

POWER MANAGEMENT

BiCMOS Current-Mode PWM Controllers

- 1MHz Operation
- No Cross-Conduction Current
- 50ns Current-Sense Delay

The IMP38C4x and IMP38HC4x are fixed frequency, high performance, current-mode PWM controllers that are pin compatible with bipolar 384x devices but feature improvements resulting from IMP's BiCMOS processing and circuit design. Notable among the improvements are zero cross-conduction/shoot-through current, reduced start-up and operating current, lower current-sense delay, higher frequency operation, full supply voltage swing at the output and a 1% trimmed voltage reference.

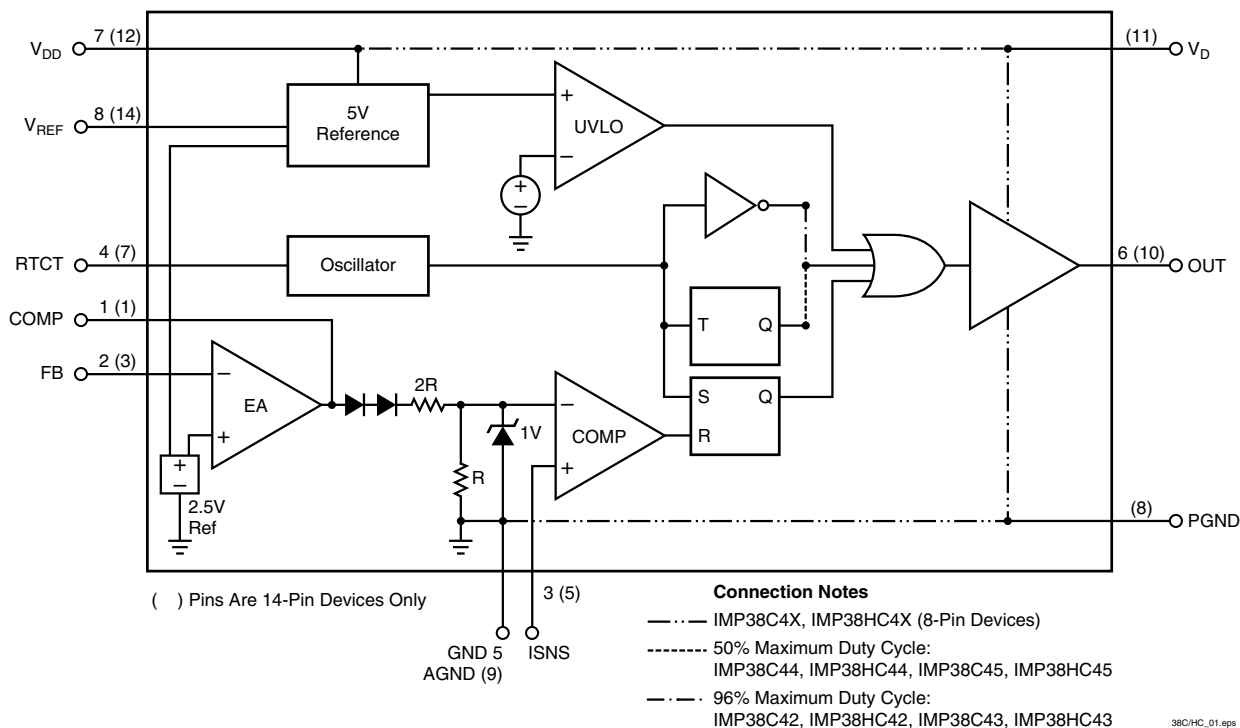
IMP38C4x and IMP38HC4x output driver stage has zero cross-conduction current. A proprietary output state-machine monitors each output MOSFET and guarantees by design zero cross-conduction current. This is an industry first for 384x PWM devices.

Under-voltage lockout (UVL) performance has been improved. When the power supply voltage is below the startup voltage, internal circuitry puts the output into a low impedance state. The output will sink 20mA and remain below 1.3V, well below the turn-on threshold voltage of the external MOSFET. Even when V_{DD} drops to zero volts, the out pin will not rise above approximately 1.3V because the output UVLO circuit is

Key Features

- ◆ 384x Series Pinout with BiCMOS Technology
- ◆ Zero Cross-Conduction Current by Design
- ◆ 1MHz Operation
- ◆ 65ns Maximum Current-Sense Delay
- ◆ 120µA Maximum Start-Up Current
- ◆ 1.5mA Maximum Operating Current
- ◆ High Output Current Drive
 - 1.0A, IMP38HC4x
 - 0.5A, IMP38C4x
- ◆ 20V Maximum Supply Voltage
- ◆ 2.5V, 1%, Trimmed Error Amplifier Reference
- ◆ Trimmed Oscillator Discharge Current
- ◆ Pin-for-Pin Enhanced Replacements for Micrel MIC38C/HC4x and GMT38C4x/HC4x

Block Diagrams



powered through the out pin. Leakage current from the external power MOSFETs will not force the PWM output to rise and turn the external MOSFETs on.

