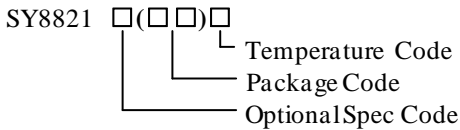


High Efficiency 2MHz, Dual 1.0A Synchronous Step Down Regulator

General Description

The SY8821B is a dual output, high efficiency 2MHz synchronous step down DC/DC regulator capable of delivering up to 1.0A for each output channel. The SY8821B operates over a wide input voltage range from 2.3V to 5.5V and integrates a main switch and a synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss.

Ordering Information



Ordering Number	Package type	Note
SY8821BSAC	DFN2×1.5-8	--

Features

- 2.3V to 5.5V Input Voltage
- 2MHz Switching Frequency
- 180° Out of Phase Operation
- Output Current: 1.0A for Each Channel
- Low Quiescent Current: Typical 45μA for Both Channels
- Low $R_{DS(ON)}$ for Internal Switches (PFET/NFET): 125mΩ/100mΩ
- Internal Soft-start
- 100% Dropout Operation
- RoHS Compliant and Halogen Free
- Compact Package: DFN2x1.5-8

Applications

- SSD
- Cell Phones
- Digital Cameras
- PDAs
- Portable Media Players

Typical Applications

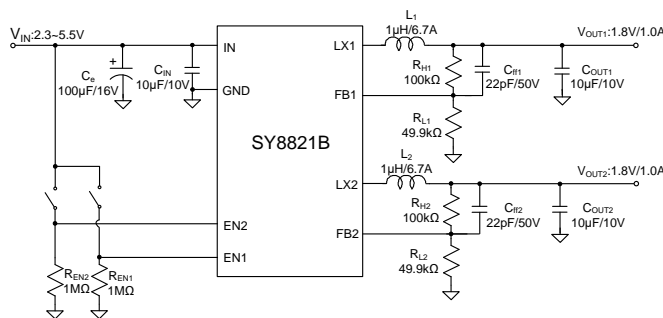


Figure1. Schematic Diagram

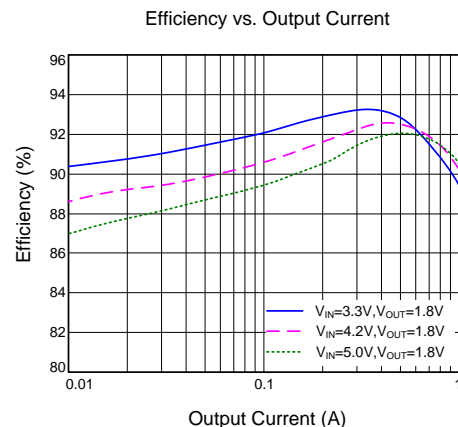
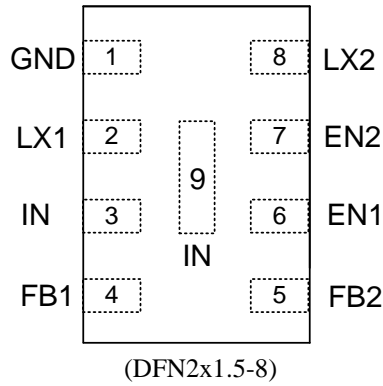


Figure2. Efficiency vs. Output Current

Pinout (top view)



Top Mark: Xdryz for SY8821BSAC (device code: Xd, x=*year code*, y=*week code*, z= *lot number code*)

Pin Name	Pin Number	Pin Description
GND	1	Ground pin.
LX1	2	Inductor pin for output1. Connect this pin to the switching node of the inductor.
IN	3	Power input pin. Decouple this pin to the GND pin with at least a 10μF ceramic capacitor.
FB1	4	Feedback pin for output1. Connect this pin to the center point of the output resistor divider (as shown in figure 1) to program the output1 voltage: $V_{OUT1}=0.6V_{\text{X}}(1+R_{H1}/R_{L1})$
FB2	5	Feedback pin for output2. Connect this pin to the center point of the output resistor divider (as shown in Figure 1) to program the output2 voltage: $V_{OUT2}=0.6V_{\text{X}}(1+R_{H2}/R_{L2})$
EN1	6	Enable pin for output1. Do not leave it floating.
EN2	7	Enable pin for output2. Do not leave it floating.
LX2	8	Inductor pin for output2. Connect this pin to the switching node of the inductor.
IN	9	Power input pin. Connect this pin to the IN pin. Do not leave it floating.

