High·performance·auxiliary·power·controller IC

1. Feature

Designed for wide supply voltage for PWM chips
Optimized for QC2.0 / 3.0 / 4.0 and higher fast charging system
Optimized for USB Type-C PD/PPS power supply system
The maximum allowable input voltage up to 200V
Automatically limit the maximum output voltage is not higher than 23V
Low standby power requirements for 48V output in USB PD system
The total effective series voltage is less than 1.5V
Ultra low static operating current can be as low as 20uA
Ultra-simple structure without any external settings device
Saving at least three electronic components in USB PD system
Minimize the board space to optimize the PCB design
Available a small SOT23 and SOT89 package，Easy to use

2. Applications

QC2.0/3.0/4.0 and higher charger
USB Type-C PD/PPS charger
0~48V Battery charger
Other wide output voltage range power supply

3. Description

The LN3220 is a high-performance switching power supply PWM chip-assisted power management IC that can easily be used in QuickCharge (QC2.0 / 3.0 / 4.0) and USB Type-C PD power supply systems with extremely wide output voltage variations In the PWM chip for power supply, the system output voltage increases when the VCC voltage is not higher than 23V, which can guarantee the normal operation of the PWM chip, power supply chip can allow up to 200V input voltage range, so that the system can easily meet such as The output voltage varies from 3V to 48V for PD or wider up 0~48V.

The output limit circuit integrated in the chip can effectively limit the power supply output voltage to no more than 23V in extremely high input voltage conditions, ensuring that the PWM chip does not enter the overvoltage protection state and reduces the PWM chip operation Power consumption, improve system life and reliability.

The highly integrated design makes the chip work without any external auxiliary devices, greatly simplifying the system application design, effectively reducing the board area, very suitable for high device density with a small power supply system.

Available in a Halogen free SOT23-3 and SOT89 package that meets RoHs requirements.

4. Functional Block Diagram

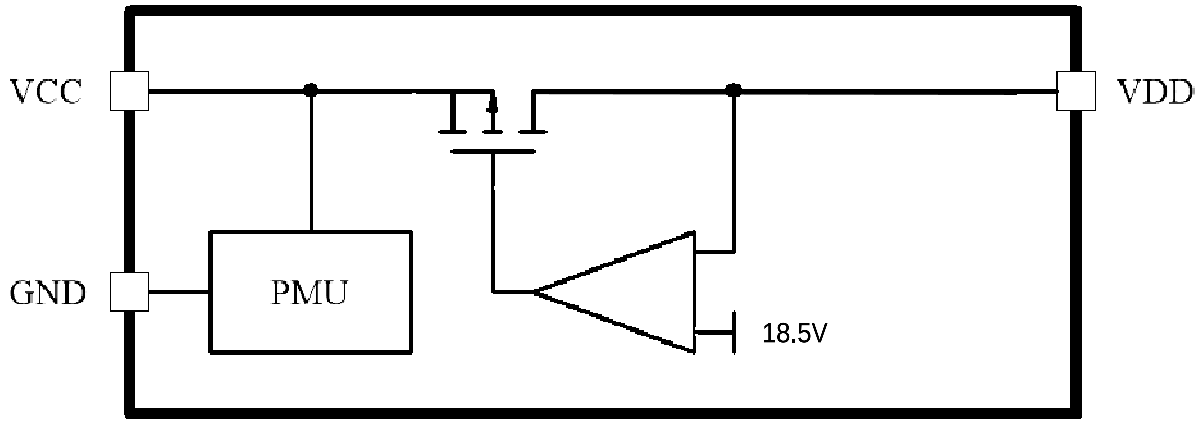


Fig1. Internal functional block diagram

5. Pin Definitions

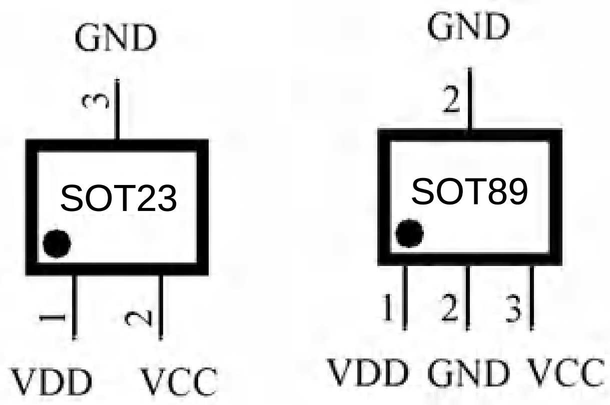


Fig2. Pin Definitions

6. Pin Function Description

PIN		Symbol	Function
SOT23	SOT89		
1	1	VDD	Output voltage pin, connected to PWM chip's VDD
2	3	VCC	Power supply pin, connect the auxiliary power supply circuit
3	2	GND	Ground pin, It is necessary to implement cooling measures by the pin.

