Overview

LP2178AL is a high-efficiency and high-precision non-isolated step-down switching power supply constant voltage control driver chip. It is suitable for non-isolated Buck and Buckboost topologies with a full range of input voltages from 85VAC to 265VAC, and is especially suitable for driving power supplies such as small appliances and white appliances.

LP2178AL integrates high-voltage power tubes and adopts constant voltage control mode. The system can work in CCM and DCM modes. It adopts a unique PFM control method to improve audio characteristics.

Built-in unique peak current control, no CS resistor required; built-in startup circuit, no startup resistor required. Simple peripheral application and high reliability.

LP2178AL has multiple protection functions, including VCC clamping/undervoltage protection, output short circuit protection, inductor overcurrent protection and over-temperature protection.

LP2178AL adopts SOP8L

Features

ÿ Integrated 750V power tube ÿ
Constant voltage control, fixed 5V output voltage ÿ
Built-in unique peak current control, no CS resistor required ÿ Built-in
startup circuit, no startup resistor required ÿ Excellent
dynamic performance ÿ Excellent
EMI characteristics ÿ Excellent
output load regulation rate ÿ Low standby
power consumption <75mW ÿ Excellent
audio characteristics in the full load range ÿ Multiple
protection functions

application

ÿ Open power supplies such as small appliances and white appliances

Typical Applications

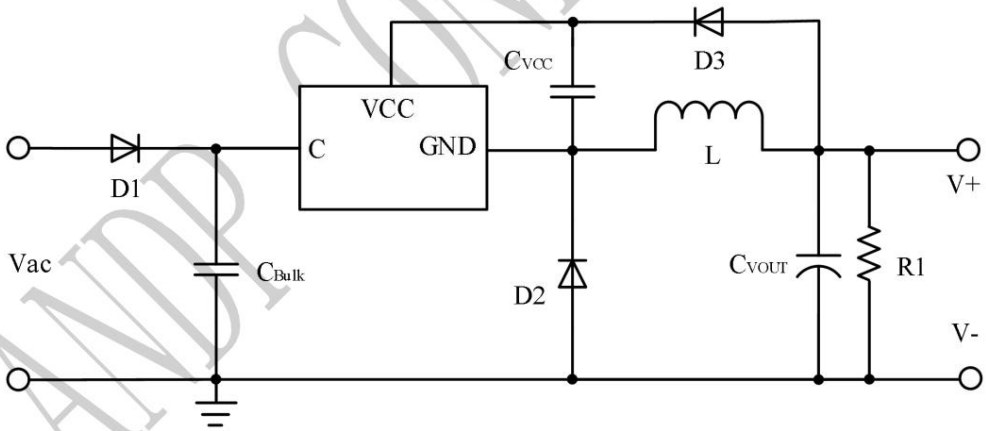


Figure 1 LP2178AL Buck Typical Application

Ordering Information

Order model	Encapsulation	Packaging	seal
LP2178AL	SOP8L	Taping 4000 pcs/reel	LP2178 ALXXXX

*XXXX: batch number

Pin package

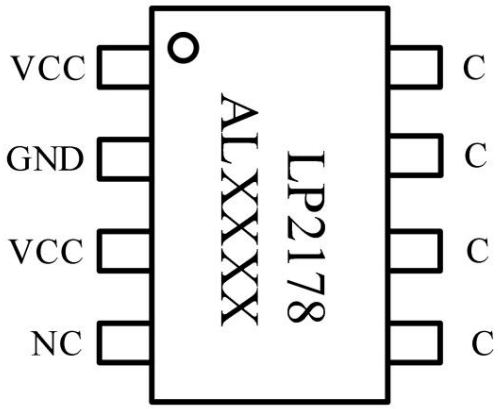


Figure 2 Pin package diagram

Pin Description

serial number	Pin Name	describe
1ÿ3	VCC	Chip power supply and feedback signal detection
2	GND	Chip Ground
4	NC	Floating pin
5ÿ6ÿ7ÿ8	C	The collector C of the built-in power transistor

