

## PWM SWITCHER CONTROLLER & 7.5A ADJUSTABLE LOW DROPOUT REGULATOR COMBO

PATENT PENDING  
PRELIMINARY DATASHEET

### FEATURES

- The US2076 eliminates the need for a separate switching controller IC
- Minimum part count allows lower system cost
- Adjustable 7.5A LDO on board
- 1.1V Dropout at 7.5A
- On board MOSFET driver
- Fastest transient response of any controller method. ( 0 to 100% Duty Cycle in 100 nS )
- 1% internal voltage reference
- Internal Thermal shutdown
- Internal Under Voltage Lockout protects MOSFET during start-up

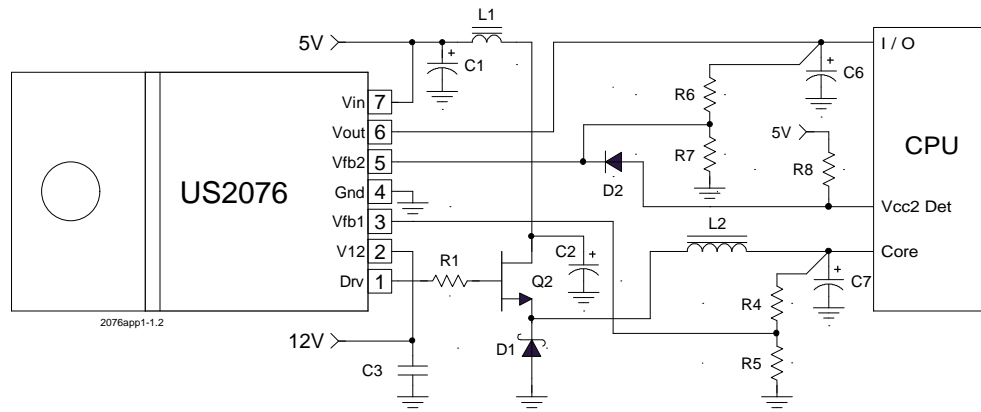
### APPLICATIONS

- Dual supply low voltage processor applications, such as: P55C™, CYRIX M2™, POWER PC™ and AMD K6™

### DESCRIPTION

The US2076 is a dual function IC combining a switching controller and a 7.5A adjustable low dropout regulator all in a compact 7 pin TO220 and TO263 surface mount packages providing a total solution for dual supply processor applications such as an Intel P55C™, AMD K6™, as well as Cyrix 6X86L™ and the M2™ processors. Typically in these applications a dual supply regulator converts 5V to 3.3V for I/O supply and a jumper programmable supply of 1.25V to 3.5V for CORE supply. The linear regulator portion in the US2076 is an adjustable one that can be programmed to 3.30V output and has a minimum of 7.5A current capability designed to provide ample current for most applications. The US2076 uses an internal regulator generated from the 12V supply to power the switching controller as well as the 12V supply to drive the power MOSFET, allowing a low cost N channel MOSFET switch to be used. The IC also includes an error comparator for fast transient response, a precise voltage reference for setting the output voltage as well as a direct drive of the MOSFET for the minimum part count.

### TYPICAL APPLICATION



Typical application of US2076 in a flexible motherboard designed for Intel P55™, P54™, AMD K5 & K6™ as well as Cyrix M1™ and M2™ applications.

Notes: P54C, P55C are trade marks of Intel Corp. K5 & K6 are trade marks of AMD corp. Cyrix 6X86L, M1, M2 are trade marks of Cyrix Corp. Power PC is trade mark of IBM Corp.

