intel®

TECHNICAL PAPER

Small and Low-Cost Power Supply Solution for Intel's Flash Memory Products

BILAL QURESHI
MCD APPLICATIONS ENGINEER

SALIM B. FEDEL
SENIOR APPLICATIONS ENGINEER

August 1994

Order Number: 297534-001

CG-041493

1.0 INTRODUCTION

Intel Flash memory devices with two power supply sources, a 5V V_{CC} and 12V V_{PP}, offer flexibility. For example, in a flash array, one simple off-chip circuit can be used by the entire array to supply the V_{PP} voltage to any flash chip. V_{CC} is the primary power source, and the only power source needed to read the memory. V_{PP} is required when writing or erasing the memory.

This technical paper describes a state-of-the-art 5V to 12V power conversion solution, which uses no inductors, fits in 0.1" sq. area and yet costs less than $2.00, in volume quantities.

A detailed description of the solution is presented in the next section. Section 3.0 deals with the components used, their type, value, price and vendors to contact. References are provided in the Additional Information section.

2.0 DETAILED DESCRIPTION

The power solution uses one MAXIM's MAX662A with four small, surface-mount capacitors to generate regulated V_{PP} with no need for inductors (Figure 1). MAX662A is available in a small, 8-pin narrow surface mount package. The entire design fits in 0.1" sq. area, as shown in the layouts of Figures 2 and 3.

Optimal Attributes

- Very Low Cost
- Small Size: 0.1" sq. (67.9 mm^2)Total Board Area (Single Sided)
- Low Shutdown Current
- Fast Rise Time from Shutdown
- No Inductor Necessary
- All-Surface Mount

Main Features

- Input Voltage Range: 4.75V to 5.5V
- Output Voltage: 12V ± 5%
- Output Current Capability up to 30 mA at V_{IN} = 5V
- Typical Efficiency: 74% at Load = 30 mA
- 500 KHz Switching Frequency
- Shutdown Feature on Chip

2.1 Maxim Integrated Products - MAX662A: V_{PP} at 30 mA

The MAX662A provides a regulated 12V output voltage at 30 mA from a 5V ± 5% power supply. It uses internal charge pumps and external capacitors to generate 12V, eliminating inductors. Regulation is provided by pulse-skipping scheme that monitors the output voltage level and turns on the charge pumps when the output voltage begins to droop. The solution boasts a typical efficiency of 74% with V_{CC} = 5V and I_{OUT} = 30 mA.

For protection from accidental erasure of flash memory, a shutdown pin is provided. In shutdown mode, the charge-pump switching action is halted and V_{IN} is connected to V_{OUT} through a 1k internal resistor.

2.2 Charge-Pump Capacitors, C1 and C2

Since the values of C1 and C2 are critical, 0.22 µF ceramic capacitors are used. Small surface-mount capacitors C2012Y5V1E224Z from TDK are used to achieve smallest board area size.

2.3 Input and Output Capacitors, C4 and C5

The type of input bypass (C4) and output filter capacitor (C5) affect performance. TDK C3216Y5V1C225Z and C2012Y5V1C105ZT, 2.2 µF and 1 µF low ESR ceramic capacitors are used. The low ESR of these units eliminates the need for decoupling between V_{IN} and V_{OUT}.

2.4 Layout Considerations

To ensure stability and decrease noise, careful attention is paid to keeping the connections short. Since only one side of the board is used, this 12V solution can be placed right beneath the flash chip in a two-sided board designs, thereby saving space and reducing pin to pin track length.

To keep the inductance in the circuit to a minimum, thick track lines are employed (0.025" wide). Some critical dimensions are given below:

Total Length: 0.345" (8.763 mm)

Total Width: 0.305" (7.747 mm)

Track Width: 0.025" (0.635 mm)

Track-Track Spacing: 0.01" (0.254 mm)

