LTC2952 Pushbutton On/Off Power Path Controller

DESCRIPTION

Demonstration circuit 1033B features the LTC©2952, a micropower, multipurpose, pushbutton On/Off PowerPath™ controller that provides voltage monitoring and supervisory features, as well as ideal diode power paths. Selectable PowerPath management modes allow a variety of power on and off configurations, including pushbutton on/off control and voltage detection on/off control.

The LTC2952's pushbutton input has independently programmable ON and OFF de-bounce times. A simple microprocessor interface allows for proper system housekeeping prior to power down. The status of digital pins G1STAT, $\overline{PFO}$, $\overline{RST}$ and $\overline{INT}$ are displayed with LEDs. Under system fault conditions, the part's internal $\overline{KILL}$ timer ensures that the system can be shut down. High reliability systems may utilize the LTC2952's power fail, voltage monitoring, diode status, watchdog and µP reset features to monitor power status and ensure system integrity.

The DC1033B operates over the full LTC2952 range of 2.7V to 28V to accommodate a wide variety of input power supplies. Low forward drop ideal diodes and very low standby current (25µA typ) make the LTC2952 ideally suited for battery powered or power conscious applications.

Design files for this circuit board are available at http://www.linear.com/demo/DC1033B

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range	V1 and/or V2	2.7V to 28V
Output Voltage V_S	Configuration A	V1 or V2*
	Configuration B	V1 or V2*
	Configuration C, Pushbutton Enable On	V1 or V2*
	Configuration D, Pushbutton Enable On, V2 > V2 Threshold	V1 or V2*
DC/DC Out 2P6V	Configuration A-D, Pushbutton Enable On	2.6V
V2 Trip Threshold	Default Resistors (R9 and R10), JP2 Set to Monitor V2	4.725V
Power Fail Input Voltage PFI	Default Resistors (R3 and R4) Monitor V_S	3.055V
	Resistor Options (R17 and R4) Set to Monitor V2	3.055V
Voltage Monitor VM	Default Resistors (R1 and R2) Monitor 2P6V	2.325V
	Resistor Options (R16 and R2) Set to Monitor V_S	3.055V
Pushbutton On Time ONT	JP3 Set to OPEN, LTC2952 Default ONT	26ms
	JP3 Set to CAP to Connect 22nF to ONT Pin	26ms + 205ms
Pushbutton Off Time OFFT	JP4 Set to OPEN, LTC2952 Default OFFT	26ms
	JP4 Set to CAP to Connect 68nF to OFFT Pin	26ms + 632ms

* V_S will be the ideal diode OR of V1 and V2. There is only a slight voltage drop across the ideal diode.

QUICK START PROCEDURE

(Configuration A)

Demonstration circuit 1033B is easy to set up to evaluate the performance of the LTC2952. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below. This Quick Start Procedure sets up the DC1033B for Configuration A. See Operating Principles for further description of the different configurations

1. Place jumpers in the following positions:

   JP1: LO

   JP2: LO

   JP3: CAP

   JP4: CAP

   JP5: UNTIE

2. Connect a voltmeter across V_S and GND.
3. Apply a voltage of 2.7V to 28V across V2 (WALL).
4. Apply a voltage of 2.7V to 28V across V1 (BAT).
5. Measure V_S, which will be the ideal diode OR of the higher supply V2 or V1.
6. Push down once and hold on Pushbutton SW1 for a Turn On. Observe both SUP_EN and $\overline{RST}$ LEDs turn on. After a short period, $\overline{RST}$ turns off.
7. Push down again and hold on Pushbutton SW1 for a Turn Off. Observe while SUP_EN LED is on, $\overline{INT}$ LED turns on momentarily. After a short period, both SUP_EN and $\overline{INT}$ LEDs turn off.

Note: LED sequence in steps 6 and 7 are the same for configurations A through D.

