

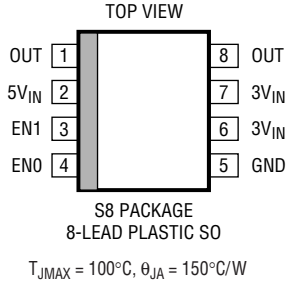
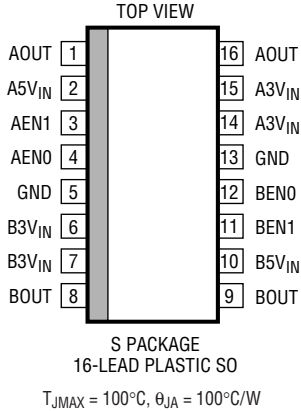
LTC1470/LTC1471

ABSOLUTE MAXIMUM RATINGS (Note 1)

3.3V Supply Voltage ($3V_{IN}$) (Note 2) 7V
 5V Supply Voltage ($5V_{IN}$) (Note 2) 7V
 Enable Input Voltage $5V_{IN}$ to (GND – 0.3V)
 Output Voltage (OFF) (Note 2) 7V to (GND – 0.3V)
 Output Short-Circuit Duration Indefinite

Operating Temperature
 LTC1470C 0°C to 70°C
 LTC1470E (Note 7) –40°C to 85°C
 Junction Temperature 100°C
 Storage Temperature Range –65°C to 150°C
 Lead Temperature (Soldering, 10 sec) 300°C

PACKAGE/ORDER INFORMATION

	ORDER PART NUMBER		ORDER PART NUMBER
	LTC1470CS8 LTC1470ES8		LTC1471CS
	S8 PART MARKING		
	1470 1470E		

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. $3V_{IN} = 3.3\text{V}$, $5V_{IN} = 5\text{V}$ (Note 3), unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$3V_{IN}$	3.3V Supply Voltage Range		2.70		3.60	V
$5V_{IN}$	5V Supply Voltage Range		4.75		5.25	V
I_{3VIN}	3.3V Supply Current	Program to Hi-Z (Note 4)	●	0.01	10	μA
		Program to 3.3V, No Load (Note 4)	●	40	80	μA
		Program to 5V, No Load (Note 4)	●	0.01	10	μA
I_{5VIN}	5V Supply Current	Program to Hi-Z (Note 4)	●	0.01	10	μA
		Program to 3.3V (Note 4)	●	100	160	μA
		Program to 5V (Note 4)	●	140	200	μA
R_{ON}	3.3V Switch ON Resistance	Program to 3.3V, $I_{OUT} = 500\text{mA}$		0.12	0.16	Ω
	5V Switch ON Resistance	Program to 5V, $I_{OUT} = 500\text{mA}$		0.14	0.18	Ω
I_{LKG}	Output Leakage Current OFF	Program to Hi-Z, $0\text{V} \leq V_{OUT} \leq 5\text{V}$ (Note 4)	●		± 10	μA
I_{LIM3V}	3.3V Current Limit	Program to 3.3V, $V_{OUT} = 0\text{V}$ (Note 5)		1		A
I_{LIM5V}	5V Current Limit	Program to 5V, $V_{OUT} = 0\text{V}$ (Note 5)		1		A
V_{ENH}	Enable Input High Voltage		●	2.0		V
V_{ENL}	Enable Input Low Voltage		●		0.8	V
I_{EN}	Enable Input Current	$0\text{V} \leq V_{EN} \leq 5\text{V}$			± 1	μA

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ELECTRICAL CHARACTERISTICS $3V_{IN} = 3.3V$, $5V_{IN} = 5V$ (Note 3), $T_A = 25^\circ C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
t_0 to t_3	Delay and Rise Time (Note 6)	Transition from 0V to 3.3V, $R_{OUT} = 100\Omega$, $C_{OUT} = 1\mu F$	0.2	0.32	1.0	ms
t_3 to t_5	Delay and Rise Time (Note 6)	Transition from 3.3V to 5V, $R_{OUT} = 100\Omega$, $C_{OUT} = 1\mu F$	0.2	0.52	1.0	ms
t_0 to t_5	Delay and Rise Time (Note 6)	Transition from 0V to 5V, $R_{OUT} = 100\Omega$, $C_{OUT} = 1\mu F$	0.2	0.38	1.0	ms

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: For the LTC1470, the two output pins (1, 8) must be connected together and the two 3.3V supply input pins (6, 7) must be connected together. For the LTC1471, the two AOUT pins (1, 16) must be connected together, the two BOUT pins (8, 9) must be connected together, the two A3V_{IN} supply input pins (14, 15) must be connected together, the two B3V_{IN} supply pins (6, 7) must be connected together and the two GND pins (5, 13) must be connected together.

Note 3: Power for the input logic and charge pump circuitry is derived from the 5V_{IN} supply pin(s) which must be continuously powered.