Block Diagram

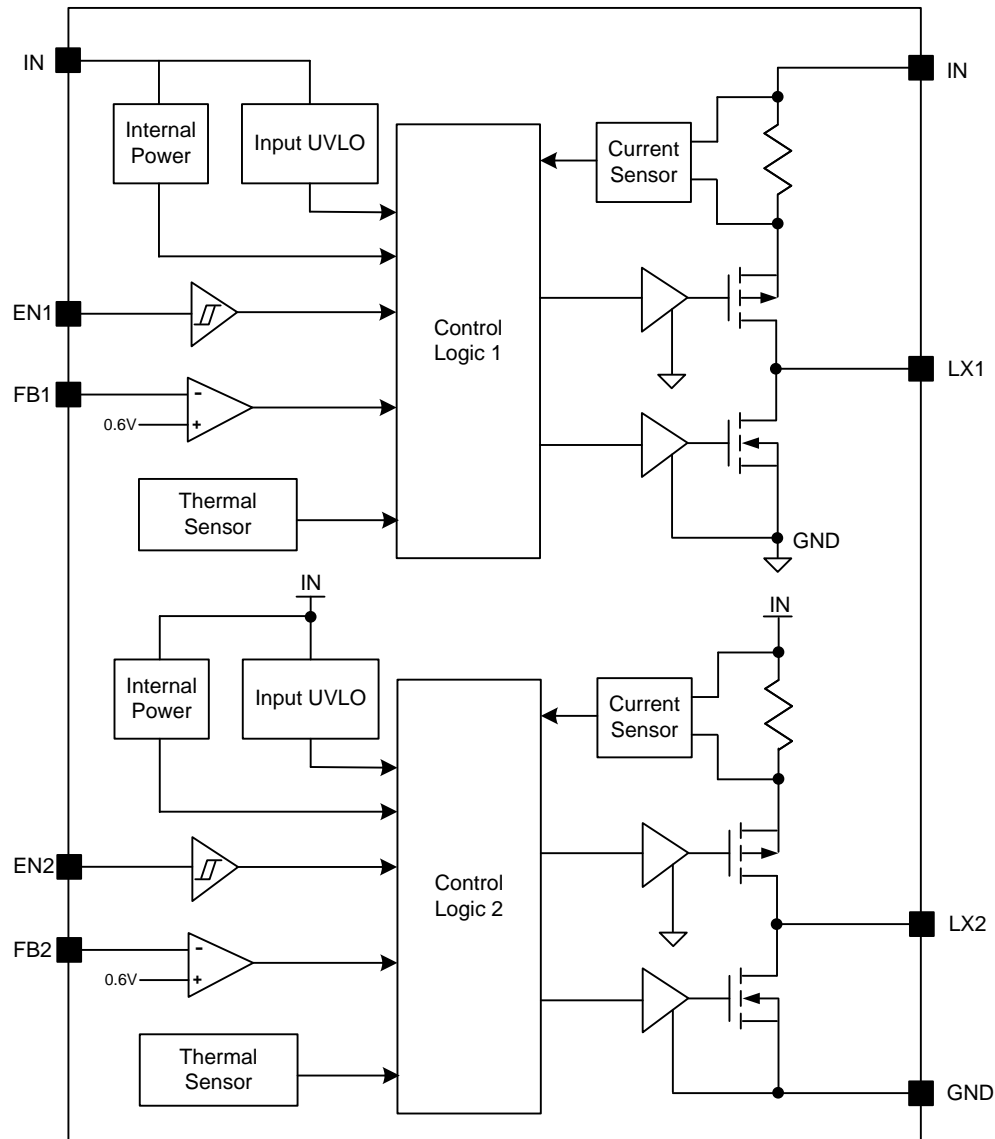


Figure3. Block Diagram



SY8821B

Absolute Maximum Ratings (Note 1)

