

Features

- 2.5 to 15 V supply voltage operating range.
- Low current consumption: 6 mA in operation, 1 μ A or less in stand-by.
- 20 kHz to 1 MHz operation frequency range.
- Provides a fixed output current with minimal supply voltage fluctuations by using an external resistor to set the output current.
- Totem-pole output.
- Built-in soft start circuit.
- Built-in timer-latch short circuit detection and protection circuit (SCP).

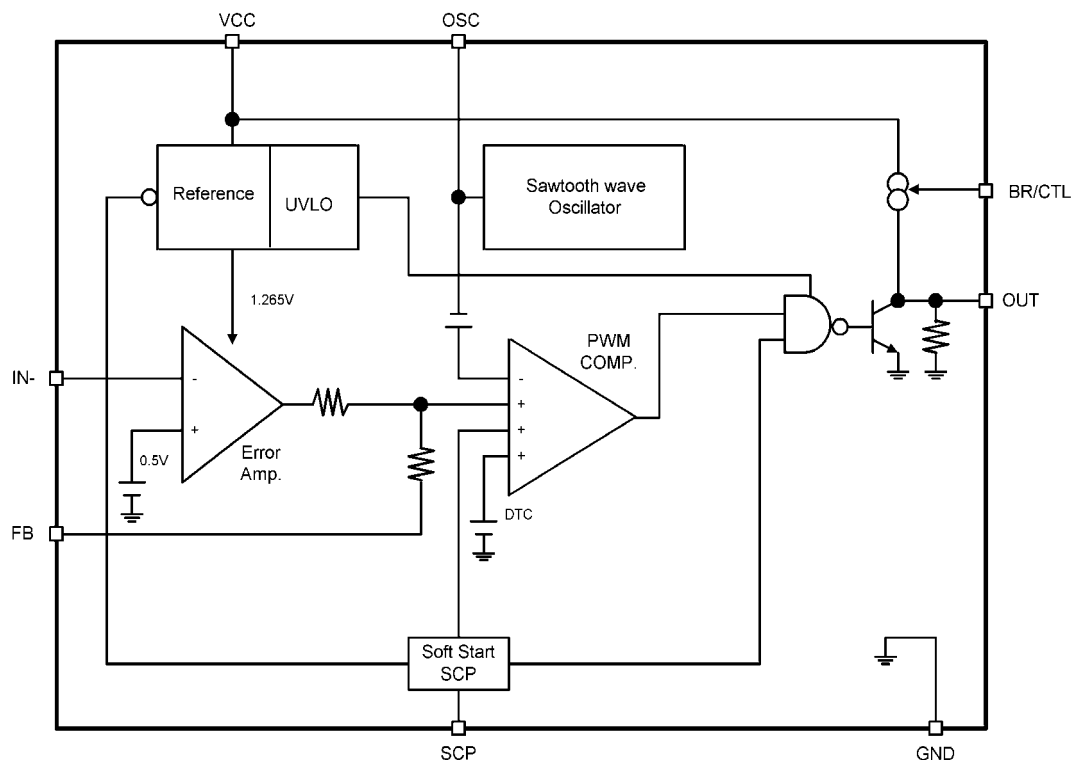
General Description

The AT1380A is a single-channel PWM control IC for DC/DC conversion with soft start function and short circuit detection. Adjustable soft start is programmed with an external capacitor on SCP pin. The AT1380A is ideal for up, down and fly-back conversion.

Applications

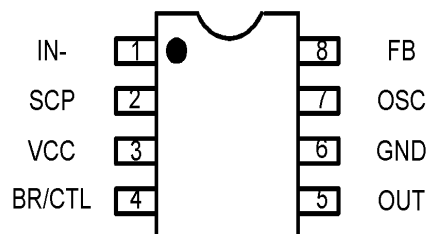
- LCD Displays
- PDAs
- Digital Still Cameras

Block Diagram



Aimtron reserves the right without notice to change this circuitry and specifications.

Pin Configuration



Ordering Information

| Part number | Package | Marking |
|--------------|-----------------|--|
| AT1380AS | SOP8 | AT1380AS |
| AT1380AS_PBF | SOP8, Pb-Free | AT1380AS, Date Code with one bottom line |
| AT1380AS_GRE | SOP8, Green | AT1380AS, Date Code with two bottom line |
| AT1380AP | TSSOP8 | AT1380AP |
| AT1380AP_PBF | TSSOP8, Pb-Free | AT1380AP, Date Code with one bottom line |
| AT1380AP_GRE | TSSOP8, Green | AT1380AP, Date Code with two bottom line |

