

**SILERGY**

Application Note: SY98081/A/B/C/D/E/F

High Efficiency 3MHz, 0.6A**Inductor Built-in Synchronous Step Down Regulator****Preliminary Specification**

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General Description

SY98081/A/B/C/D/E/F are 3MHz, 0.6A synchronous step-down converters which integrates an inductor and a control IC in one tiny package (2.0mm×1.5mm, H=1.0mm). It can operate over a wide input voltage range from 2.5V to 5.5V and integrate main switch and synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss.

Ordering Information

SY98081□(□□)□
 □ Temperature Code
 □ Package Code
 □ Optional Spec Code

Ordering Number	Package	Note
SY98081QUC	QFN2×1.5-8	V_{OUT} Adjustable
SY98081AUC	QFN2×1.5-8	Fixed 1.2V _{OUT}
SY98081BUC	QFN2×1.5-8	Fixed 1.5V _{OUT}
SY98081CUC	QFN2×1.5-8	Fixed 1.8V _{OUT}
SY98081DUC	QFN2×1.5-8	Fixed 2.5V _{OUT}
SY98081EUC	QFN2×1.5-8	Fixed 3.3V _{OUT}
SY98081FUC	QFN2×1.5-8	Fixed 1.0V _{OUT}

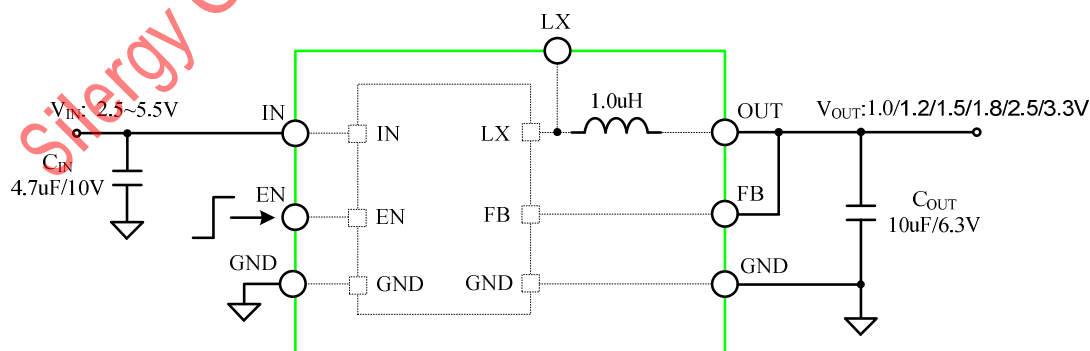
Features

- Low $R_{DS(ON)}$ for internal switches (top/bottom) 230mΩ/150mΩ
- Integrate an inductor to minimizes the external components and PCB layout design
- 2.5~5.5V input voltage range
- Output voltage:
 - SY98081: Output voltage adjustable
 - SY98081A: Fixed 1.2V_{OUT}
 - SY98081B: Fixed 1.5V_{OUT}
 - SY98081C: Fixed 1.8V_{OUT}
 - SY98081D: Fixed 2.5V_{OUT}
 - SY98081E: Fixed 3.3V_{OUT}
 - SY98081F: Fixed 1.0V_{OUT}
- High switching frequency 3MHz minimizes the external components
- Internal soft-start limits the inrush current
- 100% dropout operation
- RoHS Compliant and Halogen Free
- Output auto discharge function
- Compact package: QFN2x1.5-8

Applications

- Mobile phone, Smart phone
- Bluetooth Headsets
- WiMAX PDA, MID, UMPC
- Portable game console
- Digital camera, Camcorder

