

28V, 3A Buck Constant Current Switching Regulator for White LED



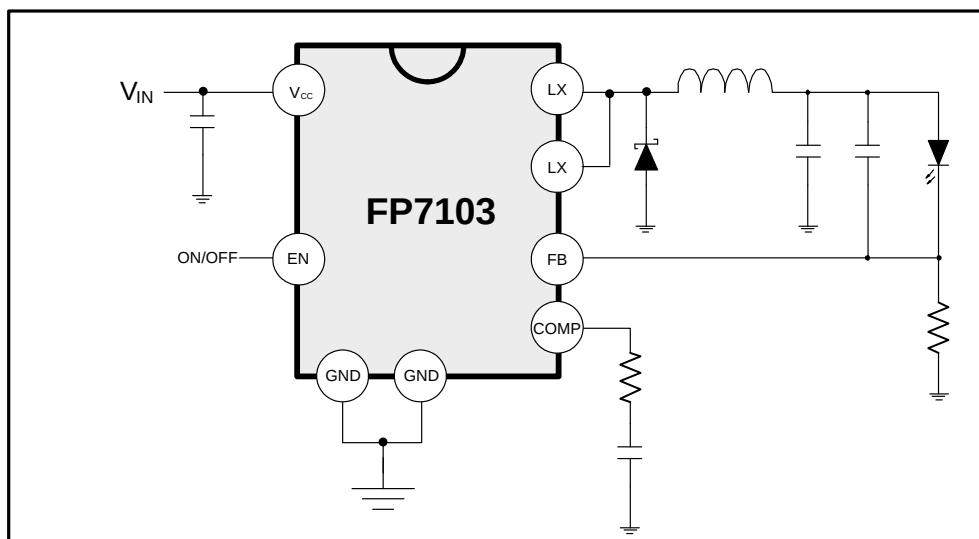
General Description

The FP7103 is a PWM control buck converter designed to provide a simple, high efficiency solution for driving high power LEDs. With a 0.25V reference voltage feedback control to minimize power dissipation, an external resistor sets the current as needed for driving various types of LEDs. The FP7103 includes a high current P-MOSFET to realize high efficiency and excellent transient characteristics. The PWM control circuit is able to change the duty ratio linearly from 0 up to 100%. Other features include user accessible EN pin for enabling, thermal shutdown, cycle-by-cycle current limit and over current protection.