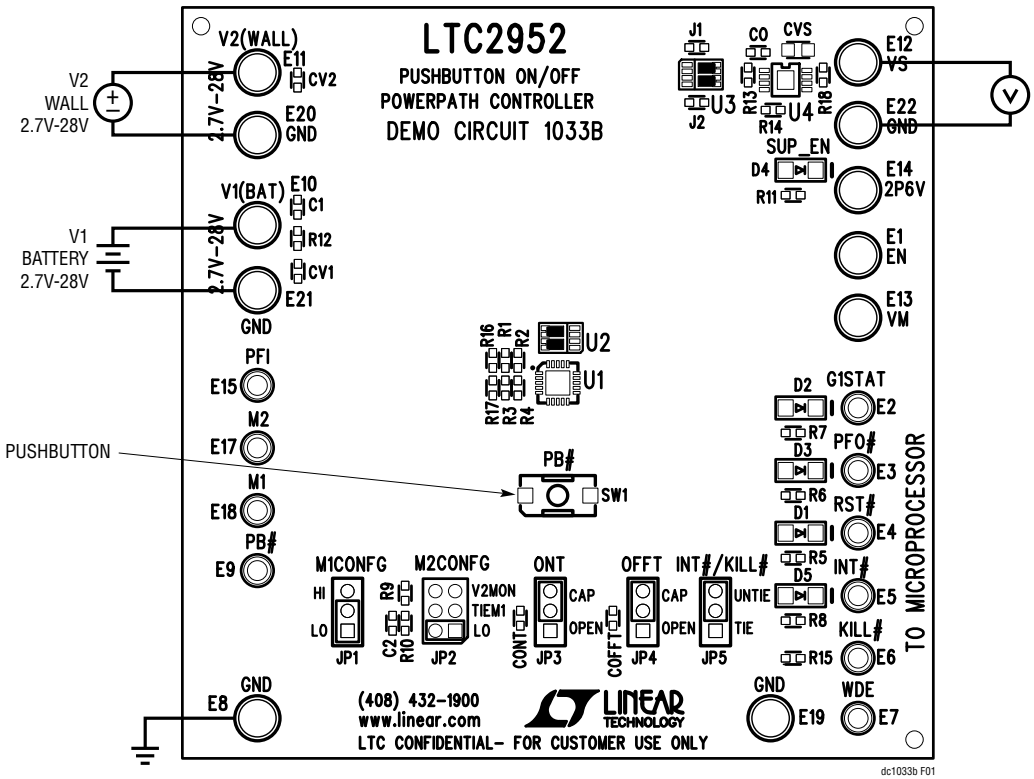


Figure 1. Basic Equipment Setup

OPERATING PRINCIPLES

The DC1033B operates from 2.7V to 28V applied to either V1 or V2. Configuration of M1 and M2 of the LTC2952 determines the power path to the output voltage and the example DC/DC converter (U4). P-Channel MOSFETs U2 and U3 are driven by the LTC2952 for the ideal diode feature providing a low forward voltage drop. J1 and J2 provide a bypass option if one or both of the PFETs in U3 are not needed. A pushbutton turns on and off the Enable that drives the DC/DC converter and in some configuration also turns on and off the ideal diode power paths. The pushbutton on and off times are set by jumper selectable external capacitors. The status of G1STAT indicates the status of G1. $\overline{PFO}$ gives an output signal (shown with an LED) if voltage at the PFI input is below the threshold. $\overline{RST}$ and $\overline{INT}$ provide maintenance to a microprocessor on a power up or power down. Immediate shutdown can be done by pulling low on $\overline{KILL}$.

CONFIGURATION A

(M1 low, M2 low): Pushbutton Controller with Automatic Load Switching Between WALL and Battery

Set both JP1 (M1CONFG) and JP2 (M2CONFG) to LO to enable both ideal diodes always. V_S will be the ideal diode OR of V1 and V2 where V_S equals the higher of the two supplies minus the slight ideal diode drop. G1STAT LED turns on when V2 > V1. The pushbutton turns on and off the EN pin which drives the shutdown of the DC/DC converter.

CONFIGURATION B

(M1 low, M2 monitor): Pushbutton Controller with Preferential WALL Operation and Automatic Load Switching to Battery

Set JP1 (M1CONFG) to LO and JP2 (M2CONFG) to V2MON to configure M2 as a monitor on the Wall Adapter voltage V2. When V2 is above the trip threshold, the ideal diode for V2 is turned on always, while the ideal diode for V1 is shutdown, even if V1 is greater than V2. V_S will then equal V2 minus the ideal diode voltage drop.