Current-sense propagation delay time is 35ns typical, 65ns maximum, representing an up to 75 percent reduction over other 38xx implementations.

Output stage drive is 0.5A for IMP38C4x devices. The high-drive IMP38HC4x family is rated at 1.0A peak current drive.

Like conventional 384x controllers, the IMP38C4x and IMP38HC4x controllers use the current-mode architecture for superior load regulation, pulse-by-pulse current limiting and output MOSFET protection. All versions operate up to 20 volts.

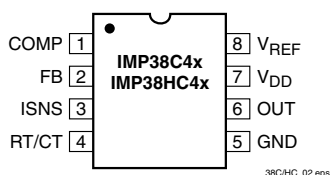
For maximum application flexibility, start-up voltage ranges from 14.5V to 8.4V. Start-up current has been reduced to 120µA maximum and operating current has been reduced to 1.5mA maximum.

The IMP38C4x/IMP38HC4x are available in 8-pin and 14-pin DIP and SO packages as well as the 8-pin MicroSO package. The 14-pin devices provide separate pins for the controller power supply and the output driver supply. This configuration maximizes application flexibility and performance. The 14-pin package can also dissipate more power. Devices in the compact 8-pin packages do not have separate output drive supply connections.

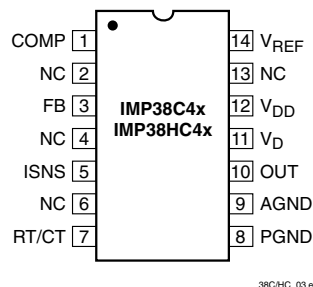
The IMP38C4x and IMP38HC4x families operate over the -40°C to +85°C temperature range.

Pin Configuration

SO/MicroSO/DIP



SO/DIP



Pin Descriptions

| Pin Number | | Name | Function |
|---------------|----------------|------------------|--|
| 8-Pin Package | 14-Pin Package | | |
| 1 | 1 | COMP | Output of the Error amplifier and input to the PWM comparator. |
| 2 | 3 | FB | Inverting input of the Error Amplifier. |
| 3 | 5 | ISNS | Current sense comparator input. It is internally limited to 1V. |
| 4 | 7 | RT/CT | Oscillator RC timing component connection. Resistor RT is connected to V _{REF} and capacitor CT is connected to ground. Different values of RT and CT determine the maximum duty cycle. |
| 5 | 8 | GND/PGND | Combined power and analog ground for 8-pin packaged devices and power ground for 14-pin package. |
| 6 | 10 | OUT | High-power, totem-pole driver output. OUT pin is actively held LOW when V _{CC} is below the UVLO threshold. |
| 7 | 12 | V _{DD} | Supply voltage input. |
| 8 | 14 | V _{REF} | 5V-reference voltage output. |
| | 9 | AGND | Analog ground connection for 14-pin package. |
| | 11 | V _D | Output driver supply voltage for 14-pin package. |
| | 2, 4, 6, 13 | NC | No internal connection. |

