



**HT7627**

## **PFM Step-up DC/DC Converter & Voltage Detector**

### **Features**

- High output voltage accuracy:  $\pm 5\%$
- Low ripple and low noise
- Low start-up voltage  
(when the output current is 1mA): 0.95V
- Low current consumption: 14 $\mu$ A with 1.5V input (typ.)
- Fixed output voltage: 2.7V
- Built-in 2.1V (typ.) voltage detector
- 8-pin SOP package

### **Applications**

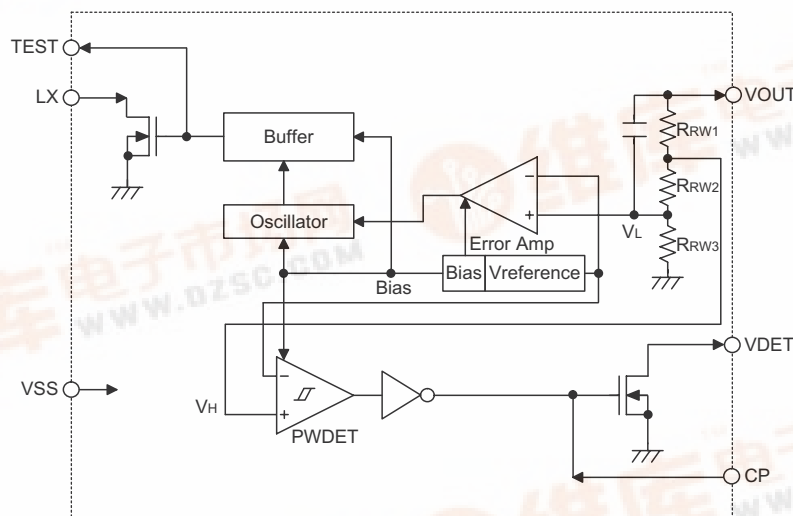
- Pager
- RF Mouse/Keyboard

### **General Description**

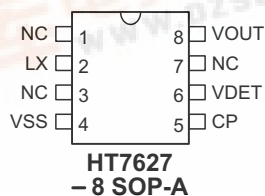
The HT7627 DC/DC converter with built in voltage detector is a high performance CMOS IC, suitable for use in battery-powered system application with low noise and low supply current. The HT7627 consists of two major parts, one is DC/DC converter and the other is voltage detector. The DC/DC converter part consists of reference voltage source, error amplifier, control transis-

tor, oscillation circuit and output voltage setting resistor. The voltage detector part consists of a high-precision and low power consumption standard voltage source, a comparator, hysteresis circuit and an output driver. As external parts, a coil, a diode, and a capacitor are available for obtaining a constant output (2.7V) higher than the input voltage for the DC/DC converter part.

### **Block Diagram**



### **Pin Assignment**



## Pin Description

Pin No.	Pin Name	I/O	Description
1, 3, 7	NC	—	No connection
2	LX	I	Switching pin
4	VSS	—	Negative power supply, ground
5	CP	I	External capacitor for adjusting VDET output delay time.
6	VDET	O	Voltage detector open drain output (needs a pull-high resistor)
8	VOUT	O	DC/DC converter voltage output

## Absolute Maximum Ratings

Supply Voltage .....	$V_{SS}-0.3V$ to $V_{SS}+6V$	Storage Temperature .....	$-40^{\circ}C$ to $125^{\circ}C$
Switching pin Voltage .....	$V_{SS}-0.3V$ to $V_{SS}+6V$	Operating Temperature .....	$-25^{\circ}C$ to $70^{\circ}C$
Power Consumption .....	150mW		

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## Electrical Characteristics

$T_a=25^{\circ}C$ ,  $V_{OUT}=2.7V$

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{OUT}$	Output Voltage	—	2.56	2.7	2.75	V
$V_{IN}$	Input Voltage	—	—	—	5	V
$V_{start}$	Starting Voltage	$L=330\mu H$ , $I_L=1mA$	—	0.95	1.1	V
$V_{hold}$	Voltage Hold	—	0.9	—	—	V
$I_{in}$	Current Consumption	Measure at no load	—	14	20	$\mu A$
$I_{LX}$	LX Switching Current	$V_{IN}=1.5V$	60	—	—	mA
$I_{LEAK}$	LX Leakage Current	—	—	—	1	$\mu A$
$f_{OSC}$	Oscillator Frequency	$V_{IN}=1.5V$	—	139	—	kHz
$V_{DET}$	H→L Detectable Voltage	—	2.0	2.1	2.2	V
	L→H Detectable Voltage	—	2.2	2.3	2.4	V
$V_{HYS}$	Hysteresis Width	—	—	0.2	—	V
$I_{DETOL}$	$V_{DET}$ Output Sink Current	$V_{OUT}=2.2V$ , $V_{DET}=0.2V$	0.5	—	—	mA

