SY20621D

High Efficiency, 3A, 2.5V- 6V Input Synchronous Step Down DC/DC converter

General Description

The SY20621D is a step-down module converter with built-in power MOSFETs and inductor. The SY20621D achieves 3A of continuous output current from a 2.5V to 6V input voltage with excellent load and line regulation. It provides accurate regulation for a variety of loads over Tj= -40°C to 125°C. The output voltage can be regulated as low as 0.6V. Only input capacitors, output capacitor and FB resistor divider are needed to complete the design.

The device is equipped with cycle-by-cycle current limit, hiccup over current protection and thermal shutdown protection.

Features

- Wide Input Voltage Range: 2.5V to 6V
- Capable of 3A constant output current
- High Output Voltage Accuracy Over Temperature Range (Ta -40°C to 105°C)
- FCCM under all Io Range
- Pseudo 2.4MHz switching frequency
- Internal Soft-start Limits the Inrush Current
- Reliable Protection Mode:
  Auto-retry Mode for UVP, UVLO and OTP.
  Hiccup Mode for OCP
- 100% dropout operation
- RoHS Compliant and Halogen Free
- Compact Package: MDFN2.5×2×1.08 mm

Ordering Information

SY20621□(□□□)

- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY20621DAAE	MDFN2.5×2-10	--

Applications

- Smart Phone
- Telecom Applications
- Optical Module

Typical Applications

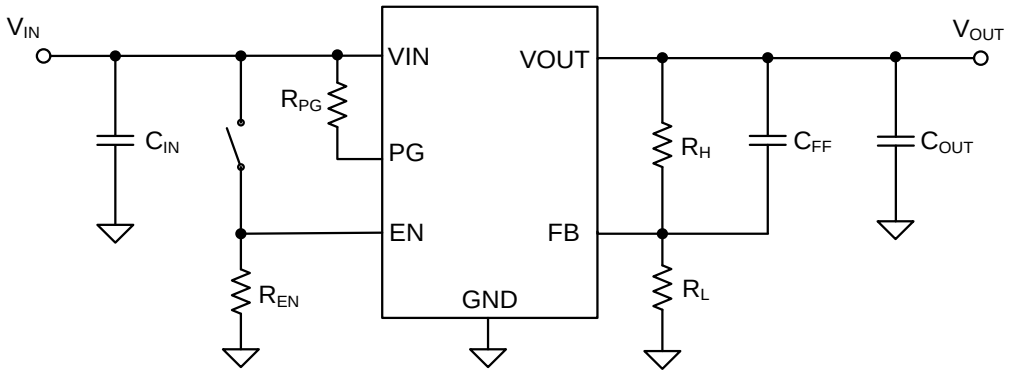
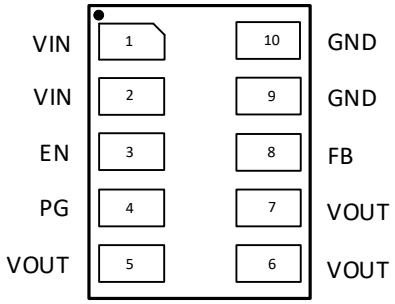


Figure 1. Schematic Diagram

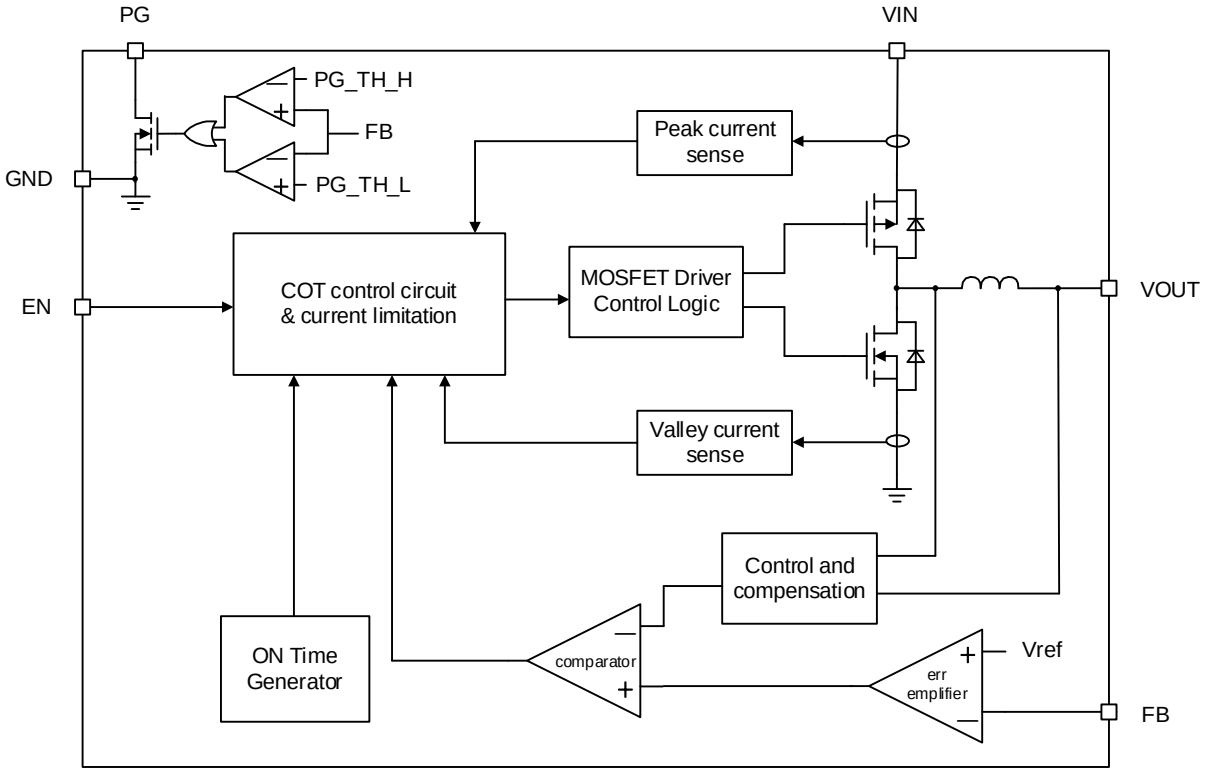
Pinout (top view)



(MDFN2.5×2-10)

Pin Name	Pin Number	Pin Description
VIN	1,2	Input pin. Decouple this pin to GND pin with at least 10μF ceramic capacitor.
EN	3	Enable pin. Pull high to enable the device. Pull low to disable the device.
PG	4	Power good open drain output pin.
VOUT	5,6,7	Output voltage pin. Decouple this pin to GND pin with at least a 20μF ceramic capacitor.
FB	8	Output Feedback Pin. Connect this pin to the center point of the output resistor divider to program the output voltage: $V_{OUT}=0.6\times(1+R_H/R_L)$.
GND	9,10	Ground pin.

