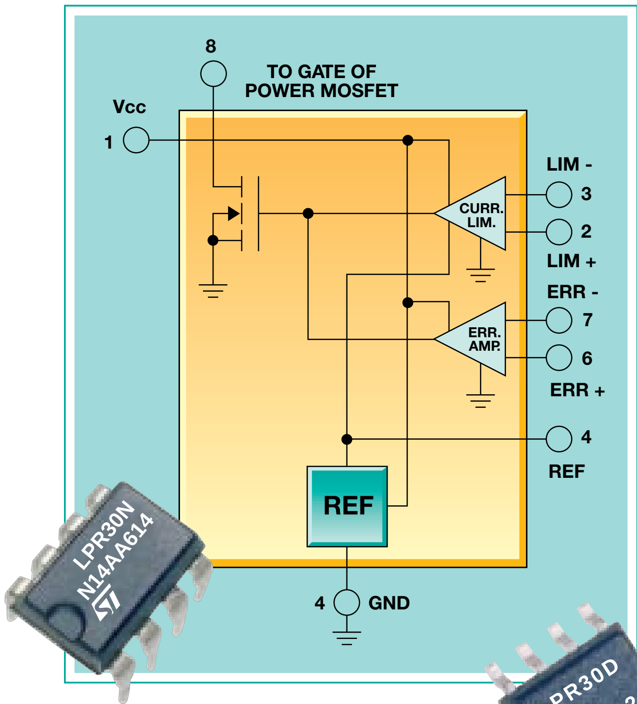
LPR30

by T. Sampieri
Standard Circuit Product Marketing

LOW DROP VOLTAGE REGULATOR DRIVER FOR AN EXTERNAL MOSFET

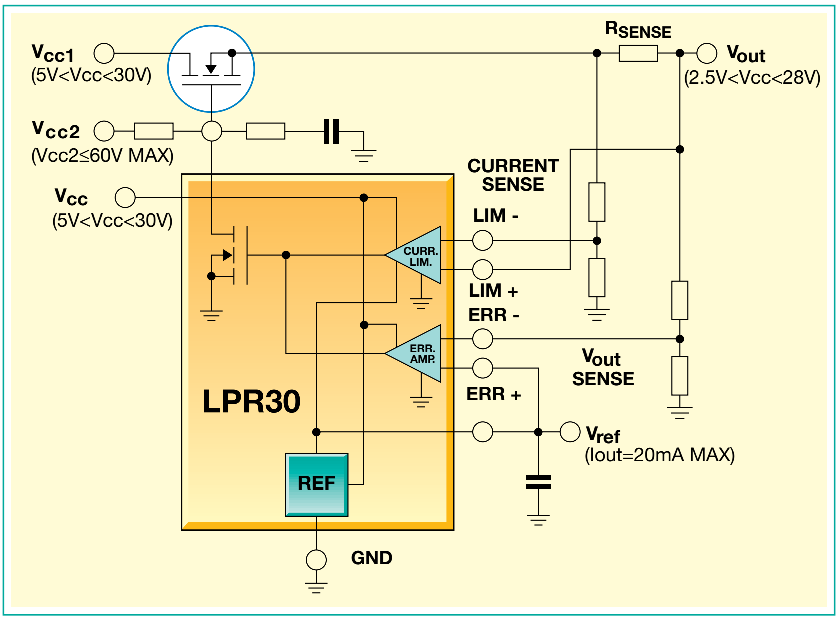
The **LPR30** is a very Low Dropout Regulator Controller in a single IC solution for very high current, low dropout linear voltage regulation. It uses an external N-channel Power MOSFET as the linear pass element. The **LPR30** features a dropout voltage as low as the $R_{DS(on)}$ of the external Power MOSFET multiplied by the output current. Consequently, the output current can be as high as the Power MOSFET can provide (using an adequate heatsink).

The V_{CC} of the **LPR30** ranges from 5V to 30V. For very low dropout voltage operation, the **LPR30** requires an external gate drive supply to provide the control voltage needed to drive the gate of the external Power MOSFET.



