

Wide Input Range Step-Down Synchronous DC/DC Converter with External PMOS Driver

FEATURES

- Internal P-MOS+N-MOS Switch Structure
- External PMOS Driver
- Wide Input Voltage: 4.5V to 30V
- Up to typical 3.5A Current Limit at 5V Output
- High Efficiency up to 94%@12V_{IN} to 5V/3A
- PFM in Light Load Condition
- Internal Compensation
- Output Line Drop Compensation
- Hiccup Output Short Current Protection
- $\pm 2\%$ Feedback Voltage Accuracy
- Integrated Soft Start
- Thermal Shutdown
- Duty Cycle up to 100%
- Low BOM Cost
- SOP8 Package

GENERAL DESCRIPTION

TMI2286D is a wide input voltage, high efficiency active CC step-down DC/DC converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode. TMI2286D provides up to typical 3.5A output current at 5V output. Maximum 100% duty cycle could be obtained. TMI2286D internal integrate high side PMOSFET (25mΩ@V_{IN}=12V, 40mΩ@V_{IN}=5V) and low side NMOSFET with 25mΩ. The external PMOSFET can be paralleled between V_{IN} and SW to reduce voltage drop in application. Advanced production features include UVLO, Thermal Shutdown, Soft Start and input OVP.

APPLICATIONS

- Car Charger/ Adaptor
- Rechargeable Portable Devices
- General-Purpose CC/CV Power Suppliers

TYPICAL APPLICATION

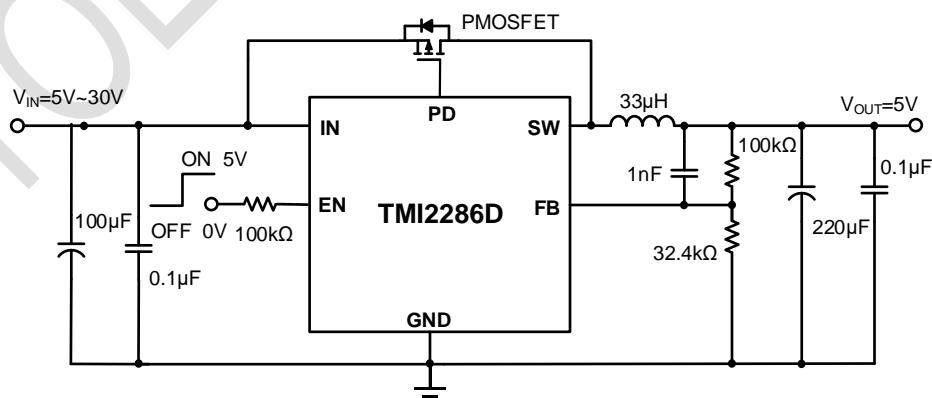


Figure 1. Basic Application Circuit with External PMOSFET

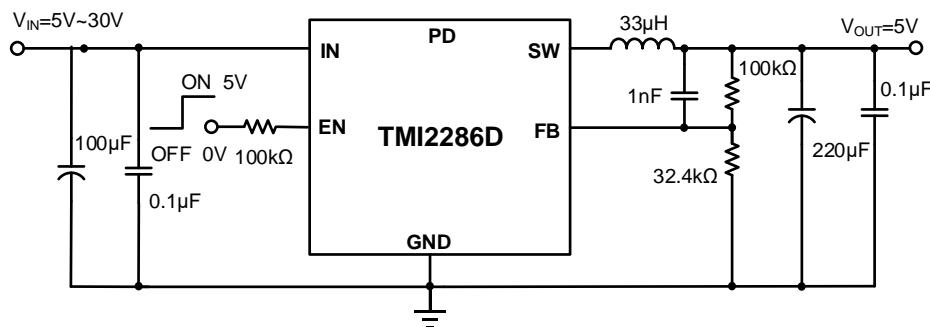


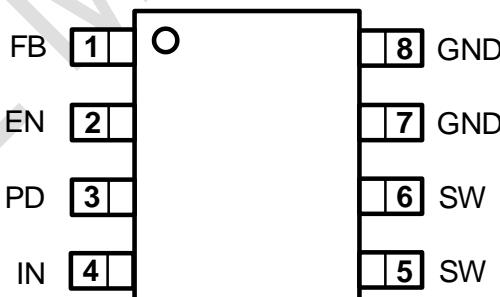
Figure 2. Basic Application Circuit without External PMOSFET

