SY20611

High Efficiency 3MHz, 1.2A Inductor Built-in Synchronous Step Down Regulator

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_{DSON} 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 Minimizes 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

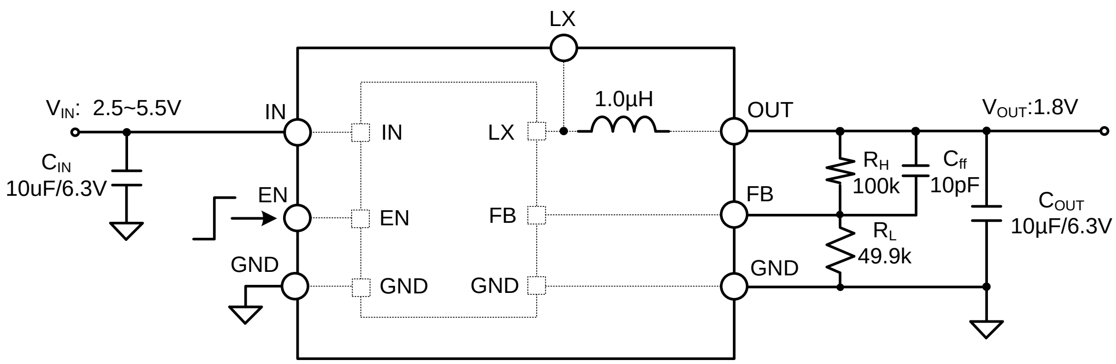


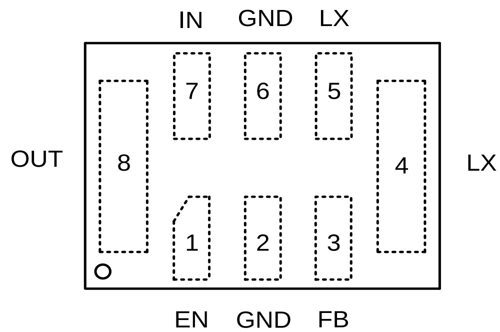
Figure1. Schematic Diagram

Ordering Information

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

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× (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 10µF ceramic capacitor.
OUT	8	Output pin. Decouple this pin to ground with at least a 10µF ceramic capacitor.

Block Diagram

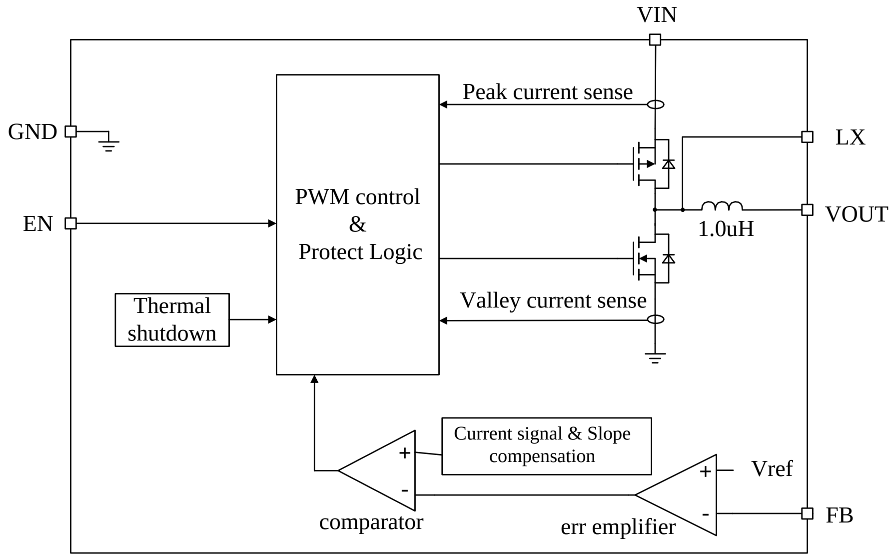


Figure 2. Block Diagram

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°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} = 10μF, T_A = 25°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}×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		mΩ
NFET R_{ON}	$R_{DS(ON),N}$			150		mΩ
Inductance	L			1.0		uH
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		°C
Thermal Shutdown Hysteresis	T_{HYS}			15		°C
Output Discharge Resistor	R_{DSC}			120		Ω

