A2102V-002

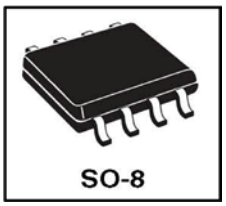
CC/CV Mode Step Down Switching Regulator

Version 2.1
Feb. 16, 2012

Reversion History

Date	Reversion #	Description	Page
2011/11/25	2.0	New datasheet format released, add Application Information.	18
2012/02/16	2.1	Modify MOS Ron Max value	18

General Description



The A2102V is a step down switching regulator, which has a built-in 40V P-channel power MOSFET for delivering output current. The A2102V is designed to allow for operating a wide supply voltage range from 8V to 33V and capable of delivering 3A output current.
The A2102V features a programmable CV/CC mode control functions, the CV mode (Constant Voltage) function to provide a regulated voltage output and the CC mode (Constant Current) function provide a current limitation function, it is suitable for the DC / DC switching power applications when requested the current limitation function.

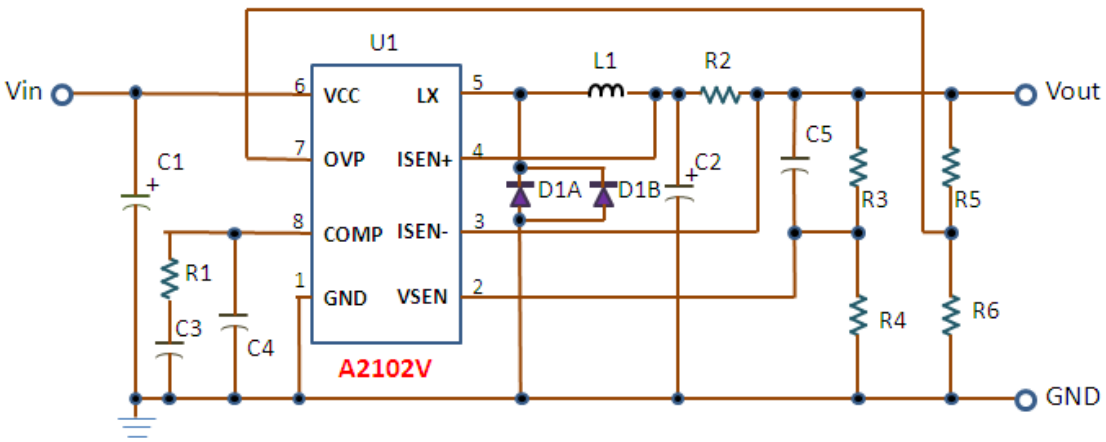
Features

- 8V~33V operating voltage range
- Built-In 40V, P-Channel MOSFET
- Fixed 100KHz operating frequency
- CC/CV mode control
- +/- 1% voltage reference accuracy
- +/- 4% current limit accuracy
- Soft Start function for start-up
- Output Over-Voltage Protection
- Over Temperature Protection
- Fold back Short-Circuit Protection
- High efficiency operation
- SOP-8 Package
- ISO7637-2 Pulse 1~4 Compliant