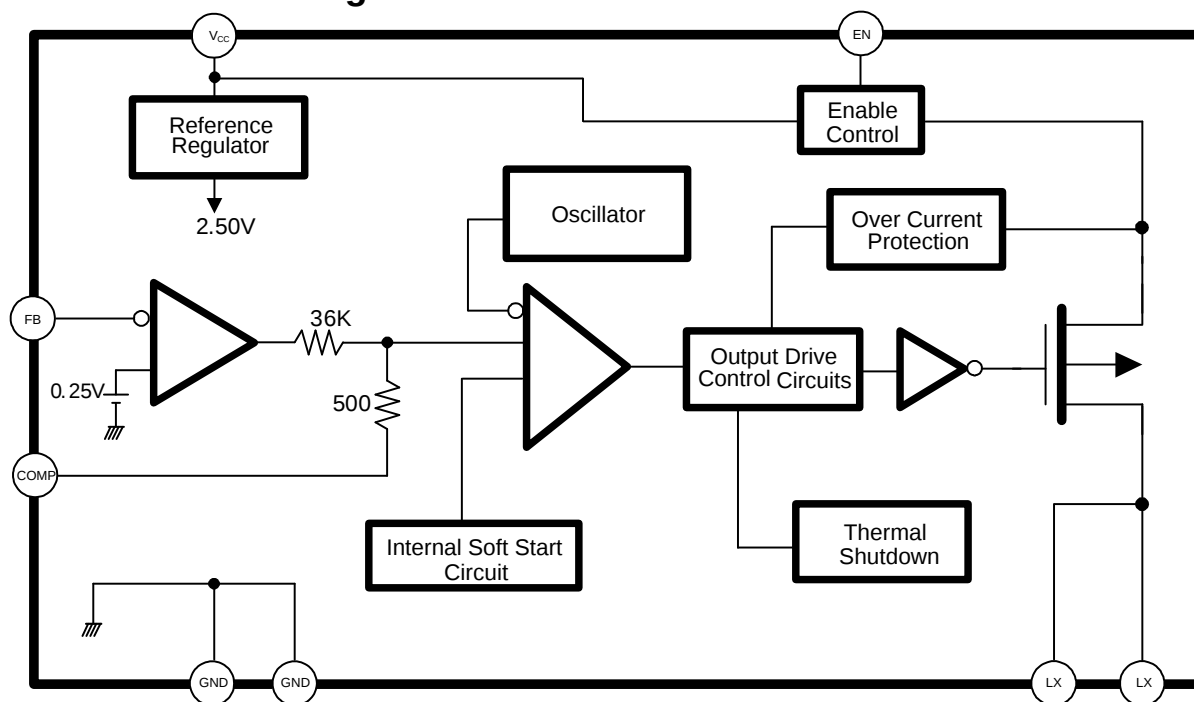
Features

- Wide Supply Voltage Operating Range: 3.6 to 28V
- Built-in P-MOSFET for 3A Loading Capability
- Precision Feedback Reference Voltage: 0.25V (2%)
- Low Current Consumption: 4mA
- Internal Fixed Oscillator Frequency: 320KHz (Typ.)
- Internal Soft-Start Function (SS)
- Over Current Protection
- Package: SOP-8L& SOP-8L(EP)

Typical Application Circuit



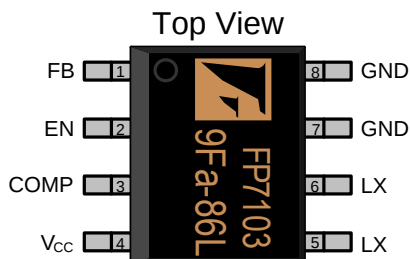
Function Block Diagram



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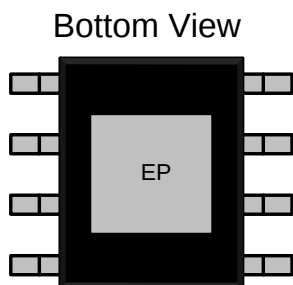
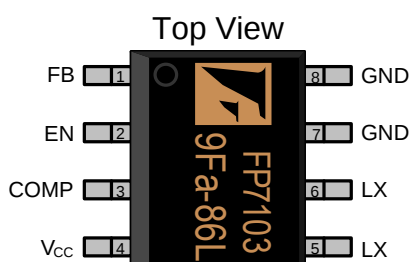
Pin Descriptions

SOP- 8L



Name	No.	I / O	Description
FB	1	I	Error Amplifier Inverting Input
EN	2	I	Enable Control
COMP	3	O	Error Amplifier Compensation Output
V _{CC}	4	P	IC Power Supply (PMOS Source)
LX	5	P	PMOS High Current Output
LX	6	P	PMOS High Current Output
GND	7	O	IC Ground
GND	8	O	IC Ground

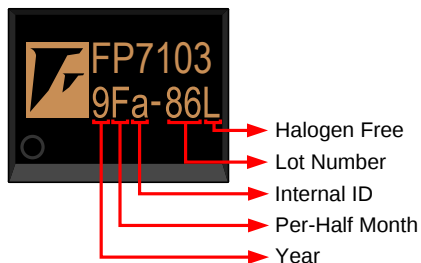
SOP-8L (EP)



Name	No.	I / O	Description
FB	1	I	Error Amplifier Inverting Input
EN	2	I	Enable Control
COMP	3	O	Error Amplifier Compensation Output
V _{CC}	4	P	IC Power Supply (PMOS Source)
LX	5	P	PMOS High Current Output
LX	6	P	PMOS High Current Output
GND	7	O	IC Ground
GND	8	O	IC Ground
EP	9	P	Exposed PAD. Must connect to LX

