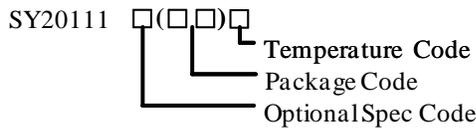


### General Description

SY2011A/B/C/D/E/F are high efficiency 3MHz synchronous step down DC/DC regulator ICs capable of delivering up to 1A output current. 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



Ordering Number	Package Type	Note
SY20111ADQC	DFN1.5×1.5-6	Fixed 1.2V <sub>OUT</sub>
SY20111BDQC	DFN1.5×1.5-6	Fixed 1.5V <sub>OUT</sub>
SY20111CDQC	DFN1.5×1.5-6	Fixed 1.8V <sub>OUT</sub>
SY20111DDQC	DFN1.5×1.5-6	Fixed 2.5V <sub>OUT</sub>
SY20111EDQC	DFN1.5×1.5-6	Fixed 3.3V <sub>OUT</sub>
SY20111FDQC	DFN1.5×1.5-6	Fixed 1.0V <sub>OUT</sub>

### Features

- Low  $R_{DS(ON)}$  for internal switches (top/bottom) 230mΩ/150mΩ
- 2.5~5.5V input voltage range
- Fixed output voltage:
  - SY20111A: Fixed 1.2V<sub>OUT</sub>
  - SY20111B: Fixed 1.5V<sub>OUT</sub>
  - SY20111C: Fixed 1.8V<sub>OUT</sub>
  - SY20111D: Fixed 2.5V<sub>OUT</sub>
  - SY20111E: Fixed 3.3V<sub>OUT</sub>
  - SY20111F: Fixed 1.0V<sub>OUT</sub>
- 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: DFN1.5×1.5-6

### Applications

- Portable Navigation Device
- Set Top Box
- USB Dongle
- Media Player
- Smart phone

### Typical Applications

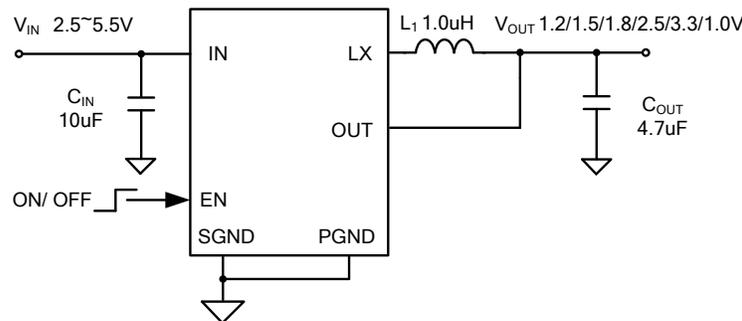
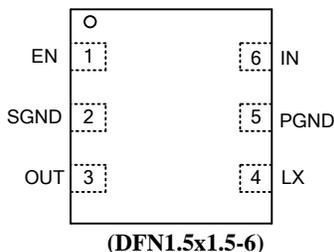


Figure1. Schematic Diagram



# SY2011A/B/C/D/E/F

## Pinout (Top View)



**Top Mark:** QYxyz for SY2011A (device code: QY, x=year code, y=week code, z=lot number code)  
 QBxyz for SY2011B (device code: QB, x=year code, y=week code, z=lot number code)  
 QCxyz for SY2011C (device code: QC, x=year code, y=week code, z=lot number code)  
 QDxyz for SY2011D (device code: QD, x=year code, y=week code, z=lot number code)  
 RLxyz for SY2011E (device code: RL, x=year code, y=week code, z=lot number code)  
 RMxyz for SY2011F (device code: RM, x=year code, y=week code, z=lot number code)

Pin Name	Pin Number	Pin Description
EN	1	Enable control. Pull high to turn on. Do not float.
PGND	5	Power ground pin.
SGND	2	Signal ground pin.
LX	4	Inductor pin. Connect this pin to the switching node of inductor.
IN	6	Input pin. Decouple this pin to GND pin with at least 10uF ceramic cap.
OUT	3	Output Pin. Connect this pin to the output.