38C-HC_101.eps

Ordering Information

| IMP Ordering Part Number | Package | Operating Temperature Range | Startup Voltage | Minimum Operating Voltage | Maximum Duty Cycle | Reference Voltage | Peak Output Current Drive |
|--------------------------|----------------|-----------------------------|-----------------|---------------------------|--------------------|-------------------|---------------------------|
| IMP38C42EPA | 8-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 0.5A |
| IMP38C42EPD | 14-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 0.5A |
| IMP38C42ESA | 8-SO | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 0.5A |
| IMP38C42ESD | 14-SO | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 0.5A |
| IMP38C42EMA | 8-MicroSO | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 0.5A |
| IMP38C42/D | DIE | | | | | | |
| IMP38C43EPA | 8-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 0.5A |
| IMP38C43EPD | 14-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 0.5A |
| IMP38C43ESA | 8-SO | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 0.5A |
| IMP38C43ESD | 14-SO | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 0.5A |
| IMP38C43EMA | 8-MicroSO | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 0.5A |
| IMP38C43/D | DIE | | | | | | |
| IMP38C44EPA | 8-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 0.5A |
| IMP38C44EPD | 14-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 0.5A |
| IMP38C44ESA | 8-SO | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 0.5A |
| IMP38C44ESD | 14-SO | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 0.5A |
| IMP38C44EMA | 8-MicroSO | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 0.5A |
| IMP38C44/D | DIE | | | | | | |
| IMP38C45EPA | 8-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 0.5A |
| IMP38C45EPD | 14-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 0.5A |
| IMP38C45ESA | 8-SO | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 0.5A |
| IMP38C45ESD | 14-SO | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 0.5A |
| IMP38C45EMA | 8-MicroSO | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 0.5A |
| IMP38C45/D | DIE | | | | | | |
| IMP38HC42EPA | 8-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 1.0A |
| IMP38HC42EPD | 14-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 1.0A |
| IMP38HC42ESA | 8-SO | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 1.0A |
| IMP38HC42ESD | 14-SO | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 1.0A |
| IMP38HC42EMA | 8-MicroSO | -40°C to 85°C | 14.5V | 9.0V | 96% | 2.5V | 1.0A |
| IMP38HC42/D | DIE | | | | | | |
| IMP38HC43EPA | 8-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 1.0A |
| IMP38HC43EPD | 14-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 1.0A |
| IMP38HC43ESA | 8-SO | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 1.0A |
| IMP38HC43ESD | 14-SO | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 1.0A |
| IMP38HC43EMA | 8-MicroSO | -40°C to 85°C | 8.4V | 7.6V | 96% | 2.5V | 1.0A |
| IMP38HC43/D | DIE | | | | | | |
| IMP38HC44EPA | 8-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 1.0A |
| IMP38HC44EPD | 14-Plastic DIP | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 1.0A |
| IMP38HC44ESA | 8-SO | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 1.0A |
| IMP38HC44ESD | 14-SO | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 1.0A |
| IMP38HC44EMA | 8-MicroSO | -40°C to 85°C | 14.5V | 9.0V | 50% | 2.5V | 1.0A |
| IMP38HC44/D | DIE | | | | | | |
| IMP38HC45EPA | 8-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 1.0A |
| IMP38HC45EPD | 14-Plastic DIP | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 1.0A |
| IMP38HC45ESA | 8-SO | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 1.0A |
| IMP38HC45ESD | 14-SO | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 1.0A |
| IMP38HC45EMA | 8-MicroSO | -40°C to 85°C | 8.4V | 7.6V | 50% | 2.5V | 1.0A |
| IMP38HC45/D | DIE | | | | | | |

For SO and MicroSO packages, append "IT" to the ordering part number for tape and reel packaging.

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Absolute Maximum Ratings

| | |
|---|-----------------|
| V _{CC} Supply Voltage | 20V |
| V _{CC} Supply Current | 30mA |
| I _{OUT} Current | 1.0A |
| Current-Sense and Feedback Inputs | 0.3V to 5.5V |
| Operation Junction Temperature | +150°C |
| Storage Temperature | -65°C to +150°C |
| Lead Soldering Temperature (10 seconds) | +300°C |

| | |
|--------------------------------------|---------|
| Package Thermal Resistance | |
| 8-Pin Plastic DIP (θ_{JA}) | 125°C/W |
| 8-Pin MicroSO (θ_{JA}) | 250°C/W |
| 8-Pin SO (θ_{JA}) | 170°C/W |
| 14-Pin Plastic DIP (θ_{JA}) | 90°C/W |
| 14-Pin SO (θ_{JA}) | 145°C/W |

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

Electrical Characteristics

Unless otherwise noted, V_{CC} = 15V, R_T = 10k Ω and C_T = 3.3nF. Specifications are over the -40°C to +85°C ambient temperature range.

Bold/blue specifications indicate enhanced performance features.

