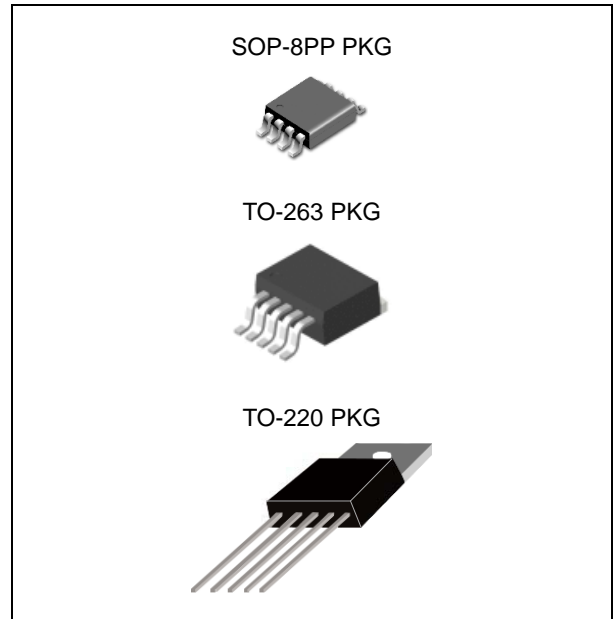


FEATURES

- 3.3V, 5V, 12V and Adjustable output versions
- Adjustable version output voltage range, 1.23V to 57V
- $\pm 4\%$ max over line and load condition
- Available in TO-220, TO-263 and SOP-8PP
- Guaranteed 3A output load current
- Input voltage range up to 60V
- Requires only 4 external components
- Excellent line and load regulation specifications
- 150kHz fixed frequency internal oscillator
- Low power standby mode, I_{STB} typically 30uA
- High efficiency
- Thermal shutdown and current limit protection
- Output short protection by reduction of frequency by 3 times



ORDERING INFORMATION

| Device | Package |
|-----------------|-----------|
| LM2596HVGDP-ADJ | SOP-8PP |
| LM2596HVGDP-X.X | |
| LM2596HVGR-ADJ | TO-263 5L |
| LM2596HVGR-X.X | |
| LM2596HVGT-ADJ | TO-220 5L |
| LM2596HVGT-X.X | |

X.X = Output Voltage = 3.3, 5.0, 12

APPLICATION

- Simple high-efficiency step-down (buck) regulator
- Efficient pre-regulator for linear regulators
- On-card switching regulators

DESCRIPTION

The LM2596HV series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5V, 12V, and an adjustable output version.

Available in a standard 5-lead TO-220 package and a 5-lead TO-263 surface mount package.

External shutdown is included, featuring typically 30 μ A standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown, and protection from output short for full protection under fault conditions.

Absolute Maximum Ratings ^(Note 1)

| CHARACTERISTIC | SYMBOL | MIN. | MAX. | UNIT |
|------------------------------------|--------------|------|-------------------|--------------|
| Supply Voltage | V_{IN} | - | 63 | V |
| ON/OFF Pin Input Voltage | $V_{ON/OFF}$ | -0.3 | 60 (or V_{IN}) | V |
| FB pin voltage | V_{FB} | -0.3 | 25 (or V_{IN}) | V |
| Output voltage to GND | V_{OUT} | -1 | | V |
| Storage Temperature Range | T_{STG} | -65 | 150 | $^{\circ}$ C |
| Maximum Junction Temperature Range | $T_{J,MAX}$ | - | 150 | $^{\circ}$ C |

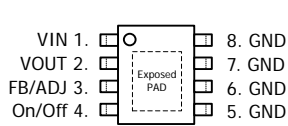
Operating Ratings

| CHARACTERISTIC | SYMBOL | MIN. | MAX. | UNIT |
|-------------------|------------|------|------|------|
| Supply Voltage | V_{IN} | 4.5 | 60 | V |
| Load Current | I_{LOAD} | - | 3.0 | A |
| Temperature Range | T_J | -40 | 125 | |

