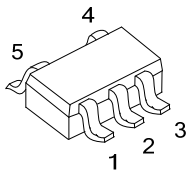
# 1.2A 1.5MHZ SYNCHRONOUS BUCK CONVERTER




SOT-23-5
(JEDEC TO-236)

## ■ DESCRIPTION

The UTC **UD05121** is a monolithic synchronous buck regulator with a built in internal power MOSFET. It achieves 1.2A continuous output current fix switching frequency with excellent load and line regulation.

Current mode operation provides fast transient response and eases of loop stabilization.

Fault condition protection includes cycle-by-cycle current limiting, output short circuit protection and thermal shutdown. In shutdown mode the regulator draws less than 1μA of supply current. Internal soft-start minimizes the inrush supply current at initial startup.

The UTC **UD05121** requires a minimum number of readily available standard external components.

## ■ FEATURES

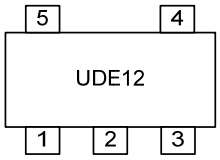
* 2.5V~5.5V input voltage range
* Up to 1.2A Output Current
* 300/200mΩ Internal Power MOSFET Switch
* Stable with Low ESR Output Ceramic Capacitors
* Up to 95% Efficiency
* Less than 1μA Shutdown Current
* 1.5Mhz Switching Frequency
* Thermal Shutdown Protection
* Current limit and short circuit protections.
* Output Adjustable from 0.6V to $V_{IN}$
* Build-in soft start function

## ■ ORDERING INFORMATION

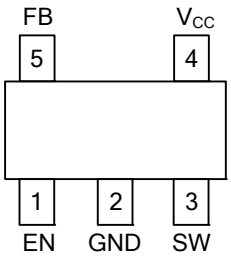
| Ordering Number | Package | Packing |
|---|---|---|
| UD05121G-AE5-R | SOT-23-5 | Tape Reel |

| | |
|---|---|
| UD05121G-AE5-R<br>(1)Packing Type<br>(2)Package Type<br>(3)Green Package | (1) R: Tape Reel<br>(2) AE5: SOT-23-5<br>(3) G: Halogen Free and Lead Free |

