

General Description

The SY20611 is a 3MHz, 1.2A synchronous step-down converter which integrates an inductor and a control IC in one tiny package (2.5mm×2.0mm, H=1.15mm). It can operate over a wide input voltage range from 2.5V to 5.5V and integrates main switch and a synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss.

Applications

- Mobile Phone, Smart Phone
- Bluetooth Headsets
- WiMAX PDA, MID, UMPC
- Portable Game Console
- Digital Camera, Camcorder

Features

- Low $R_{DS(ON)}$ for Internal Switches (Top/Bottom): 230mΩ/150mΩ
- Integrate an Inductor to Minimize the External Components and PCB Layout Design
- 2.5~5.5V Input Voltage Range
- 1.2A Continuous Output Current Capability
- 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: QFN2.5×2-8

Typical Applications

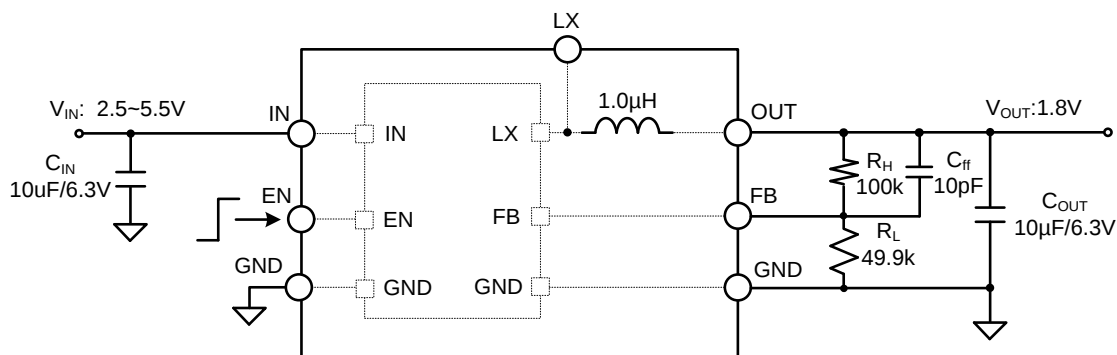
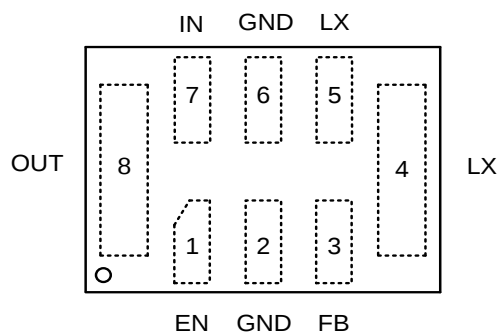


Figure1. Schematic Diagram

**Ordering Information**

Ordering Part Number	Package type	Top Mark
SY20611RCC	QFN2.5×2-8 RoHS Compliant and Halogen Free	Dtxyz

x=year code, y=week code, z= lot number code

Pinout (top view)

Pin Name	Pin Number	Pin Description
EN	1	Enable control. Pulled high to turn on. Do not leave it floating.
GND	2, 6	Ground pin.
FB	3	Output adjustable version. Connect this pin to the center point of the output resistor divider to program the output voltage: $V_{OUT}=0.6 \times (1+R_1/R_2)$.
LX	4, 5	Built-in inductor node. Leave it floating.
IN	7	Input pin. Decouple this pin to the GND pin with at least a 10 μ F ceramic capacitor.
OUT	8	Output pin. Decouple this pin to ground with at least a 10 μ F ceramic capacitor.