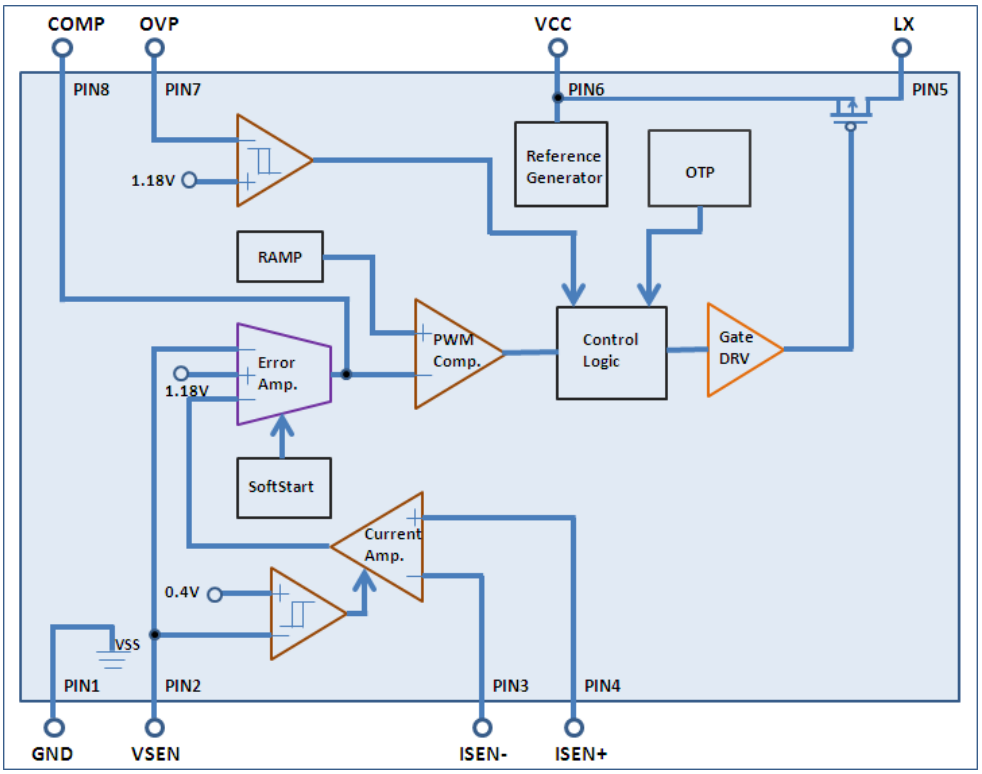
Applications

- Car charger
- Portable charger applications
- DC/DC converters with current limited
- General Purpose CV/CC power supply

Typical Application Circuits



Block Diagram



Ordering and Marking Information

Order Information

A 2 1 02 V- XXX

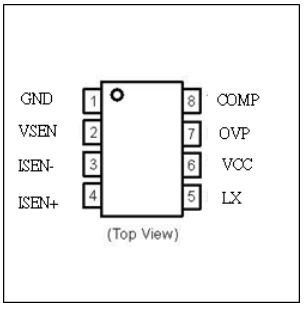
Bin Number
001 : +/- 2% current limit accuracy
002 : +/- 4% current limit accuracy
Package type
V : SOP-8
Serial number
Assembly type
1 : W/I MOS, 2 : W/O MOS
Product Code
2 : DC-DC

Marking Information

AVT
A2102V → **Part Name**
XX XX X XX XX
Sub. Lot
Lot ID
Year
Week

Signal Descriptions

Pin Configurations



Pin Description

Pin No.	Symbol	Description
1	GND	Ground pin
2	VSEN	The voltage sense input pin
3	ISEN-	The current sense negative input pin.
4	ISEN+	The current sense positive input pin.
5	LX	Regulator Output pin.
6	VCC	The input supply voltage pin
7	OVP	The over-voltage sense input pin.
8	COMP	The E/A output pin for frequency compensation.

Functional Descriptions

CV/CC mode control

The A2102V provides CV/CC function. The CV (constant voltage) function is implemented to deliver a regulated output voltage for the output terminal, and the CC (constant current) function is to limit output current to be a limited value to prevent the device damaged due to output short circuit or over current condition.

Soft Start function

The A2102V is composed of built-in internal soft start function to prevent a large surge current happening when during start-up period due to the surge current charging output filter capacitors.

Output Over-Voltage Protection

The A2102V provides output over-voltage protection function. When output over-voltage happens, the A2102V shuts down and recovers to normal state automatically if output over-voltage is released.

Output Short-Circuit Protection

The A2102V provides output short-circuit protection function. When output over-voltage happens, the A2102V shuts down and recovers to normal state automatically if output short-circuit is released.

Electrical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
VCC to GND	V_{cc}	−0.3 to +40	V
LX to VCC	LX	+0.3 to −40	V
VSEN to GND	VSEN	−0.3 to +7	V
ISEN+ to GND	ISEN+	−0.3 to +7	V
ISEN- to GND	ISEN-	−0.3 to +7	V
OVP to GND	OVP	−0.3 to +7	V
COMP to GND	COMP	−0.3 to +7	V
Maximum Output Current	I_{cc}	3	A
Power Dissipation at Ta <60 °C	P_D	0.75	W
ESD	V_{HBM}	±2000	V
	V_{MM}	±200	V
Maximum Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	−60 to 150	°C
Lead Temperature (Reflow)	T_{LEAD}	260	°C

Note: Stress beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those are indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Operating Conditions

Parameter	Symbol	Limits	Units
Temperature Range	T_J	－40 to 150	^oC

Thermal Data

Parameter	Symbol	SOP- 8	Units
Thermal Resistance Junction to Ambient	θ_{ja}	100	^oC /W
Thermal Resistance Junction to Case	θ_{jc}	15	^oC /W