## ■ MARKING



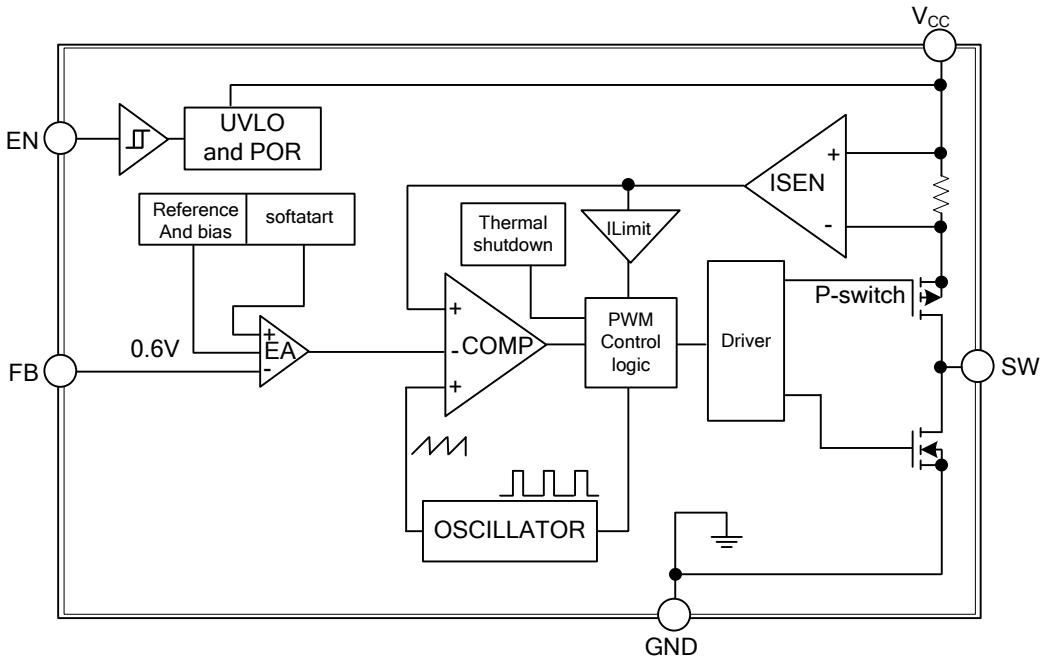
## ■ PIN CONFIGURATION




## ■ PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION |
|---|---|---|
| 1 | EN | Chip enable pin. Active high. |
| 2 | GND | Ground pin |
| 3 | SW | Switching pin |
| 4 | $V_{CC}$ | $V_{CC}$ input pin |
| 5 | FB | Feedback pin |

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATING ($T_A$= 25°C, unless otherwise specified)

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| $V_{CC}$ Pin Voltage | $V_{IN}$ | -0.3~7 | V |
| SW Pin Voltage | $V_{SW}$ | -0.7 ~ $V_{IN}$+0.3 | V |
| EN, FB Pins Voltage | | -0.3 ~ $V_{IN}$+0.3 | V |
| Continuous Power Dissipation | $P_D$ | 400 | mW |
| Junction Temperature | $T_J$ | -40~125 | °C |
| Storage Temperature | $T_{STG}$ | -65~150 | °C |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Stresses exceed those ratings may damage the device.

## ■ THERMAL CHARACTERISTICS

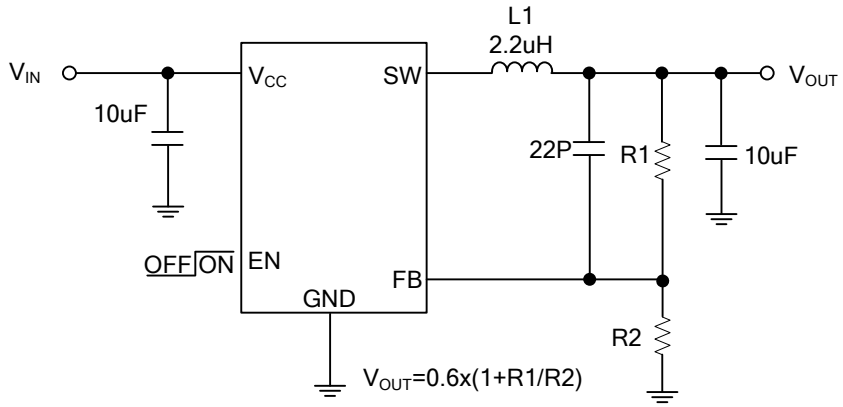
| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Junction to Ambient | $\theta_{JA}$ | 250 | °C/W |
| Junction to Case | $\theta_{JC}$ | 110 | °C/W |

Note: $\theta_{JA}$ is measured with the PCB copper are of approximately 1 $in^2$ (Multi-layer).

## ■ ELECTRICAL CHARACTERISTICS ($V_{IN}$=5V, $V_{EN}$=5V, $V_{OUT}$=1.8V, $T_A$= 25°C)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | 2.5 | | 5.5 | V |
| Input UVLO | UVLO | $I_{OUT}$=0A | 1.8 | 2.2 | 2.5 | V |
| Input OVLO | OVLO | $I_{OUT}$=0A | | 6.0 | | V |
| Quiescent Current | $I_{CCQ}$ | $V_{FB}$=1V | | 250 | 350 | μA |
| Shutdown Current | $I_{SD}$ | $V_{EN}$=0V | | 0.1 | 1 | μA |
| FB Pin Voltage | $V_{FB}$ | | 0.588 | 0.6 | 0.612 | V |
| FB Pin Current | $I_{FB}$ | | | | ±50 | nA |
| Load Regulation | | 0A<$I_{OUT}$<1.2A | | 0.6 | | % |
| Load Regulation | | 2.5A<$V_{IN}$<5.5V | | 0.3 | | %/V |
| EN Pin Voltage High | $V_{ENH}$ | | 1.5 | | | V |
| EN Pin Voltage Low | $V_{ENL}$ | | | | 0.4 | V |
| EN Pin Leakage Current | | $V_{EN}$=3V | | 0.1 | 1 | uA |
| Switching Frequency | $F_{OSC}$ | | 1.1 | 1.5 | 1.9 | MHz |
| Current Limit | $C_L$ | $V_{IN}$=3V, $V_{FB}$=0.5V or $V_{OUT}$=90%, Duty Cycle<35% | 1.4 | 1.7 | | A |
| Switching Maximum Duty | Dmax | | | | 100 | % |
| Minimum Duty | Dmin | | 0 | | | % |
| P-Switch $R_{DS(ON)}$ | $R_{DS(ON)-P}$ | | | 300 | | mΩ |
| N-Switch $R_{DS(ON}$ | $R_{DS(ON)-N}$ | | | 200 | | mΩ |
| Low Side Discharger | | | | 60 | | Ω |
| Thermal Shutdown | $T_{SD}$ | | | 160 | | °C |
| Thermal Shutdown Protection hysteresis | $T_{SH}$ | | | 30 | | °C |