When V2 falls below the trip threshold, both ideal diodes are enabled. V_S will be the ideal diode OR of V1 and V2 where V_S equals the higher of the two supplies minus the slight ideal diode drop. The pushbutton turns on and off the EN pin which drives the shutdown of the DC/DC converter.

CONFIGURATION C

(M1 high, M2 high): Pushbutton Control of Ideal Diodes Drivers

Set JP1 (M1CONFG) to HI and JP2 (M2CONFG) to TIEM1. M1 has an internal pull-up current and pulls up M2 as well when tied together. This sets up the pushbutton to have full control on both ideal diodes and the EN pin. On a pushbutton turn on, both ideal diode drivers are turned on as well as the DC/DC converter. V_S will be the ideal diode OR of V1 and V2 where V_S equals the higher of the two supplies minus the ideal diode drop. On a pushbutton turn off, both ideal diode drivers are shutdown and V_S is turned off.

CONFIGURATION D

(M1 high, M2 monitor): Battery Backup with Pushbutton Power Path Controller

Set JP1 (M1CONFG) to HI and JP2 (M2CONFG) to V2MON. M1 is set high due to its internal pull-up current. M2 monitors V2. When V2 is below the trip threshold, both ideal diodes are shutdown always and the input to the $\overline{PB}$ pin is ignored. When V2 is above the trip threshold, the pushbutton has full control of the EN pin and ideal diode drivers.

Also while M1 is high, a transition on M2 will force a pushbutton turn on or turn off. To test this, move the V2 input to be above and below the trip threshold.

OPERATING PRINCIPLES

ONT/OFFT PROGRAMMING

Additional pushbutton turn on and off de-bounce time can be set by attaching a capacitor from the ONT and OFFT pins to GND and can be done through JP3 and JP4, respectively, on the DC1033B. Select OPEN for the Internal Default Time of the LTC2952 only or choose CAP for additional timing. See figures 2, 3, 4 and 5 for timing differences. The additional timing can be calculated using the following equations:

$t_{ONT} = C_{ONT}$ [F] • 9.3 x 106 [Ω]

$t_{OFFT} = C_{OFFT}$ [F] • 9.3 x 106 [Ω]

$\overline{\text{INT}}$/$\overline{\text{KILL}}$

The $\overline{\text{INT}}$ pin can be tied to the $\overline{\text{KILL}}$ pin through JP5 to immediately shutdown when $\overline{\text{INT}}$ pulls low during a turn off sequence. When the pins are untied, the $\overline{\text{INT}}$ pin becomes open collector for the interrupt period before power is turned off.

VOLTAGE MONITORS PFI AND VM

Voltage monitoring is also provided by the Power Fail Input (PFI) and Voltage Monitor (VM) pins. If the voltage at PFI falls below its threshold, a signal is given at $\overline{\text{PFO}}$ and shown with an LED. If the voltage at VM falls below its threshold, a signal is given at $\overline{\text{RST}}$ and also shown with an LED. $\overline{\text{RST}}$ is typically connected to the Reset of a microcontroller to reset the device and halt operation until the supply voltage is above a specified voltage.

WATCHDOG AND EXTEND FUNCTION WITH WDE

During a shutdown process after the $\overline{\text{INT}}$ pin goes high impedance, a rising or falling edge on the WDE pin within a 500ms period extends the waiting period before the EN line is set low. See figure 6 and 7 for timing comparison. The WDE pin can also be used with the VM pin to provide a watchdog timer.

