

Features

- Output Voltage: 3.3V, 5V, 12V and Adjustable Output Version
- Adjustable Version Output Voltage Range, 1.23V to 37V \pm 4%
- 150 KHz \pm 15% Fixed Switching Frequency
- Voltage Mode Non-Synchronous PWM Control
- Thermal-Shutdown and Current-Limit Protection
- ON/OFF Shutdown Control Input
- Operating Voltage Can be Up to 40V
- Output Load Current: 3A
- TO220-5L TO220-5L(R) and TO263-5L Packages
- Low Power Standby Mode
- Built-In Switching Transistor on Chip

Applications

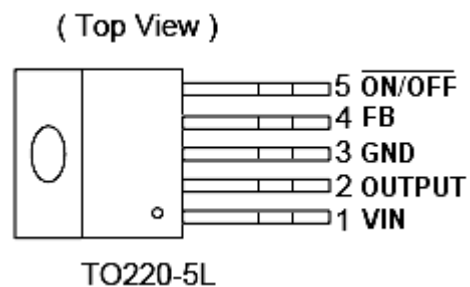
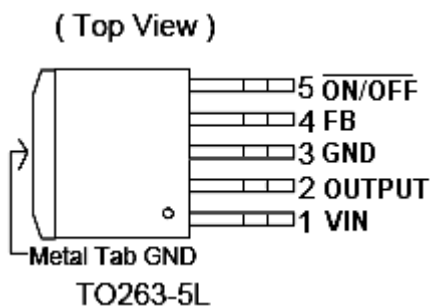
- Simple High-efficiency Step-Down Regulator
- On-card Switching Regulators
- Positive to Negative Converter

General Description

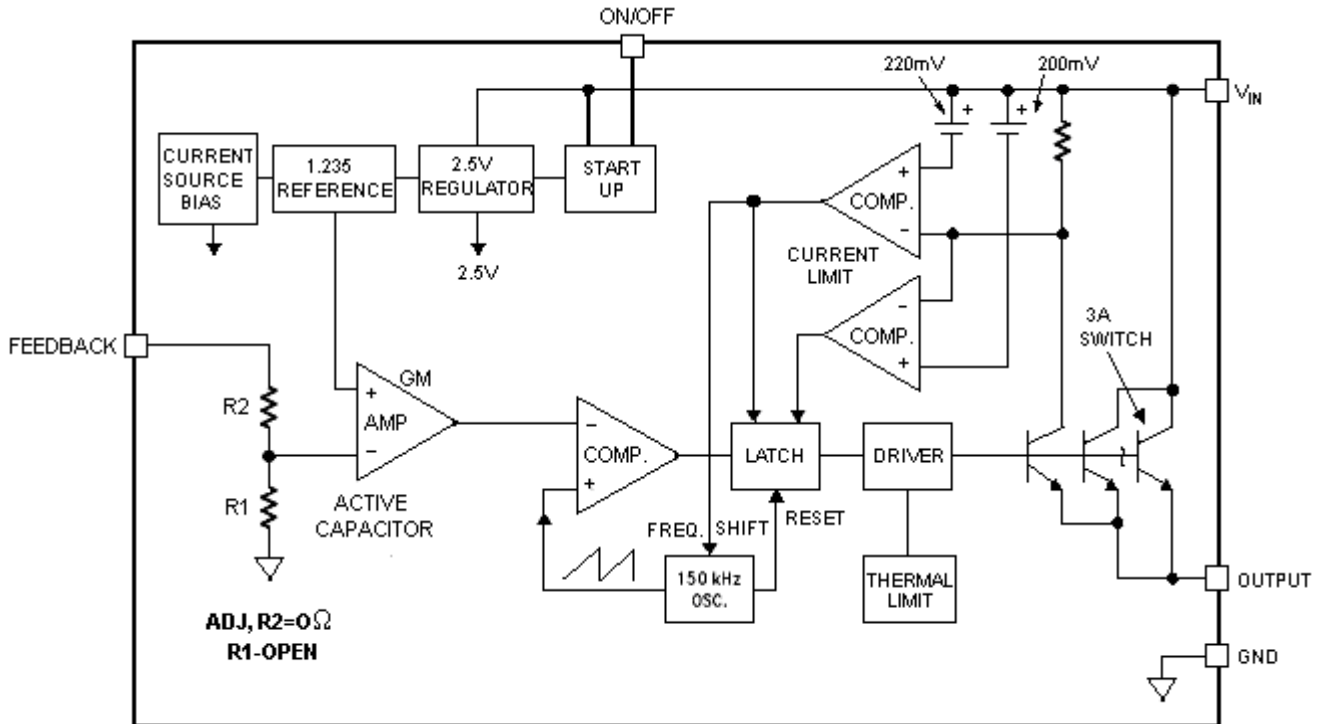
The HYM2596 series are monolithic IC that design for a step-down DC/DC converter, and own the ability of driving a 3A load without additional transistor component. Due to reducing the number of external component, the board space can be saved easily. The external shutdown function can be controlled by logic level and then come into standby mode. The internal compensation makes feedback control have good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch. The HYM2596 series operates at a switching frequency of 150 KHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Other features include a guaranteed 14% tolerance on output voltage under specified input voltage and output load conditions, and \pm 15% on the oscillator frequency. The output version included fixed 3.3V, 5V, 12V, and an adjustable type. The packages are available in a standard 5-lead TO-220 package and a 5-lead TO-263.