The regulator output is constant-current limited when the controller detects 50mV across an external sense resistor (R_{SENSE}). It has an internal high precision (+/- 1%) Voltage Reference at 2.5V. The output regulated voltage is programmable from 1V to 50V. Flexible design is achieved by the availability of the Voltage Reference Output through an external pin (n.4) that is able to supply more than 20mA as a load current. The LPR30 is available in 8-pin plastic DIP and in SO-8 for SMD. In both package versions it is able to operate from 0°C to 70°C.

Typical application



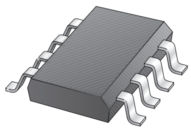
FEATURES

- Very low dropout Power MOSFET driver
- High precision V_{ref} = 2.5V (+/- 1%)
- Very low current drain (Typ. 2mA)
- Reference output current > 20mA
- Operating supply voltage from 5V to 30V
- Max V_{in} on gate (pin n.8) up to 60V
- Internal current limit operational amplifier offset trimmed at 50mV +/-4mV
- No capacitor is needed for stability of reference output
- Temperature range: 0°C to 70°C

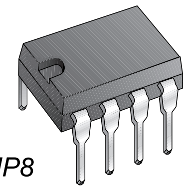
Type	Package
LPR30N	DIP8
LPR30D	SO-8
LPR30D-TR	SO-8 IN TAPE & REEL

APPLICATIONS

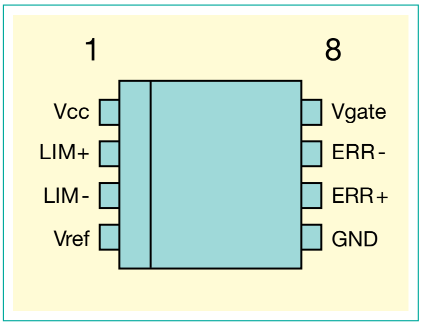
- Ultra-high current, ultra-low dropout voltage regulator
- Constant high current source
- Low part count 5.0V to 3.3V computer supply
- Low noise/low drop SMPS post regulator
- Motherboard