Pin Description

| Pin No. | Symbol | I/O | Description |
|---------|--------|-----|---|
| 1 | IN- | I | Error amplifier inverting input |
| 2 | SCP | — | Soft start and SCP setting capacitor connection |
| 3 | VCC | — | Power supply |
| 4 | BR/CTL | I | Output current setting |
| 5 | OUT | O | Totem-pole type output |
| 6 | GND | — | Ground |
| 7 | OSC | — | Capacitor and resistor connection pin for setting the oscillation frequency |
| 8 | FB | O | Error amplifier output |

Absolute Maximum Ratings

(T_a=+25°C)

| Parameter | Symbol | Condition | Rated Value | | Unit |
|-----------------------|-----------------------------|---------------------|-------------|------|------|
| | | | Min. | Max. | |
| Power supply voltage | V _{CC} | — | — | 15 | V |
| Output source current | I _O ⁺ | — | — | -50 | mA |
| Output sink current | I _O ⁻ | — | — | 50 | mA |
| Allowable dissipation | P _D | SOP-8, Ta ≤ +25°C | — | 570 | mW |
| | P _D | TSSOP-8, Ta ≤ +25°C | — | 430 | mW |
| Operating temperature | T _{OP} | — | -30 | +85 | °C |
| Storage temperature | T _{stg} | — | -55 | +125 | °C |
| ESD Classification | | MIL-STD-883 | Class 2 | | |

* : When mounted on a 10 cm square double-sided epoxy board

WARNING: Do not exceed these ratings. IC devices can be permanently damaged by stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings.

Recommended Operating Conditions

(Ta=+25°C)

| Parameter | Symbol | Values | | | Unit |
|-----------------------------------|-----------------------------|--------|------|-----------------|------|
| | | Min. | Typ. | Max. | |
| Power supply voltage | V _{CC} | 2.5 | -- | 13.5 | V |
| Error amplifier input voltage | V _I | -0.2 | -- | 1.0 | V |
| BR/CTL pin input voltage | V _{BR} | -0.2 | -- | V _{CC} | V |
| Output source current | I _O ⁺ | -20 | -- | -- | mA |
| Output sink current | I _O ⁻ | -- | -- | 40 | mA |
| SCP pin capacitance | C _{PE} | -- | 0.1 | -- | μF |
| Phase compensation capacitance | C _P | -- | 0.1 | -- | μF |
| Output current setting resistance | R _B | 150 | 390 | 5000 | Ω |
| Timing resistance | R _T | 1.0 | 3.0 | 10.0 | kΩ |
| Timing capacitance | C _T | 100 | 270 | 10000 | pF |
| Oscillation frequency | f _{OSC} | 10 | 500 | 1000 | kHz |
| Operating temperature | T _{OP} | -30 | +25 | +85 | °C |

WARNING: Recommended operating conditions are normal operating ranges for the IC device. All the device's electrical characteristics are warranted for operation within these ranges. Use IC devices only within the recommended operating conditions. Operation outside these ranges may adversely affect the reliability and can result in device failure.

