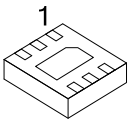
5.5V, 1.5A, 1.5MHZ HIGH EFFICIENCY PWM STEP-DOWN DC/DC CONVERTER



DFN-6(2x2)

■ DESCRIPTION

UTC **UD05151** is a high efficiency step-down DC/DC converter operated with the current mode and the constant frequency. The internal switch and synchronous rectifier are integrated for high efficiency. External Schottky diodes are not required. The supply current is only 200μA during operation and drops to less than 1μA in shutdown. UTC **UD05151** can supply 1.5A of load current from 2.5V to 5.5V supply voltage. The output voltage can be regulated as low as 0.6V.

The switching frequency is set at 1.5MHz, allowing the use of small surface mount inductors and capacitors. It can run 100% duty cycle for low dropout application.

■ FEATURES

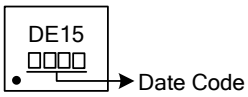
* 2.5V to 5.5V Input Voltage Range
* Adjustable Output Voltage as Low as 0.6V
* High Efficiency: Up to 95%
* 1.5MHz Constant Switching Frequency
* 1.5A Available Load Current
* 100% Duty Cycle in Dropout
* Current Mode Control
* Short Circuit Protection
* Thermal Fault Protection
* <0.1μA Shutdown Current

■ ORDERING INFORMATION

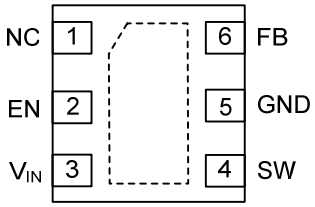
Ordering Number	Package	Packing
UD05151G-K06-2020-R	DFN-6(2×2)	Tape Reel

UD05151G-K06-2020-R (1)Packing Type	(1) R: Tape Reel
(2)Package Type	(2) K06-2020: DFN-6(2×2)
(3)Green Package	(3) G: Halogen Free and Lead Free

■ MARKING



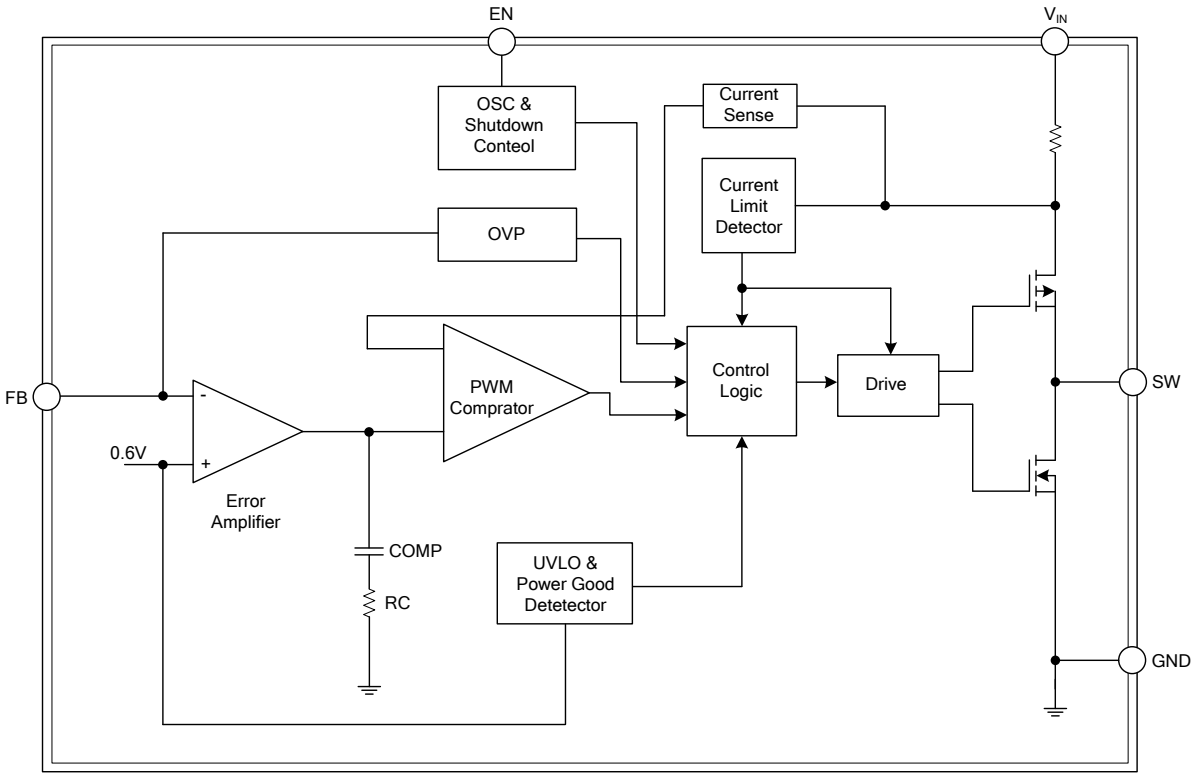
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	NC	No Internal Connection (Floating or Connecting to GND).
2	EN	On/Off Control Input. Pull EN above 1.5V to turn the device on.
3	V_{IN}	Power Supply Input. Drive 2.5V to 5.5V voltage to this pin to power on this chip. Connecting a 10uF ceramic bypass capacitor between V_{IN} and GND to eliminate noise
4	SW	Switch Output. Connect this pin to the switching end of the inductor.
5	GND	Ground. This pin is the voltage reference for the regulated output voltage. For this reason care must be taken in its layout.
6	FB	Feedback Input. Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING (Note 1)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{IN}	6	V
SW Voltage	V_{SW}	-0.3~V_{IN}+0.3	V
All Other Pins		-0.3~+6	V
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	-65~+150	°C

