Designing High-Voltage, Programmable Power Supply for driving High-current Pulsed loads

Part - 2

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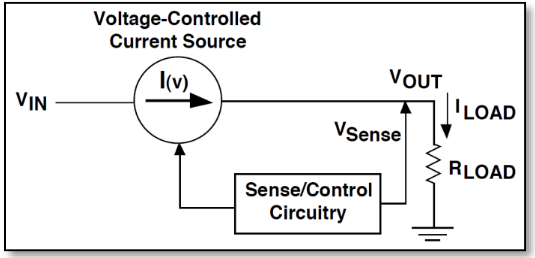
Challenge to Solve

Floating the regulators to support high voltages

Need of Floating Regulators

- A linear regulator operates by using a voltage-controlled current source to force a fixed voltage to appear at the regulator output terminal.
- The control circuitry must monitor (sense) the output voltage, and adjust the current source (as required by the load) to hold the output voltage at the desired value.
- Any regulator has datasheet specifications controlled by the semiconductor process.
- To operate the device safely without crossing the absolute maximum limits of the regulator, it needs some tricks to float the voltage levels.



6.1 Absolute Maximum Ratings

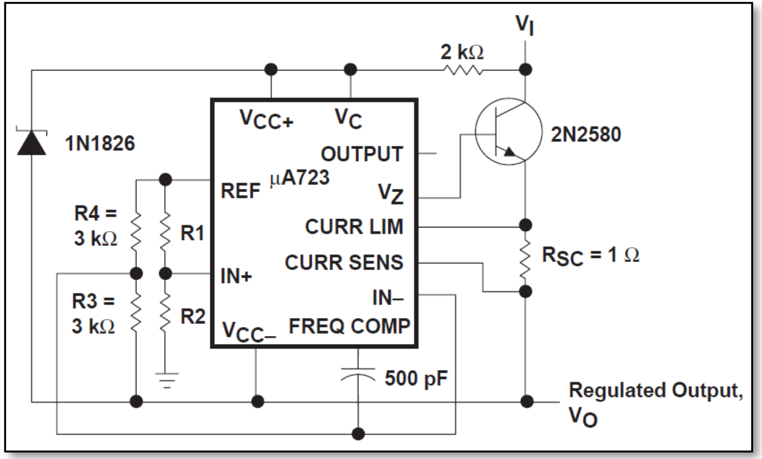
Over junction temperature range, unless otherwise noted.[1]

		MIN	MAX	UNIT
Voltage[2]	IN pin to GND pin	–0.4	+36	V
	EN pin to GND pin	–0.4	+36	V
	EN pin to IN pin	–36	+0.4	V
	OUT pin to GND pin	–0.4	+36	V
	NR pin to GND pin	–0.4	+36	V
	SENSE/FB pin to GND pin	–0.4	+36	V
	0P1V pin to GND pin	–0.4	+36	V
	0P2V pin to GND pin	–0.4	+36	V
	0P4V pin to GND pin	–0.4	+36	V
	0P8V pin to GND pin	–0.4	+36	V
	1P6V pin to GND pin	–0.4	+36	V
	3P2V pin to GND pin	–0.4	+36	V
	6P4V1 pin to GND pin	–0.4	+36	V
	6P4V2 pin to GND pin	–0.4	+36	V
Current	Peak output	Internally limited		
Temperature	Operating virtual junction, T_J	–40	125	°C