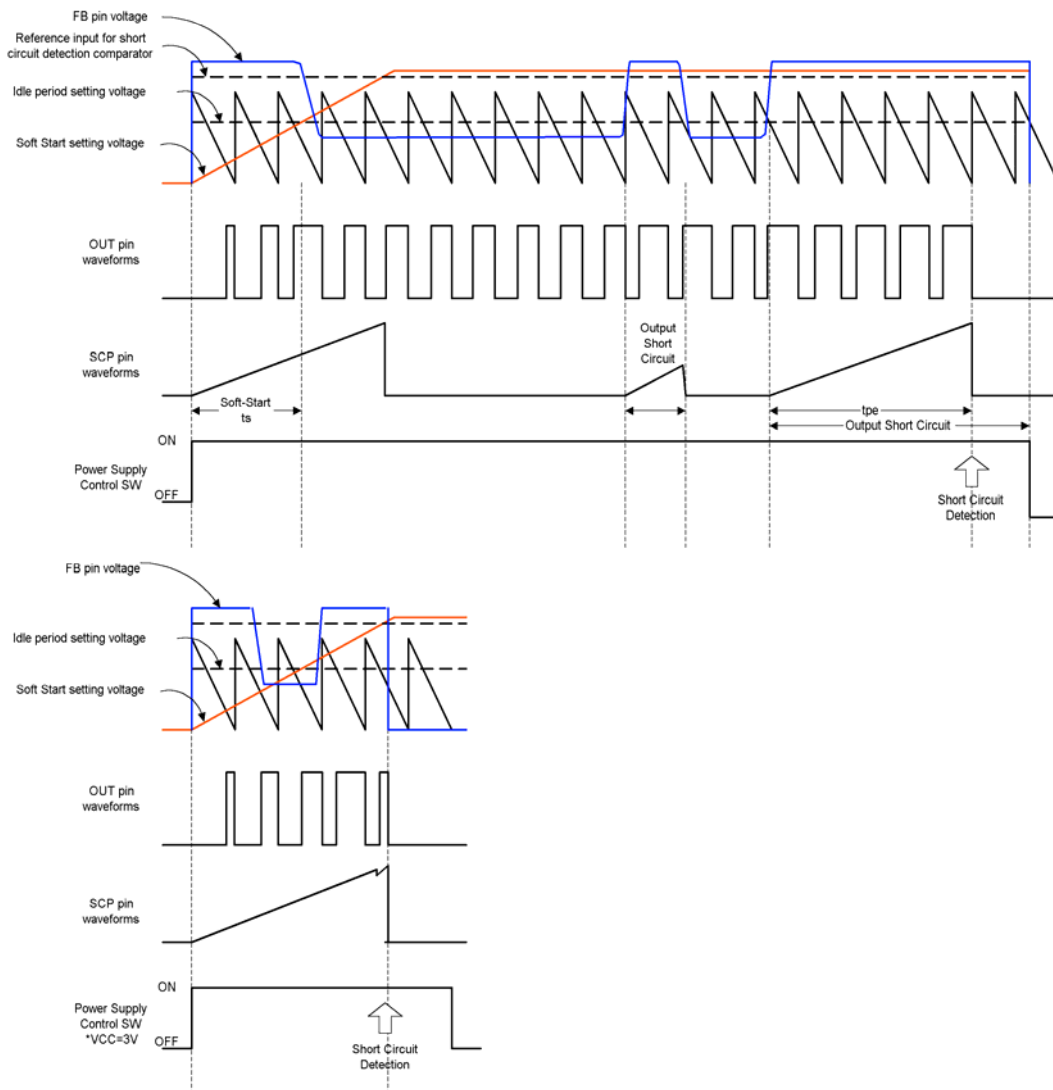
Electrical Characteristics

(V_{CC}=+3.0V, Ta=+25°C)

