

LTC4365/LTC4365-1: Overvoltage, Undervoltage and Reverse Supply Protection Controller

DESCRIPTION

Demonstration circuit DC1555C is intended to demonstrate the performance of the LTC4365 and LTC4365-1 Undervoltage, Overvoltage and Reverse Supply Protection Controllers.

The **LTC®4365/LTC4365-1** protect circuits from input voltages that may be too high, too low or negative. It operates by controlling the gates of two back-to-back connected MOSFETs to keep the output in a safe range. The OV and UV protection levels are adjusted by resistive dividers at the OV and UV pins. Asserting the $\overline{\text{SHDN}}$ pin disables the MOSFETs and places the controller in a low-current shutdown state. The $\overline{\text{FAULT}}$ pin is asserted when the Controller is in shutdown mode or when the input voltage is outside of the UV or OV level.

The LTC4365 and LTC4365-1 can withstand DC voltages between -40V and $+60\text{V}$ and have a valid operating range of 2.5V to 34V .

Regarding the supply protection parameters, the LTC4365 and LTC4365-1 are identical. The only differences are in the gate fault recovery delay time and the delay from turn-off to low-power operation. These delays are 36ms (typ, both) for the LTC4365, while they are 1ms and 0.7ms respectively for the LTC4365-1.

The DC1555C includes the controller, two back-to-back connected power MOSFETs, three jumpers and three LEDs to indicate the input and output voltages and the $\overline{\text{FAULT}}$ pin signal.

Design files for this circuit board are available at
<http://www.linear.com/demo/DC1555C>

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PERFORMANCE SUMMARY ($T_A = 25^\circ\text{C}$)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Board Input Voltage Range		-30		30	V
$V_{\text{IN(UVLO)}}$	Input Supply Undervoltage Lockout	V_{IN} Rising	1.8	2.2	2.4	V
I_{VIN}	Input Supply Current	$\overline{\text{SHDN}} = 0\text{V}$ $\overline{\text{SHDN}} = 2.5\text{V}$		10 25	50 150	μA μA
$I_{\text{VIN(R)}}$	Reverse Input Supply Current	$V_{\text{IN}} = -40\text{V}$, $V_{\text{OUT}} = 0\text{V}$		-1.2	-1.8	mA
ΔV_{GATE}	External N-Channel Gate Drive ($\text{GATE} - V_{\text{OUT}}$)	$V_{\text{IN}} = V_{\text{OUT}} = 5\text{V}$, $I_{\text{GATE}} = -1\mu\text{A}$ $V_{\text{IN}} = V_{\text{OUT}} = 12\text{V}$ to 34V , $I_{\text{GATE}} = -1\mu\text{A}$	3 7.4	3.6 8.4	4.2 9.8	V V
$I_{\text{GATE(UP)}}$	External N-Channel Gate Pull-Up current	$\text{GATE} = V_{\text{IN}} = V_{\text{OUT}} = 12\text{V}$	-12	-20	-30	μA
$I_{\text{GATE(FAST)}}$	External N-Channel Fast Gate Pull-Down Current	Fast Shutdown, $\text{GATE} = 20\text{V}$, $V_{\text{IN}} = V_{\text{OUT}} = 12\text{V}$	31	50	72	mA
$I_{\text{GATE(SLOW)}}$	External N-Channel Gentle Gate Pull-Down Current	Gentle Shutdown, $\text{GATE} = 20\text{V}$, $V_{\text{IN}} = V_{\text{OUT}} = 12\text{V}$	50	90	150	μA
V_{UV}	UV Input Threshold Voltage	UV Falling $\rightarrow \Delta V_{\text{GATE}} = 0\text{V}$	492.5	500	507.5	mV
V_{OV}	OV Input Threshold Voltage	OV Rising $\rightarrow \Delta V_{\text{GATE}} = 0\text{V}$	492.5	500	507.5	mV
$t_{\text{GATE(FAST)}}$	External N-Channel Fast Gate Turn-Off Delay	$C_{\text{GATE}} = 2.2\text{nF}$, UV or OV Fault		2	4	μs
t_{FAULT}	OV, UV Fault Propagation Delay	Overdrive = 50mV , $V_{\text{IN}} = V_{\text{OUT}} = 12\text{V}$		1	2	μs
V_{SHDN}	$\overline{\text{SHDN}}$ Input Threshold	$\overline{\text{SHDN}}$ Falling to $\Delta V_{\text{GATE}} = 0\text{V}$	0.4	0.75	1.2	V

OPERATING PRINCIPLES

The LTC4365/LTC4365-1 monitors the input rail voltage and disconnects downstream circuits when the input voltage is too low, too high or negative. The LTC4365 provides accurate overvoltage and undervoltage comparators to ensure that power is applied to the system only if the input supply is within the allowable voltage window. Reverse

supply protection circuit automatically isolates the load from negative input voltages.