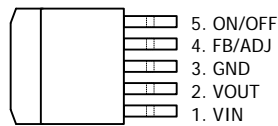
Ordering Information

| VOUT | Package | Order No. | Description | Supplied As | Status |
|------|------------|-----------------|------------------------|-------------|------------|
| ADJ | SOP-8PP-8L | LM2596HVGDP-ADJ | 3A, 150kHz, Adjustable | Reel | Active |
| | TO-263-5L | LM2596HVGR-ADJ | 3A, 150kHz, Adjustable | Reel | Active |
| | TO-220-5L | LM2596HVGT-ADJ | 3A, 150kHz, Adjustable | Tube | Active |
| 3.3V | SOP-8PP-8L | LM2596HVGDP-3.3 | 3A, 150kHz, Fixed | Reel | Contact us |
| | TO-263-5L | LM2596HVGR-3.3 | 3A, 150kHz, Fixed | Reel | Active |
| | TO-220-5L | LM2596HVGT-3.3 | 3A, 150kHz, Fixed | Tube | Contact us |
| 5.0V | SOP-8PP-8L | LM2596HVGDP-5.0 | 3A, 150kHz, Fixed | Reel | Active |
| | TO-263-5L | LM2596HVGR-5.0 | 3A, 150kHz, Fixed | Reel | Active |
| | TO-220-5L | LM2596HVGT-5.0 | 3A, 150kHz, Fixed | Tube | Active |
| 12V | SOP-8PP-8L | LM2596HVGDP-12 | 3A, 150kHz, Fixed | Reel | Contact us |
| | TO-263-5L | LM2596HVGR-12 | 3A, 150kHz, Fixed | Reel | Active |
| | TO-220-5L | LM2596HVGT-12 | 3A, 150kHz, Fixed | Tube | Active |

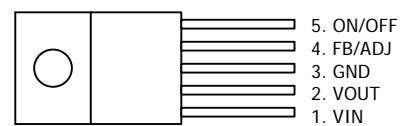
PIN CONFIGURATION



SOP-8PP



TO-263-5L



TO-220-5L

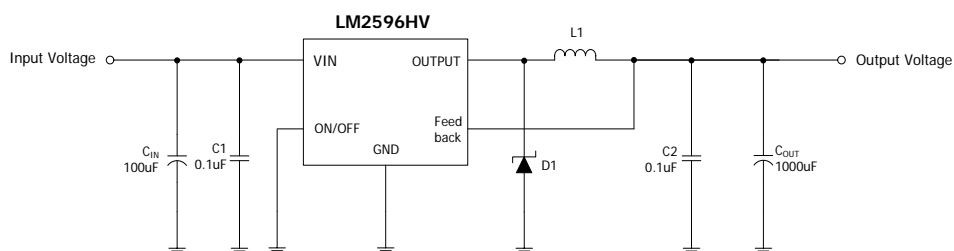
PIN DESCRIPTION

| Pin No. | TO-263 / TO-220 5 LEAD | | Pin No. | SOP-8PP 8 LEAD | |
|---------|------------------------|--|---------------|----------------|--|
| | Name | Function | | Name | Function |
| 1 | VIN | Input Supply | 1 | VIN | Input Supply |
| 2 | VOUT | Output Voltage | 2 | VOUT | Output Voltage |
| 3 | GND | Ground | 3 | FB / ADJ | Output Voltage Feedback or Output Adjust |
| 4 | FB / ADJ | Output Voltage Feedback or Output Adjust | 4 | ON/OFF | ON/OFF Shutdown |
| 5 | ON/OFF | ON/OFF Shutdown | 5 / 6 / 7 / 8 | GND | Ground |

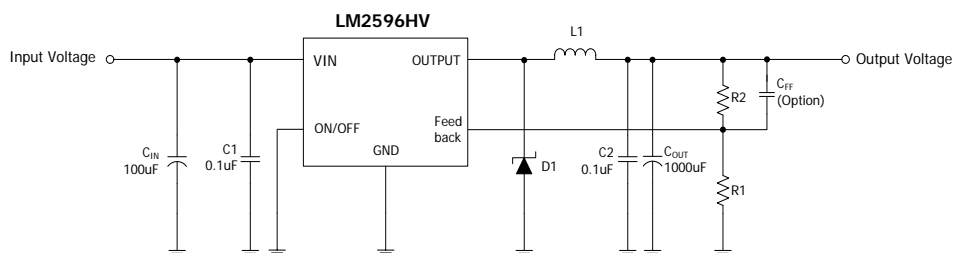
* Exposed Pad of SOP8-PP package should be externally connected to GND.