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|--------------------------------|-----------------------|---|-------------|-------------|-------------|----------|
| Reference | | | | | | |
| Output voltage | V _{REF} | T _A = +25°C, I _O = 1mA | 4.90 | 5.00 | 5.10 | V |
| Line Regulation | | 12V ≤ V _{CC} ≤ 18V, I _{OUT} = 5 μ A | | 2 | 20 | mV |
| Load Regulation | | 1mA ≤ I _O ≤ 20mA | | 1 | 25 | mV |
| Temperature Stability | TC _{REF} | Note 1 | | 0.2 | | mV/°C |
| Total Reference Variation | | Line, Load, Temperature, Note 1 | 4.82 | | 5.18 | V |
| Output Noise Voltage | V _N | 10Hz ≤ f ≤ 10kHz, T _A = +25°C, Note 1 | | 50 | | μ V |
| Long Term Stability | | T _A = 125°C, 1000 Hours, Note 1 | | | TBD | mV |
| Output Short Circuit | I _{SC} | | -30 | -40 | -180 | mA |
| Oscillator Section | | | | | | |
| Initial Accuracy | f _{INIT} | T _A = 25°C, Note 5 | 49 | 52 | 55 | kHz |
| Voltage Stability | | 12V ≤ V _{CC} ≤ 18V | | 0.2 | 1.0 | % |
| Temperature Stability | TC _{OSC} | Note 1 | | 0.04 | | %/°C |
| Discharge Current | | V _{RT/CT} = 2V | 7.2 | 8.4 | 12.0 | mA |
| Amplitude peak-to-peak | V _{OSC, P-P} | V _{RT/CT} peak-to-peak | 1.1 | 1.7 | 2.3 | V |
| Error Amplifier Section | | | | | | |
| Input Voltage | V_{IN} | V_{COMP} = 2.5V | 2.45 | 2.50 | 2.55 | V |
| Input Bias Current | I _B | V _{FB} = 4.5V | -1 | | 1 | μ A |
| Open Loop Gain | A _{VOL} | 2V ≤ V _O ≤ 4V, Note 1 | 65 | 90 | | dB |
| Unity Gain Bandwidth | UGBW | Note 1 | 0.7 | 1.0 | | MHz |
| Power Supply Rejection Ratio | PSRR | V _{START} ≤ V _{CC} ≤ V _{CCMAX} | 60 | | | dB |
| Output Sink Current | I _{OL} | V _{FB} = 2.7V, V _{comp} = 1.1V | 2 | 6 | | mA |
| Output Source Current | I _{OH} | V _{FB} = 2.3V, V _{comp} = 5.0V | -0.5 | -1.0 | | mA |
| V _{OUT} High | V _{OH} | V _{FB} = 2.3V, R _L = 15k Ω to ground | 4.5 | 4.6 | 5.0 | V |
| V _{OUT} Low | V _{OL} | V _{FB} = 2.7V, R _L = 15k Ω to V _{REF} | | 0.30 | 0.50 | V |

Electrical Characteristics

Unless otherwise noted, $V_{CC} = 15V$, $R_T = 10k\Omega$ and $C_T = 3.3nF$. Specifications are over the $-40^\circ C$ to $+85^\circ C$ ambient temperature range. **Bold/blue** specifications indicate enhanced performance features.

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|--|--------------|---|-------------|-------------|-------------|----------|
| Current Sense | | | | | | |
| Gain | A_{VOL} | Notes 1, 2 and 3 | 2.90 | 3.00 | 3.10 | V/V |
| Over Current Protection Threshold | | $V_{comp} = \max$, Note 2 | 0.9 | 0.98 | 1.1 | V |
| Power Supply Rejection Ratio | PSRR | $V_{START} \leq V_{CC} \leq 18V$ | | 70 | | dB |
| Input Bias Current | I_B | | | -0.1 | -2.0 | μA |
| Delay to Output | T_{PD} | $V_{FB} = 0V$, ISNS 0V to 2V, $C_L = 1nF$ | | 50 | 65 | ns |
| Output | | | | | | |
| IMP38C4x ON Resistance, High ON Resistance, Low | $R_{DS(ON)}$ | $I_{SOURCE} = 0.2A$ $I_{SINK} = 0.2A$ | | 20 11 | | Ω |
| IMP38HC4x ON Resistance, High ON Resistance, Low | $R_{DS(ON)}$ | $I_{SOURCE} = 0.2A$ $I_{SINK} = 0.2A$ | | 10 5.5 | | Ω |
| Peak Drive Current | | HC devices H devices | 1.0 0.5 | | | A |
| IMP38C4x Rise Time | T_R | $T_A = 25^\circ C$, $C_L = 1nF$ | | 40 | 70 | ns |
| IMP38C4x Fall Time | T_F | $T_A = 25^\circ C$, $C_L = 1nF$ | | 30 | 50 | ns |
| IMP38HC4x Rise Time | T_R | $T_A = 25^\circ C$, $C_L = 1nF$ | | 20 | 50 | ns |
| IMP38HC4x Fall Time | T_F | $T_A = 25^\circ C$, $C_L = 1nF$ | | 15 | 40 | ns |
| Shoot-through Current | | | | 0 | | mA |
| Undervoltage Lockout | | | | | | |
| Start Threshold | | IMP38C42/4, IMP38HC42/4 IMP38C43/5, IMP38HC43/5 | 13.5 7.8 | 14.5 8.4 | 15.5 9.0 | V |
| Minimum Operating Voltage | | IMP38C42/4, IMP38HC42/4 IMP38C43/5, IMP38HC43/5 | 8 7.0 | 9 7.6 | 10 8.2 | V |
| Pulse Width Modulator | | | | | | |
| Maximum Duty Cycle | | IMP38C42/3, IMP38HC42/3, | 94 | 96 | | % |
| Maximum Duty Cycle | | IMP38C44/5, IMP38HC44/5 | 48 | 50 | | % |
| Minimum Duty Cycle | | | | | 0 | % |
| Supply Current | | | | | | |
| Start-Up Current | | $V_{CC} = 13V$ for IMP38C42/44, IMP38HC42/44 $V_{CC} = 7.5V$ for IMP38C43/45, IMP38HC43/45 | | 95 | 120 | μA |
| Operating Current | I_{CC} | $V_{FB} = V_{IS} = 0$ | | 0.5 | 1.5 | mA |

