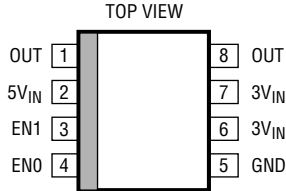
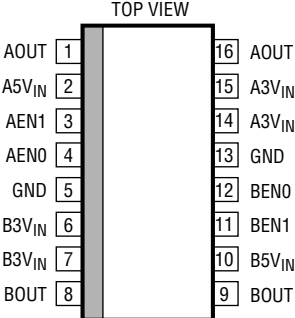


LTC1470/LTC1471

ABSOLUTE MAXIMUM RATINGS (Note 1)

3.3V Supply Voltage ($3V_{IN}$) (Note 2)	7V	Operating Temperature	
5V Supply Voltage ($5V_{IN}$) (Note 2)	7V	LTC1470C	0°C to 70°C
Enable Input Voltage	$5V_{IN}$ to (GND – 0.3V)	LTC1470E (Note 7)	–40°C to 85°C
Output Voltage (OFF) (Note 2)	7V to (GND – 0.3V)	Junction Temperature	100°C
Output Short-Circuit Duration	Indefinite	Storage Temperature Range	–65°C to 150°C
		Lead Temperature (Soldering, 10 sec)	300°C

PACKAGE/ORDER INFORMATION

 S8 PACKAGE 8-LEAD PLASTIC SO $T_{JMAX} = 100^{\circ}\text{C}$, $\theta_{JA} = 150^{\circ}\text{C/W}$	ORDER PART NUMBER	 S PACKAGE 16-LEAD PLASTIC SO $T_{JMAX} = 100^{\circ}\text{C}$, $\theta_{JA} = 100^{\circ}\text{C/W}$	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

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.

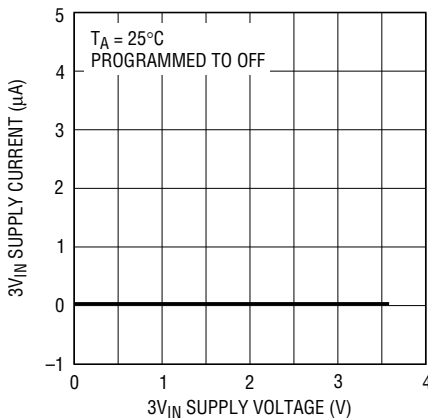
Note 5: The output is protected with foldback current limit which reduces the short-circuit (0V) currents below peak permissible current levels at higher output voltages.

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.

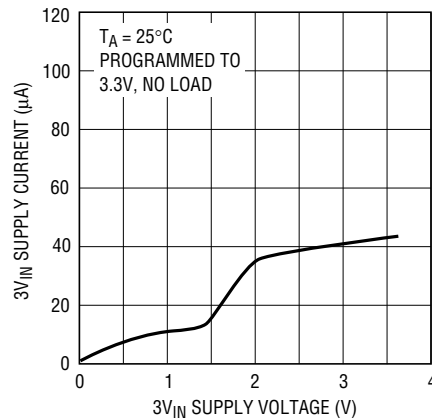
TYPICAL PERFORMANCE CHARACTERISTICS (LTC1470 or 1/2 LTC1471)

3V_{IN} Supply Current (OFF)



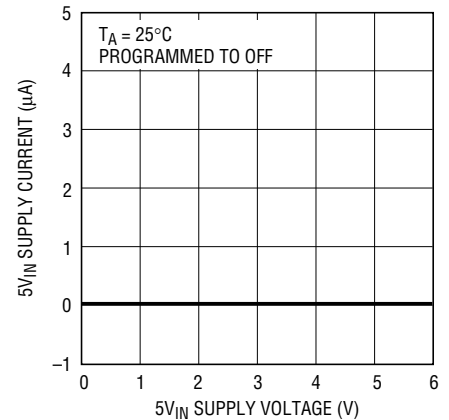
1470/71 G04

3V_{IN} Supply Current (3.3V ON)