### PACKAGE ORDER INFORMATION

Tj (°C)	7 PIN PLASTIC TO220 (T)	7 PIN PLASTIC TO263 (M)
0 TO 125	US2076CT	US2076CM

# US2076

## ABSOLUTE MAXIMUM RATINGS

12V Supply Voltage .....	14V
Vin Supply Voltage .....	7V
LDO Power Dissipation .....	Internally Limited
FB Pin Voltage.....	-0.3V to 5V
Storage Temperature Range .....	-65 TO 150°C
Operating Junction Temperature .....	0 TO 150°C

## PACKAGE INFORMATION

7 PIN PLASTIC TO220 (T)	7 PIN PLASTIC TO263 (M)
<p>FRONT VIEW</p> <p><math>\theta_{JT}=2.7^{\circ}\text{C/W}</math>   <math>\theta_{JA}=60^{\circ}\text{C/W}</math></p>	<p>FRONT VIEW</p> <p><math>\theta_{JA}=35^{\circ}\text{C/W}</math> for 1" Square pad</p>

## ELECTRICAL SPECIFICATIONS

Unless otherwise specified the following specification applies over,  $V_{in}=5V$ ,  $V_{12}=12V$ , and  $T_j=0$  to  $125^{\circ}\text{C}$ . Low duty cycle pulse testing are used which keeps junction and case temperatures equal to the ambient temperature.

### LDO Section

PARAMETER	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
F.B Voltage Initial Accuracy	Vfb2	$T_j=25^{\circ}\text{C}$	1.237	1.250	1.262	V
F.B Voltage Total Variation	Vfb2		1.225	1.250	1.275	V
F.B Input Bias Current	I <sub>fb2</sub>	Vfb2=1.25V	-1		+1	uA
Dropout Voltage (note 2)		Vout=1.25V, I <sub>o</sub> =7.5A		1.1		V
Line Regulation		Vout=1.25V, I <sub>o</sub> =10mA, $3 < V_{in} < 6V$		0.2		%
Load Regulation (note 1)		Vout=1.25V, $10\text{mA} < I_{o} < 7.5A$		0.5		%
Thermal Regulation		30 mS Pulse		0.01		%/W
Minimum Load Current (note 3)					10	mA
Ripple Rejection		f=120HZ, Co=25uF Tan, I <sub>o</sub> =1A		70		dB
V12 Supply Current	I <sub>cc2</sub>	Vfb2=1V, Vfb1=1.5V, I <sub>o</sub> =7.5A		75		mA

### Switching Controller Section

PARAMETER	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
F.B Voltage Initial Accuracy	Vfb1	$T_j=25^{\circ}\text{C}$	1.237	1.250	1.262	V
F.B Voltage Total Variation	Vfb1		1.225	1.250	1.275	V
F.B Input Bias Current	I <sub>fb1</sub>	Vfb1=1.25V	-1		+1	uA
Min On Time		Vfb1 is sq wave with 300 ns on time and 2 uS off time		800		nS
Min Off Time		Vfb1 is sq wave with 300 ns off time and 2 uS on time		800		nS
V12 Supply Current	I <sub>cc1</sub>	Vfb1=1V, Vfb2=1.5V		10		mA
Maximum Duty Cycle	D <sub>max</sub>	Vfb1=1V			100	%
Minimum Duty Cycle	D <sub>min</sub>	Vfb1=1.5V	0			%
Gate Drive Rise/Fall Time	V <sub>gate</sub>	Load=IRL3303		70		nS
F.B Hysterises				12		mV

**Note 1 :** Low duty cycle pulse testing with Kelvin connections are required in order to maintain accurate data.

**Note 2 :** Drop-out voltage is defined as the minimum differential voltage between  $V_{in}$  and  $V_{out}$  required to maintain regulation at  $V_{out}$ . It is measured when the output voltage drops 1% below its nominal value.

**Note 3 :** Minimum load current is defined as the minimum current required at the output in order for the output voltage to maintain regulation. Typically the resistor dividers are selected such that it automatically maintains this current.

