

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

Part - 2

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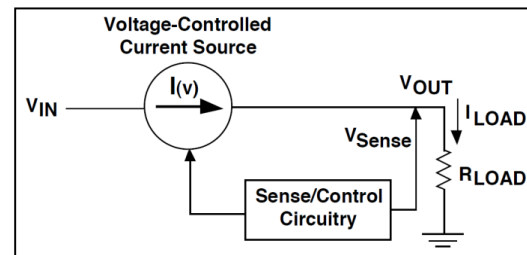
SEM – Industrial Systems, Medical Sector

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.

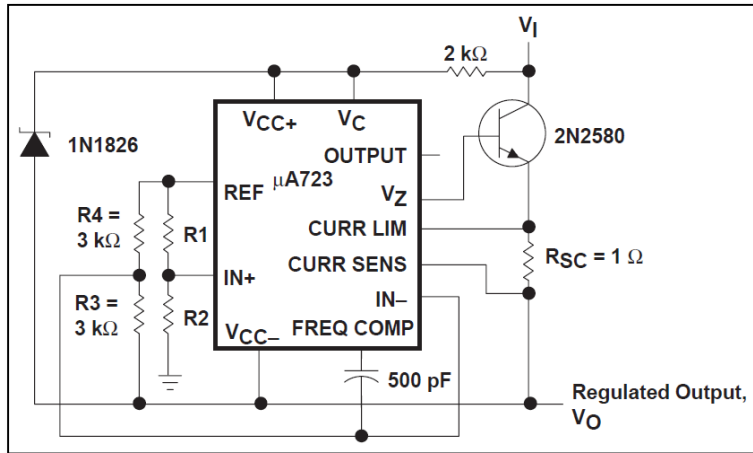


6.1 Absolute Maximum Ratings				
Over junction temperature range, unless otherwise noted. ⁽¹⁾				
		MIN	MAX	UNIT
Voltage ⁽²⁾	IN pin to GND pin	-0.4	+36	V
	EN pin to GND pin	-0.4	+36	V
	EN pin to IN pin	-36	+0.4	V
	OUT pin to GND pin	-0.4	+36	V
	NR pin to GND pin	-0.4	+36	V
	SENSE/FB pin to GND pin	-0.4	+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
	1P8V 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

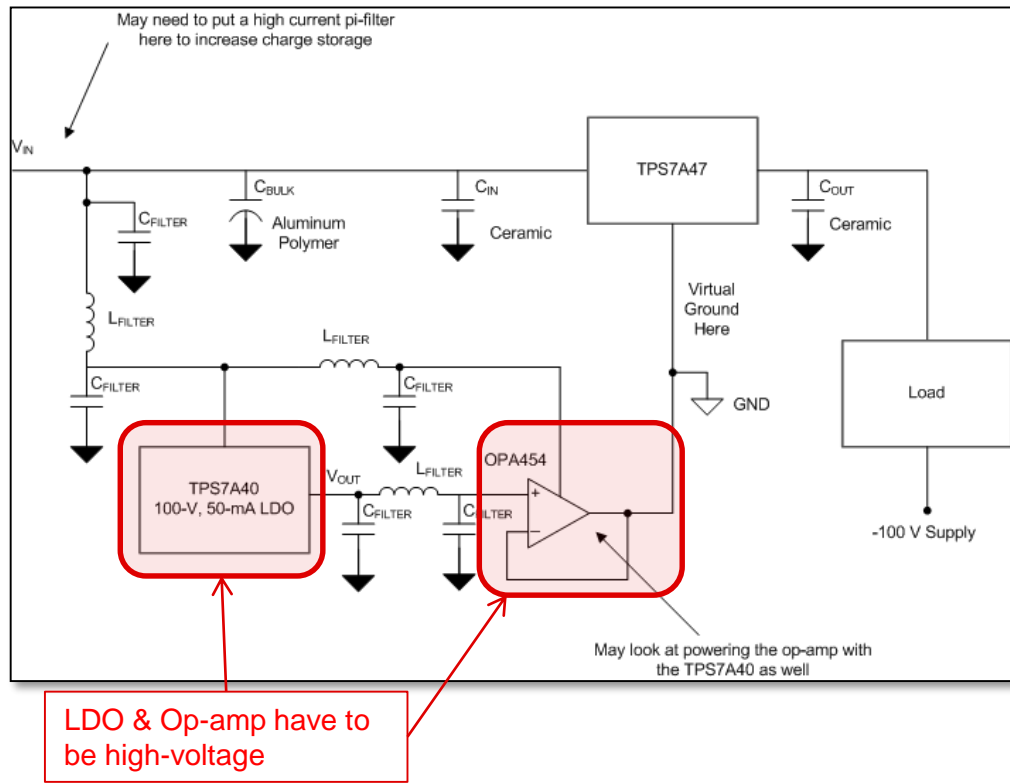
(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to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