Note 1. Guaranteed by design. Not 100% tested in production.

Note 2. Measured at trip point of $V_{FB} = 0V$.

Note 3. Gain is defined as:

$$A = \frac{\Delta V_{COMP}}{\Delta V_{CS}}, 0 \leq V_{CS} \leq 0.8V$$

Note 4. Adjust V_{CC} above the start threshold before setting at 15V.

Note 5. Output frequency equals the oscillator frequency for IMP38C42/3 and IMP38HC42/3 devices. Output frequency equals one-half the oscillator frequency for IMP38C44/5 and IMP38HC44/5 devices.

Table 1. Startup and Operating Voltage Selection Guide

| Duty Cycle | UVLO Thresholds | |
|------------|--|---|
| | Start-up at 8.4V Operating Minimum = 7.6V | Start-up at 14.5V Operating Minimum = 9.0V |
| 0% to 96% | IMP38C43/HC43 | IMP38C42/HC42 |
| 0% to 50% | IMP38C45/HC45 | IMP38C44/HC44 |

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Application Information

The IMP38C and IMP38HC devices are compatible with generic 384x PWM devices. The following discussion highlights the differences and advantages of the IMP 'C' and 'HC' designs.

Start-up Current

IMP's BiCMOS process allows for substantial reduction in the start-up current. Typical start-up current is 95µA, with a maximum limit of 120µA. Low start-up current allows high resistance, lower-wattage, start-up resistors to supply controller start-up power.

Operating Current

Operating current has been reduced to 1.5mA maximum. Compared to the 11mA needed for a typical bipolar controller and 6mA for competitive BiCMOS controllers, IMP's low operating current allows the controller to run cooler and with better efficiency. In addition, the V_{CC} hold-up capacitance (used during start-up) can be reduced.

Output Driver

The IMP38HC4x/38C4x CMOS output stage drives external power MOSFETs to the full supply voltage. Low ON-resistance and high peak current drive combine to give greater than 1000pF gate capacitance drive capability. Rise and fall time requirements may dictate the appropriate value of output capacitance. Within the restrictions of output capacity and controller power dissipation, switching frequencies can exceed 1MHz.

The CMOS output stage "break-before-make" action is guaranteed by design and insures that no cross-conduction current will flow. This minimizes heat dissipation, increases efficiency and enhances reliability.

Oscillator Operation

Two external components, RT and CT, set the switching frequency.

With V_{CC} = 14V, RT = 10k and CT = 3.3nF, nominal switching frequency is 50kHz.

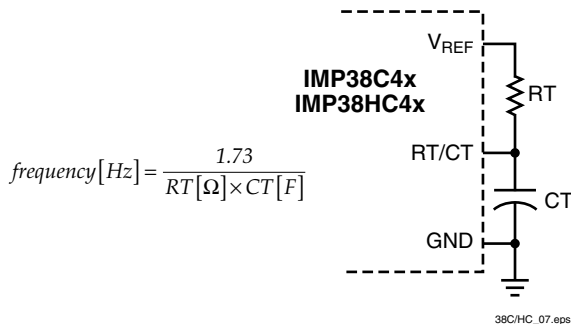


Figure 1. Oscillator Component Selection

Transient Protection

Good high-frequency layout practices should be followed. Avoid long printed-circuit traces and component leads. Locate oscillator and compensation components near the IC. Avoid capacitive and inductive coupling of the switching waveform into the high-impedance inputs of the error amplifier, oscillator, and current-sense amplifier. V_{REF} and V_{CC} stability will be aided by using high-frequency decoupling capacitors.