Block Diagram



Absolute Maximum Ratings (Note 1)

Supply Input Voltage ---------- 0.3V to 7V
All Other Pins ---------- -0.3V to V_{IN} + 0.3V
Power Dissipation, P_D @ T_A = 25°C, MDFN ---------- 2.15W
Package Thermal Resistance (Note 2)
θ_{JA} ---------- 46°C/W
Ψ_{JB} ---------- 35°C/W
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -55°C to 125°C
Junction Temperature, Operating ---------- -40°C to 125°C

Recommended Operating Conditions (Note 3)

Supply Input Voltage ---------- 2.5V to 6V
Output voltage ---------- 0.6V to Vin
Output Current Range ---------- 0A to 3A

Electrical Characteristics

(V_{IN} = 3.3V, V_O =1.8V, I_O = 3A, C_O = 3×10μF, FB divider resistor accuracy = 1%, T_J=-40℃ to +125℃, Typical values are at T_J=25℃, unless otherwise specified. The values are guaranteed by test, design or statistical correlation)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Specifications						
Input Voltage Range	V_{IN}		2.5		6	V
Input UVLO Threshold (falling)	$V_{UVLO,FALLING}$	EN=V_{IN}	2	2.2	2.3	V
Input UVLO Hysteresis	V_{HYS}			200		mV
Input Current with No Load	I_{IN}	I_O=0A	10	16	30	mA
Shutdown Current	I_{SHDN}			0.1	15	μA
Output Specifications						
Feedback Reference Voltage	V_{REF}	T_J=-40°C-125°C	0.591	0.6	0.609	V
		T_J=25°C	0.594	0.6	0.606	V
Load Regulation (Note 4)	ΔV_{LDR}	T_A=25°C, I_O=0 to 3A			±1	%
Line Regulation (Note 4)	ΔV_{LNR}	V_{IN}=2.5-6V ,Io=1.5A			±1	%
Temperature Regulation (Note 4)	ΔT	T_A=-40°C to 105°C, I_O=1.5A			±2	%
Bottom FET Valley Current Limit	$I_{LIM,BOT}$			4		A
Rise Time	t_{RISE}	From EN high to 95% of VOUT nominal	0	0.3	1	ms
General Specifications						
Switching Frequency	f_{SW}		1.92	2.4	2.88	MHz
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis	T_{HYS}			20		°C
Maximum Duty Cycle (Note 4)	D_{MAX}		100			%
Min On Time(Note 4)	$t_{ON,MIN}$			50		ns
Signal Specifications						
EN Pin Logic High Threshold (rising)	$V_{EN,rising}$		1.0			V
EN Pin Logic Low Threshold (falling)	$V_{EN,falling}$				0.4	V
EN Pull-down Resistance	R_{EN}	EN Low	300	400	500	kΩ
Power Good Asserts Threshold	$V_{PG,ASSERTS}$	VOUT rising	92	95	98	%
		VOUT falling	85	88	91	%

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} and Ψ_{JB} are based on a four-layer Silergy Evaluation Board (1.6mm thickness, 2OZ copper, 95% copper coverage) in the natural convection at T_A = 25° C. Junction temperature (T_J) refers to the hottest device, which is inductor temperature and case temperature (T_C) as well for this product. Board temperature (T_B) refers to the PCB point to the hottest IC pin with a 1mm distance on the same PCB surface layer.

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

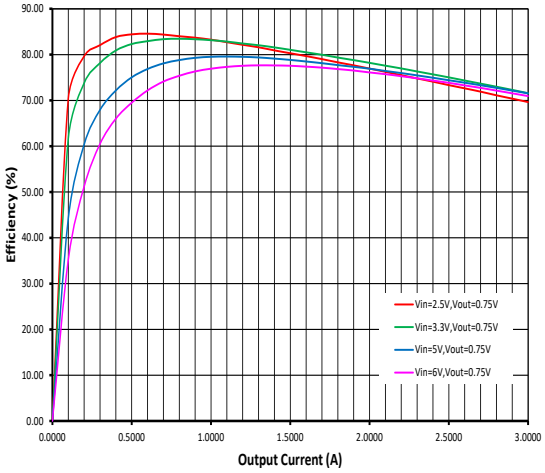
Note 4: The values are guaranteed by design. No production test.

Typical Performance Characteristics

(V_{IN} = 3.3V, T_A = 25°C, unless otherwise specified.)

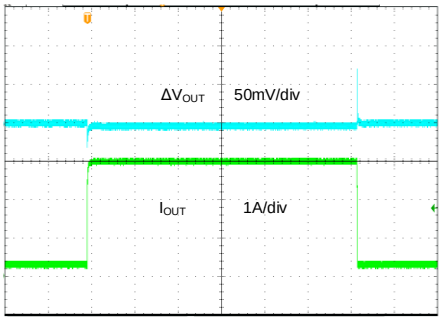
V_{OUT}=0.75V

Efficiency vs Output Current



Load Transient

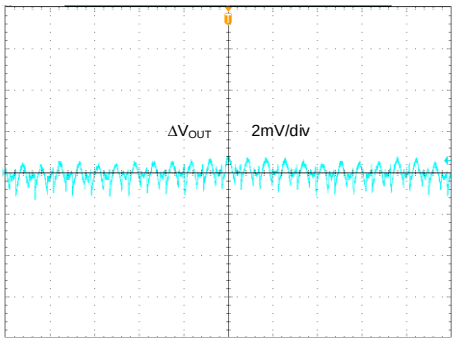
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=0.3~3A)



Time (400μs/div)

Output Ripple

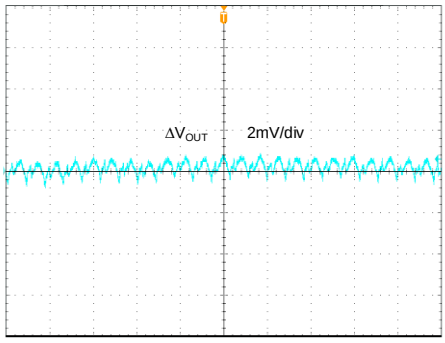
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=3A)