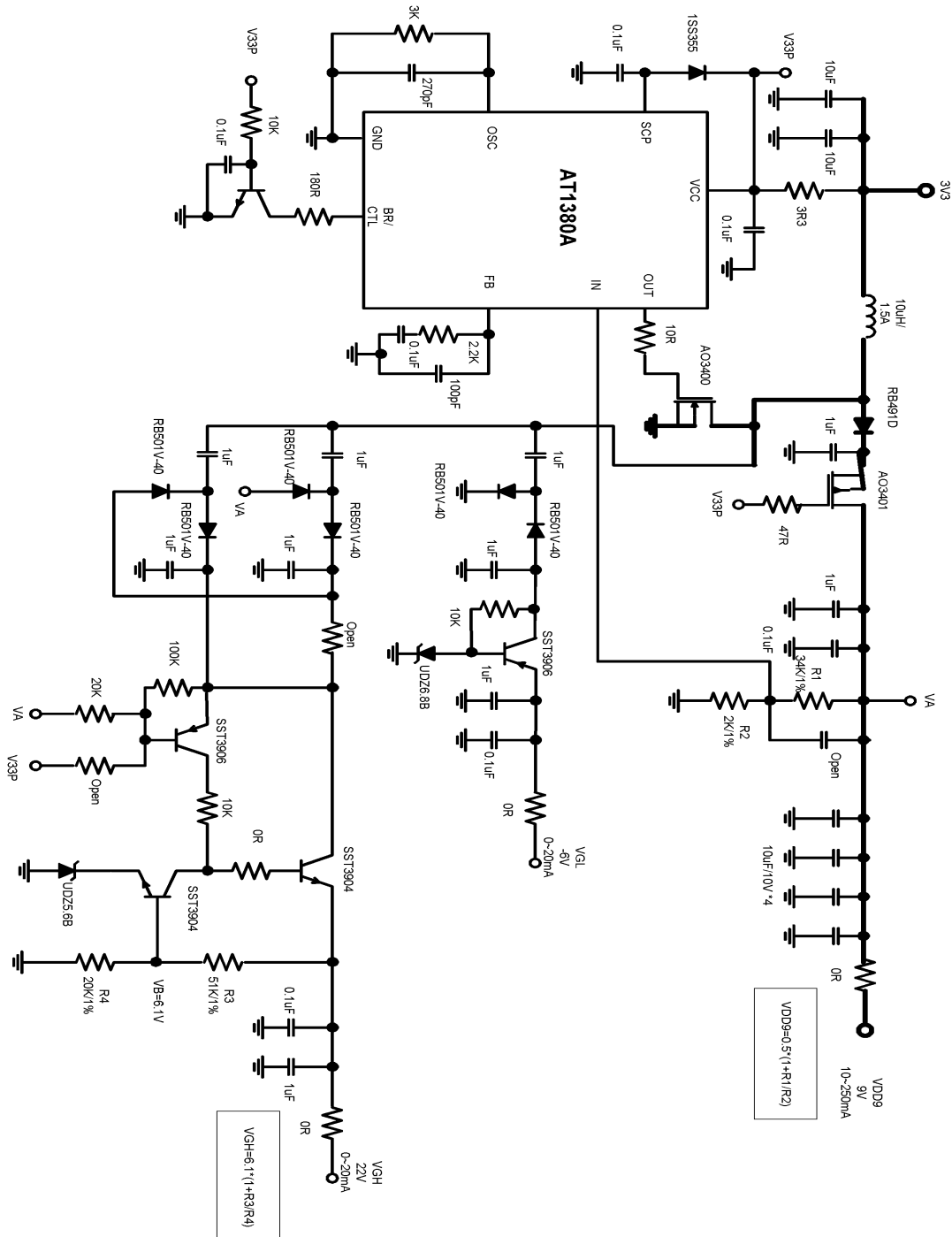
| Parameter | | Symbol | Condition | Values | | | Unit |
|--------------------------------------|--|------------------------------|---|--------|------|------|------|
| | | | | Min. | Typ. | Max. | |
| VCC Under voltage Lockout (U.V.L.O.) | Reset voltage for falling Vcc. OUT remains off if Vcc is below this level. | V _R | -- | -- | 1.8 | 1.9 | V |
| | Startup voltage for rising Vcc. | V _{TH} | -- | 2.4 | 2.5 | 2.6 | V |
| Soft start | Charging current | I _{CS} | V _{SCP} =0V | -1.5 | -1.0 | -0.7 | μA |
| | Voltage at soft start completion | V _{IS} | -- | 0.7 | 0.8 | 0.9 | V |
| Short circuit detection (S.C.P.) | Charging current | I _{CPC} | V _{SCP} =0V | -1.5 | -1.0 | -0.7 | μA |
| | Threshold voltage | V _{IPC} | -- | 0.7 | 0.8 | 0.9 | V |
| Sawtooth waveform oscillator (OSC) | Oscillation frequency | f _{OSC} | R _T =3kΩ, C _T =270pF | 400 | 500 | 600 | kHz |
| | Frequency input Stability | f _{AV} | V _{CC} =2.5V to 13.5V | -- | 2 | 10 | % |
| | Frequency variation with temperature | f _{ΔT} | Ta = -30°C to 85°C | -- | 5 | -- | % |
| Error amplifier | Input threshold Voltage | V _T | V _{FB} = 450mV | 480 | 500 | 520 | mV |
| | V _T input stability | V _{TAV} | V _{CC} =2V to 13.5V | -- | 5 | 20 | mV |
| | V _T variation with Temperature | V _{TΔT} | Ta = -30°C to 85°C | -- | 1 | -- | % |
| | Input bias current | I _B | V _{IN} = 0V | -1.0 | -0.2 | 1.0 | μA |
| | Voltage gain | A _V | -- | 70 | 100 | 145 | V/V |
| | Frequency bandwidth | BW | A _V = 0 dB | -- | 6 | -- | MHz |
| | Maximum output voltage range | V _{OM} ⁺ | -- | 0.78 | 0.87 | -- | V |
| | | V _{OM} ⁻ | -- | -- | 0.05 | 0.2 | V |
| | Output source current | I _{OM} ⁺ | V _{FB} = 450mV | -- | -40 | -24 | μA |
| Output sink current | I _{OM} ⁻ | -- | 24 | 40 | -- | μA | |
| Idle period adjustment section | Maximum duty cycle | T _{DUTY} | R _T =3.3kΩ, C _T =270pF f _{OSC} = 500KHz | 75 | -- | 85 | % |
| Output section | Output voltage | V _{OH1} | R _B = 390Ω, I _O = -15 mA | 1.0 | 1.2 | -- | V |
| | | V _{OH2} | R _B = 750Ω, V _{CC} = 3.0V I _O = -10 mA | 0.8 | 1.0 | -- | V |
| | | V _{OL1} | R _B = 390Ω, I _O = -15 mA | -- | 0.1 | 0.2 | V |
| | | V _{OL2} | R _B = 750Ω, V _{CC} = 3.0V I _O = -10 mA | -- | 0.1 | 0.2 | V |
| | Output source current | I _O ⁺ | R _B = 390Ω, V _O = 0.9V | -- | -40 | -30 | mA |
| | Output sink current | I _O ⁻ | R _B = 390Ω, V _O = 0.3V | 40 | 70 | -- | mA |
| | Pull down resistance | R _O | -- | 20 | 30 | 40 | kΩ |