## Absolute Maximum Ratings (Note 1)

Supply Input Voltage ----- 6.0V  
 Enable, FB Voltage-----  $V_{IN} + 0.6V$   
 Power Dissipation,  $P_D$  @  $T_A = 25^\circ C$ ,  
 DFN1.5x1.5-6 ----- 0.8W  
 Package Thermal Resistance (Note 2)  
 $\theta_{JA}$  -----  $145^\circ C/W$   
 $\theta_{JC}$  -----  $81^\circ C/W$   
 Junction Temperature Range -----  $125^\circ C$   
 Lead Temperature (Soldering, 10 sec.) -----  $260^\circ C$   
 Storage Temperature Range -----  $-65^\circ C$  to  $150^\circ C$

## Recommended Operating Conditions (Note 3)

Supply Input Voltage ----- 2.5V to 5.5V  
 Junction Temperature Range -----  $-40^\circ C$  to  $125^\circ C$   
 Ambient Temperature Range -----  $-40^\circ C$  to  $85^\circ C$



# SY2011A/B/C/D/E/F

## Electrical Characteristics

( $V_{IN} = 5V$ ,  $V_{OUT} = 2.5V$ ,  $L = 1.0\mu H$ ,  $C_{OUT} = 4.7\mu F$ ,  $T_A = 25^\circ C$ , 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		$\mu A$
Shutdown Current	$I_{SHDN}$	$EN=0$		0.1	1	$\mu A$
Output Voltage	$V_{OUT}$	SY20111A	1.176	1.2	1.224	V
		SY20111B	1.47	1.5	1.53	V
		SY20111C	1.764	1.8	1.836	V
		SY20111D	2.45	2.5	2.55	V
		SY20111E	3.234	3.3	3.366	V
		SY20111F	0.98	1.0	1.02	V
PFET RON	$R_{DS(ON),P}$			230		$m\Omega$
NFET RON	$R_{DS(ON),N}$			150		$m\Omega$
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		$\Omega$

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

**Note 2:**  $\theta_{JA}$  is measured in the natural convection at  $T_A = 25^\circ C$  on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. Exposed Paddle of DFN package is the case position for  $\theta_{JC}$  measurement.

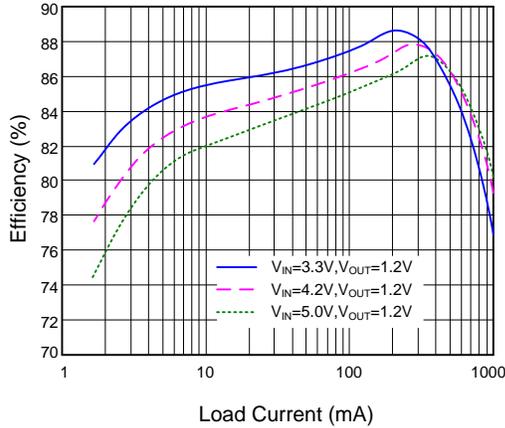
**Note 3:** The device is not guaranteed to function outside its operating conditions.