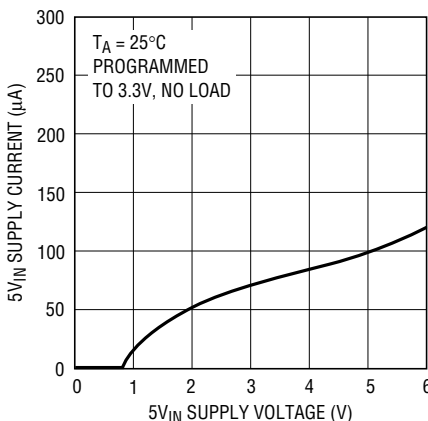
1470/71 G05

5V_{IN} Supply Current (OFF)



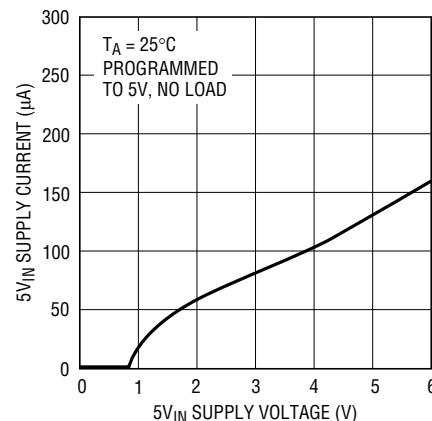
1470/71 G01

5V_{IN} Supply Current (3.3V ON)



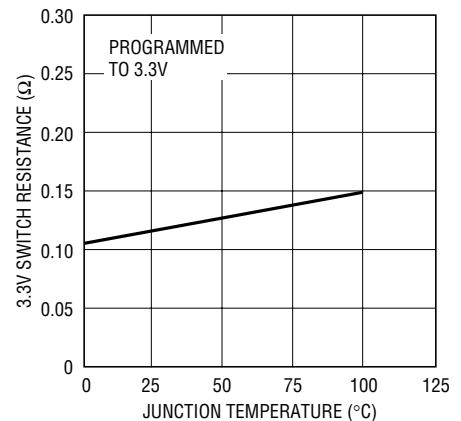
1470/71 G03

5V_{IN} Supply Current (5V ON)



1470/71 G02

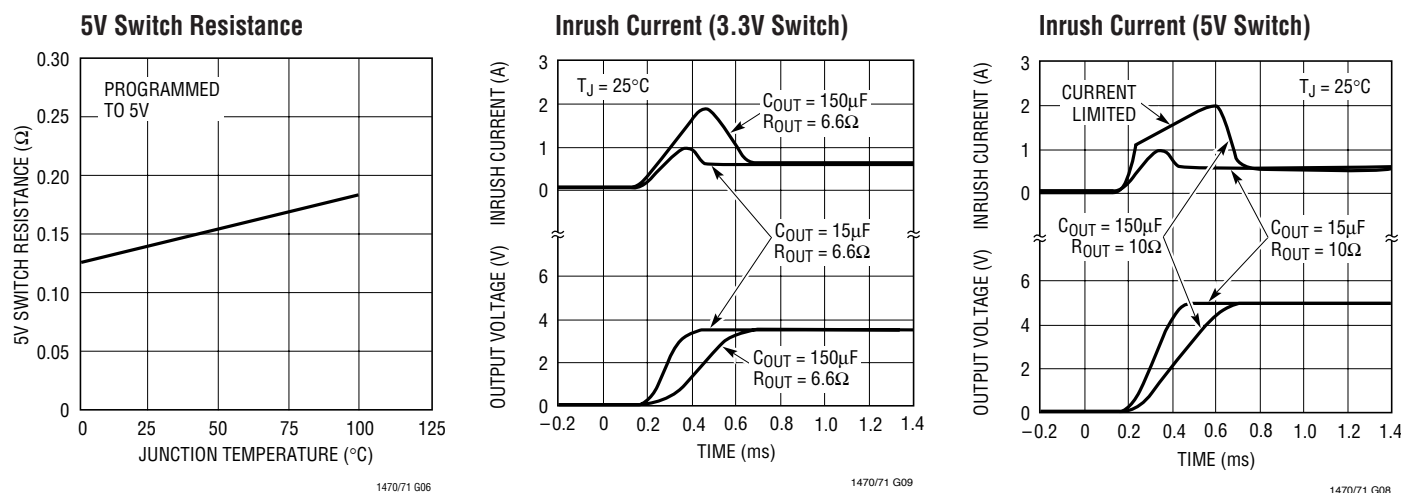
3.3V Switch Resistance



1470/71 G07

14701fa

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.

