深圳市创宇欣电子有限公司
TEL:0755-82923906 FAX：0755-61640813 Http://www.chuangyuxin.com

Liteon Semiconductor Corporation

LSP3124

150KHZ 3A PWM Buck DC/DC Converter

■ FEATURES

- Output voltage: 3.3V, 5.0V, 12V, and adjustable output version
- Adjustable version output voltage range:1.23V to 18V±4%
- 150KHz±15% fixed switching frequency
- Voltage mode non-synchronous PWM control
- Thermal-shutdown and current-limit protection
- ON/OFF shutdown control input
- Operating voltage can be up to 22V
- Output load current: 3A
- Low power standby mode
- Built-in switching transistor on chip
- TO252-5L packages

■ APPLICATIONS

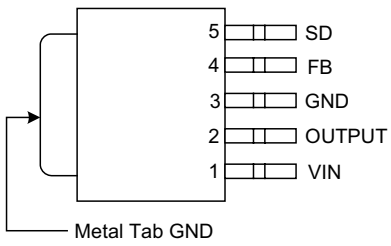
- Simple High-efficiency step-down regulator
- On-card switching regulators
- Positive to negative converter

■ GENERAL DESCRIPTION

The LSP3124 series are monolithic IC that design for a step-down DC/DC converter, and own the ability of driving a 3 A load without additio nal transistor component. Due to reducing th e numb er o f e xternal component, the board s pace can be saved easily.
The external shutdown function can be controlled by logic le vel a nd then come in to s tandby mod e. T he internal compensation mak es feedback control have good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over tempera ture operating from damag e, and current limit is against over current operating of the output switch. If current limit function occurred and V_{FB} is down to 0.5V below , the switching frequency will be reduced. The LSP3124 series operates at a switching frequency of 150 KHz thus allowing smaller sized filter components than what wo uld be need ed with lower frequency switching reg ulators. Oth er features include a g uaranteed ±4% tolerance on output voltage under specified input voltage and output load conditions, and ±15% on the oscillator frequency. The ou tput version include d fixe d 3 .3V, 5V, 12V, and an adjustable type. The package is available in a standard 5-lead TO-252 package.

■ PIN CONFIGURATION

(Top View)



Symbol	Name	Descriptions
1	Vin	Operating Voltage Input
2	Output	Switching Output
3	Gnd	Ground
4	FB	Output Voltage Feedback Control
5	SD	ON/OFF Shutdown

■ ABSOLUTE MAXIMUM RATINGS

Symbol Paramrter		Rating	Unit
V_{CC}	Supply Voltage	+24	V
V_{SD}	ON/OFF Pin input Voltage	-0.3 to +18	V
V_{FB}	Feedback Pin Voltage	-0.3 to +18	V
V_{OUT}	Output Voltage to Ground	-1	V
P_D	Power Dissipation	Internally Limited	W
T_{ST}	Storage Temperature	-65 to +150	℃
T_{OP}	Operating Temperature	-40 to +125	℃
V_{OP}	Operating Voltage	+4.5 to +22	V

■ ELECTRICAL CHARACTERISTICS (ALL OUTPUT VOLTAGE VERSIONS)

Unless otherwise specified, V_{IN}=12V for 3.3V,5V, adjustable version and V_{IN}=18V for the 12V version. I_{LOAD}=0.5A