Time (1μs/div)

Output Ripple

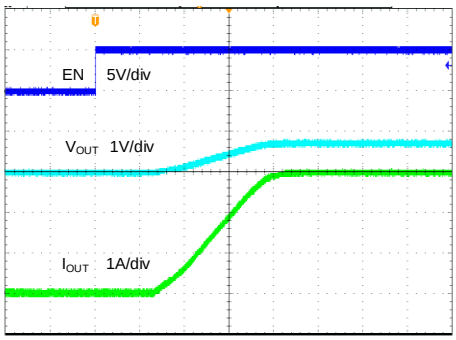
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=0A)



Time (1μs/div)

Startup from EN

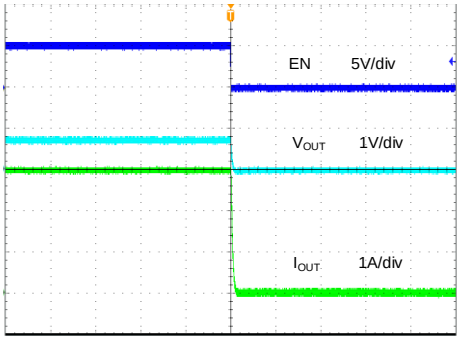
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=3A)



Time (200μs/div)

Shutdown from EN

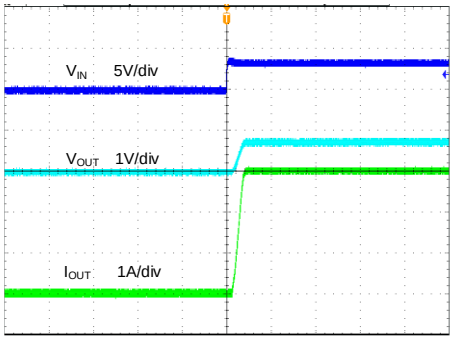
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=3A)



Time (200μs/div)

Startup from V_{IN}

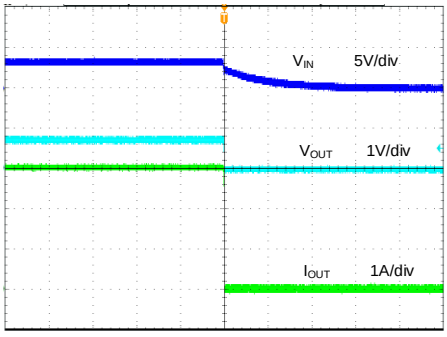
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=3A)



Time (2ms/div)

Shutdown from V_{IN}

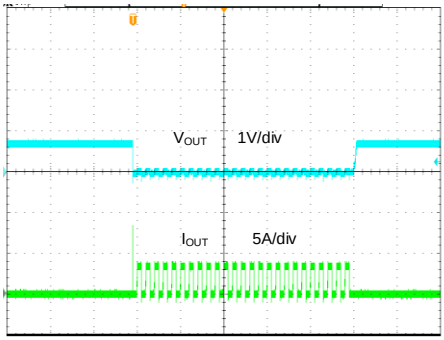
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=3A)



Time (2ms/div)

Short Circuit Protection

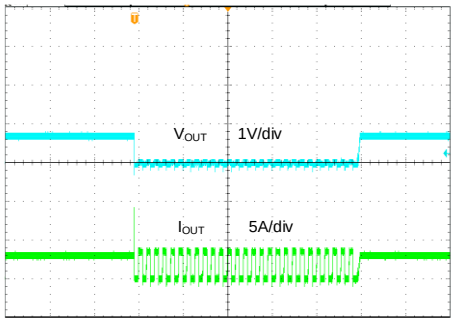
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=0A-Short)



Time (10ms/div)

Short Circuit Protection

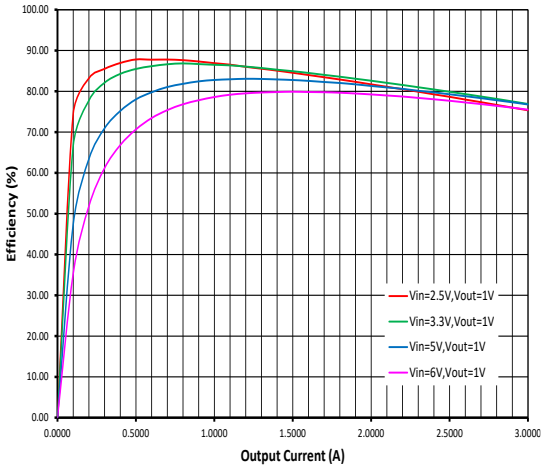
(V_{IN}=3.3V, V_{OUT}=0.75V, I_{OUT}=3A-Short)



Time (10ms/div)

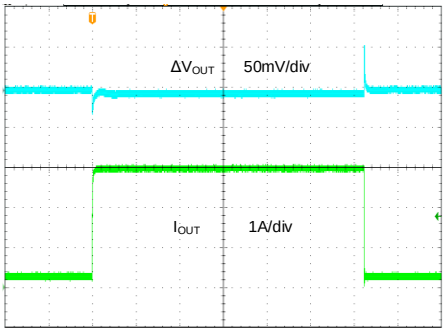
V_{OUT}=1V

Efficiency vs Output Current



Load Transient

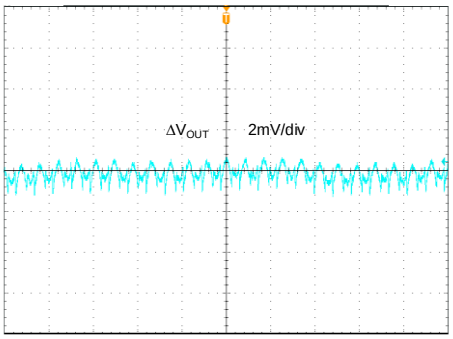
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=0.3A~3A)



Time (400μs/div)

Output Ripple

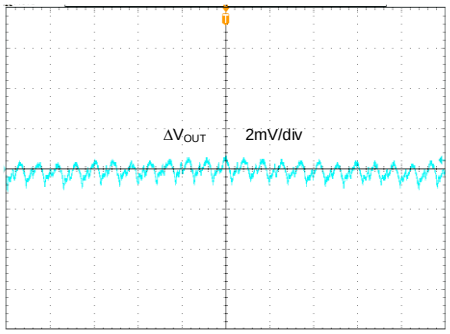
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=3A)



