

# 1.5MHz Dual 1.2A Synchronous Step-Down Converter

## FEATURES

- High Efficiency: Up to 96%
- 1.5MHz Constant Frequency Operation
- 1.2A Output Current
- No Schottky Diode Required
- 2.3V to 6V Input Voltage Range
- Output Voltage as Low as 0.6V
- PFM for High Efficiency in Light Load
- 100% Duty Cycle in Dropout Operation
- Low Quiescent Current: 40 $\mu$ A
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- Input overvoltage protection(OVP)
- <1 $\mu$ A Shutdown Current

## APPLICATIONS

- Cellular and Smart Phones
- Wireless and DSL Modems
- PDAs
- Portable Instruments
- Digital Still and Video Cameras
- PC Cards

## GENERAL DESCRIPTION

The STI8021 is a 1.5MHz constant frequency current mode, dual high-efficiency PWM step-down converter. It is ideal for portable equipment requiring very high current up to 1.2A each channel from single-cell Lithium-ion batteries while still achieving over 90% efficiency during peak load conditions. The STI8021 also can run at 100% duty cycle for low dropout operation, extending battery life in portable systems while light load operation provides very low output ripple for noise sensitive applications. The STI8021 can supply up to 1.2A output load current each channel from a 2.5V to 5.5V input voltage and the output voltage can be regulated as low as 0.6V. The high switching frequency minimizes the size of external components while keeping switching losses low. The internal slope compensation setting allows the device to operate with smaller inductor values to optimize size and provide efficient operation. The STI8021 is available in adjustable (0.6V to VIN). The device is available in a Pb-free, DFN3\*3-10 package and is rated over the -40°C to +85°C temperature range. Operation modes, PWM control and PFM Mode switching control, allow a high efficiency over the wider range of the load.

## TYPICAL APPILICATION

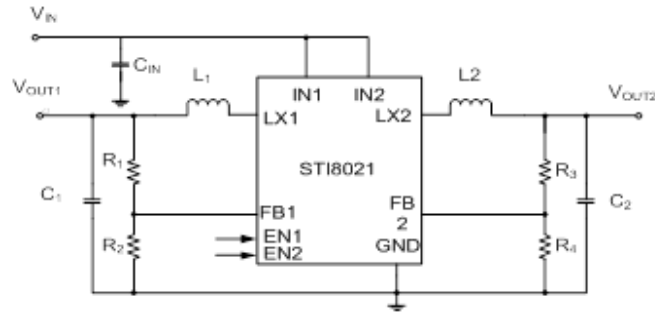
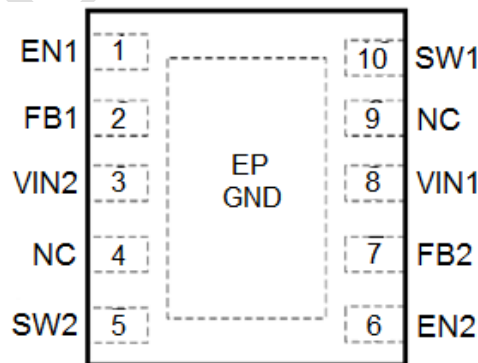


Figure 1. Basic Application Circuit

## ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
Input Supply Voltage	-0.3~6.3	V
LX Voltages	-0.3~6.5	V
EN,FB Voltage	-0.3~6.5	V
Junction Temperature(Note2)	155	°C
Power Dissipation	600	mW
Lead Temperature(Soldering,10s)	260	°C

## PACKAGE/ORDER INFORMATION



DFN3\*3-10

Top Mark: S8021 YYXXX

Part Number	Package	Top mark	Quantity/ Reel
STI8021	SOT23-6	S8021 YYXXX	3000

**PIN FUNCTIONS**

Pin	Name	Function
1	EN1	Enable Input
2	FB1	Feedback
3	VIN2	Power Input
4	NC	
5	SW/LX2	Power Switching Output
6	EN2	Enable Input
7	FB2	Feedback
8	VIN1	Power Input
9	NC	
10	SW/LX1	Power Switching Output

**ESD RATING**

Items	Description	Value	Unit
$V_{ESD}$	Human Body Model for all pins	±2000	V

**JEDEC specification JS-001**
**RECOMMENDED OPERATING CONDITIONS**

Items	Description	Min	Max	Unit
Voltage Range	IN	2.5	5.5	V
TA	Operating Temperature Range	-40	85	°C

## ELECTRICAL CHARACTERISTICS (Note 3)

( $V_{IN}=V_{EN}=3.6V$ ,  $V_{OUT}=1.8V$ ,  $L=2.2\mu H$ ,  $C_{in}=4.7\mu F$ ,  $C_{out}=10\mu F$ ,  $T_A = 25^\circ C$ , unless otherwise noted.)