Note: 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.

■ RECOMMENDED OPERATING CONDITIONS (Note 2)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Supply Voltage	V_{IN}	2.5~5.5	V
Output Voltage	V_{OUT}	0.6~5.5	V
Ambient Temperature	T_A	-40~85	°C

■ THERMAL RESISTANCES CHARACTERISTICS

PARAMETER	SYMBOL	RATINGS	UNIT
Junction To Ambient	θ_{JA}	120	°C/W
Junction to Case	θ_{JC}	22	°C/W

■ ELECTRICAL CHARACTERISTICS

(V_{IN}=3.6V, V_{OUT}=1.8V, L1=2.2uH, C2=10uF, T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Supply Voltage	V_{IN}		2.5		5.5	V
Quiescent Current	I_Q	Switching Without I_{Load} 5V→3.3V		3.2		mA
Shutdown Current	I_S	V_{EN}=0V, V_{IN}=5.5V		0.1	1	μA
IN Under Voltage Lockout Threshold	UVLO	V_{IN} Falling Edge	2.0	2.2	2.5	V
IN Under Voltage Lockout Hysteresis				0.2		V
Reference Voltage	V_{REF}		0.582	0.6	0.618	V
Output Voltage Accuracy	$\Delta V_{OUT}/V_{OUT}$	I_{OUT}=0~1.5A	-3		3	%
FB Input Current	I_{FB}	V_{FB}=0.65V	-50		50	nA
PFET On Resistance (Note 3)	$R_{(ON)\ P}$	I_{SW}=200mA		0.28		Ω
NFET On Resistance (Note 3)	$R_{(ON)\ N}$	I_{SW}=-200mA		0.25		Ω
SW Leakage Current			-1		1	μA
PFET Current Limit		Duty Cycle=100%, Current Pulse Width<1ms	1.8	2.2		A
Oscillator Frequency	F_{SW}	V_{IN}=3.6V, I_{OUT}=200mA	1.2	1.5	1.8	MHZ
Maximum Duty Cycle				100		%
Minimum On-Time (Note 3)	T_{ON}			80		nS
Thermal Shutdown Trip Threshold (Note 3)				145		°C
EN High-Level Input Voltage		-40°C≤T_A≤+85°C	1.5			V
EN Low-Level Input Voltage					0.4	V
EN Input Current		V_{EN}=0V~5.5V	-1		1	μA

Notes: 1. Stresses exceed those ratings may damage the device.
2. If out of its operation conditions, the device is not guaranteed to function.
3. Guaranteed by design.

■ APPLICATION INFORMATION

Setting Output Voltage

The external resistor divider sets the output voltage. The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. Table 1 shows a list of resistor selection for common output voltages:

$$V_{OUT} = 0.6 \cdot (1+\frac{R1}{R2})\ V$$

Selecting the Inductor

A 1μH to 4.7μH inductor with DC current rating at least 25% higher than the maximum load current is recommended for most applications. For best efficiency, the inductor DC resistance shall be <20mΩ.

