

# LP3878-ADJ Evaluation Board

National Semiconductor  
Application Note 1409  
Chester Simpson  
October 2005

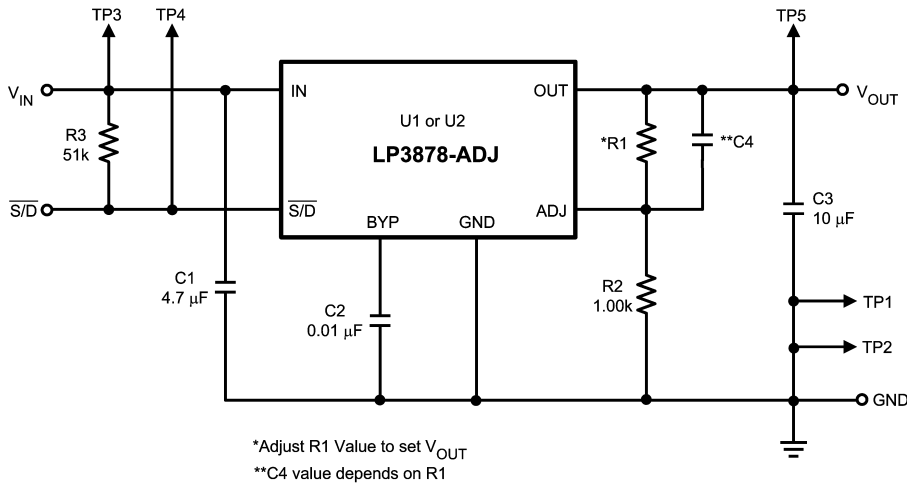


## Introduction

The LP3878-ADJ is an 800 mA low-dropout linear regulator whose output voltage can be externally set to any value between 1V and 5.5 V using two resistors. This application note gives information about the evaluation board supplied to demonstrate the function of this part.

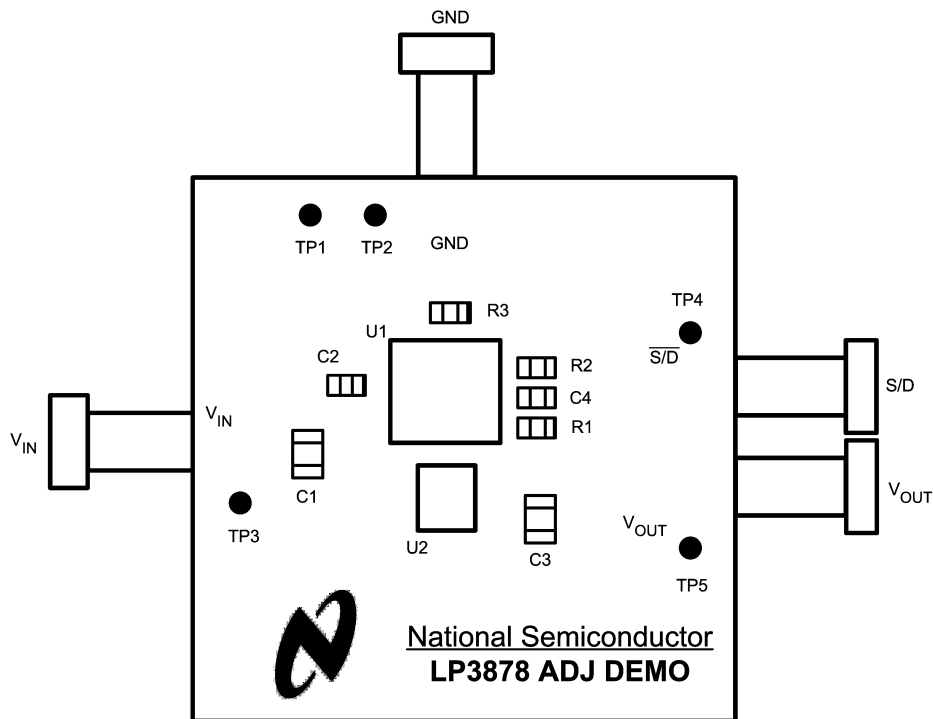
## Basic Application Circuit

The basic application circuit shown below provides the component designators used on the evaluation board.