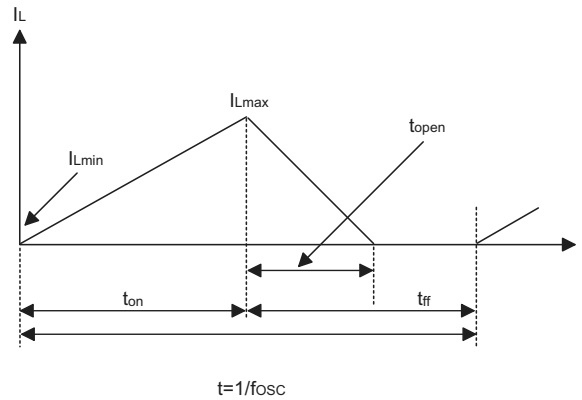
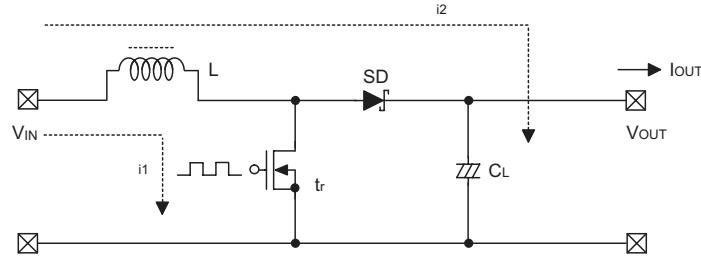
## Functional Description

### Operation of step-up DC/DC converter

The following figures show the basic circuit configuration of the step-up operation of the IC. In the configuration, when the transistor  $tr$  is entirely Off, the output voltage is the value of the input voltage  $V_{IN}$  minus the voltage reduced by inductor  $L$  and Schottky diode  $SD$ . When  $tr$  has been On for time  $t_{on}$  and is suddenly turned

Off, voltage  $V_L$  is generated at the edges of  $L$  because of the energy accumulated during the  $t_{on}$  period. Therefore, the peak value of the voltage generated at that time is  $V_{IN}+V_L$ , and it is stored in the output capacitor  $C_L$  via  $SD$ . This generates the step-up output voltage  $V_{OUT}$  that is larger than  $V_{IN}$ .

The operation will be explained with reference to the following diagrams:



Step1:  $t_r$  is turned ON and current  $I_L (=i_1)$  flows, so that energy is charged in L. At this moment,  $I_L (=i_1)$  is increased from  $I_{Lmin}$  to reach  $I_{Lmax}$  in proportion to the on-time period ( $t_{on}$ ) of  $t_r$ .

Step2: When  $t_r$  is turned OFF, Schottky diode (SD) is turned ON in order that L maintains  $I_L$  at  $I_{Lmax}$ , so that current  $I_L (=i_2)$  is released.

Step3:  $I_L (=i_2)$  is gradually decreased,  $I_L$  reaches  $I_{Lmin}$  after a time period of  $t_{open}$ , so that SD is turned OFF.  $t_r$  will be turned ON in the next cycle.

In the case of PWM control system, the output voltage is maintained constant by controlling the on-time period ( $t_{on}$ ), with the oscillator frequency ( $f_{OSC}$ ) being maintained constant.

#### Voltage detector operation

The HT7627 built-in voltage detector is equipped with a high stability voltage reference which is connected to the negative of a comparator — denoted as  $V_{ref}$  in the following figure for NMOS output voltage detector.

When the voltage drop to the positive input of the comparator (i.e.  $V_B$ ) is higher than  $V_{ref}$ ,  $V_{OUT}$  goes high, and  $V_B$  is expressed as  $V_{BH} = V_{DD} \times (R_B + R_C) / (R_A + R_B + R_C)$ . If  $V_{DD}$  is decreased so that  $V_B$  falls to a value less than  $V_{ref}$ , the comparator output inverts from high to low,  $V_{OUT}$  goes low,  $V_C$  is high, RC is bypassed, and  $V_B$  becomes:  $V_{BL} = V_{DD} \times R_B / (R_A + R_B)$ , which is less than  $V_{BH}$ . By so doing, the comparator output will remain low to prevent the circuit from oscillating when  $V_B \approx V_{ref}$ .