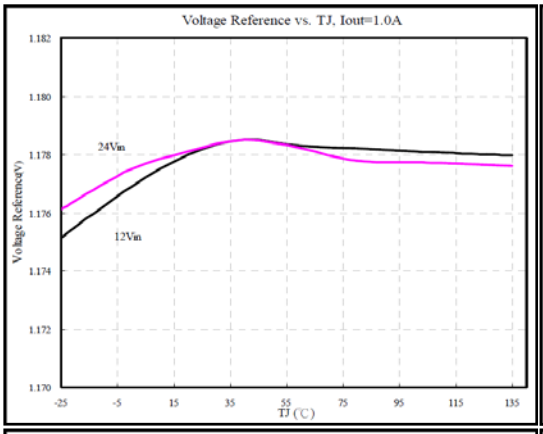
Electrical Characteristics

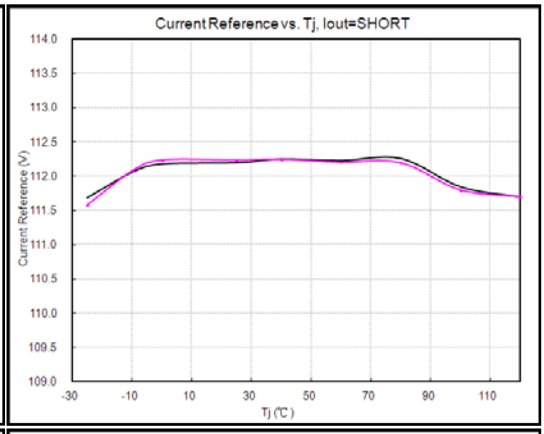
(Vin=12V, Ta=25℃, Io=2.0A, unless otherwise specified)

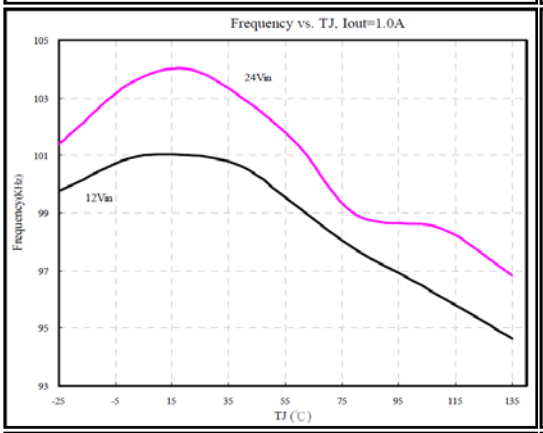
Parameter	Symbol	Conditions	Min	Type	Max	Units
Input Voltage Section						
Input Voltage	V_{IN}		8		33	V
Input Voltage Surge	$V_{IN, SURGE}$				40	V
Input No Load Current	$I_{no-load}$	Io=0A			10	mA
Oscillator Section						
Operating Frequency	F_{osc}		90		110	KHz
		Tj= -25 ^{o}C to 125 ^{o}C	85		115	KHz
Duty Cycle Range					95	%

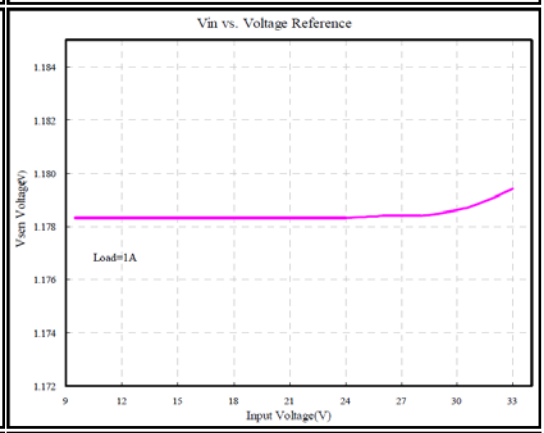
Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Error Amplifier Section						
Reference Voltage of the Voltage Error Amplifier	V_{VSEN}		1.168	1.18	1.192	V
		Tj= -25 °C to 125℃	1.155		1.205	V
Reference Voltage of the Current Error Amplifier for **A2102V-001**	V_{ISEN}		109.5	112	114.5	mV
		Tj= -25 °C to 125℃	107.5		116.5	mV
Reference Voltage of the Current Error Amplifier for **A2102V-002**	V_{ISEN}		107.5	112	116.5	mV
		Tj= -25 °C to 125℃	105.5		118.5	mV
Tran conductance of Error Amplifier	G_{Merr}			150		uA/V
Output Over Voltage Protection Section						
Reference Voltage of the Over Voltage Comparator	V_{OVP}		1.145	1.18	1.215	V
		Tj= -25 °C to 125℃	1.133		1.227	V
Output Short Circuit Protection Section						
Reference Voltage of the Short Circuit Fold back Comparator	V_{SCP}			0.4		V
MOSFET Section						
Drain-Source Breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_O=250uA	-40			V
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{in}=24.0V, I_O=1A			120	mΩ