ABSOLUTE MAXIMUM RATINGS

Parameter	Value	Unit
Input Supply Voltage IN, PD, SW	-0.3~33	V
All Other Pins EN, FB Voltage Range	-0.3~6	V
Storage Temperature Range	-65~150	°C
Junction Temperature Range	-40~150	°C
Junction-to-ambient Thermal Resistance	60	°C/W
Junction-to-case Thermal Resistance	46	°C/W
Power Dissipation	2	W
Lead Temperature (Soldering, 10s)	260	°C

Over operating free-air temperature range (unless otherwise noted)

PACKAGE/ORDER INFORMATION



SOP8

Top Mark: T2286D XXXXX (T2286D: Device Code, XXXXX: Inside Code)

Part Number	Package	Top mark	Quantity/ Reel
TMI2286D	SOP8	T2286D XXXXX	3000

TMI2286D devices are Pb-free and RoHS compliant.

PIN FUNCTIONS

Pin	Name	Function
1	FB	Feedback pin.
2	EN	Enable Pin. EN pin has internal pull up connection. Please do not pull EN to Vin directly. To use the EN function, the EN pin needs to be connected in series with a resistance of 10KΩ to 500KΩ.
3	PD	External P-MOSFET Driver Pin.
4	IN	Power input pin.
5	SW	Switch pin. Connected to external Inductor.
6		
7	GND	Ground.
8		

ESD RATING

Items	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	± 2000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Typ	Max	Unit
V_{IN}	IN Voltage Range	4.5		30	V
T_J	Operating Junction Temperature Range	-40		125	°C

ELECTRICAL CHARACTERISTICS

(V_{IN}=12V, V_{OUT}=5V, T_A = 25°C, unless otherwise noted.)

Parameter	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		4.5		30	V
Input Over Voltage Protection Threshold			32		V
Under Voltage Lockout Threshold	V _{IN} rising		4.0		V
UVLO Hysteresis			0.18		V
Quiescent Current	No Load		1		mA
Feedback Voltage Accuracy	PWM Operation	1.19	1.22	1.25	V
Soft Start Time			4		ms
Switching Current limit	Duty=50%		5		A
SW leakage				10	µA
Maximum Duty Cycle	Fs=130kHz			100	%
Switching Frequency			120		kHz
Switch On-Resistance (high side)	V _{IN} =12V		25		mΩ
	V _{IN} =5V		40		mΩ
Switch On-Resistance (low side)	V _{IN} =12V		25		mΩ
Short circuit Frequency	V _{FB} =0V		40		kHz
Minimum On Time			27		ns
EN Input Low Voltage				0.3	V
EN Input High Voltage		1.5			V
Thermal Shutdown Threshold	Guaranteed By design		160		°C
Thermal Shutdown Hysteresis	Guaranteed By design		20		°C

APPLICATION INFORMATION

TMI2286D is a wide input voltage, high efficiency active CC step-down DC/DC converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode with external PMOS driver function. TMI2286D provides up to typical 3.5A output current limit at 5V output and different input voltage without external PMOSFET. If external PMOSFET is paralleled, the output current limit value increases since the high side RDS(ON) is become smaller. Maximum 100% duty cycle could be obtained.

TMI2286D internal Integrate 25mΩ@V_{IN}=12V/40mΩ@V_{IN}=5V high side and 25mΩ low side power MOSFET at V_{IN}=12V. The external paralleled PMOS can be used to reduce voltage drop from input side to output side in 100% duty cycle mode. Advanced production features include UVLO, Thermal Shutdown, Soft Start and input OVP.

Output Voltage Setting

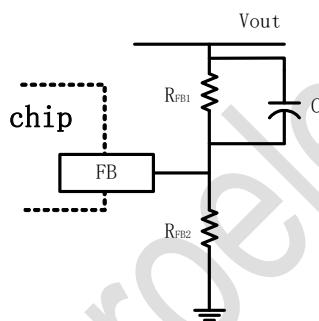


Figure 3. Output Voltage Setting

Figure 3 shows the connection for setting the output voltage. Select the proper ratio of the two feedback resistors RFB1 and RFB2 based on the output voltage. Adding a capacitor in parallel with RFB1 helps the system stability and transient response. Typically, for car charger application, use RFB2 \approx 32.4kΩ and determine RFB1 according to the following equation 1. Please note output voltage with load current applied may be higher than calculated value because of output line drop compensation that is explained in below section.

$$R_{FB1} = R_{FB2} \times \left(\frac{V_{OUT}}{1.22} - 1 \right) \quad (\text{Equation 1})$$