SO-8



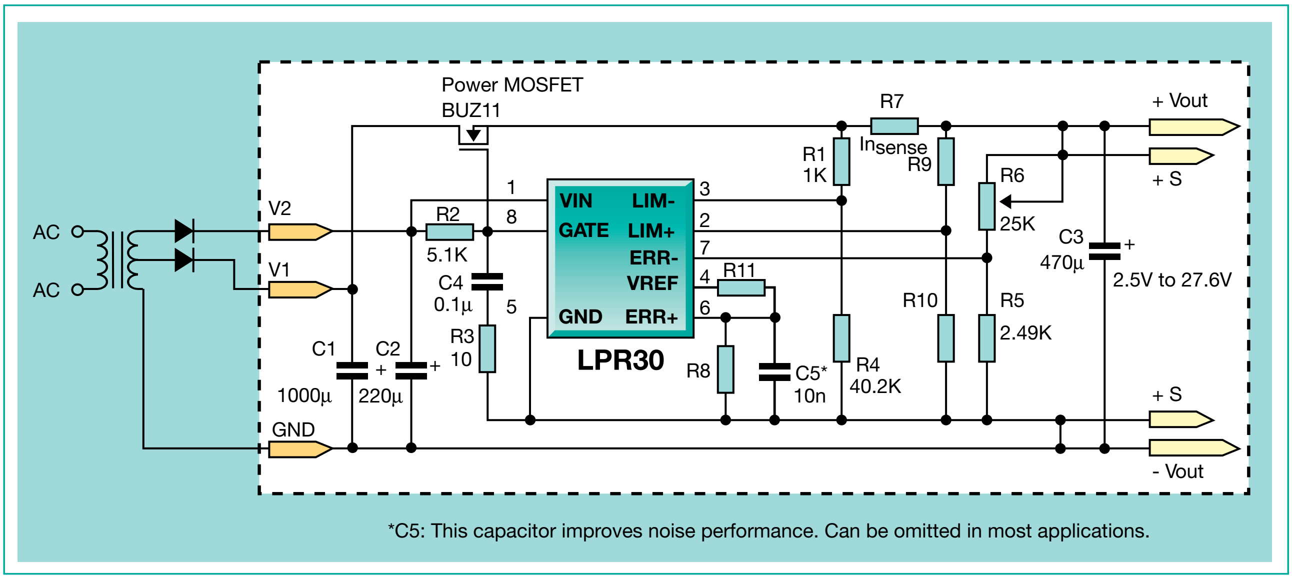
DIP8



Pin configuration

LPR30 DEMOBOARD

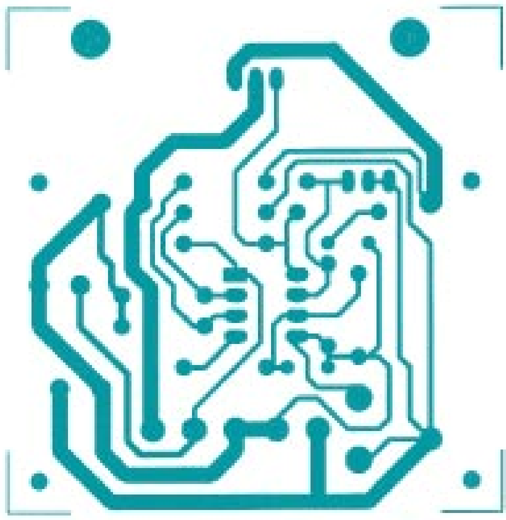
The schematic that follows is of a fixed voltage regulator demoboard developed to show the optimum performance of the LPR30.



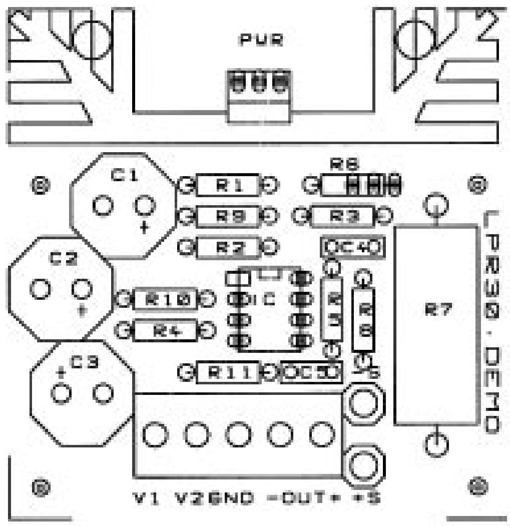
LPR30 demoboard circuit

If a V_{out} >25V is required, resistors R8 and R11 and capacitor C5 can be omitted and pin 4 and 6 of the IC are connected together.

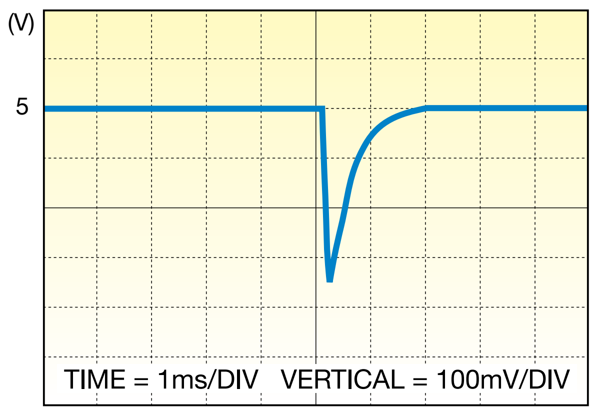
The capacitor C5 can be left to reduce noise. In order to allow the complete Power MOSFET driving, V2 must be greater than $V_{out} + V_{(GS)sat}$.
If V1 is predicted to be greater than $V_{out} + V_{(GS)sat}$ it is possible to use a single supply, connecting V1 and V2 together. The use of a logic level Power MOSFET (such as STB80N03L-06) lowers the V2 voltage (V_{in} must be less than 30V).
If the V_{out} is forseen to be less than 30V, R9 and R10 can be omitted and pin 2 of the IC can be connected direcly at the R7 resistor (Vout side).
The waveform below shows the settling time with a load variation from 0mA to 1500mA. It is evident that the response is limited by R2, R3 and C4.
R3-C4 net is chosen to give a compromise between response speed and stability. C3 also improves the system stability.
The waveform on the right shows the maximum current that the voltage reference is able to supply (pin n. 4).
A datailed description of this demoboard is available in an Application Note.