For most designs, the required inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \cdot (V_{IN} - V_{OUT})}{V_{IN} \cdot \Delta I_L \cdot F_{SW}}$$

Where ΔI_L is the inductor ripple current. Choose inductor ripple current approximately 30% of the maximum load current, 1.5A.

The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light load conditions below 100mA, larger inductance is recommended for improved efficiency.

Selecting the Input Capacitor

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency shall be less than input source impedance to prevent high frequency switching current passing to the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 10μF capacitor is sufficient.

Selecting the Output Capacitor

The output capacitor keeps output voltage ripple small and ensures regulation loop stable. The output capacitor impedance shall be low at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended.

The output ripple ΔV_{OUT} is approximately:

$$\Delta V_{OUT} \leq \frac{V_{OUT} \cdot (V_{IN} - V_{OUT})}{V_{IN} \cdot F_{SW} \cdot L} \cdot [ESR + \frac{1}{8 \cdot F_{SW} \cdot C2}]$$

■ PCB LAYOUT RECOMMENDATION

1. The high current paths (GND, VIN and SW) should be placed very close to the device with short, direct and wide traces.
2. Place the input capacitors, output capacitors as close to the device as possible. Trace to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.
3. CIN must be close to Pins VIN and GND. The loop area formed by CIN and VIN/GND pins must be minimized.
4. The external feedback resistors shall be placed next to the FB pin.
5. Keep the switching node SW short and away from the feedback network.

■ TYPICAL APPLICATION CIRCUIT

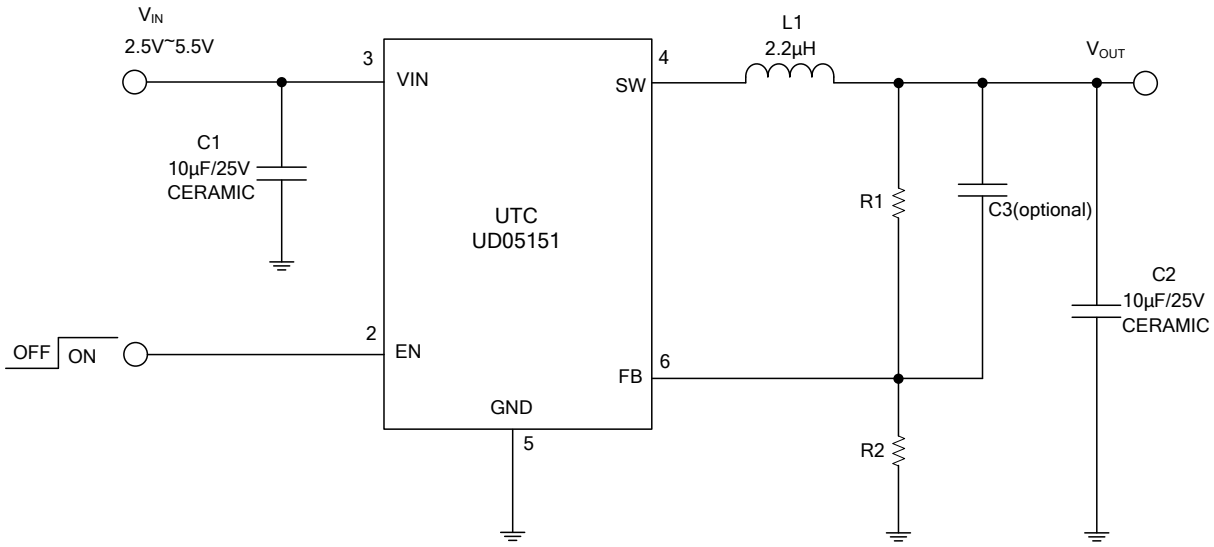


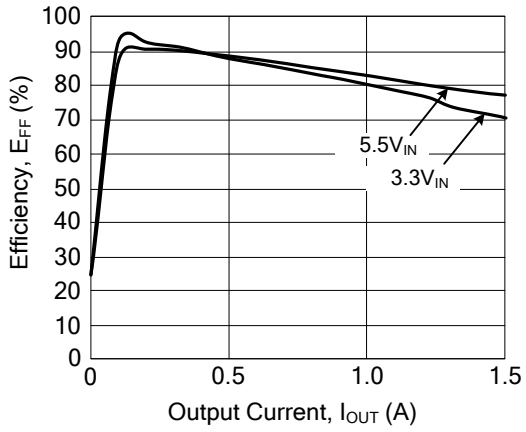
Table 1 Recommended Component Selection

V_{OUT}	R1	R2	C3	L1	C2
3.3V	300K	68K	1.5pF	2.2μH	10μF
2.5V	150K	47K	7pF	2.2μH	10μF
1.8V	100K	50K	10pF	2.2μH	10μF
1.2V	100K	100K	12pF	1.5μH	20μF
1.0V	68K	100K	15pF	1.2μH	20μF