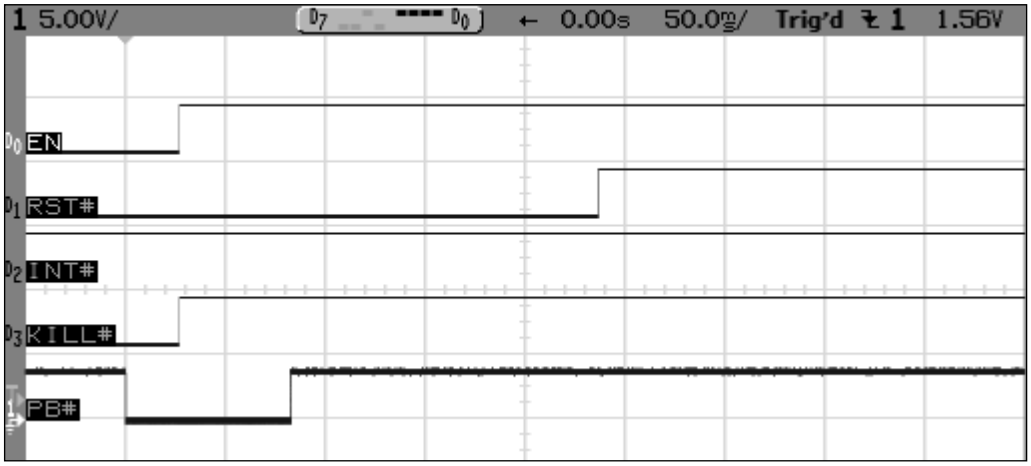


Figure 2. Pushbutton Turn ON with No Additional Timing

OPERATING PRINCIPLES

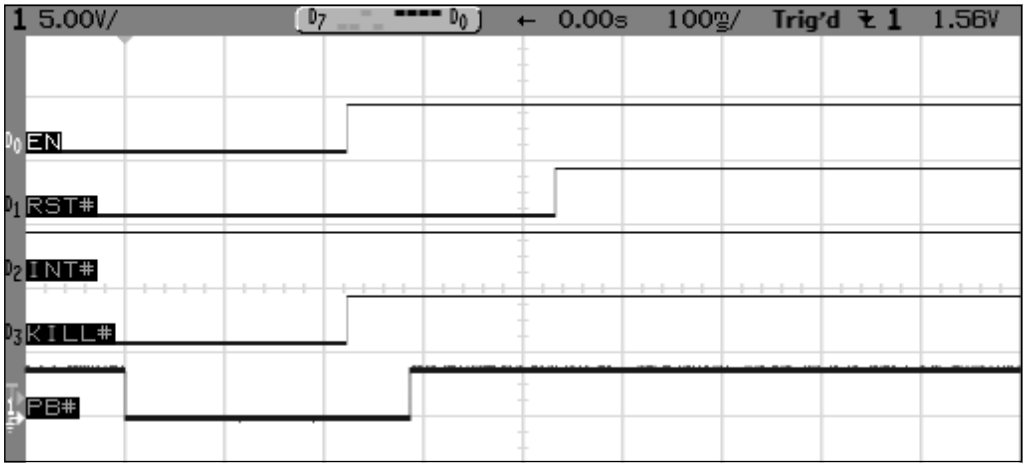


Figure 3. Pushbutton Turn ON with 22nF at ONT

