Application Note: SY7070/SY7070A

0.7V Minimum Input, Fixed Output 100mA Maximum Output Current Synchronous Boost

General Description

SY7070/A is a high efficiency, synchronous, current hysteresis control; step-up boost converter designed for single-cell or dual-cell alkaline, NiMH, or NiCd battery-powered applications. It can convert down to 0.7V input voltage. It adopts NMOS for the main switch and PMOS for the synchronous switch.

Ordering Information

SY7070 □(□□)□

- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY7070AAC	SOT23-5	V_{OUT}=3.3V
SY7070AAAC	SOT23-5	V_{OUT}=3.0V

Features

- 0.7V Minimum input voltage
- 5.5uA typical quiescent current
- Input under-voltage lockout
- Bypass function during shutdown
- Low $R_{DS(ON)}$ (main switch/synchronous switch) at output: 0.5/0.7ohm
- Fixed output voltage
  - SY7070: fixed 3.3V
  - SY7070A: fixed 3.0V
- Typical 350mA peak current limit
- Compact SOT23-5 package.

Applications

- Battery powered applications
- Consumer and portable medical products
- Personal care products
- Smartphones
- White or status LEDs

Typical Applications

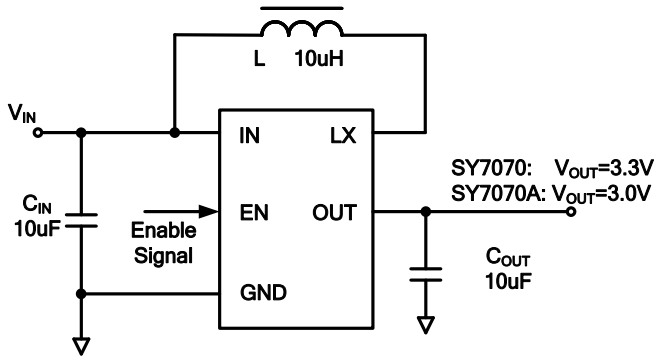
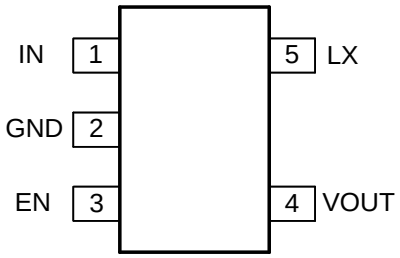


Figure 1. Schematic Diagram

Pinout (top view)



(SOT23-5)

Top mark: SY7070：**RQ*xyz*** (Device code: RQ, ***x=year code, y=week code, z= lot number code***)

SY7070A：**TY*xyz*** (Device code: TY, ***x=year code, y=week code, z= lot number code***)

Name	Number	Description
IN	1	Input pin. Decouple this pin to GND pin with 10uF ceramic cap.
GND	2	Ground pin.
VOUT	4	Output pin. Decouple this pin to GND pin with a minimum of 10uF ceramic cap. SY7070, fixed 3.3V; SY7070A, fixed 3.0V.
LX	5	Inductor node. Connect an inductor between IN pin and LX pin.
EN	3	Enable pin. Pull it high to turn on or pull it low to shut down the part. Do not leave it floating.

Absolute Maximum Ratings (Note 1)

All Pins to GND---------- 6V

Power Dissipation, P_D @ T_A = 25℃ SOT23-5 ---------- 0.6W

Package Thermal Resistance (Note 2)

θ_{JA} ---------- 161℃/W

θ_{JC} ---------- 130℃/W

Junction Temperature Range ---------- 150℃

Lead Temperature (Soldering, 10 sec.) ---------- 260℃

Storage Temperature Range ---------- -65℃ to 150℃

Recommended Operating Conditions (Note 3)

IN ---------- 0.7V to 5.0V

EN ---------- 0V to V_{OUT}+0.3V

All other pins ---------- 0-5.0V

Junction Temperature Range ---------- -40℃ to 125℃

Ambient Temperature Range ---------- -40℃ to 85℃

Electrical Characteristics

(V_{IN} =1.2V, V_{OUT}=3.3V, I_{OUT}=10mA, T_A = 25℃ unless otherwise specified)