Time (1μs/div)

Output Ripple

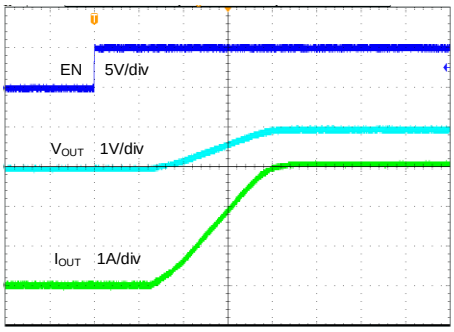
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=0A)



Time (1μs/div)

Startup from EN

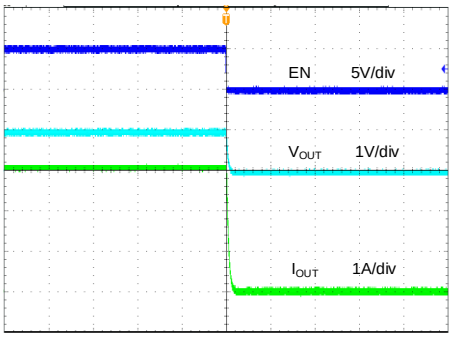
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=3A)



Time (200μs/div)

Shutdown from EN

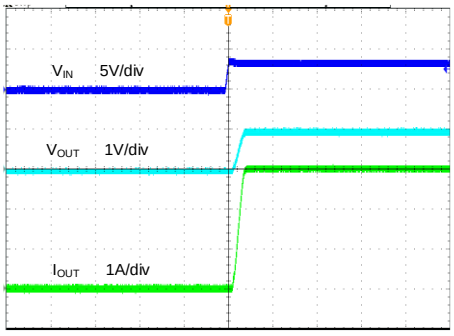
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=3A)



Time (200μs/div)

Startup from V_{IN}

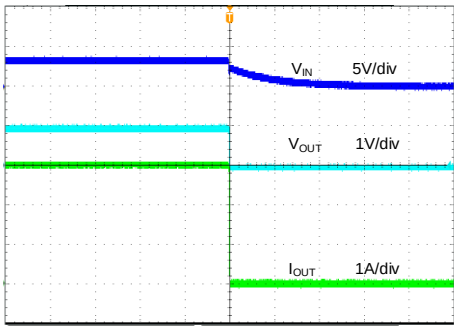
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=3A)



Time (2ms/div)

Shutdown from V_{IN}

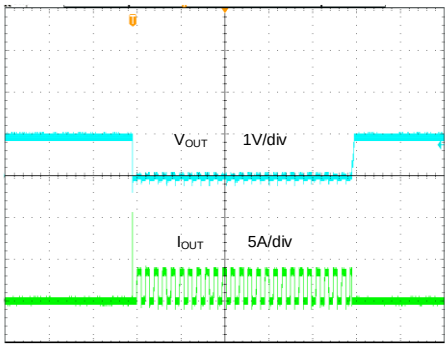
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=3A)



Time (2ms/div)

Short Circuit Protection

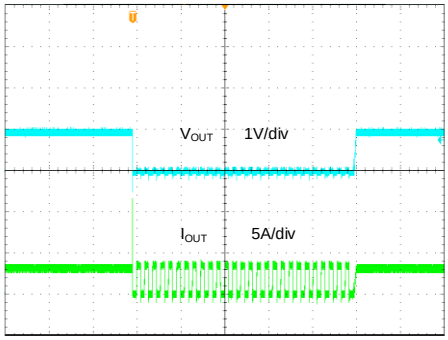
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=0A-Short)



Time (10ms/div)

Short Circuit Protection

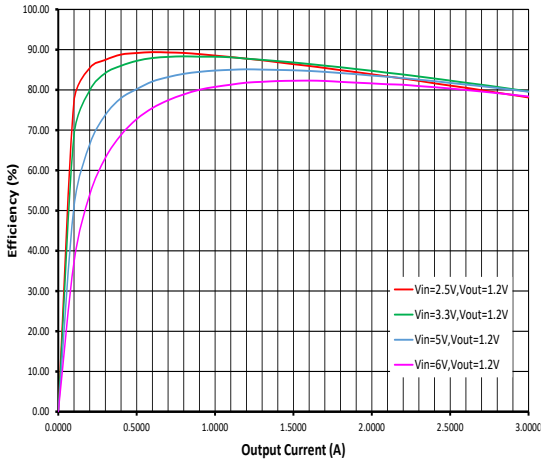
(V_{IN}=3.3V, V_{OUT}=1V, I_{OUT}=3A-Short)



Time (10ms/div)

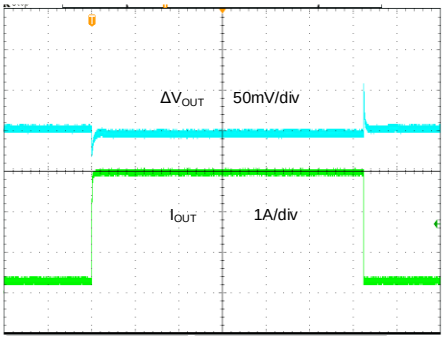
V_{OUT}=1.2V

Efficiency vs Output Current



Load Transient

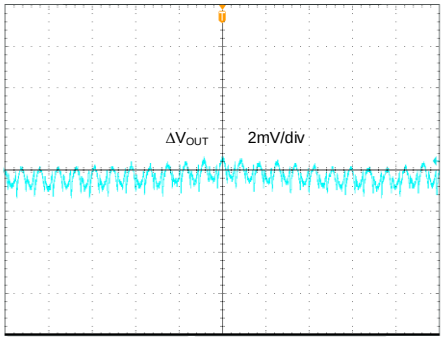
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=0.3~3A)



Time (400μs/div)

Output Ripple

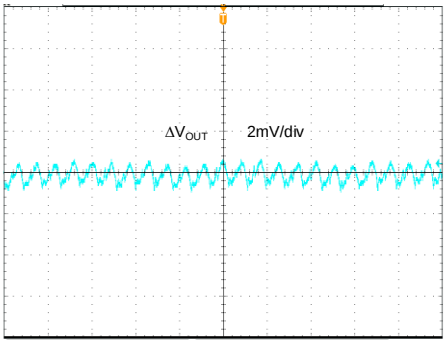
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=3A)



