

Features

- Low startup voltage: 0.85V (Typical)
- High efficiency up to 85%
- Ultra low no load input current
- High output voltage accuracy: $\pm 2.5\%$
- Fixed output voltage: 1.8V, 2.2V, 2.7V, 3.0V, 3.3V, 3.7V and 5.0V
- Ultra low shutdown current: 0.1 μ A (Typical)
- Package type: 3-pin SOT89 and 5-pin SOT23

Applications

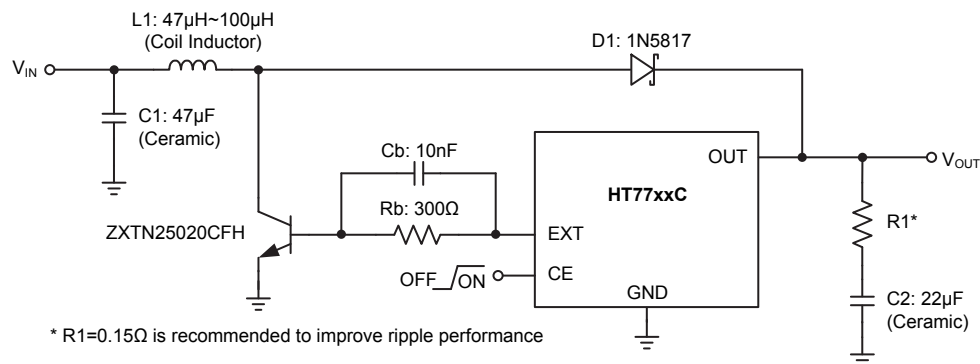
- One, two and three cell alkaline and NiMH/NiCd battery powered portable products
- Portable equipment/handheld devices

General Description

The HT77xxC series is a set of PFM step-up DC/DC converters with high efficiency and low ripple. The series features extremely low start-up voltage and high output voltage accuracy. They require only few external components to provide a fixed output voltage of 1.8V, 2.2V, 2.7V, 3.0V, 3.3V, 3.7V and 5.0V. CMOS technology ensures low supply current and makes them ideal for battery-operated applications powered from one or more cells.

The HT77xxC series consist of an oscillator, a PFM control circuit, a gate driver, a reference voltage unit and a high speed comparator. They employ pulse frequency modulation (PFM) for minimum supply current and ripple at light output loading. These devices are available in space saving 3-pin SOT89 and 5-pin SOT23 packages. For the 5-pin SOT23 package, it also contains a chip enable function to reduce power consumption during shutdown mode.

Typical Application Circuits

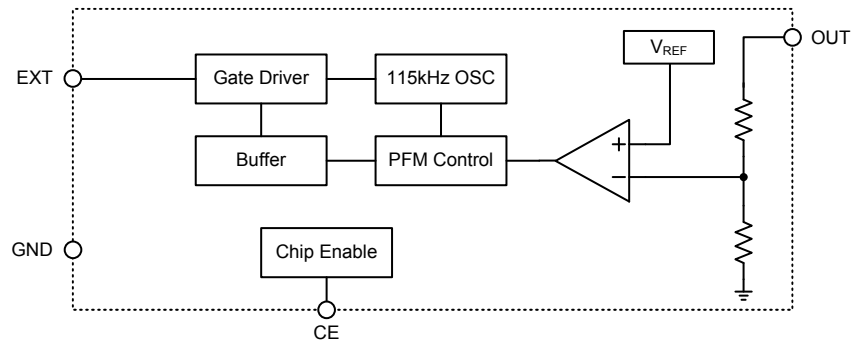


Selection Table

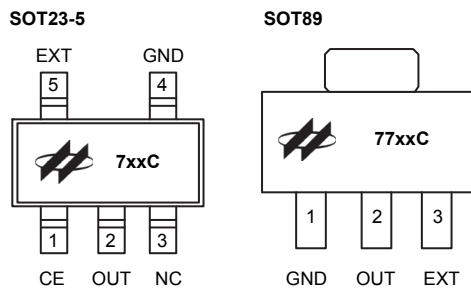
Part No.	Output Voltage	Packages	Markings
HT7718C	1.8V	SOT89 SOT23-5	77xxC marking for SOT89 type 7xxC marking for SOT23-5 type
HT7722C	2.2V		
HT7727C	2.7V		
HT7730C	3.0V		
HT7733C	3.3V		
HT7737C	3.7V		
HT7750C	5.0V		

Note: "xx" stands for output voltages.