7. Typical Simplified Schematic

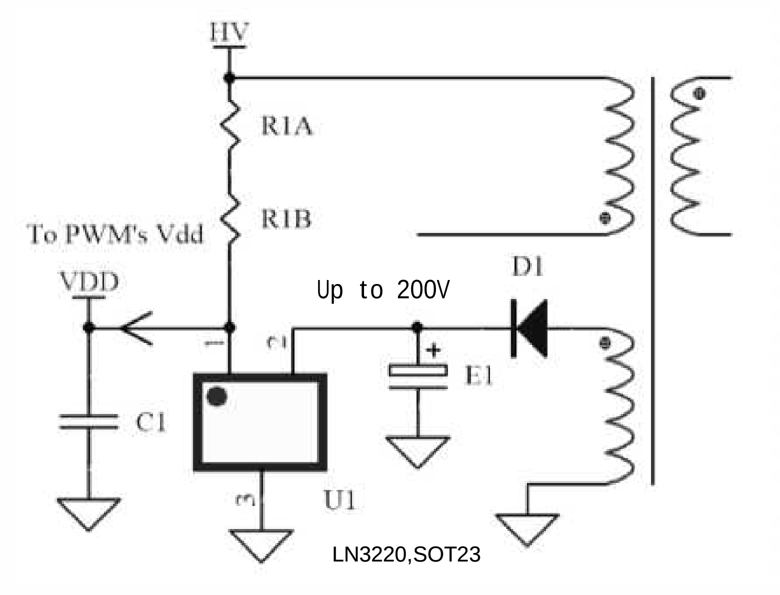


Fig3. Typical Simplified Schematic

(R1A/R1B is the starting resistor of the PWM IC, they are not needed for high-voltage start-up ICs.)

8. Absolute Maximum Ratings *

Item	Parameter	unit
VCC Pin Voltage	200**	V
VDD Pin Voltage	60***	V
VDD Pin Current	15****	mA
Min/Max Operating Junction Temperature T_J	-40 to +150	℃
Min/Max Operating Ambient Temperature Ta	-20 to +105	℃
Min/Max Storage Temperature Tstg	-55 to +150	℃
PD SOT23-3	250	mW
PD SOT89	750	mW
ESD:		
HBM	2500	V
MM	250	V

Note*: Stresses beyond those listed under “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 under “recommended operating conditions” is not implied. Exposure to absolute maximum-rated conditions for ex tended periods may affect device reliability.** : with 1Ma limit. *** : with 1Ma limit. ****: For test, Pulse width is 1ms and cycle is 1S.

9. Recommended Operating Conditions*

Symbol	Parameter		Min	Type	Max	Unit
VCC	VCC Voltage				200	V
VDD	VDD Voltage				50	V
IVDD	VDD Current	SOT23		5	10	mA
		SOT89		8	10	
TA	Operating ambient temperature		-20		85	℃

Note*：The recommended operating conditions are typical reference operating conditions under general and reasonable applications, and are for reference only during use. The system design should have sufficient voltage and current margins, and should fully consider the impact of power dissipation to ensure that the chip does not exceed the maximum allowable junction temperature.

10. Electrical Characteristics(Ta = 25℃, VCC=20V, if not otherwise noted)

VCC Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{VCC}	VCC range	I_{VDD}=1mA	0		200	V
I_Q	Operating current	VCC=15V,VDD=OPEN	-	-	0.01	mA

VDD Section

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{VDD}	VDD range	VCC=0V	0	-	23	V
V_{VDD1}	VDD out voltage	VCC=30V，I_{VDD}=1mA	-	18.5	23	V
V_{VDD2}	VDD out voltage	VCC=14V，I_{VDD}=1mA	12.5	-	14	V
I_{VDD}	Max VDD current	VCC=14V	-	12	-	mA

Thermal Data

Symbol	Parameter	Rating		Unit
		SOT23	SOT89	
θ_{JA}[1]	Thermal Resistance Junction-Ambient	350	25	℃/W
θ_{JC}[2]	Thermal Resistance Junction-Case	20	10	℃/W

Notes: 1. All leads are soldered on a 100mm^2 copper foil with 1oz thick to measuring. 2. Measured on the surface of the package near pin 3(SOT23)/pin 2(SOT89).