All Pins	-----	6V
LX Voltage	-----	-0.3V ^(*1) to 6V ^(*2)
Power Dissipation, P _D @ T _A = 25°C, DFN2×1.5-8	-----	1.2W
Package Thermal Resistance (Note 2)		
θ _{JA}	-----	80°C/W
θ _{JC}	-----	15°C/W
Junction Temperature Range	-----	-40°C to 150°C
Lead Temperature (Soldering, 10 sec.)	-----	260°C
Storage Temperature Range	-----	-65°C to 150°C
(*1) LX Voltage Tested Down to -3V<40ns		
(*2) LX Voltage Tested Up to +7V<40ns		

Recommended Operating Conditions (Note 3)

Supply Input Voltage	-----	2.3V to 5.5V
Enable, FB Voltage	-----	V _{IN} +0.3V
Junction Temperature Range	-----	-40°C to 125°C
Ambient Temperature Range	-----	-40°C to 85°C

Electrical Characteristics

($V_{IN}=5V$, $V_{OUT1}=V_{OUT2}=2.5V$, $L_1=L_2=1.0\mu H$, $C_{OUT1}=C_{OUT2}=10\mu F$, $T_A=25^\circ C$, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		2.3		5.5	V
Input UVLO Rising Threshold	$V_{UVLO,RISING}$				2.3	V
Input UVLO Falling Threshold	$V_{UVLO,FALLING}$				2.0	V
Quiescent Current	I_Q	EN1=1 or EN2=1, $I_{OUT1}=I_{OUT2}=0$, no switching		35		μA
		EN1=1 and EN2=1, $I_{OUT1}=I_{OUT2}=0$, no switching		45		μA
Shutdown Current	I_{SHDN}	$V_{EN1}=V_{EN2}=0V$		0.1	1	μA
Feedback Reference Voltage	V_{REF1} , V_{REF2}		588	600	612	mV
Top FET R_{ON}	$R_{DS(ON),TOP1}$ $R_{DS(ON),TOP2}$			125		$m\Omega$
Bottom FET R_{ON}	$R_{DS(ON),BOT1}$ $R_{DS(ON),BOT2}$			100		$m\Omega$
EN1,EN2 Input Voltage High	$V_{EN1,H}$, $V_{EN2,H}$		1.2			V
EN1,EN2 Input Voltage Low	$V_{EN1,L}$, $V_{EN2,L}$				0.4	V
Soft-start Time	t_{SS1} , t_{SS2}			1.0		ms
Switching Frequency	F_{SW}	$I_{OUT1}=0.5A$, $I_{OUT2}=0.5A$		2.0		MHz
CH1 Top FET Current Limit	$I_{LMT,TOP1}$		1.3			A
CH2 Top FET Current Limit	$I_{LMT,TOP2}$		1.3			A
Thermal Shutdown Temperature	T_{SD}			150		$^\circ C$
Thermal Shutdown Hysteresis	T_{HYS}			20		$^\circ C$

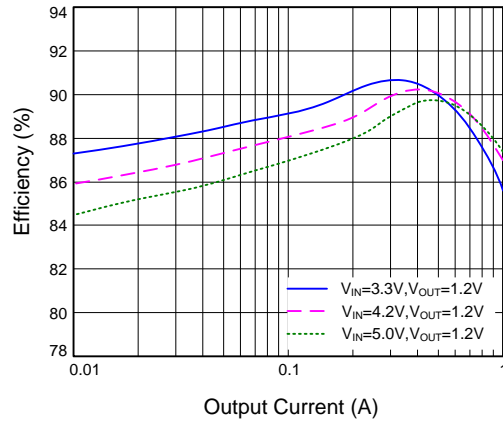
Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute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

Note 2: θ_{JA} of SY8821BSAC is measured in the natural convection at $T_A=25^\circ C$ on 20Z two-layer Silergy evaluation board. Paddle of QFN2x1.5-8 package is the case position for SY8821BSAC θ_{JC} measurement.