Limit parameters (Note **1)**

symbol	parameter	Parameter Range	Unit
VCC	power supply voltage and feedback signal detection pin power	-0.3~7	V
PDMAX	consumption (Note 2)	0.45	IN
ÿJA	Thermal resistance from PN junction to ambient	120	ÿ/W
TJ	Operating junction temperature range	-40 to 150	ÿ
TSTG	storage temperature range	-55 to 150	ÿ
	ESD (Note 3)	ÿ2	KV

Note 1: The maximum limit value means that if the chip is beyond the working range, it may be damaged. The recommended working range means that within this range, the device functions normally, but it is not completely guaranteed. Electrical parameters define the DC and AC voltage behavior of a device within its operating range and under test conditions that guarantee specific performance indicators. Parameter specification. For parameters without upper and lower limits, the specification does not guarantee their accuracy, but their typical values reasonably reflect the device performance.

Note 2: The maximum power dissipation will decrease as the temperature rises, which is also determined by TJMAX, ÿJA, and the ambient temperature TA . The maximum allowable power dissipation is PDMAX = (TJMAX - TA)/ ÿJA or the lower value of the number given in the extreme range.

Note 3: Human body model, 100pF capacitor discharged through 1.5Kÿ resistor.

Recommended working range

chip	parameter	Parameter Range	Unit
LP2178AL	Io @Vo=5V (Input voltage: 85VAC~265VAC@temperature riseÿTÿ30ÿ)	ÿ100	mA

Electrical parameters (Note **4,** 5) (Unless otherwise specified, VCC **= 5V, TA = 25°C)**

symbol	describe	condition	Min	Typ	Max	Unit
Supply voltage						
VCC_ST	VCC startup voltage	VCC rises	3.60	4.10	4.60	V
VCC_UVLO	VCC undervoltage protection threshold	VCC drops	2.20	2.55	2.90	V
VCC_CLAMP	VCC clamp voltage	ICC=20mA	5.55	5.9	6.25	V
IS	VCC startup current	VCC= VCC-ST- 0.5V		1	3	uA
ICC	VCC operating current	VCC=4.8V			1100	uA
constant pressure control						
VCC_REG	constant voltage feedback control		5.23	5.38	5.53	V
threshold peak current control						
IPK_MAX	Maximum peak current		240	260	280	mA
IPK_MIN	minimum peak current leading			80		mA
TLEB	edge blanking time			350		ns
Operating frequency						
FSWMAX	maximum operating frequency		38	44	50	KHz
FSWMIN	minimum operating frequency	No load		2.5		KHz
JUDGE	Frequency jitter ratio			±7		%
Protection function						
VVCC_HICCUP	output short circuit protection	Vo< VVCC_HICCUP&60mS		3.5		V
IL_OCP	inductor over-current protection	IL_OCP>1.50* IPK_MAX&7 cycles output over-current		390		mA
IOCP		Io>IOCP, short circuit	130			mA
protection TON_MAX	maximum on-time maximum on-time limit			18		us
DON_MAX	Maximum duty cycle	Maximum duty cycle limit			50	%
TSD	Overheat protection temperature			150		ÿ
THYS	Overheat protection hysteresis			30		ÿ
Built-in power transistor						
VCBO	C, B voltage	IC=0.1mA	750			V
ICESAT	C, E Saturation current	IB = 40mA		300		mA

Note 4: Typical parameter values are measured at 25°C.

Note 5: The minimum and maximum specification ranges in the data sheet are guaranteed by testing, and the typical values are guaranteed by design, testing or statistical analysis.