11. Typical parameter charts and test waveforms

Chart1. VDD vs VCC

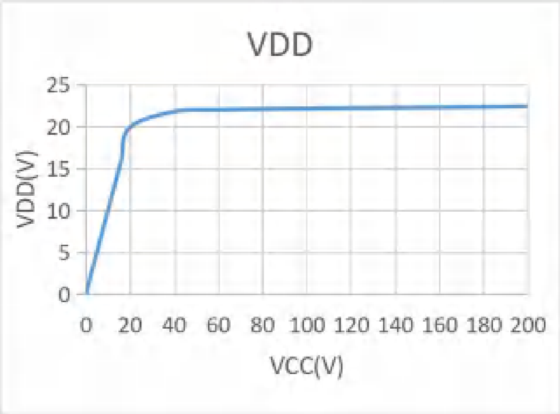


Chart2. VDD vs VCC @out=5mA

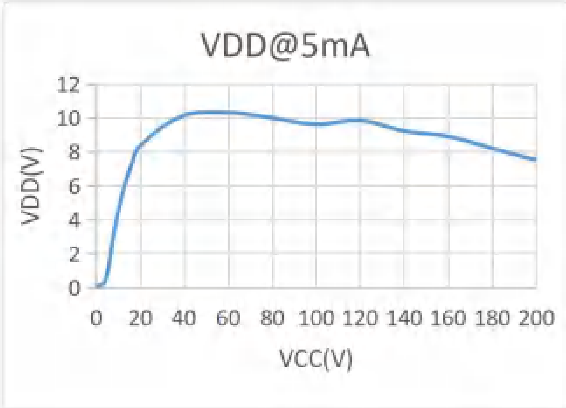
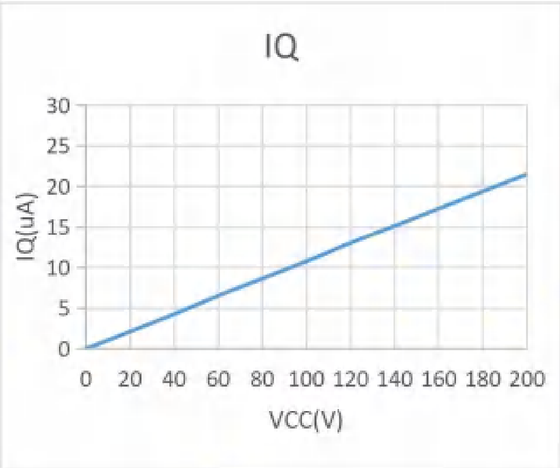


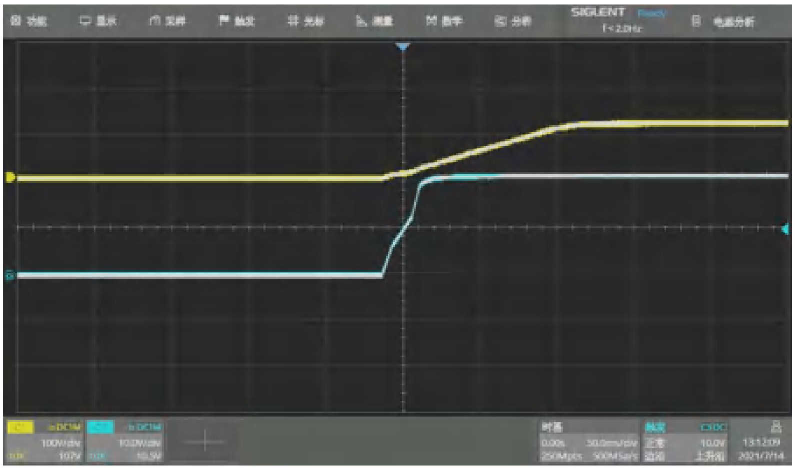
Chart3. IQ vs VCC



Turnon

Chart4. VCC=60V vs VDD

Chart5. VCC=120V vs VDD



12. Application and Implementation

The LN3220 is a PWM chip for wide output voltage switching power supply systems designed for use in a wide range of output voltage variations. It allows the system to operate in applications such as 3V to 48V output voltage range Without worrying about overpressure.