TYPICAL APPLICATION

- Fixed Output Voltage Version



- Adjustable Output Voltage Version



ELECTRICAL CHARACTERISTICS

Unless specified otherwise, $V_{IN} = 12V$ for the 3.3V, 5V and adjustable versions, $I_{LOAD} = 0.5A$, $V_{IN} = 18V$ for 12V version. The boldface type denotes the specifications, which apply over full operating temperature range $T_J = -40$ to $+125^\circ C$.

| PARAMETER | SYMBOL | TEST CONDITION ^(Note 2) | | MIN. | TYP. | MAX. | UNIT |
|---|---------------|---|---|--------------|-------|--------------|------|
| SYSTEM PARAMETERS ^(Note 3) | | | | | | | |
| Feedback Voltage | V_{FB} | LM2596HV-ADJ | $8V \leq V_{IN} \leq 60V$, $0.2A \leq I_{LOAD} \leq 3A$ | 1.193 | 1.230 | 1.273 | V |
| | | | | 1.180 | | 1.285 | |
| Output Voltage | V_O | LM2596HV-3.3 | $5.5V \leq V_{IN} \leq 60V$, $0.2A \leq I_{LOAD} \leq 3A$ | 3.185 | 3.30 | 3.432 | V |
| | | | | 3.152 | | 3.465 | |
| | | LM2596HV-5.0 | $8V \leq V_{IN} \leq 60V$, $0.2A \leq I_{LOAD} \leq 3A$ | 4.825 | 5.00 | 5.20 | V |
| | | | | 4.775 | | 5.25 | |
| | | LM2596HV-12 | $15V \leq V_{IN} \leq 60V$, $0.2A \leq I_{LOAD} \leq 3A$ | 11.58 | 12.00 | 12.48 | V |
| | | | | 11.46 | | 12.60 | |
| Line Regulation | Line Reg | $8 \leq V_{IN} \leq 60V$, $I_{LOAD} = 0.2A$ | | | 0.3 | | % |
| Load Regulation | Load Reg | $10mA \leq I_{LOAD} \leq 3A$, $V_{IN} = 12V$ | | | 0.3 | | % |
| Efficiency | η | LM2596HV-ADJ | $V_{IN} = 12V$, $I_{LOAD} = 3A$, $V_{OUT} = 5V$ | | 79 | | % |
| | | LM2596HV-3.3 | $V_{IN} = 12V$, $I_{LOAD} = 3A$ | | 77 | | % |
| | | LM2596HV-5.0 | $V_{IN} = 12V$, $I_{LOAD} = 3A$ | | 79 | | % |
| | | LM2596HV-12 | $V_{IN} = 15V$, $I_{LOAD} = 3A$ | | 83 | | % |
| DEVICE PARAMETERS | | | | | | | |
| Quiescent Current | I_Q | $V_{FB} = 12V$ force driver off ^(Note 6) | | | 5 | 8 | mA |
| Feedback Bias Current | I_{FB} | $V_{FB} = 1.3V$ (Adjustable version only) | | -250 | -70 | | nA |
| | | | | -450 | | | |
| Shutdown Supply Current | I_{STB} | $V_{ON/OFF} = 5V$, $V_{IN} = 60V$ | | | 30 | 220 | uA |
| | | | | | | 280 | |
| Oscillator Frequency | F_{OSC} | ^(Note 8) | | 133 | 150 | 168 | KHz |
| | | | | 120 | | 180 | |
| Oscillator Frequency of short Circuit Protect | F_{SCP} | When $V_{OUT} < 40\%$ from nominal, $I_{OUT} = CL$ ^(Note 8) | | | 50 | | KHz |
| Max. duty Cycle | $DC_{(MAX.)}$ | $V_{FB} = 0V$ force driver on ^(Note 5) | | 100 | | | % |
| Min. duty Cycle | $DC_{(MIN.)}$ | $V_{FB} = 12V$ force driver off ($V_{FB} = 15V$, For 12V Version) | | | | 0 | |

| | | | | | | |
|------------------------------|-----------|---|------------|------------|-------------|---------|
| Current Limit | CL | Peak Current. No outside circuit. $V_{FB}=0V$ (Note 4, 8) | 4.1 | 5.3 | 6.7 | A |
| | | | 3.8 | | 7.0 | |
| Saturation Voltage | V_{SAT} | $I_{OUT}=3A$. No outside circuit. $V_{FB}=0V$ (Note 4) | | 1.35 | 1.50 | V |
| | | | | | 1.70 | |
| Output Leakage Current | I_L | $V_{OUT}=0V$. No outside circuit. $V_{FB}=12V$ (Note 6, 7) | -300 | -50 | | μA |
| Output Leakage Current | I_{L1} | $V_{OUT}=-1V$. No outside circuit. $V_{FB}=12V$ (Note 6, 7) | -30 | -3 | | mA |
| ON/OFF Input Threshold | V_{TH} | | 0.6 | 1.3 | 2.0 | V |
| ON/OFF Input Current | I_H | $V_{ON/OFF}=2.5V$ | -5 | -0.1 | 5 | μA |
| | I_L | $V_{ON/OFF}=0.5V$ | -1 | -0.01 | 1 | μA |
| Thermal Shutdown Temperature | T_{SD} | T_J | | 160 | | |

Note 1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2. All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face).