Typical Applications

**Figure1. Schematic Diagram (For SY98081A/B/C/D/E/F)**

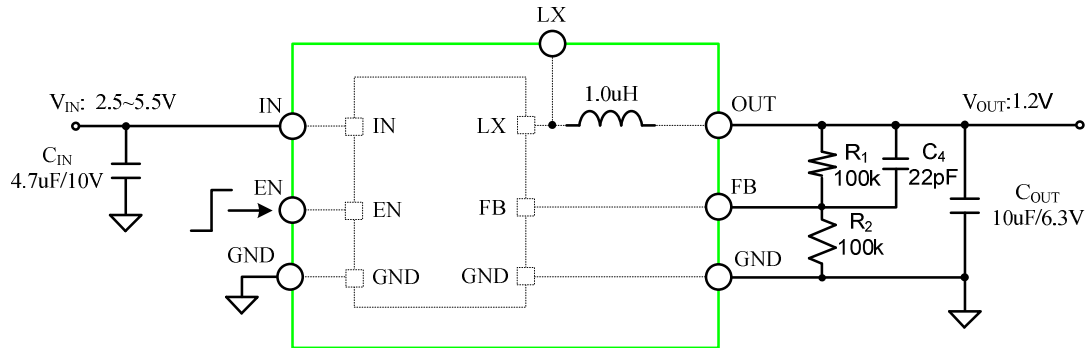
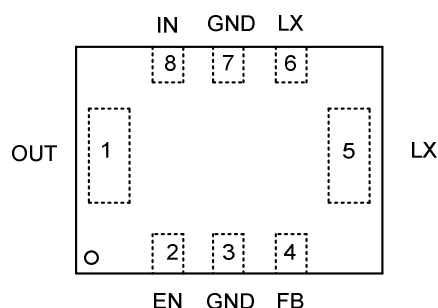


Figure2. Schematic Diagram (For SY98081)



SY98081/A/B/C/D/E/F

Pinout (Top View)



Top Mark: YGxyz for SY98081 (device code: YG, x=year code, y=week code, z=lot number code)
 UMxyz for SY98081A (device code: UM, x=year code, y=week code, z=lot number code)
 UNxyz for SY98081B (device code: UN, x=year code, y=week code, z=lot number code)
 TPxyz for SY98081C (device code: TP, x=year code, y=week code, z=lot number code)
 UOxyz for SY98081D (device code: UO, x=year code, y=week code, z=lot number code)
 UPxyz for SY98081E (device code: UP, x=year code, y=week code, z=lot number code)
 UQxyz for SY98081F (device code: UQ, x=year code, y=week code, z=lot number code)

Pin Name	Pin Number	Pin Description	
OUT	1	Output Pin. Decouple this pin to ground with at least 4.7uF ceramic cap.	
EN	2	Enable control. Pull high to turn on. Do not float.	
GND	3, 7	Ground pin.	
FB	4	SY98081	Output adjustable version. Connect this pin to the center point of the output resistor divider to program the output voltage: $V_{OUT}=0.6 \times (1+R_1/R_2)$.
		SY98081A/B/C/D/E/F	Fixed output version. Connect this pin to the output for the output voltage regulation.
LX	5, 6	Built-in inductor node. Leave it floating.	
IN	8	Input pin. Decouple this pin to GND pin with at least 4.7uF ceramic cap.	

Absolute Maximum Ratings (Note 1)

Supply Input Voltage, LX, OUT pins ----- 6.0V
 Enable, FB Voltage ----- $V_{IN} + 0.6V$
 Power Dissipation, P_D @ $T_A = 25^\circ C$,
 QFN2x1.5-8 ----- TBD
 Package Thermal Resistance (Note 2)
 θ_{JA} ----- TBD
 θ_{JC} ----- TBD
 Junction Temperature Range ----- $-150^\circ C$
 Lead Temperature (Soldering, 10 sec.) ----- $260^\circ C$
 Storage Temperature Range ----- $-65^\circ C$ to $150^\circ C$



SY98081/A/B/C/D/E/F

Recommended Operating Conditions (Note 3)

Supply Input Voltage	2.5V to 5.5V
Junction Temperature Range	-40°C to 125°C
Ambient Temperature Range	-40°C to 85°C