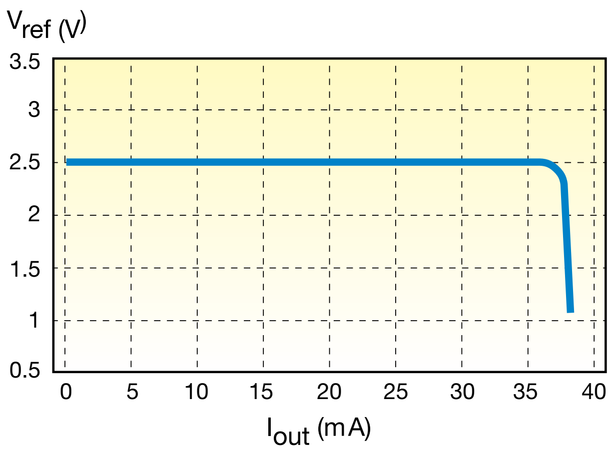
Solder side of demoboard



Component side of demoboard



Load variation from 0mA to 1500mA



Reference Output Voltage vs Load Current

LPR30

by T. Sampieri - Standard Circuits Product Marketing
& F. Lentini - Application Engineer

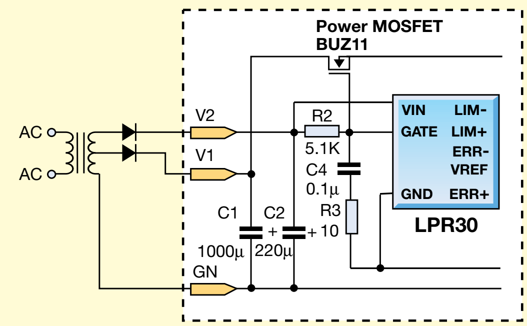
LOW DROP VOLTAGE REGULATOR FOR AN EXTERNAL POWER MOSFET NEW APPLICATIONS

In the previous edition of the Express we introduced the new extremely fast low drop voltage regulator driver for an external (N-channel) Power MOSFET. As part of our on going promotion we have developed new applications for this innovative driver.

INCREASED RESPONSE SPEED

The response of the LPR30 is already very fast, but with some very small changes it is possible to greatly improve its performance. In the standard configuration the total response is limited by the compensation network (R2, R3 and C4), which limits the voltage rise-time at the gate of the external Power MOSFET.

Improved stability performances are given with R3=0Ω and C4=2.2µF electrolytic capacitor. With the preset value of C4, the response time is determinated by R2.

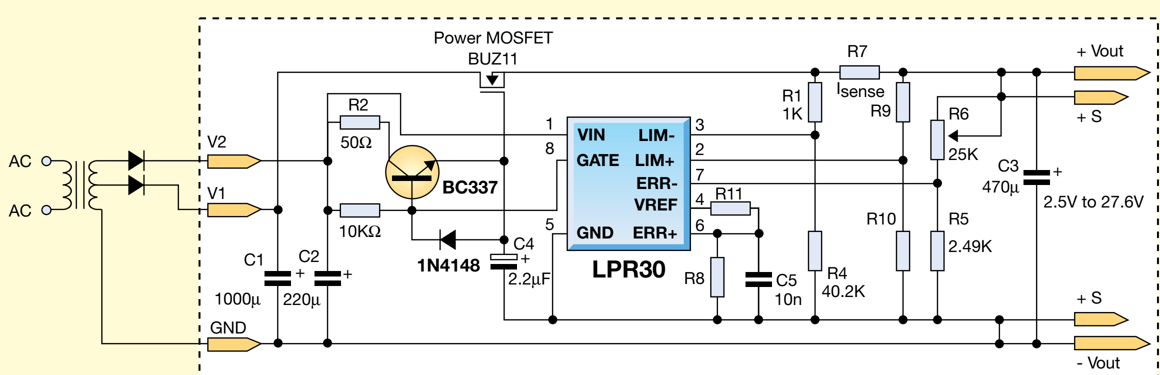


LPR30 standard demoboard circuit

This value must be chosen for a current no higher than 100mA on pin 8 of the LPR30. For instance with V2=12V, we suggest a R2 value of 100Ω. In this case, under static conditions:

$$I_{R2} = VR2/R2 \cong (V2 - V_{GS} - V_{out})/R2$$

I_{R2} reaches the maximum value in short circuit conditions when V_{out}=0V and V_{GS} is minimum (near the threshold value).