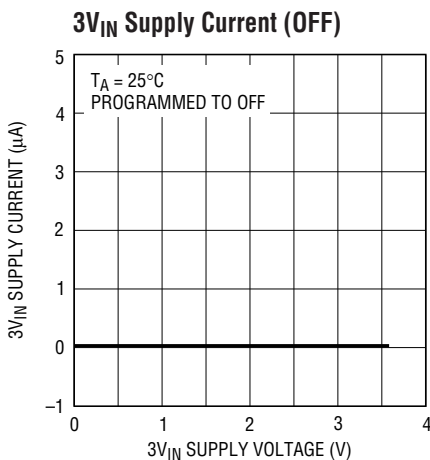
Note 4: Measured current is per channel with the other channel programmed off for the LTC1471.

Note 5: The output is protected with foldback current limit which reduces the short-circuit (0V) currents below peak permissible current levels at higher output voltages.

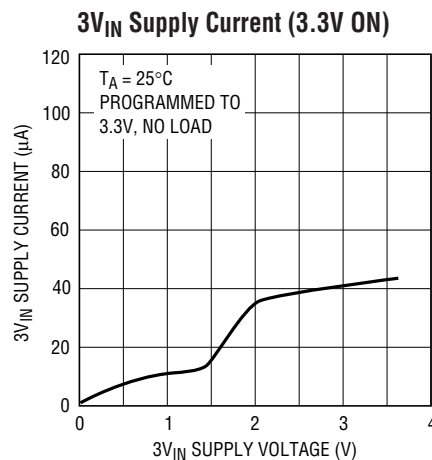
Note 6: To 90% of final value.

Note 7: The LTC1470 is guaranteed to meet performance specifications from 0°C to 70°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

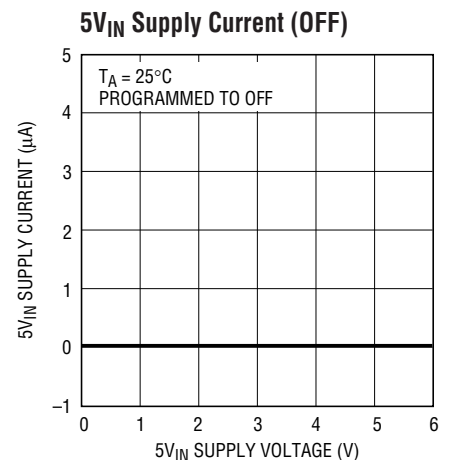
TYPICAL PERFORMANCE CHARACTERISTICS (LTC1470 or 1/2 LTC1471)