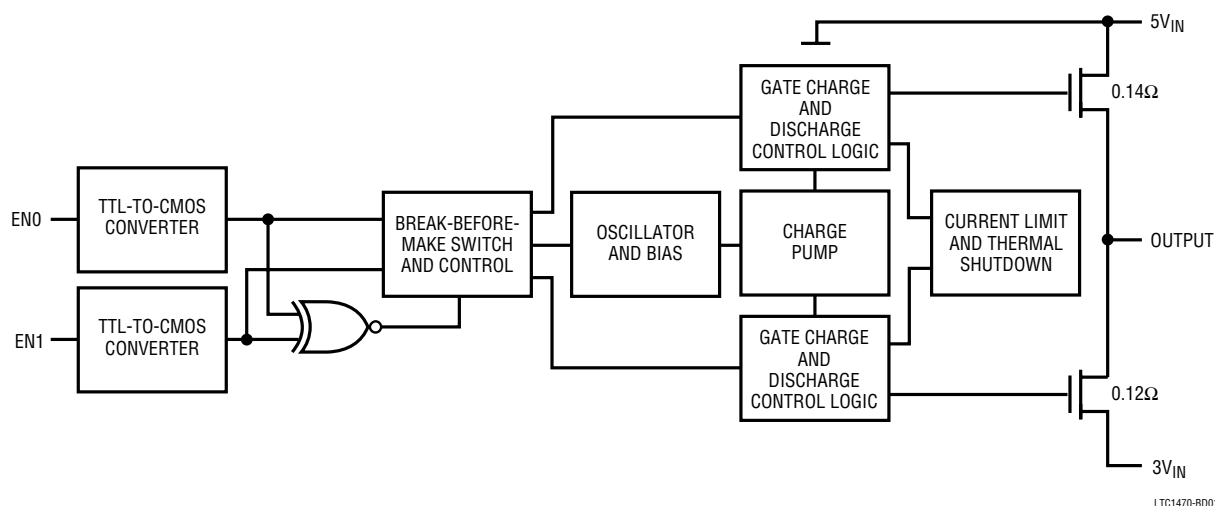
EN1, EN0 (Pins 3, 4, 11, 12): Enable Inputs. The enable inputs are designed to interface directly with industry standard PCMCIA controllers and are high impedance CMOS gates with ESD protection diodes to ground, and

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)



OPERATION

The LTC1470 (or 1/2 of the LTC1471) consists of the following functional blocks:

Input TTL/CMOS Converters

The enable inputs are designed to accommodate a wide range of 3V and 5V logic families. The input threshold voltage is approximately 1.4V with approximately 100mV of hysteresis. The inputs enable the bias generator, the gate charge pumps and the protection circuitry which are powered from the 5V supply. Therefore, when the inputs are turned off, the entire circuit is powered down and the 5V supply current drops below 1 μ A.

XOR Input Circuitry

By employing an XOR function, which locks out the 3.3V switch when the 5V switch is turned on and locks out the 5V switch when the 3.3V switch is turned on, there is no danger of both switches being on at the same time. This XOR function also makes it possible to work with either active-low or active-high PCMCIA V_{CC} switch control logic (see Applications Information section for further details).

Break-Before-Make Switch Control

Built-in delays are provided to ensure that the 3.3V and 5V switches are non-overlapping. Further, the gate charge pump includes circuitry which ramps the NMOS switches

on slowly (400 μ s typical rise time) but turns them off much more quickly (typically 10 μ s).