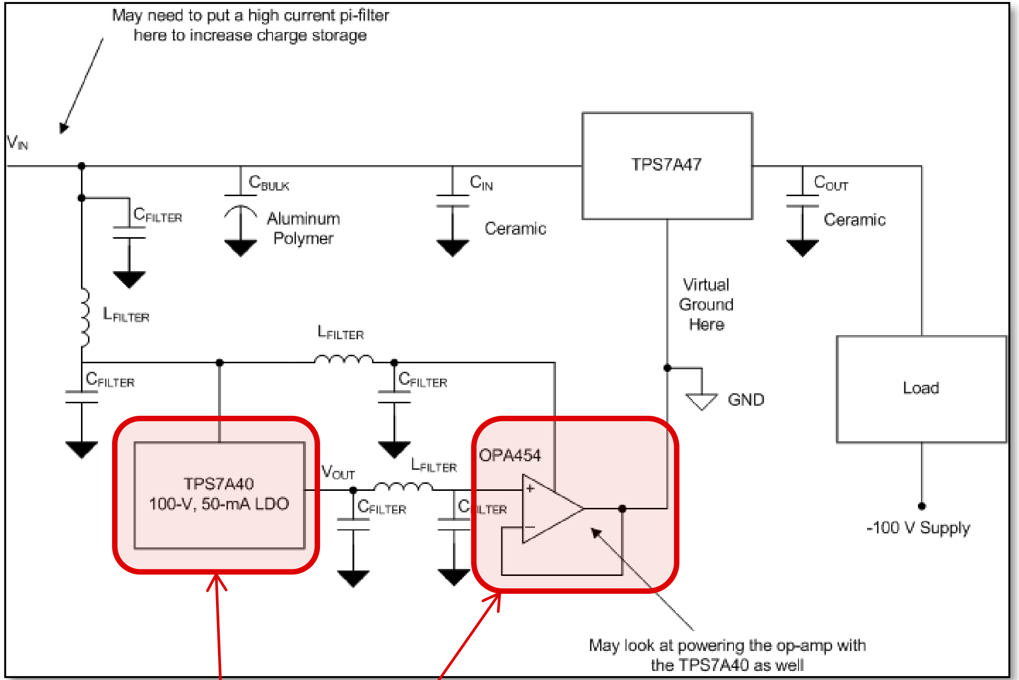
(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability..

(2) All voltages are with respect to network ground terminal.

It is NOT a new concept!



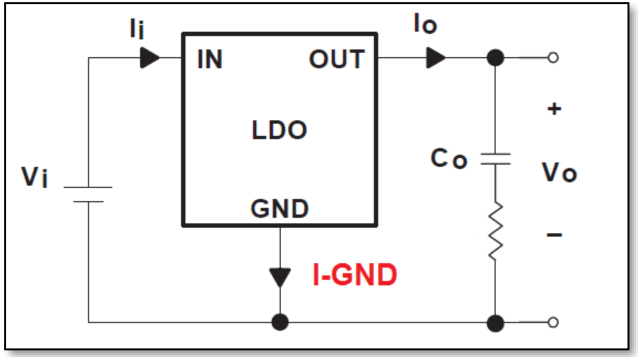
Positive Floating Regulator using μA723



LDO & Op-amp have to be high-voltage

Designing the floating regulator circuit

- Ground Pin Current is provided in the datasheet of regulator.