Block Diagram

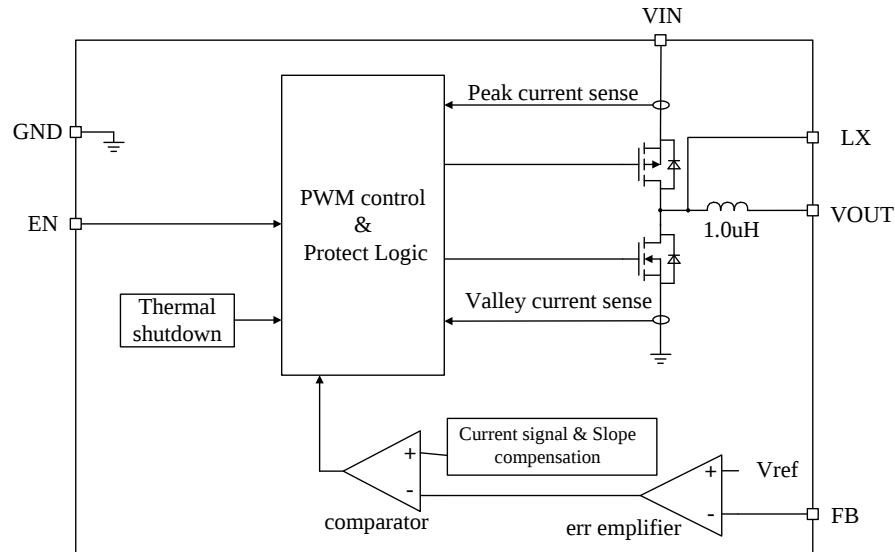


Figure 2. Block Diagram

Absolute Maximum Ratings (1)		Min	Max	Unit
LX			6	V
FB			$V_{IN}+0.6$	
Junction Temperature, Operating			150	°C
Lead Temperature (Soldering,10sec.)			260	
Storage Temperature		-65	150	

Thermal Information (2)		Min	Max	Unit
θ_{JA} Junction-to-ambient Thermal Resistance			51.2	°C/W
θ_{JC} Junction-to-case Thermal Resistance			5.83	
P_D Power Dissipation $T_A=25^\circ\text{C}$			1.2	W

Recommended Operating Conditions (3)		Min	Max	Unit
IN		2.5	5.5	V
Junction Temperature		-40	125	°C
Ambient Temperature		-40	85	°C

Electrical Characteristics

Electrical Characteristics $V_{IN} = 5V$, $V_{OUT} = 1.8V$, $C_{OUT} = 10\mu F$, $T_A = 25^\circ C$, 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	$I_{OUT}=0$, $V_{FB}=V_{REF}\times 105\%$		40		μA
Shutdown Current	I_{SHDN}	$EN=0$		0.1	1	μA
Feedback Reference Voltage	V_{REF}		0.588	0.6	0.612	V
PFET R_{ON}	$R_{DS(ON),P}$			230		$m\Omega$
NFET R_{ON}	$R_{DS(ON),N}$			150		$m\Omega$
Inductance	L			1.0		μH
PFET Current Limit	I_{LIM}		1.5			A
EN Rising Threshold	V_{ENH}		1.2			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

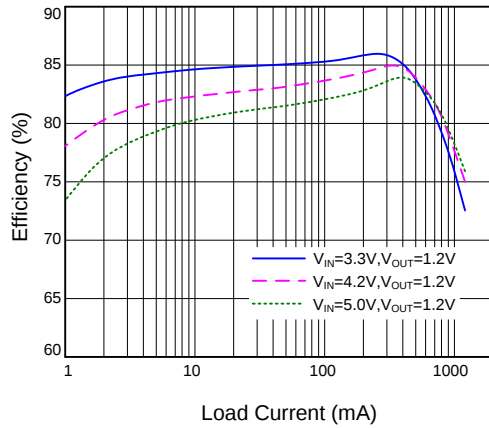
Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

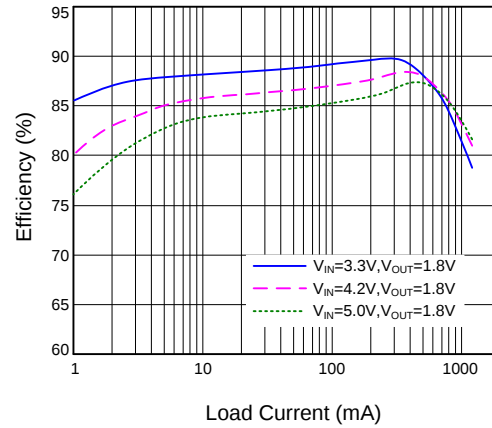
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