Marking Information

SOP-8L & SOP-8L (EP)



Halogen Free: Halogen free product indicator

Lot Number: Wafer lot number's last two digits

For Example: 132386TB → 86

Internal ID: Internal Identification Code

Per-Half Month: Production period indicated in half month time unit

For Example: January → A (Front Half Month), B (Last Half Month)

February → C (Front Half Month), D (Last Half Month)

Year: Production year's last digit

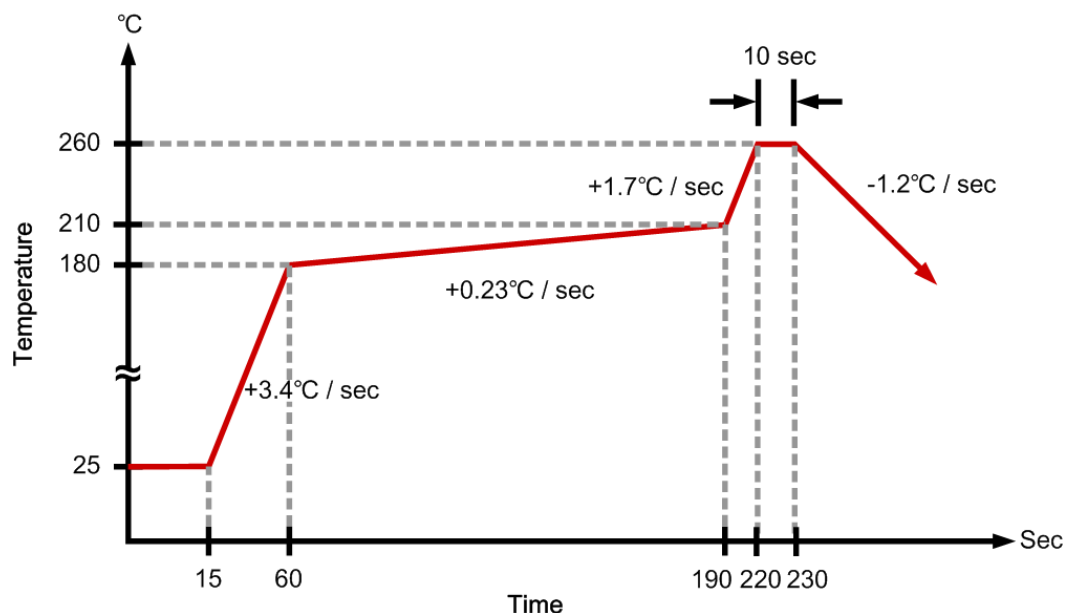
Ordering Information

Part Number	Operating Temperature	Package	MOQ	Description
FP7103DR-LF	-25°C ~ +85°C	SOP-8L	2500EA	Tape & Reel
FP7103XR-LF	-25°C ~ +85°C	SOP-8L (EP)	2500EA	Tape & Reel

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{IN}				28	V
Output Source Current					3	A
Error Amplifier Inverting Input			-0.3		+1.2	V
Allowable Dissipation		$T_A \leq +25^\circ\text{C}$			650	mW
Thermal Resistance Junction to Ambient	θ_{JA}				+175	$^\circ\text{C} / \text{W}$
Thermal Resistance Junction to Case	θ_{JC}				+45	$^\circ\text{C} / \text{W}$
ESD Susceptibility		HBM (Human Body Mode)		2		KV
		MM (Machine Mode)		200		V
Storage Temperature			-55		+125	$^\circ\text{C}$
Lead Temperature (soldering, 10 sec)					+260	$^\circ\text{C}$

IR Re-flow Soldering Curve



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Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V_{IN}		3.6		28	V
Operating Temperature			-25		85	°C