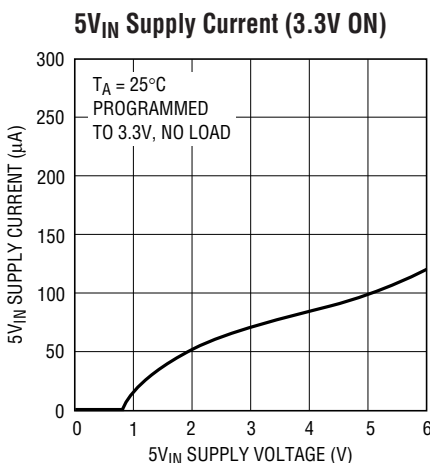
1470/71 G04



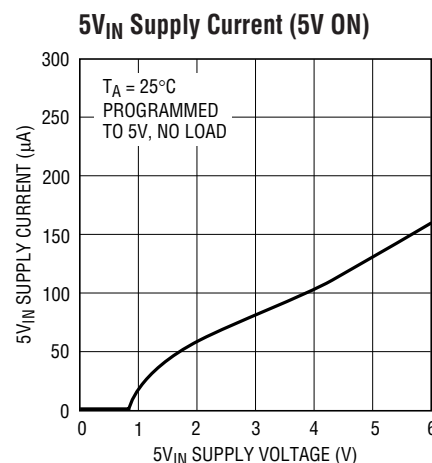
1470/71 G05



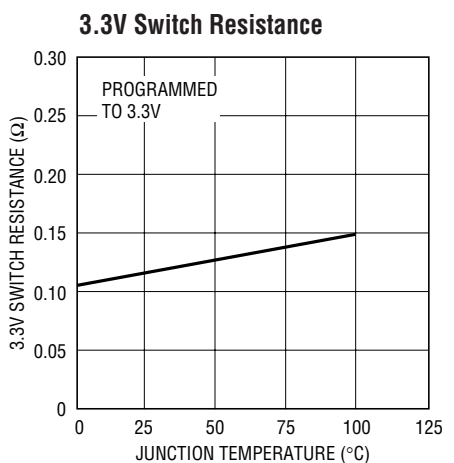
1470/71 G01



1470/71 G03



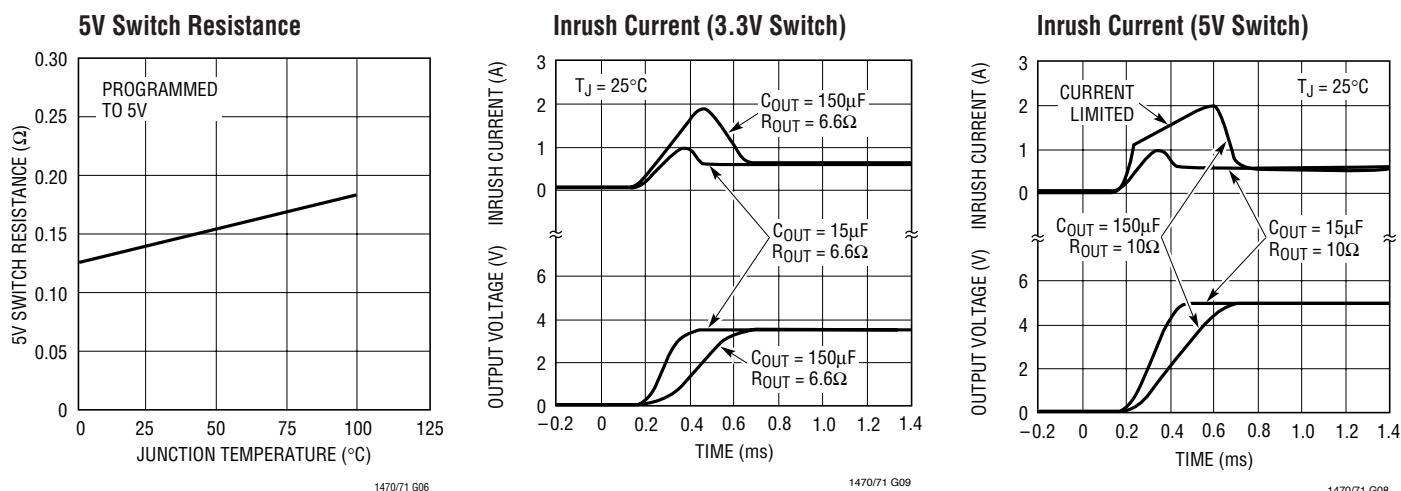
1470/71 G02



1470/71 G07

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TYPICAL PERFORMANCE CHARACTERISTICS (LTC1470 or 1/2 LTC1471)



PIN FUNCTIONS

LTC1470

OUT (Pins 1, 8): Output Pins. The outputs of the LTC1470 are switched between three operating states: OFF, 3.3V and 5V. These pins are protected against accidental short circuits to ground by SafeSlot current limit circuitry which protects the socket, the card, and the system power supplies against damage. A second level of protection is provided by thermal shutdown circuitry which protects both switches against over-temperature conditions.

5V_{IN} (Pin 2): 5V Input Supply Pin. The 5V_{IN} supply pin serves two purposes. The first purpose is as the power supply input for the 5V NMOS switch. The second purpose is to provide power for the input, gate drive, and protection circuitry for both the 3.3V and 5V V_{CC} switches. This pin must therefore be continuously powered.

EN1, EN0 (Pins 3, 4): Enable Inputs. The two V_{CC} Enable inputs are designed to interface directly with industry standard PCMCIA controllers and are high impedance CMOS gates with ESD protection diodes to ground, and

should not be forced above 5V_{IN} or below ground. Both inputs have about 100mV of built-in hysteresis to ensure clean switching between operating modes. The LTC1470 is designed to operate *without* 12V power. The gates of the V_{CC} NMOS switches are powered by charge pumps from the 5V_{IN} supply pins (see Applications Information section for more detail). The Enable inputs should be turned off (both asserted high or both asserted low) at least 100 μs before the 5V_{IN} power is removed to ensure that both V_{CC} NMOS switch gates are fully discharged and both switches are in the high impedance mode.

GND (Pin 5): Ground Connection.

3V_{IN} (Pins 6, 7): 3V Input Supply Pins. The 3V_{IN} supply pins serve as the power supply input for the 3.3V switches. These pins do not provide any power to the internal control circuitry and therefore do not consume any power when unloaded or turned off.

PIN FUNCTIONS

LTC1471

AOUT, BOUT (Pins 1, 16, 8, 9): Output Pins. The outputs of the LTC1471 are switched between three operating states: OFF, 3.3V and 5V. These pins are protected against accidental short circuits to ground by SafeSlot current limit circuitry which protects the socket, the card, and the system power supplies against damage. A second level of protection is provided by thermal shutdown circuitry.

5V_{IN} (Pins 2, 10): 5V Input Supply Pins. The 5V_{IN} supply pins serve two purposes. The first purpose is as the power supply input for the 5V NMOS switches. The second purpose is to provide power for the input, gate drive, and protection circuitry. These pins must therefore be continuously powered.