12.1 VCC supply and VDD voltage output

The LN3220 internal power management unit starts operation after VCC is powered up and generates the required internal reference voltage signal and outputs a maximum voltage-limited voltage (typically 18.5V) at the VDD pin for use by an external PWM chip. Only need to apply the necessary decoupling capacitor at the VCC terminal (usually not less than 1uF) to meet the system, the VDD pin can be in accordance with the requirements of the PWM chip to connect its required storage capacitor (usually 4.7uF Of the electrolytic or non-polar capacitor) to build a complete system, auxiliary winding design should make VCC is not greater than 200V.

Typical capacitor connections are shown below:

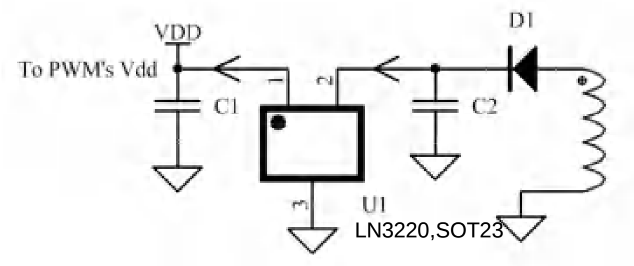
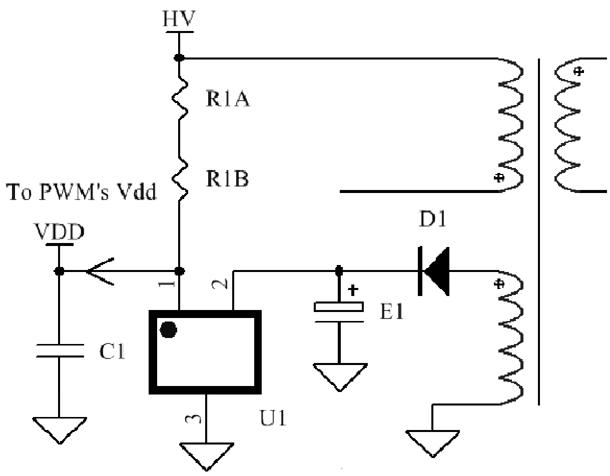


Fig4 Typical capacitor connections Schematic

VDD terminal can still be based on the PWM chip to start charging the normal connection to the original start circuit, including high-voltage start or resistance start mode.

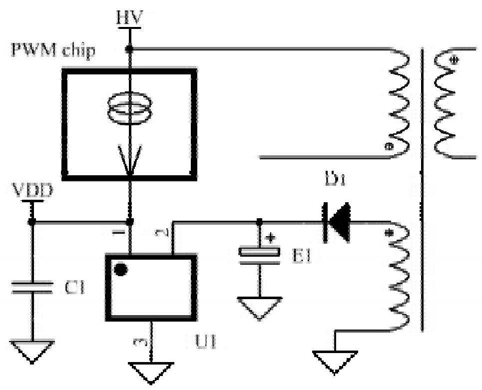
A complete resistor start-up system typical connection circuit is shown below:



LN3220,SOT23

Fig5. Typical resistor start-up system Schematic (R1A/R1B is the starting resistor of the PWM IC)

A complete high-voltage start-up system typical connection circuit as follows:



LN3220,SOT23

Fig6. Typical high-voltage start-up system Schematic

In a typical connection mode, the capacitors on both ends of the IC will be charged at the same time when the system is started. If you need to avoid the capacitor on the VCC side from affecting the charging speed, you can further connect an isolation diode in series with the VDD side, such as miniaturized S4, SOD523, to achieve complete reverse isolation.