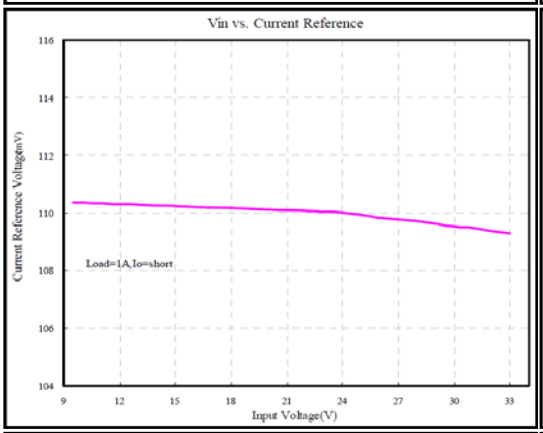
Typical Performance Characteristics

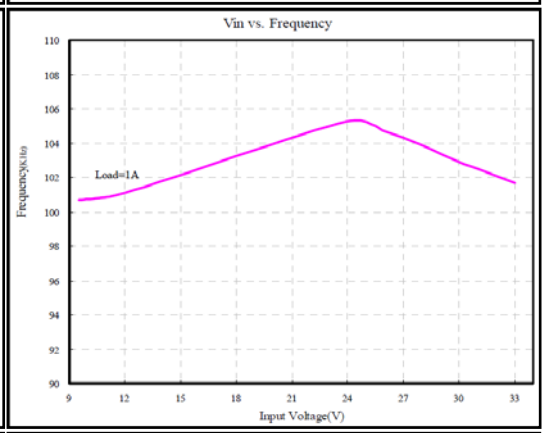


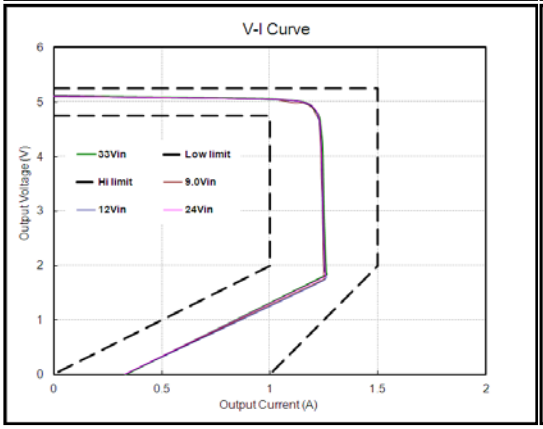


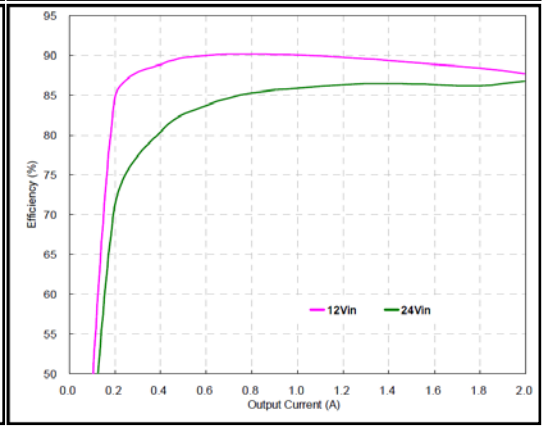




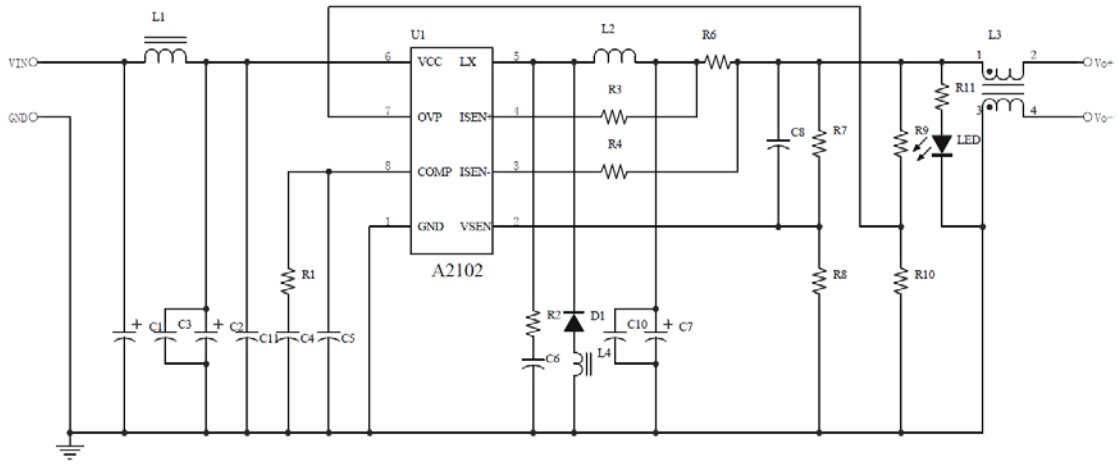








Application Circuits



BOM List for A2102V

Device	Description	Value	Q'ty
C1	Input ECAP, 47uF/35V, 6.3*7mm	47uF/35V	1
C2	Input ECAP, 100uF/35V, 6.3*7mm	100uF/35V	1
C3	MLCC, 0603, X7R	104	1
C4	MLCC, 0603, X7R	473	1
C5	MLCC, 0603, NPO	47pF	1
C6	MLCC, 0805, X7R	102	1
C7	Output ECAP, 220uF/6.3V, 6.3φ*7mm	220uF/6.3V	1
C8	MLCC, 0603, X7R	NA	0
C10	MLCC, 0603, X7R	104	1
C11	MLCC, 0603, X7R	104	1
D1	Schottky Diode, SMB, 40V/5A	SB54	1
L1	DR Choke, 4 φ *6mm	15uH	1
L2	Power Inductor, T- 5052B, L= 100uH wire=0.65	100uH	1
L3	T Core, 6*3*3, 0.5φ*2C*3Ts	22uH	1
L4	SMD Bead Core , 0805, 220Ω 3000mA	BEAD	1
LED	LED, GREEN	LED	1