Block Diagram



Pin Assignment



Pin Description

Pin No.		Pin Name	Pin Description
SOT89	SOT23-5		
—	1	CE	Chip enable pin, high active.
2	2	OUT	Output voltage pin
—	3	NC	No connection
1	4	GND	Ground pin
3	5	EXT	Gate driver output pin

Absolute Maximum Ratings

Parameter		Value	Unit
OUT		-0.3 to +6.0	V
EXT and CE		-0.3 to +6.0	V
Maximum Junction Temperature		+150	°C
Storage Temperature Range		-65 to +150	°C
Lead Temperature (Soldering 10sec)		+260	°C
ESD Susceptibility	Human Body Mode	5000	V
	Machine Mode	400	V
Junction-to-Ambient Thermal Resistance, θ_{JA}	SOT89	200	°C/W
	SOT23-5	500	
Power Dissipation, P_D	SOT89	0.625	W
	SOT23-5	0.25	

Recommended Operating Ratings

Parameter	Value	Unit
V_{IN}	0.85 to 5	V
Operating Temperature Range	-40 to +85	°C

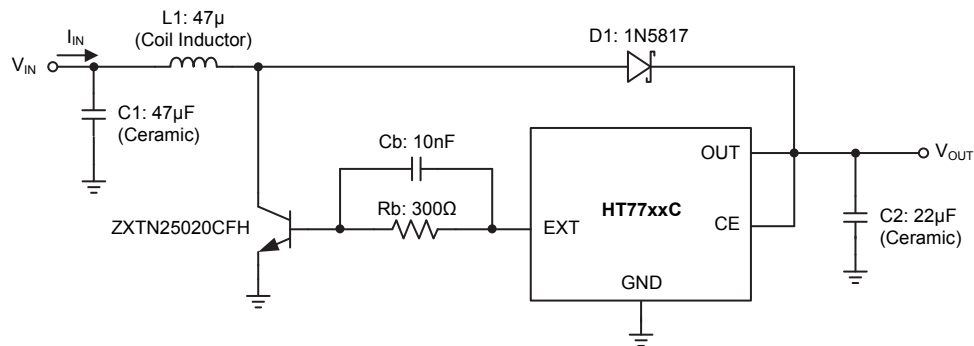
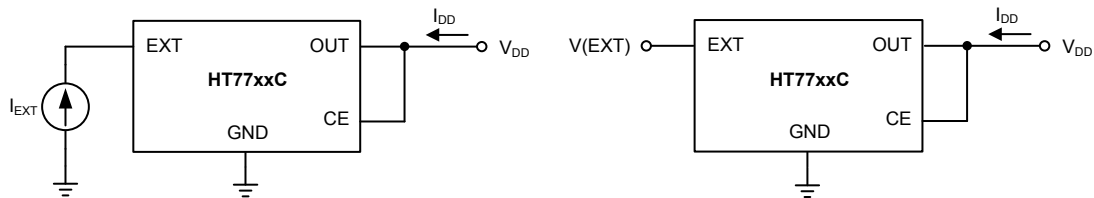
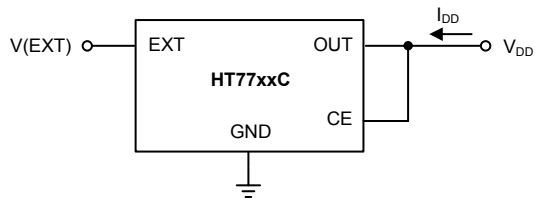
Note that Absolute Maximum Ratings indicate limitations beyond which damage to the device may occur. Recommended Operating Ratings indicate conditions for which the devices are intended to be functional, but do not guarantee specified performance limits.

Electrical Characteristics

 $V_{IN}=0.6 \times V_{OUT}$, $I_{OUT}=10\text{mA}$ and $T_a=+25^\circ\text{C}$, unless otherwise specified

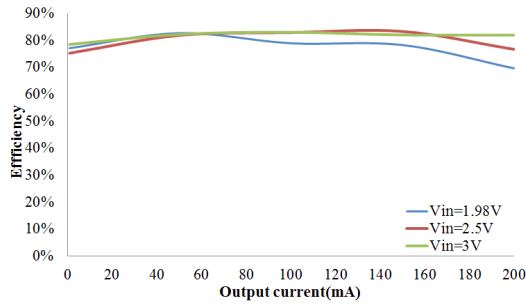
Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range	—	—	—	5.5	V
ΔV_{OUT}	Output Voltage Accuracy	—	-2.5	—	+2.5	%
V_{ST}	Startup Voltage (Fig.1)	$V_{IN}: 0\text{V} \rightarrow 2\text{V}$, $I_{OUT}=1\text{mA}$	—	0.85	1	V
V_{HOLD}	Hold on Voltage (Fig.1)	$V_{IN}: 2\text{V} \rightarrow 0\text{V}$, $I_{OUT}=1\text{mA}$	—	—	0.7	V
I_{IN}	No Load Input Current (Fig.1)	$I_{OUT}=0\text{mA}$	8	10	20	μA
I_{DD}	Non-switching Current (Fig.2)	$V_{DD}=V_{OUT}+0.5\text{V}$	—	5	10	μA
I_{SHDN}	Shutdown Current (Fig.1)	$\text{CE}=\text{GND}$	—	0.1	1	μA
$R_{P(ON)}$	High Side On Resistance (Fig.3)	$V_{DD}=1.7\text{V}$, $I_{EXT}=10\text{mA}$ $V_{OUT}=1.8\text{V}$	—	46	—	Ω
		$V_{DD}=3.2\text{V}$, $I_{EXT}=10\text{mA}$ $V_{OUT}=3.3\text{V}$	—	37	—	
		$V_{DD}=4.85\text{V}$, $I_{EXT}=10\text{mA}$ $V_{OUT}=5.0\text{V}$	—	30	—	
$R_{N(ON)}$	Low Side On Resistance (Fig.3)	$V_{DD}=1.7\text{V}$, $I_{EXT}=-10\text{mA}$ $V_{OUT}=1.8\text{V}$	—	25	—	Ω
		$V_{DD}=3.2\text{V}$, $I_{EXT}=-10\text{mA}$ $V_{OUT}=3.3\text{V}$	—	17	—	
		$V_{DD}=4.85\text{V}$, $I_{EXT}=-10\text{mA}$ $V_{OUT}=5.0\text{V}$	—	15	—	
V_{IH}	CE High Threshold	—	1.6	—	—	V
V_{IL}	CE Low Threshold	—	—	—	0.4	V
f_{OSC}	Maximum Oscillator Frequency (Fig.2)	$V_{DD}=0.9 \times V_{OUT}$, measured at EXT pin	—	115	—	kHz
D_{OSC}	Oscillator Duty Cycle (Fig.2)	$V_{DD}=0.9 \times V_{OUT}$, measured at EXT pin	65	75	85	%
η	Efficiency	—	—	85	—	%