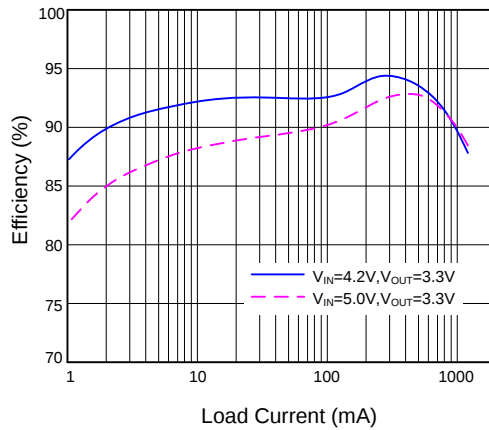
Efficiency vs. Load Current



Efficiency vs. Load Current

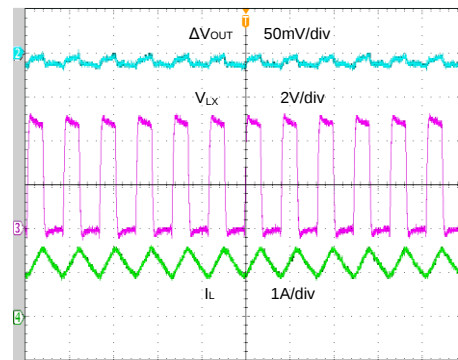


Efficiency vs. Load Current



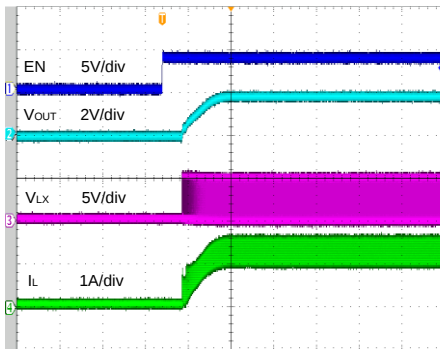
Output Ripple

($V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1.2A$)



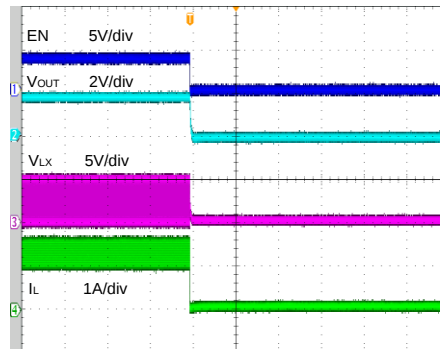
Startup From Enable

($V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1.2A$)



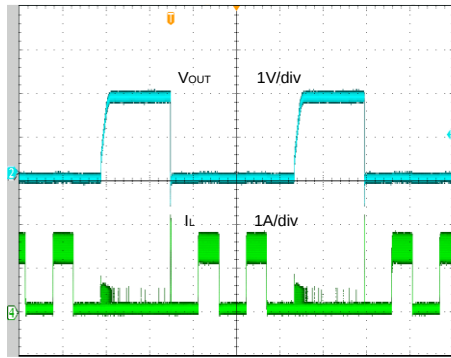
Shutdown from Enable

($V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1.2A$)



Short Circuit Protection

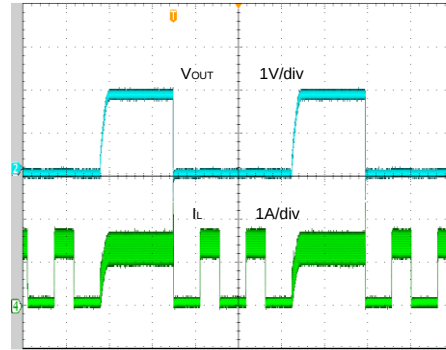
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, 0A to Short)



Time (4ms/div)