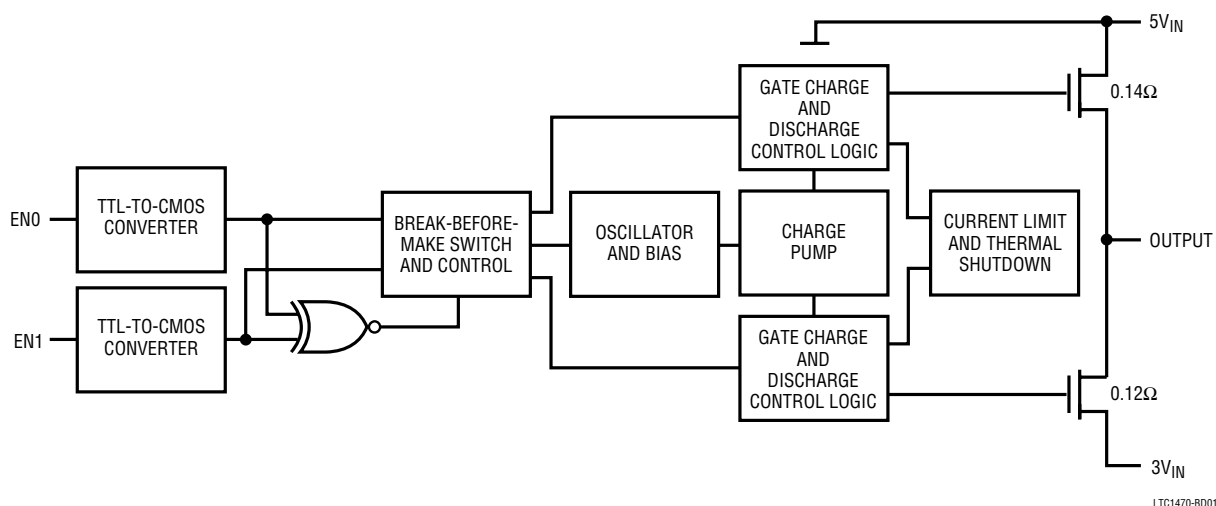
EN1, EN0 (Pins 3, 4, 11, 12): Enable Inputs. The enable inputs are designed to interface directly with industry standard PCMCIA controllers and are high impedance CMOS gates with ESD protection diodes to ground, and

should not be forced above 5V_{IN} or below ground. All four inputs have about 100mV of built-in hysteresis to ensure clean switching between operating modes. The LTC1471 is designed to operate *without* 12V power. The gates of the V_{CC} NMOS switches are powered by charge pumps from the 5V_{IN} supply pins (see Applications Information section for more detail). The enable inputs should be turned off at least 100μs before the 5V_{IN} power is removed to ensure that all NMOS switch gates are fully discharged and are in the high impedance mode.

GND (Pins 5, 13): Ground Connections.

3V_{IN} (Pins 6, 7, 14, 15): 3V Input Supply Pins. The 3V_{IN} supply pins serve as the power supply input for the 3.3V switches. These pins do not provide any power to the internal control circuitry, and therefore, do not consume any power when unloaded or turned off.

BLOCK DIAGRAM (LTC1470 or 1/2 LTC1471)



APPLICATIONS INFORMATION

Truth Table for CL-PD6710 Controller

A_V _{CC_3}	A_V _{CC_5}	OUT
EN0	EN1	
0	0	Hi-Z
0	1	3.3V
1	0	5V
1	1	Hi-Z

Interfacing with “365” Type Controllers

The LTC1470 also interfaces directly with “365” type controllers as shown in Figure 2. Note that the V_{CC} Enable inputs are connected differently than to the CL-PD6710 controller because the “365” type controllers use active-high logic control of the V_{CC} switches (see the following Switch Truth Table). No “glue” logic is required to interface to this type of PCMCIA compatible controller.

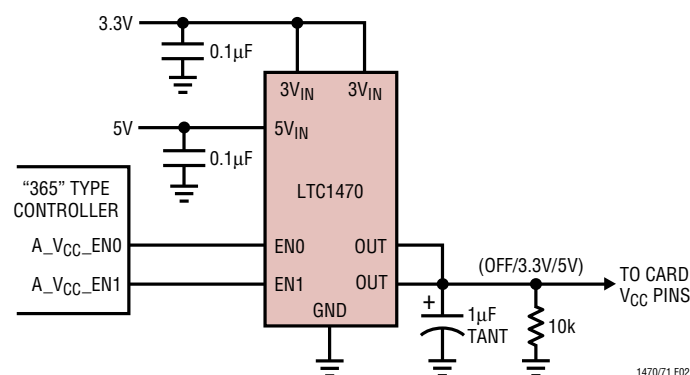


Figure 2. Direct Interface with “365” Type PCMCIA Controller

Truth Table for “365” Type Controller

A_V _{CC_EN0}	A_V _{CC_EN1}	OUT
EN0	EN1	
0	0	Hi-Z
0	1	3.3V
1	0	5V
1	1	Hi-Z

Supply Bypassing

For best results bypass the supply input pins with 1µF capacitors as close as possible to the LTC1470. Sometimes much larger capacitors are already available at the outputs of the 3.3V and 5V power supply. In this case it is still good practice to use 0.1µF capacitors as close as possible to the device, especially if the power supply output capacitors are more than 2" away on the printed circuit board.