Block Diagram and Pin Diagram

Pin Assignment



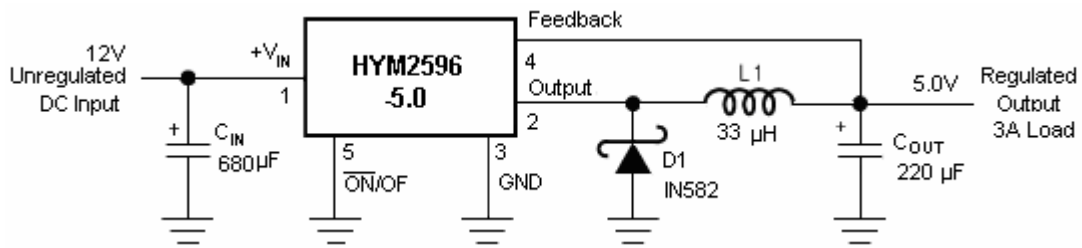
Block Diagram



Pin Description

| Pin Number | Symbol | Description |
|------------|------------------------|--|
| 1 | +V_{IN} | This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator. |
| 2 | Output | Internal switch. The voltage at this pin switches between (+V _{IN} -V _{SAT}) and approximately -0.5V, with a duty cycle of approximately V _{OUT} /V _{IN} . To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept to a minimum. |
| 3 | GND | Circuit ground. |
| 4 | Feedback | Senses the regulated output voltage to complete the feedback loop. |
| 5 | ON/OFF | Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 25V) shuts the regulator down. If this shutdown feature is not needed, the ON /OFF pin can be wired to the ground pin or it can be left open, in either case the regulator will be in the ON condition. |

Typical Application (Fixed Output Voltage Versions)



Absolute Maximum Rating

| Parameter | Rating | Unit |
|------------------------------|--------------------|------|
| Maximum Supply Voltage | +45 | V |
| ON/OFF Pin Input Voltage | -0.3 to 25 | V |
| Feedback Pin Voltage | -0.3V to 25 | V |
| Output Voltage to Ground | -1 | V |
| Power Dissipation | Internally limited | W |
| Storage Temperature Range | -65 to +150 | °C |
| Maximum Junction Temperature | +150 | °C |
| Temperature Range | -40 to +125 | °C |
| Supply Voltage | 4.5 to 40 | V |