Electrical Characteristics

($V_{IN} = 5V$, $V_{OUT} = 1.8V$, $C_{OUT} = 4.7\mu F$, $T_A = 25^\circ C$, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.5		5.5	V
Quiescent Current	I_Q	$I_{OUT}=0$, $V_{FB}=V_{REF} \cdot 105\%$		40		μA
Shutdown Current	I_{SHDN}	EN=0		0.1	1	μA
Feedback Reference Voltage	V_{REF}	SY98081	0.588	0.6	0.612	V
Output Voltage	V_{OUT}	SY98081A	1.176	1.2	1.224	V
		SY98081B	1.47	1.5	1.53	V
		SY98081C	1.764	1.8	1.836	V
		SY98081D	2.45	2.5	2.55	V
		SY98081E	3.234	3.3	3.366	V
		SY98081F	0.98	1.0	1.02	V
PFET RON	$R_{DS(ON),P}$			230		m Ω
NFET RON	$R_{DS(ON),N}$			150		m Ω
Inductance	L			1.0		μH
PFET Current Limit	I_{LIM}		1.3			A
EN rising threshold	V_{ENH}		1.5			V
EN falling threshold	V_{ENL}				0.4	V
Input UVLO threshold	V_{UVLO}				2.5	V
UVLO hysteresis	V_{HYS}			0.1		V
Oscillator Frequency	F_{OSC}			3		MHz
Min ON Time				65		ns
Max Duty Cycle			100			%
Soft Start Time	T_{SS}			1		ms
Thermal Shutdown Temperature	T_{SD}			150		$^\circ C$
Thermal Shutdown Hysteresis	T_{HYS}			15		$^\circ C$
Output discharge resistor	R_{DSC}			120		Ω

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.

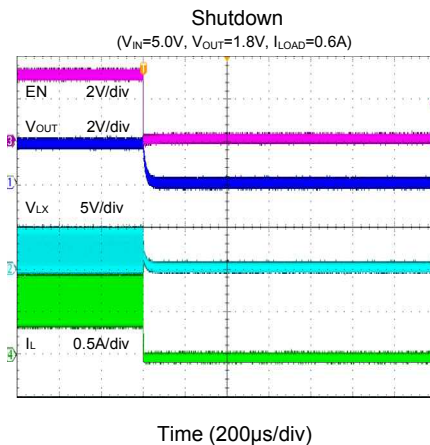
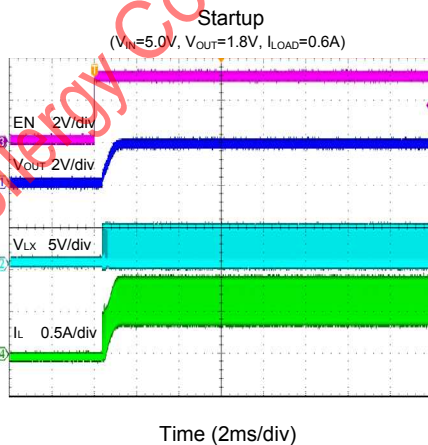
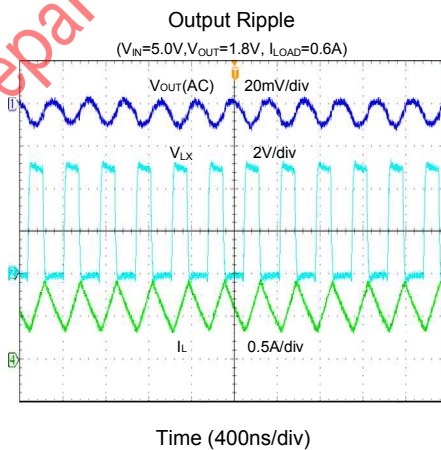
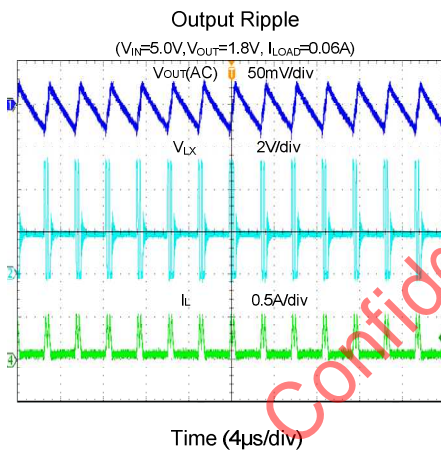
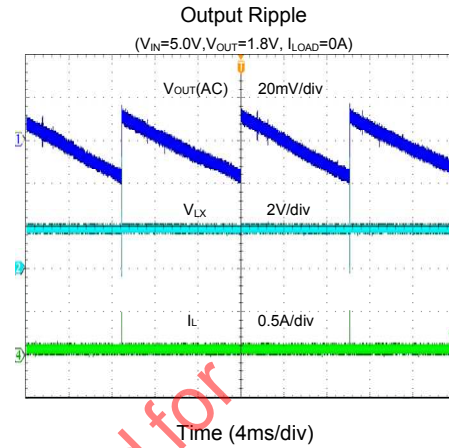
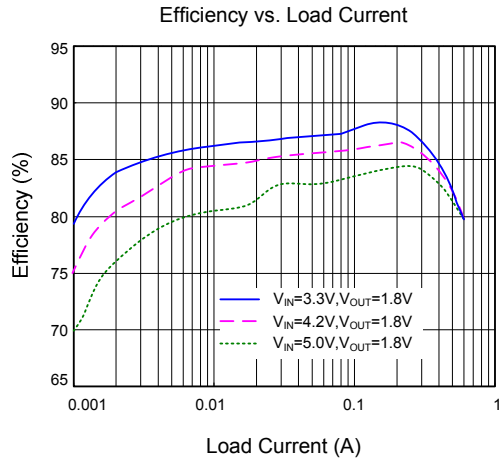
Note 2: θ_{JA} is measured in the natural convection at $T_A = 25^\circ C$ on a four-layer Silergy Evaluation Board.