Output Capacitors and Pull-Down Resistor

The output pin is designed to ramp on slowly, typically 400µs rise time. Therefore, capacitors as large as 150µF can be driven without producing voltage spikes on the 3V_{IN} or 5V_{IN} supply pins (see graphs in Typical Performance Characteristics section). The output pin should have a 0.1µF to 1µF capacitor for noise reduction and smoothing.

A 10k pull-down resistor is recommended at the output to ensure that the output capacitor is fully discharged when the output is switched OFF. This resistor also ensures that the output is discharged between the 3.3V and 5V transition.

Supply Sequencing

Because the 5V supply is the source of power for both of the switch control circuits, it is best to sequence the power supplies such that the 5V supply is powered before, or simultaneous to, the application of 3.3V.

It is interesting to note, however, that the switches are NMOS transistors which require charge pumps to generate gate voltages higher than the supply rails for full enhancement. Because the gate voltages start at 0V when the supplies are first activated, the switches always start in the off state and do not produce glitches at the outputs when powered.

If the 5V supply must be turned off, it is important to program all switches to the Hi-Z or 0V state at least 100µs before the 5V power is removed to ensure that the NMOS switch gates are fully discharged to 0V. Whenever possible, however, it is best to leave the 5V_{IN} pin(s) continuously powered. The LTC1470/LTC1471 quiescent current drops to <1µA with all the switches turned off and therefore no 5V power is consumed in the standby mode.

APPLICATIONS INFORMATION

TOTAL SYSTEM COST CONSIDERATIONS

The cost of an additional step-up switching regulator, inductor, rectifier and capacitors to produce 12V for VPP can be eliminated by using an auxiliary winding on either the 3.3V or 5V output of the system switching regulator to produce an auxiliary 15V supply for VPP power.

And, because the LTC1470/LTC1471 do not require 12V power to operate (only 5V), the 12V VPP regulation and switching may be operated separately from the 3.3V/5V V_{CC} switching. This increases system configuration flexibility and *reduces total system cost* by eliminating the need for a third regulator for 12V power.

LTC1142HV Auxiliary Winding Power Supply

Figure 3 is a schematic diagram which describes how a loosely regulated 15V power supply is created by adding an auxiliary winding to the 5V inductor in a split 3.3V/5V LTC1142HV power supply system. An LT1313, dual VPP regulator/driver with SafeSlot protection, produces “clean” 3.3V, 5V and 12V power from this loosely regulated 15V output for the PC card slot VPP pins. (See LT1312 and LT1313 data sheets for further detail.)

A turns ratio of 1:1.8 is used for transformer T1 to ensure that the input voltage to the LT1313 falls between 13V and 20V under all load conditions. The 9V output from this additional