Internal structure diagram

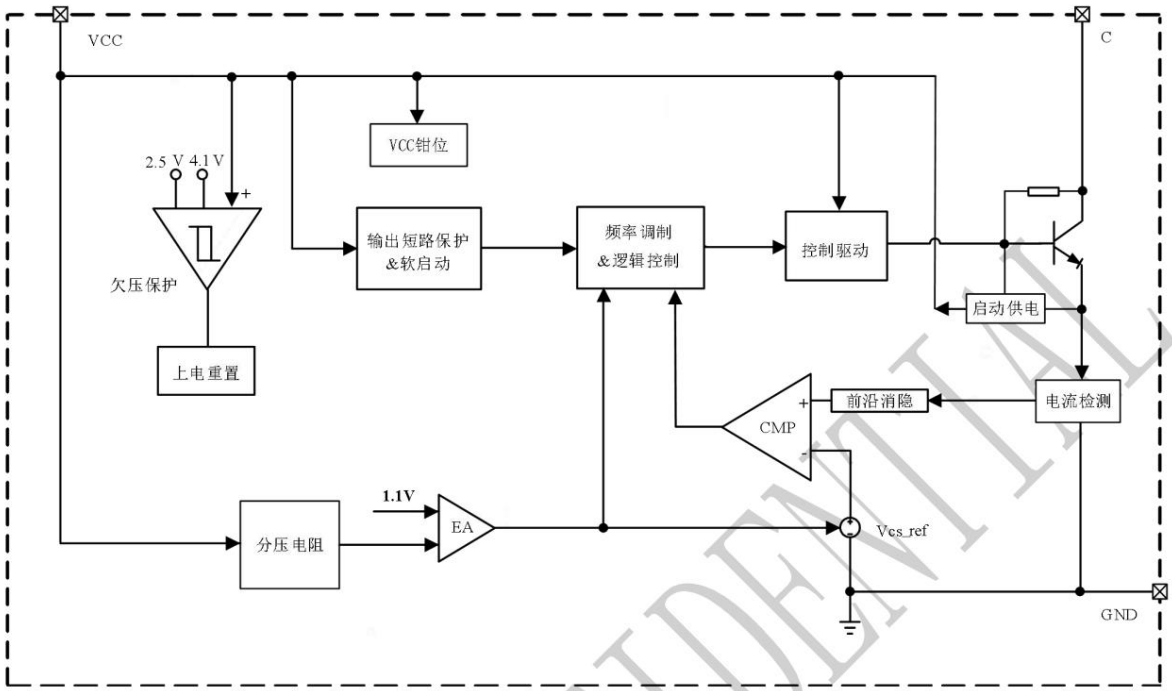


Figure 3 LP2178AL internal block diagram

Application Information

LP2178AL is a high-efficiency and high-precision non-isolated step-down switching power supply constant voltage control driver chip. LP2178AL integrates high-voltage power tubes and adopts constant voltage control mode. The system can work in CCM and DCM modes. It adopts a unique PFM control method to improve audio characteristics. The peripheral application is simple and the reliability is strong.

start up

The chip only needs 1uA startup current. After the system is powered on, the capacitor of VCC is charged through the internal startup power supply circuit. When the VCC voltage reaches the chip startup threshold, the internal control circuit of the chip starts to work; at this time, the startup power supply circuit will continue to maintain the power supply, so that the output voltage can rise and establish normally. When the output voltage rises and works stably, VCC is powered by the output voltage.

Constant pressure control

The constant voltage control is set by the VCC constant voltage feedback control threshold, and the calculation formula is as follows:

Vo = V_ + 3 2

Where VO is the output voltage, VCC_REG is the VCC constant voltage feedback control threshold (typical value 5.38V), VD2 is the freewheeling tube voltage drop, and VD3 is the VCC feedback (power supply) diode voltage drop.