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



SY98081/A/B/C/D/E/F

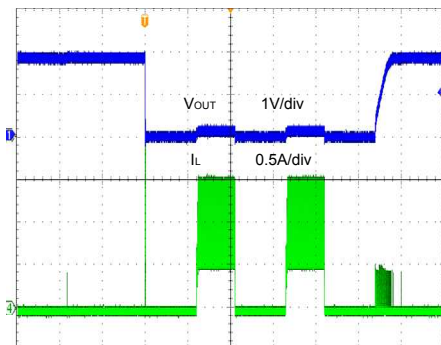
Typical Performance Characteristics (SY98081C)





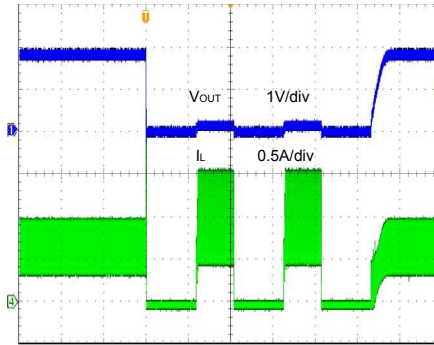
SY98081/A/B/C/D/E/F

Short Circuit Protection
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, 0A to Short)



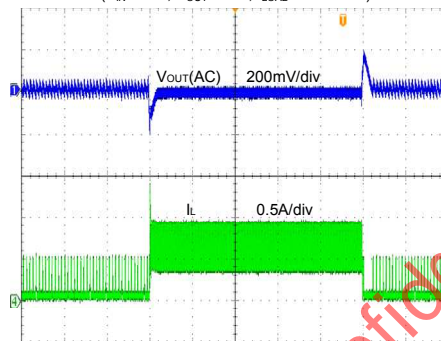
Time (2ms/div)

Short Circuit Protection
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, 0.6A to Short)



Time (2ms/div)

Load Transient
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, $I_{LOAD}=0.06-0.6A$)



Time (40μs/div)



SY98081/A/B/C/D/E/F

Operation

SY98081/A/B/C/D/E/F are 3MHz, 0.6A synchronous step-down converters which integrates an inductor and a control IC in one tiny package (2.0mm×1.5mm, H=1.2mm). It can operate over a wide input voltage range from 2.5V to 5.5V and integrate main switch and synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss.