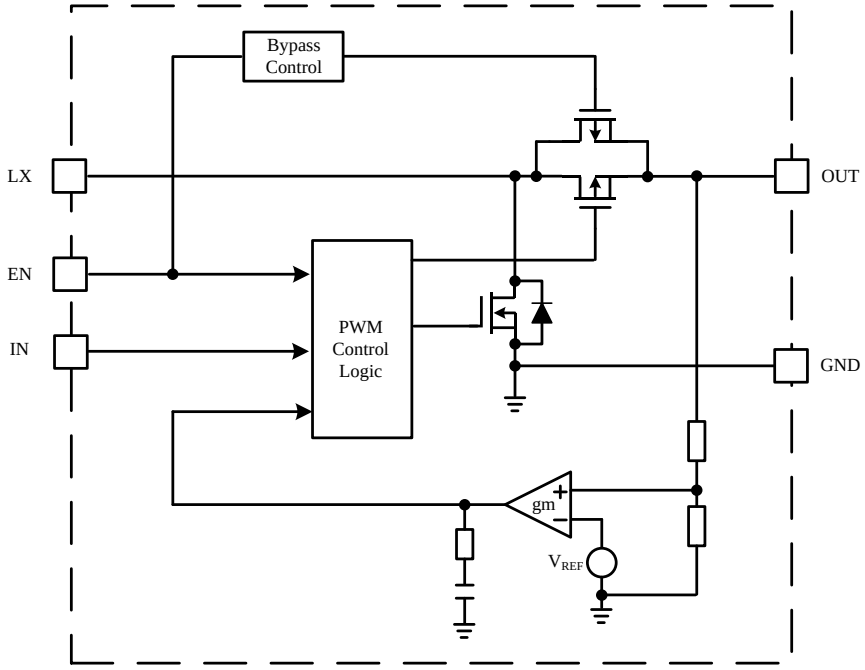
Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage		V_{IN}		0.7		5.0	V
Minimum V_{IN} at start-up		V_{START}			0.75		V
Quiescent Current	V_{IN}	IQ	Io=0mA,V_{EN}=V_{IN}=1.2V,		0.5		μA
	V_{OUT}		V_{OUT}=3.4V		5.5		
Shut Down Current		I_{SHDN}	V_{EN}=0V, V_{IN}=3.0V			1	μA
EN Rising Threshold		V_{ENH}	V_{IN}≤1.6	0.75xV_{IN}			V
			1.6<V_{IN}<5.0	1.2			V
EN Falling Threshold		V_{ENL}	V_{IN}≤1.6			0.2×V_{IN}	V
			1.6<V_{IN}<5.0			0.32	V
Low Side Main FET R_{ON}		$R_{DS(ON)1}$	V_{OUT}=3.3V		0.5		Ω
Synchronous FET R_{ON}		$R_{DS(ON)2}$	V_{OUT}=3.3V		0.7		Ω
Main FET Current Limit		I_{LIM}		300	350		mA
Output Voltage		V_{OUT}	SY7070	3.201	3.3	3.399	V
			SY7070A	2.901	3.0	3.099	V
Thermal Shutdown Temperature		T_{SD}			150		℃
Thermal Shutdown Hysteresis		T_{HYS}			20		℃
Under Voltage Lockout For Turn Off Protection		V_{UVLO}	V_{IN} decreasing		0.6		V

Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

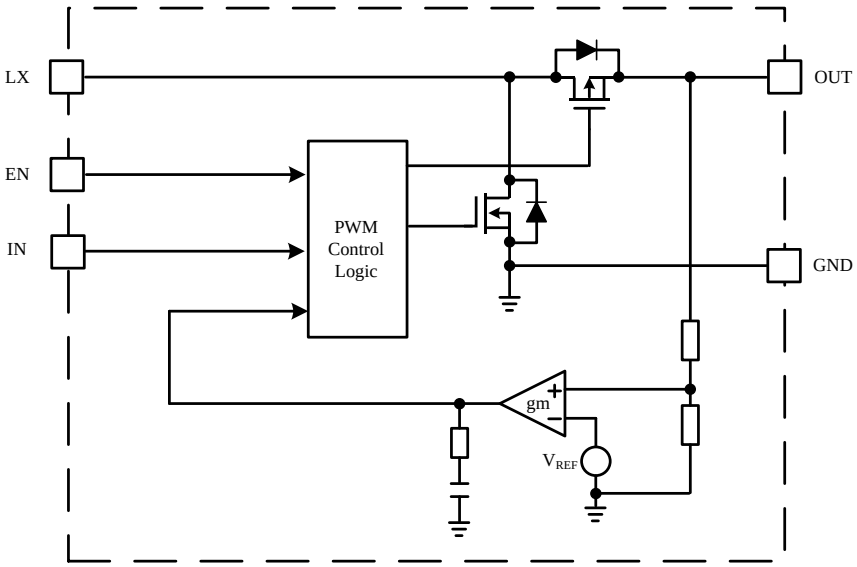
Note 2: θJA is measured in the natural convection at T_A = 25℃ on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. Test condition: Device mounted on 2" x 2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad on top layer and thermal vias to bottom layer ground plane.

Note 3: The device is not guaranteed to function outside its operating conditions.

Function Block



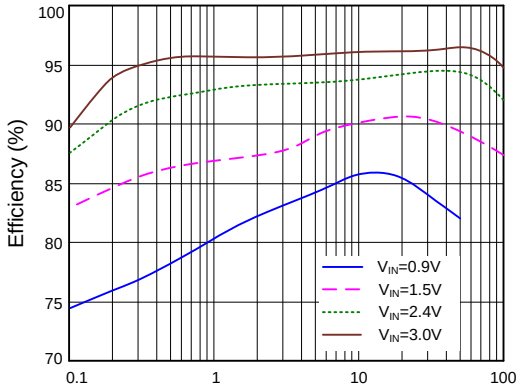
(SY7070)



(SY7070A)

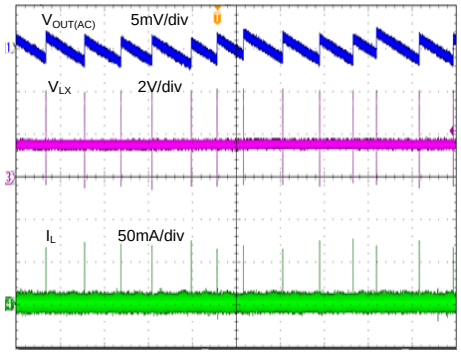
Typical Performance Characteristics (for SY7070)

Efficiency vs. Load Current



Steady State

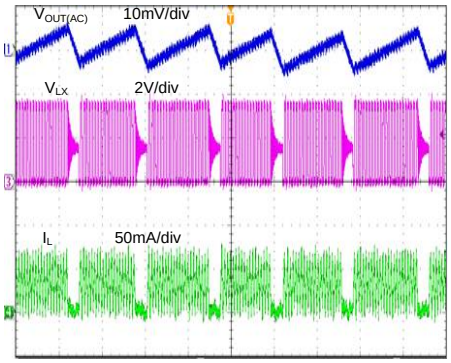
(V_{IN}=1.5V, V_{OUT}=3.3V, Null Load)



Time (2ms/div)

Steady State

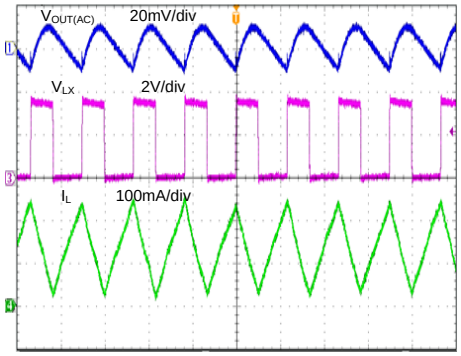
(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=10mA)