Undervoltage Lockout

Several different thresholds are available.

| Undervoltage Lockout Thresholds | |
|--|---|
| Start-up at 8.4V Operating Minimum = 7.6V | Start-up at 14.5V Operating Minimum = 9.0V |
| IMP38C43/HC43 | IMP38C42/HC42 |
| IMP38C45/HC45 | IMP38C44/HC44 |

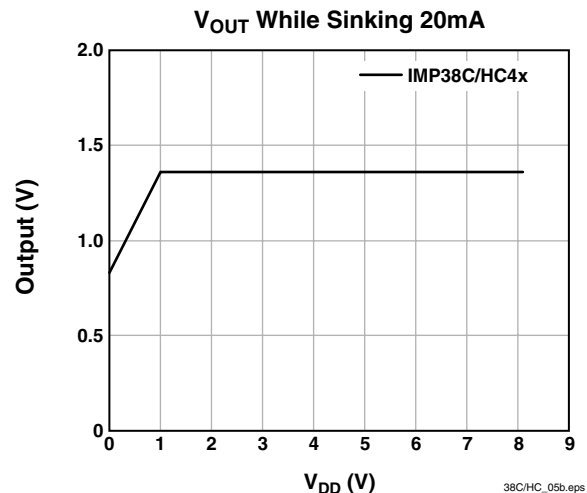
38C/HC_104.eps

Under-voltage lockout (UVL) performance has been improved. When the power supply voltage is below the startup voltage, internal circuitry puts the output into a low impedance state and sets the output to zero. The output will sink up to 20mA in this controlled state and remain below 1.3V, well below the turn-on threshold voltage of the external MOSFET.

With the IMP38C/HC4x output stage design, leakage current from the external power MOSFETs will not force the PWM output to rise and turn the external MOSFET on.

Even when V_{DD} drops to zero volts, the OUT pin will not rise above approximately 1.3V because the UVLO circuit is powered through the OUT pin.

The IMP output stage performance in UVL mode, while sinking 20mA, is shown in Figure 2.



38C/HC_05b.eps

Figure 2. Output Stage Performance in UVL Mode

Application Information

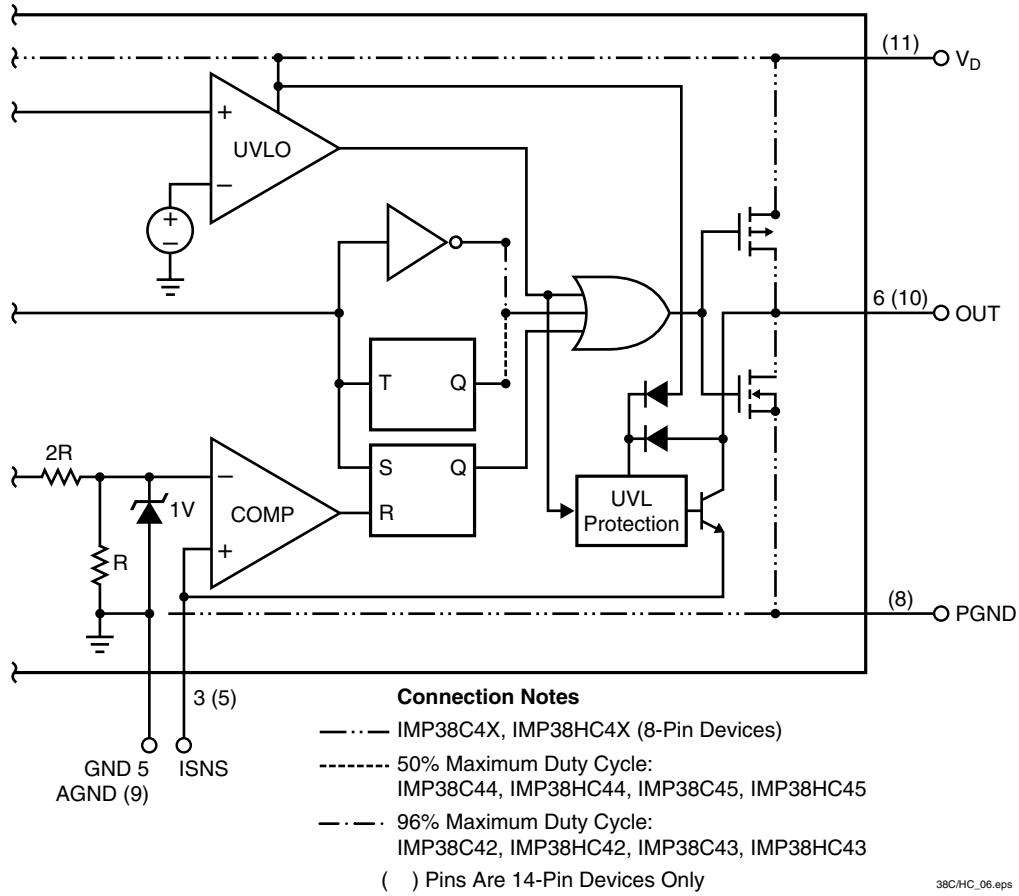
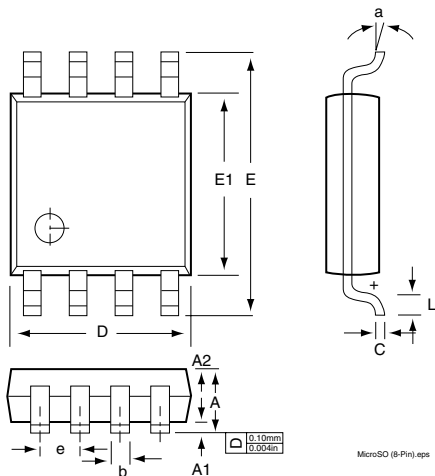