Short Circuit Protection

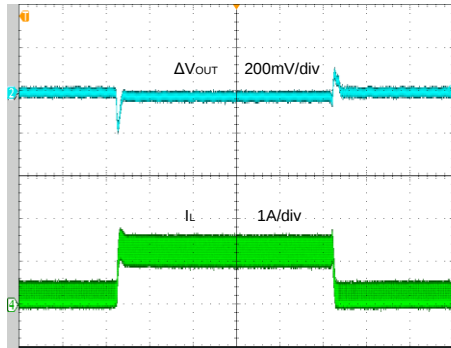
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, 1.2A to Short)



Time (4ms/div)

Load Transient

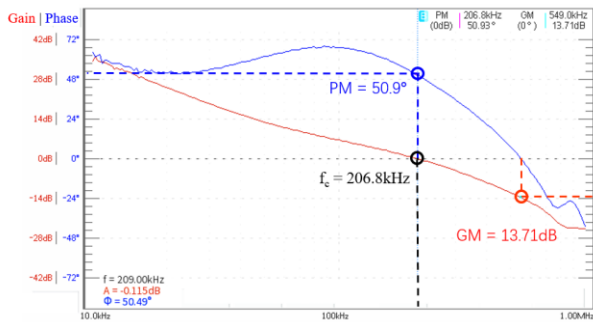
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, $I_{LOAD}=0.12-1.2A$)



Time (100μs/div)

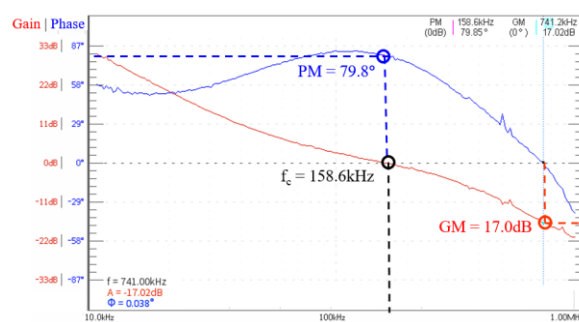
Bode plot

($V_{IN}=3.3V$, $V_{OUT}=1V$, $I_{OUT}=1.2A$)



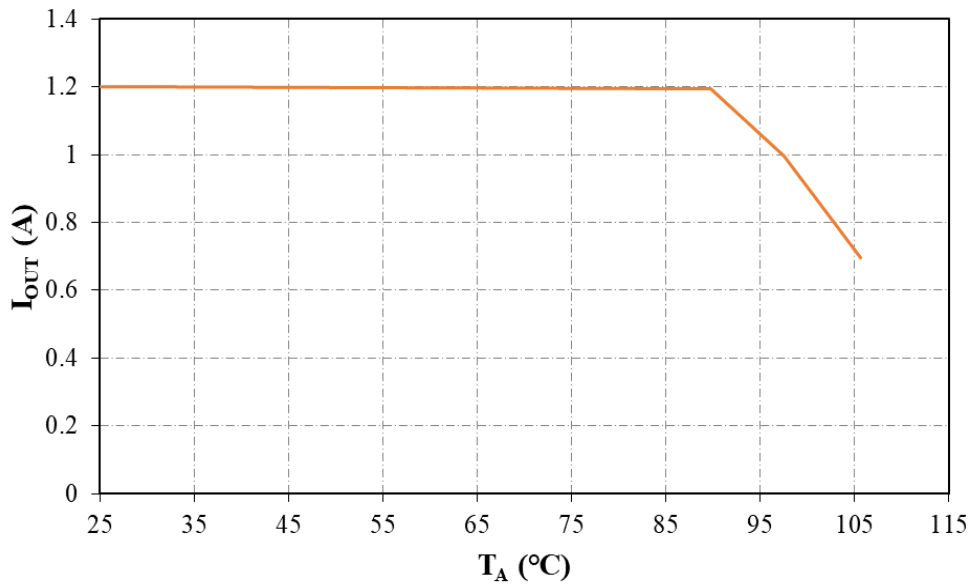
Bode plot

($V_{IN}=3.3V$, $V_{OUT}=1.8V$, $I_{OUT}=1.2A$)





Thermal Derating Curve
($V_{IN}=3.3V$, $V_{OUT}=1.8V$, no air flow)



Note:

- 1) T_A : Air temperature, 0.5 inch above the IC.
- 2) Based on a Two-layer Silergy evaluation board in the natural convection.
- 3) The IC case temperature is not beyond 115°C under this TD curve.
- 4) For customer's specific application, the recommended the IC case temperature limitation is 115°C.