During normal operation, a high voltage charge pump enhances the gate of external N-channel power MOSFETs.

The controller consumes 10 μ A during shutdown and 125 μ A while operating.

QUICK START PROCEDURE

Demonstration circuit 1555C is easy to set up to evaluate the performance of the LTC4365/LTC4365-1. Refer to Figures 1a and 1b for proper measurement equipment setup and follow the procedure below.

Note that the circuit on the DC1555C is optimized for 12V operation. The Si4230 FET limits overvoltage and reverse voltage to 30V and -30V, respectively. Refer to the LTC4365 data sheet for applications optimized for other voltages.

Reverse Voltage Tests (Figure 1a)

- 1) Set JP1 to EN.
- 2) Set JP2 and JP3 to CONNECT LED.
- 3) Connect a power supply across V_{IN} and GND in a negative configuration (connect positive rail to GND and negative rail to V_{IN}).
- 4) Connect voltmeters at the input and output and ammeter in series with supply.
- 5) Ramp supply down to -30V (referenced to GND).
- 6) Verify that the output voltage is between 0V and -0.5V, all LEDs are off, and the input current is <1.8mA. (FET leakage or other board leakage paths can pull V_{OUT} slightly negative, but it will be clamped by the internal protection diode.)
- 7) Ramp supply back to 0V.

Undervoltage/Overvoltage Test (Figure 1b)

- 8) Reverse the polarity of power supply connection across V_{IN} to GND (connect positive rail to V_{IN} and negative rail to GND).
- 9) Ramp supply up to 30V and verify green V_{IN} LED, red \overline{FAULT} LED, green V_{OUT} LED, and V_{OUT} according to Table 1 within the various voltage ranges.
- 10) Ramp supply down from 30V down to 0V and verify green V_{IN} LED, red \overline{FAULT} LED, green V_{OUT} LED, and V_{OUT} according to Table 1.
- 11) Repeat steps 9 and 10 with 8A load connected across V_{OUT} and GND.

Table 1

V_{IN}	V_{OUT}	V_{IN} LED	V_{OUT} LED	\overline{FAULT} LED
0V to 5.77V	= 0V	Off/Dim/On	Off	On
6.56V to 13.51V	= V_{IN}	On	On	Off
15.47V to 30V	= 0V	On	Off	On

Jumper Test

- 12) Remove load and set supply to 9V.
- 13) Move jumpers and verify LEDs according to Table 2.

