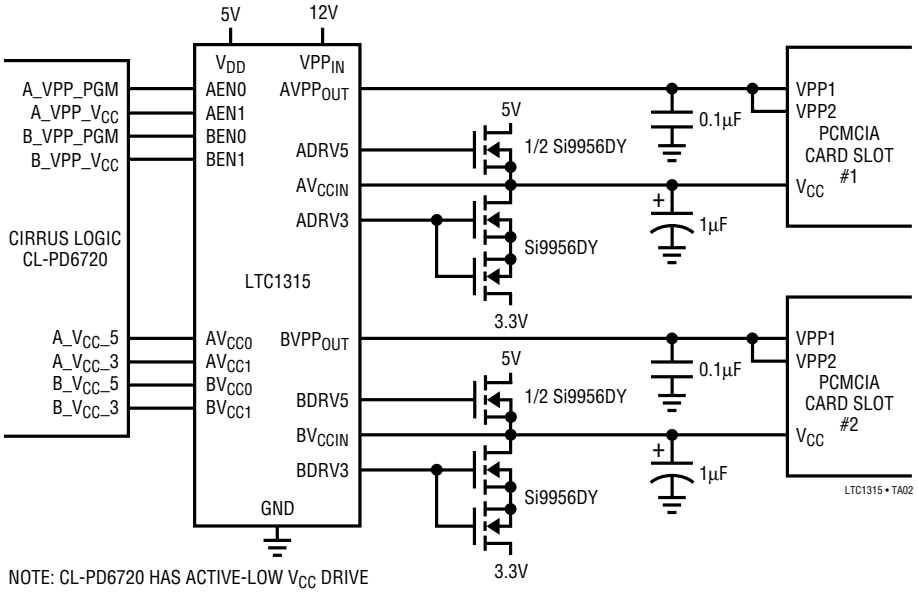
Single Slot Interface to CL-PD6710



NOTE: CL-PD6710 HAS ACTIVE-LOW V_{CC} DRIVE

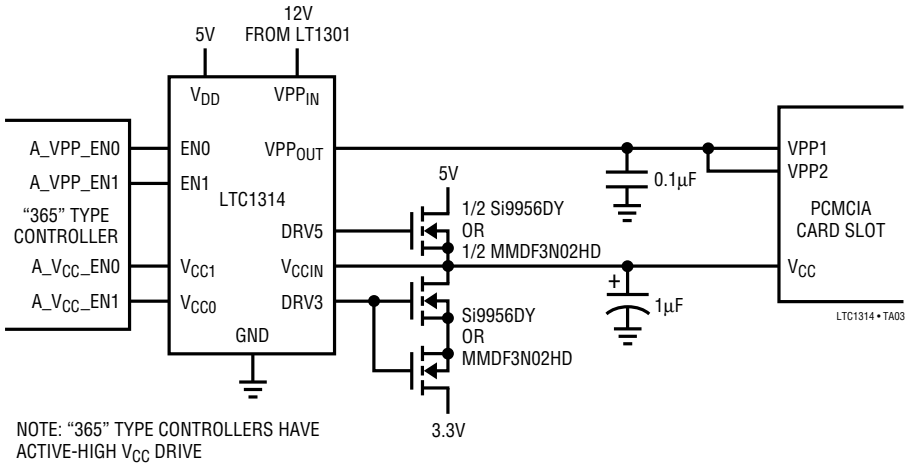
TYPICAL APPLICATIONS

Dual Slot Interface to CL-PD6720



NOTE: CL-PD6720 HAS ACTIVE-LOW V_{CC} DRIVE

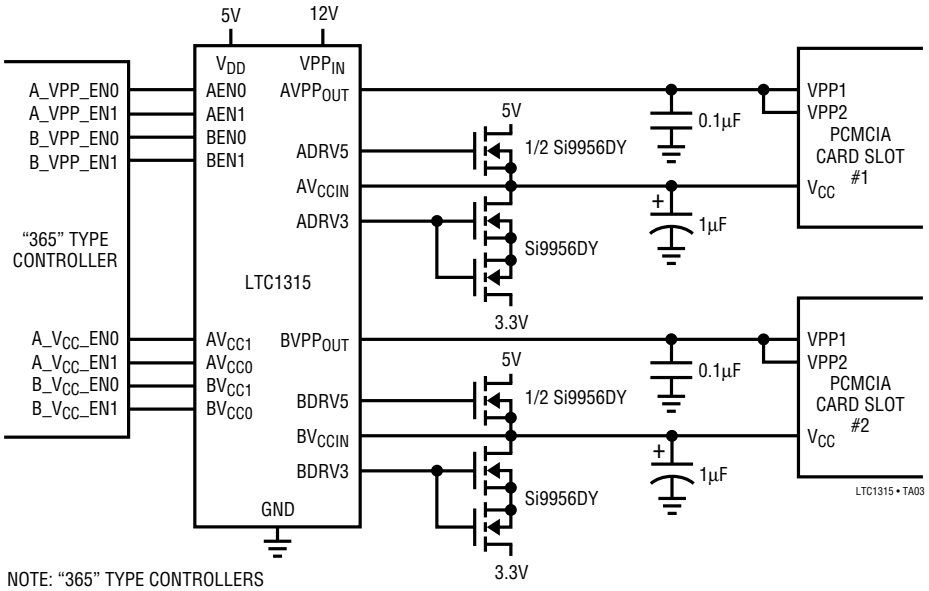
Single Slot Interface to "365" Type Controller