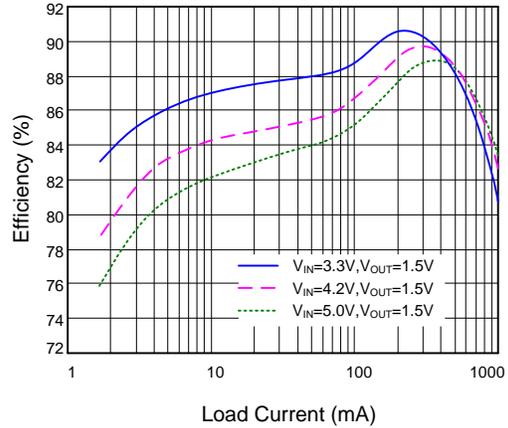
# SY2011A/B/C/D/E/F

## Typical Performance Characteristics

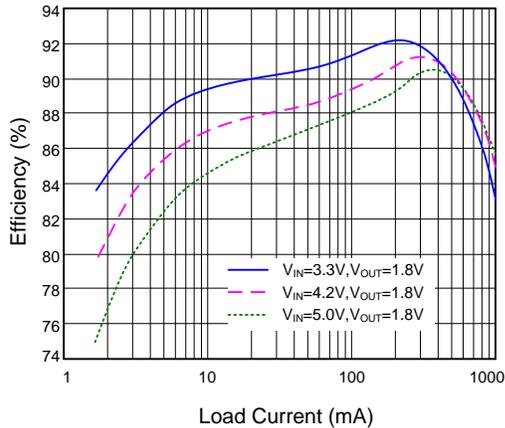
Efficiency vs. Load Current (SY20111A)



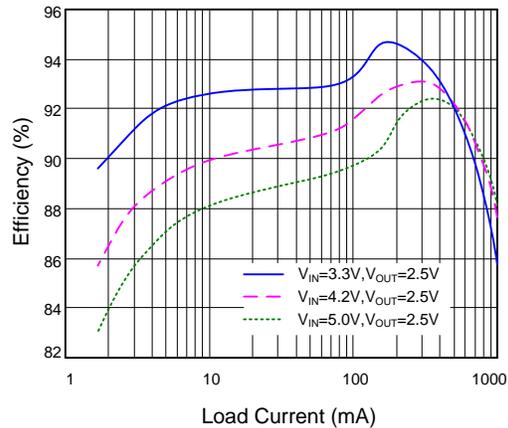
Efficiency vs. Load Current (SY20111B)



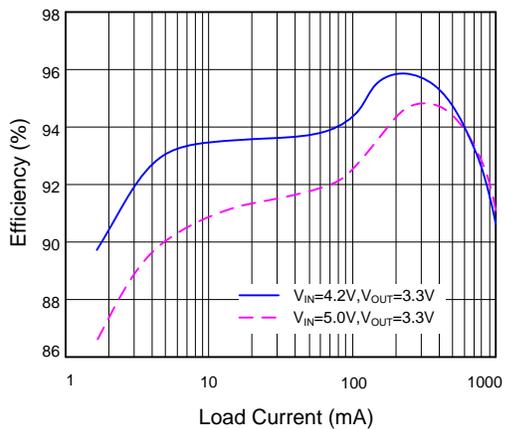
Efficiency vs. Load Current (SY20111C)



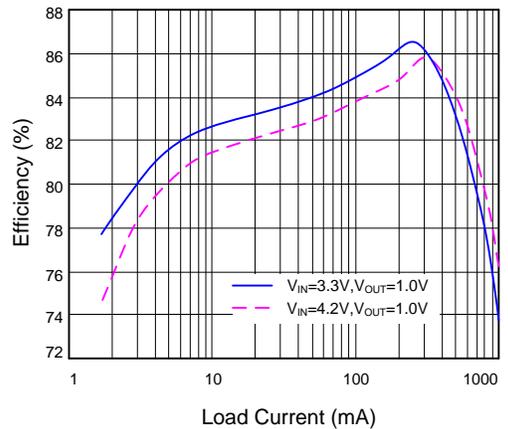
Efficiency vs. Load Current (SY20111D)



Efficiency vs. Load Current (SY20111E)

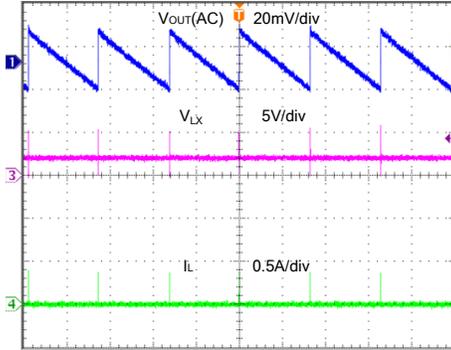


Efficiency vs. Load Current (SY20111F)