Operation

SY20611 is a 3MHz, 1.2A synchronous step-down converter which integrates an inductor and a control IC in one tiny package (2.5mm×2.0mm, H=1.15mm). It can operate over a wide input voltage range from 2.5V to 5.5V and integrates main switch and synchronous switch with very low $R_{DS(on)}$ to minimize the conduction loss.

Applications Information

Because of the high integration in SY20611, the application circuit based on this regulator is rather simple. Only the input capacitor C_{IN} and the output capacitor C_{OUT} and the feedback resistors (R_H and R_L) need to be selected for the targeted application specifications.

Feedback Resistor Dividers R_H and R_L :

Choose R_H and R_L to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R_H and R_L . A value between 100k Ω and 1M Ω is highly recommended for both resistors. If $R_L=120k\Omega$ is chosen, then R_H can be calculated to be:

$$R_H = \frac{(V_{OUT} - 0.6V) \times R_L}{0.6V}$$

Input Capacitor C_{IN} :

A typical X7R or better grade ceramic capacitor greater than 10 μ F capacitance is recommended. To minimize the potential noise problem, this ceramic capacitor should be placed really close to the IN and the 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 an X7R or better grade ceramic capacitor with 6V rating and greater than 10 μ F capacitance.

Layout Design:

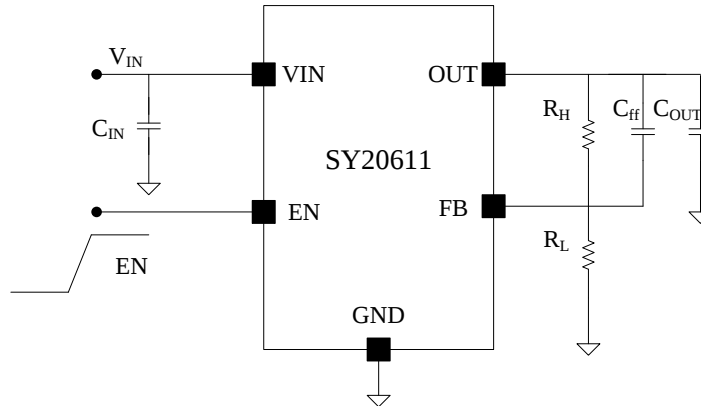
For the minimum noise problems, the following components should be close to the IC: C_{IN} and C_{OUT} .

- 1) It is desirable to maximize the PCB copper area connecting to the 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 the IN and the 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 the FB pin.

Load Transient Considerations:

SY20611 integrates the compensation components to achieve good stability and fast transient response. In some applications, adding a 10pF ceramic capacitor in parallel with R_H may further speed up the load transient response and is thus recommended for applications with large load transient step requirements.

Typical Application Circuit



Bom List

Designator	Description	Part Number	Manufacturer
C _{IN}	10uF/10V,0603,X5R	C1608X5R1A106M	TDK
C _{ff}	10pF/50V,0603, X5R	C1608C0G1H10D	TDK
C _{OUT}	10uF/10V,0603,X5R	C1608X5R1A106M	TDK
R _H	100kohm, 1%, 0603	RC0603FR-07100KL	Yageo
R _L	Open, set 0.6V	NA	NA
	150kohm, 1%, 0603,set 1V	RC0603FR-07150KL	Yageo
	100kohm, 1%, 0603,set 1.2V	RC0603FR-07100KL	Yageo
	49.9kohm, 1%, 0603, set 1.8V	RC0603FR-0749K9L	Yageo
	22.1kohm, 1%, 0603, set 3.3V	RC0603FR-0722K1L	Yageo