Symbol	Paramrter		Conditions		Min.	Typ.	Max.	Unit
I_B	Feedback bias current		V_{FB}=1.3V(Adjustable version only)		-10		-50	nA
							-100	
F_{OSC}	Oscillator frequency				127	150	173	KHz
					110		**173**	
F_{CSP}	Short Circuit Oscillator Frequency		When Current Limit Occur and V_{FB} ＜ 0.5V, T_A=25°C		10 30 50			kHz
V_{SAT}	Saturation voltage		I_{OUT}=3A no outside circuit V_{FB}=0V force driver on				1.4	V
							1.5	
DC	Max.Duty Cycle(ON)		V_{FB}=0V force driver on				100	%
	Min.Duty Cycle(OFF)		V_{FB}=12V force driver off		0			
I_{CL}	Current limit		Peak current no outside circuit V_{FB}=0V force driver on		3.6		6.9	A
					3.4		**7.5**	
I_L	Output=0	Output leakage current	no outside circuit V_{FB}=12V force driver off				-50	μA
	Output=-1		V_{IN}=22V				-30	mA
I_Q	Quiescent Current		V_{FB}=12V force driver off			5	10	mA
I_{STBY}	Standby Quiesient Current		ON/OFF Pin=5V V_{IN}=22V		70		200	μA
							250	
V_{IL}	ON/OFF pin logic input threshold voltage		Low(regultaor ON)			1.3	0.6	V
V_{IH}			High(regultaor OFF)		2.0			
I_H	ON/OFF pin logic input current		V_{LOGIC}=2.5V(OFF)				-15	μA
I_L	ON/OFF pin input current		V_{LOGIC}=0.5V(ON)				-5	
θ_{JC}	Thermal Resistence		TO252-5L	Junction to case	10			℃/W
θ_{JA}	Thermal Resistence with Copper Area of Approximately 3 in^2		TO252-5L	Junction to ambient	50			℃/W

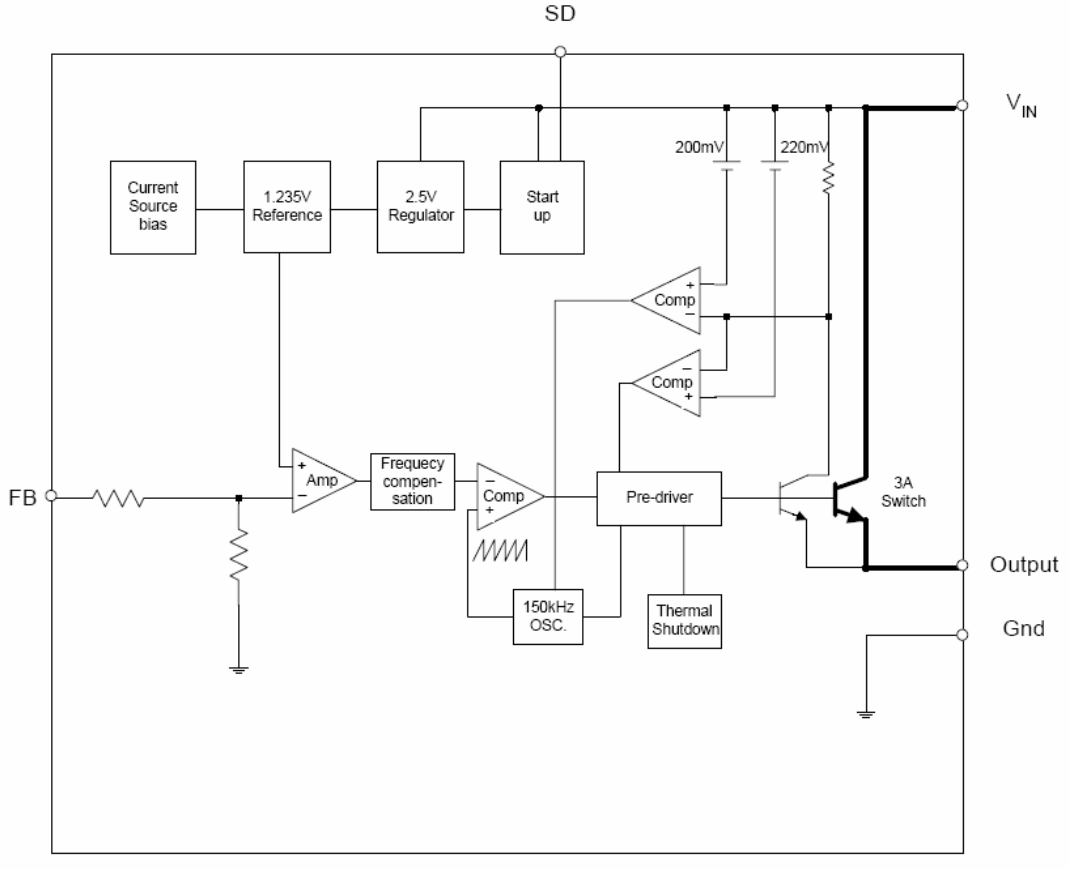
Specifications with **boldface type** are for full operating temperature range, the other type are for TJ=25°C.