CC/CV Operation Mode and Short Circuits Protection

TMI2286D operates in either CC mode or CV mode. In the CV mode, the output voltage is regulated and the output voltage is equal to the value set by feedback divider resistors RFB1 and RFB2 with the addition of line drop compensation voltage according to the load current value. When output current increases and reaches the 3.5A typical CC current threshold with only internal MOSFET, the device enters into CC mode and output current is regulated and output voltage drops down with output current increasing. TMI2286D inductor peak current value is related to output current limit value, so the inductance has effect on output current limit. The typical 3.5A output current limit is based on 33μH effective inductance value. When output voltage drops until feedback voltage VFB

is below the output short voltage threshold V_{OS} which is about 0.765V (typical), TMI2286D enters into hiccup mode to periodically disable and restart switching operation. The hiccup mode helps to reduce power dissipation and thermal rise during output short to GND condition. The period of TMI2286D hiccup mode is about 475ms.

Programmable Output Line Drop compensation

TMI2286D also provides programmable cable voltage drop compensation by using the impedance at the FB pin to compensate voltage drop across the charger's output cable line. The typical cable compensation voltage can be expressed as:

$$\Delta V_{OUT} (V) = 9.37 \times 10^{-7} \times I_{OUT} (A) \times R_{FB1} (\Omega) \quad (\text{Equation 2})$$

By adjusting the value of high side feedback divider resistor R_{FB1} , the cable compensation voltage can be programmed. If TMI2286D is used as a general DC/DC converter, the smaller R_{FB1} value could reduce output line drop voltage. The recommended value is 10k Ω to 30k Ω for DC/DC converter application.

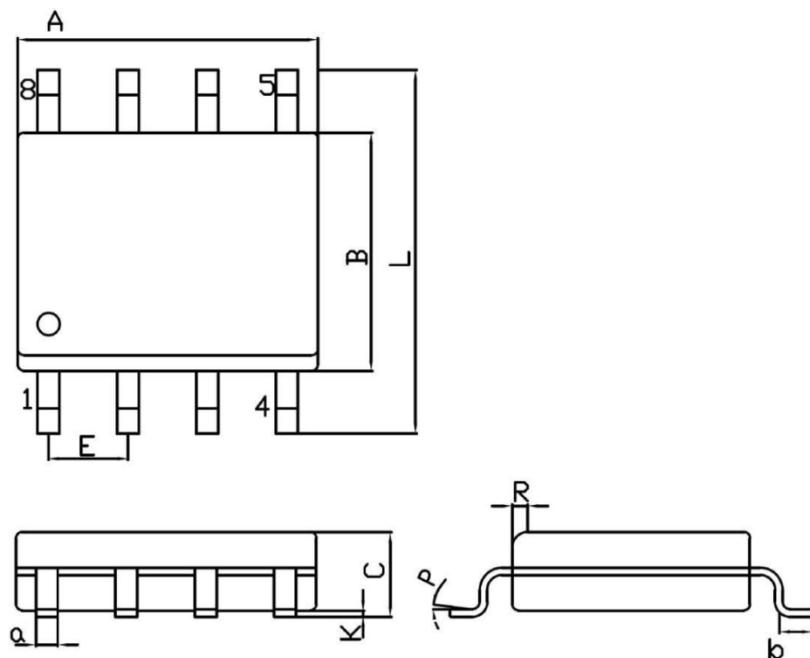
PC Board Layout Guidance

When laying out the printed circuit board, the Following checklist should be used to ensure proper operation of the IC.

- 1) Arrange the power components to reduce the AC loop size consisting of C_{IN} , IN pin, SW pin and the IC power GND.
- 2) Place input decoupling ceramic capacitor C_{IN} as close to IN pin as possible. C_{IN} is connected power GND with via or short and wide path.
- 3) Return FB to signal GND pin, and connect the signal GND to power GND at a single point for best noise immunity.
- 4) Place feedback resistor close to FB pin.