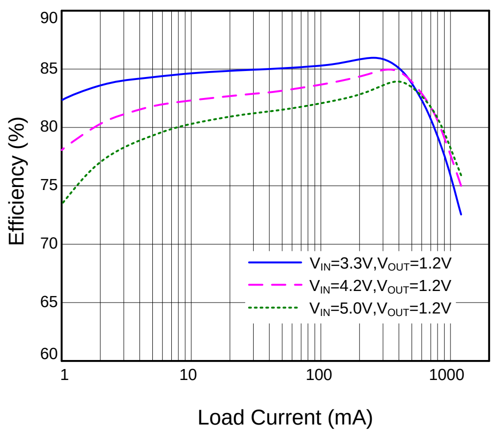
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θJA is measured in the natural convection at T_A = 25°C on a four-layer Silergy Evaluation Board.

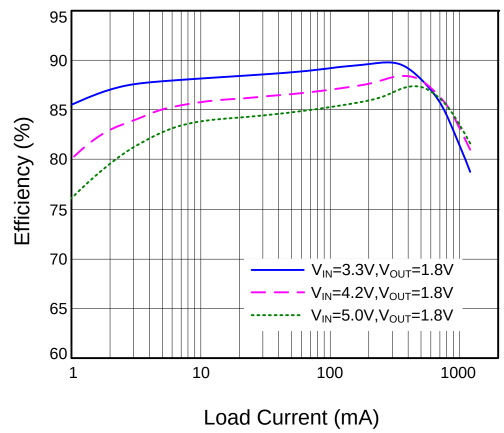
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

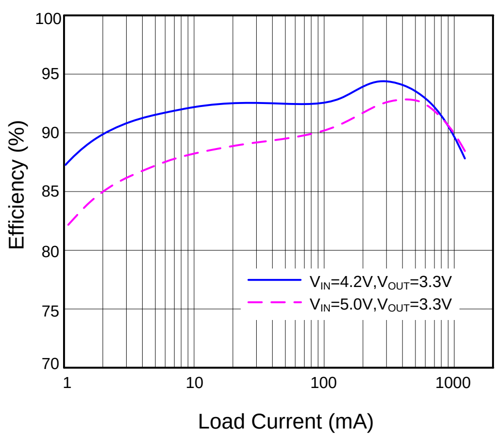
Efficiency vs. Load Current



Efficiency vs. Load Current

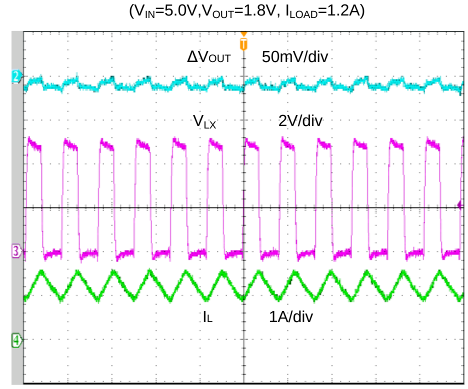


Efficiency vs. Load Current



Output Ripple

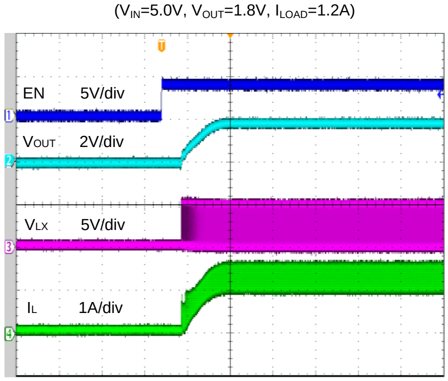
(V_{IN}=5.0V,V_{OUT}=1.8V, I_{LOAD}=1.2A)



Time (400ns/div)