R1	Chip R , 0603 , 5%	100K	1
R2	Chip R , 0805 , 5%	10R	1
R3	Chip R , 0603 , 5%	51R	1
R4	Chip R , 0603 , 5%	51R	1
R6	Chip R , 1206 , 1%	0.045R	1

R7	Chip R , 0603 , 1%	390K	1
R8	Chip R , 0603 , 1%	118K	1
R9	Chip R , 0603 , 5%	470R	1
R10	Chip R , 0603 , 5%	120R	1
R11	Chip R , 0603 , 5%	1K	1
J1	Chip R , 1206 , 1%	0	1
J2	Chip R , 1206 , 1%	0	1
U1	Buck Controller, CC/CV function, Vin 8 ~ 33V, SOP-8	A2102V	1

Application Information

Output Voltage Setting:

Figure 1 shows the connections for setting the output voltage value. Typically, selecting the proper ratio of the two feedback resistors R_{Vsen1} and R_{Vsen2} by using $R_{Vsen2} \approx 118k\Omega$ and determining V_{sen} from the following equation:

$$R_{vsen1} = R_{vsen2}\left\{\frac{V_{OUT}}{1.18V} - 1\right\}$$

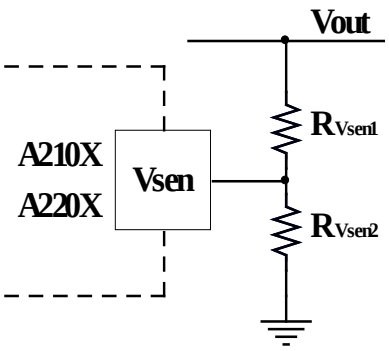


Figure 1: Output Voltage Setting

CC Current Setting:

The constant current value of A2102V is set by a Rs resistor which is connected between $I_{sen}+$ and $I_{sen}-$ pin. The output current of CC mode and Rs resistor are set by the following equation:

$$Rs = \frac{0.112}{ICC}$$

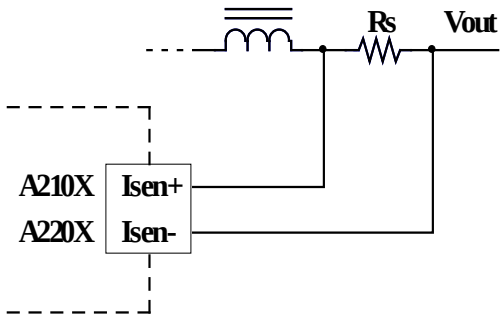


Figure 2: Constant Current Mode Setting

Input Capacitor Selection:

The bulk input capacitor selection is based on the voltage rating, the RMS current carrying capability, and the required input voltage ripple.

The capacitor voltage rating is recommended with 1.5 times for the maximum input voltage as conservative guideline, depending on the application condition.

The capacitor RMS current rating is considered for stress condition, and the trapezoid current waveform as the simplified formula is described:

$I_{RMS} = I_{OMAX} * \sqrt{(V_O/V_I)}$

V_I = input voltage ; V_O = output voltage ; I_{OMAX} = maximum output current.

The capacitor values with respect to the required input voltage ripple if neglect ESR is described:

$C = I_{OMAX} * \Delta T / \Delta V$

ΔT = capacitor supplied charging time ; ΔV = allowable input voltage ripple.

Output Rectifier Selection:

The output rectifier is selected by the consideration of the reverse voltage rating, the current rating，and the reverse recovery time and forward voltage drop for the power loss.

The reverse voltage rating should be at least 1.25 times the maximum input voltage for the consideration of voltage arc.

The current rating should be larger than the maximum inductor current.

The diode conduction loss is due to the forward conduction and is described:

$P_{COND} = I_{OMAX} * V_F * (1 - V_O/V_I)$

V_I = input voltage ; V_O = output voltage ; I_{OMAX} = maximum output current ;

V_F = diode forward voltage.

The diode reverse recovery loss is due to the reverse recovery from the forward conduction to the reverse blocking state, and is described:

$P_{RR} = Q_{RR} * V_I / Ts$

V_I = input voltage ; Q_{RR} = diode reverse recovery charge ; Ts = switching period.

Output Inductor Selection:

The output inductor is selected for the trade-offs between the output inductor current ripple, dc resistance for power loss, load transient response time, and the physical size.

The output inductor current ripple determines the output voltage ripple requirement, and the inductor's dc resistance concerns the power loss.
The larger the inductor value, the smaller the inductor ripple current, but the slower the transient response time, the larger the inductor dc resistance, and hence the larger the power loss.

The inductance value is described:
$L = Vo * (1 - V_O/V_I) * Ts / \Delta I_L$
V_I = input voltage ; V_O = output voltage ;
Ts = switching period ; ΔI_L = inductor ripple current.

Output Capacitor Selection:

The output capacitor is selected for the trade-offs between output ripple voltage requirement, the output voltage rating, the RMS current rating, the ESR and ESL for the load transient, and the physical size.

The capacitor voltage rating is recommended with 1.5 times for the maximum output voltage as conservative guideline。

The capacitor RMS current rating is considered for stress condition，and the trapezoid current waveform as the simplified formula is described：
$I_{RMS} = \Delta I_L / 2\sqrt{3}$; ΔI_L = Inductor ripple current.

The output ripple voltage with respect to the capacitor ESR is described：
$\Delta V = \Delta I * (ESR + Ts / (8*C))$
ΔI = capacitor ripple current，which is equivalent to the inductor ripple current ;
ESR = capacitor equivalent series resistance ; Ts = switching period.

PC Board Layout Consideration

Good PC Board layout is very important in switching converter design. If designed improperly, the PC Board could radiate excessive noise and contribute to the converter instability.

Follows below PC Board layout guidelines could get better performance:

- Path A :

  The Vo- is returned to input bulk capacitor C2, by passing through output capacitor C7.

- Path B :

  The output rectifier D1, together with Snubber R2 and C2, are shunt to common ground and returned to input bulk capacitor C2.

- Path C and D :

  The decoupling capacitor C11, the compensation network R1, C4, C5, the voltage feedback network R7, R8, C8, and the overvoltage sensing network R9, R10, are connected to IC ground, and returned to input bulk capacitor C2 and output capacitor C7.