Parameter	Conditions	Min	Typ	Max	Unit
<b>Channel1 / Channel2</b>					
Input Voltage Range $V_{INx}$		2.5		5.5	V
Input OVP			6.3		V
UVLO Threshold			2.2		V
Input DC Supply Current	(Note 4)				$\mu A$
PWM Mode	$V_{out} = 90\%$ , $I_{Load}=0mA$		150	300	$\mu A$
PFM Mode	$V_{out} = 105\%$ , $I_{Load}=0mA$		40	75	$\mu A$
Shutdown Mode	$V_{EN} = 0V$ , $V_{IN}=4.2V$		0.1	1.0	$\mu A$
Regulated Feedback Voltage $V_{FBx}$	$T_A = 25^\circ C$	0.588	0.600	0.612	V
	$T_A = 0^\circ C \leq T_A \leq 85^\circ C$	0.586	0.600	0.613	V
	$T_A = -40^\circ C \leq T_A \leq 85^\circ C$	0.585	0.600	0.615	V
Reference Voltage Line Regulation	$V_{in}=2.5V$ to $5.5V$		0.1		%/V
Output Voltage Accuracy	$V_{IN} = 2.5V$ to $5.5V$ , $I_{out}=10mA$ to $2000mA$	-3		+3	% $V_{out}$
Output Voltage Load Regulation	$I_{out}=10mA$ to $2000mA$		0.2		%/A
Oscillation Frequency	$V_{out}=100\%$		1.5		MHz
	$V_{out}=0V$		300		KHz
On Resistance of PMOS	$I_{SW}=100mA$		300		$m\Omega$
On Resistance of NMOS	$I_{SW}=-100mA$		150		$m\Omega$
Peak Current Limit	$V_{IN}= 3.6V$ , $V_{out}=1.8V$	1.5			A
EN Threshold		0.30	1.0	1.50	V
EN Leakage Current			$\pm 0.01$	$\pm 1.0$	$\mu A$
SW Leakage Current	$V_{ENx}=0V$ , $V_{INx}=V_{sw}=5V$		$\pm 0.01$	$\pm 1.0$	$\mu A$

**Note 1: Absolute Maximum Ratings** are those values beyond which the life of a device may be impaired.

**Note 2:**  $T_J$  is calculated from the ambient temperature  $T_A$  and power dissipation  $P_D$  according to the following formula:  $T_J = T_A + (P_D) \times (250^\circ C/W)$ .

**Note 3:** 100% production test at  $+25^\circ C$ . Specifications over the temperature range are guaranteed by design and characterization.

**Note 4:** Dynamic supply current is higher due to the gate charge being delivered at the switching frequency

## OPERATION

The STI8021 is a dual high output current monolithic switch mode step-down DC-DC converter. The device operates at a fixed 1.5MHz switching frequency, and uses a slope compensated current mode architecture. This step-down DC-DC converter can supply up to dual respective 1200mA output current at  $V_{IN} = 3.6V$  and has an input voltage range from 2.5V to 5.5V. It minimizes external component size and optimizes efficiency at the heavy load range. The slope compensation allows the device to remain stable over a wider range of inductor values so that smaller values ( $2.0\mu H$  to  $10\mu H$ ) with lower DCR can be used to achieve higher efficiency. Only a small bypass input capacitor is required at the output. The adjustable version can be programmed with external feedback to any voltage, ranging from 0.6V to nearly the input voltage. It uses internal MOSFETs to achieve high efficiency and can generate very low output voltages by using an internal reference of 0.6V. At dropout, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the low  $R_{DS(ON)}$  drop of the P-channel high-side MOSFET and the inductor DCR. The internal error amplifier and compensation provides excellent transient response, load and line regulation. Internal soft start eliminates any output voltage overshoot when the enable or the input voltage is applied.