PACKAGE INFORMATION

SOP8



Unit: mm

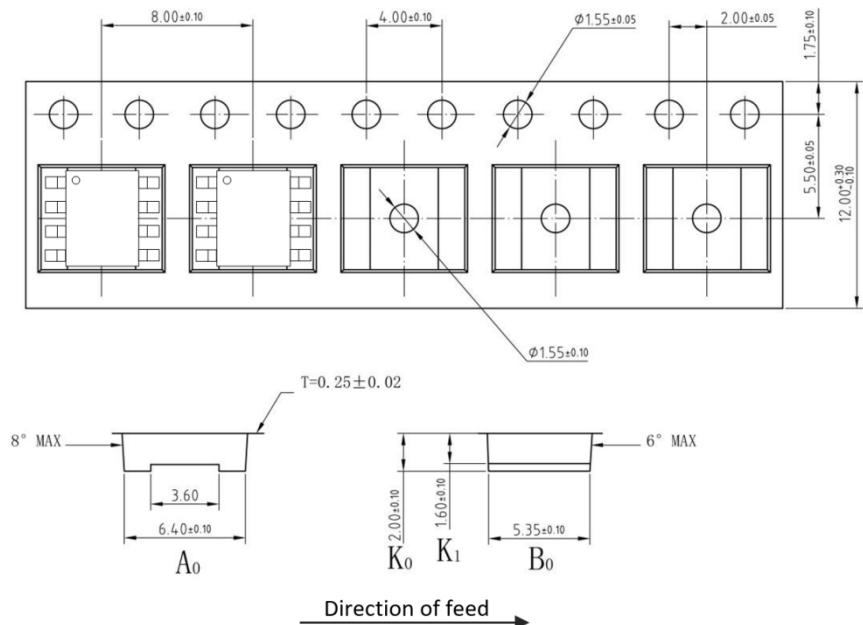
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
A	4.70	5.10	C	1.35	1.75
B	3.70	4.10	a	0.35	0.49
L	6.00	6.40	R	0.30	0.60
E	1.27 BSC		P	0°	
K	0.12	0.22	b	0.40	1.25

Note:

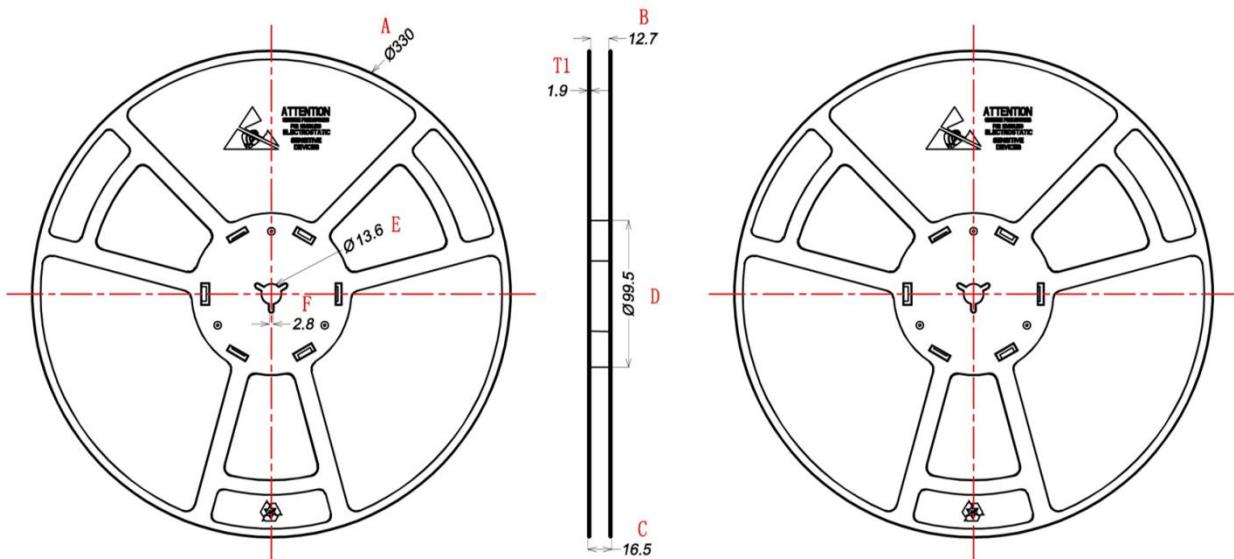
- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading top mark from left to right.

TAPE AND REEL INFORMATION

TAPE DIMENSIONS: SOP8



REEL DIMENSIONS: SOP8



Unit: mm

A	B	C	D	E	F	T1
Ø 330±1	12.7±0.5	16.5±0.3	Ø 99.5±0.5	Ø 13.6±0.2	2.8±0.2	1.9±0.2

Note:

- 1) All Dimensions are in Millimeter
- 2) Quantity of Units per Reel is 3000
- 3) MSL level is level 3.

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