Note: Absolute maximum ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the devices are intended to be functional, but do not guarantee specific performance limits. The guaranteed specifications apply only for the test conditions listed.

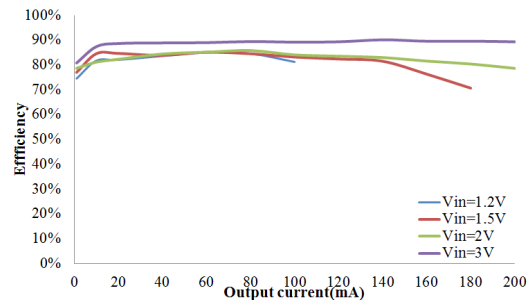

Fig. 1

Fig. 2

Fig. 3

Typical Performance Characteristics

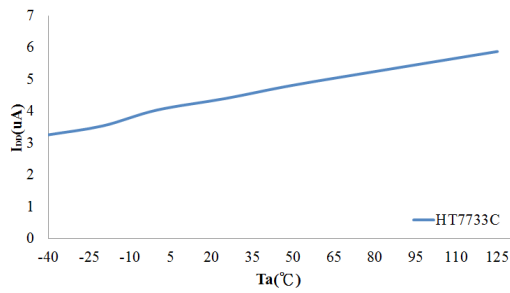
$V_{IN}=0.6 \times V_{OUT}$, $C_{IN}=47\mu F$, $C_{OUT}=22\mu F$, $L=47\mu H$, $T_a=25^\circ C$, unless otherwise noted