Applications Information

Because of the high integration in SY98081/A/B/C/D/E/F, the application circuit based on this regulator IC is rather simple. Only input capacitor C_{IN} and output capacitor C_{OUT} need to be selected for the targeted application specifications.

Input capacitor C_{IN} :

A typical X7R or better grade ceramic capacitor and greater than 4.7uF capacitance is recommended. To minimize the potential noise problem, place this ceramic capacitor really close to the IN and GND pins. Care should be taken to minimize the loop area formed by C_{IN} , and IN/GND pins.

Output capacitor C_{OUT} :

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 X7R or better grade ceramic capacitor with 6V rating and greater than 10uF capacitance.

Layout Design:

For the minimum noise problems, we should place the following components close to the IC: C_{IN} and C_{OUT} .

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.

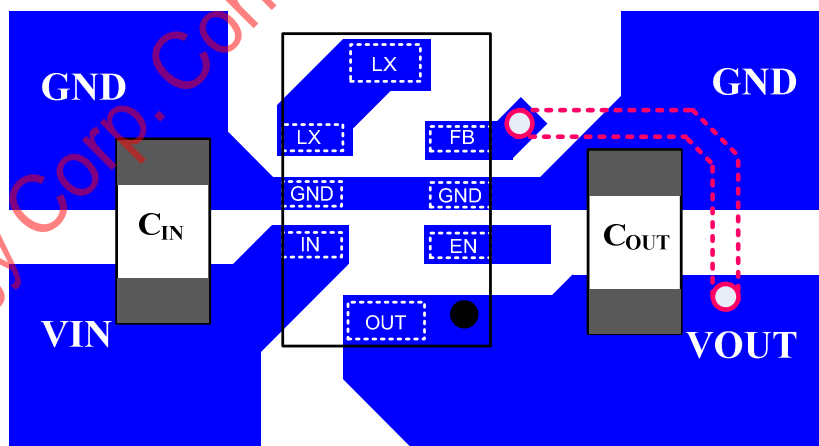
2) C_{IN} must be close to IN and GND pins. The loop area formed by C_{IN} and GND must be minimized.

3) Connect the LX pins together to reduce the inductor DCR. It is strongly recommended to reduce the LX routing area to avoid the potential noise problem.

4) The trace connecting to the FB pin must NOT be adjacent to the LX node on the PCB layout to minimize the noise coupling to FB pin.

Load Transient Considerations:

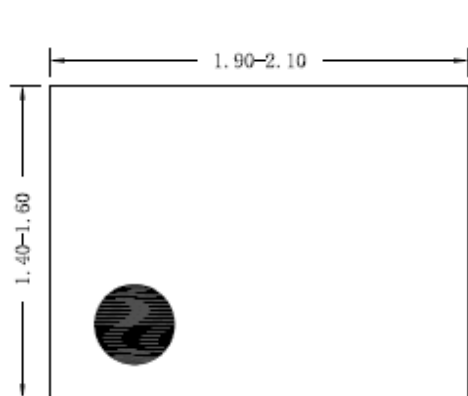
SY98081/A/B/C/D/E/F integrate the compensation components to achieve good stability and fast transient response.