Startup From Enable

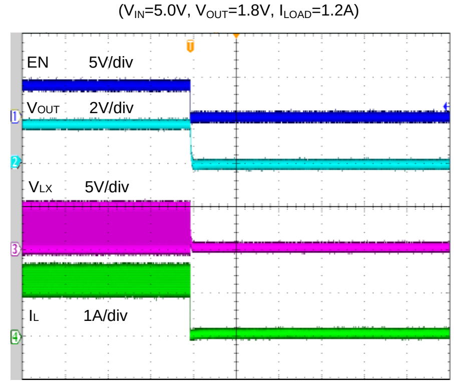
(V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1.2A)



Time (800μs/div)

Shutdown from Enable

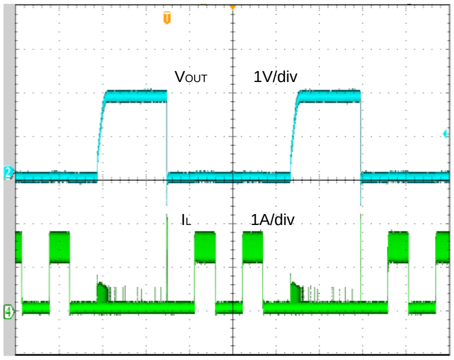
(V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1.2A)



Time (800μs/div)

Short Circuit Protection

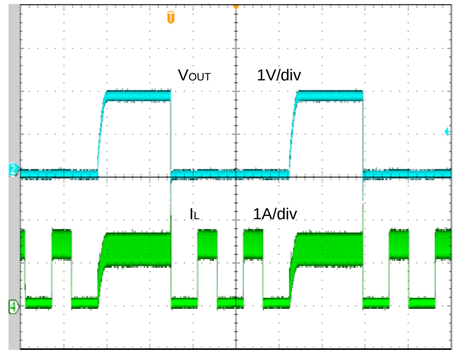
(V_{IN}=5.0V, V_{OUT}=1.8V, 0A to Short)



Time (4ms/div)

Short Circuit Protection

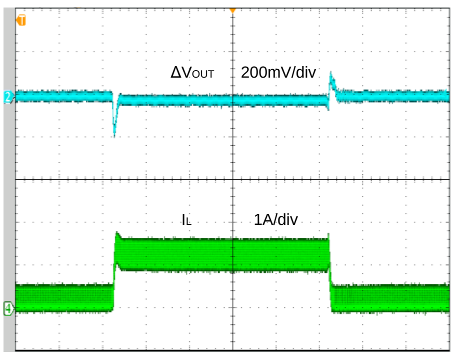
(V_{IN}=5.0V, V_{OUT}=1.8V, 1.2A to Short)



Time (4ms/div)

Load Transient

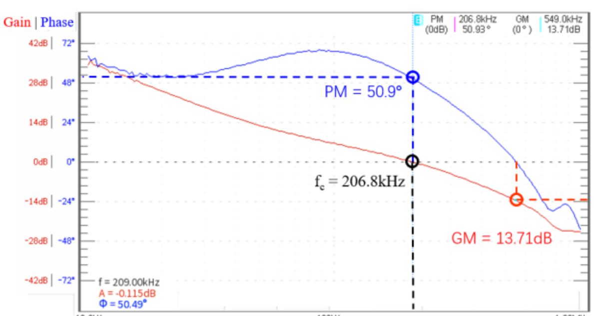
(V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=0.12-1.2A)



Time (100μs/div)