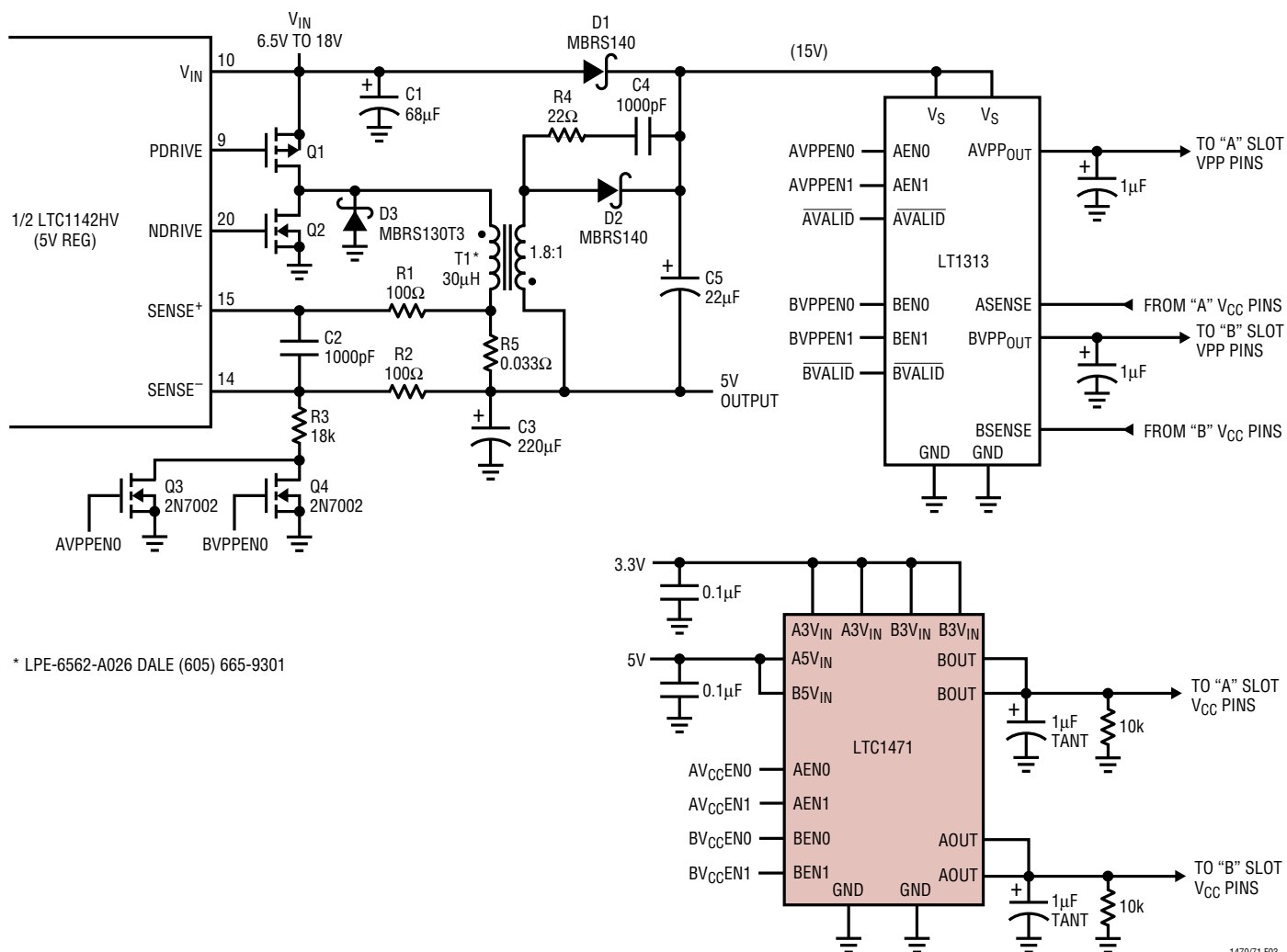
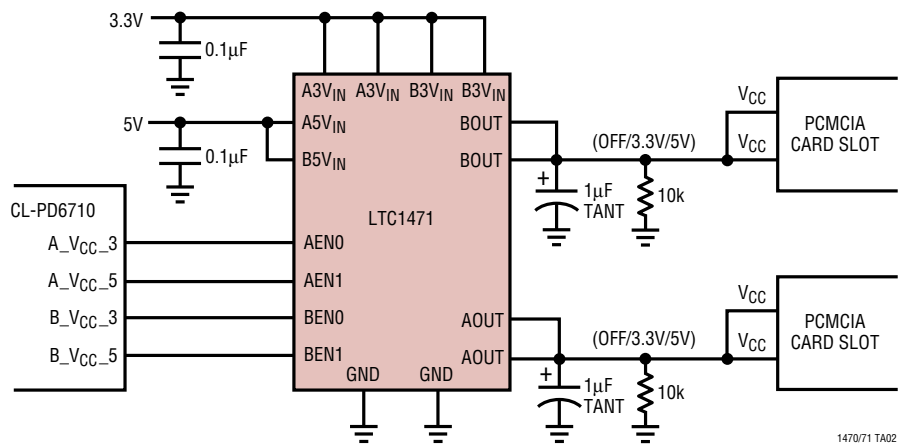


Figure 3. Cost Effective Complete SafeSlot Dual PCMCIA Power Management System (with 15V Auxiliary Supply from LTC1142HV 5V Regulator Inductor)

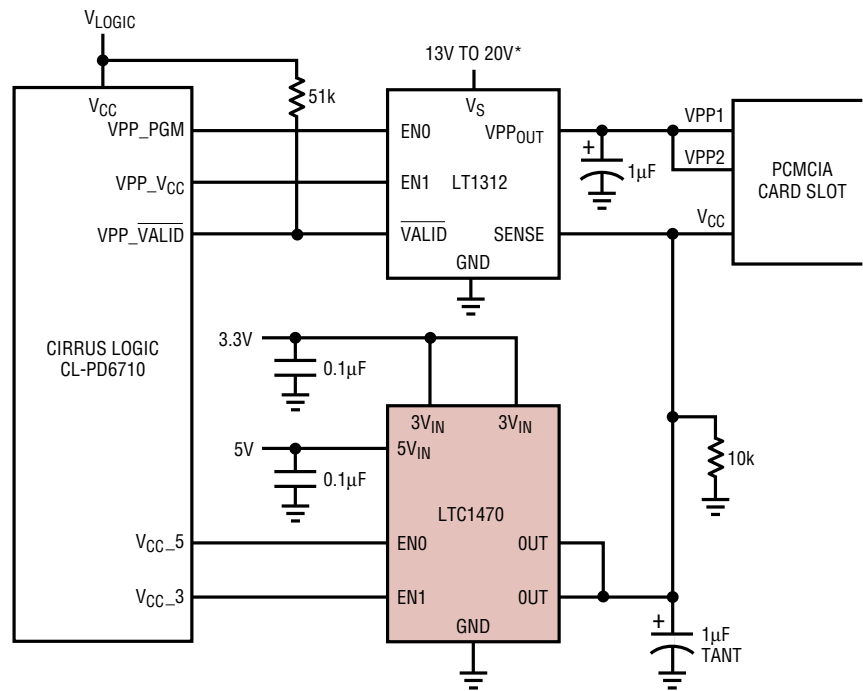
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TYPICAL APPLICATIONS