The typical connection circuit as follows:

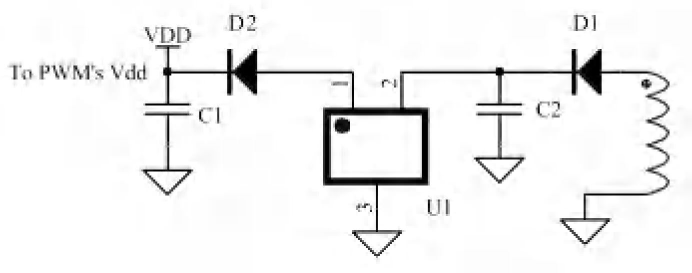
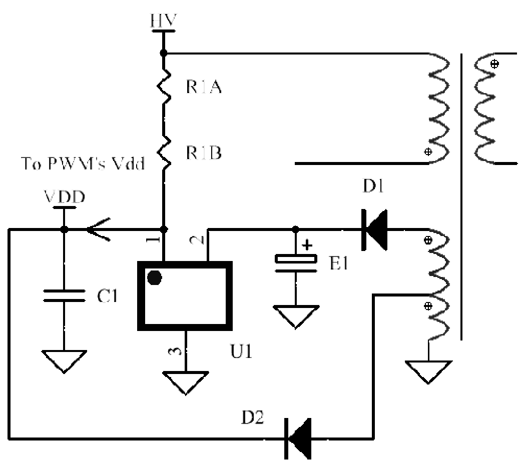


Fig7. Typical circuit connection with reverse isolation.

In general applications only need to connect the LN3220 in the auxiliary winding rectifier circuit and the PWM chip can be between, when the PWM chip operating current is larger to cause the system to high output voltage, VCC follow the voltage rise after the LN3220 produced Or when the system is required to have a low standby power level when the system is switched to a high output voltage, it is possible to further add an additional second auxiliary winding to the system transformer and pass it as follows Circuit and system can be connected to:



LN3220,SOT23

Fig8. Typical low power loss system Schematic

(R1A/R1B is the starting resistor of the PWM IC,they are not needed for high-voltage start-up

In this circuit, it is necessary to select the position of the auxiliary winding taps according to the system voltage parameters reasonably so that the voltage of the tap position can be slightly exceeded by 23V under the required conditions to block the LN3220 output so that the PWM chip can draw from the lower voltage The current required to effectively reduce the system loss, LN3220 static loss will be reduced to below 5mW.

12.2 Reasonable power consumption design

Should be reasonable design of power supply and parameters to ensure that LN3220 work will not produce excessive power consumption. It is recommended that the power consumption is not more than 0.2W is better in SOT23 and not more than 0.5W is better in SOT89. The typical power loss during operation is related to the PWM chip current as follows:

$$P_D = (V_{CC} - V_{DD}) * I_{PWM\_VDD}$$

13. PCB Layout Guidelines

13.1 VCC retrograde and PCB loop design

The position and loop size of the transformer auxiliary winding rectifier circuit should be designed reasonably, and the VCC decoupling capacitor should be placed near to get the best system noise level and anti-interference level.

The following figure is a typical layout loop diagram:

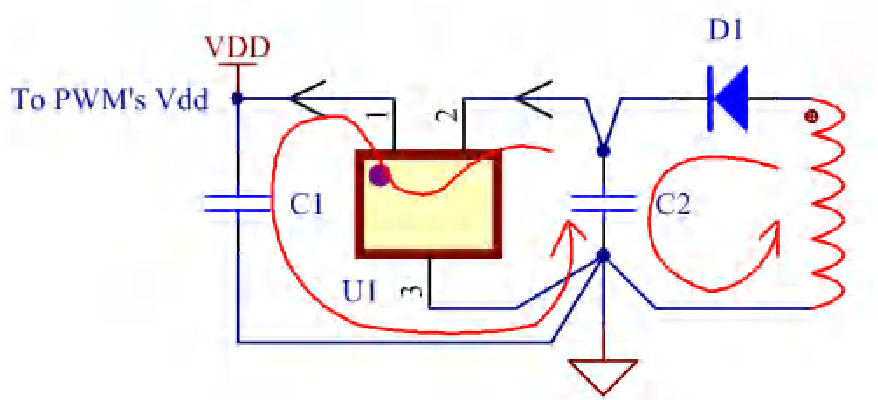


Fig9. Typical PCB Layout loop Schematic

13.2 Typical layout reference

An example of a typical PCB layout is shown below.