■ ELECTRICAL CHARACTERISTICS (CONTINUED)

Sy	mbol	Parameter	Conditions	Typ.	Limit	Unit
LSP3124-ADJ	V_{FB}	Output Feedback	5V≤V_{IN}≤22V 0.2A≤I_{LOAD}≤3A V_{OUT} programmed for 3V	1.23	1.193/**1.18** 1.267/**1.28**	V V_{MIN} V_{MAX}
	η Efficiency		V_{IN} =12V, I_{LOAD} =3A	75		%
LSP3124-3.3V	V_{OUT}	Output voltage	5.5V≤V_{IN}≤22V 0.2A≤I_{LOAD}≤3A	3.3	3.168/**3.135** 3.432/**3.465**	V V_{MIN} V_{MAX}
	η Efficiency		V_{IN} =12V, I_{LOAD} =3A	75		%
LSP3124-5.0V	V_{OUT}	Output voltage	8V≤V_{IN}≤22V 0.2A≤I_{LOAD}≤3A	5	4.8/**4.75** 5.2/**5.25**	V V_{MIN} V_{MAX}
	η Efficiency		V_{IN} =12V, I_{LOAD} =3A	80		%
LSP3124-12V	V_{OUT}	Output voltage	15V≤V_{IN}≤22V 0.2A≤I_{LOAD}≤3A	12	11.52/**11.4** 12.48/**12.6**	V V_{MIN} V_{MAX}
	η Efficiency		V_{IN} =16V, I_{LOAD} =3A	90		%

Specifications with **boldface type** are for full operating temperature range, the other type are for TJ=25°C.

■ BLOCK DIAGRAM



■ FUNCTION DESCRIPTION

Pin Function

V_{IN}

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimiz e voltage trans ients and to supply the switching current s needed by the regulator.

Ground

Circuit ground.

Output

Interna l switch. The voltage a t th is p in switches between (V_{IN} – V_{SAT}) and approxima tely – 0.5 V, with a du ty cycle of app roxima tely V $_{OUT}$ / V_{IN}. T o minimize coupling to sensitive circuitry, the PC board copper are a connected to this pin should be kept a minimum.

Feedback

Senses the regulated output voltage to complete the feedback loop.

ON/OFF

Allows the s witching reg ulator circuit to be shutd own using lo gic leve l sig nals thus dr opping the total input supply curre nt to approximately 1 50uA. Pulling this pin below a threshold voltage of approxima tely 1.3 V turns the regulator on , and pu lling this pin ab ove 1.3 V (u p to a ma ximum o f 18 V) shuts the r egulator do wn. If th is shutdown feature is not needed, the ON/O FF pin can be wired to the ground pin.

Thermal Considerations

The TO-252 surface mou nt package tab is designed to be soldered to the copper on a printed circuit b oard. Th e copper and the board are the heat sink for this package and the other heat p roducing components, such as th e catch diode and induc tor. The PC boa rd copper ar ea that the package is soldered to sho uld be at least 0.4 in^2, and ideally should have 2 or more square inches of 2 oz. Additional copper area improves the thermal characteristics, but with copper areas greater than approximately 6 in^2, only sma ll improve ments in hea t dissipation are realized. If further thermal improvements a re n eeded, double sid ed, m ultilayer PC board w ith large copper areas and/or airflow are recommended.