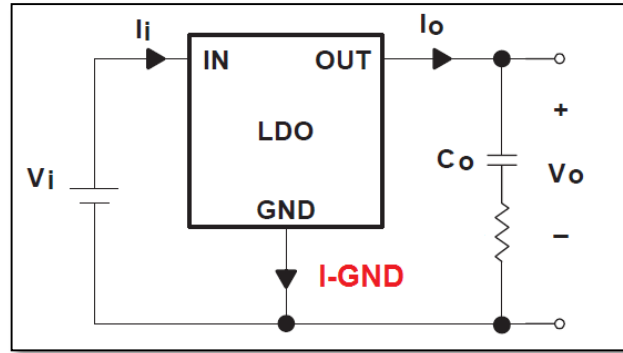


Positive Floating Regulator using μA723



Designing the floating regulator circuit

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



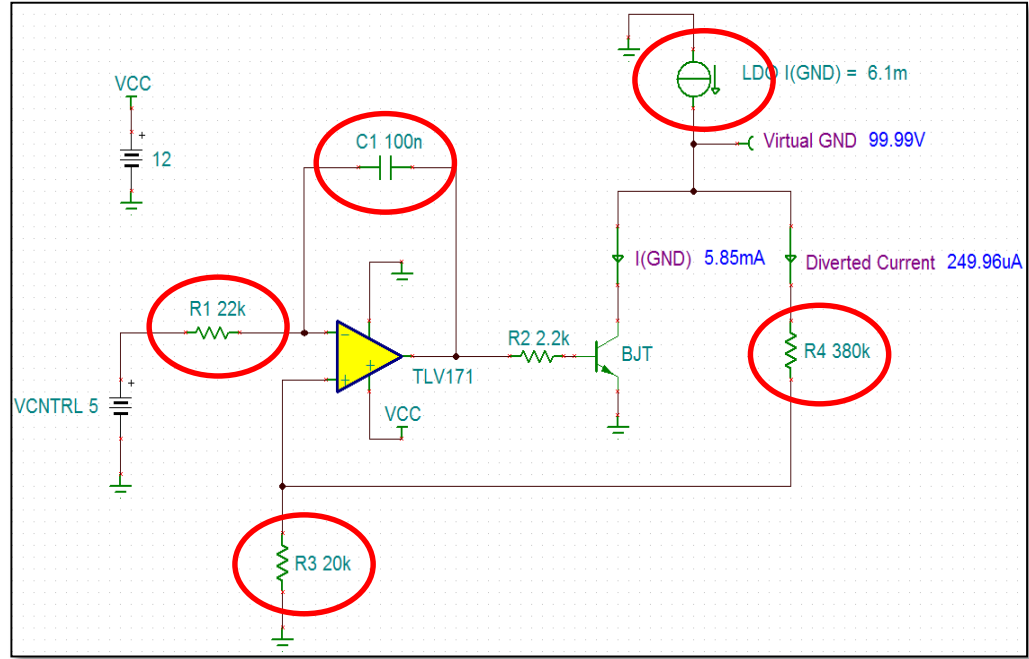
$I_{(GND)}$	Ground pin current	$I_o = 0 \text{ mA}$	0.58	1.0	mA
		$I_o = 1 \text{ A}$	6.1		mA

