

Operation

HM1488B is a synchronous buck regulator IC that integrates the PWM control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss. With ultra low $R_{ds(on)}$ power switches and proprietary PWM control, this regulator IC can achieve the highest efficiency and the highest switch frequency simultaneously to minimize the external inductor and capacitor size, and thus achieving the minimum solution footprint.

HM1488B provides protection functions such as cycle by cycle current limiting and thermal shutdown protection. HM1488B will sense the output voltage conditions for the fault protection.

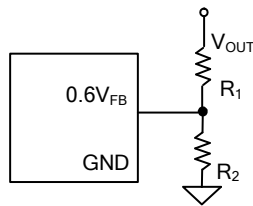
Applications Information

Because of the high integration in the HM1488B IC, the application circuit based on this regulator IC is rather simple. Only input capacitor C_{IN} , output capacitor C_{OUT} , output inductor L and feedback resistors (R_1 and R_2) need to be selected for the targeted applications specifications.

Feedback resistor dividers R_1 and R_2 :

Choose R_1 and R_2 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_1 and R_2 . A value of between $10k\Omega$ and $1M\Omega$ is highly recommended for both resistors. If V_{OUT} is $3.3V$, $R_1=100k$ is chosen, then using following equation, R_2 can be calculated to be $22.1k$:

$$R_2 = \frac{0.6V}{V_{OUT} - 0.6V} R_1$$



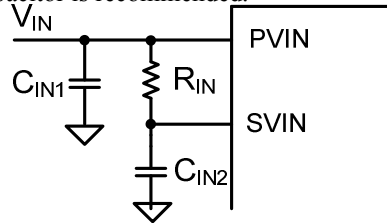
Input capacitor C_{IN} :

The ripple current through input capacitor is calculated as:

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

To minimize the potential noise problem, place a typical X5R or better grade ceramic capacitor really close to the PVIN and GND pins. Care should be taken to minimize the loop area formed by C_{IN} , and

PVIN/GND pins. In this case, a $10\mu F$ low ESR ceramic capacitor is recommended.



The internal analog circuit is powered from SVIN. To avoid the noise issue, a $1\mu F$ ceramic capacitor connected closely from SVIN to GND is recommended. An RC filter can also be added from power input to SVIN.

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 X5R or better grade ceramic capacitor greater than $47\mu F$ 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 HM1488B regulator IC 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 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 $DCR < 10m\Omega$ to achieve a good overall efficiency.

Soft-start

Connect a capacitor from softstart programming pin to ground to program the softstart time.

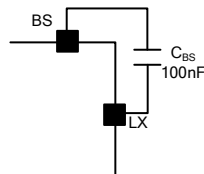
$$T_{SS} = C_{SS} * 0.6V / 10\mu A$$

Enable Operation

Pulling the EN pin low ($< 1.2V$) will shut down the device. During shutdown mode, the HM1488B shutdown current drops to lower than 5uA. Driving the EN pin high ($> 1.3V$) will turn on the IC again.

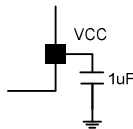
External Bootstrap Cap

This capacitor provides the gate driver voltage for internal high side MOSEFET. A 100nF low ESR ceramic capacitor connected between BS pin and LX pin is recommended.



VCC LDO

The 3.3V internal reference. This pin should be bypassed to ground with a 1uF ceramic capacitor. This pin may be used with an external DC load of 20mA or less



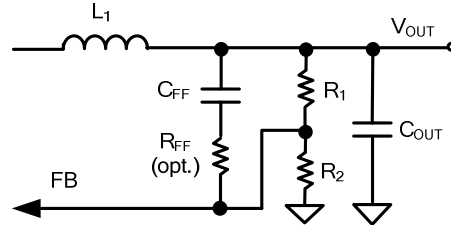
Power Good Indication

PG is an open-drain output pin. This pin will pull to ground if output voltage is lower than 90% of regulation voltage. Otherwise this pin will go to a high impedance state.

Feed forward capacitor C_{FF}:

The HM1488B regulator IC adopts the instant PWM architecture to achieve good stability and fast transient responses. In applications with high step load current, adding an RC network R_{FF} and C_{FF} parallel with R1

may further speed up the load transient responses.



A 1kΩ R_{FF} is recommended. The selection of C_{FF} is related to the output capacitance. Refer to the follow table for proper C_{FF} value.

C _{OUT} (uF)	C _{FF} (nF)
47	0.1
100	0.68
220	1
330	3.3
470	6.8
680	10
1000	47

Layout Design:

The layout design of HM1488B regulator is relatively simple. For the best efficiency and minimum noise problem, we should place the following components close to the IC: C_{IN}, C_{VCC}, L, R1 and R2.

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.