Time (1μs/div)

Output Ripple

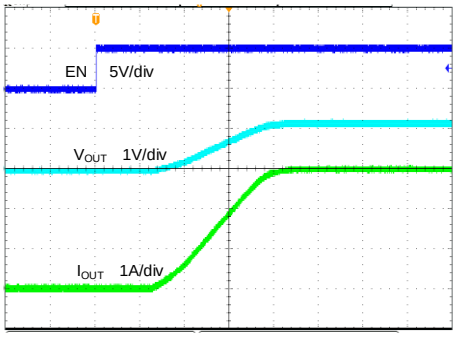
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=0A)



Time (1μs/div)

Startup from EN

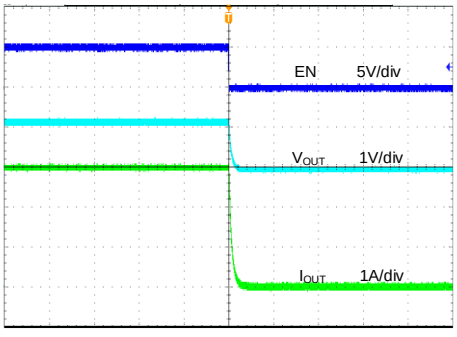
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=3A)



Time (200μs/div)

Shutdown from EN

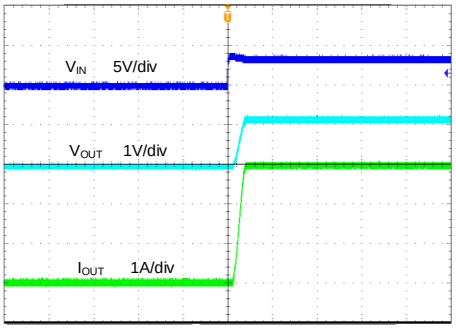
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=3A)



Time (200μs/div)

Startup from V_{IN}

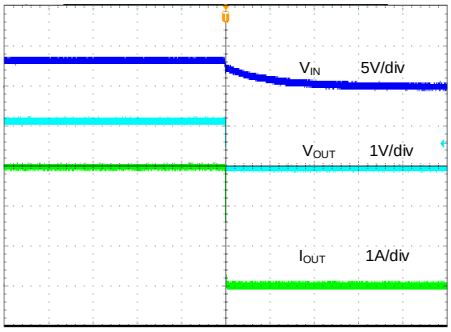
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=3A)



Time (2ms/div)

Shutdown from V_{IN}

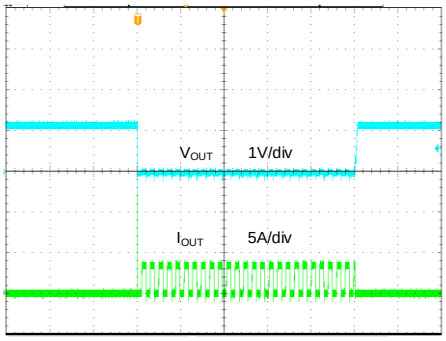
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=3A)



Time (2ms/div)

Short Circuit Protection

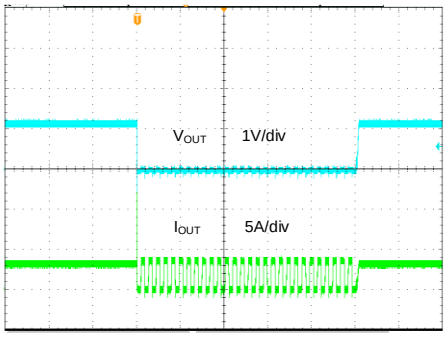
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=0A-Short)



Time (10ms/div)

Short Circuit Protection

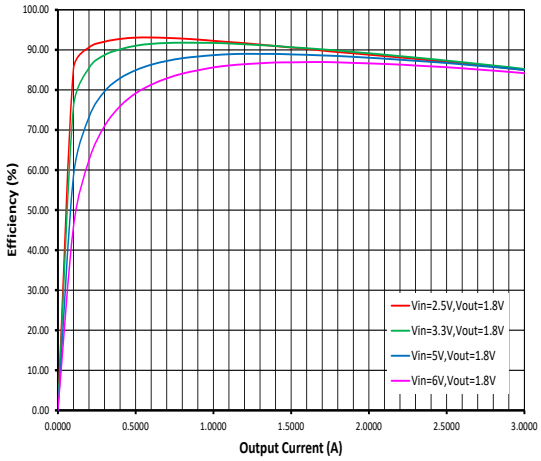
(V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=3A-Short)



Time (10ms/div)

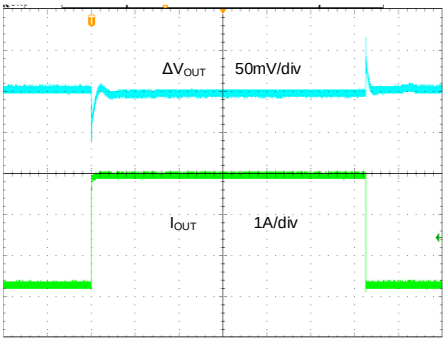
V_{OUT}=1.8V

Efficiency vs Output Current



Load Transient

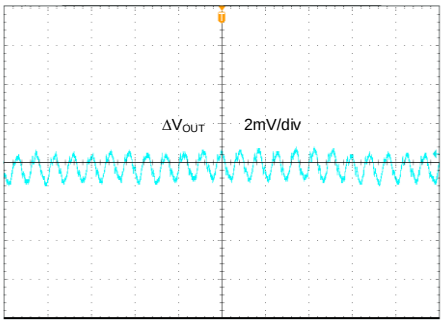
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=0.3~3A)



Time (400μs/div)

Output Ripple

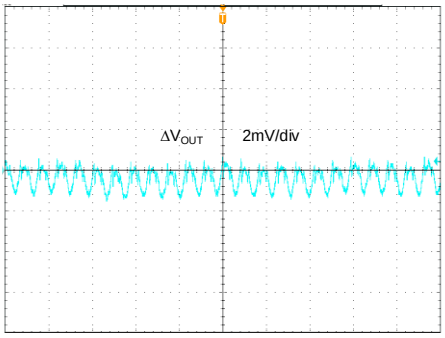
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=3A)