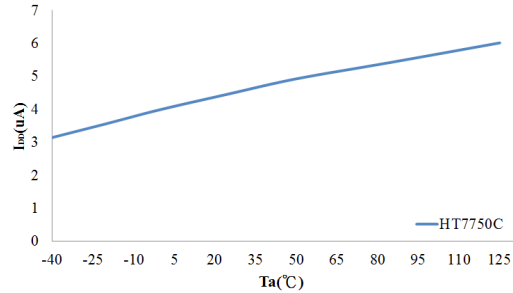
HT7733C Efficiency vs. Output Current



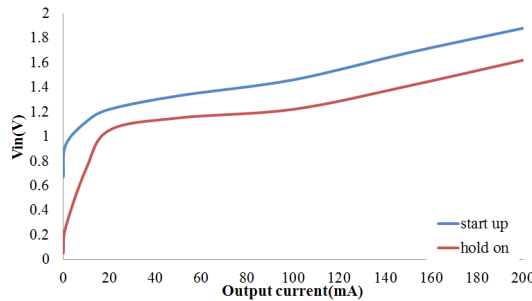
HT7750C Efficiency vs. Output Current



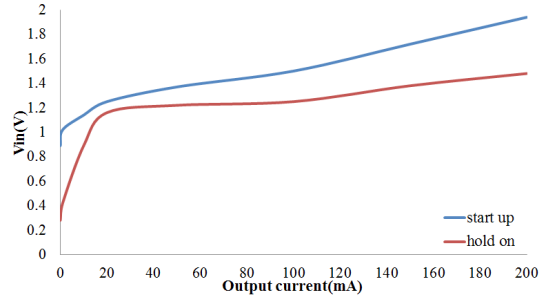
HT7733C I_{DD} vs. T_a



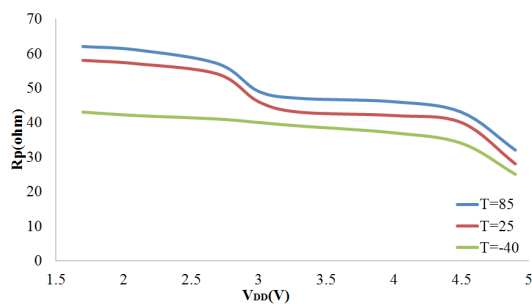
HT7750C I_{DD} vs. T_a



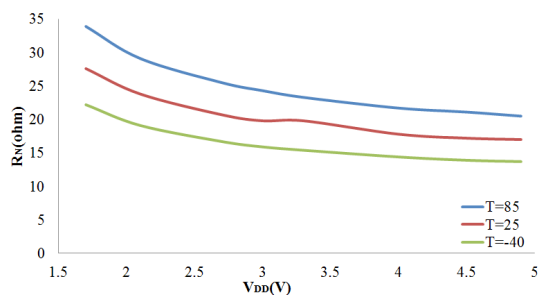
HT7733C Startup/Hold-on Voltage



HT7750C Startup/Hold-on Voltage

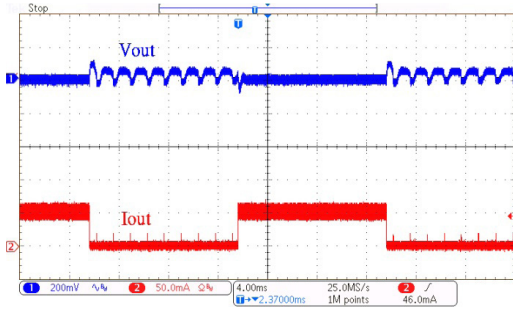


R_P vs. V_{DD}

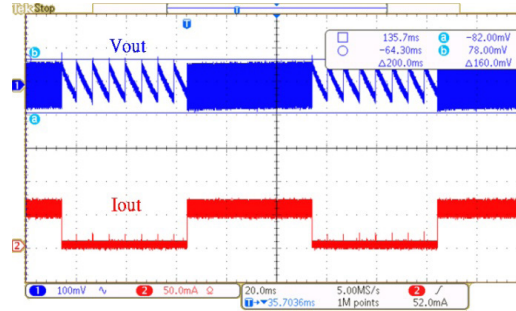


R_N vs. V_{DD}

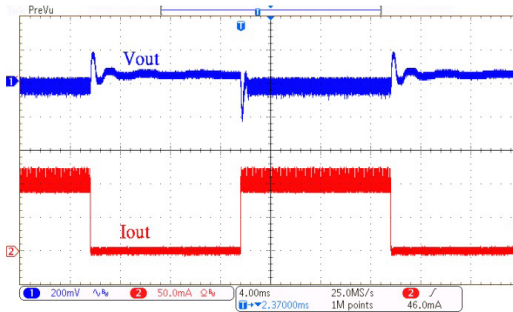
$V_{IN}=0.6 \times V_{OUT}$, $C_{IN}=47\mu F$, $C_{OUT}=22\mu F$, $L=47\mu H$, $T_a=25^\circ C$, unless otherwise noted



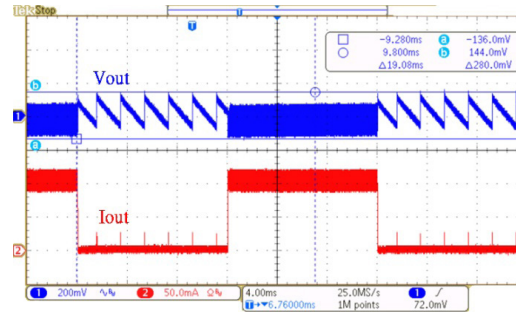
HT7733C Load Transient (1mA to 50mA)



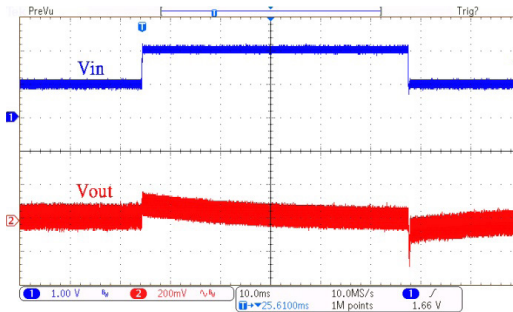
HT7750C Load Transient (1mA to 50mA)



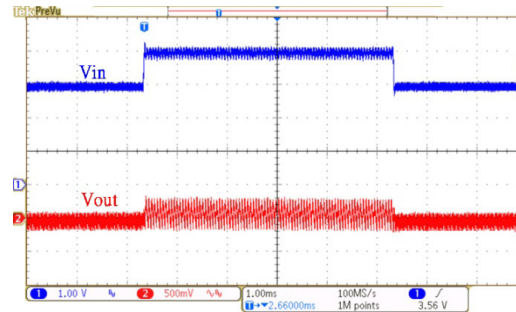
HT7733C Load Transient (1mA to 100mA)



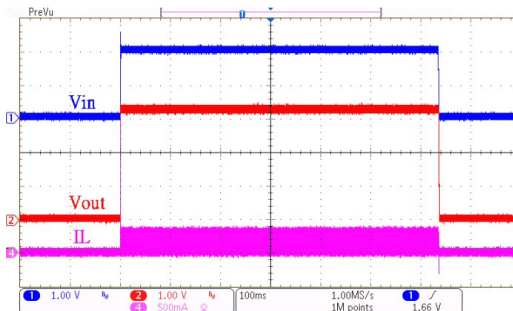
HT7750C Load Transient (1mA to 100mA)