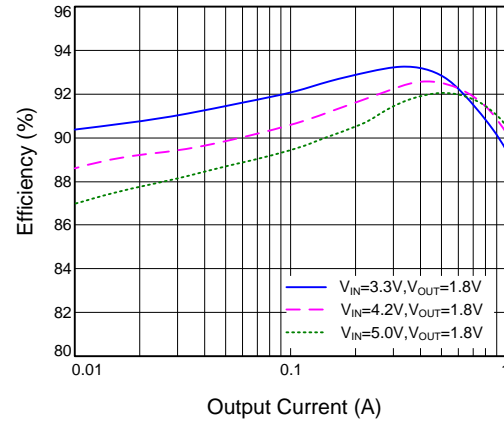
Note 3: The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

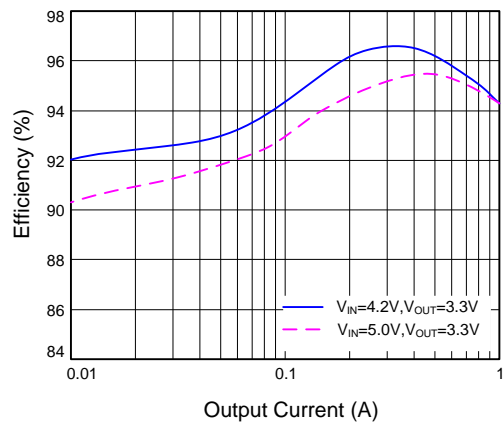
Efficiency vs. Output Current



Efficiency vs. Output Current

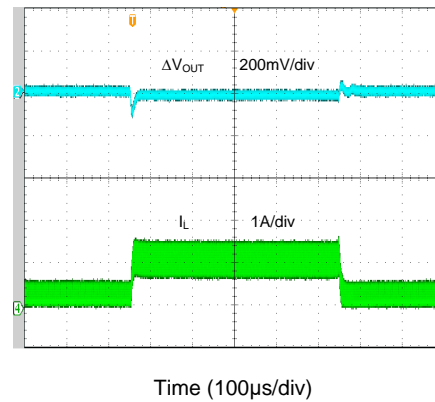


Efficiency vs. Output Current



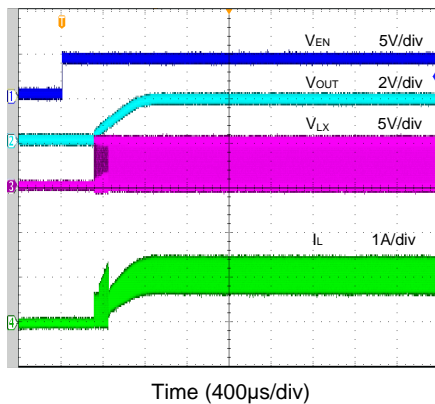
Load Transient

($V_{IN}=5.0V, V_{OUT}=1.8V, I_O=0.1\sim1A$)



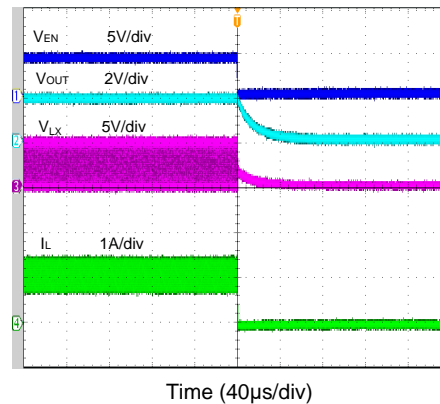
Startup from Enable

($V_{IN}=5.0V, V_{OUT}=1.8V, I_{OUT}=1.0A$)