## ■ TYPICAL APPLICATION CIRCUIT




$V_{OUT}=V_{FB} \times (1+R1/R2)$, $V_{FB}$ = 0.6V, R2 suggest 60k~300kΩ

## ■ FUNCTION DESCRIPTION

**Normal Operation**

The **UD05121** uses a user adjustable frequency, current mode, synchronous step-down architecture with internal paver switch. During normal operation, the internal power switch is turned on each cycle when the oscillator sets the SR latch, and turned off when the comparator resets the SR latch. The peak inductor current at which comparator resets the SR latch is controlled by the output of error amplifier EA. While the high-side switch is off, the external schottky diode turns on until either the inductor current starts to reverse or the beginning of the next switching cycle.

**Setting the Output Voltage**

Application circuit item shows the basic application circuit with adjustable output version. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = V_{FB} \times (1 + \frac{R1}{R2}),\ V_{FB} = 0.6V,\ R2 \text{ suggest } 60k \sim 300k\Omega$$

Table 1. Resistor select for output voltage setting

| $V_{OUT}$ | R1 | R2 |
|---|---|---|
| 1.0V | 100K | 150K |
| 1.2V | 100K | 100K |
| 1.5V | 150K | 100K |
| 1.8V | 200K | 100K |
| 2.5V | 470K | 150K |
| 3.3V | 450K | 100K |

**Dropout Operation**

As the input supply voltage decreases to a value approaching the output voltage, the duty cycle increases toward the maximum on-time. Further reduction of the supply voltage forces the high-side switch to remain on for more than one cycle until it reaches 100% duty cycle.

The output voltage is dropped from the input supply for the voltage which across the high-side switch.

**Over Temperature Protection**

In most applications the **UD05121** does not dissipate much heat due to high efficiency. But, in applications where the **UD05121** is running at high ambient temperature with low supply voltage and high duty cycles, such as in dropout, the heat dissipated may exceed the maximum junction temperature of the part. If the junction temperature reaches approximately 160°C, the internal high-side power switch will be turned off and the LX node will become high impedance.

**Over Current Protection**

The **UD05121** cycle-by-cycle limits the peak inductor current to protect embedded switch from damage. Hence the maximum output current (the average of inductor current) is also limited. In case the load increases, the inductor current is also increase. Whenever the current limit level is reached, the output voltage cannot be regulated and starting to drop.

**Soft-Start**

The **UD05121** employs internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout or shut-down mode, the soft-start circuitry will slowly ramp up the output voltage.

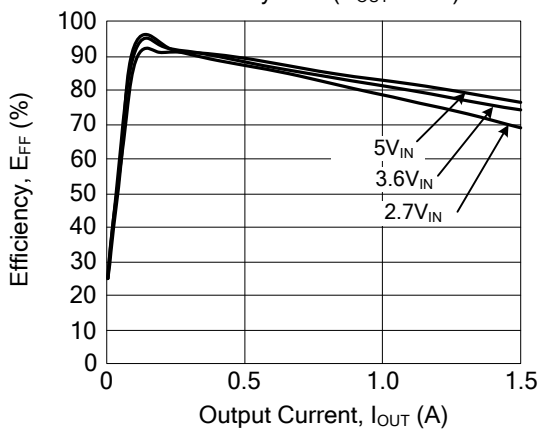
**Short-circuit Protection**

Short-circuit protection will activate once the feedback voltage falls below, and the operating frequency will be reducing normal switching frequency to reduce power delivered from input to output.