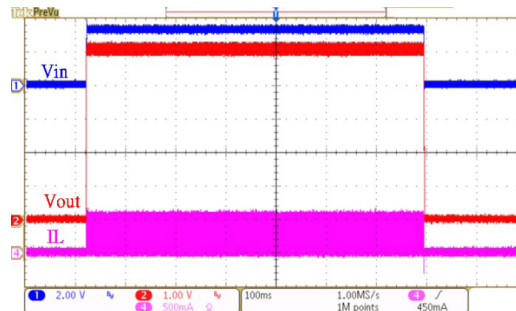
HT7733C Line Transient (1V to 2V, $I_{OUT}=50mA$)



HT7750C Line Transient (3V to 4V, $I_{OUT}=100mA$)

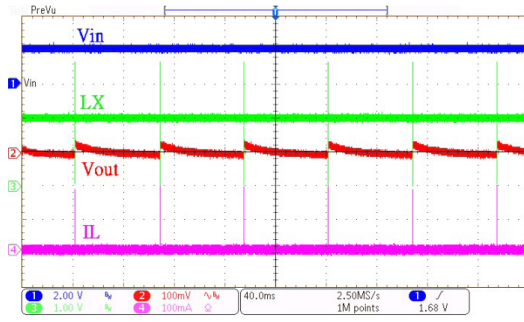


HT7733C Power ON/OFF ($I_{OUT}=50mA$)

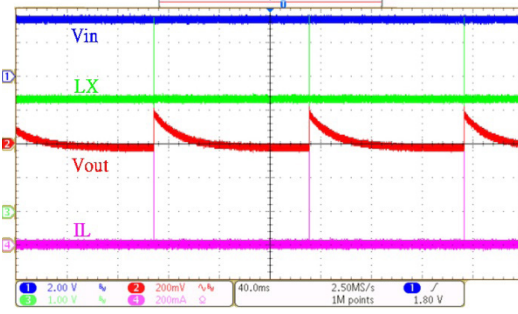


HT7750C Power ON/OFF ($I_{OUT}=50mA$)

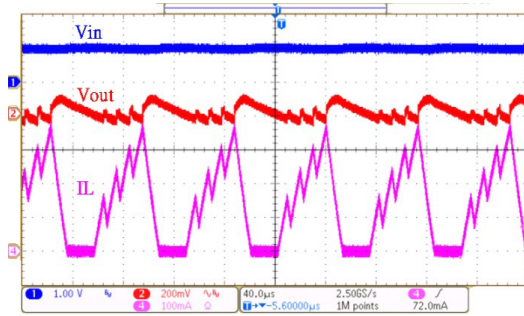
$V_{IN}=0.6 \times V_{OUT}$, $C_{IN}=47\mu F$, $C_{OUT}=22\mu F$, $L=47\mu H$, $T_a=25^\circ C$, unless otherwise noted



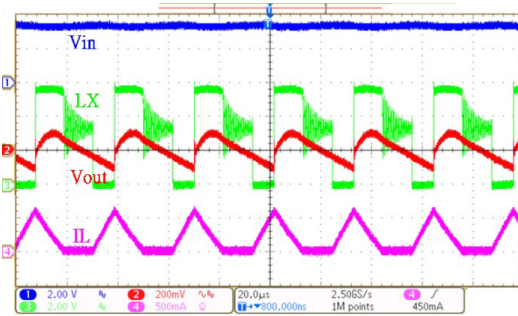
HT7733C Operation ($I_{OUT}=0mA$)



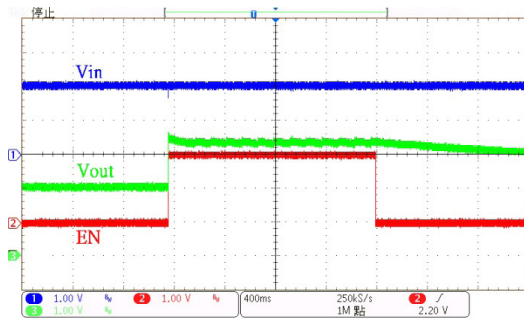
HT7750C Operation ($I_{OUT}=0mA$)



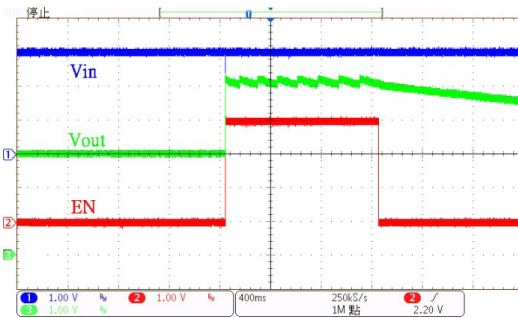
HT7733C Operation ($I_{OUT}=100mA$)



HT7750C Operation ($I_{OUT}=100mA$)



HT7733C Chip Enable/Disable



HT7750C Chip Enable/Disable

Component Selection

Power Inductor

It's recommended to use a 47 μ H or higher inductance to remain low output ripple voltage in most applications. Increasing the inductance gains lower output ripple voltage. It is suggested that to choose lower DCR to reduce the efficiency loss, typically $DCR < 1\Omega$. Otherwise, the chosen saturation current of the inductor should be greater than its peak current in applications, typically 1A or higher.