Bias, Oscillator and Gate Charge Pump

When either the 3.3V or 5V switch is enabled, a bias current generator and high frequency oscillator are turned on. The on-chip capacitive charge pump generates approximately 12V of gate drive for the internal low $R_{DS(ON)}$ NMOS V_{CC} switches from the 5V_{IN} power supply. Therefore, an external 12V supply is not required to switch the V_{CC} output. The 5V_{IN} supply current drops below 1 μ A when both switches are turned off.

Gate Charge and Discharge Control

All switches are designed to ramp on slowly (400 μ s typical rise time). Turn-off time is much quicker (typically 10 μ s). To ensure that both V_{CC} NMOS switch gates are fully discharged, program the switch to the high impedance mode at least 100 μ s before turning off the 5V power supply.

Switch Protection

Both switches are protected against accidental short circuits with SafeSlot foldback current limit circuits which limit the output current to typically 1A when the output is shorted to ground. Both switches also have thermal shut-down which limits the power dissipation to safe levels.

APPLICATIONS INFORMATION

The LTC1470/LTC1471 are designed to interface directly with industry standard PCMCIA card controllers.

Interfacing with the CL-PD6710

Figure 1 is a schematic diagram showing the LTC1470 interfaced with a standard PCMCIA slot controller. The LTC1470 accepts logic control directly from the CL-PD6710.

The XOR input function allows the LTC1470 to interface directly to the active-low V_{CC} control outputs of the CL-PD6710 for 3.3V/5V voltage selection (see the following Switch Truth Table). Therefore, no "glue" logic is required to interface to this PCMCIA compatible card controller.