PFM and peak current **IPK control**

PFM and peak current IPK control, as shown in Figure 4:

Phase 1: operating at the maximum peak current IPK_MAX and the maximum operating frequency FSWMAX;

Phase 2: Working at the maximum peak current IPK_MAX, and the operating frequency decreases from the maximum operating frequency FSWMAX to 30KHzÿ

Stage 3: Working at 30KHz operating frequency, and the peak current gradually decreases from the maximum peak current IPK_MAX as the load current decreases;

Stage 4: The peak current continues to decrease as the load current decreases, decreasing to the minimum peak current IPK_MIN; the operating frequency gradually decreases from 30KHz as the load current decreases;

Phase 5: Working at the minimum peak current IPK_MIN; the operating frequency continues to decrease as the load current decreases, decreasing to the minimum operating frequency FSWMINÿ

When no-load, it operates at the minimum peak current IPK_MIN.

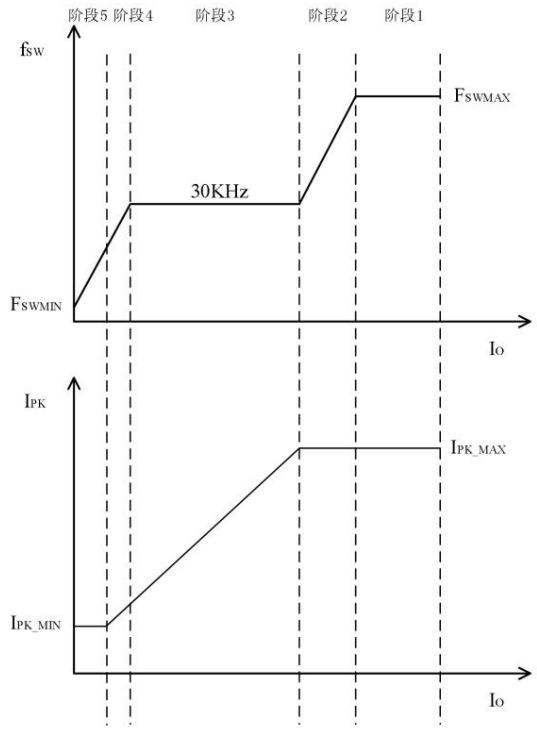


Figure 4

Soft Start

As shown in Figure 5, the VCC capacitor is charged through the startup circuit, VCC reaches the startup voltage VCC_ST, and the chip outputs a PWM switching signal; at this time, the output voltage begins to rise, and because the output voltage is still small, the VCC voltage will drop to 3.5V, and VCC is maintained at 3.5V through self-power supply. The PWM switch signal goes through the following three stages, and the soft start ends. At the end of the soft start, the output voltage rises to VO_MIN: if VO_MIN>3.5V, the chip works normally; if VO_MIN<3.5V, the chip output is short-circuit protected.

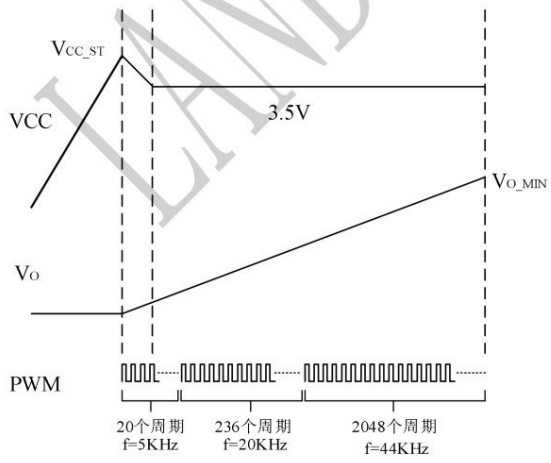


Figure 5

5V/100mA Buck System Parameter Recommendations

Lÿ1mH

D1ÿM7

D2ÿES1J

D3ÿM7

CVCC: 1uF/10V, SMD

R1ÿ1Kÿ

CVO>100uF/10V

CVIN>3.3uF/400V

Protection function

Including VCC clamping/undervoltage protection, output short circuit protection, inductor overcurrent protection and over-temperature protection.