Time (1μs/div)

Output Ripple

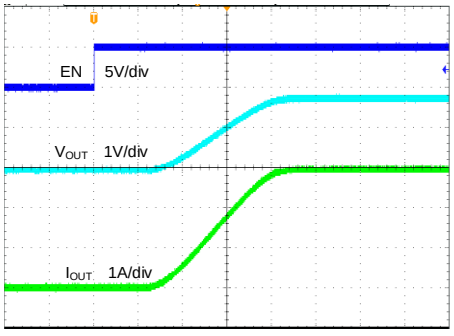
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=0A)



Time (1μs/div)

Startup from EN

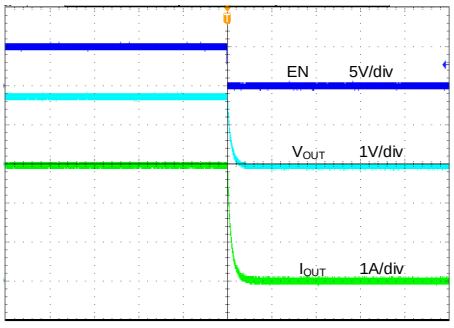
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=3A)



Time (200μs/div)

Shutdown from EN

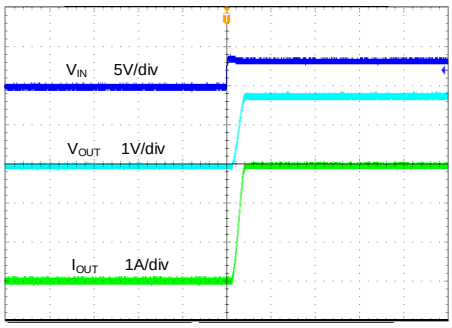
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=3A)



Time (200μs/div)

Startup from V_{IN}

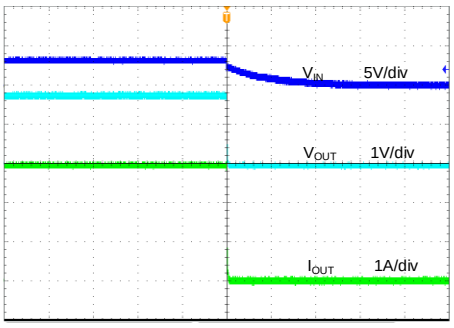
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=3A)



Time (2ms/div)

Shutdown from V_{IN}

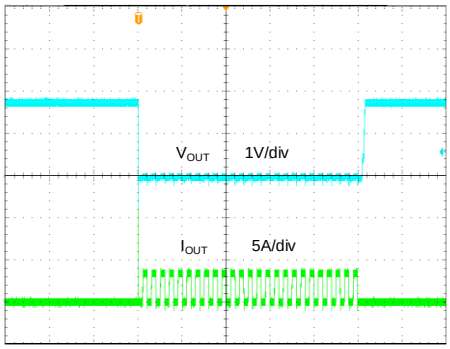
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=3A)



Time (2ms/div)

Short Circuit Protection

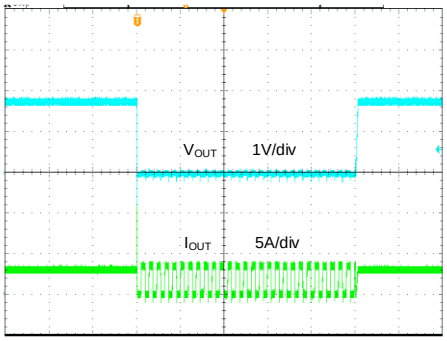
(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=0A-Short)



Time (10ms/div)

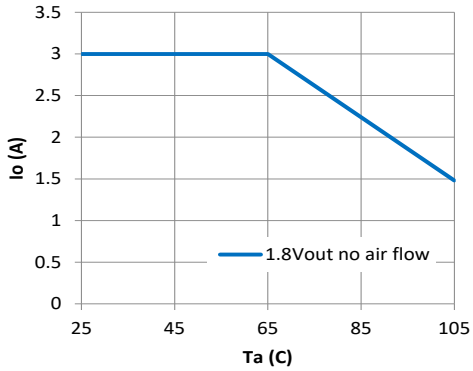
Short Circuit Protection

(V_{IN}=3.3V, V_{OUT}=1.8V, I_{OUT}=3A-Short)



Time (10ms/div)

Thermal Derating Curve @V_{IN}=3.3V



1) T_A: Air temperature, 0.5 inch above IC.
2) Based on a four-layer Silergy Evaluation Board in the natural convection.
3) The inductor temperature is not beyond 115℃ under this TD curve.
4) For customer's specific application, the recommended inductor temperature limitation is 115℃.

Operation General Description

The SY20621D is a high efficiency 2.4MHz synchronous step down DC/DC regulator which is capable of delivering up to 3A output currents. It can operate over a wide input voltage range from 2.5V to 6V and integrate main switch and synchronous switch with very low $R_{DS(ON)}$ to minimize the conduction loss.

Applications Information

Only the input capacitor C_{IN}, 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 of between 10kΩ and 1MΩ is highly recommended for both resistors. If R_H =100kΩ is chosen, then R_L can be calculated to be:

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

A feedforward capacitor(C_{FF}) could be placed paralleling to R_H to improve the transient response. Please refer to the EVB document for the C_{FF} recommendation.

Input Capacitor C_{IN}

To minimize the potential noise problem, place a typical X7R or better grade ceramic capacitor greater than 10μF capacitance, Place this ceramic capacitor really close to the V_{IN} and GND pins. Care should be taken to minimize the loop area formed by CIN, and V_{IN}/GND pins.

External Capacitor Recommendation

	Description	Vendor	PN
CIN	10μF/10V/X7R, 0603	Murata	GRM188D71A106KA73#

Output Capacitor COUT

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 greater than 20μF capacitance. Place this ceramic capacitor really close to the V_{OUT} and GND pins to minimize the loop area formed by COUT, and the V_{OUT}/GND pins.

External Capacitor Recommendation

	Description	Vendor	PN
COUT	10μF/6.3V/X7T, 0603	Murata	GRM188D70J106MA73D

The typical output ripple is shown in above performance characteristic section, basically presenting the output ripple under -10°C~80°C ambient temperature. The stability is also ensured in this temperature range.