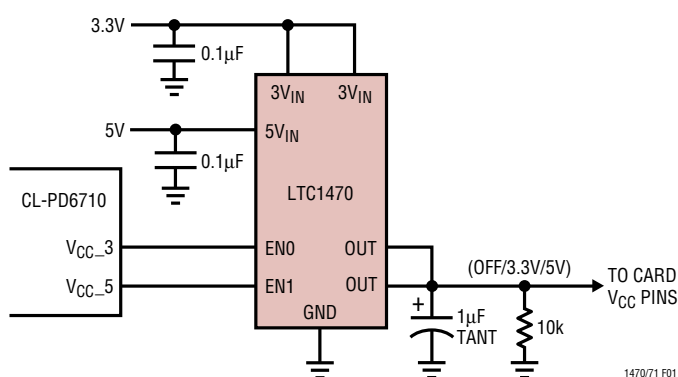


Figure 1. Direct Interface to CL-PD6710 PCMCIA Controller

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

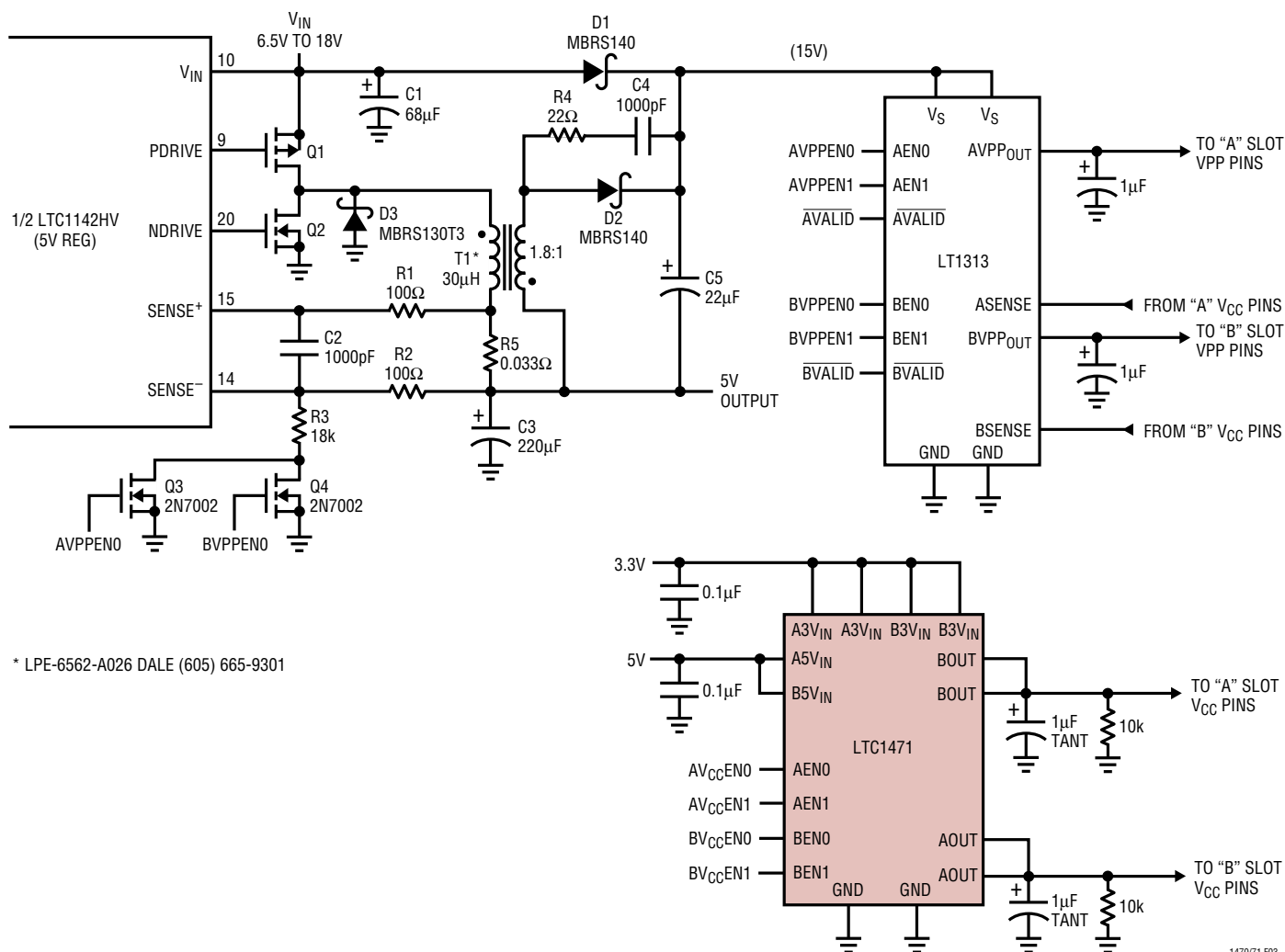


Figure 3. Cost Effective Complete SafeSlot Dual PCMCIA Power Management System (with 15V Auxiliary Supply from LTC1142HV 5V Regulator Inductor)

The schematic diagram illustrates the PCMCIA card slot control circuit. It features three main components: the Cirrus Logic CL-PD6710, the LT1312 voltage detector, and the LTC1470 voltage detector.