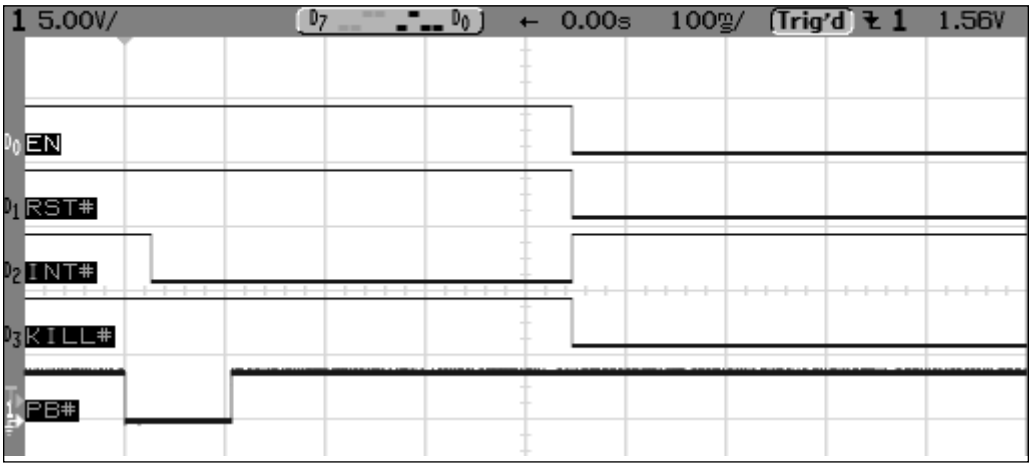


Figure 4. Pushbutton Turn OFF with No Additional Timing

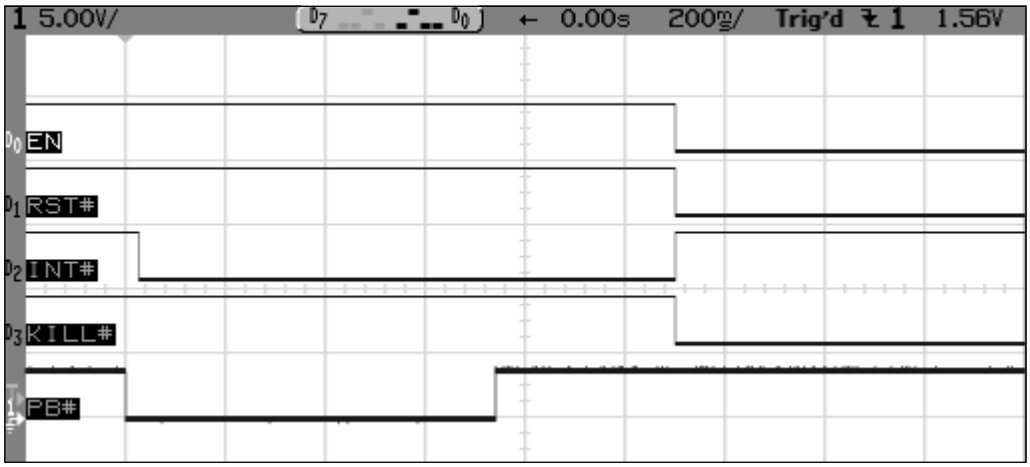


Figure 5. Pushbutton Turn OFF with 68nF at OFFT