Schottky Diode

The breakdown voltage rating of the diode should be higher than the maximum output voltage. The current rating for the diode is suggested to use 1A or higher rating.

Input Capacitor

A low ESR ceramic capacitor (C_{IN}) is needed between the VIN pin and GND pin. Use ceramic capacitors with X5R or X7R dielectrics for their low ESRs and small temperature coefficients. For most applications, a 47 μ F capacitor will suffice.

Output Capacitor

The selection of C_{OUT} is driven by the maximum allowable output voltage ripple. Use ceramic capacitors with X5R or X7R dielectrics for their low ESR characteristics. Capacitors in the range of 22 μ F to 100 μ F are a good starting point with an ESR of 0.1 Ω or less. Usually, it's suggested to 22 μ F in most applications.

Ripple Improved Resistor When No Load Condition

It's strong suggested to add a ripple improved resistor, R1, to keep the switching stability when no load condition. It is recommended to set R1 to 0.15 Ω . Notice that this extra resistor improves the ripple performance under no load conditions, but induces higher ripple voltage when load is heavy.

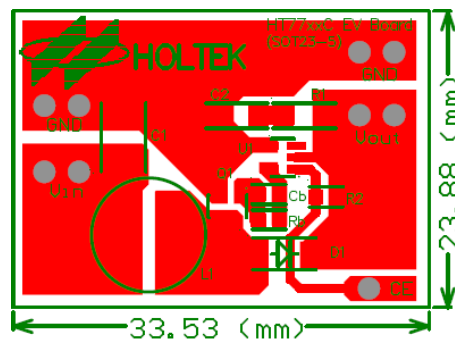
External Power Elements

Lower $R_{DS(ON)}$ of power elements gain better transferred efficiency. It's recommended to use ZXMN2B14FH or AFN2306A for the external MOSFETs and ZXTN25020CFH for the external Bipolar Junction Transistor.

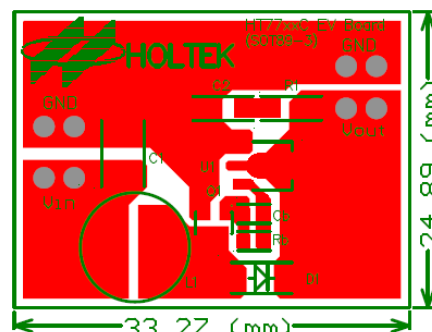
PCB Layout Suggestion

To reduce problems with conducted noise, there are some important points to note on the PCB layout.

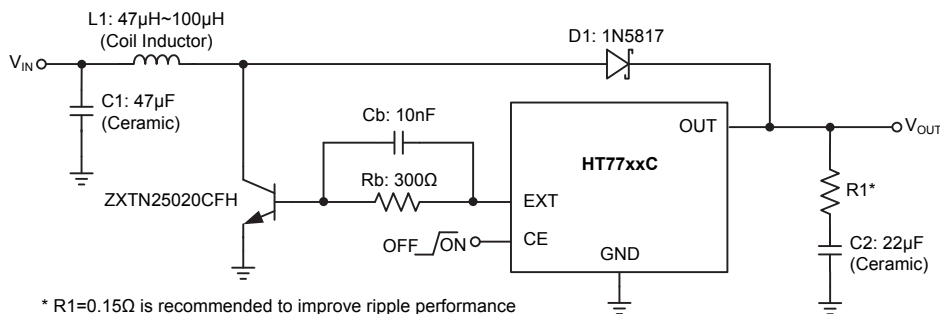
- The input bypass capacitor must be placed close to the VIN pin
- The inductor, schottky diode and output capacitor trace should be as short as possible to reduce conducted and radiated noise and increase overall efficiency.



SOT23-5 PCB Layout Example



SOT89 PCB Layout Example



Thermal Consideration

The maximum power dissipation depends upon the thermal resistance of the IC package, PCB layout, rate of surrounding airflow and difference between the junction and ambient temperature. The maximum power dissipation can be calculated by the following formula:

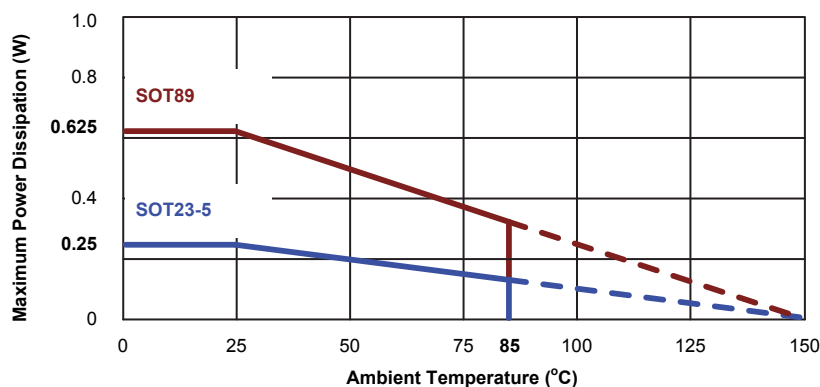
$$P_{D(MAX)} = (T_{J(MAX)} - T_a) / \theta_{JA} \dots \dots (W)$$

Where $T_{J(MAX)}$ is the maximum junction temperature, T_a is the ambient temperature and θ_{JA} is the junction to ambient thermal resistance.

For maximum operating rating conditions, the maximum junction temperature is 150°C. However, it's recommended that the maximum junction temperature does not exceed 125°C during normal operation to maintain high reliability. The de-rating curve of the maximum power dissipation is show below:

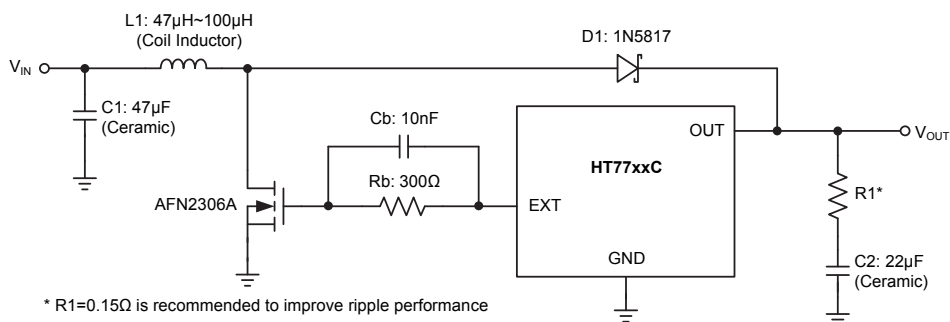
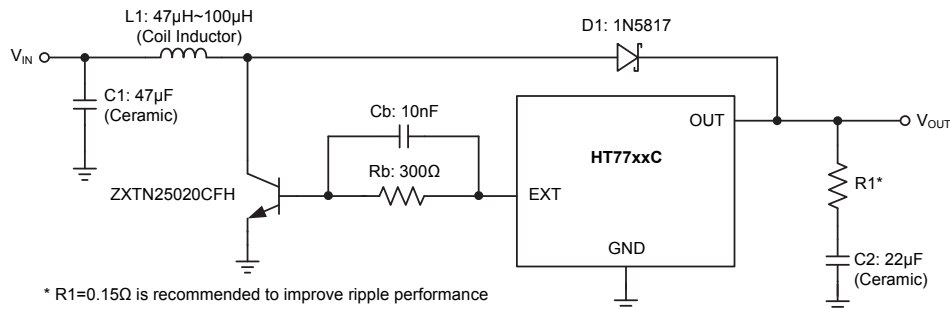
$$P_{D(MAX)} = (150^\circ\text{C} - 25^\circ\text{C}) / (500^\circ\text{C}/\text{W}) = 0.25\text{W}$$

For a fixed $T_{J(MAX)}$ of 150°C, the maximum power dissipation depends upon the operating ambient temperature and the package's thermal resistance, θ_{JA} . The de-rating curve below shows the effect of rising ambient temperature on the maximum recommended power dissipation.

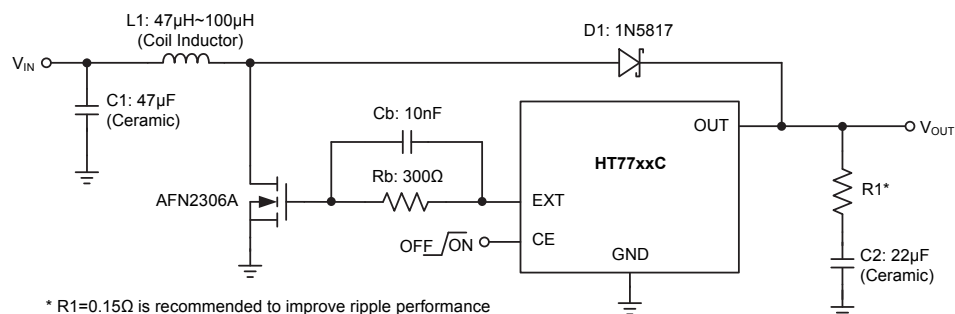
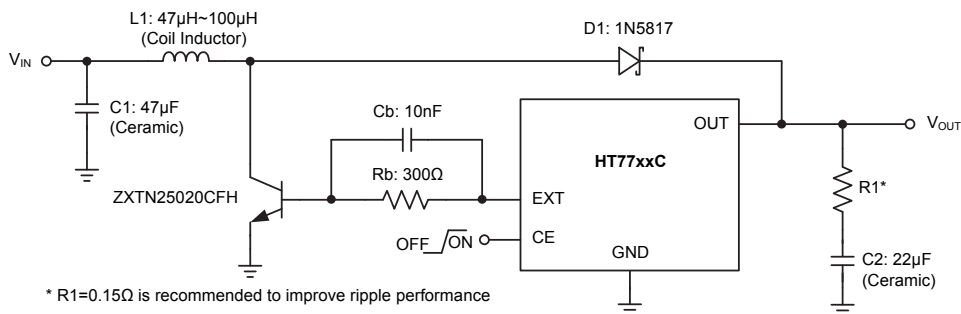