Figure 3. UVL Protection Circuit

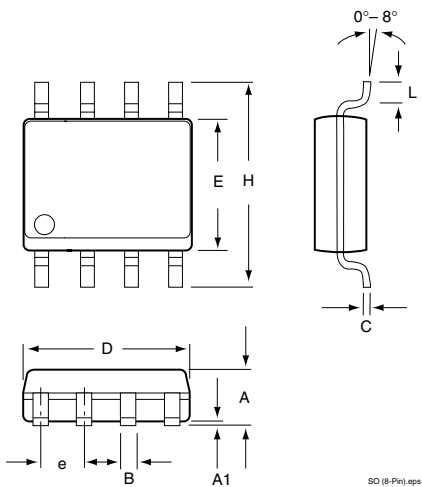
Package Dimensions

SO (8-Pin)



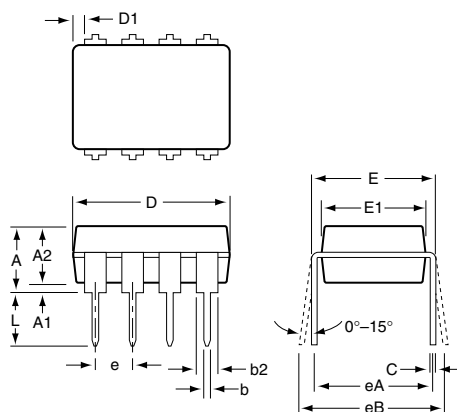
MicroSO (8-Pin).eps

SO (8-Pin)



SO (8-Pin).eps

Plastic DIP (8-Pin)



Plastic DIP (8-Pin).eps

| | Inches | | Millimeters | |
|-------------------------------|------------|--------|-------------|-------|
| | Min | Max | Min | Max |
| MicroSO (8-Pin)* | | | | |
| A | — | 0.0433 | — | 1.10 |
| A1 | 0.0020 | 0.0059 | 0.050 | 0.15 |
| A2 | 0.0295 | 0.0374 | 0.75 | 0.95 |
| b | 0.0098 | 0.0157 | 0.25 | 0.40 |
| C | 0.0051 | 0.0091 | 0.13 | 0.23 |
| D | 0.1142 | 0.1220 | 2.90 | 3.10 |
| e | 0.0256 BSC | | 0.65 BSC | |
| E | 0.193 BSC | | 4.90 BSC | |
| E1 | 0.1142 | 0.1220 | 2.90 | 3.10 |
| L | 0.0157 | 0.0276 | 0.40 | 0.70 |
| a | 0° | 6° | 0° | 6° |
| SO (8-Pin)** | | | | |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| B | 0.013 | 0.020 | 0.33 | 0.51 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| e | 0.050 | | 1.27 | |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |
| D | 0.189 | 0.197 | 4.80 | 2.00 |
| Plastic DIP (8-Pin)*** | | | | |
| A | — | 0.210 | — | 5.33 |
| A1 | 0.015 | — | 0.38 | — |
| A2 | 0.115 | 0.195 | 2.92 | 4.95 |
| b | 0.014 | 0.022 | 0.36 | 0.56 |
| b2 | 0.045 | 0.070 | 1.14 | 1.78 |
| b3 | 0.030 | 0.045 | 0.80 | 1.14 |
| D | 0.355 | 0.400 | 9.02 | 10.16 |
| D1 | 0.005 | — | 0.13 | — |
| E | 0.300 | 0.325 | 7.62 | 8.26 |
| E1 | 0.240 | 0.280 | 6.10 | 7.11 |
| e | 0.100 | — | 2.54 | |
| eA | 0.300 | — | 7.62 | |
| eB | — | 0.430 | — | 10.92 |
| eC | — | 0.060 | — | — |
| L | 0.115 | 0.150 | 2.92 | 3.81 |