### Output Ripple

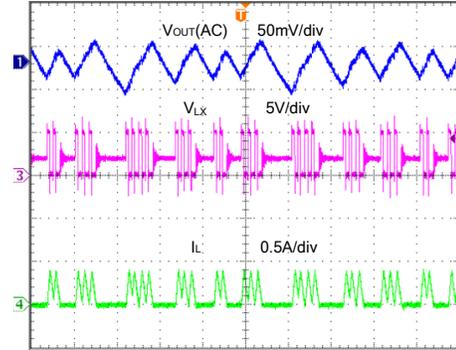
( $V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=0A$ )



Time (40µs/div)

### Output Ripple

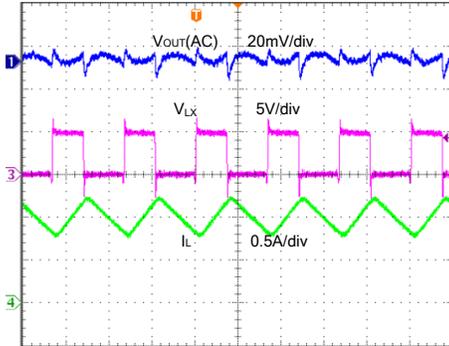
( $V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=0.1A$ )



Time (2µs/div)

### Output Ripple

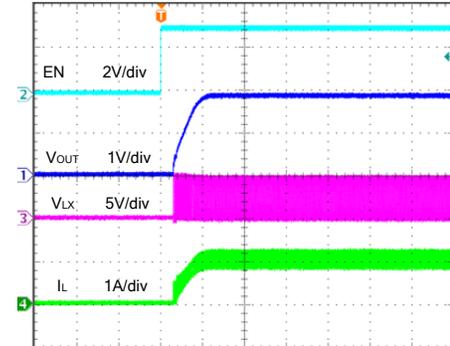
( $V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1.0A$ )



Time (200ns/div)

### Startup

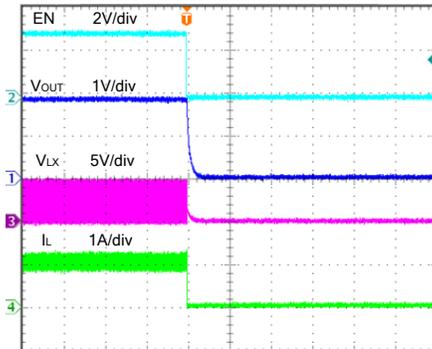
( $V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1A$ )



Time (1ms/div)

### Shutdown

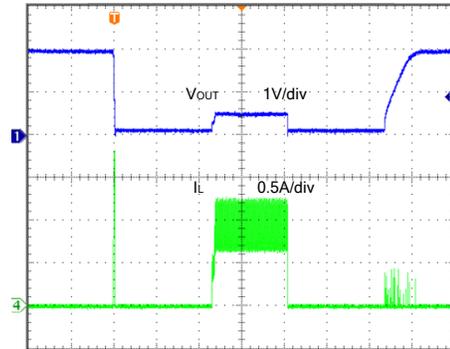
( $V_{IN}=5.0V, V_{OUT}=1.8V, I_{LOAD}=1A$ )