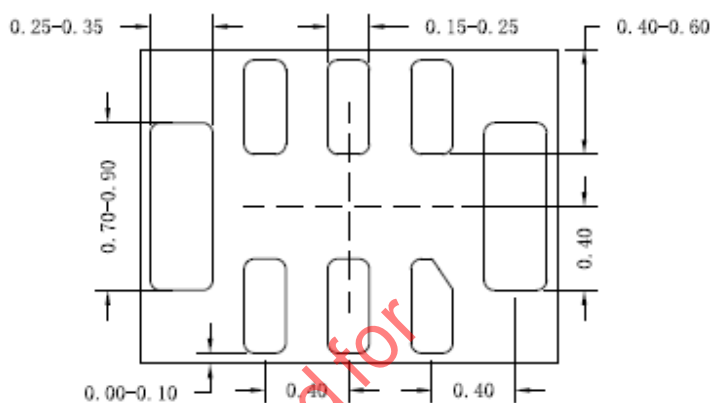


SY98081/A/B/C/D/E/F

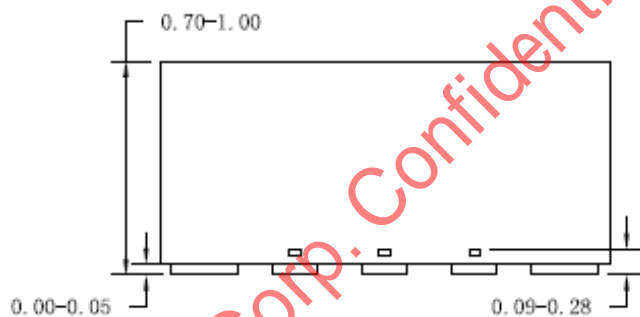
QFN2x1.5-8 FC Package Outline Drawing



Top View



Bottom View



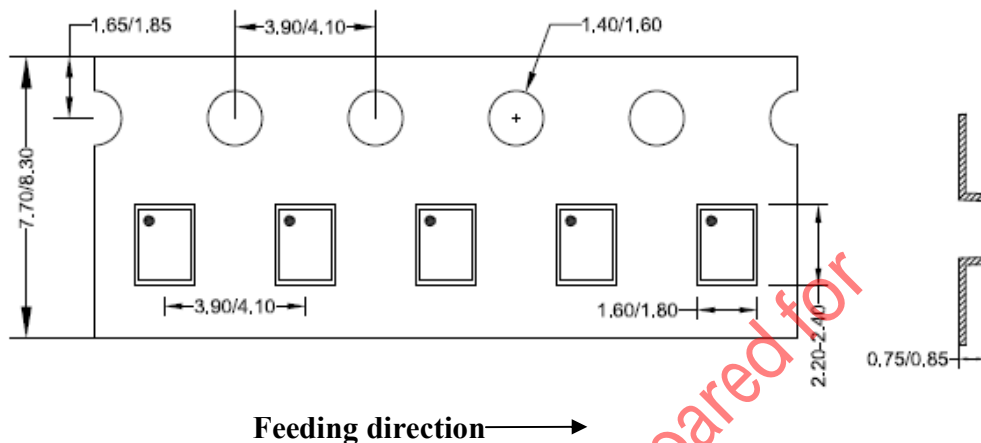
Side View

Notes: All dimension in MM and exclude mold flash & metal burr

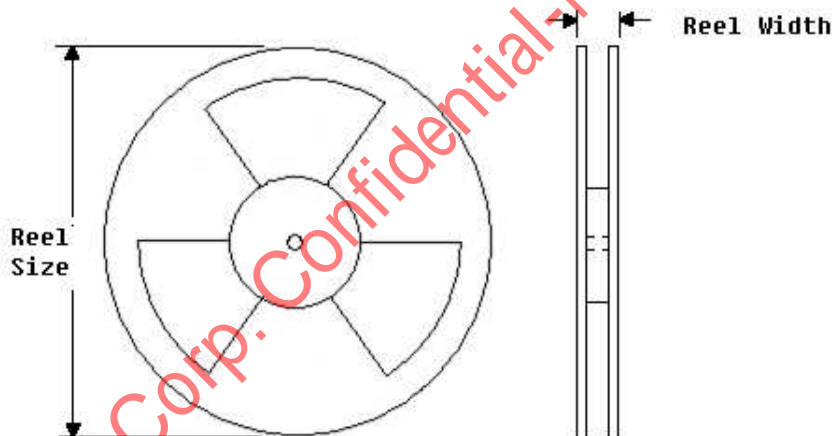
Taping & Reel Specification

1. Taping orientation

1.1. QFN2x1.5



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
QFN2x1.5	8	4	7	8.4	400	160	3000

3. Others: NA