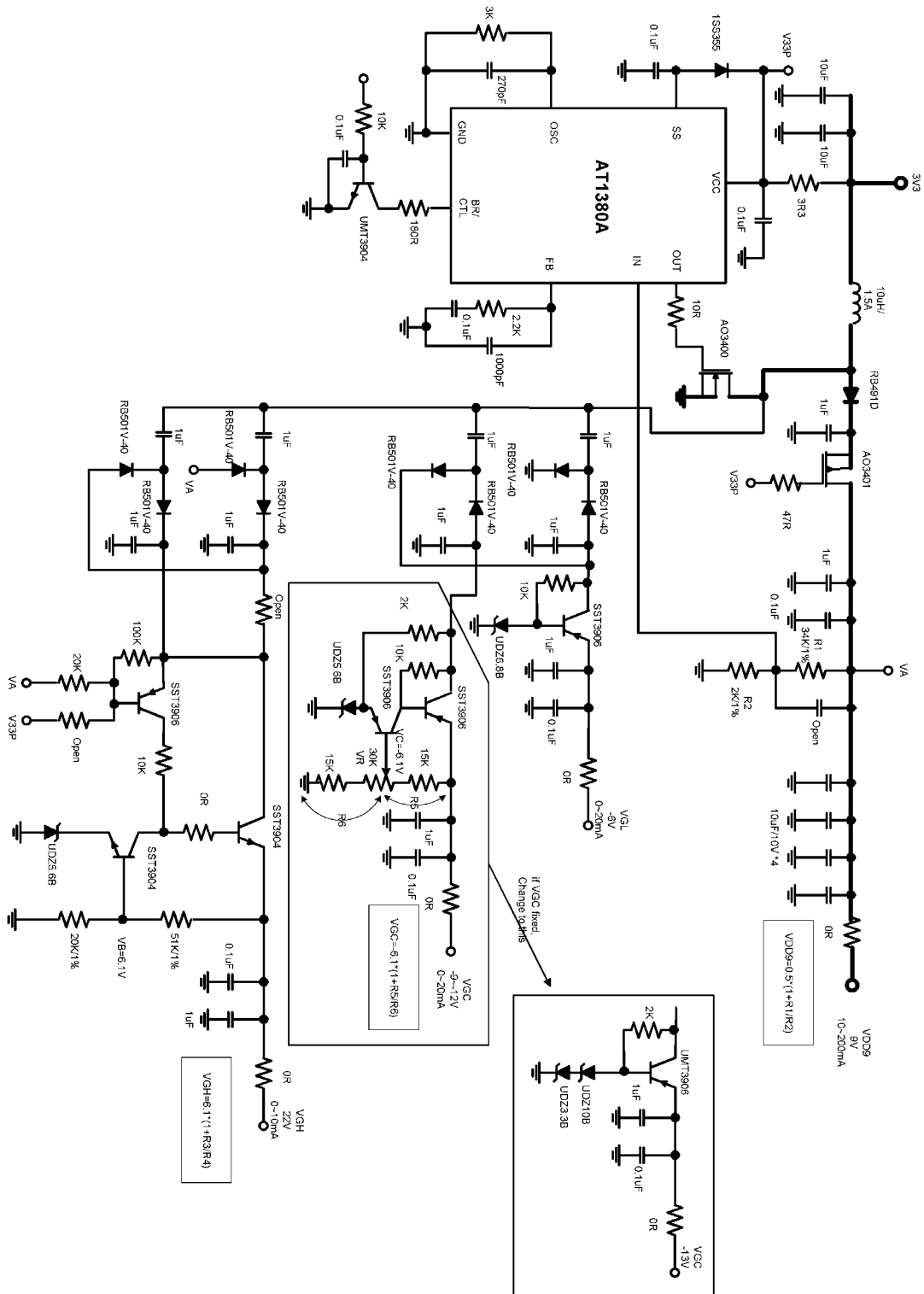
| | | | | | | | |
|---|------------------------|-----------|---|------|------|------|---------|
| Output current Setting section/ Control section | Pin voltage | V_{BR} | $R_B = 390\Omega$ | 0.10 | 0.19 | 0.25 | V |
| | Input off condition | I_{OFF} | -- | -20 | -- | 0 | μA |
| | Input on condition | I_{ON} | | -- | -- | -45 | μA |
| | Pin current range | I_{BR} | | -1.8 | -- | -0.1 | m A |
| Entire device | Stand-by current | I_{CCS} | BR/CTL pin open or V_{CC} | -- | -- | 1 | μA |
| | Average supply current | I_{CC} | $R_B = 390,$ $V_{CC} = 2.5 \sim 13.5V$ | -- | 6 | 10.0 | m A |