38CHC_105.at3

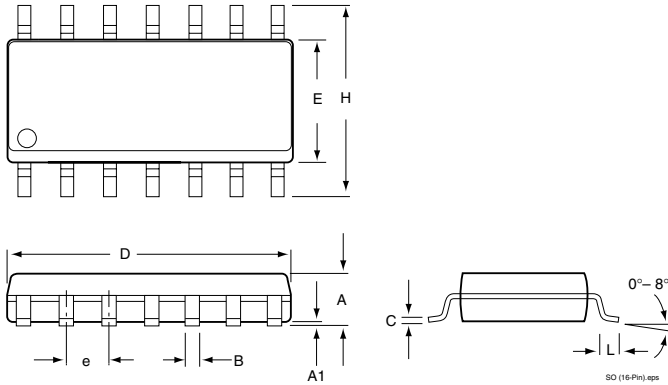
* JEDEC Drawing MO-187AA

** JEDEC Drawing MS-112AA

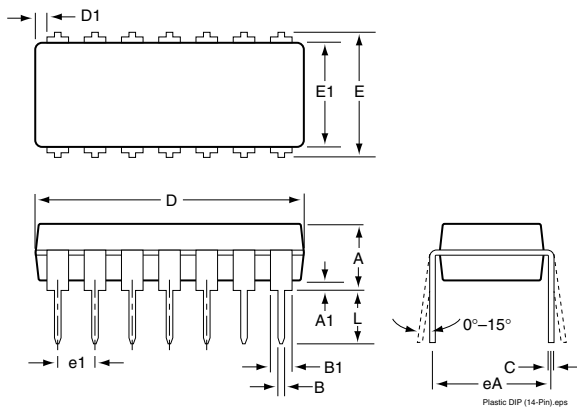
*** JEDEC Drawing MS-001BA

Package Dimensions

SO (14-Pin)



Plastic DIP (14-Pin)



| | Inches | | Millimeters | |
|-------------------------------|-----------|--------|-------------|-------|
| | Min | Max | Min | Max |
| SO (14-Pin)* | | | | |
| A | 0.0926 | 0.1043 | 2.35 | 2.65 |
| A1 | 0.0040 | 0.118 | 0.10 | 0.30 |
| B | 0.013 | 0.020 | 0.33 | 0.51 |
| C | 0.0091 | 0.0125 | 0.23 | 0.32 |
| D | 0.3465 | 0.3622 | 8.80 | 9.20 |
| E | 0.214 | 0.2992 | 7.40 | 7.60 |
| e | 0.050 BSC | | 1.27 BSC | |
| H | 0.394 | 0.419 | 10.00 | 10.65 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |
| Plastic DIP (14-Pin)** | | | | |
| A | 0.155 | 0.200 | 3.94 | 5.08 |
| A1 | 0.20 | 0.50 | 0.51 | 1.27 |
| B | 0.014 | 0.020 | 0.356 | 0.508 |
| B1 | 0.050 | 0.065 | 1.27 | 1.65 |
| C | 0.008 | 0.012 | 0.204 | 0.304 |
| D | 0.745 | 0.770 | 18.93 | 19.55 |
| E | 0.300 | 0.325 | 7.62 | 8.25 |
| E1 | 0.240 | 0.260 | 6.10 | 6.60 |
| e1 | 0.100 TYP | | 2.54 TYP | |
| eA | 0.300 TYP | | 7.62 TYP | |
| L | 0.100 | — | 3.18 | 3.81 |

* JEDEC Drawing MS-013 AF

** JEDEC Drawing MO-001 AA-AB

38C/HC_106.at3



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Printed in USA
Publication #: 3001
Revision: D
Issue Date: 08/30/00
Type: Preliminary