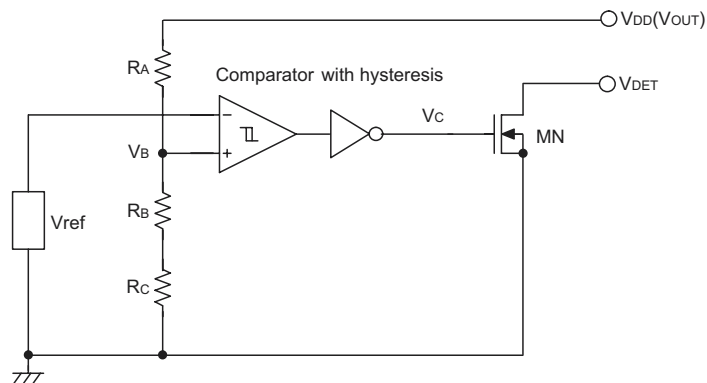
If  $V_{DD}$  falls below the minimum operating voltage, the output becomes undefined. When  $V_{DD}$  goes from low to  $V_{DD} \times R_B / (R_A + R_B) > V_{ref}$ , the comparator output and  $V_{OUT}$  goes high. The detectable voltage is defined as:

$$V_{DETECT} (-) = \frac{R_A + R_B + R_C}{R_B + R_C} \times V_{ref}$$

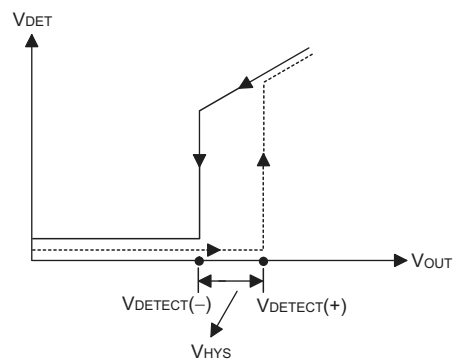
The release voltage is defined as:

$$V_{DETECT} (+) = \frac{R_A + R_B + R_C}{R_B} \times V_{ref}$$

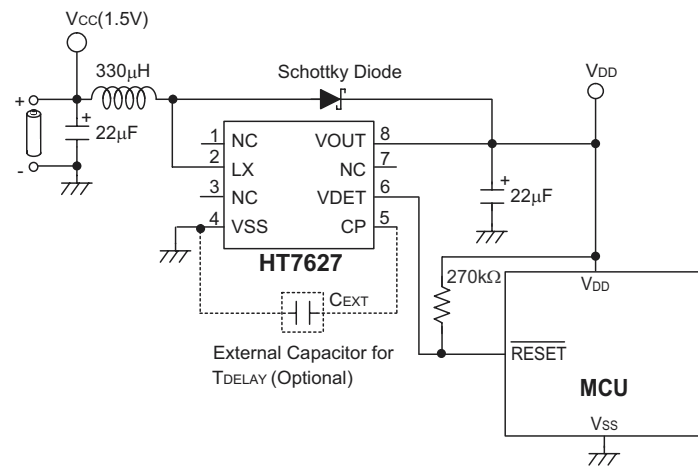
The hysteresis width is  $V_{HYS} = V_{DETECT(+)} - V_{DETECT(-)}$



The following figure shows the hysteresis effect according to the previous figure.



## Application Circuits



**Holtek Semiconductor Inc. (Headquarters)**

No.3, Creation Rd. II, Science-based Industrial Park, Hsinchu, Taiwan  
Tel: 886-3-563-1999  
Fax: 886-3-563-1189  
<http://www.holtek.com.tw>

**Holtek Semiconductor Inc. (Sales Office)**

11F, No.576, Sec.7 Chung Hsiao E. Rd., Taipei, Taiwan  
Tel: 886-2-2782-9635  
Fax: 886-2-2782-9636  
Fax: 886-2-2782-7128 (International sales hotline)

**Holtek Semiconductor (Hong Kong) Ltd.**

RM.711, Tower 2, Cheung Sha Wan Plaza, 833 Cheung Sha Wan Rd., Kowloon, Hong Kong  
Tel: 852-2-745-8288  
Fax: 852-2-742-8657

**Holtek Semiconductor (Shanghai) Inc.**

7th Floor, Building 2, No.889, Yi Shan Rd., Shanghai, China  
Tel: 021-6485-5560  
Fax: 021-6485-0313  
<http://www.holtek.com.cn>

**Holmate Technology Corp.**

48531 Warm Springs Boulevard, Suite 413, Fremont, CA 94539  
Tel: 510-252-9880  
Fax: 510-252-9885  
<http://www.holmate.com>

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