Timing Chart



Typical Application Schematic





Functional Description

Soft Start SCP

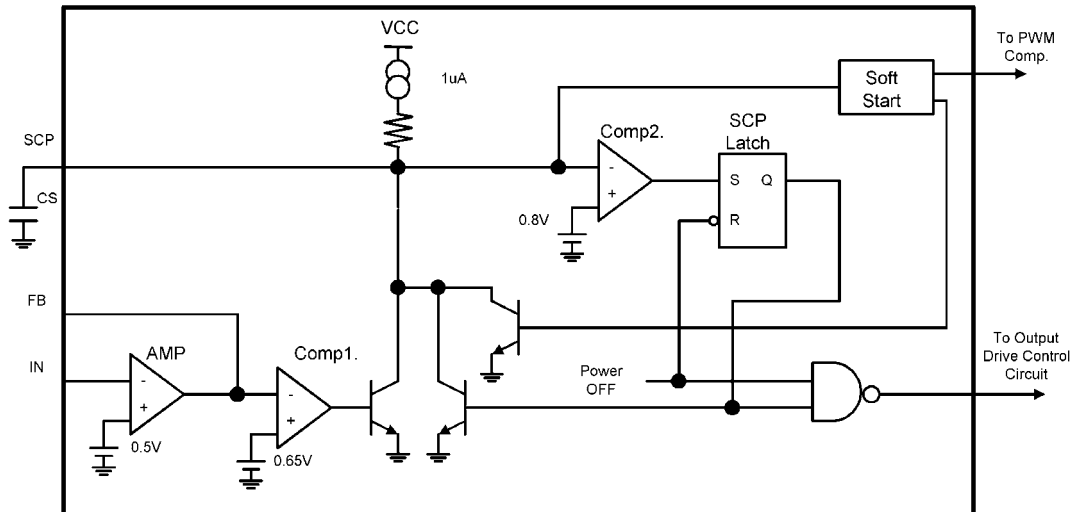


Figure 1. Soft-Start SCP circuit

At power-on, the AT1380A enters the soft-start mode to prevent current spike and overshoot. The capacitor CS is charged from 0V at a constant current of 1µA.

The soft-start time for the duty cycle

$$t_s = 0.8 \times CS(\mu F)$$

When V_{SCP} reaches 0.8V, the AT1380A leaves the soft-start mode to enter the normal mode and enable the SCP function. If the output load conditions change rapidly causing the output to drop suddenly, the external capacitor CS will start to charge because the error amplifier output (FB pin) is fixed at V_{OM+} . When the external capacitor is charged above 0.8V, the output pin is set low. Once the latch circuit has set, the capacitor CS will be discharged to low state and the latch circuit will not reset until power is turned off or the power supply is restarted.

Short-circuit detection time (or full soft-start time) :

$$t_{PE} = 0.8 \times CS(\mu F)$$

Setting Oscillating Frequency

The oscillator circuit generates a triangular sawtooth wave with a peak of 0.8V and a trough of 0.1V using the timing capacitor (CT) and the timing resistor (RT) that are connected to the OSC pin. This oscillator can provide oscillating frequency in the range from 20KHz to 1MHz. The waveform of the OSC pin is shown as Figure 2.

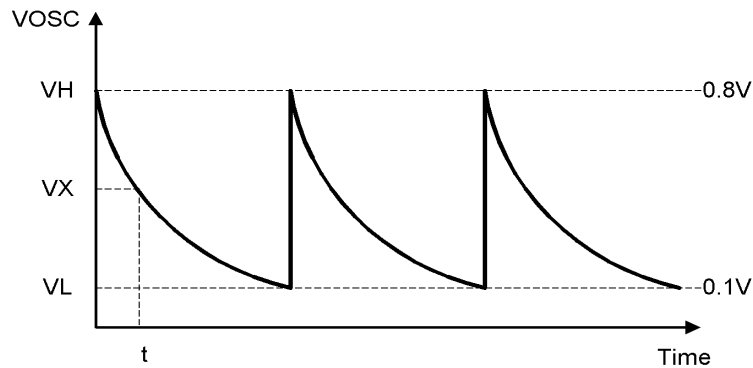


Figure 2 Oscillator Waveform

The cycle (T) can be determined as follows:

$$VX = VH e^{-\frac{t}{CT \times RT}} \quad t = -CT \times RT \times \log_e \left(\frac{VX}{VH} \right)$$

$$T = -CT \times RT \times \log_e (0.1 / 0.8) = 2.1 \times CT \times RT [s]$$

Switching Regulator Function

(1) Reference voltage circuit

A temperature-compensated reference voltage (~1.25V) is generated by the reference voltage circuit from the voltage supplied by the power supply pin (pin 3). The circuit also sets the idle period besides providing the reference voltage for the switching regulator.