New LPR30 power supply application (Application note available on DSG web)

With these values and V_{out}=5V, I_{R2} is 20mA in normal conditions and becomes 100mA under short circuit conditions.
In this case maximum Power dissipated on R2 is :

$$P_{R2} = R2 * (I_{R2max})^2 = 1W$$

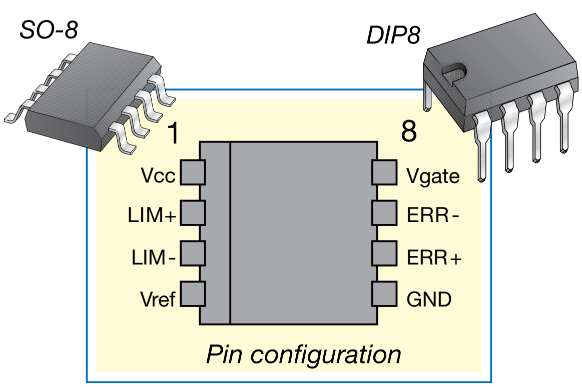
If V2 is higher than 12V, the power dissipated on R2 could be too high.

A VERSATILE SOLUTION

The use of a small NPN transistor (such as BC337) could solve the problem of a high dissipation value.
This transistor would work only during the transition of the load, increasing the total reaction speed, but in static situations it will be "off", opening the connection to ground, so the resistor R2 will not dissipate any power.
For this reason it is possible to reduce the value of the resistor to 50Ω further improving the total response speed without sacrificing any power.

FASTER THAN COMPETITION

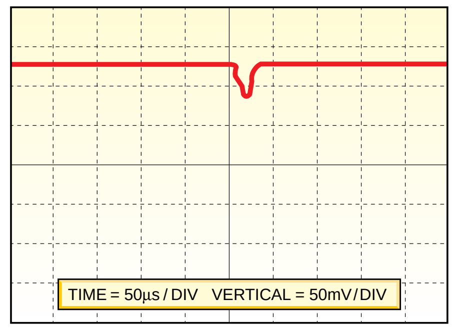
A leading manufacturer of low drop Voltage Regulators publicized the optimum speed of its LT1585 (output current 4.6A) Under identical conditions our LPR30 is roughly 50% faster !