OPERATING PRINCIPLES

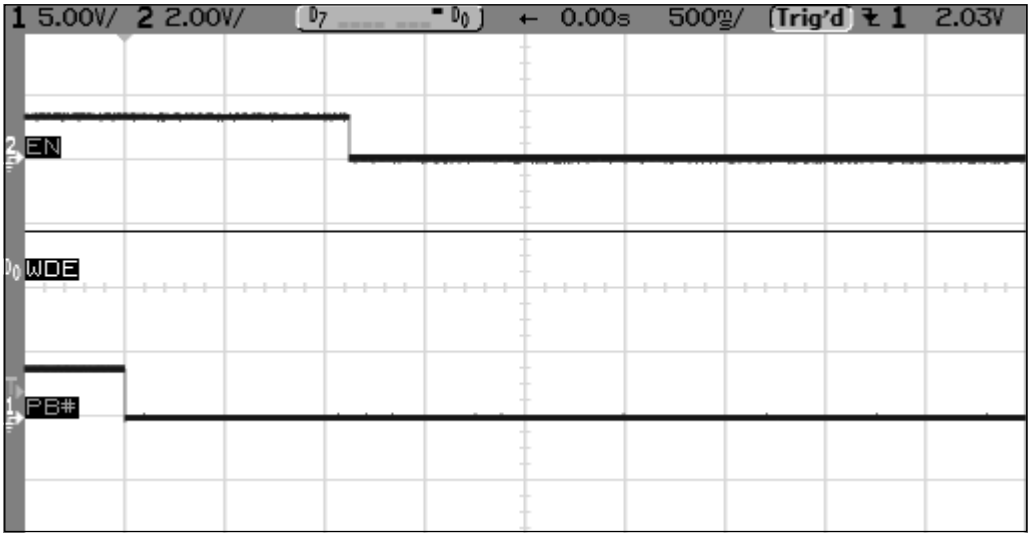


Figure 6. Pushbutton Turn OFF with No WDE Extension

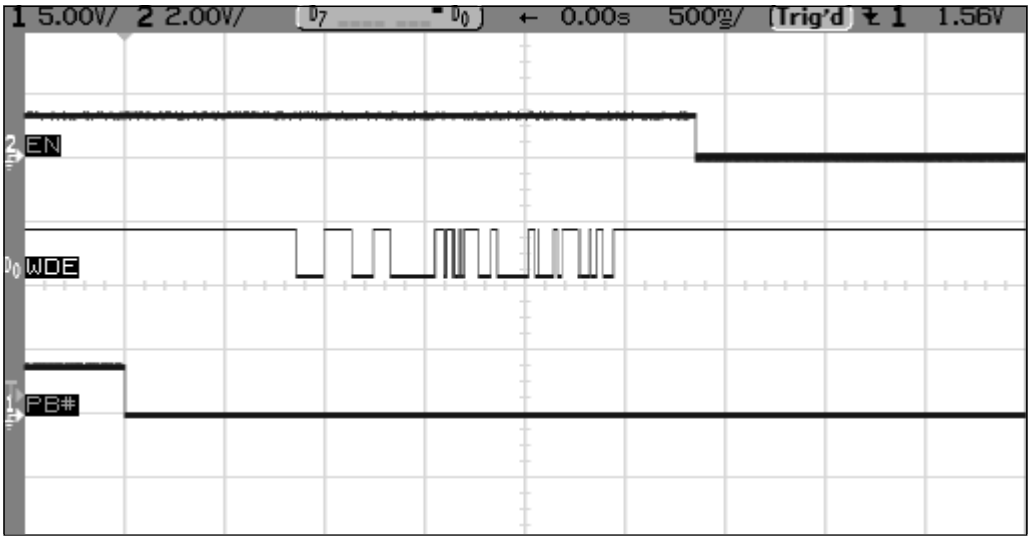
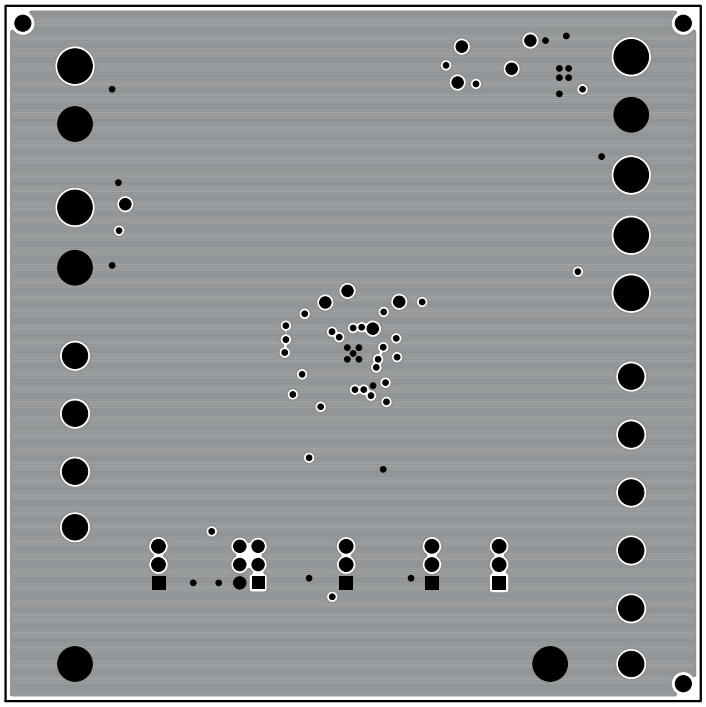