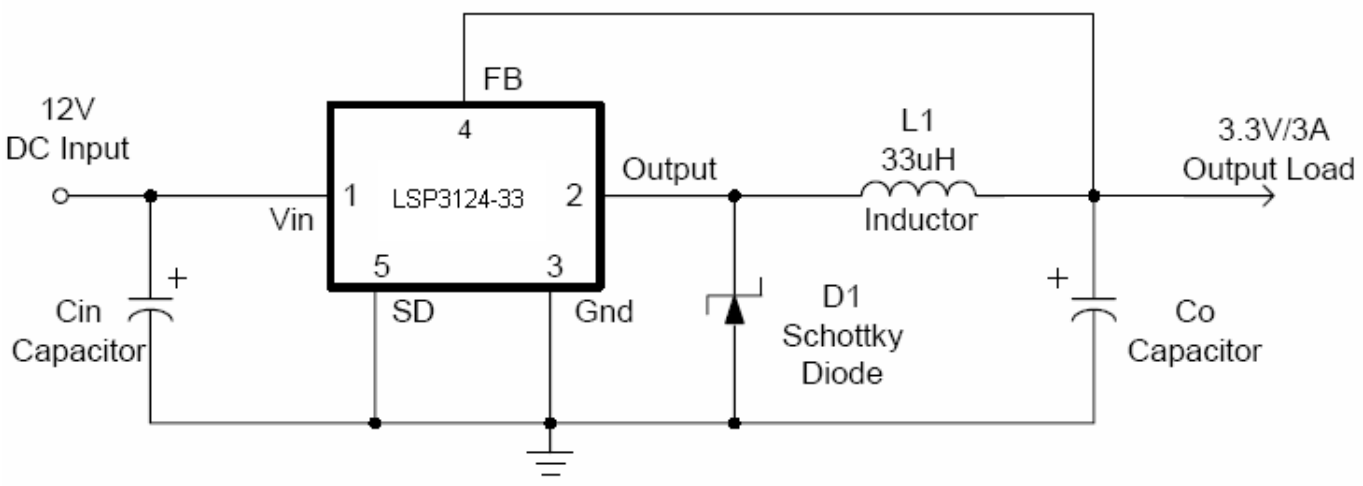
The LSP312 4 (TO-252 p ackage) junction te mpera ture rise abo ve a mbient temperature with a 3 A lo ad for various input and output voltages. This data was taken with the circuit operatin g as a buck switching regulator with all components mo unted on a PC board to simulate th e junction temperature u nder actual operating conditions. T his curve ca n be used for a quick check for the a pproxima te junction temp erature for various conditions, b ut be aware tha t there a re many factors that can affect the ju nction tempe rature. When load currents higher than 2 A are used, doub le sided or multilayer PC boards with large copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.

For the best thermal per formance, wide copper tr aces and ge nerous amou nts o f prin ted circuit boa rd copper should be us ed in the bo ard la yout. (Once exception to this is the ou tput (s witch) pin , which should not ha ve large areas o f copper .) Large areas of copper provide the best transfer o f heat (lower ther mal resistanc e) to the surrounding air, and moving air lowers the thermal resistance even further.