Table 2

JP1	JP2/JP3	V_{IN} LED	V_{OUT} LED
EN	CONNECT LED	On	On
DIS	CONNECT LED	On	Off
EN	Open	Off	Off

QUICK START PROCEDURE

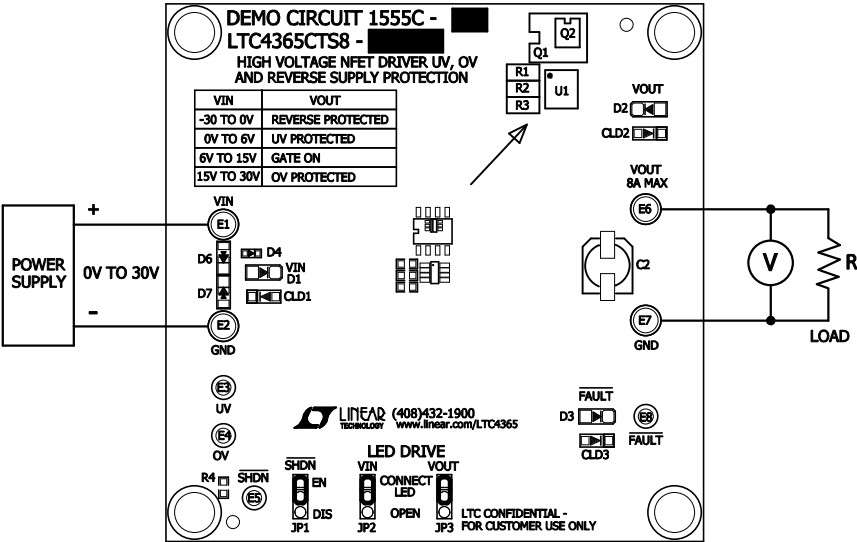


Figure 1a. Reverse Voltage Measurement

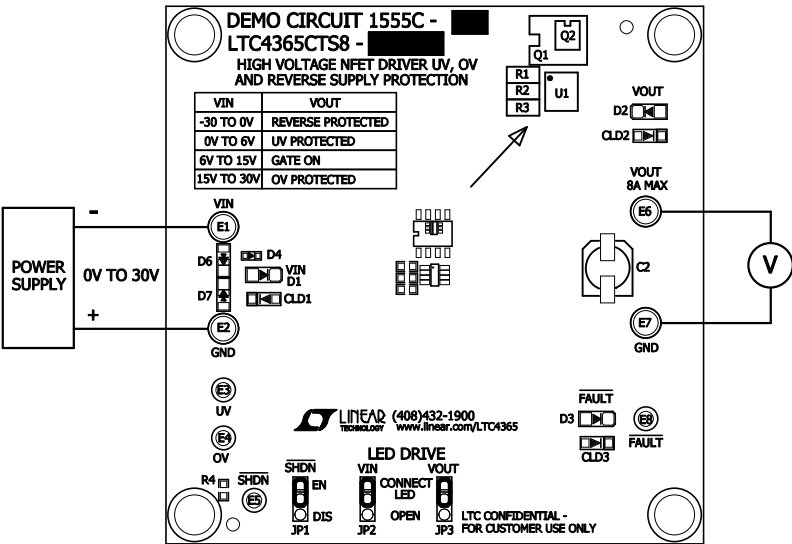
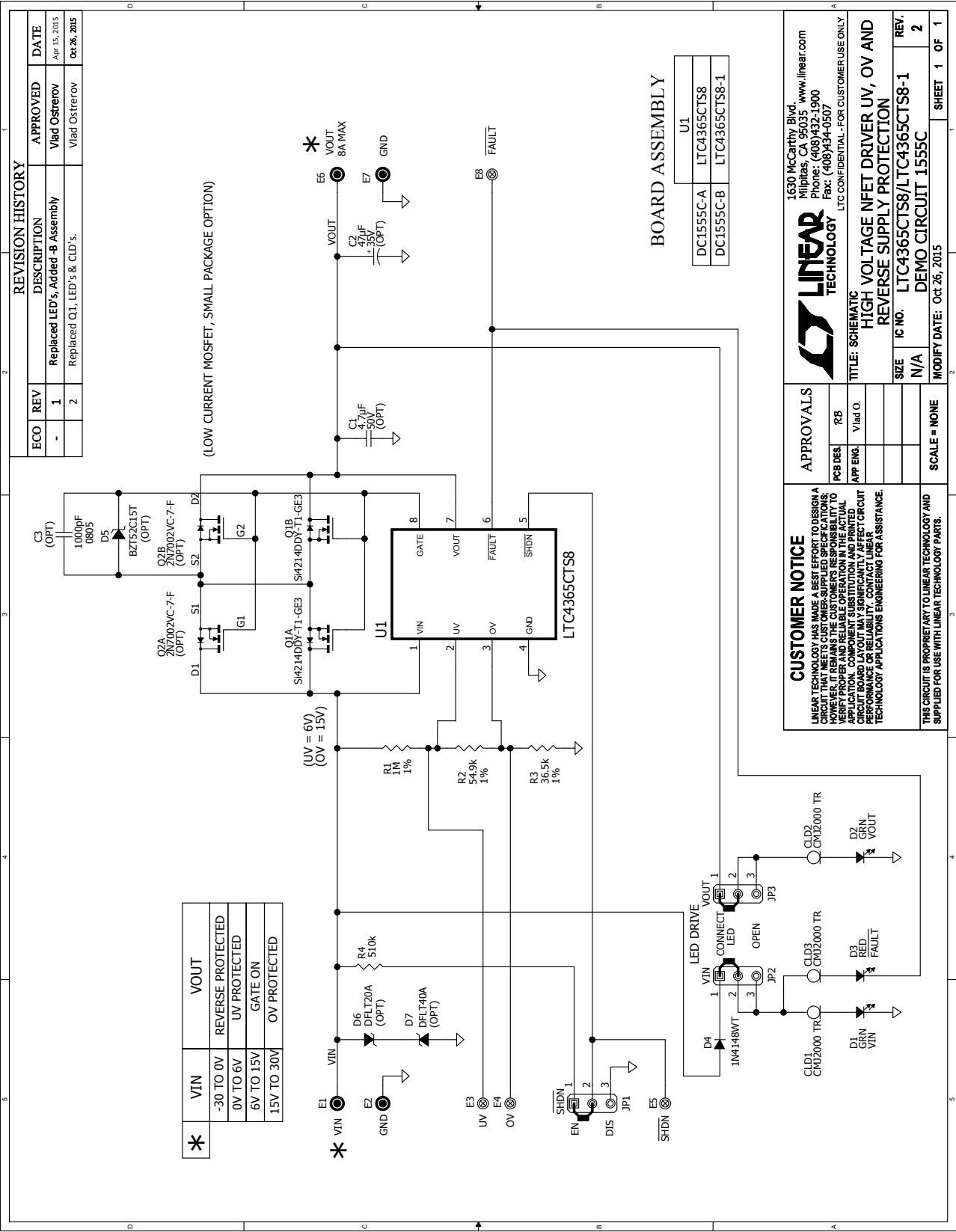


Figure 1b. Undervoltage/Overvoltage Measurement

SCHEMATIC DIAGRAM



DEMO MANUAL DC1555C

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