## PIN DESCRIPTIONS

PIN #	PIN SYMBOL	PIN DESCRIPTION
3	Vfb1	A resistor divider from this pin to the output of the switching regulator and ground sets the Core supply voltage.
6	Vout	The output of the linear regulator. A minimum of a 100uF low ESR capacitor must be connected from this pin to ground to insure stability.
7	Vin	The input pin of the linear regulator. Typically a large storage capacitor is connected from this pin to ground to insure that the input voltage does not sag below the minimum drop out voltage during the load transient response. This pin must always be higher than $V_{out}$ plus the maximum dropout voltage in order for the device to regulate properly.
4	Gnd	This pin is connected to the IC substrate and must be connected to the lowest potential in the system. It is also connected to the Tab of the package.
1	Drv	The PWM output of the switching controller. This pin is a totem pole drive that is connected to the gate of the power MOSFET. A resistor may be placed in series from this pin to the gate in order to reduce switching noise.
5	Vfb2	A resistor divider from this pin to the output of the linear regulator and ground sets the I/O supply voltage.
2	V12	This pin is connected to the 12V supply voltage. A high frequency cap must be connected from this pin to the GND pin of the IC.

## BLOCK DIAGRAM

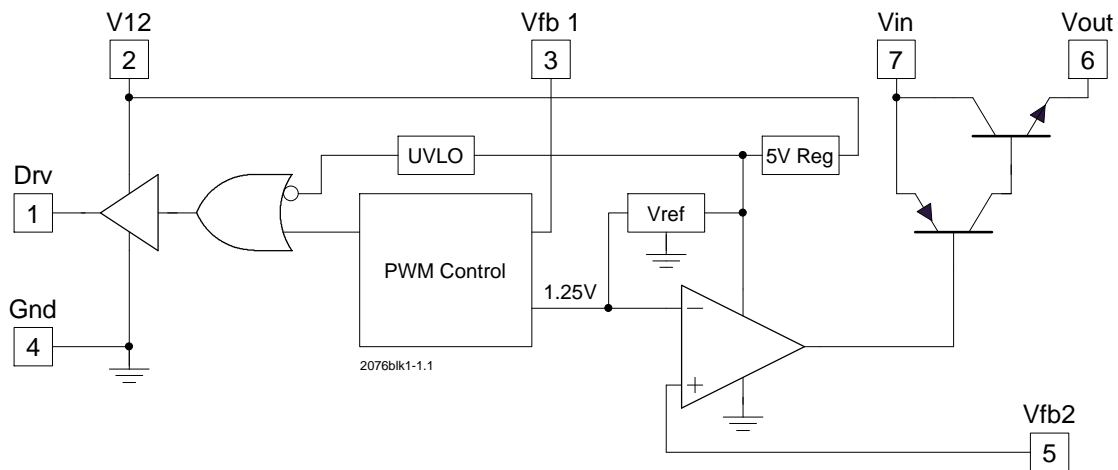


Figure 1 - Simplified block diagram of the US2076

# US2076

## TYPICAL APPLICATION

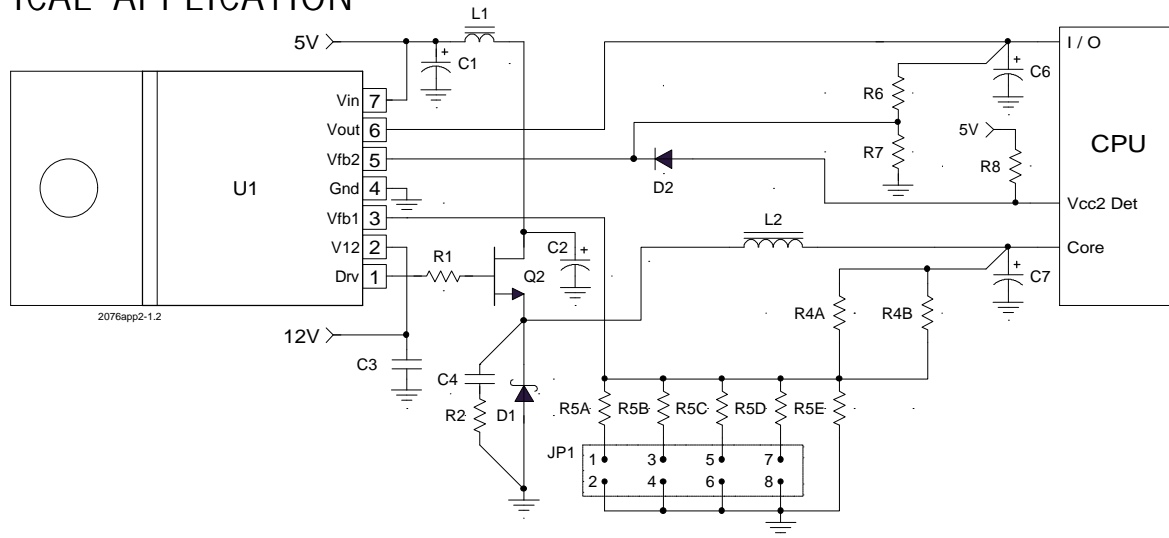


Figure2- Typical application of US2076 in a flexible motherboard with the 4 bit VID output voltage selection. This circuit uses a single jumper that programs the output voltage in 16 steps with 0.1V steps from 2V to 3.5V, designed for Intel P55™, P54™, AMD K5 & K6™ as well as Cyrix M1™ and M2™ applications. The Vcc2Det pin automatically shuts down the I/O when a single plane processor is dropped in the socket.