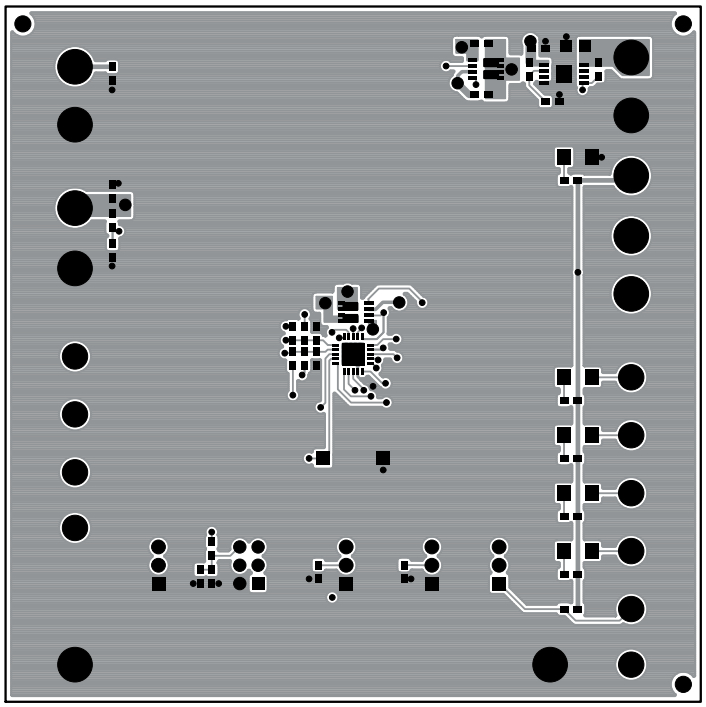
Figure 7. Pushbutton Turn OFF with Transitions at WDE for Time Extension