Dual Slot 3.3V/5V PCMCIA Controller with SafeSlot Current Limit
(Systems with No 12V Power Requirements)



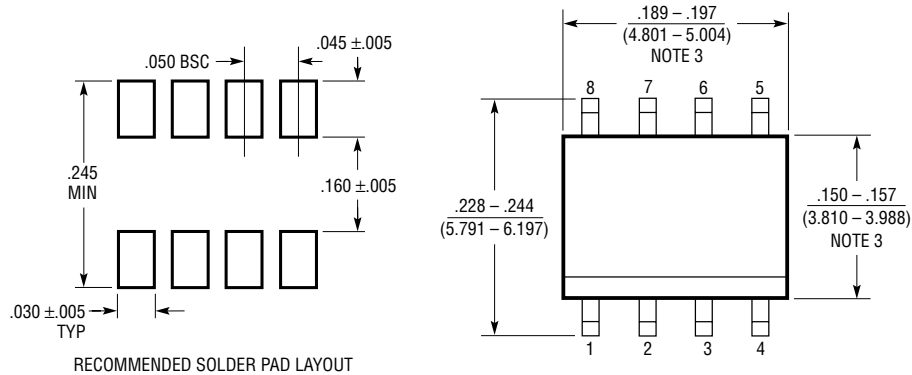
Single Slot PCMCIA Controller with SafeSlot Current Limit
Protection Using LT1312 Single VPP Regulator/Driver



* FROM OVERWINDING ON 3.3V OR 5V INDUCTOR IN SYSTEM POWER SUPPLY.
SEE FIGURES 3, 4 FOR FURTHER DETAIL

PACKAGE DESCRIPTION

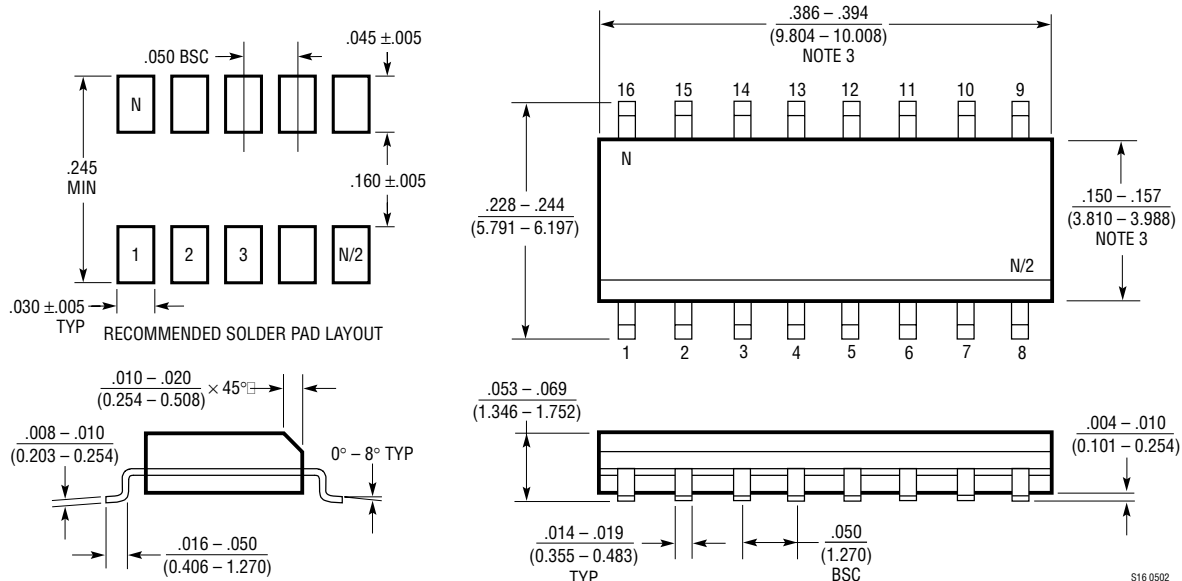
S8 Package 8-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610)



NOTE:
1. DIMENSIONS IN INCHES (MILLIMETERS)
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