Time (10μs/div)

Steady State

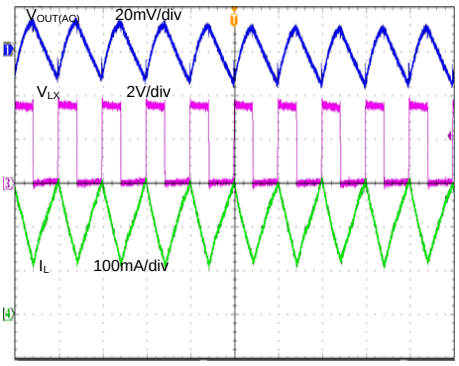
(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=50mA)



Time (2μs/div)

Steady State

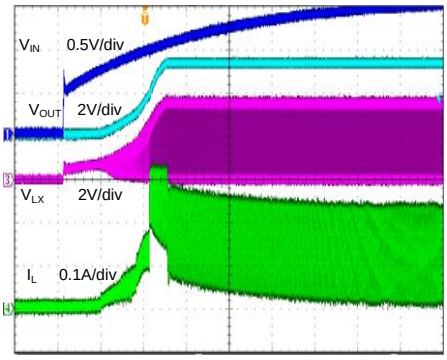
(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=80mA)



Time (2μs/div)

Startup from V_{IN}

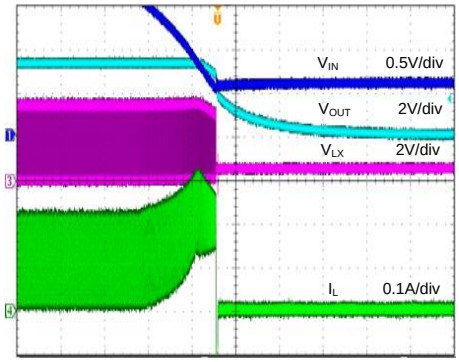
(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=50mA)



Time (800μs/div)

Shutdown from V_{IN}

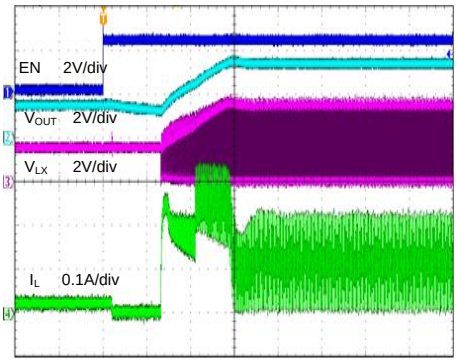
(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=50mA)



Time (800μs/div)

Startup from Enable

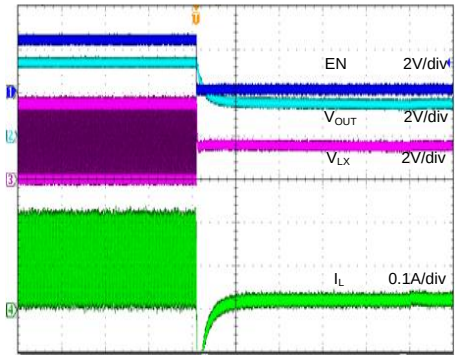
(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=50mA)



Time (100μs/div)

Shutdown from Enable

(V_{IN}=1.5V, V_{OUT}=3.3V, I_{LOAD}=50mA)



Time (200μs/div)

Applications Information

SY7070/A is a high efficiency, low input voltage, step-up synchronous boost converter designed for single-cell or dual-cell alkaline, NiMH, or NiCd battery-powered applications. It adopts NMOS for the main switch and PMOS for the synchronous switch.