PCB Design

When designing the LP2178AL PCB, the following guidelines need to be followed:

VCC bypass capacitor CVCC:

CVCC needs to be close to the chip VCC and GND pins;

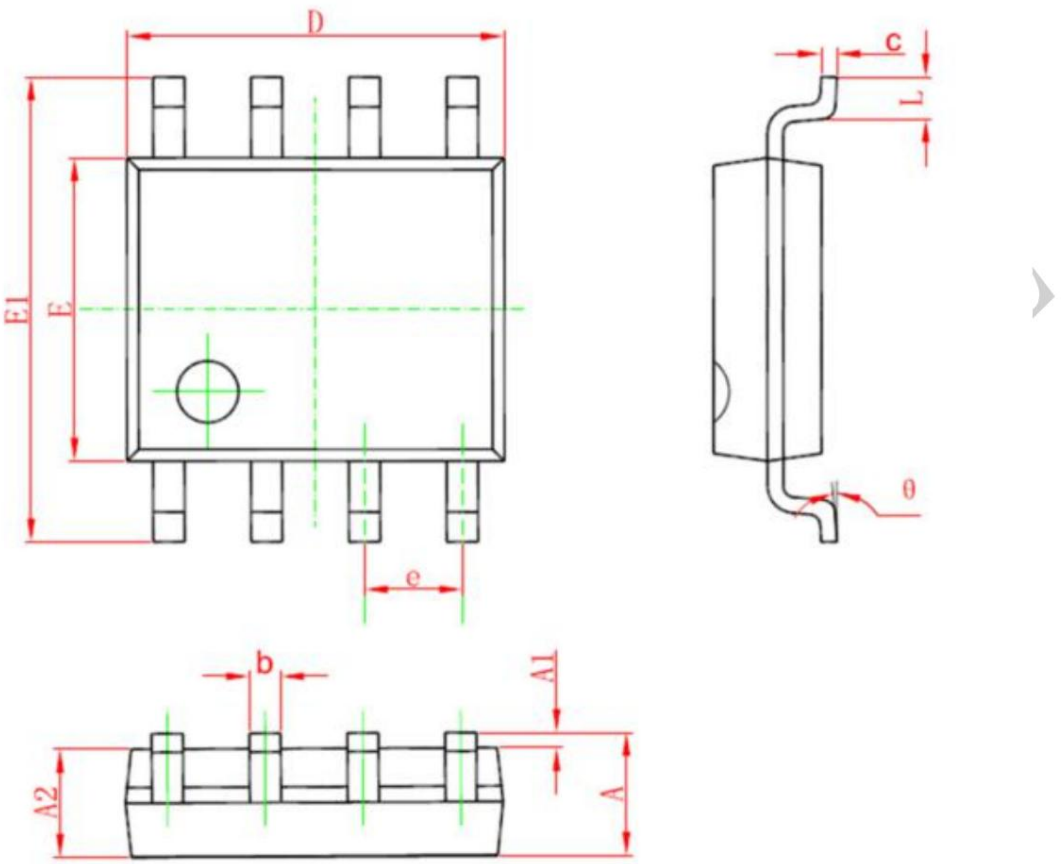
Power loop area

Reduce the area of the power loop, such as the loop area of the power inductor, power tube, bus capacitor, as well as the loop area of the power inductor, freewheeling diode, and output capacitor, to reduce EMI radiation.

C Pin

Appropriately increase the copper area of the C pin to improve chip heat dissipation.

Package information (SOP8L)



Symbol	Dimensions in Millimeters			Symbol	Dimensions in Millimeters	
A	1.35	1.75		E1	5.80	6.20
A1	0.05	0.25		AND	3.80	4.05
A2	1.30	1.50		and	1.27BSC	
b	0.30	0.51		L	0.40	1.27
c	0.10	0.25		i	0º	8th
D	4.70	5.10			/	