For the application where T_A is below -10°C or above 80°C, more peripheral ceramic capacitors are needed. The minimum CIN is 2*10μF, and the minimum COUT is 3*10μF to guarantee operation stability in -40°C~105°C ambient temperature.

Over Current Protection

With load current increasing, as soon as the high side power FET current gets higher than peak current limit threshold(~5A), the high side power FET will turn off and the low side power FET will keep turning on until low side power FET current decrease below the valley current limit threshold(~4A). If the load current continues to increase, the output voltage will drop.

Thermal Shutdown Protection

If the junction temperature of SY20621D is higher than the thermal shutdown temperature (typical 150℃), the IC will turn off both high side power FET and low side power FET, and then enters thermal shutdown protection mode. It will remain in this state until the junction temperature decreases below 130℃. After exiting this state, the IC auto retries to normal operation.

Layout Design

To achieve a higher efficiency and better noise immunity, following components should be placed close to the IC: C_{IN} and C_{OUT}.

1) C_{IN} must be close to the pins V_{IN} and GND. The loop area formed by C_{IN} and GND must be minimized.
2) C_{OUT} must be close to the pins V_{OUT} and GND. The loop area formed by C_{OUT} and GND must be minimized.
3) Place the FB components (R_H, R_L, C_{FF}) as close to the FB pin as possible.
4) 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.

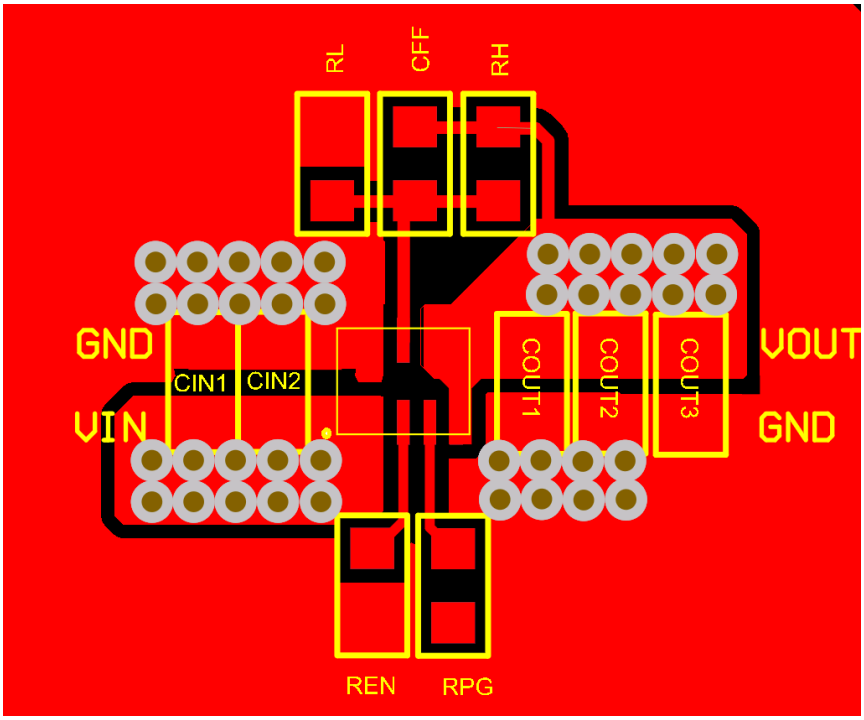
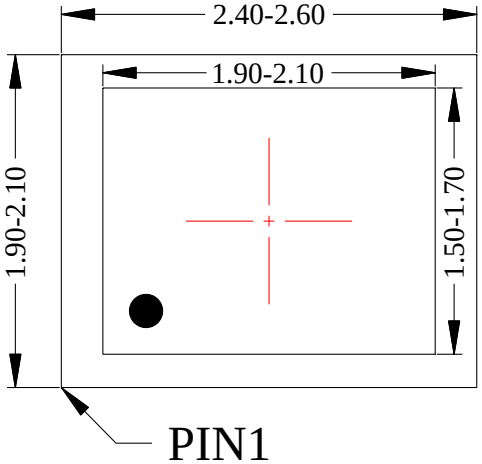
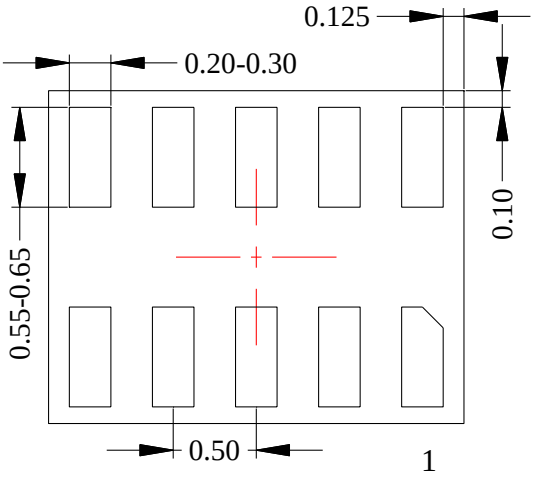