S08 0303

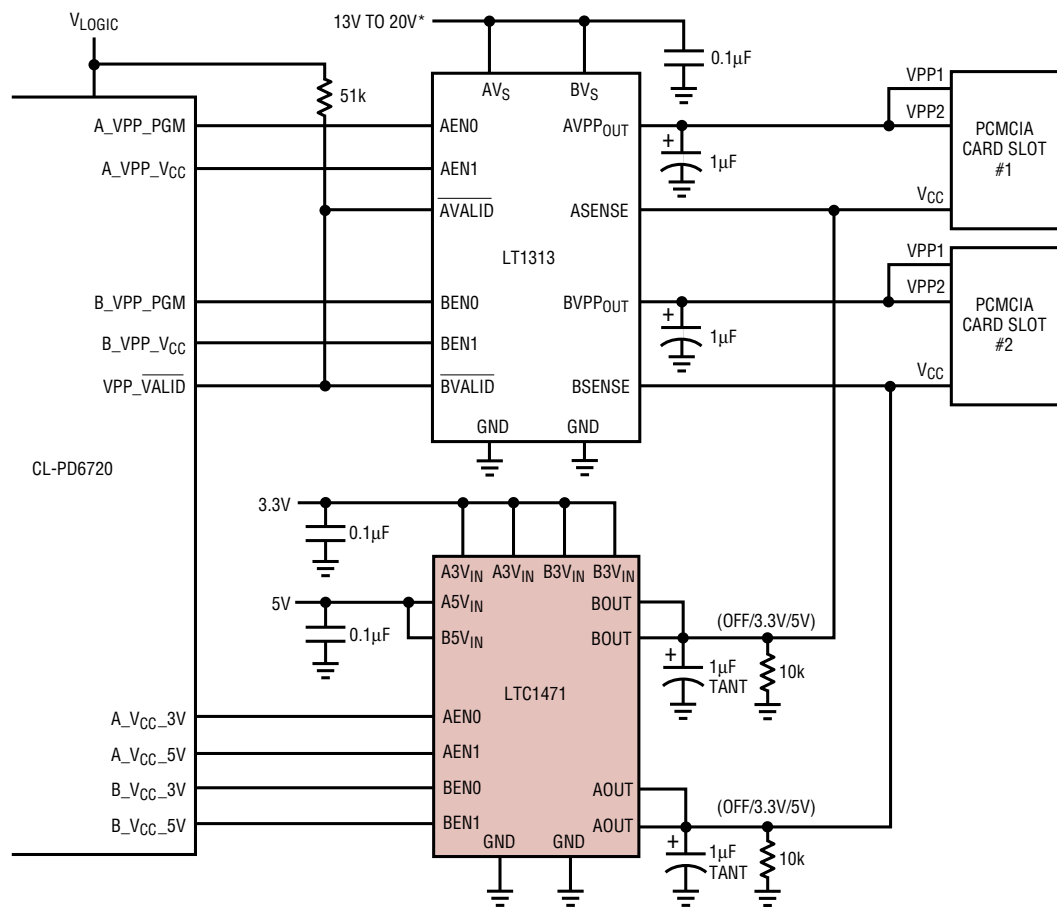
S Package 16-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610)



NOTE:
1. DIMENSIONS IN INCHES (MILLIMETERS)
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

S16 0502

TYPICAL APPLICATIONS



* FROM OVERWINDING ON 3.3V OR 5V INDUCTOR IN SYSTEM POWER SUPPLY.
SEE FIGURES 3, 4 FOR FURTHER DETAILS

1470/71 TA04

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC3405/LTC3405A LTC3405A-1.5 LTC3405A-1.8	300mA (I _{OUT}), 1.5MHz, Synchronous Step-Down DC/DC Converters	95% Efficiency, V _{IN} = 2.7V to 6V, V _{OUT} = 0.8V, I _Q = 20µA I _{SD} = <1µA, ThinSOT Package
LTC3406/LTC3406B	600mA (I _{OUT}) 1.5MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V _{IN} = 2.5V to 5.5V, V _{OUT} = 0.6V, I _Q = 20µA I _{SD} = <1µA, ThinSOT Package
LTC3411	1.25A (I _{OUT}), 4MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V _{IN} = 2.5V to 5.5V, V _{OUT} = 0.8V, I _Q = 60µA I _{SD} = <1µA, MS10 Package
LTC3412	2.5A (I _{OUT}), 4MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V _{IN} = 2.5V to 5.5V, V _{OUT} = 0.8V, I _Q = 60µA I _{SD} = <1µA, TSSOP16E Package
LTC3413	3A (I _{OUT}), Sink/Source, 2MHz, Monolithic Synchronous Regulator for DDR/QDR Memory Termination	90% Efficiency, V _{IN} = 2.25V to 5.5V, V _{OUT} = V _{REF} /2, I _Q = 280µA I _{SD} = <1µA, TSSOP16E Package
LT3430	60V, 2.75A (I _{OUT}), 200kHz, High Efficiency Step-Down DC/DC Converter	90% Efficiency, V _{IN} = 5.5V to 60V, V _{OUT} = 1.20V, I _Q = 2.5mA I _{SD} = 25µA, TSSOP16E Package
LTC3440	600mA (I _{OUT}), 2MHz, Synchronous Buck-Boost DC/DC Converter	95% Efficiency, V _{IN} = 2.5V to 5.5V, V _{OUT} = 2.5V, I _Q = 25µA I _{SD} = <1µA, MS Package

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