TPS7A47

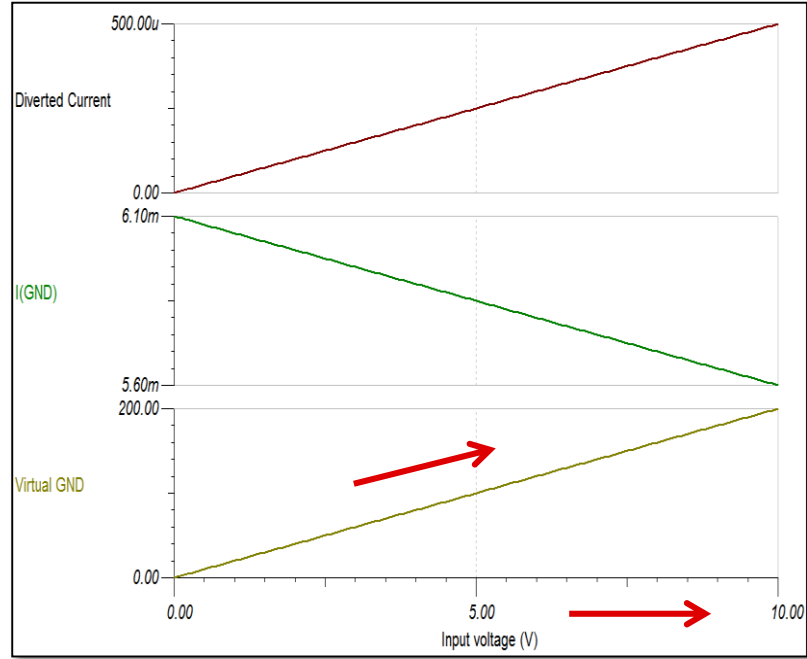
I_{GND}	Ground current	$I_{OUT} = 0 \text{ mA}$	55	100	μA
		$I_{OUT} = 100 \text{ mA}$	950		μA