Electrical Characteristics (All Output Voltage Versions)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------|---------------------------|---|------------|------|----------------------|------|
| I _{FB} | Feedback Bias Current | V _{FB} =1.3V (Adjustable version only) | | 40 | 60 | nA |
| | | | | | 100 | |
| F _{OSC} | Oscillator Frequency | | 127 | 150 | 173 | KHz |
| | | | 110 | | 173 | |
| V _{SAT} | Saturation Voltage | I _{OUT} =3A No outside circuit V _{FB} =0V force driver on | | 1.3 | 1.4 1.5 | V |
| DC | Max. Duty Cycle (ON) | V _{FB} =0V force driver on | | 100 | | % |
| | Min. Duty Cycle (OFF) | V _{FB} =12V force driver off | | 0 | | |
| I _{CL} | Current Limit | Peak current No outside circuit V _{FB} =0V force driver on | 3.6 | 4.0 | 5.5 6.5 | A |
| I _L | Output=0 | no outside circuit V _{FB} =12V force driver off | | | 200 | µA |
| | Output=-1 | | | | V _{IN} =40V | |
| I _Q | Quiescent Current | V _{FB} =12V force driver off | | 5 | 10 | mA |
| I _{STBY} | Standby Quiescent Current | ON/OFF pin=5V V _{IN} =40V | | 150 | 250 | µA |
| | | | | | 300 | |
| V _{IL} | ON/OFF pin Logic Input | Low (regulator ON) | | | 0.6 | |

HYM2596

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| | | | | | | |
|---------------|--|------------------------|---------------------|------|-----|-------|
| V_{IH} | Threshold Voltage | High (regulator OFF) | 2.0 | 1.3 | | V |
| I_H | ON/OFF Pin Logic Input Current | $V_{LOGIC}=2.5V$ (OFF) | | 15 | 25 | uA |
| I_L | ON/OFF Pin Input Current | $V_{LOGIC}=0.5V$ (ON) | | 0.02 | 5 | |
| θ_{JC} | Thermal Resistance | TO220-5L | Junction to Case | | 2.5 | |
| | | TO263-5L | | | 3.5 | |
| θ_{JA} | Thermal Resistance With Copper area of Approximately 3 in ² | TO220-5L | Junction to Ambient | | 28 | °C /W |
| | | TO263-5L | | | 23 | |

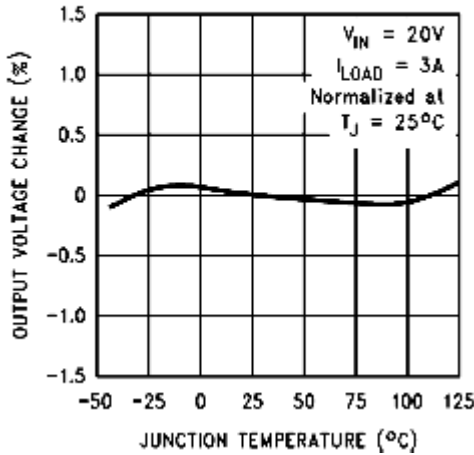
Electrical Characteristics (Continued)