Figure 2. PCB Layout Suggestion

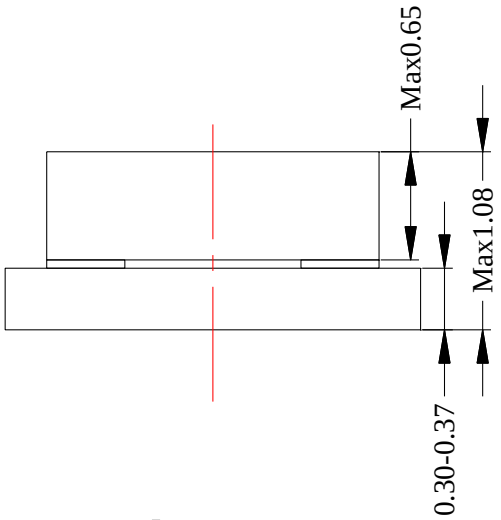
MDFN2.5X2-10 Package Outline Drawing



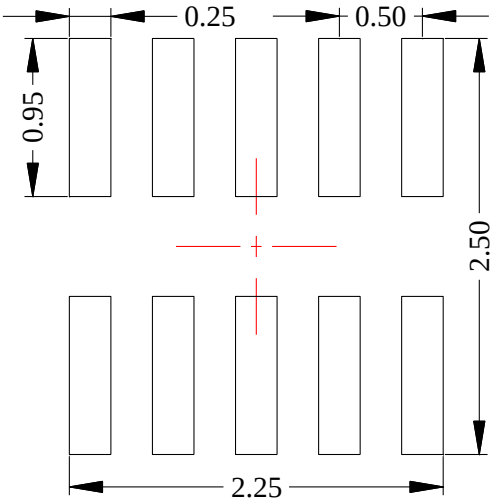
Top View



Bottom View



Side View



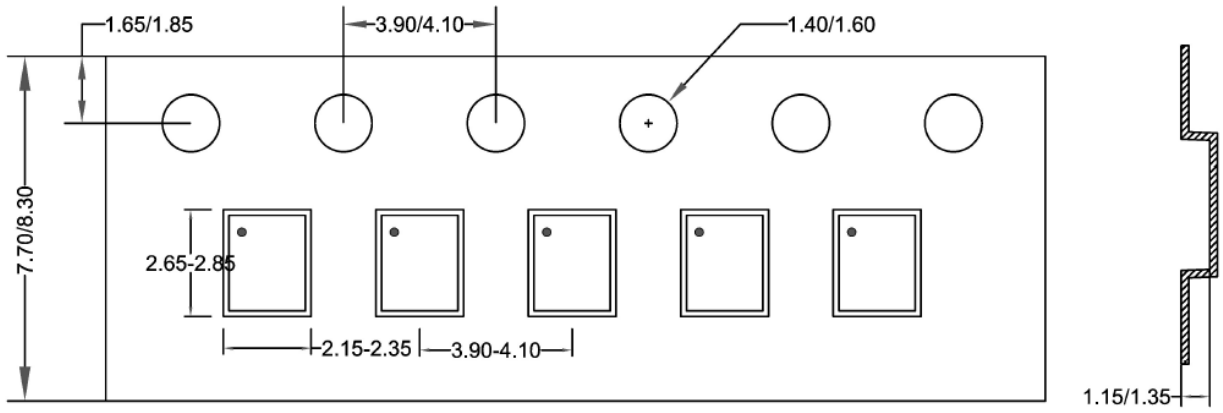
Recommended PCB layout
(Reference only)

Notes: 1.All dimension in millimeter and exclude mold flash & metal burr.
2.Center line on drawing refers to the chip body center.

Taping & Reel Specification

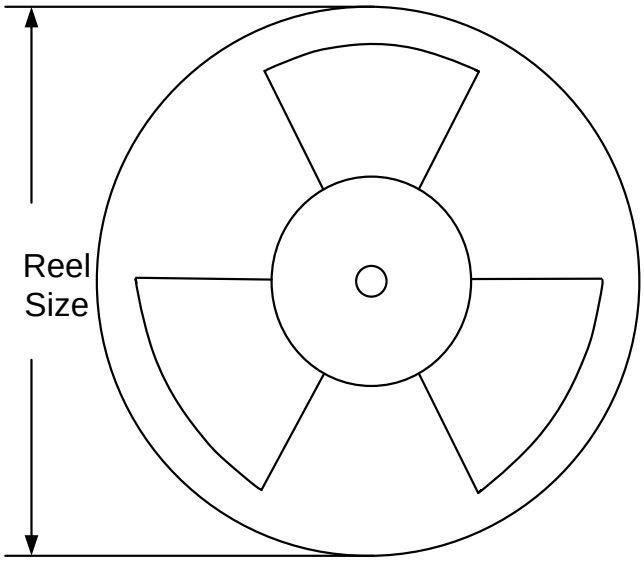
1. Taping Orientation

MDFN2.5x2-10



Feeding Direction ⟶

2. Carrier Tape & Reel specification for packages

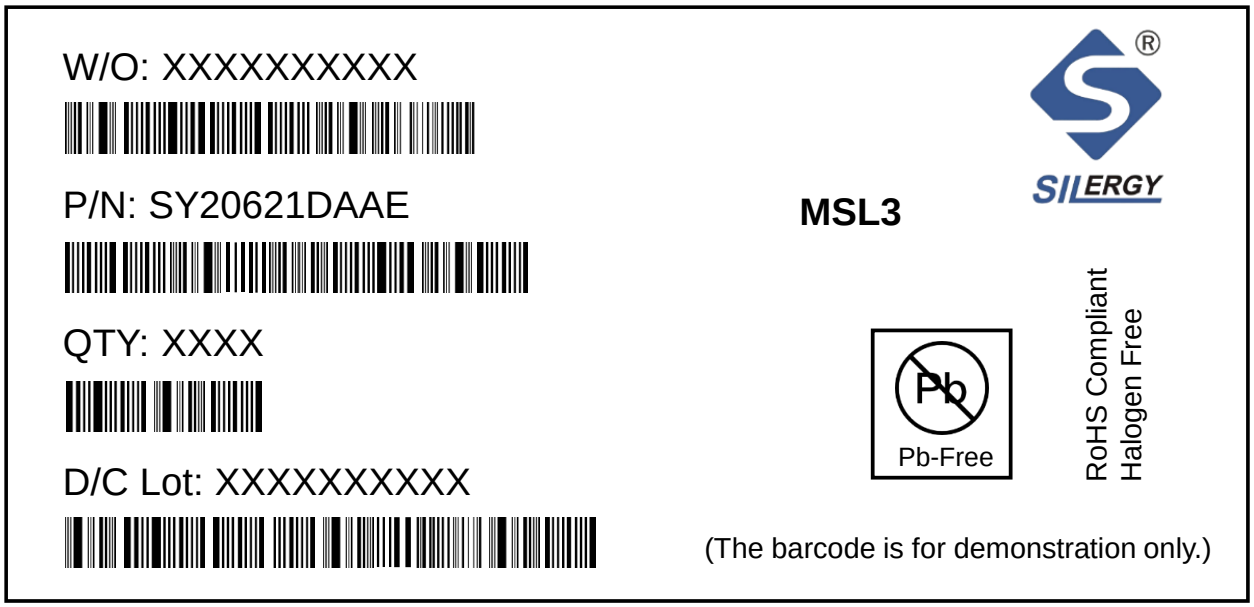


Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer * length(mm)	Leader * length (mm)	Qty per reel (pcs)
MDFN2.5x2-10	8	4	7"	400	160	2500

Packaging Information

Device Marking: **HAF**

Label Information



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