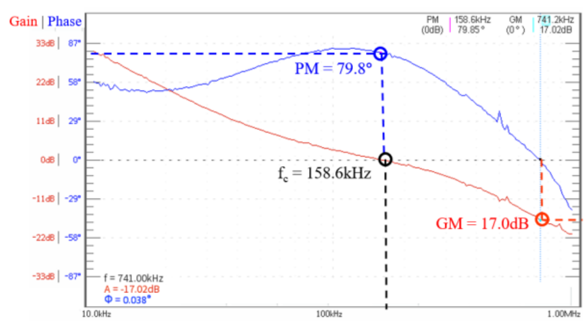
Bode plot

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

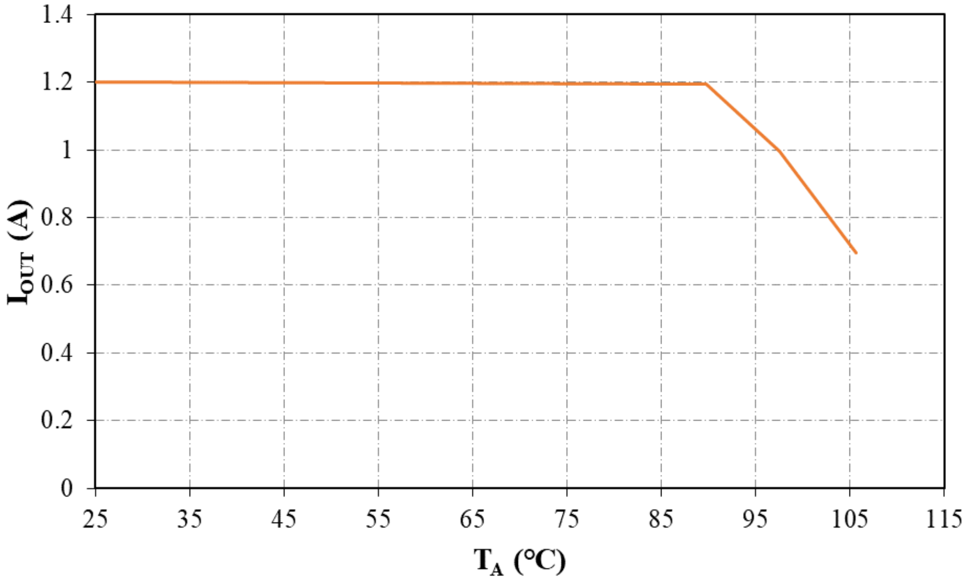


Bode plot

(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_{DSON} 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 100kΩ and 1MΩ is highly recommended for both resistors. If R_L=120kΩ is chosen, then R_H can be calculated to be:

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

Input Capacitor C_{IN}:

A typical X7R or better grade ceramic capacitor greater than 10μF 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 10μF 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.

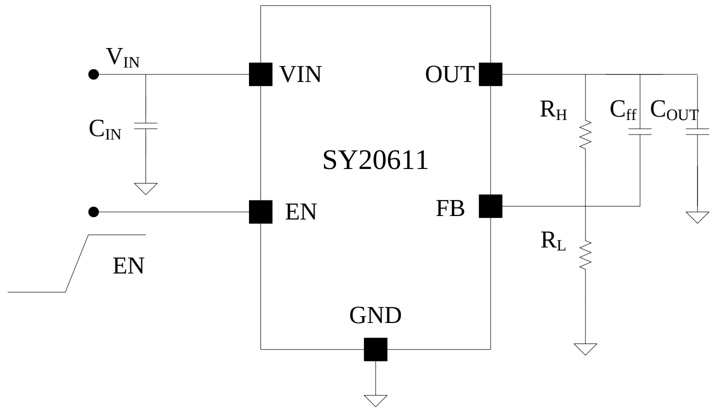
3) Connect the LX pins together to reduce the inductor DCR. It is strongly recommended to reduce the LX routing area to avoid the potential noise problem.