Input capacitor CIN:

To minimize the potential noise problem, place a typical X5R or better grade ceramic capacitor really close to the IN and GND pins. Care should be taken to minimize the loop area formed by CIN, and IN/GND pins. In this case, a 10uF low ESR ceramic capacitor is recommended to improve transient behavior of the regulator and EMI behavior of the total power supply circuit.

Output capacitor COUT:

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X5R or better grade ceramic capacitor with 6.3V rating and greater than 10uF capacitance.

Inductor L:

A proper inductor must be connected between Pin VIN and Pin LX for the SY7070/A stable operation. 4.7uH inductor value is strongly recommended.

Choosing inductance values will affect the switching frequency f proportional to 1/L as show in below equation:

$$L = \frac{1}{f \times 200mA} \times \frac{V_{IN} \times (V_{OUT} - V_{IN})}{V_{OUT}}$$

Bypass switch:

SY7070 internal integrates a Bypass Switch in parallel with the synchronous rectifying PMOS. When the IC is enabled, the Bypass Switch will be turned off to allow the IC to work as a standard boost regulator. When the IC is disabled, the Bypass Switch will be turned on to provide a direct, low impedance connection from the input voltage to the load. The Bypass Switch is not impacted by under-voltage lockout, overvoltage or thermal shutdown.

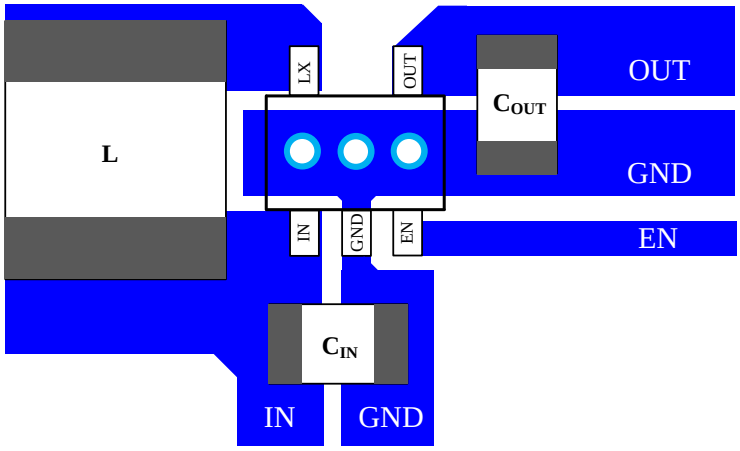
Recommended PCB Layout:

For the best efficiency and minimum noise problems, we should place the following components close to the IC: CIN, COUT，L.

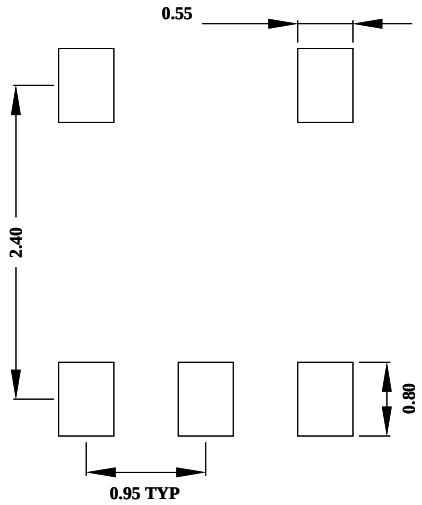
1) It is desirable to maximize the PCB copper area connecting to GND pin to achieve the best thermal and noise performance. If the board space allowed, a ground plane is highly desirable.

2) COUT must be close to Pins OUT and GND. The loop area formed by C_{OUT} and GND must be minimized.

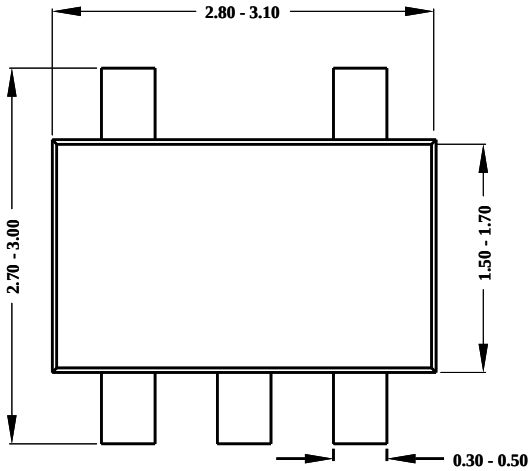
3) The PCB copper area associated with LX pin must be minimized to avoid the potential noise problem.