DC Electrical Characteristics ($V_{CC}=6V$, $T_A=25^{\circ}C$, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Reference						
Output Voltage	V _{REF}	FB connected to COMP	0.245	0.25	0.255	V
Input Regulation	△V _{REF}	V _{CC} = 3.6 V to 25 V		2	12.5	mV
Output Voltage Change with Temperature	△V _{REF} / V _{REF}	T _A = -25°C to +25°C		1	2	%
		T _A = +25°C to +85°C		1	2	
Oscillator Section						
Oscillation Frequency	f			320		KHz
Frequency Change with Voltage	Δf / ΔV	V _{CC} =3.6V to 25V		5		%
Frequency Change with Temperature	Δf / ΔT	T _A = -25°C to +85°C		5		%
Error Amplifier Section						
Input Bias Current	I _B		-1.0	-0.2	1.0	μA
Voltage Gain	A _v			100		V / V
Frequency Bandwidth	BW	A _v =0 dB		6		MHz
Output Voltage Swing Positive	V _{POS}		1.7	2		V
Output Voltage Swing Negative	V _{NEG}			0.1	0.2	V
Output Source Current	I _{SOURCE}	V _{comp} =200mV	-15	-30		μA
Output Sink Current	I _{SINK}	V _{comp} =200mV	15	30		μA
Idle Period Adjustment Section						
Maximum Duty Cycle	T _{DUTY}	V _{FB} =0.2V		100		%
Output Section						
PMOS D-S Voltage	V _{DSS}	V _{COMP} =0.1V		-20		V
PMOS Source Current	I _D			-3		A
PMOS On Resistance	R _{DS (ON)}	V _{CC} =5.0V, V _{FB} =0V		64	87	mΩ
		V _{CC} =10V, V _{FB} =0V		40	52	
Output Leakage Current	I _L	V _{DS} =-24V, V _{GS} =0V			-1	μA
Thermal Shutdown Section						
Thermal shutdown Temperature				150		°C
Over Current Protection Section						
PMOS OCP Current	I _{OCP}			4		A

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Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Total Device Section						
EN Input Current	I_{EN}	EN pin Open			20	μA
Upper Threshold Voltage (EN)	V_{UPPER}			1.12		V
Lower Threshold Voltage (EN)	V_{LOW}			0.87		V
Hysteresis	V_{HYS}		210	250		mV
Average Supply Current	I_{AVE}			4	6	mA
V_{CC} Shutdown Current	$I_{shutdown}$			15		μA

Detailed Description

Voltage Reference

A built-in 2.5V reference regulator supplies FP7103 internal circuits. Also, this 2.5V reference voltage is divided down by an internal resistive divider to provide a 0.25V precision reference voltage to the error amplifier non-inverting terminal.

Setting the LED Current

FP7103 is a constant current buck regulator. The LEDs are connected between V_{OUT} and FB pin as shown in the **Typical Application Circuit** section. The FB pin is 0.25V in regulation. Therefore, the LEDs current I_F is set by V_{FB} and the resistor R_2 connected between FB and ground by the following equation:

$$I_F = \frac{V_{FB}}{R_2}$$

I_F should not exceed the 3A current capability of FP7103 and therefore R_2 minimum must be approximately 0.083Ω

Output Voltage

The output voltage is primarily determined by the number of LEDs(n) connected between V_{OUT} and FB pin. Therefore, V_{OUT} can be written as:

$$V_{OUT} = ((n \times V_F) + V_{FB})$$

Where V_F is the forward voltage of one LED at the set LED current level (see LED manufacturer datasheet for forward characteristics curve)

Oscillator

The fixed PWM frequency is generated by an internal oscillator. Its typical values are 320KHz.