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

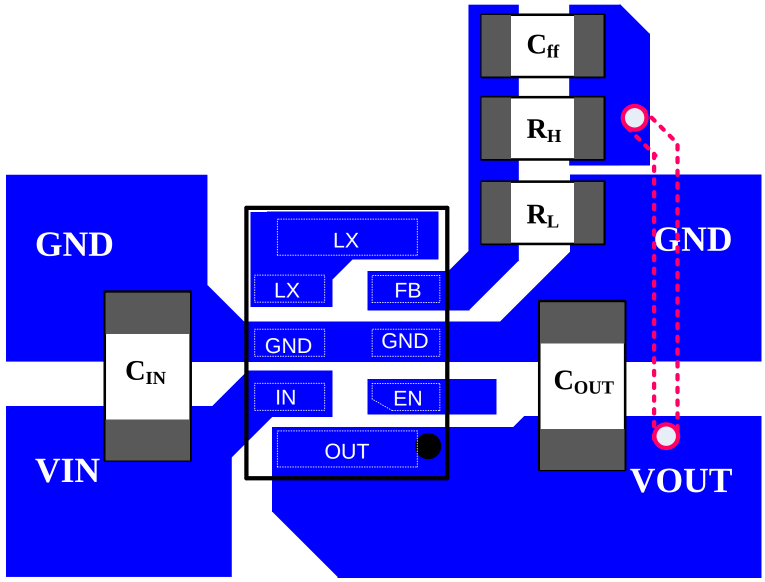
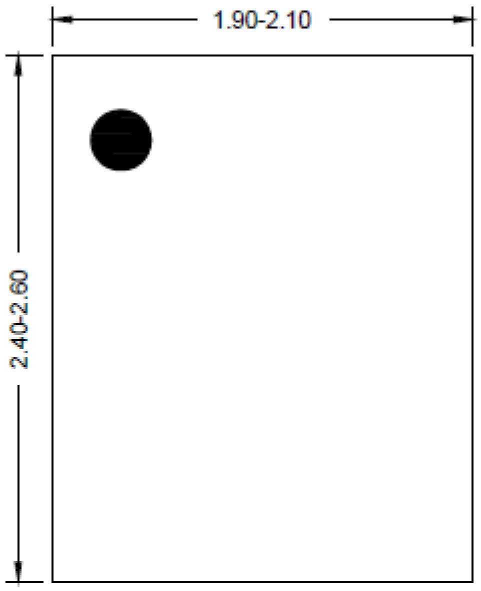
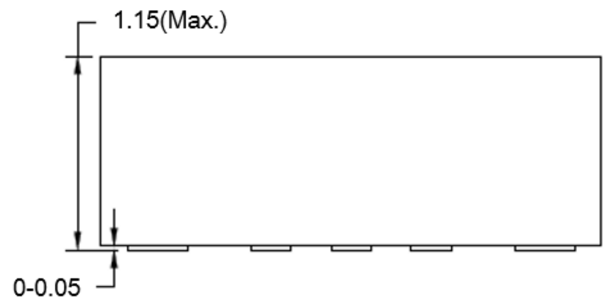