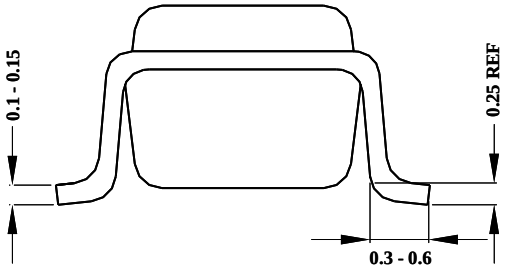


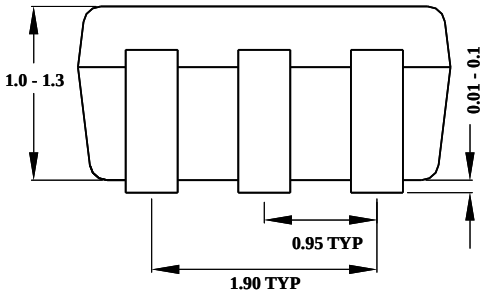
SOT23-5 Package outline & PCB layout design



Recommended Pad Layout



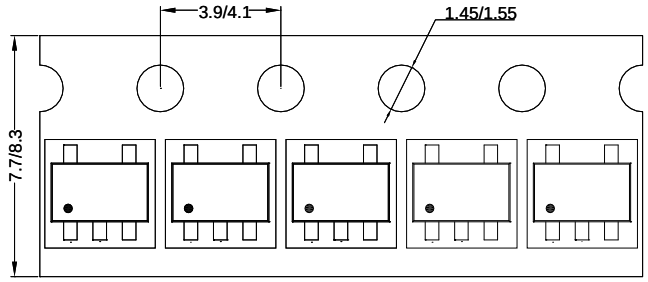




Notes: All dimensions are in millimeters.
All dimensions don't include mold flash & metal burr.

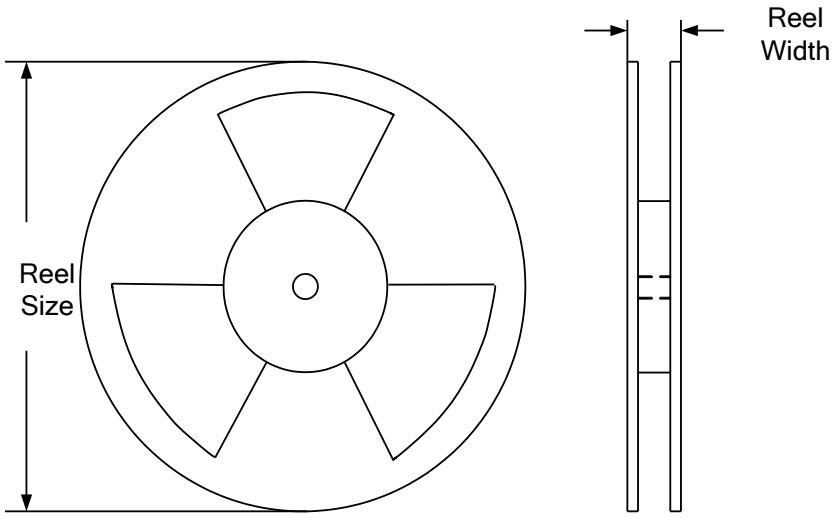
Taping & Reel Specification

1. SOT23-5 taping orientation



Feeding direction ⟶

2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Reel width(mm)	Trailer length(mm)	Leader length (mm)	Qty per reel
SOT23-5	8	4	7"	8.4	280	160	3000

3. Others: NA

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