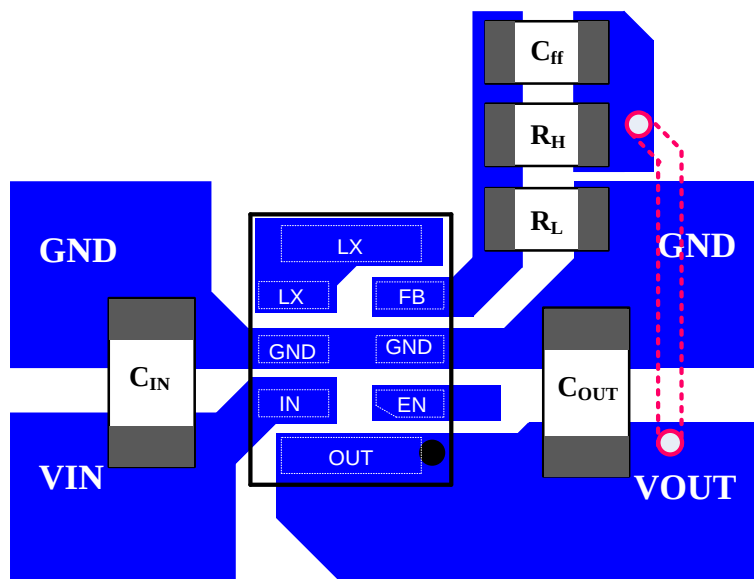
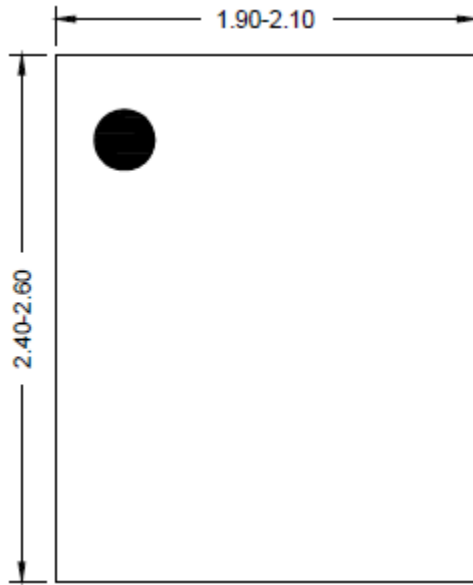
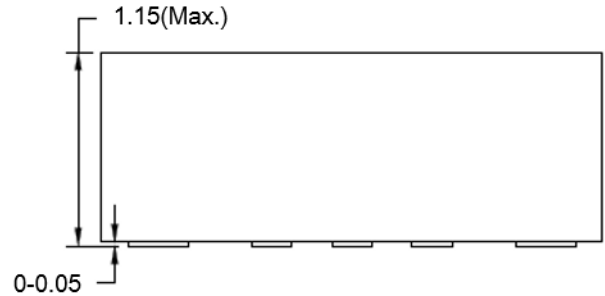