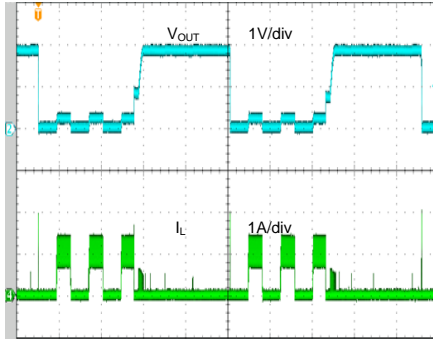
Shutdown from Enable

($V_{IN}=5.0V, V_{OUT}=1.8V, I_{OUT}=1.0A$)



Short Circuit Protection

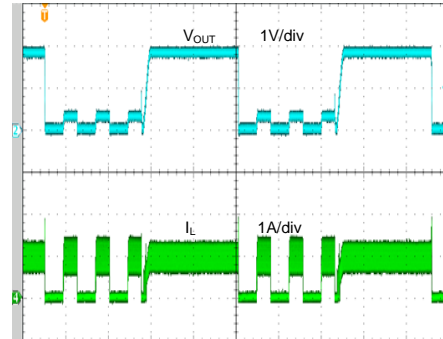
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, $I_O=0A$ ~ short)



Time (4ms/div)

Short Circuit Protection

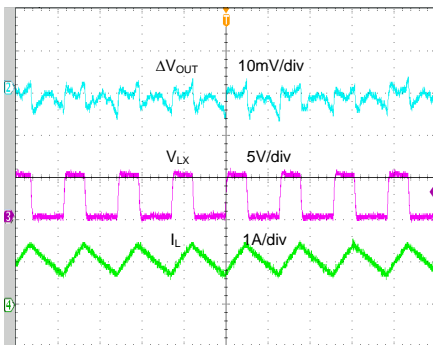
($V_{IN}=5.0V$, $V_{OUT}=1.8V$, $I_O=1A$ ~ short)



Time (4ms/div)

Output Ripple

($V_{IN}=5.0V$, $V_{OUT}=1.8V$, $I_O=1.0A$)



Time (400ns/div)

Operation

The SY8821B is a dual output, high efficiency 2MHz synchronous step down DC/DC regulator capable of delivering up to 1.0A for each output channel. The SY8821B operates over a wide input voltage range from 2.3V to 5.5V and integrates a main switch and a synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss.

Applications Information

Because of the high integration in the SY8821B, the application circuit based on this regulator is rather simple. Only the input capacitor C_{IN} , the output capacitor C_{OUT} , the output inductor L and the feedback resistors (R_H and R_L) need to be selected for the targeted applications.

Feedback Resistor Divider R_H and R_L

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

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

Input Capacitor C_{IN}

This ripple current through input capacitor is calculated as:

$$I_{CIN_RMS} = I_{OUT} \times \sqrt{D(1-D)}$$

This formula has a maximum at $V_{IN}=2V_{OUT}$ condition, where $I_{CIN_RMS}=I_{OUT}/2$. This simple worst-case condition is commonly used for DC/DC design.

With the maximum load current of 1.0A, a typical X5R or a better grade ceramic capacitor with 10V rating and larger than 10 μ F capacitance can handle this ripple current well. To minimize the potential noise problem, a ceramic capacitor should be placed really close to the IN and GND pins. Care should be taken to minimize the loop area formed by C_{IN} and V_{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 larger than 10 μ F capacitance.

Output Inductor L

There are several considerations in choosing this inductor.

- 1) Choose the inductance to provide the desired ripple current. It is suggested to choose the ripple current to be about 40% of the maximum output current. The inductance is calculated as:

$$L = \frac{V_{OUT}(1 - V_{OUT}/V_{IN,MAX})}{F_{SW} \times I_{OUT,MAX} \times 40\%}$$

Where F_{SW} is the switching frequency and $I_{OUT,MAX}$ is the maximum load current.

The SY8821B is quite tolerant of different ripple current amplitude. Consequently, the final choice of inductance can be slightly off the calculation value without significantly impacting the performance.