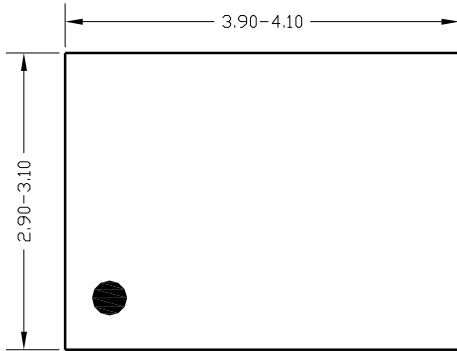
2) C_{IN} must be close to IN and GND pins. The loop area formed by C_{IN} and GND must be minimized.

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

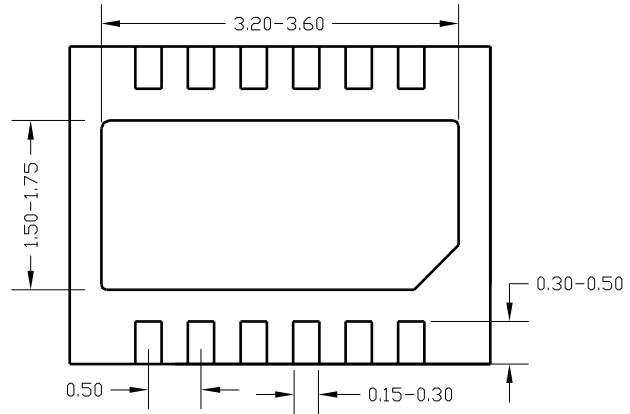
4) The components R1 and R2, and the trace connecting to the FB pin must NOT be adjacent to the LX net on the PCB layout to avoid the noise problem.