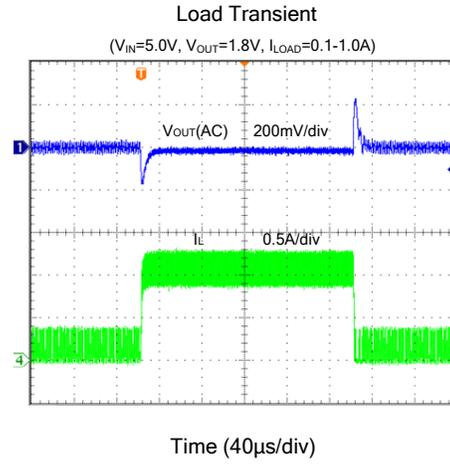
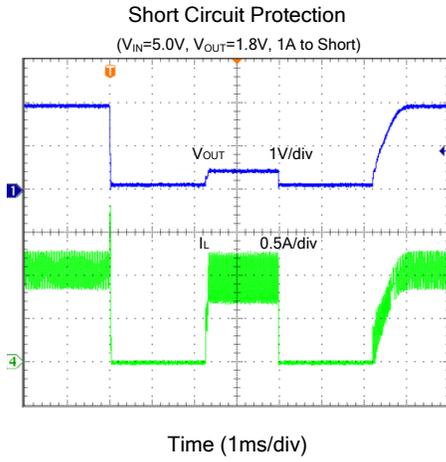
Time (100µs/div)

### Short Circuit Protection

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



Time (1ms/div)





## Operation

SY2011A/B/C/D/E/F are high efficiency 3MHz synchronous step down DC/DC regulator ICs capable of delivering up to 1A output current. 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 the SY2011A/B/C/D/E/F ICs, the application circuit based on this regulator IC is rather simple. Only input capacitor  $C_{IN}$ , output capacitor  $C_{OUT}$  and output inductor  $L$  need to be selected for the targeted applications 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 4.7uF 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 SY2011A/B/C/D/E/F regulator ICs are 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 conditions.

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

- 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  $DCR < 50\text{mohm}$  to achieve a good overall efficiency.

### Layout Design:

The layout design of SY2011A/B/C/D/E/F regulators are relatively simple. For the best efficiency and minimum noise problems, we should place the following components close to the IC:  $C_{IN}$  and  $L$ .

- 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)  $C_{IN}$  must be close to Pins IN and GND. The loop area formed by  $C_{IN}$  and GND must be minimized.

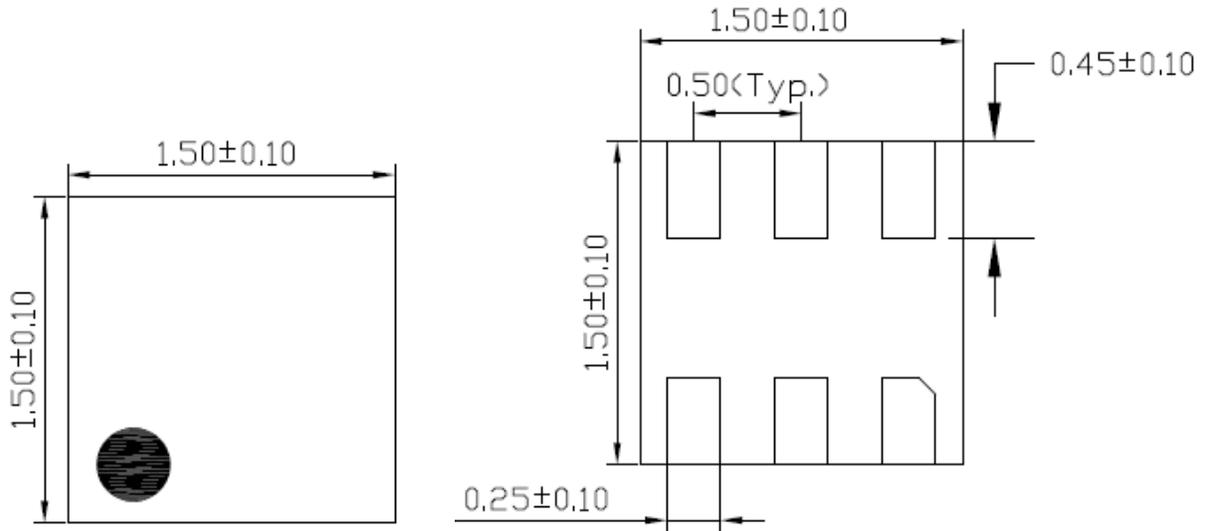
- 3) The PCB copper area associated with LX pin must be minimized to avoid the potential noise problem.