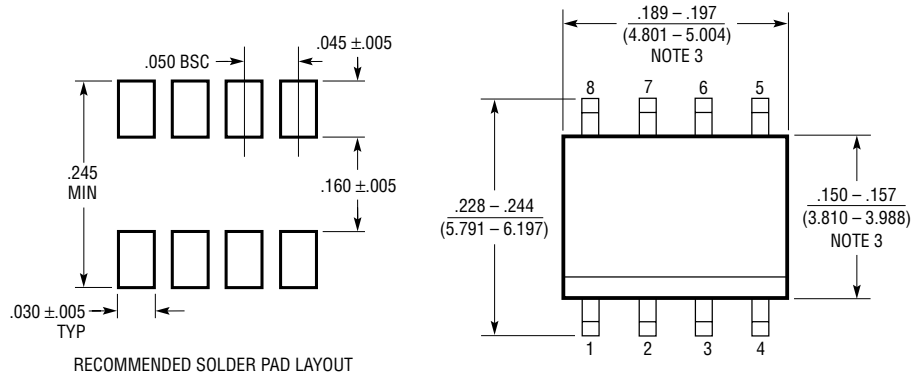
- Cirrus Logic CL-PD6710:** This component provides the control signals for the PCMCIA card slot. Its pins are connected as follows:
 - VCC:** Connected to the VCC pin of the LT1312 and the VCC pin of the LTC1470.
 - VPP_PGM:** Connected to the EN0 pin of the LT1312.
 - VPP_VCC:** Connected to the EN1 pin of the LT1312.
 - VPP_VALID:** Connected to the VALID pin of the LT1312.
 - VCC_5:** Connected to the EN0 pin of the LTC1470.
 - VCC_3:** Connected to the EN1 pin of the LTC1470.
- LT1312 Voltage Detector:** This component is used to detect the presence of a card in the slot. Its pins are connected as follows:
 - VS:** Connected to a 13V to 20V* source.
 - EN0:** Connected to the VPP_PGM signal from the CL-PD6710.
 - EN1:** Connected to the VPP_VCC signal from the CL-PD6710.
 - VALID:** Connected to the VPP_VALID signal from the CL-PD6710.
 - SENSE:** Connected to the VCC pin of the LTC1470.
 - GND:** Connected to ground.
- LTC1470 Voltage Detector:** This component is used to detect the presence of a card in the slot. Its pins are connected as follows:
 - 3VIN:** Connected to a 3.3V source.
 - 5VIN:** Connected to a 5V source.
 - EN0:** Connected to the VCC_5 signal from the CL-PD6710.
 - EN1:** Connected to the VCC_3 signal from the CL-PD6710.
 - OUT:** Connected to the VCC pin of the LT1312.
 - GND:** Connected to ground.
- PCMCIA Card Slot:** This component is connected to the VPP1, VPP2, and VCC pins of the LT1312.

The circuit also includes several passive components: a 51k resistor connected between VPP_PGM and VPP_VALID; a 1μF capacitor connected between VPP1 and VPP2; a 10k resistor connected between VCC and ground; and two 0.1μF capacitors connected between the 3.3V and 5V sources and ground.