| | Symbol | Parameter | Conditions | Typ. | Limit | Unit |
|--------------|-----------|-----------------|--|------|--|-----------------------------|
| HYM2596-3.3V | V_{OUT} | Output Voltage | $4.75V \leq V_{IN} \leq 40V$ $0.2A \leq I_{LOAD} \leq 3A$ | 3.3 | 3.168/3.135 3.432/3.465 | V V_{MIN} V_{MAX} |
| | η | Efficiency | $V_{IN}=12V, I_{LOAD}=3A$ | 73 | | % |
| HYM2596-5V | V_{OUT} | Output Voltage | $4.75V \leq V_{IN} \leq 40V$ $0.2A \leq I_{LOAD} \leq 3A$ | 5 | 4.8/4.75 5.2/5.25 | V V_{MIN} V_{MAX} |
| | η | Efficiency | $V_{IN}=12V, I_{LOAD}=3A$ | 80 | | % |
| HYM2596-12V | V_{OUT} | Output Voltage | $15 \leq V_{IN} \leq 40V$ $0.2A \leq I_{LOAD} \leq 3A$ | 12 | 11.52/11.4 12.48/12.6 | V V_{MIN} V_{MAX} |
| | η | | $V_{IN}=15V, I_{LOAD}=3A$ | 90 | | % |
| HYM2596-ADJ | V_{FB} | Output Feedback | $4.5V \leq V_{IN} \leq 40V$ $0.2A \leq I_{LOAD} \leq 3A$ V_{OUT} programmed for 3V | 1.23 | 1.193/1.18 1.267/1.28 | V V_{MIN} V_{MAX} |
| | η | Efficiency | $V_{IN}=12V, I_{LOAD}=3A$ | 73 | | % |

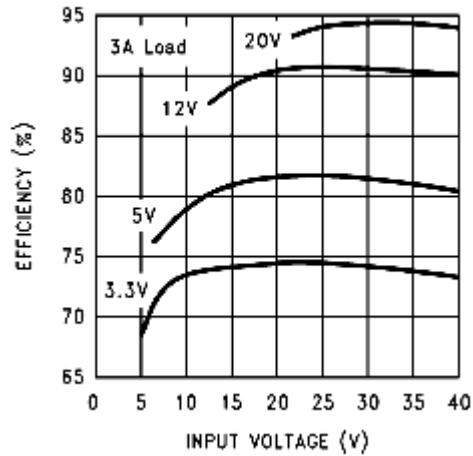
Specifications with standard type face are for $T_J = 25^\circ C$, and those with boldface type apply over full Operating Temperature Range.

Typical Performance Characteristics:

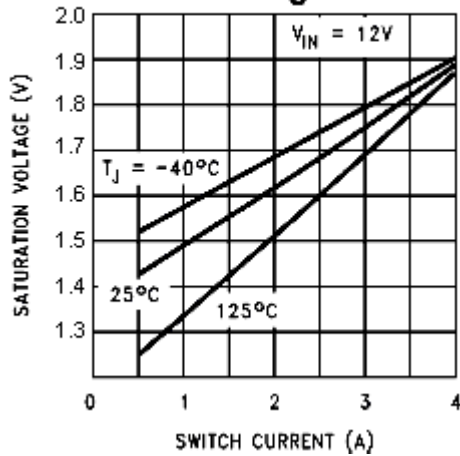
Normalized Output Voltage



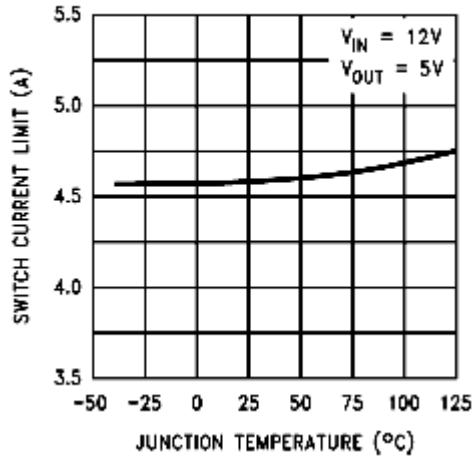
Efficiency



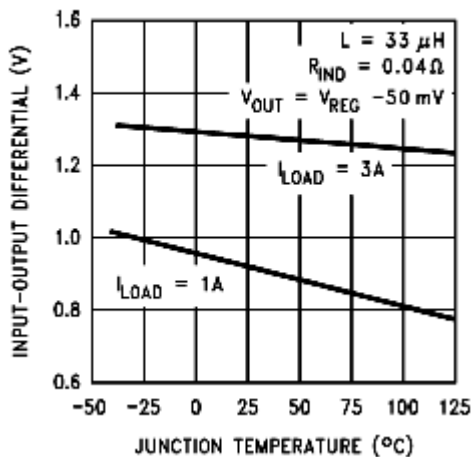
Switch Saturation Voltage



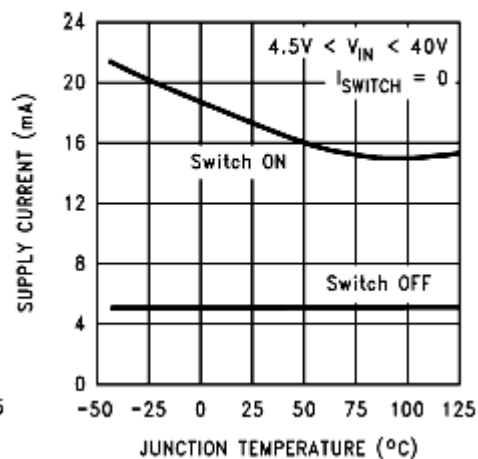
Switch Current Limit



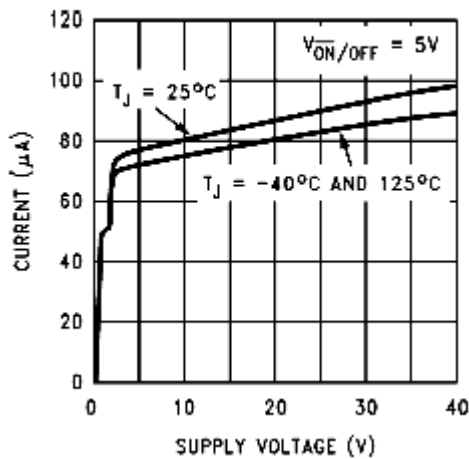
Dropout Voltage



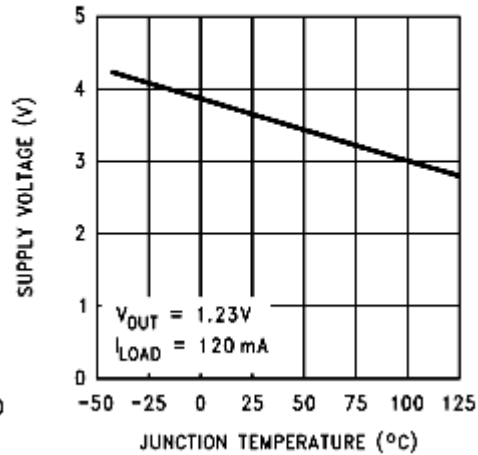
Operating Quiescent Current



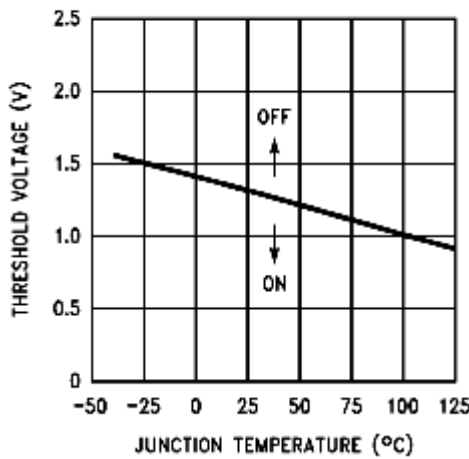
Shutdown Quiescent Current



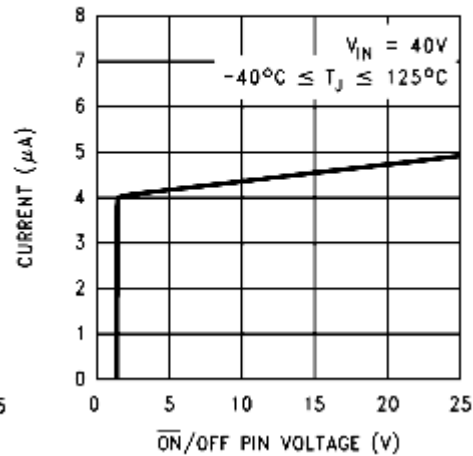
Minimum Operating Supply Voltage



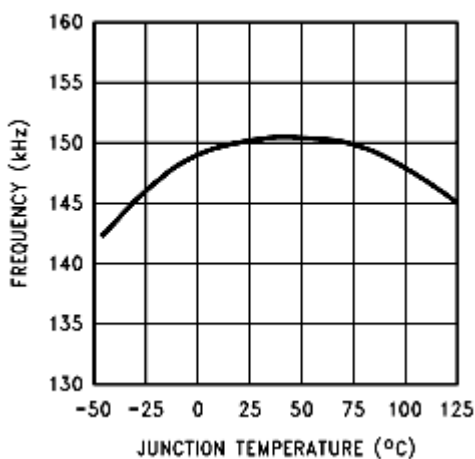
ON/OFF Threshold Voltage



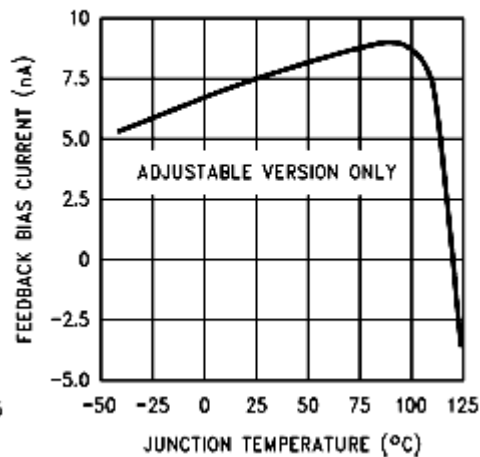
ON/OFF Pin Current (Sinking)



Switching Frequency



Feedback Pin Bias Current



Thermal Considerations

The HYM2596 is available in two packages, a 5-pin TO-220 and a 5-pin surface mount TO-263.

The TO-220 package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The HYM2596 junction temperature rises above ambient temperature for a 3A load and different input and output voltages. The data for these curves was taken with the HYM2596 (TO-220 package) operating as a buck switching regulator in an ambient temperature of 25 °C (still air). These temperature rise numbers are all approximate and there are many factors that can affect these temperatures. Higher ambient temperatures require more heat sinking.

The TO-263 surface mount package tab is designed to be soldered to the copper on a printed circuit board. The copper and the board are the heat sink for this package and the other heat producing components, such as the catch diode and inductor. The PC board copper area that the package is soldered to should be at least 0.4 in², and ideally should have 2 or more square inches of 2 oz. Additional copper area improves the thermal characteristics, but with copper areas greater than approximately 6 in², only small improvements in heat dissipation are realized. If further thermal improvements are needed, double sided, multilayer PC board with large copper areas and/or airflow are recommended.

The HYM2596 (TO-263 package) junction temperature rise above ambient temperature with a 2A load for various input and output voltages. This data was taken with the circuit operating as a buck switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but be aware that there are many factors that can affect the junction temperature. When load currents higher than 2A are used, double sided or multilayer PC boards with large copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.