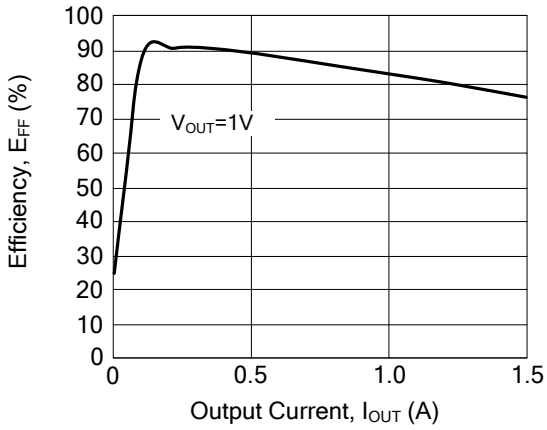
## ■ TYPICAL CHARACTERISTICS

C1=100μF, C2=330μF, L1=33μH, $T_A$=25°C

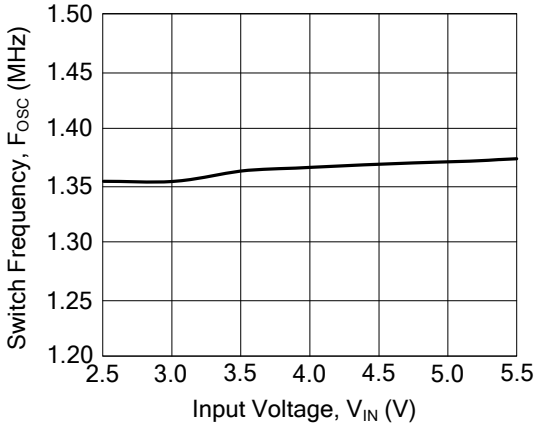
Efficiency Test ($V_{OUT}$=1.0V)



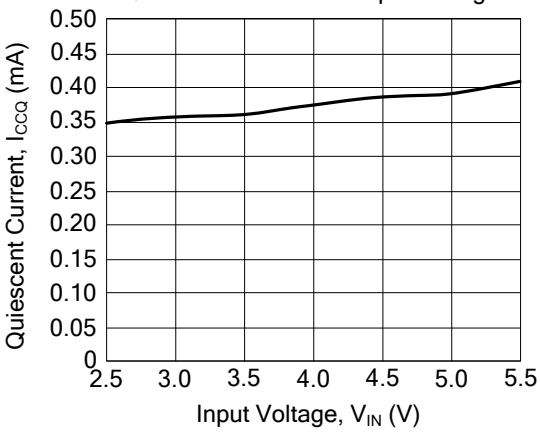

Efficiency Test ($V_{IN}$=5V)



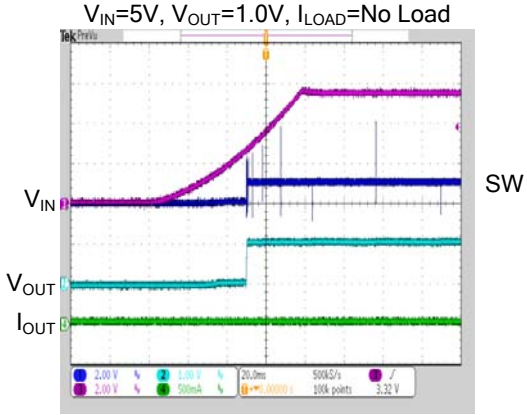

Frequency vs. Input Voltage




Quiescent Current vs. Input Voltage




$V_{IN}$=5V, $V_{OUT}$=1.0V, $I_{LOAD}$=No Load




$V_{IN}$=5V, $V_{OUT}$=1.0V, $I_{OUT}$=1.2A