20169101

Evaluation Board Basic Application Circuit



20169102

Evaluation Board Component Layout (Top View)

## Setting the Output Voltage

The output voltage is set using the two external resistors R1 and R2:

$$V_{OUT} = V_{ADJ} \times (1 + R1/R2)$$

It can be assumed that  $V_{ADJ} = 1V$ .

R2 is required to be less than 5 k $\Omega$  for stability reasons. On these boards, R2 is 1.00 k $\Omega$ . Using these values for R2 and VADJ, the appropriate value for R1 can be calculated for any value of VOUT between 1V and 5.5V. The first quantity of boards built were set to 1.8V output using a 806 $\Omega$  resistor for R1.

## Selecting Compensation Capacitor (C4)

The function of C4 is "feedforward" compensation, which is to provide a zero in the loop gain which adds phase lead at the unity gain crossover frequency. The frequency of the zero is given by:

$$f_z = 1 / (2 \times \pi \times R1 \times C4)$$

Bench testing was performed which showed the best range for the zero varied slightly based on the output voltage. For best setting time, it is recommended that C4 be selected such that:

$$(V_{OUT} > 2.5V) : 20kHz < f_z < 100kHz$$

$$(V_{OUT} \leq 2.5V) : 50kHz < f_z < 200kHz$$

**NOTE:** because C4 forms both a pole and zero, it should be made clear that the amount of beneficial phase gain which is possible reduces at lower output voltages. As the value of R1 is reduced, the pole and zero become closer in frequency. At

output voltages below about 1.5V, C4 has very little beneficial effect on phase margin (this topic is covered in detail on the LP3878-ADJ datasheet).

## Component List

The first boards were built for a 1.8V output using the 8-lead LLP package. The component list below reflects this.

**NOTE:** higher voltage rated capacitors may be substituted, but only X5R or X7R dielectric types may be used.

PCB, LP3878-ADJ

U2: IC, LP3878SD-ADJ

TP1, TP2, TP3, TP4 TP5: test point terminal, NEWARK 97H6311

VIN CONNECTOR: banana jack (RED): DIGI-KEY 108-0902-001

VOUT CONNECTOR: banana jack (BLUE): DIGI-KEY 108-0910-001

GROUND CONNECTOR: banana jack (BLACK): DIGI-KEY 108-0903-001

S/D CONNECTOR: banana jack (YELLOW): DIGI-KEY 108-0907-001

R1: resistor, 0805 case, 806  $\Omega$ , 1%

R2: resistor, 0805 case, 1.00 k $\Omega$ , 1%

R3: resistor, 0805 case, 51 k $\Omega$ , 5%

C1: ceramic capacitor, 4.7  $\mu$ F, Taiyo-Yuden #JMK316BJ475MD

C2: ceramic capacitor, 0805 case, 0.01  $\mu$ F, 10V, X5R/X7R dielectric

C3: ceramic capacitor, 10  $\mu$ F, 10V, Taiyo-Yuden # LMK325BJ106MN

C4: ceramic capacitor, 0805 case, 3300 pF, 10V, X5R/X7R dielectric

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at [www.national.com](http://www.national.com).

### LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
- A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

### BANNED SUBSTANCE COMPLIANCE

National Semiconductor manufactures products and uses packing materials that meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.

Leadfree products are RoHS compliant.



**National Semiconductor**  
Americas Customer  
Support Center  
Email: [new.feedback@nsc.com](mailto:new.feedback@nsc.com)  
Tel: 1-800-272-9959

[www.national.com](http://www.national.com)

**National Semiconductor**  
Europe Customer Support Center  
Fax: +49 (0) 180-530 85 86  
Email: [europa.support@nsc.com](mailto:europa.support@nsc.com)  
Deutsch Tel: +49 (0) 69 9508 6208  
English Tel: +44 (0) 870 24 0 2171  
Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor**  
Asia Pacific Customer  
Support Center  
Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor**  
Japan Customer Support Center  
Fax: 81-3-5639-7507  
Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)  
Tel: 81-3-5639-7560