Thermal Protection

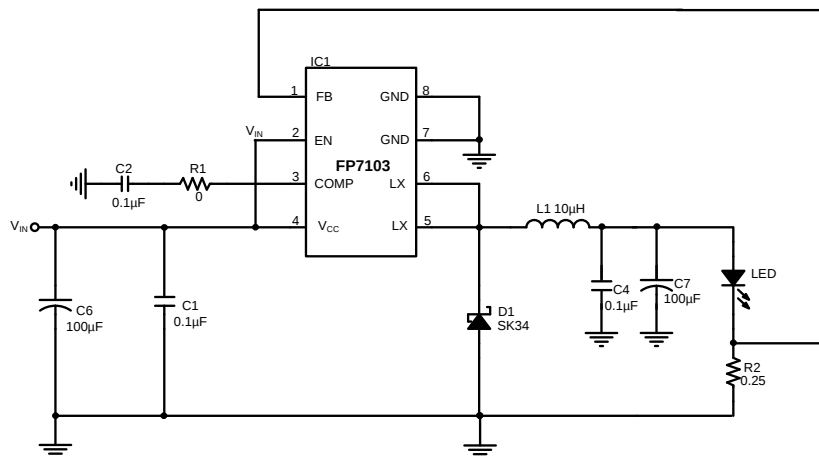
The thermal protection is triggered when junction temperature is higher than 150°C that may occurs by an abnormal heavy current loading. When this happens, the FP7103 turns output off. Once the junction temperature is cooled down to lower than 130°C, FP7103 starts again and turns the power switch on.

Over Current Protection

The FP7103 uses cycle-by-cycle current limit to protect the internal power switch. During each switching cycle, a current limit comparator detects if the power switch current exceeds the internal setting current. If it does, over current protection function decrease the oscillator frequency to prevent thermal issue.

Application Information

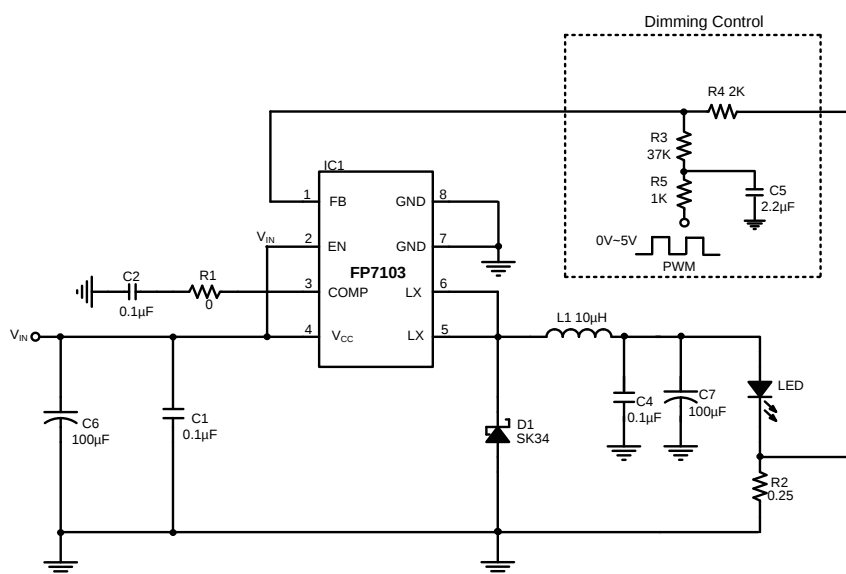
Typical Application Circuit



FP7103 3W / 5W LED for DC Input Circuit

Dimming Control Circuit

Changing the duty cycle of PWM signal can get different LED current. The PWM signal is recommended above 10kHz. The application circuit is shown in the following.



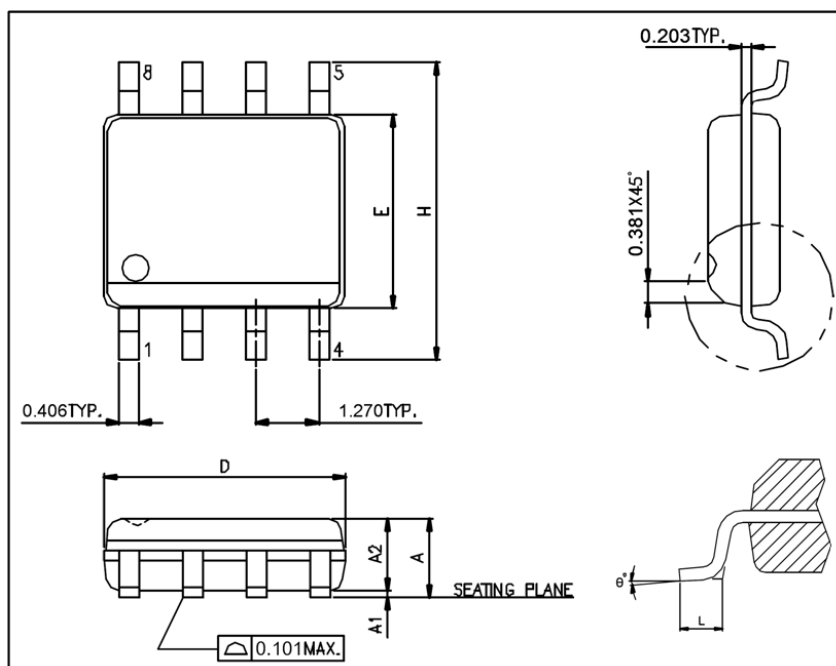
The LED current can be calculated by the following equation:

$$I_{LED} = \frac{V_{FB} - \frac{R4 \times (V_{PWM} \times \text{Duty} - V_{FB})}{R3 + R5}}{R2}$$

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Package Outline

SOP-8L

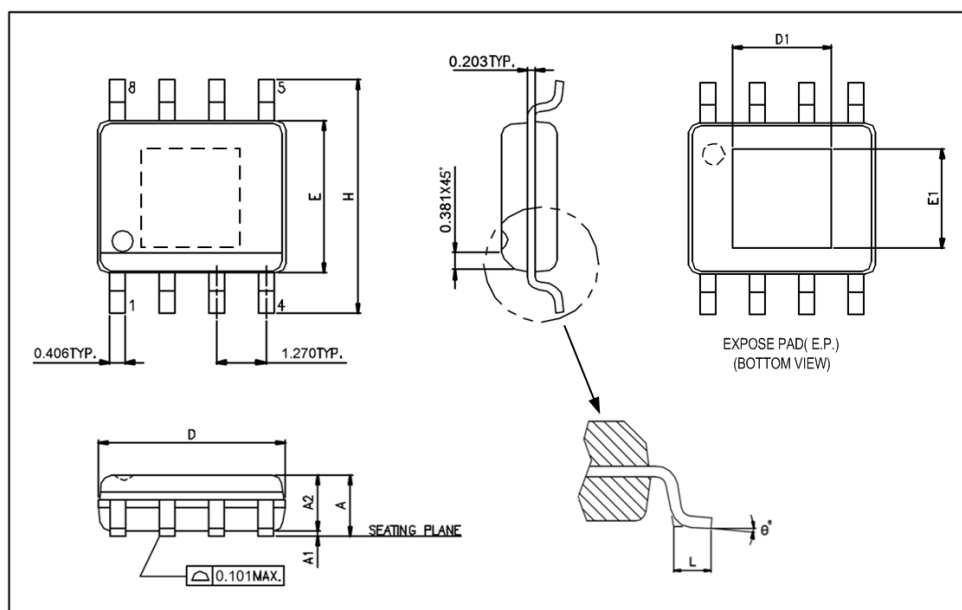


UNIT: mm

Symbols	Min. (mm)	Max. (mm)
A	1.346	1.752
A1	0.101	0.254
A2		1.498
D	4.800	4.978
E	3.810	3.987
H	5.791	6.197
L	0.406	1.270
θ°	0°	8°

Note:

1. Package dimensions are in compliance with JEDEC outline: MS-012 AA.
2. Dimension "D" does not include molding flash, protrusions or gate burrs.
3. Dimension "E" does not include inter-lead flash or protrusions.

SOP-8L (EP)

UNIT: mm

Symbols	Min. (mm)	Max. (mm)
A	1.346	1.752
A1	0.050	0.152
A2		1.498
D	4.800	4.978
E	3.810	3.987
H	5.791	6.197
L	0.406	1.270
θ°	0°	8°

Exposed PAD Dimensions:

Symbols	Min. (mm)	Max. (mm)
E1	2.184 REF	
D1	2.971 REF	

Note:

1. Package dimensions are in compliance with JEDEC outline: MO-178 AA.
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