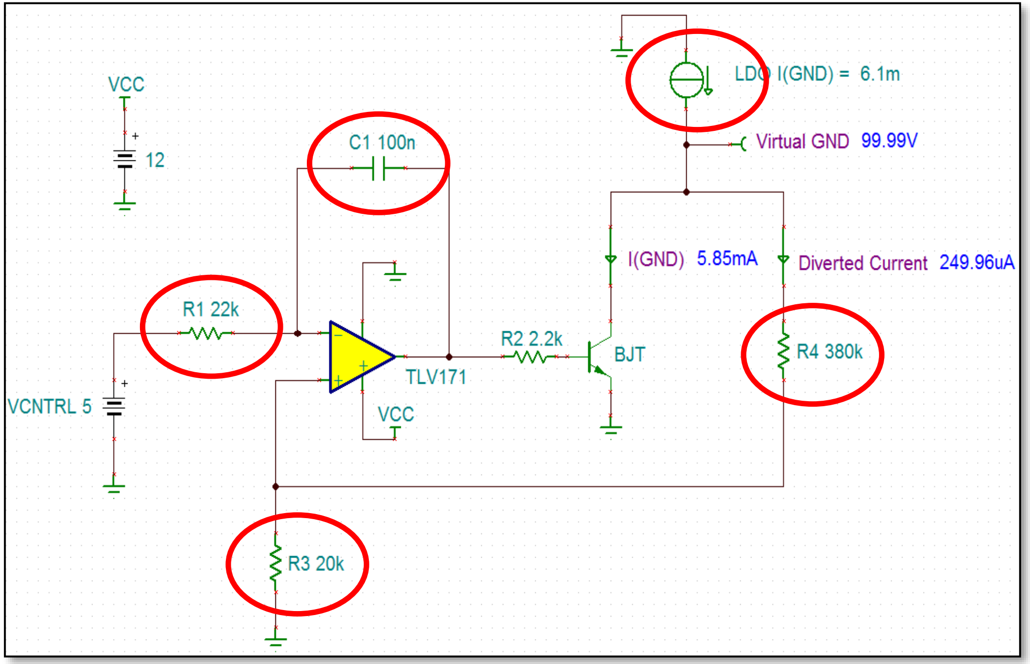
TPS7A47

$I_{(GND)}$	Ground pin current	I_O = 0 mA	0.58	1.0	mA
		I_O = 1 A	6.1		mA

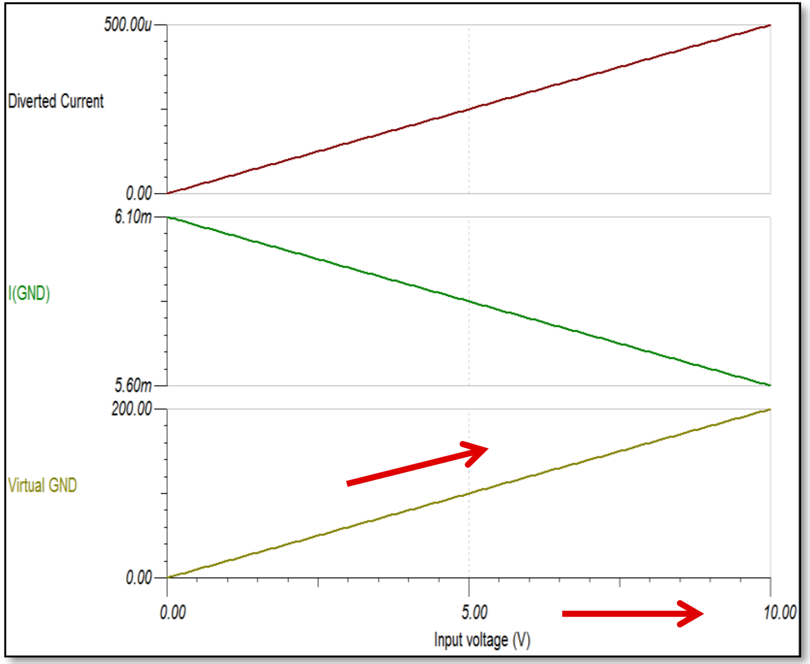
TPS7A30

I_{GND}	Ground current	I_{OUT} = 0 mA	55	100	μA
		I_{OUT} = 100 mA	950		μA

DC Amplifier for Floating the Regulator

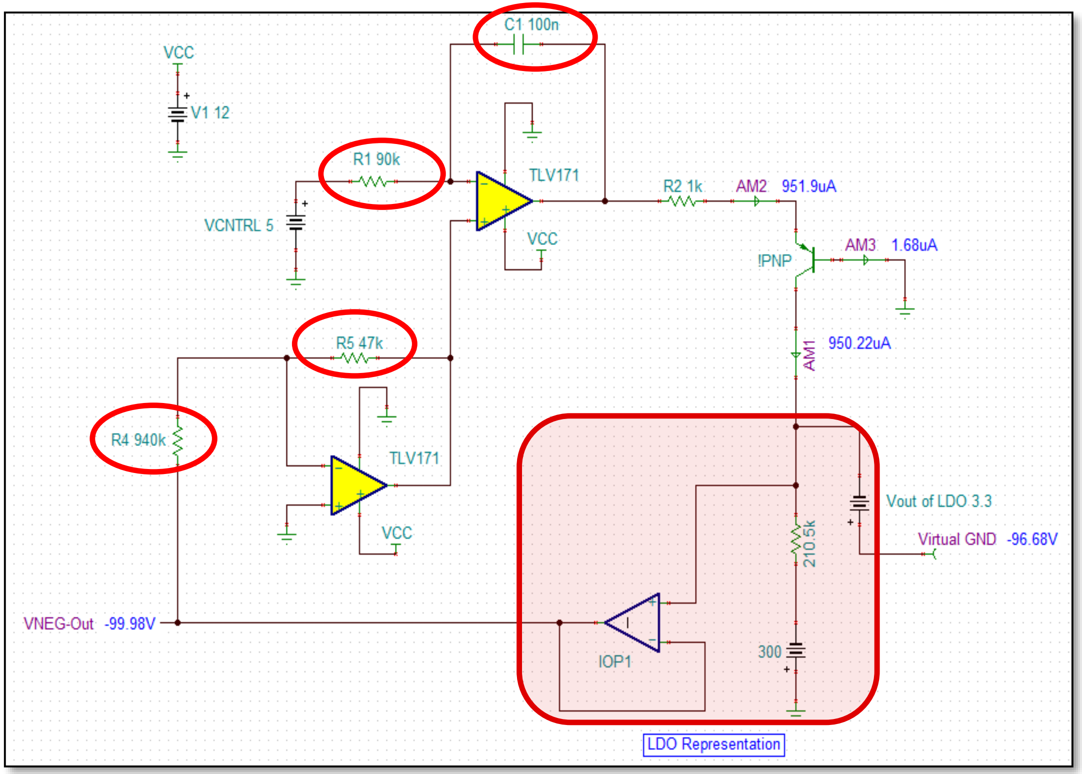


$$Virtual\ GND = \left(\frac{380k}{20k} + 1\right) \times V_{CNTL} = 20 \times V_{CNTL}$$