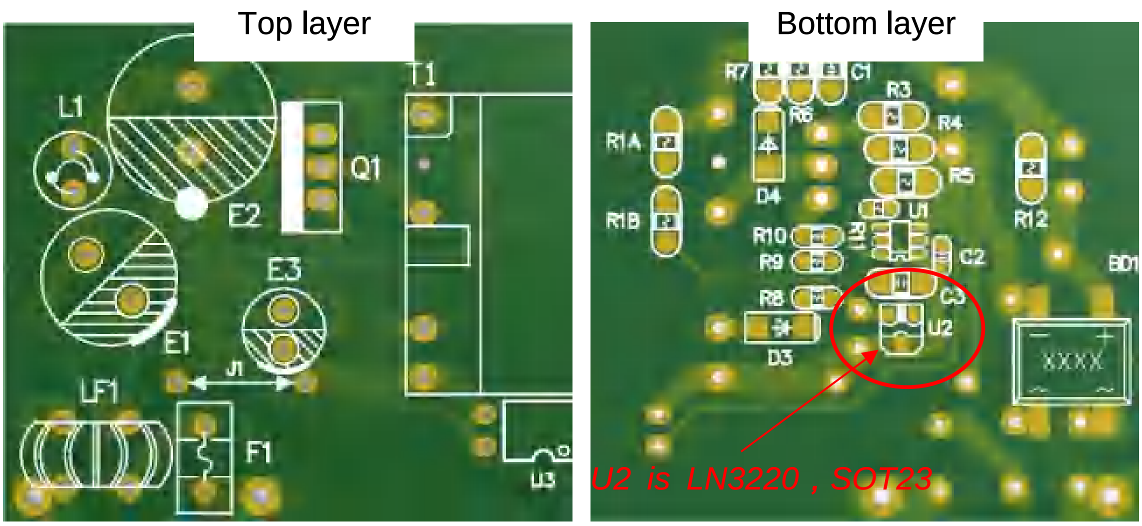


Fig10. Typical layout reference

14. Typical Application Circuit Schematic (90~265Vac, 3.3~28V USB-C PD/PPS Charger)

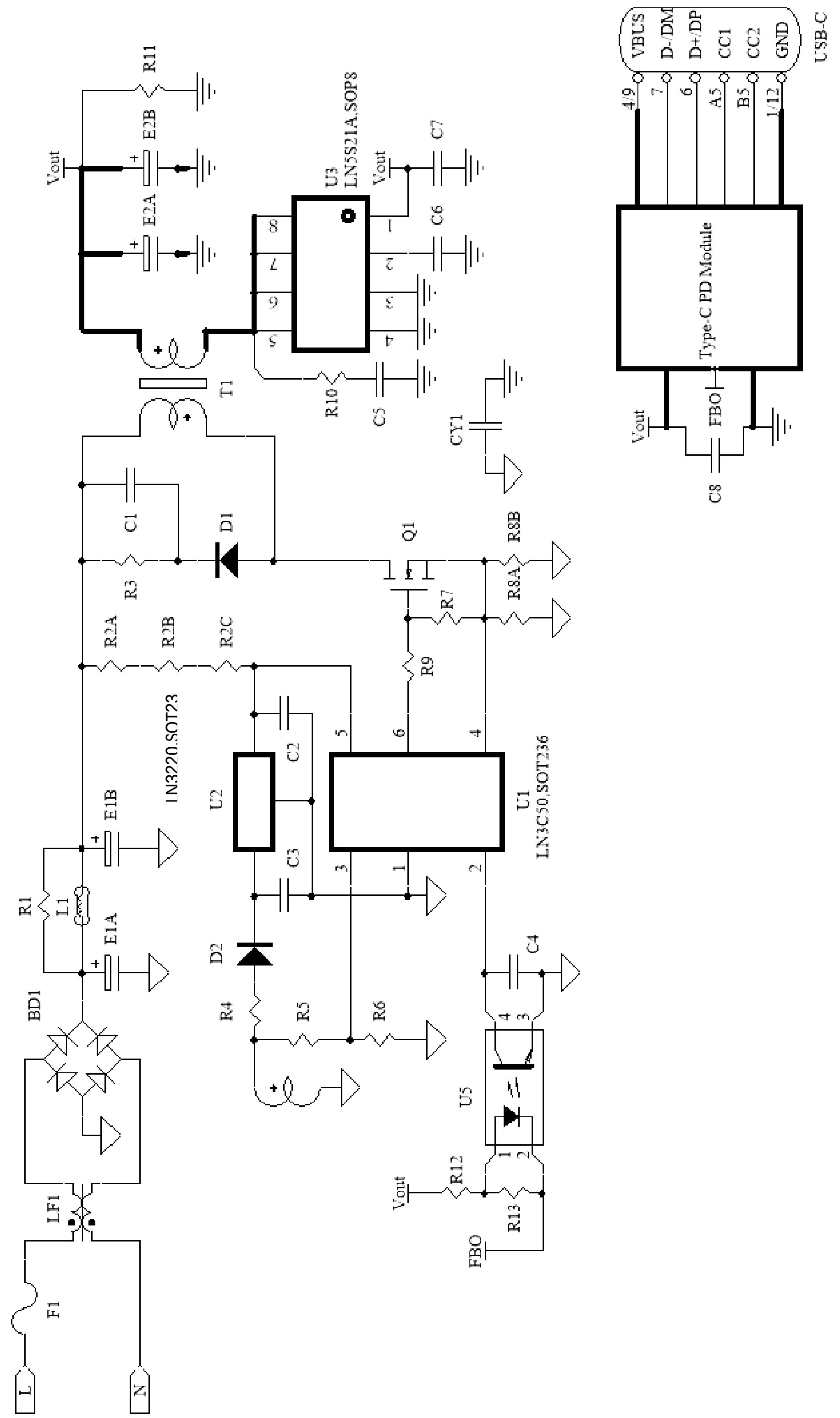
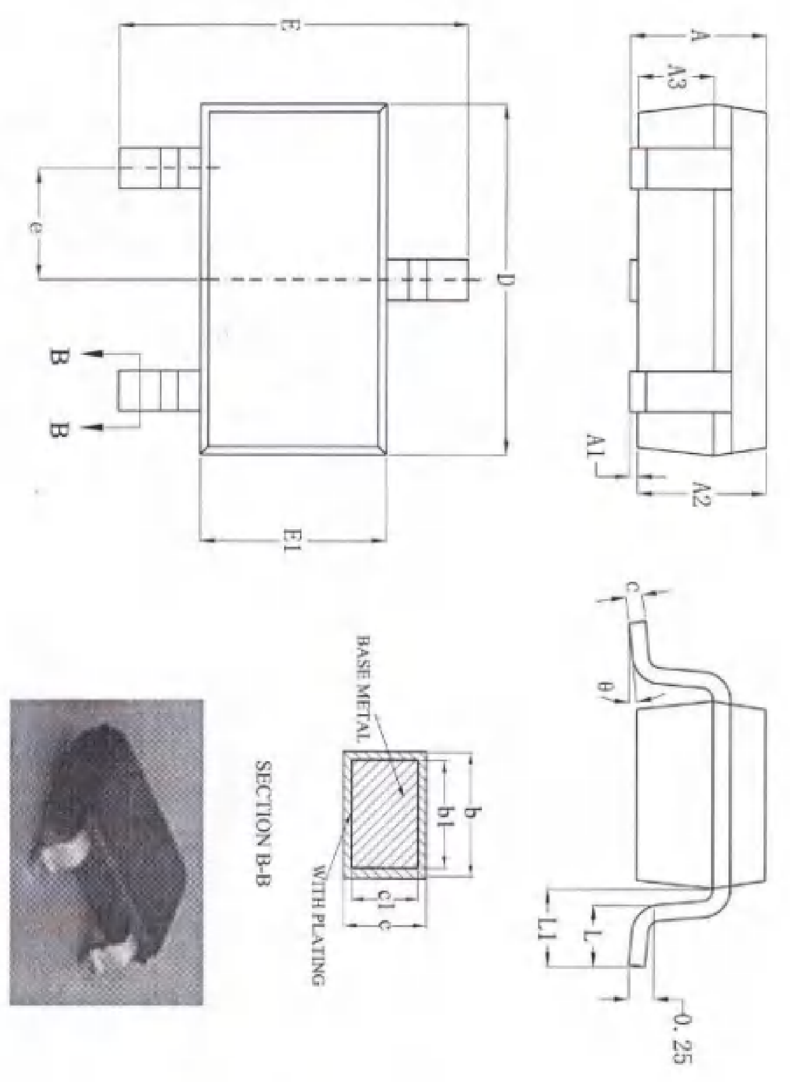