(2) Error amplifier

The error amplifier detects the output voltage of the switching regulator and sets the PWM control signal. The voltage gain is fixed. The system is made stable by connecting a phase compensation capacitor to the FB pin (pin 8).

(3) PWM comparator

The voltage comparator includes one inverting and three non-inverting inputs. The comparator is

a voltage to pulse width converter that controls the ON time of the output pulse depending on the level of input voltage. The output level remains high when the sawtooth wave is lower than the error amplifier output voltage, the soft start setting voltage, and the idle period setting voltage.

(4) Output circuit

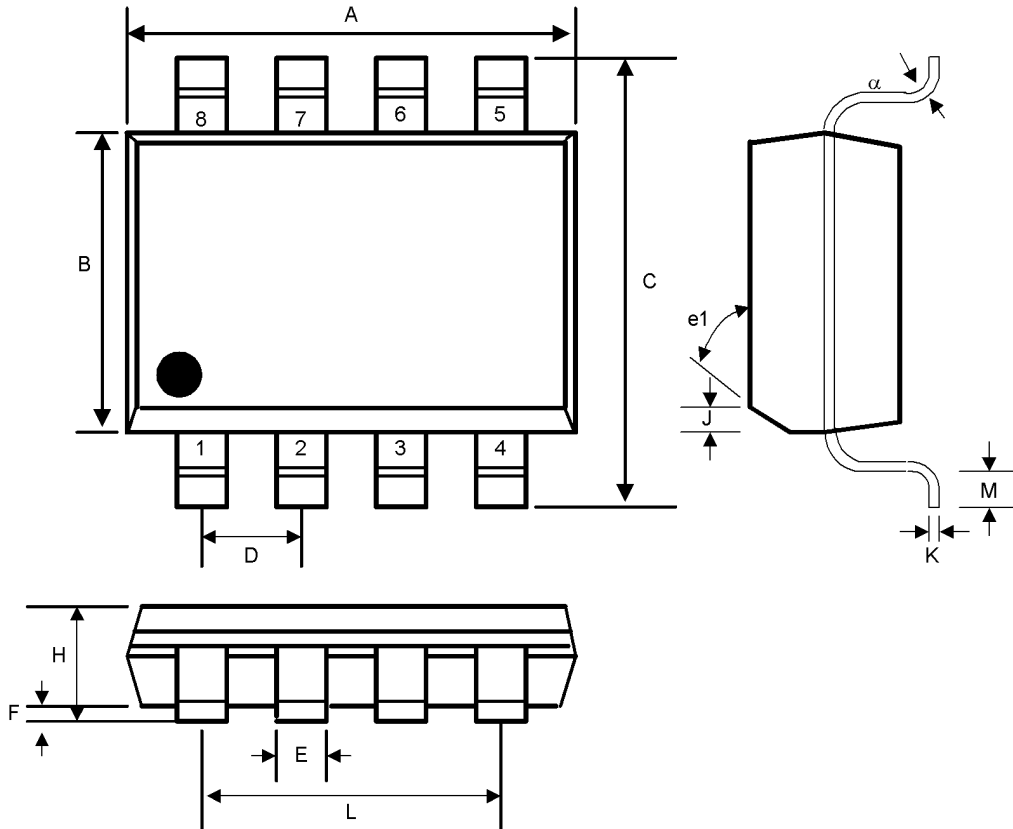
The output circuit can drive an external NPN transistor directly and has a totem pole configuration. The value of the ON/OFF current can be set by a resistor connected to the BR/CTL pin (pin 4). Stand-by mode (supply current $1\mu\text{A}$ or less) can be set by connecting the BR/CTL pin (pin4) to VCC or by making the pin open.

(5) Under-Voltage Lockout (UVLO)

Transients during powering on or instantaneous glitches in the supply voltage can cause the control IC to malfunction and damage the system. To prevent malfunction at low input voltage, the circuit compares the supply voltage to the internal reference voltage to detect a low input voltage. Once detected, the circuit sets the output pin low.