Figure3. PCB Layout Suggestion

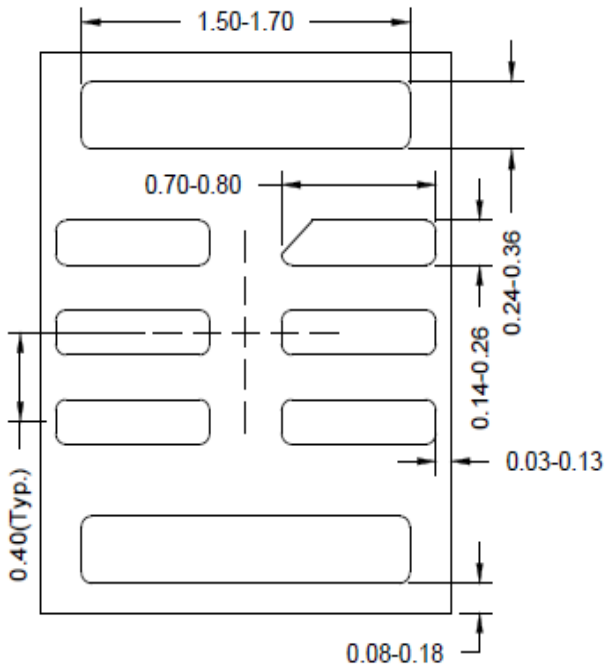
QFN2.0×2.5-8 Package Outline



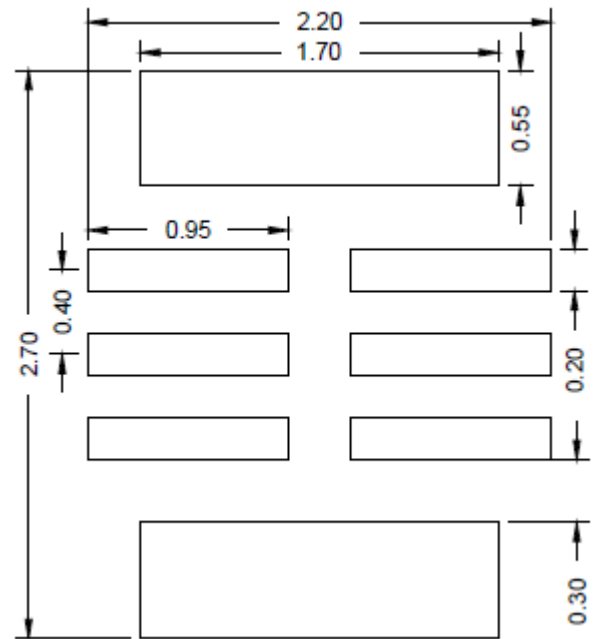
Top view



Side view



Bottom view

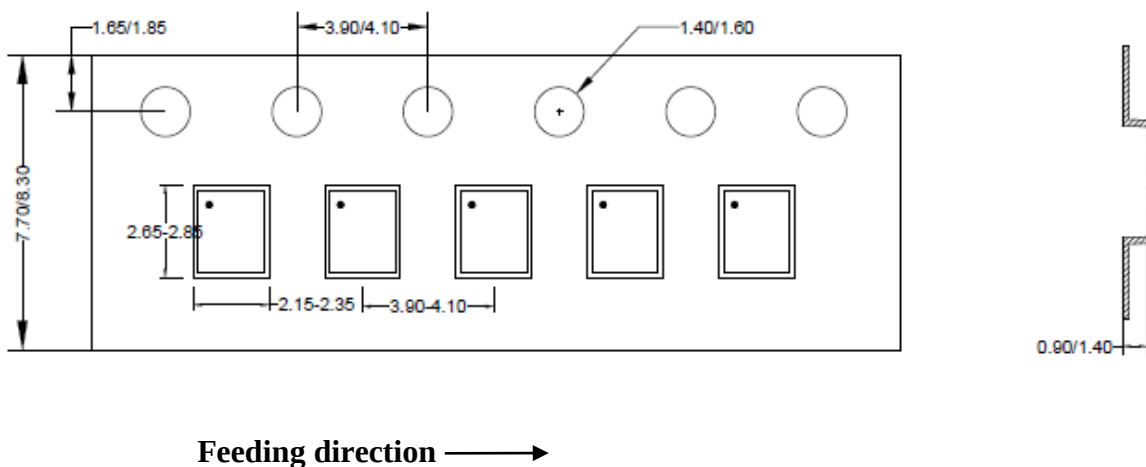


**Recommended PCB layout
(Reference only)**

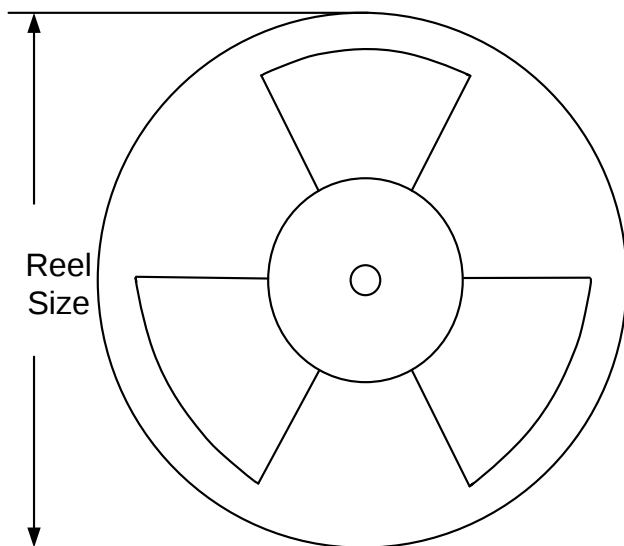
Notes: All dimension in millimeter and exclude mold flash & metal burr