Fig11. Typical Application Circuit Schematic

15. Mechanical and Packaging

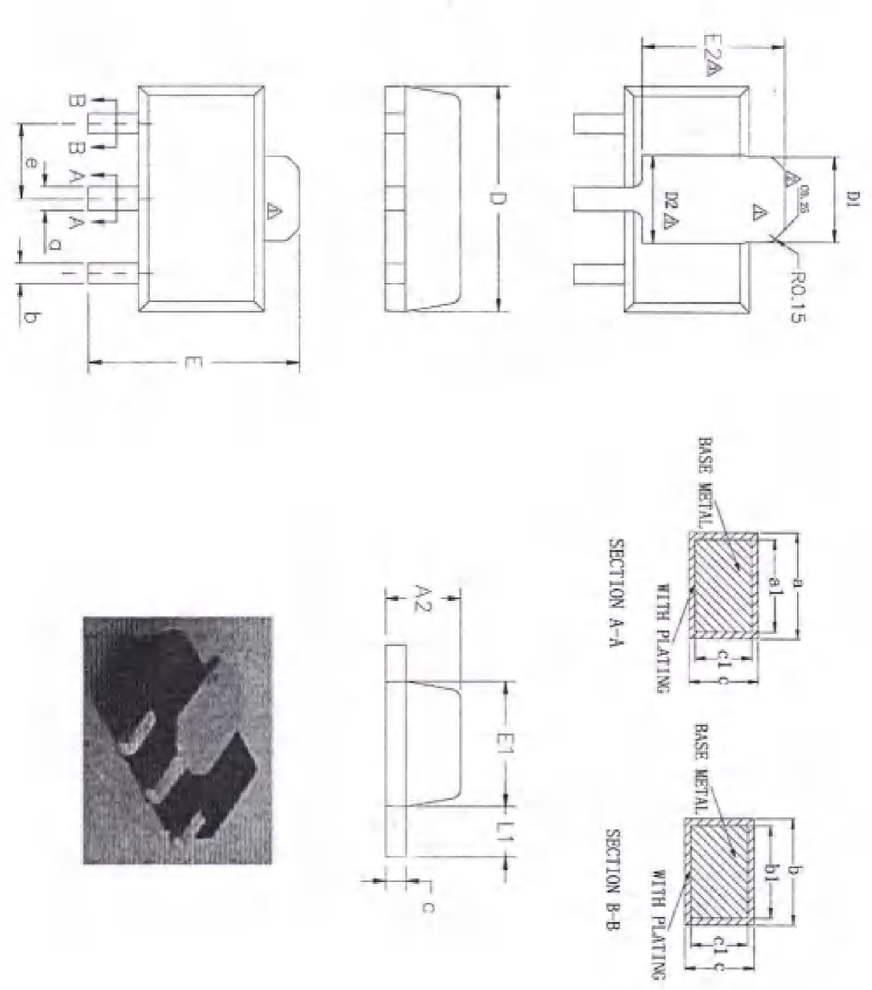
SOT23-3



SYMBOL	MILLIMETER MIN	MILLIMETER NOM	MILLIMETER MAX
A	—	—	1.25
A1	0.04	—	0.10
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.33	—	0.41
b1	0.32	0.35	0.38
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95BSC		
L	0.30	—	0.60
L1	0.60REF		
θ	0	—	8°

Fig12. SOT23 Mechanical Dimensional Drawings

SOT89-3



SYMBOL	MILLIMETER MIN	NOM	MAX
A2	1.40	1.50	1.60
b	0.38	—	0.46
b1	0.37	0.40	0.43
c	0.38	—	0.42
c1	0.37	0.38	0.39
a	0.46	—	0.56
a1	0.45	0.48	0.51
D	4.40	4.50	4.60
D1	1.62	—	1.83
E	3.95	—	4.25
E1	2.40	2.50	2.60
e	1.50BSC		
L1	0.89	—	1.20

L/F Size (mil) / Size (mm)	D2	E2
66.9*63	1.75REF	2.84REF

Fig13. SOT89 Mechanical Dimensional Drawings

16. Orderable Information

Part Number	RoHs	Package	Packing
LN3220	Halogen Free	SOT23-3	3000PCS/Reel
LN3220	Halogen Free	SOT89-3	1000PCS/Reel

17. Important Notice

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