- 4) 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 1Mohm resistor between the EN and GND pins to prevent the noise from falsely turning on the regulator at shutdown mode.

### Load Transient Considerations:

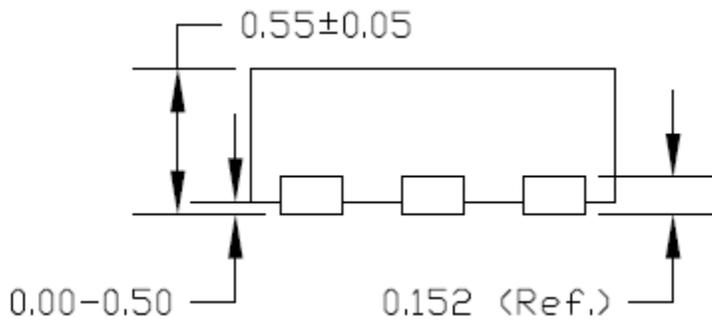
The SY2011A/B/C/D/E/F regulator ICs integrate the compensation components to achieve good stability and fast transient responses..

**DFN1.5x1.5-6L Package Outline**



**Top View**

**Bottom View**

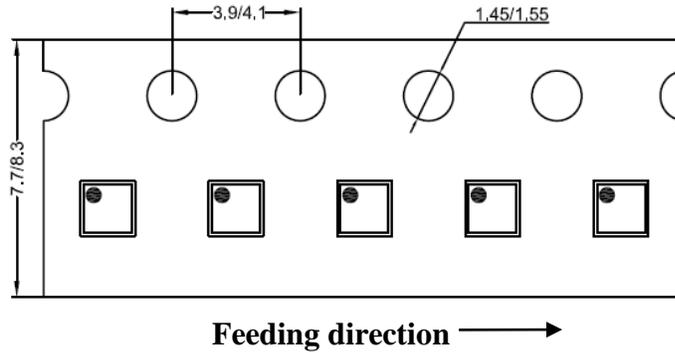


**Side View**

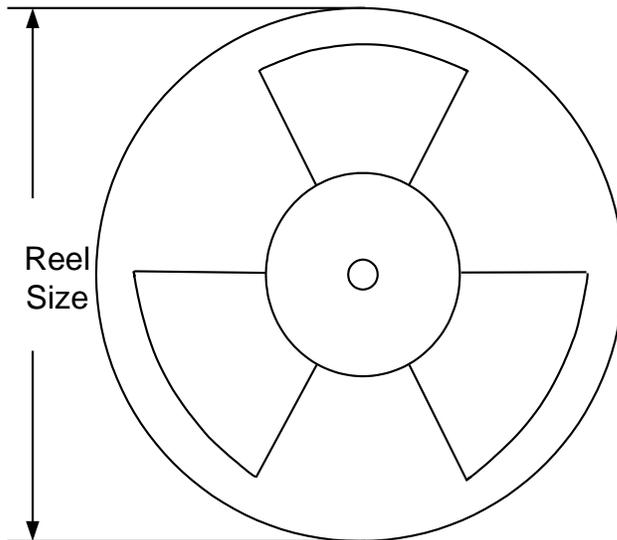
**Notes: All dimension in MM and exclude mold flash & metal burr.**

**Taping & Reel Specification**

**1. DFN 1.5x1.5-6 taping orientation**



**2. Carrier Tape & Reel specification for packages**



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
DFN1.5x1.5	8	4	7"	400	160	3000

**3. Others: NA**



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