NOTE: "365" TYPE CONTROLLERS HAVE ACTIVE-HIGH V_{CC} DRIVE

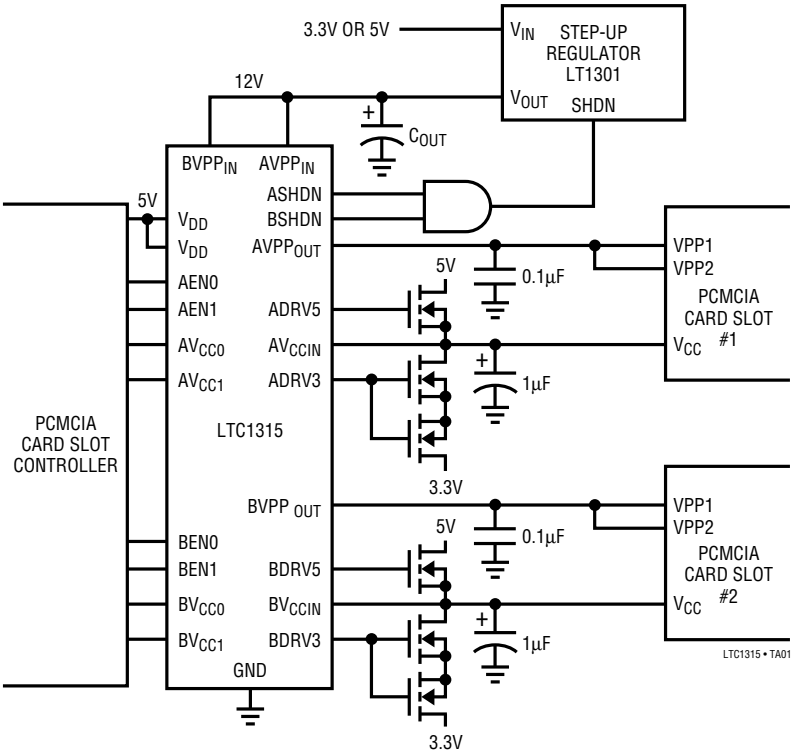
TYPICAL APPLICATIONS

Dual Slot Interfae to "365" Type Controller



NOTE: "365" TYPE CONTROLLERS HAVE ACTIVE-HIGH V_{CC} DRIVE

Typical PCMCIA Dual Slot Driver



LTC1315 Truth Table

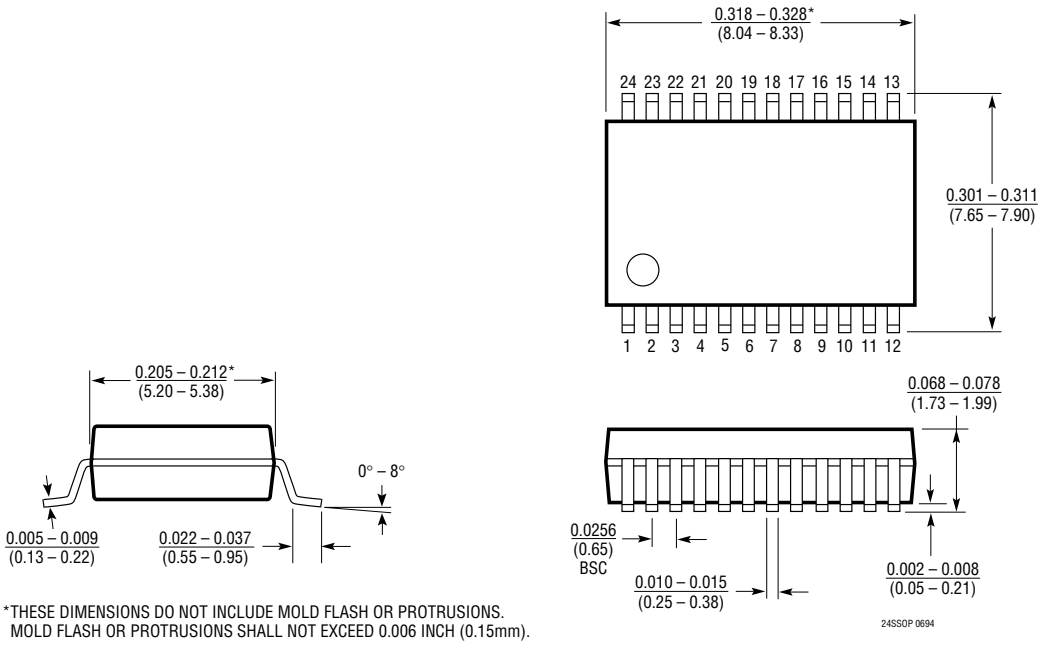
EN0	EN1	V_{CC0}	V_{CC1}	VPP_{OUT}	DRV3	DRV5
0	0	X	X	GND	X	X
0	1	X	X	V_{CCIN}	X	X
1	0	X	X	VPP_{IN}	X	X
1	1	X	X	Hi-Z	X	X
X	X	1	0	X	1	0
X	X	0	1	X	0	1
