

Software Question

A typical bicycle drivetrain has a number of cogs on the front crank (where the rider pedals) and a number of cogs on the rear cassette (on the wheel). The set of front cogs and set of rear cogs can be called the drivetrain configuration.

All cogs have an integer number of teeth and only a single cog on the front and single cog on the rear can be selected at one time.

The output ratio from the pedals to the rear wheel is defined by a gear combination:

$$\text{output ratio} = \text{tooth count on selected front cog} / \text{tooth count on selected rear cog}$$

Using the C programming language, create a module that satisfies the following requirements. Output demonstrating functionality over a number of test cases should be provided. Output should match the format indicated.

1) For a given drivetrain configuration and target ratio, determine the gear combination providing the closest ratio less than the target ratio. For example:

Example input data:

Drivetrain Configuration

- front cogs = 38, 30
- rear cogs = 28, 23, 19, 16
- target ratio = 1.6

output:

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f:30 r: 19 ratio: 1.579
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2) For an initial gear combination and target ratio, determine a shift sequence to traverse from the initial gear combination to the gear combination with the closest ratio less than the target ratio. Each shift can only change one gear on either the front or rear. For example:

Drivetrain Configuration

- front cogs = 38, 30
- rear cogs = 28, 23, 19, 16
- target ratio = 1.6
- initial combination = Front:38 Rear:28

output:

1 - f:38 r:28 ratio: 1.357
2 - f:30 r:28 ratio: 1.071
3 - f:30 r:23 ratio: 1.304
4 - f:30 r:19 ratio: 1.579

Hardware Question

An existing design uses the buck converter circuit shown below. The MOSFET M1 is going end of life, and you need to identify a suitable replacement. Review the datasheets attached and provide a suggested replacement, along with the detailed rationale for choosing that part.

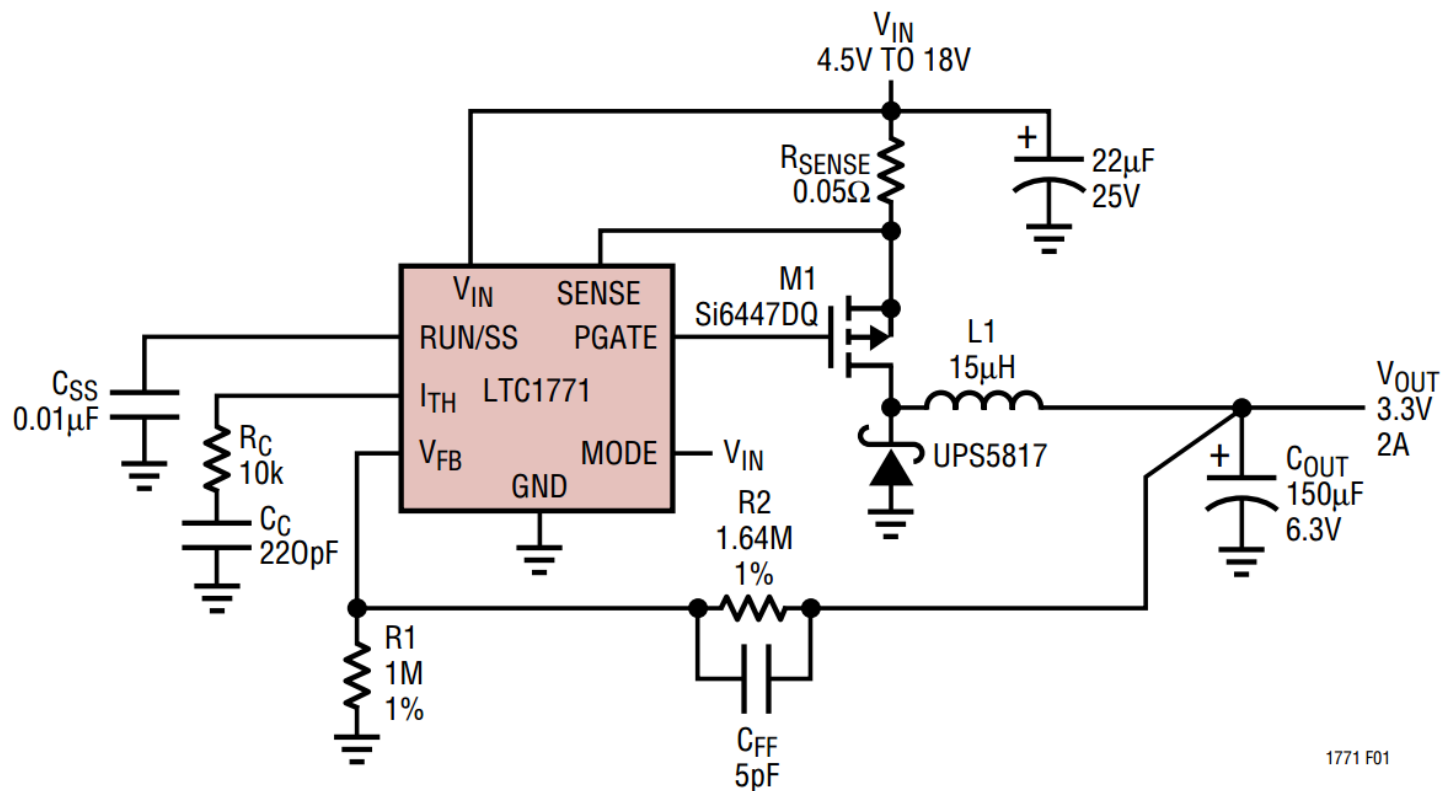


Figure 1. High Efficiency Step-Down Converter

Existing Parts



LTC1771f.pdf



Si6447DQ_70170.pdf

Potential Replacements



NDS9405.pdf



IRF7202.pdf