Ref Desig	Description	Qty	Part #	Manufacturer
U1	LDO/Switcher IC	1	US2076CT (TO220) US2076CM (TO263) (note 1)	Unisem
Q1	MOSFET	1	IRL3303 (TO220) IRL3103S (TO263) (note 1)	International Rectifier
D1	Schottky Diode	1	MBR1045CT (TO220) MBRB1545CT (TO263) (note1)	Motorola
D2	Diode, GP	1	1N4148	
L2	Inductor	1	Core:T50-18,L=4 uH Turns: 10T, 18 AWG	Micro Metal (core)
L1	Inductor	1	L=2 uH	
R1	Resistor	1	22 ohm,5%, SMT 1206 size	
R2	Resistor	1	10 ohm, 5%, SMT 1206 size	
R4A	Resistor	1	806 ohm,1%, SMT 0805 size	
R4B	Resistor	1	90.9 kohm,1%, SMT 0805 size	
R5A	Resistor	1	1.24 kohm,1%, SMT 0805 size	
R5B	Resistor	1	2.49 kohm,1%, SMT 0805 size	
R5C	Resistor	1	4.99 kohm,1%, SMT 0805 size	
R5D	Resistor	1	10 kohm,1%, SMT 0805 size	
R5E	Resistor	1	1.30 kohm,1%, SMT 0805 size	
R6	Resistor	1	ohm,1%, SMT 0805 size	
R7	Resistor	1	ohm,1%, SMT 0805 size	
R8	Resistor	1	10 kohm,5%, SMT 0805 size	
C3	Capacitor	1	1 uF,Ceramic, SMT 0805 size, Z5U	
C1	Capacitor	1	EEUFA1A681L, 680uF,10V, Elect	Panasonic
C4	Capacitor	1	470pF,Ceramic, SMT 0805 size	
C2	Capacitor	1	6MV1500GX, 1500uF,6.3V, Elect	Sanyo
C6	Capacitor	1	EEUFA1A681L, 680uF,10V, Elect	Panasonic
C7	Capacitor	4	6MV1500GX, 1500uF,6.3V, Elect	Sanyo
HS1	Heat Sink	1	For MOSFET , 577002	Aavid
HS2	Heat Sink	1	For Schottky Diode , 577002	Aavid
HS3	Heat Sink	1	For US2076 , 507222 (I/O Load Current<5A) 576602 (I/O Load Current< 3.5A)	Aavid

Note 1: For the applications where it is desirable to eliminate the heat sink, the US2076CM for U1 when load current is less than 1.5A, the IRL3103S for Q2 and MBR1545CT for D1 in TO263 packages with minimum of 1" square copper pad can be used.