TPS7A30

DC Amplifier for Floating the Regulator

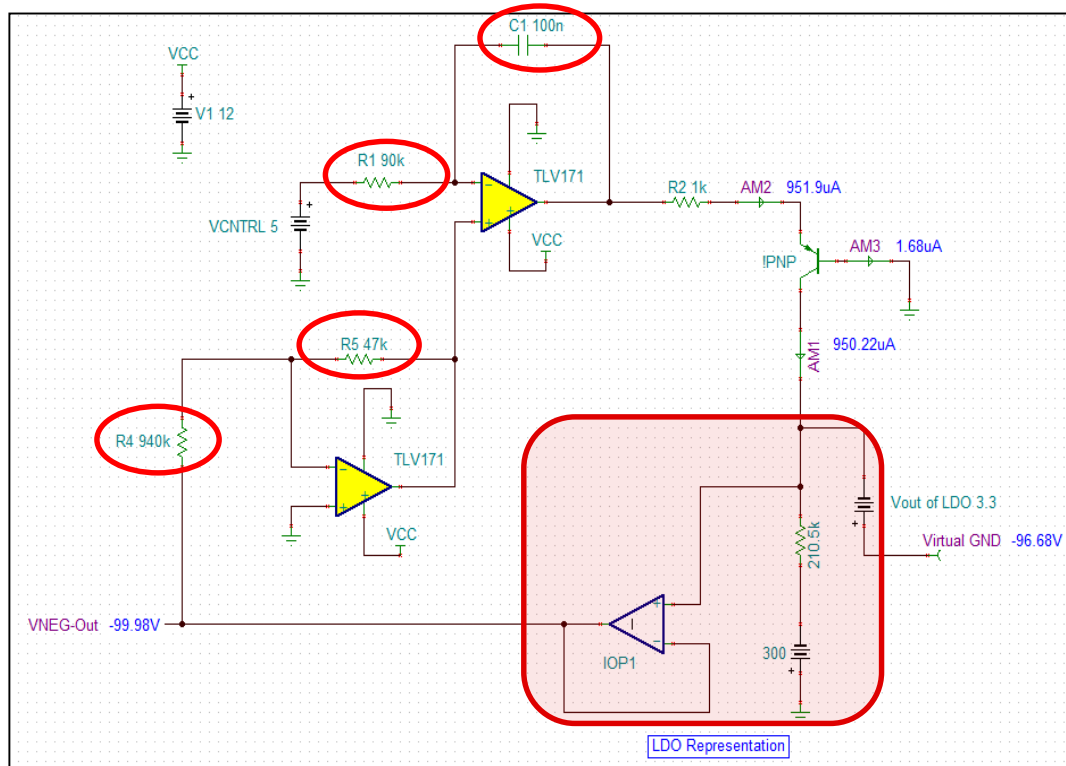


$$Virtual\ GND = \left(\frac{380k}{20k} + 1\right) \times V_{CNTL} = 20 \times V_{CNTL}$$

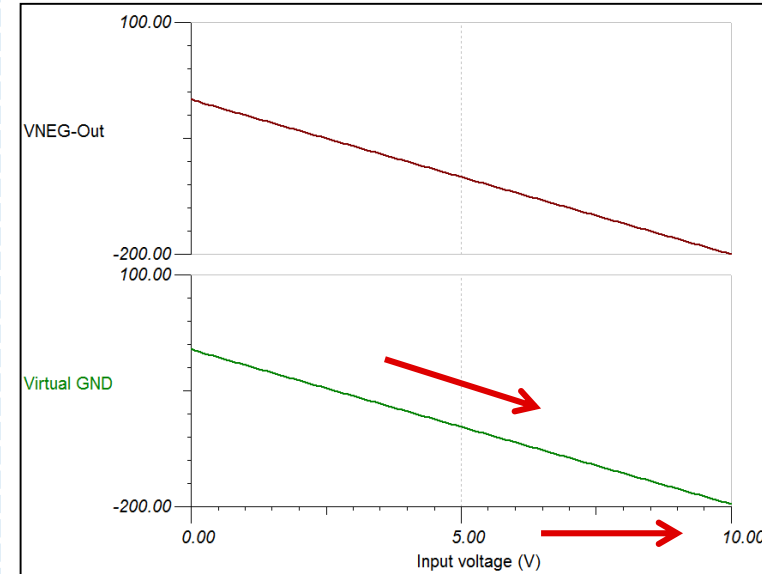


Control Voltage (varied from 0V to 10V)