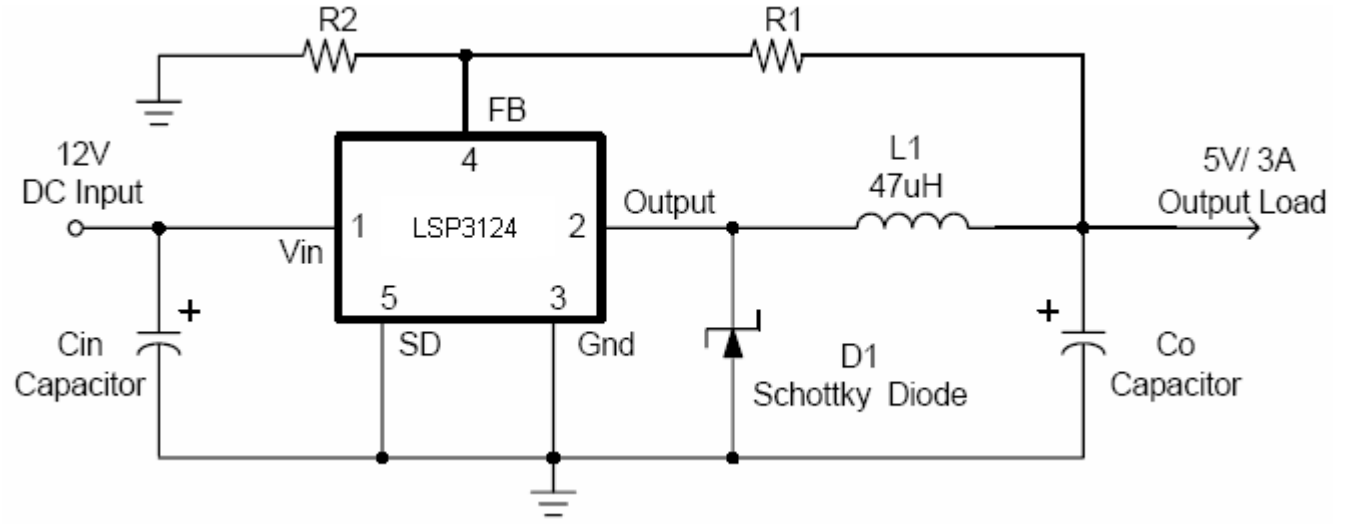
Package the rmal resistan ce and junction temperature rise nu mbers are all approximate, and there are many factors that will affect th ese numbers. Some of th ese factors include board size, shape, th ickness, p osition, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multilayer board and the amount of solder on the board. The effectiveness of the PC board to d issipate heat also depends on the size, qu antity and s pacing o f o ther compon ents on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board a nd the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC r esistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

■ TYPICAL APPLICATION CIRCUITS

(1) Fixed Output Circuit

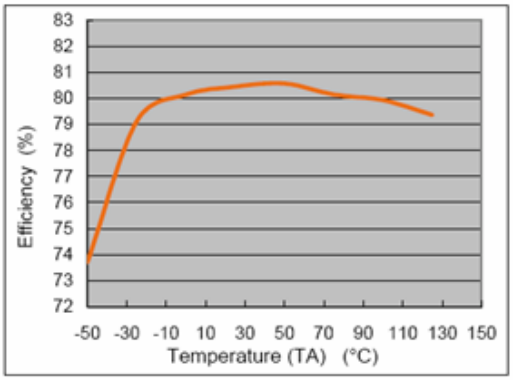


(2) Adjustable Output Circuit Vout=V_{FB}*(1+R1/R2); V_{FB}=1.23V; R2=1K typical

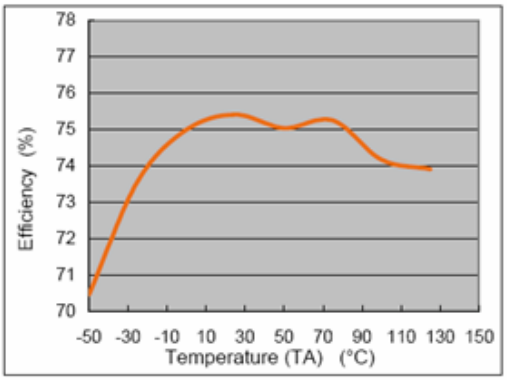


■ TYPICAL PERFORMANCE CHARACTERISTICS

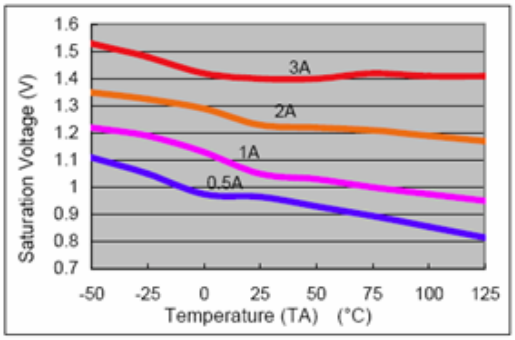
Efficiency v.s. Temperature
(Vin=12V,Vout=5V,Io=3A)