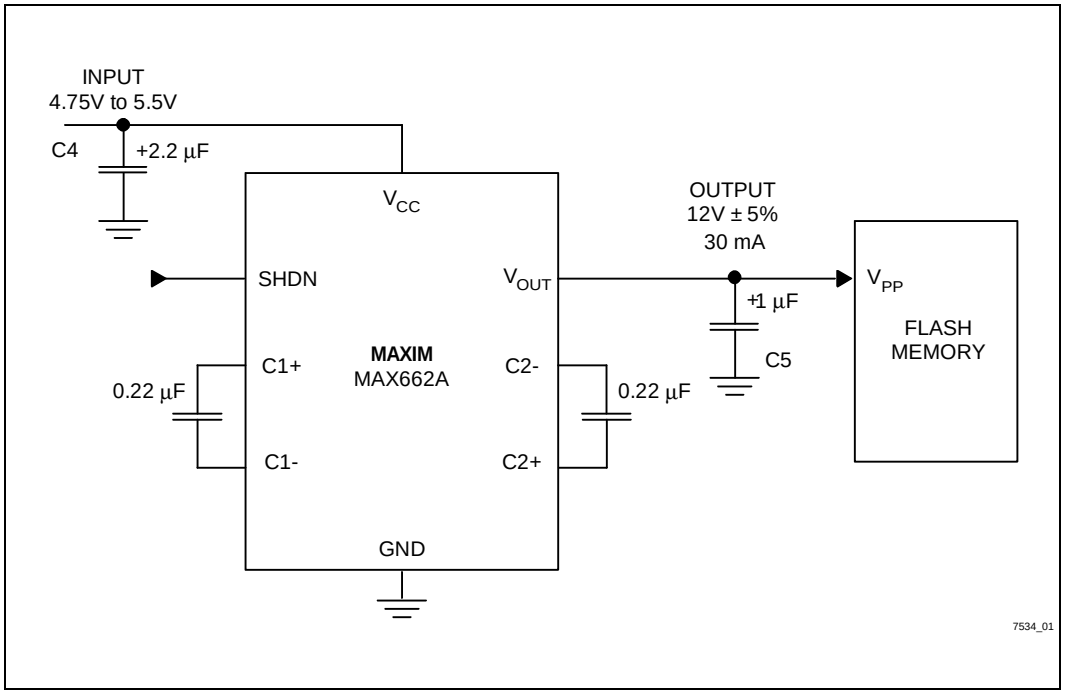

Figure 1. Maxim MAX662A 5V to 12V Converter Circuit

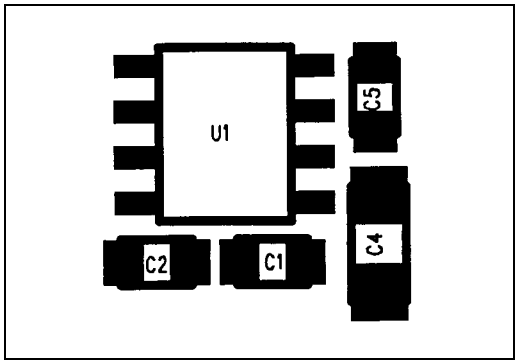

Figure 2. 5x Scale Top Side Component Placement View

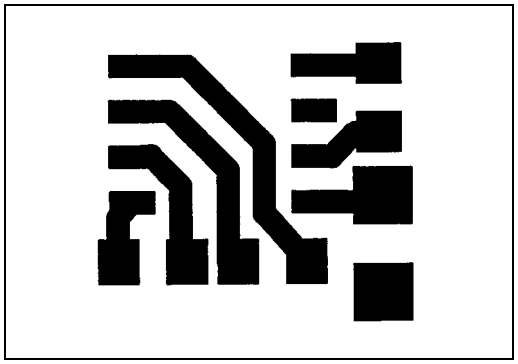

Figure 3. 5x Scale Top Side Trace View

3.0 PARTS LIST

Table 1. Parts List for the MAX662A 5V to 12V Converter

Reference	Part Number	Value/Type	Source	Cost (1)
U1	MAX662ACSA	SMPSIC	Maxim (408) 737-7600	$1.69
C1, C2	C2012Y5V1E224Z	0.22 µF Ceramic	TDK (408) 437-9585	$0.06
C4	C3216Y5V1C225Z	2.2 µF Ceramic	TDK (408) 437-9585	$0.09
C5	C2012Y5V1C105Z	1.0 µF Ceramic	TDK (408) 437-9585	$0.07
Total Cost				**$1.97**

NOTE:

1. Cost estimates based on published 10K unit-pricing at the time this technical paper was written.

4.0 SUMMARY

This technical paper summarizes low-cost 5V to 12V power solution, which uses no inductors and fits in 0.1" sq. area. The solution is based on recommendations provided by the supplier vendors, and has been verified at the Intel Corporation laboratory.

5.0 ADDITIONAL INFORMATION

5.1 References

Order Number	Document
292092	AP-357, “Power Supply Solutions for Flash Memory”
292153	AB-59, “Multi-Site Layout Planning with Intel's Flash File™ Components Including ROM Compatability”