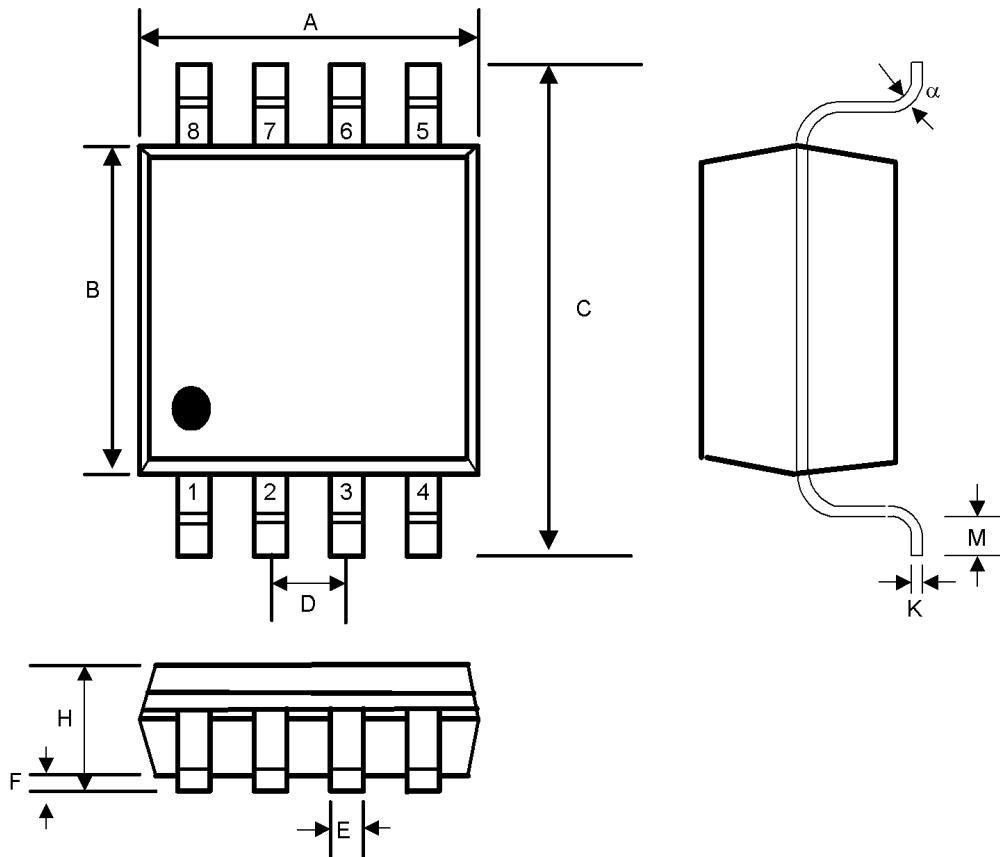
To cancel the status, set V_{CC} below the reset voltage V_R (0.9V) and then set V_{CC} up to the recommended operation range and the latch will be restored to operate normally.

Small Outline 8-pin Plastic SOL



| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|--------|--------|-------|-------------|------|-------|
| | MIN | MAX | MIN | MAX | |
| A | 0.188 | 0.197 | 4.80 | 5.00 | - |
| B | 0.149 | 0.158 | 3.80 | 4.00 | - |
| C | 0.228 | 0.244 | 5.80 | 6.20 | - |
| D | 0.050 | BSC | 1.27 | BSC | - |
| E | 0.013 | 0.020 | 0.33 | 0.51 | - |
| F | 0.004 | 0.010 | 0.10 | 0.25 | - |
| H | 0.053 | 0.069 | 1.35 | 1.75 | - |
| J | 0.011 | 0.019 | 0.28 | 0.48 | - |
| K | 0.007 | 0.010 | 0.19 | 0.25 | - |
| M | 0.016 | 0.050 | 0.40 | 1.27 | - |
| L | 0.150 | REF | 3.81 | REF | - |
| e1 | 45° | | 45° | | - |
| α | 0° | 8° | 0° | 8° | - |

Small Outline 8-pin TSSOP



| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------|--------|-------|-------------|------|-------|
| | MIN | MAX | MIN | MAX | |
| A | 0.114 | 0.122 | 2.90 | 3.10 | - |
| B | 0.169 | 0.177 | 4.30 | 4.50 | - |
| C | 0.244 | 0.260 | 6.20 | 6.60 | - |
| D | 0.026 | BSC | 0.65 | BSC | - |
| E | 0.010 | 0.012 | 0.25 | 0.30 | - |
| F | 0.002 | 0.006 | 0.05 | 0.15 | - |
| H | 0.041 | 0.047 | 1.05 | 1.20 | - |
| K | 0.005 | BSC | 0.127 | BSC | - |
| M | 0.020 | 0.028 | 0.50 | 0.70 | - |
| α | 0° | 8° | 0° | 8° | - |