Figure3. PCB Layout Suggestion

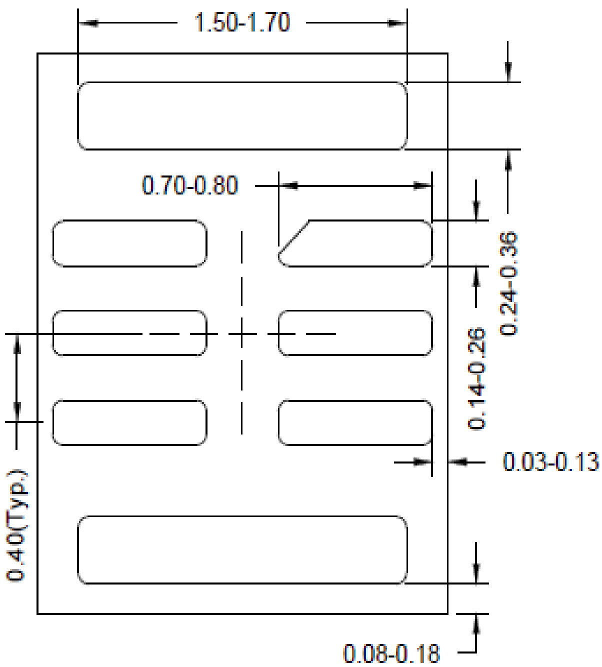
QFN2.0×2.5-8 Package Outline



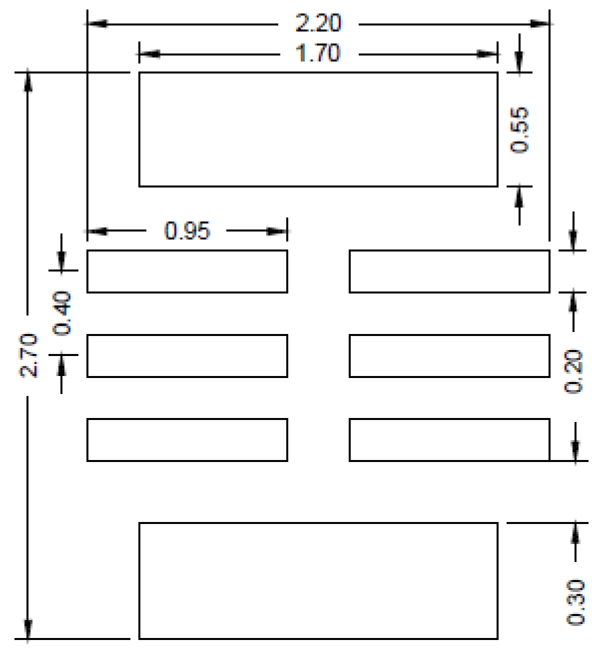
Top view



Side view



Bottom view

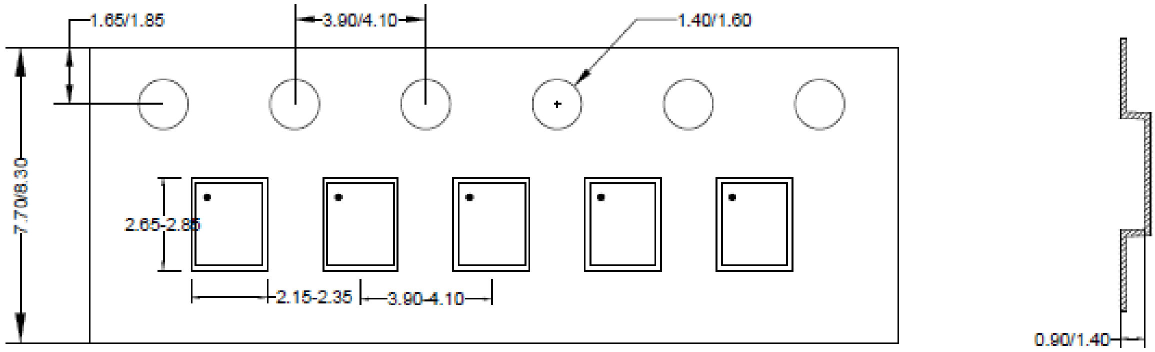


Recommended PCB layout (Reference only)

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

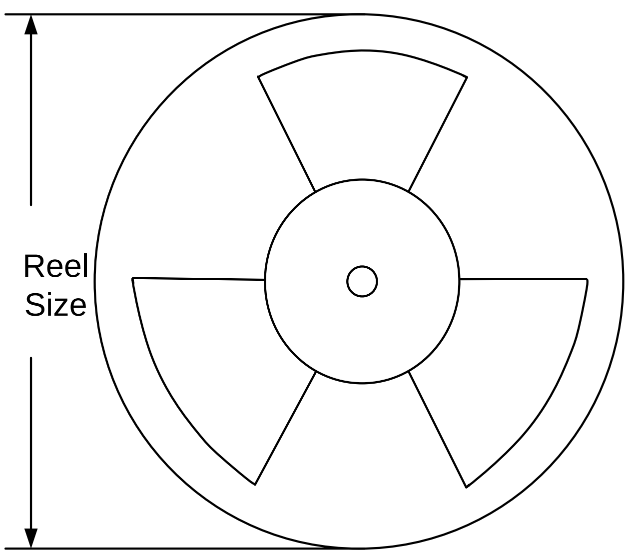
Taping & Reel Specification

1. QFN2.5×2 taping orientation



Feeding direction →

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.

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