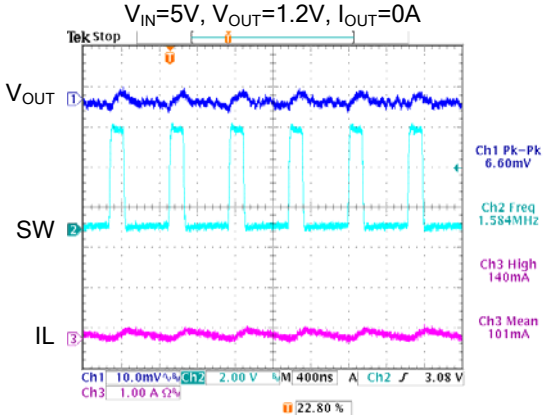
■ TYPICAL CHARACTERISTICS

C1=10μF, C2=22μF, L1=4.7μH, T_A=25°C

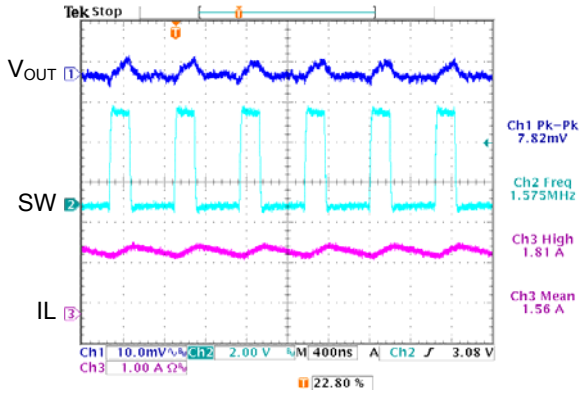
Efficiency Test (V_{IN}=1.2V)



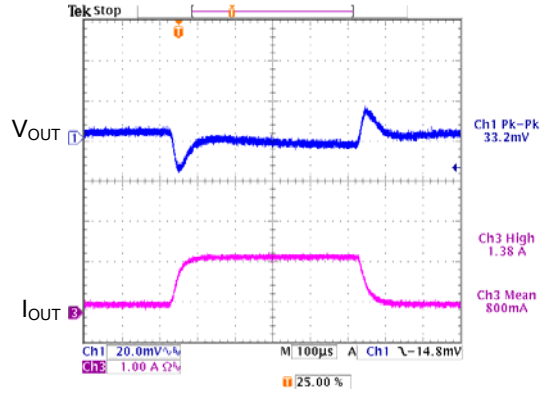
Steady State
V_{IN}=5V, V_{OUT}=1.2V, I_{OUT}=0A



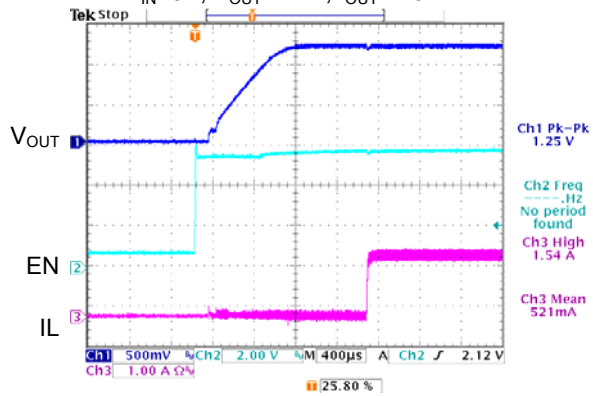
Steady State
V_{IN}=5V, V_{OUT}=1.2V, I_{OUT}=1.5A



Dynamic Loading
V_{IN}=5V, V_{OUT}=1.2V, I_{OUT}=0.15A~1.35A



Power On
V_{IN}=5V, V_{OUT}=1.2V, I_{OUT}=1.5A



Shut Down
V_{IN}=5V, V_{OUT}=1.2V, I_{OUT}=0.05A