X	X	0	0	X	0	0
X	X	1	1	X	0	0

X = DON'T CARE

PACKAGE DESCRIPTION

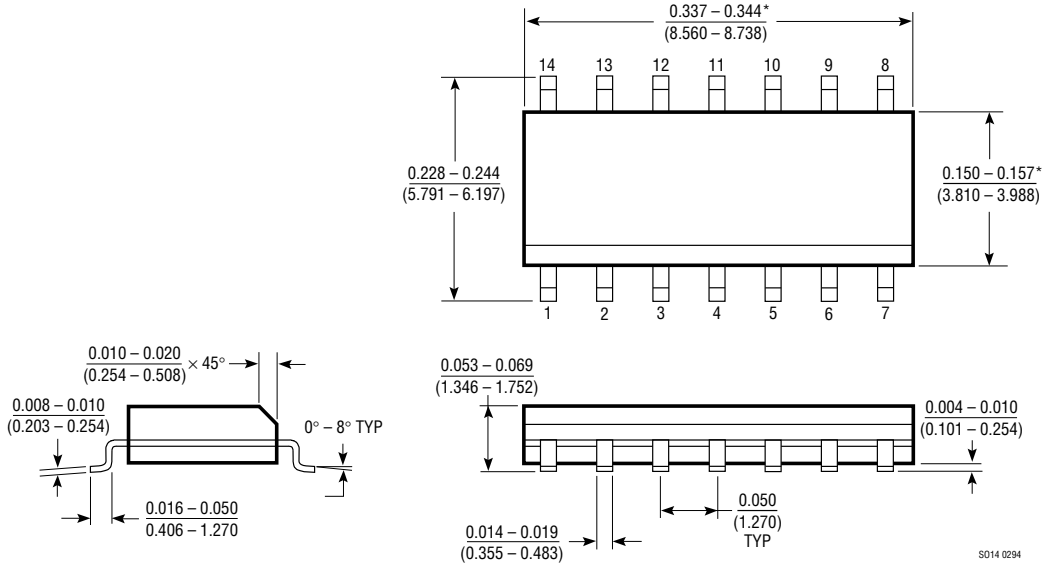
Dimensions in inches (millimeters) unless otherwise noted.

G Package
24-Lead Plastic SSOP



*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

S Package
14-Lead Plastic SOIC



*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

RELATED PARTS

See PCMCIA Product Family table on the first page of this data sheet.

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