Taping & Reel Specification

1. QFN2.5×2 taping orientation



2. Carrier Tape & Reel specification for packages



Package type	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel (pcs)
QFN2.5×2	8	4	7"	400	400	2500

3. Others: NA

Revision History

Date	Revision	Change
Oct. 27, 2022	Revision 1.0	Production Release
Oct. 27, 2021	Revision 0.9E	Update the package dimension (thickness changes from 1.1mm to 1.15mm)
Mar. 19, 2020	Revision 0.9D	Update the package dimension (thickness changes from 1mm to 1.1mm)
Sep. 12, 2018	Revision 0.9C	Update the Power Dissipation & Package Thermal Resistance.
Oct. 13, 2016	Revision 0.9B	Add Taping & Reel Specification
Aug. 14, 2015	Revision 0.9A	Update Package Outline (add recommended PCB Layout)
Mar. 4, 2015	Revision 0.9	Initial Release

The revision history provided is for informational purpose only and is believed to be accurate, however, not warranted. Please make sure that you have the latest revision.

IMPORTANT NOTICE

1. **Right to make changes.** Silergy and its subsidiaries (hereafter Silergy) reserve the right to change any information published in this document, including but not limited to circuitry, specification and/or product design, manufacturing or descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products are sold subject to Silergy's standard terms and conditions of sale.
2. **Applications.** Application examples that are described herein for any of these products are for illustrative purposes only. Silergy makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification. Buyers are responsible for the design and operation of their applications and products using Silergy products. Silergy or its subsidiaries assume no liability for any application assistance or designs of customer products. It is customer's sole responsibility to determine whether the Silergy product is suitable and fit for the customer's applications and products planned. To minimize the risks associated with customer's products and applications, customer should provide adequate design and operating safeguards. Customer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Silergy assumes no liability related to any default, damage, costs or problem in the customer's applications or products, or the application or use by customer's third-party buyers. Customer will fully indemnify Silergy, its subsidiaries, and their representatives against any damages arising out of the use of any Silergy components in safety-critical applications. It is also buyers' sole responsibility to warrant and guarantee that any intellectual property rights of a third party are not infringed upon when integrating Silergy products into any application. Silergy assumes no responsibility for any said applications or for any use of any circuitry other than circuitry entirely embodied in a Silergy product.
3. **Limited warranty and liability.** Information furnished by Silergy in this document is believed to be accurate and reliable. However, Silergy makes no representation or warranty, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. In no event shall Silergy be liable for any indirect, incidental, punitive, special or consequential damages, including but not limited to lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges, whether or not such damages are based on tort or negligence, warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, Silergy's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Standard Terms and Conditions of Sale of Silergy.
4. **Suitability for use.** Customer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of Silergy components in its applications, notwithstanding any applications-related information or support that may be provided by Silergy. Silergy products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of Silergy product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Silergy assumes no liability for inclusion and/or use of Silergy products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.
5. **Terms and conditions of commercial sale.** Silergy products are sold subject to the standard terms and conditions of commercial sale, as published at <http://www.silergy.com/stdterms>, unless otherwise agreed in a valid written individual agreement specifically agreed to in writing by an authorized officer of Silergy. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Silergy hereby expressly objects to and denies the application of any customer's general terms and conditions with regard to the purchase of Silergy products by the customer.
6. **No offer to sell or license.** Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights. Silergy makes no representation or warranty that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right. Information published by Silergy regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from Silergy under the patents or other intellectual property of Silergy.

For more information, please visit: www.silergy.com

© 2020 Silergy Corp.

All Rights Reserved.