Note 3. External components such as the schottky diode, inductor, input and output capacitors can affect switching regulator system performance. When the 2596HV is used as shown in the Figure 2 test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.

Note 4. Output pin sourcing current. No diode, inductor or capacitor connected to output.

Note 5. Feedback pin removed from output and connected to 0V.

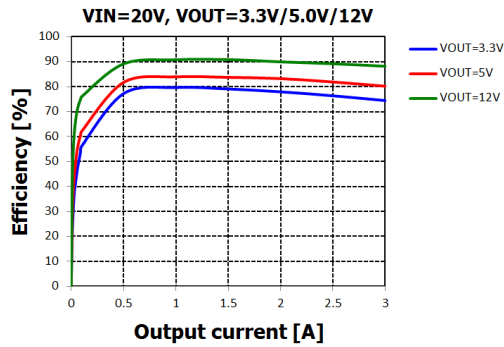
Note 6. Feedback pin removed from output and connected to +12V for the Adjustable, 3.3V, and 5V, versions, and +25V for the 12V and 15V versions, to force the output transistor OFF.

Note 7. $V_{IN}=60V$.

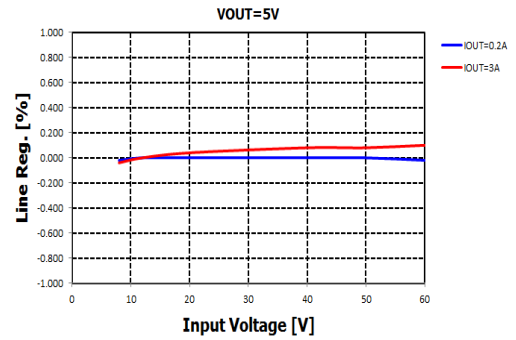
Note 8. The oscillator frequency reduces to approximately 50KHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protections feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.