Application Circuits

Without CE Pin Application Circuits



With CE Pin Application Circuits



Note: 1. When $CE=0'$, the device internal circuits such as the bandgap reference, gain block and all feedback and control circuitry will be switched off.

2. When $CE=0'$, the output voltage, V_{OUT} , is almost equal to V_{IN} .

3. If the CE pin is not used, it should be externally connected to the OUT pin.

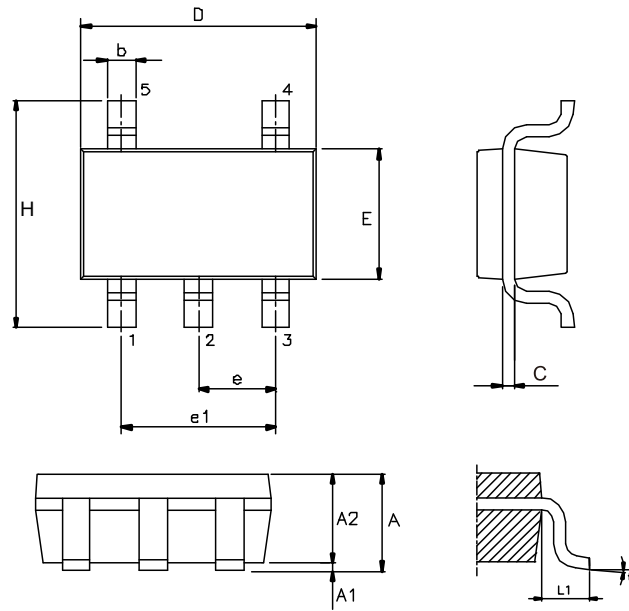
Package Information

Note that the package information provided here is for consultation purposes only. As this information may be updated at regular intervals users are reminded to consult the [Holtek website](#) for the latest version of the [package information](#).

Additional supplementary information with regard to packaging is listed below. Click on the relevant section to be transferred to the relevant website page.

- Further Package Information (include Outline Dimensions, Product Tape and Reel Specifications)
- Packing Materials Information
- Carton information

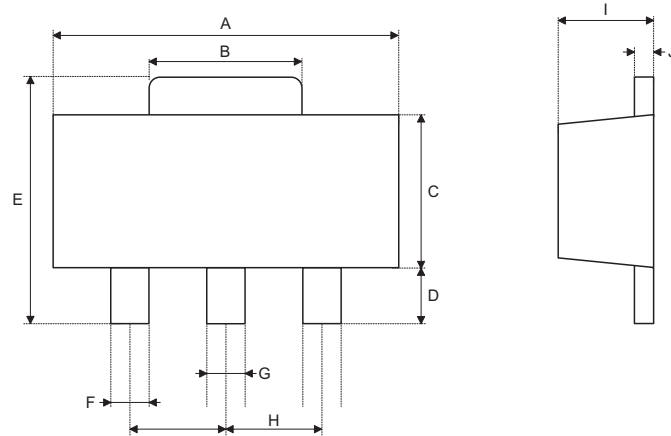
5-pin SOT23 Outline Dimensions



Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	—	0.057
A1	—	—	0.006
A2	0.035	0.045	0.051
b	0.012	—	0.020
C	0.003	—	0.009
D	—	0.114 BSC	—
E	—	0.063 BSC	—
e	—	0.037 BSC	—
e1	—	0.075 BSC	—
H	—	0.110 BSC	—
L1	—	0.024 BSC	—
θ	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	—	1.45
A1	—	—	0.15
A2	0.90	1.15	1.30
b	0.30	—	0.50
C	0.08	—	0.22
D	—	2.90 BSC	—
E	—	1.60 BSC	—
e	—	0.95 BSC	—
e1	—	1.90 BSC	—
H	—	2.80 BSC	—
L1	—	0.60 BSC	—
θ	0°	—	8°

3-pin SOT89 Outline Dimensions



Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	0.173	—	0.185
B	0.053	—	0.072
C	0.090	—	0.106
D	0.031	—	0.047
E	0.155	—	0.173
F	0.014	—	0.019
G	0.017	—	0.022
H	—	0.059 BSC	—
I	0.055	—	0.063
J	0.014	—	0.017

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	4.40	—	4.70
B	1.35	—	1.83
C	2.29	—	2.70
D	0.80	—	1.20
E	3.94	—	4.40
F	0.36	—	0.48
G	0.44	—	0.56
H	—	1.50 BSC	—
I	1.40	—	1.60
J	0.35	—	0.44

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