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

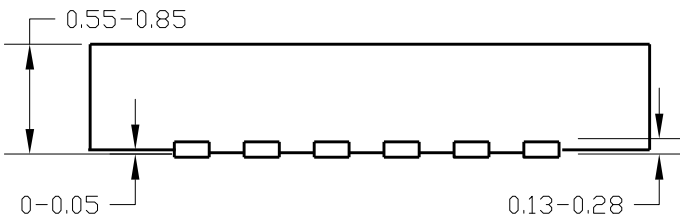
DFN4x3-12 Package outline & PCB Layout



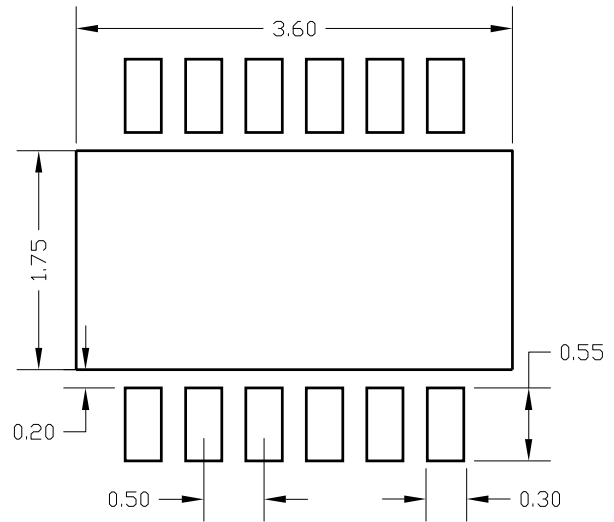
Top View



Bottom View

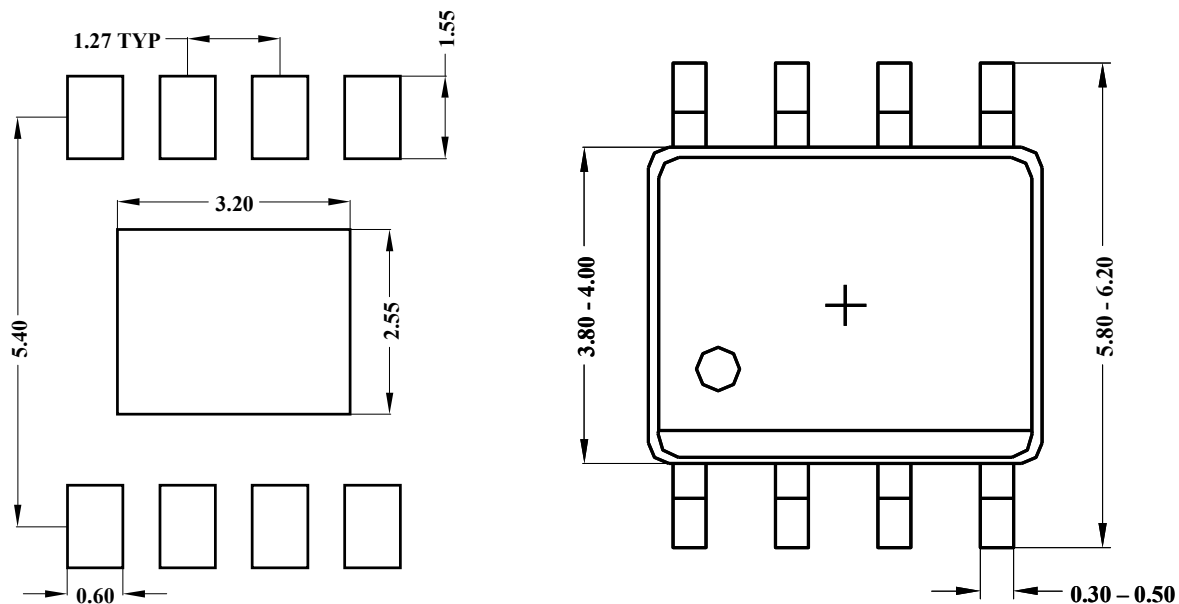


Side View

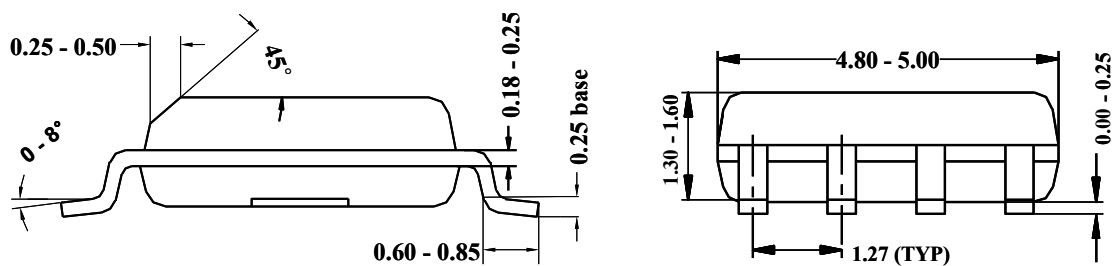


PCB layout (Recommended)

Notes: All dimension in MM and exclude mold flash & metal burr
SO8E Package outline & PCB layout design



Recommended Pad Layout

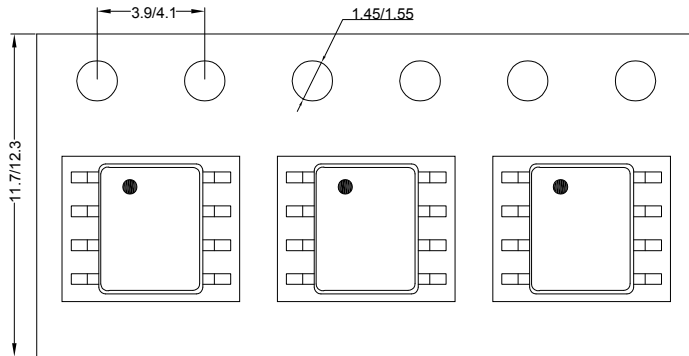


Notes: All dimensions are in millimeters.
 All dimensions don't include mold flash & metal burr.

Taping & Reel Specification

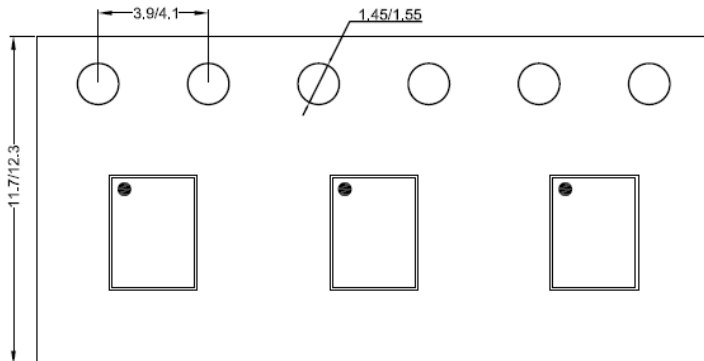
1. Taping orientation

SOP8-EP



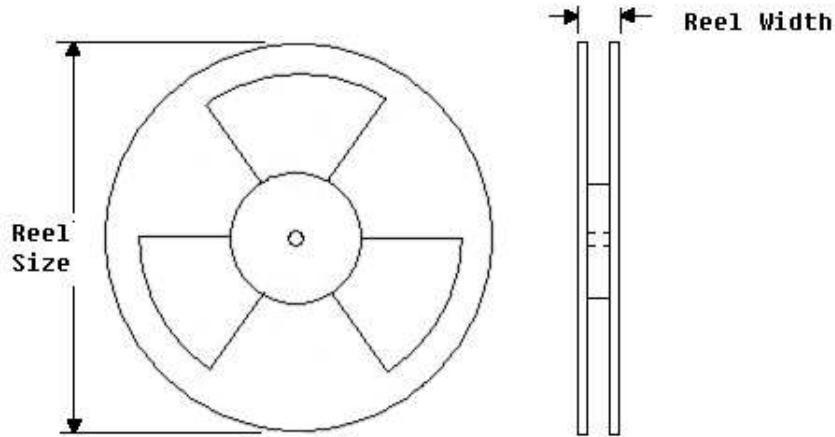
Feeding direction →

DFN4x3 (DFN4030)



Feeding direction →

2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Reel width(mm)	Trailer length(mm)	Leader length (mm)	Qty per reel
SOP8E	12	8	13"	12.4	400	400	2500
DFN4x3	12	8	13"	12.4	400	400	5000

2. Others: NA