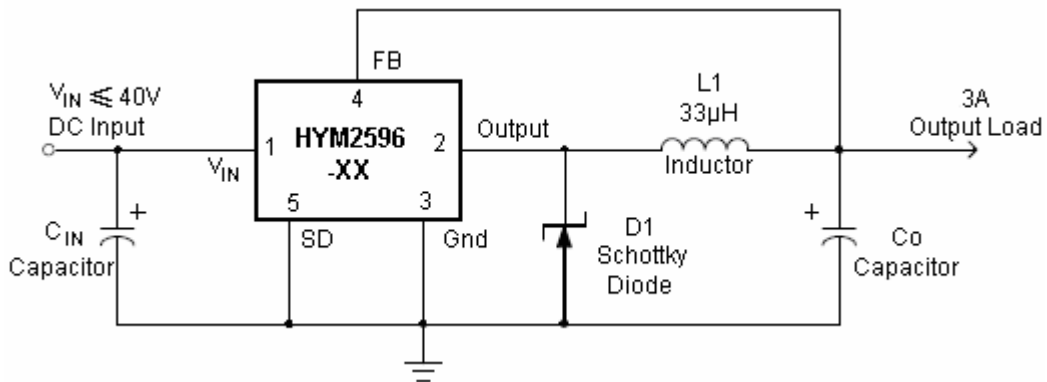
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin , which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature rise numbers are all approximate, and there are many factors that will affect these numbers. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multilayer board and the amount of solder on the board. The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving.

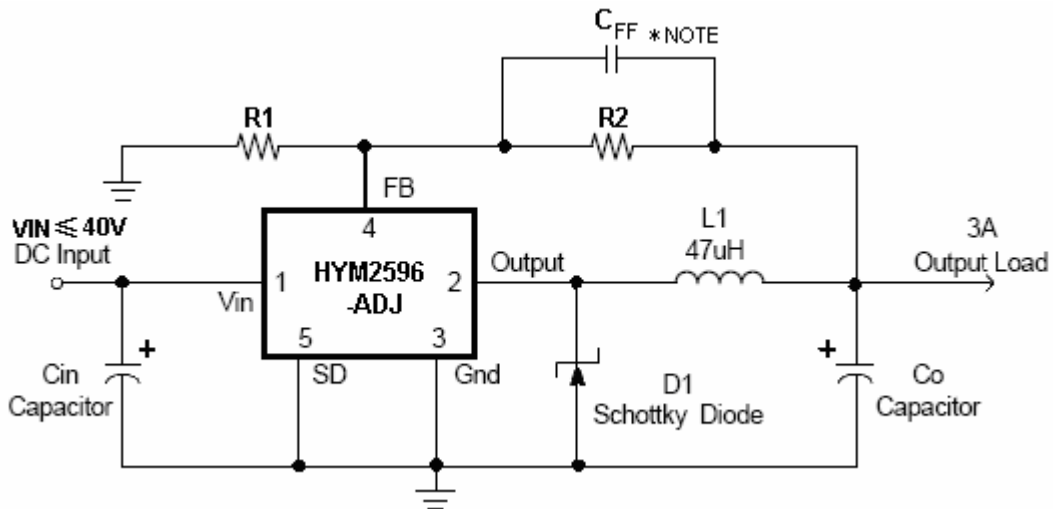
Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

Typical Application Circuit

Fixed Type Circuit



Adjustable Type Circuit



$$V_{OUT} = V_{REF} \left(1 + \frac{R_2}{R} \right)$$

where $V_{REF} = 1.23V$

$$R_2 = R_1 \left(\frac{V_{OUT}}{V_{REF}} - 1 \right)$$

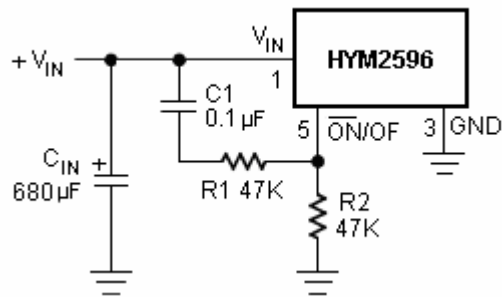
$R_2 = 1K \sim 3k$

Feedforward Capacitor (C_{FF})

For output voltages greater than approximately 10V, an additional capacitor is required. The compensation capacitor is typically between 100pF and 33nF, and is wired in parallel with the output voltage setting resistor, R₂. It provides additional stability for high output voltages, low input-output voltages, and/or very low ESR output capacitors, such as solid tantalum capacitors.

HYM2596

Delay Start Circuit



Package Information

Package Type: TO220-5L