- 2) The saturation current rating of the inductor must be selected to be greater than the peak inductor current under full load condition.

$$I_{SAT, MIN} > I_{OUT, MAX} + \frac{V_{OUT}(1 - V_{OUT}/V_{IN,MAX})}{2 \times F_{SW} \times L}$$

- 3) The DCR of the inductor and the core loss at the switching frequency must be low enough to achieve the desired efficiency requirement. It is desirable to choose an inductor with $DCR < 50m\Omega$ to achieve a good overall efficiency.

Load Transient Considerations:

The SY8821B integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a 22pF ceramic capacitor in parallel with R_H may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements.

Layout Design:

The layout design of SY8821B regulator is relatively simple. For the best efficiency and minimum noise problems, the following components should be placed close to the IC: C_{IN} , L , R_H and R_L .

- 1) It is desirable to maximize the PCB copper area connected to GND pin to achieve the best thermal and noise performance. If the board

space allowed, a ground plane is highly desirable. Reasonable vias are suggested to be placed underneath the ground pad to enhance the soldering quality and thermal performance.

- 2) Input capacitor must be close to the IN and GND pins. The loop area formed by input capacitor, IN and GND must be minimized.
- 3) The PCB copper area associated with the LX pin must be minimized to avoid the potential noise problem. For the smallest loop area of C_{IN} , IN and GND, the LX pin copper can pour area on internal or bottom layer.
- 4) The components R_H and R_L and the trace connecting to the FB pin must NOT be adjacent to the LX net on the PCB layout to avoid the noise problem.
- 5) If the system chip interfacing with the EN pin has a high impedance state at shutdown mode and the IN pin is connected directly to a power source such as a Li-Ion battery, it is desirable to add a pull-down $1M\Omega$ resistor between the EN and GND pins to prevent the noise from falsely turning on the regulator at shutdown mode.