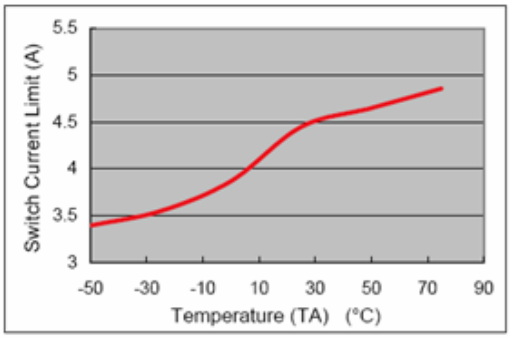
Efficiency v.s. Temperature
(Vin=12V,Vout=3.3V,Io=3A)



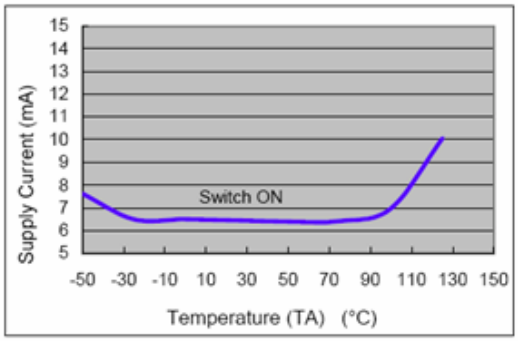
Saturation Voltage v.s. Temperature
(Vcc=12V,Vfb=0V,VSD=0)

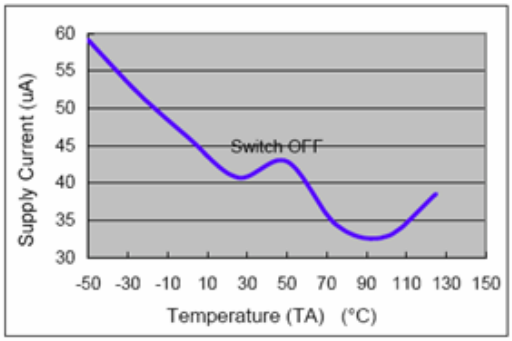


Switch Current Limit v.s. Temperature
(Vcc=12V,Vfb=0V)



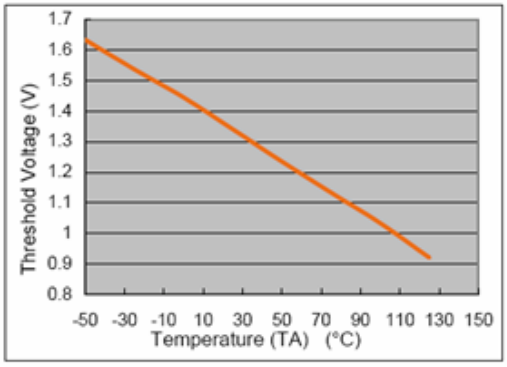
Supply Current v.s. Temperature
(Vcc=12V , No Load ,Von/off =0V(Switch ON) ,Von/off =5V(Switch OFF))