## FUNCTIONAL BLOCK DIAGRAM

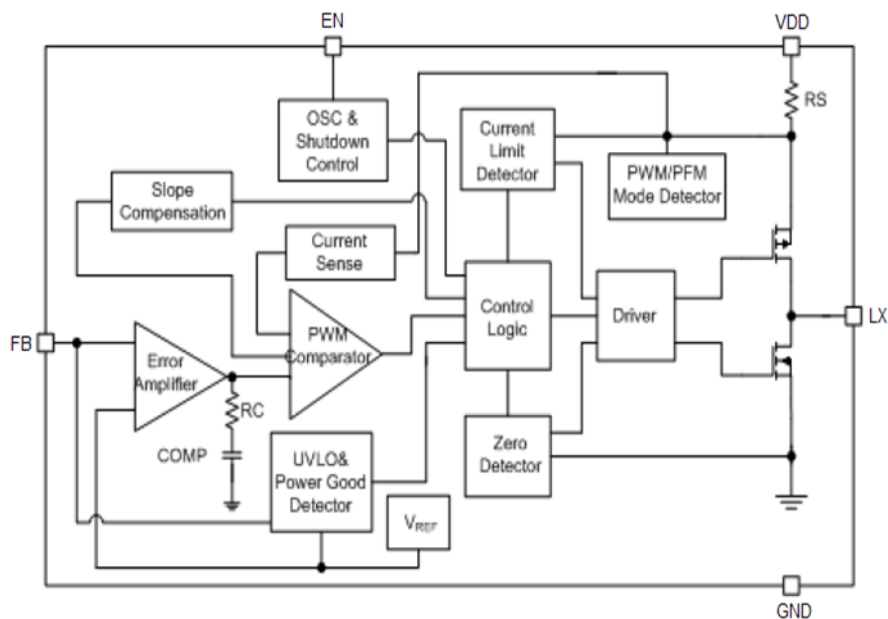


Figure 2. STI8021 Block Diagram

## APPLICATION INFORMATION

### Setting the Output Voltage

Figure 1 shows the basic application circuit for the STI8021. The STI8021 can be externally programmed. Resistors R1 and R2 in Figure 1 program the output to regulate at a voltage higher than 0.6V. To limit the bias current required for the external feedback resistor string while maintaining good noise immunity, the minimum suggested value for R2 is 59kΩ. Although a larger value will further reduce quiescent current, it will also increase the impedance of the feedback node, making it more sensitive to external noise and interference. Table 1 summarizes the resistor values for various output voltages with R2 set to either 59kΩ for good noise immunity or 316kΩ for reduced no load input current.

The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 0.6 \times \left(1 + \frac{R_1}{R_2}\right)$$

$$R_1 = (V_{OUT} / 0.6 - 1) \times R_2$$

### Inductor Selection

For most designs, the STI8021 operates with inductors of 2.0μH to 10μH. Low inductance values are physically smaller but require faster switching, which results in some efficiency loss. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where  $\Delta I_L$  is inductor Ripple Current. Large value inductors result in lower ripple current and small value inductors result in high ripple current. For optimum voltage-positioning load transients, choose an inductor with DC series resistance in the 50mΩ to 150mΩ range.

### Input Capacitor Selection

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 should be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 22μF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

### Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching

frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple  $\Delta V_{OUT}$  is determined by:

$$\Delta V_{OUT} \leq \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left( ESR + \frac{1}{8 \times f_{osc} \times C3} \right)$$

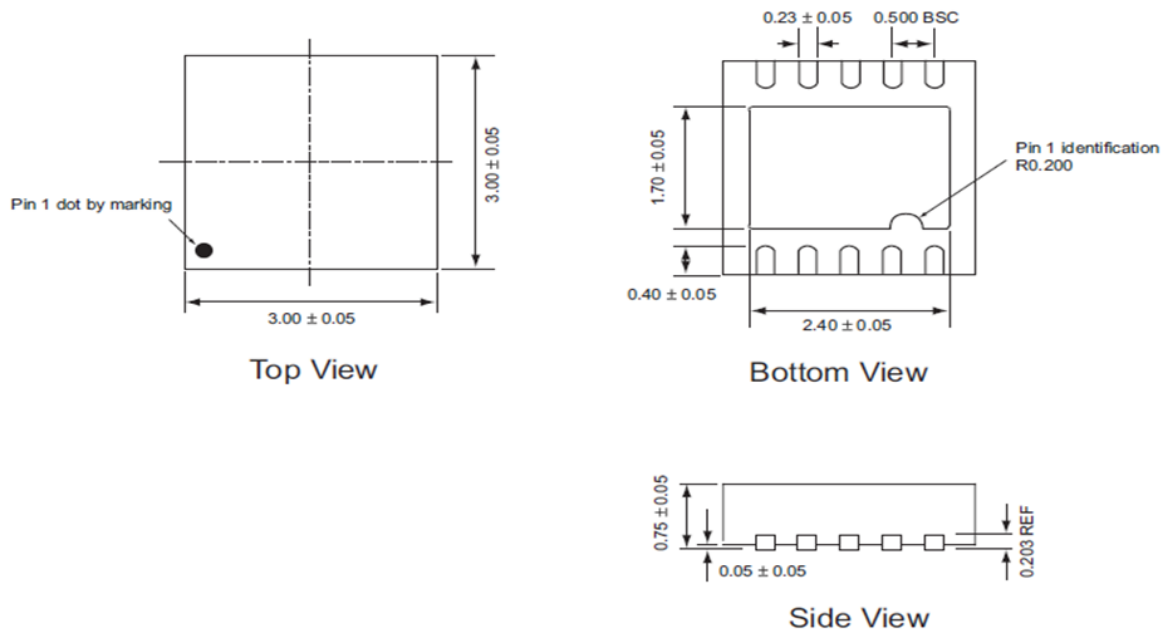
A 22 $\mu$ F ceramic can satisfy most applications.

### Layout Consideration

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the STI8021. Check the following in your layout:

1. The power traces, consisting of the GND trace, the LX trace and the VIN trace should be kept short, direct and wide.
2. Does the (+) plates of Cin connect to Vin as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
3. Keep the switching node, LX, away from the sensitive VOUT node.
4. Keep the (-) plates of Cin and Cout as close as possible

## PACKAGE INFORMATION



DFN3\*3-10

### Note:

- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading top mark from left to right,