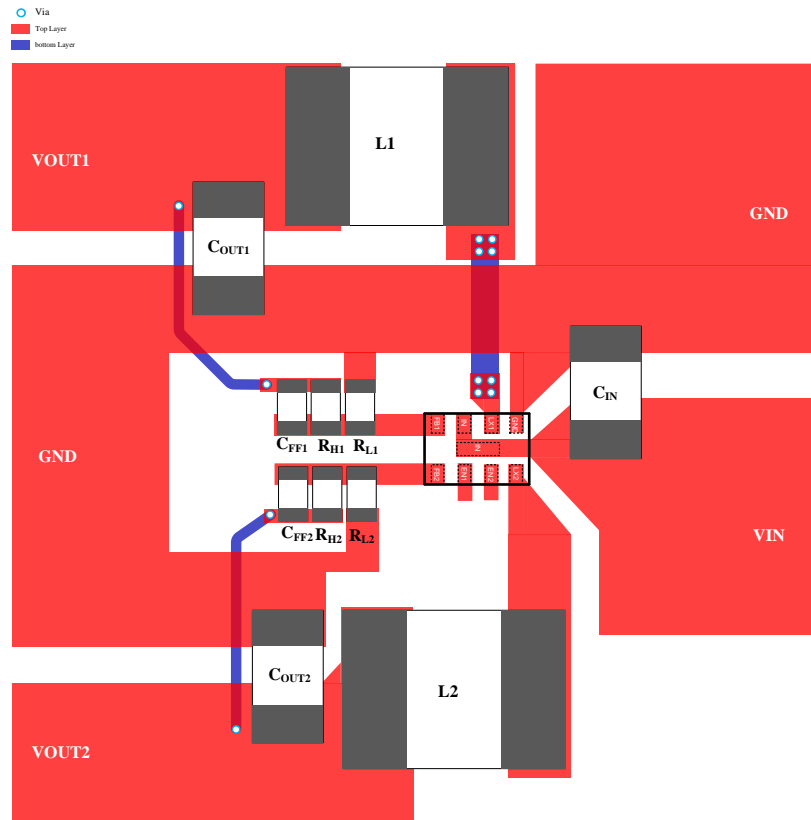
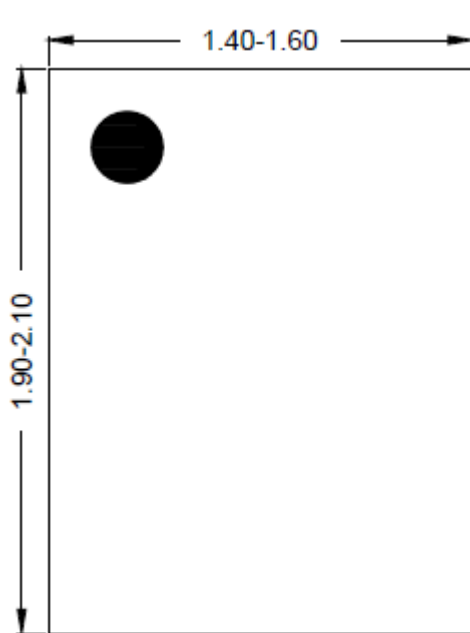
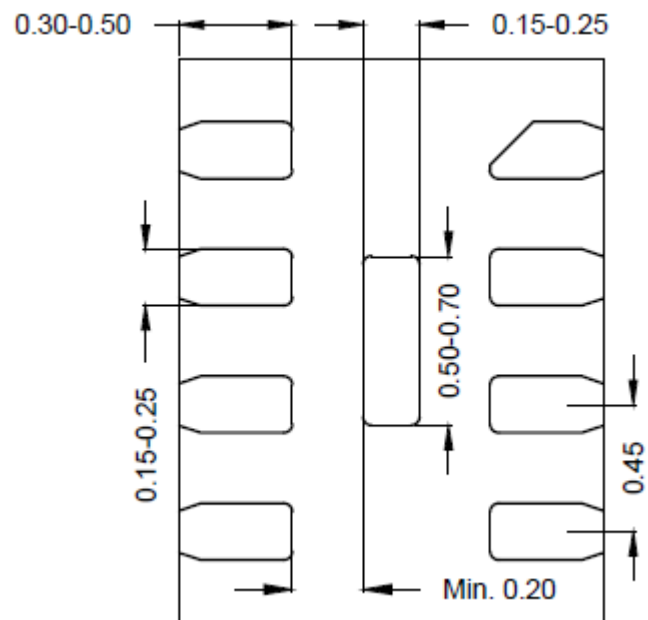