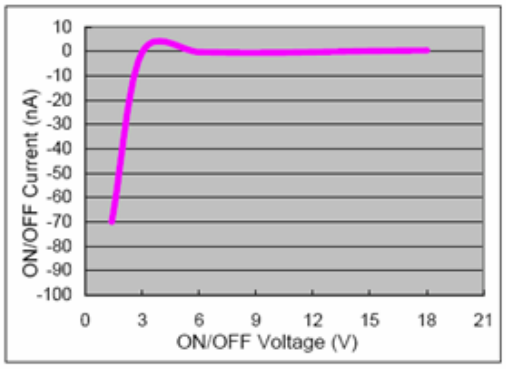


■ TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

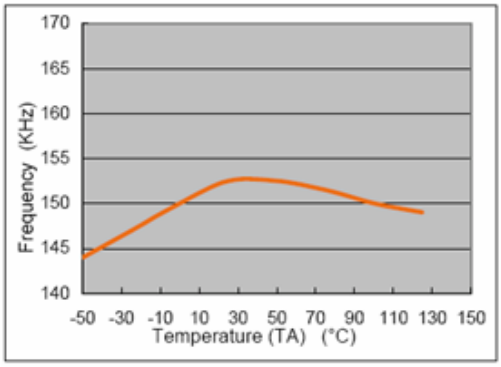
Threshold Voltage v.s. Temperature
(Vcc=12V , Io=100mA)



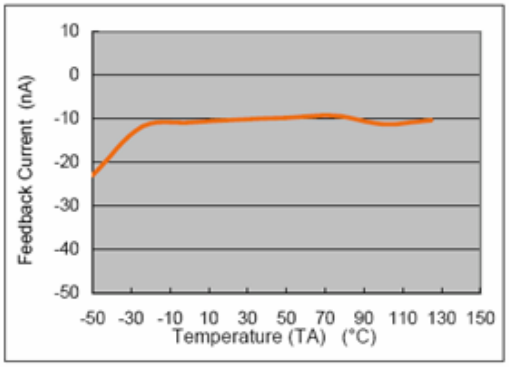
ON/OFF Current v.s. ON/OFF Voltage
(Vin=12V)



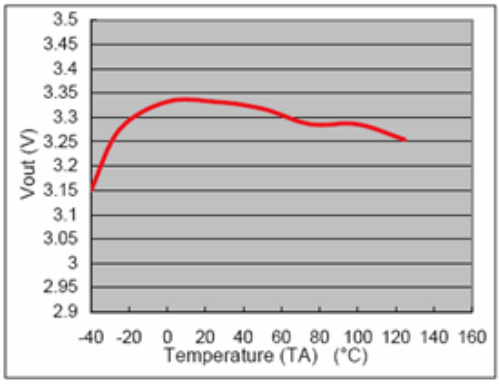
Frequency v.s. Temperature
(Vcc=12V , Io=500mA ,Vout=5V)



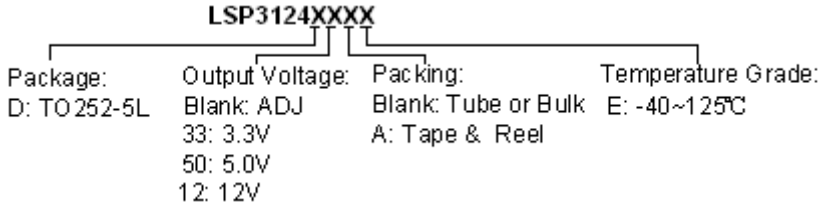
Feedback Current v.s. Temperature
(Vcc=12V , Vout=5V,Vfb=1.3V)



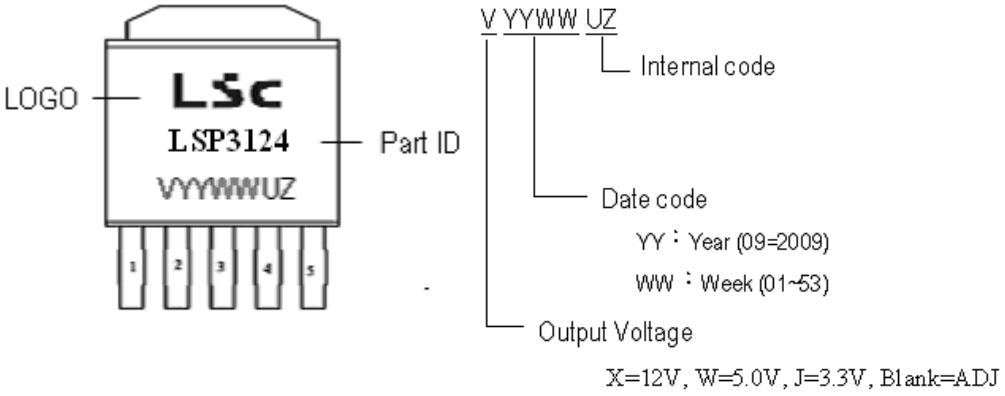
Output Voltage v.s. Temperature
(Vin=12V ,Io=3A)