TYPICAL OPERATING CHARACTERISTIC

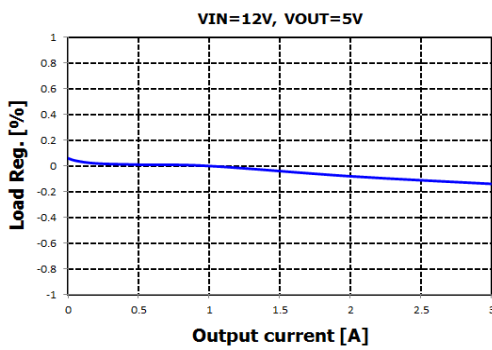
Efficiency vs. IO_{UT}



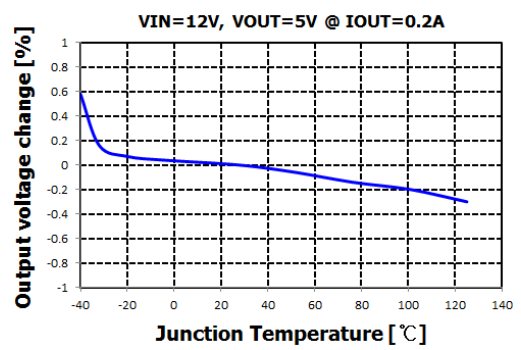
Line Regulation vs. VIN



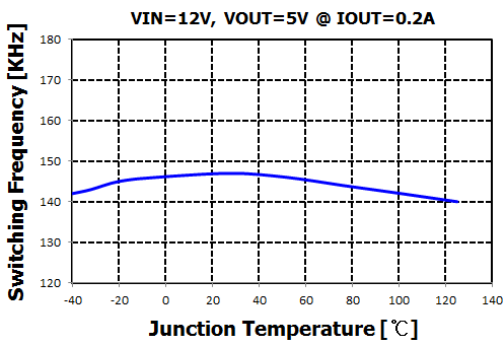
Load Regulation vs. IO_{UT}



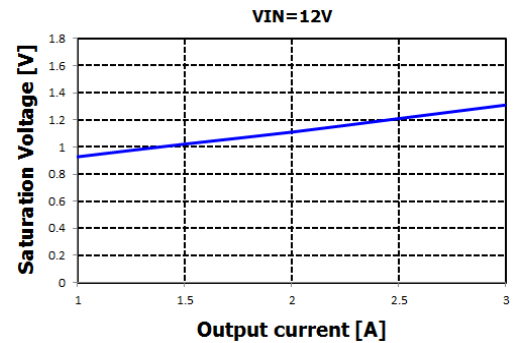
V_{OUT} vs. T_J



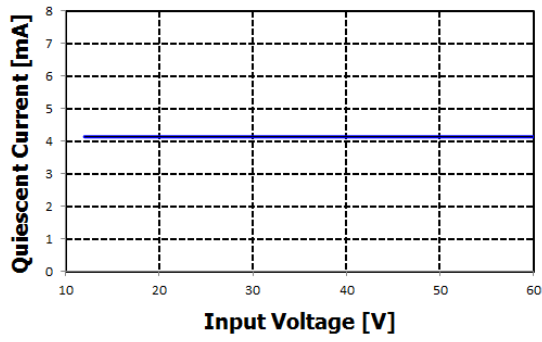
FOSC vs. T_J



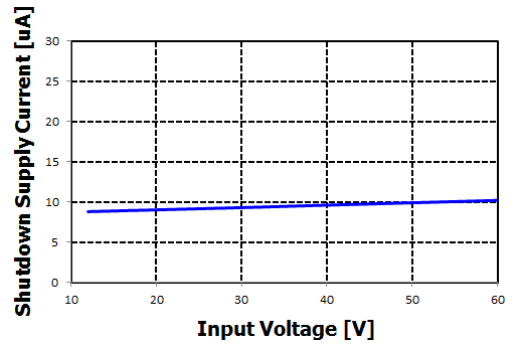
V_{SAT} vs. IO_{UT}



IQ vs. VIN



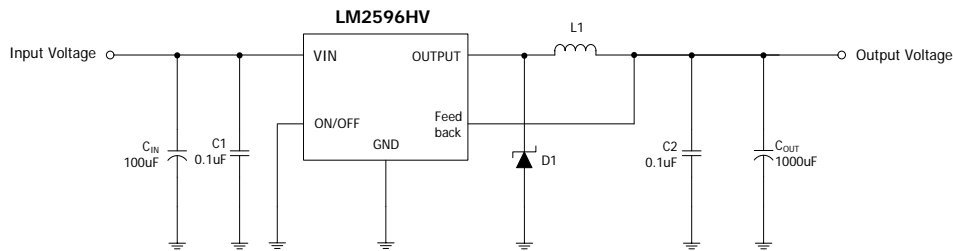
ISTB vs. VIN



APPLICATION INFORMATION

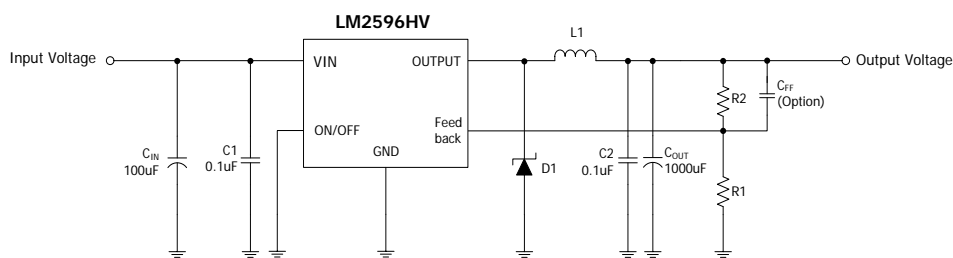
As in any switching regulator, layout is very important. Rapidly switching currents associated with wiring inductance generate voltage transients which can cause problems. For minimal inductance and ground loops, the length of the wires should be kept as short as possible. Single-point grounding or ground plane construction should be used for best results. Keep the feedback wiring away from the inductor flux

- Fixed Output Voltage Version



[Figure 1]

- Adjustable Output Voltage Version



[Figure 2]

$$* V_{OUT} = V_{FB} \left(1 + \frac{R2}{R1}\right)$$

where $V_{FB} = 1.23V$, $R1$ between $1K\Omega$ and $5K\Omega$.

REVISION NOTICE

The description in this datasheet can be revised without any notice to describe its electrical characteristics properly.