Figure4. PCB Layout Suggestion

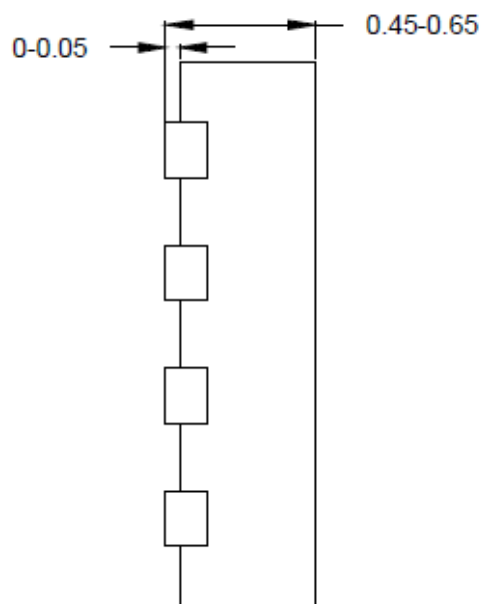
DFN2×1.5-8 Package Outline Drawing



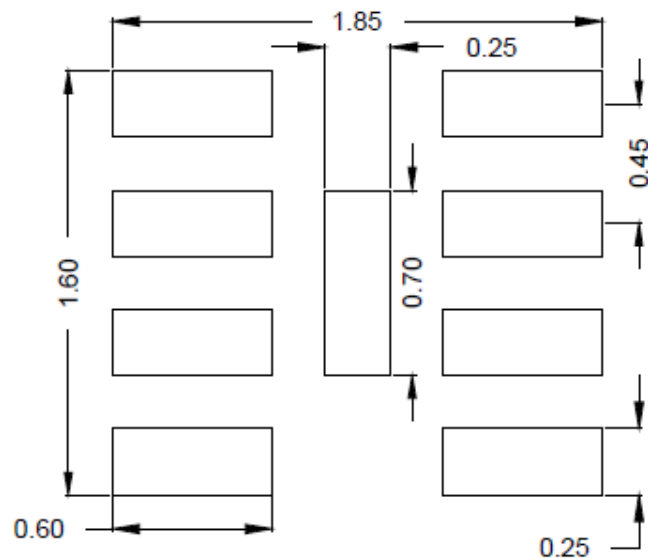
Top view



Bottom view



Side view

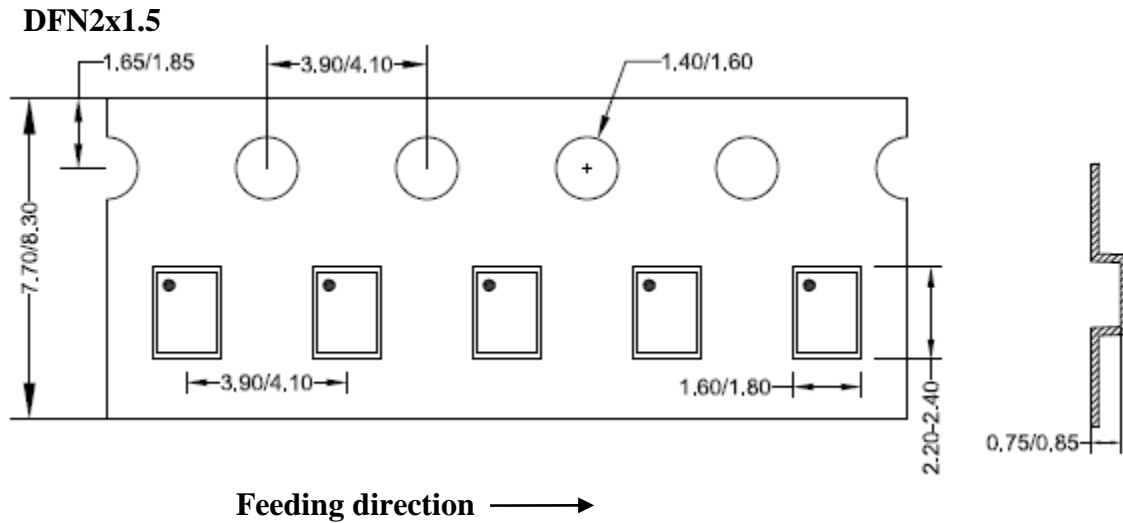


**Recommended PCB layout
(Reference only)**

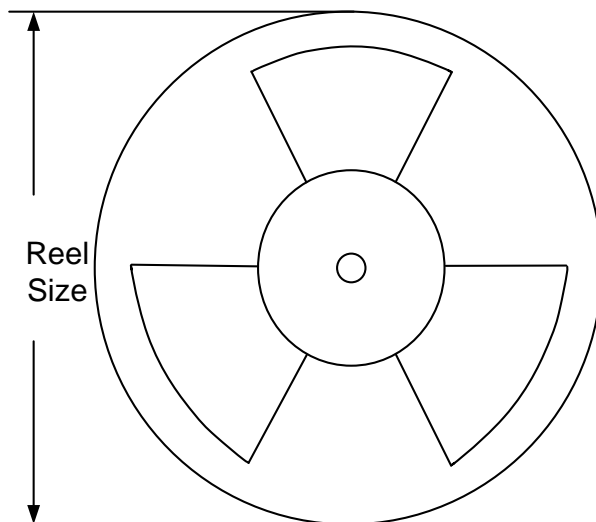
Notes: All dimension in millimeter and exclude mold flash & metal burr

Taping & Reel Specification

1. 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
DFN2x1.5	8	4	7	400	160	3000

3. Others: NA

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