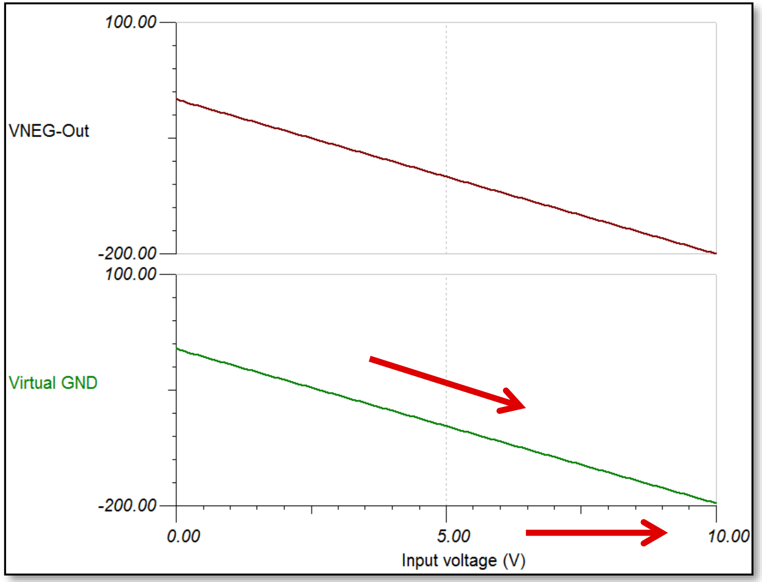


Control Voltage
(varied from 0V to 10V)

Negative Regulator – Virtual Ground Simulation Results



$$Vout = \frac{940k}{47k} \times V_{CNTL} = 20 \times V_{CNTL}$$



Control Voltage
(varied from 0V to 10V)

TIDA-01371 is available on TI.com

Visit www.ti.com/tool/TIDA-01371 to find design resources (Gerbers, Schematics and more).