PCB LAYOUT

Top Layer

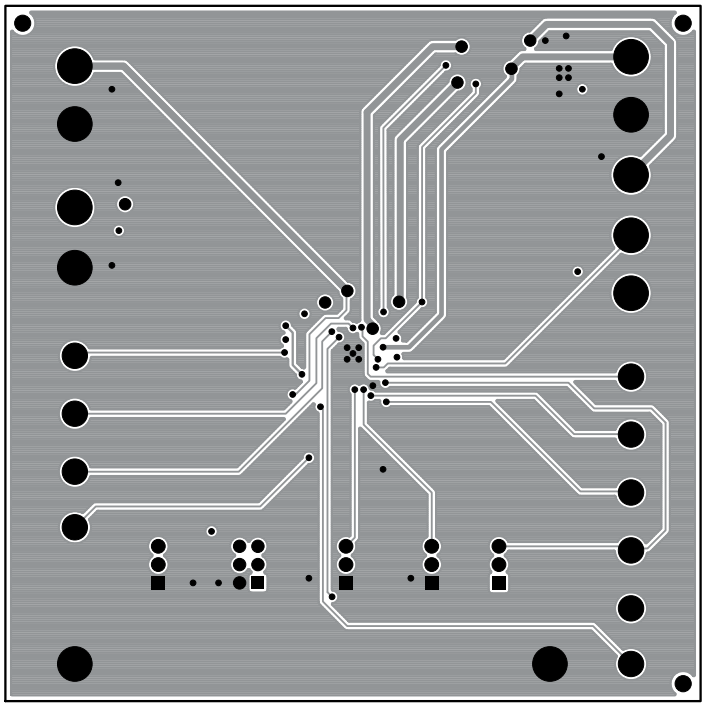


Layer 2

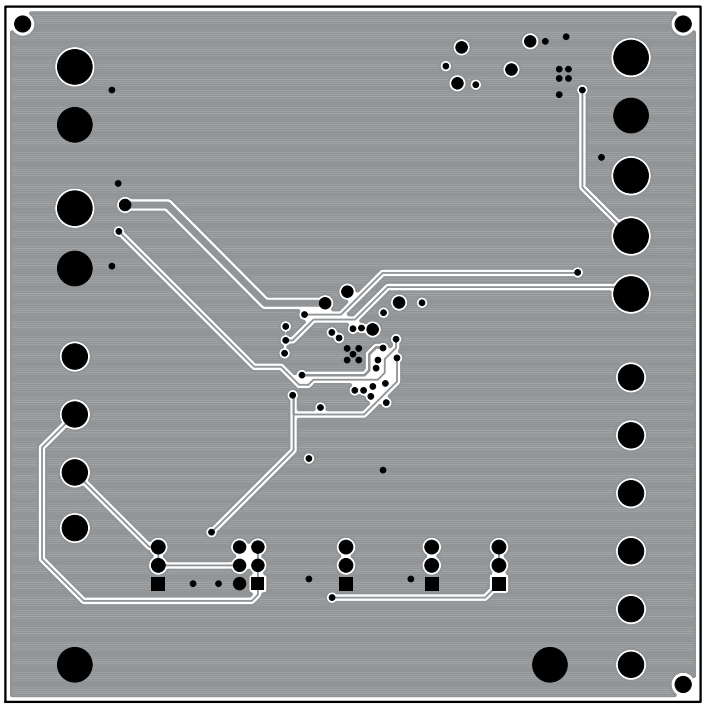


PCB LAYOUT

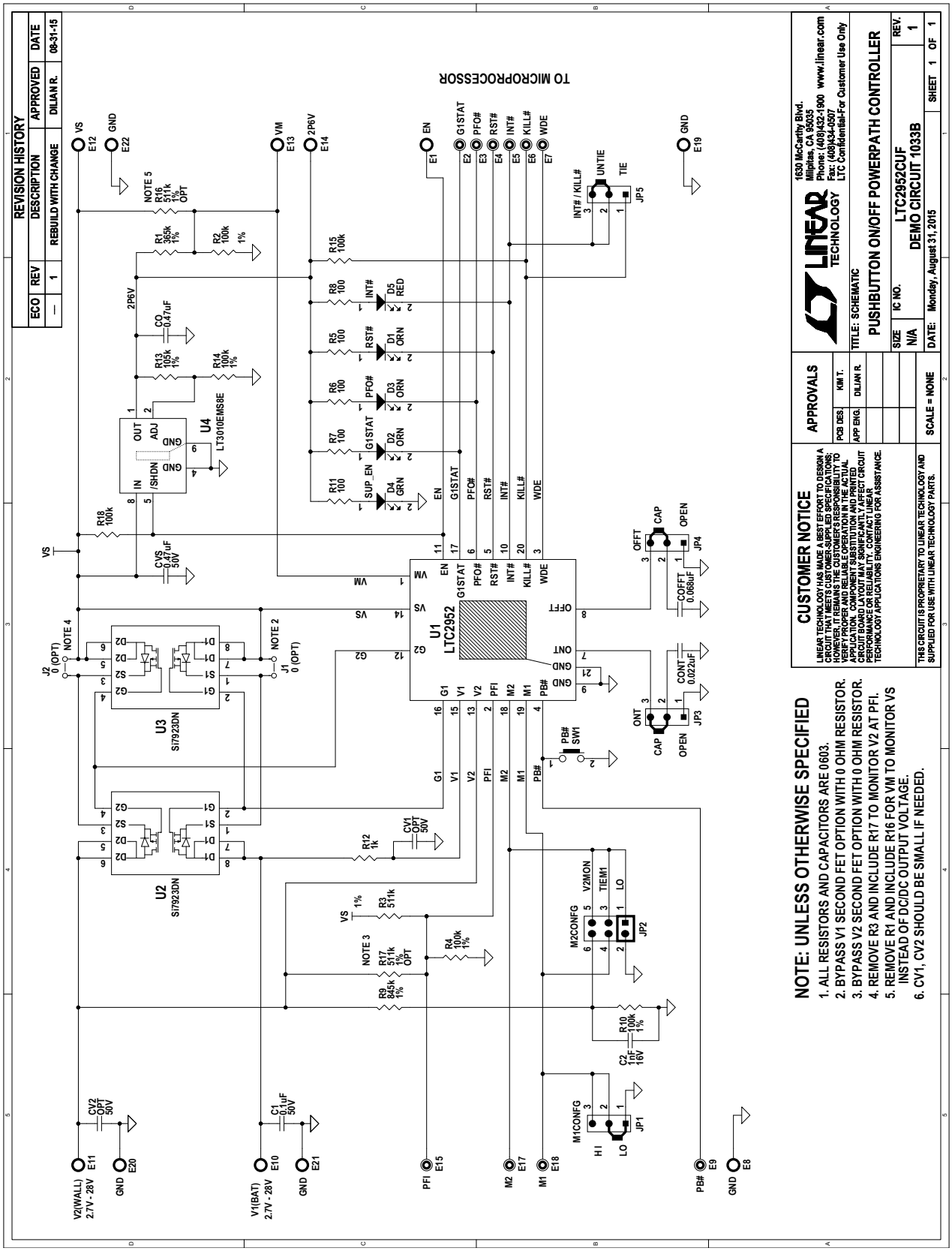
Layer 3



Bottom Layer



SCHEMATIC DIAGRAM



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