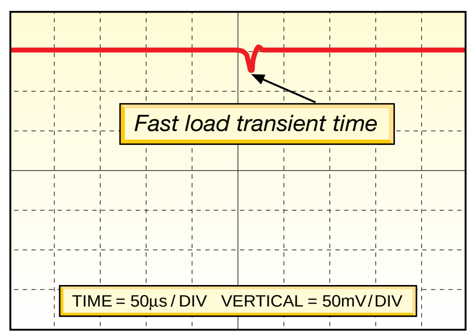
Pin configuration

Type	Package
LPR30N	DIP8
LPR30D	SO-8
LPR30D-TR	SO-8 IN TAPE & REEL

LT1585
LOAD VARIATION FROM 0.2A TO 4A

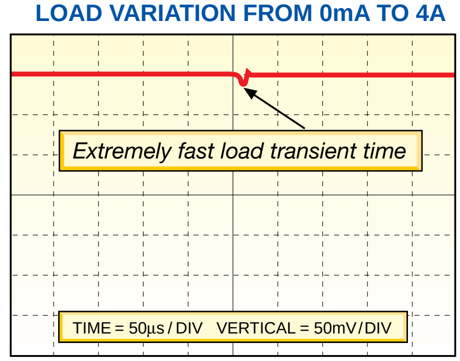


LOAD VARIATION FROM 0mA TO 4A



R2= 50Ω C_{out}= 220µF

LOAD VARIATION FROM 0mA TO 4A



R2= 50Ω C_{out}= 1000µF

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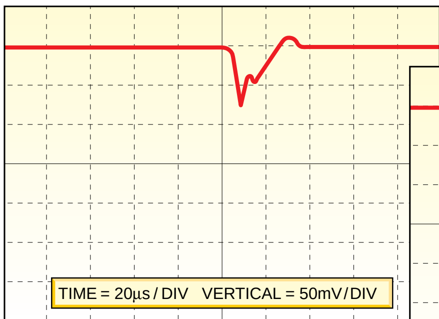
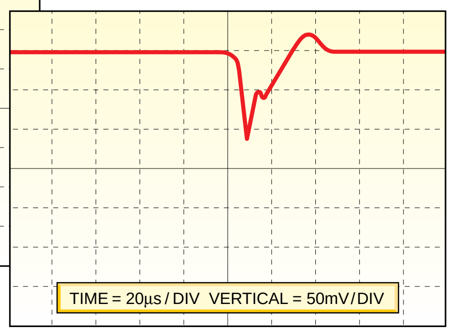
The following waveforms show the different behaviour of the demoboard configured to supply a V_{out}=5V with a maximum supply current up to I_{out}= 7A. It can clearly be seen that the transient time required to recover the V_{out} when we put a high load is always very short, from 15µs (for I_{out} from 0 to 4A) to maximum 60µs (for I_{out} from 0 to 7A).

LOAD VARIATION FROM 0mA TO 5A



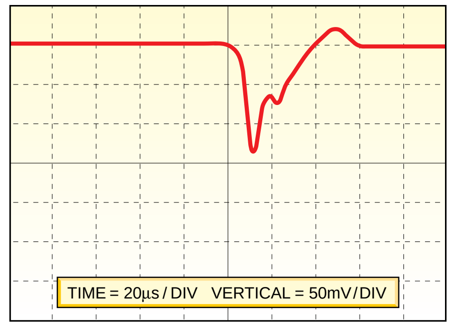
R2= 50Ω C_{out}= 220µF

LOAD VARIATION FROM 0mA TO 6A



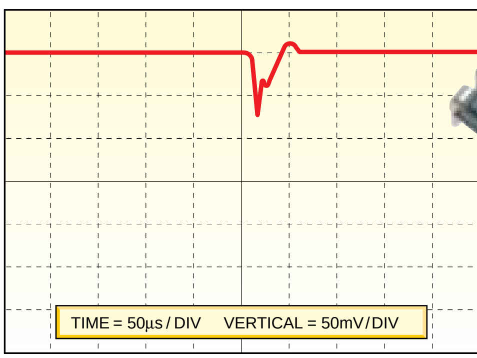
R2= 50Ω C_{out}= 220µF

LOAD VARIATION FROM 0mA TO 7A

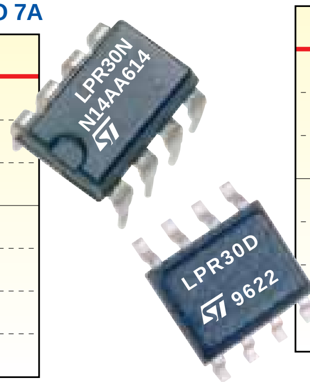


R2= 50Ω C_{out}= 220µF

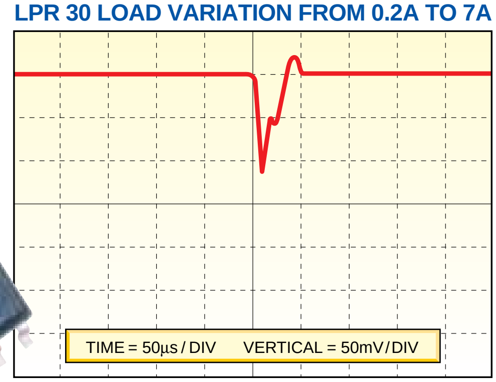
LPR 30 LOAD VARIATION FROM 0.2A TO 7A



R2= 50Ω C_{out}= 1000µF



LPR 30 LOAD VARIATION FROM 0.2A TO 7A



R2= 50Ω C_{out}= 220µF

LOAD VARIATION

The load variation is also dependent on the C_{out} capacitance value (C3). With a standard electrolytic capacitor of 1000µF, the maximum load variation is around 65mV and under the same conditions, with a maximum load of 7A and a smaller capacitor of 220µF, the load variation is still very low (150mV).

No other competitor is able to supply a device with such excellent performance!

LPR30 DEMOBOARD

A promotional kit containing a demoboard and floppy disk is available on request.