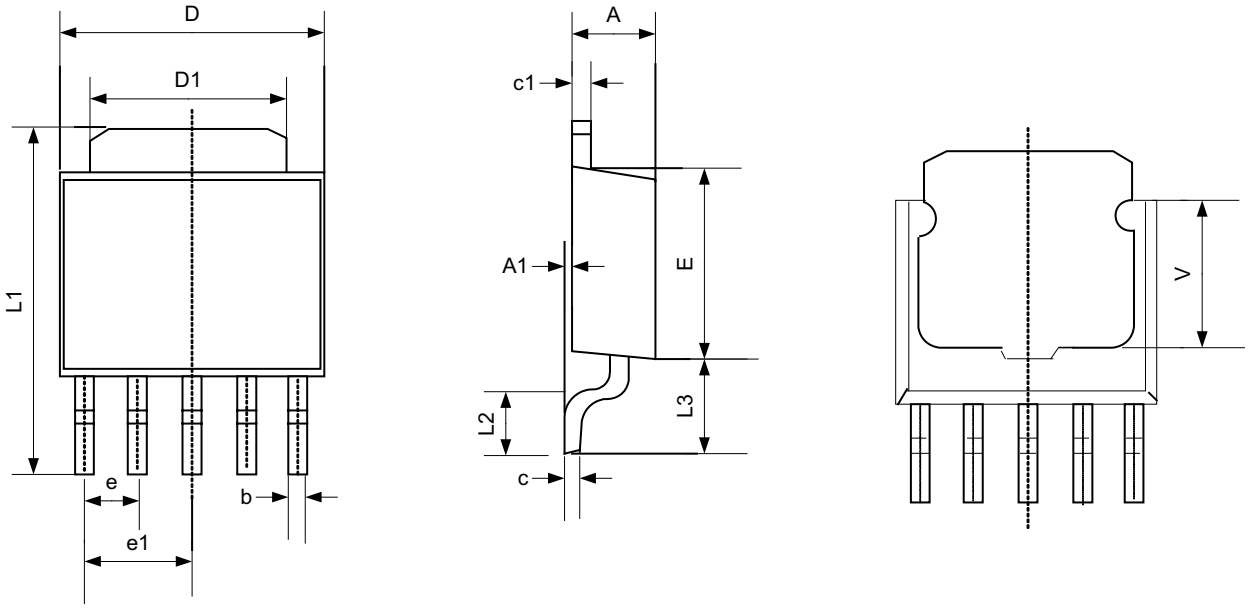
■ ORDERING INFORMATION



■ MARKING INFORMATION



■ PACKAGE INFORMATION



Symbol	Dimensions In Millimeters			Dimensions In Inches	
	Min.	Max.	Min.		Max.
A	2.200	2.400	0.087		0.094
A1	0.000	0.150	0.000		0.006
b	0.400	0.630	0.016		0.025
c	0.450	0.580	0.018		0.023
c1	0.450	0.580	0.018		0.023
D	6.350	6.850	0.250		0.270
D1	5.200	5.500	0.205		0.217
E	5.400	6.200	0.213		0.244
e	1.270TYP.			0.050TYP.	
e1	2.540TYP.			1.000TYP.	
L1	9.000		11.300	0.360	0.452
L2	0.900	1.630	0.035		0.064
L3	2.200	2.800	0.087		0.110
V	3.800REF			0.150REF	

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