Negative Regulator – Virtual Ground Simulation Results



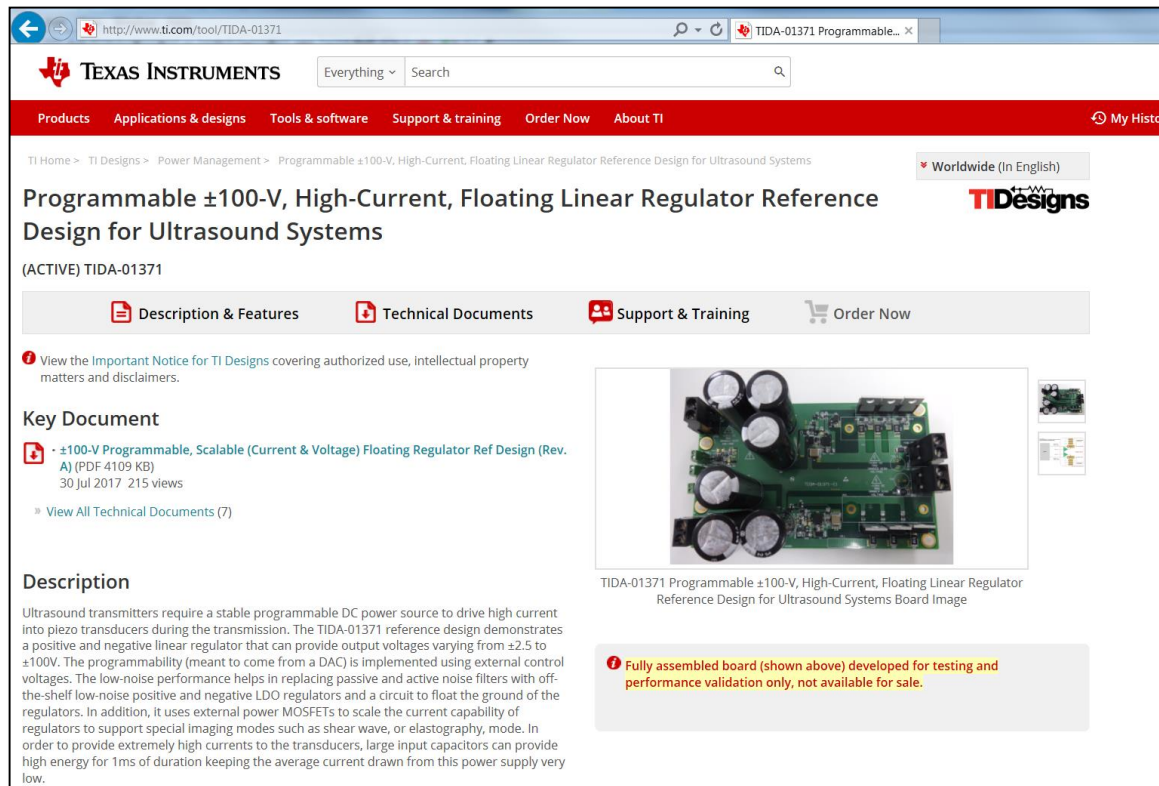
$$V_{out} = \frac{940k}{47k} \times V_{CNTL} = 20 \times V_{CNTL}$$



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).



The screenshot shows the TI.com website for the TIDA-01371 product. The page title is "Programmable ±100-V, High-Current, Floating Linear Regulator Reference Design for Ultrasound Systems". The page includes a navigation menu with options like "Products", "Applications & designs", "Tools & software", "Support & training", "Order Now", and "About TI". The main content area features a "Key Document" section with a PDF titled "±100-V Programmable, Scalable (Current & Voltage) Floating Regulator Ref Design (Rev. A)" and a "Description" section. The description explains that the design is used for ultrasound transmitters and provides details about its programmability and performance. A photograph of the reference design board is shown, along with a note stating that the board is fully assembled for testing and performance validation only, and is not available for sale.

TI Home > TI Designs > Power Management > Programmable ±100-V, High-Current, Floating Linear Regulator Reference Design for Ultrasound Systems

Programmable ±100-V, High-Current, Floating Linear Regulator Reference Design for Ultrasound Systems

(ACTIVE) TIDA-01371

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Key Document

±100-V Programmable, Scalable (Current & Voltage) Floating Regulator Ref Design (Rev. A) (PDF 4109 KB)
30 Jul 2017 215 views

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Description

Ultrasound transmitters require a stable programmable DC power source to drive high current into piezo transducers during the transmission. The TIDA-01371 reference design demonstrates a positive and negative linear regulator that can provide output voltages varying from ±2.5 to ±100V. The programmability (meant to come from a DAC) is implemented using external control voltages. The low-noise performance helps in replacing passive and active noise filters with off-the-shelf low-noise positive and negative LDO regulators and a circuit to float the ground of the regulators. In addition, it uses external power MOSFETs to scale the current capability of regulators to support special imaging modes such as shear wave, or elastography, mode. In order to provide extremely high currents to the transducers, large input capacitors can provide high energy for 1ms of duration keeping the average current drawn from this power supply very low.

TIDA-01371 Programmable ±100-V, High-Current, Floating Linear Regulator Reference Design for Ultrasound Systems Board Image

Fully assembled board (shown above) developed for testing and performance validation only, not available for sale.



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