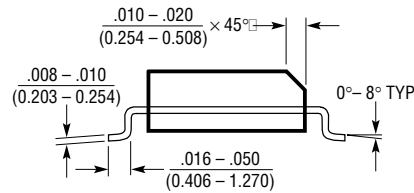
1470/71 TA03

PACKAGE DESCRIPTION

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



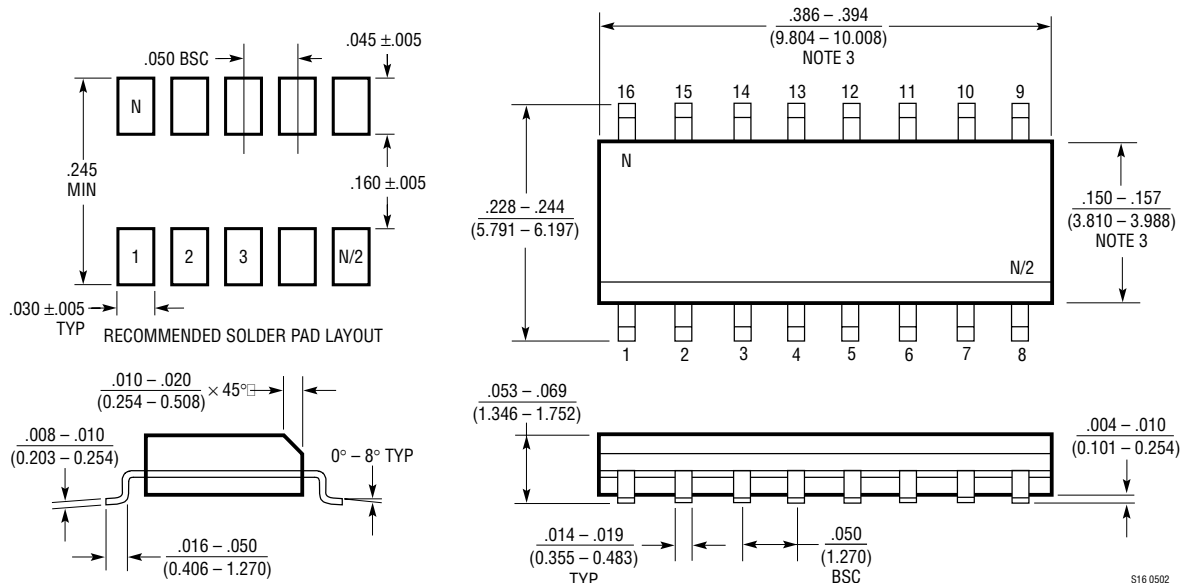
RECOMMENDED SOLDER PAD LAYOUT



- 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

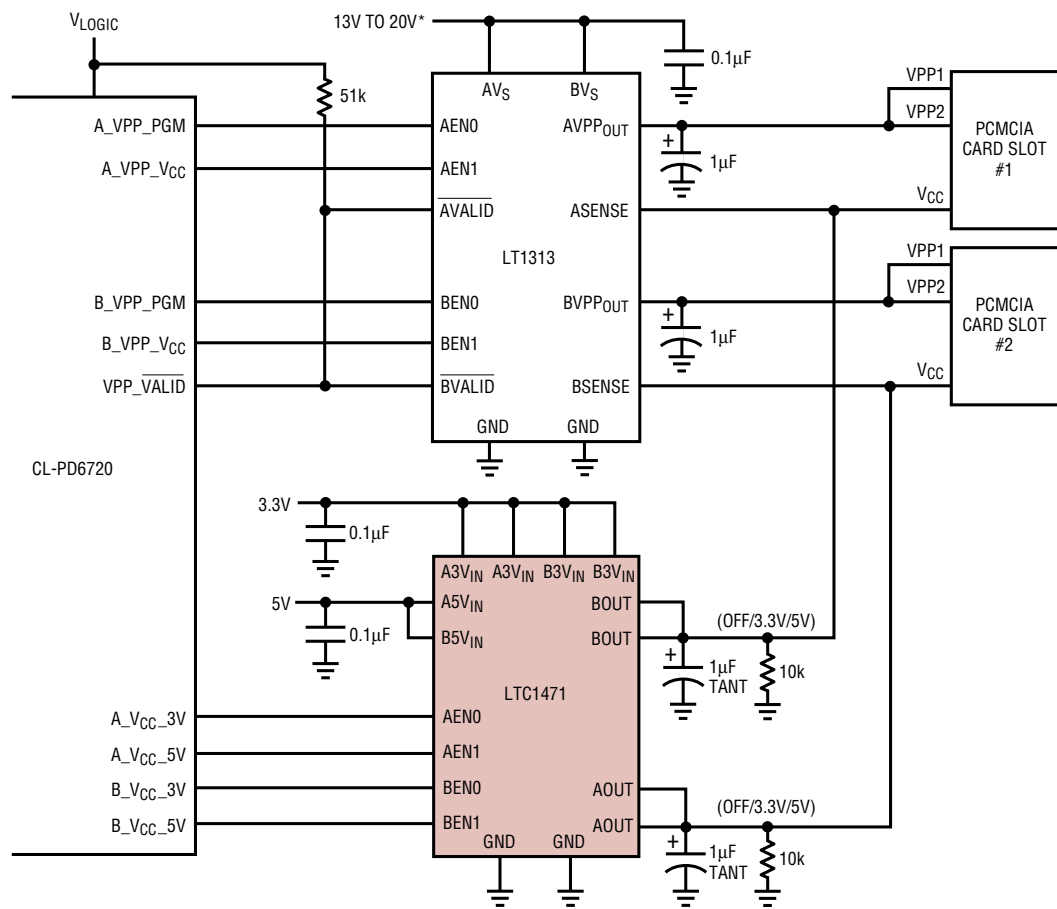
S Package 16-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610)



- 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

147011a