- Path E :

  Input capacitor C2 is returned to input ground, after all ground networks are following the above paths designed.

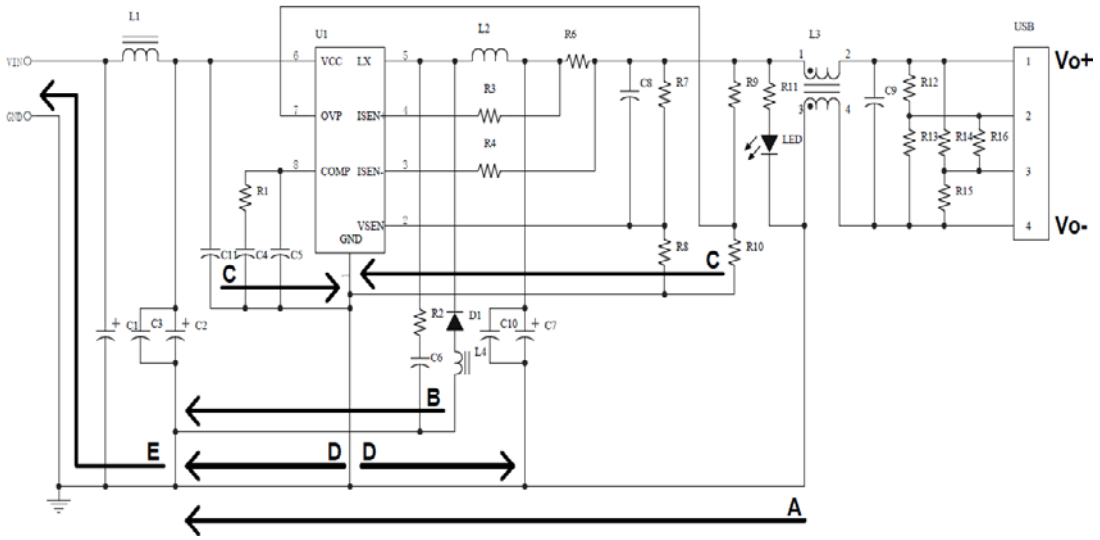


Figure 3: PC Board layout guidelines

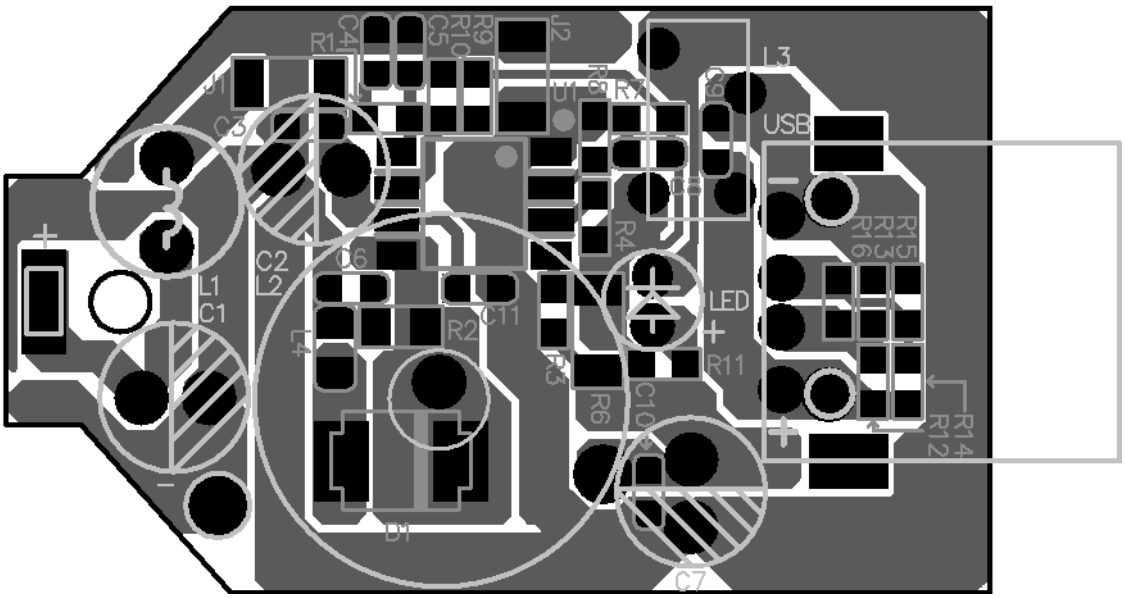


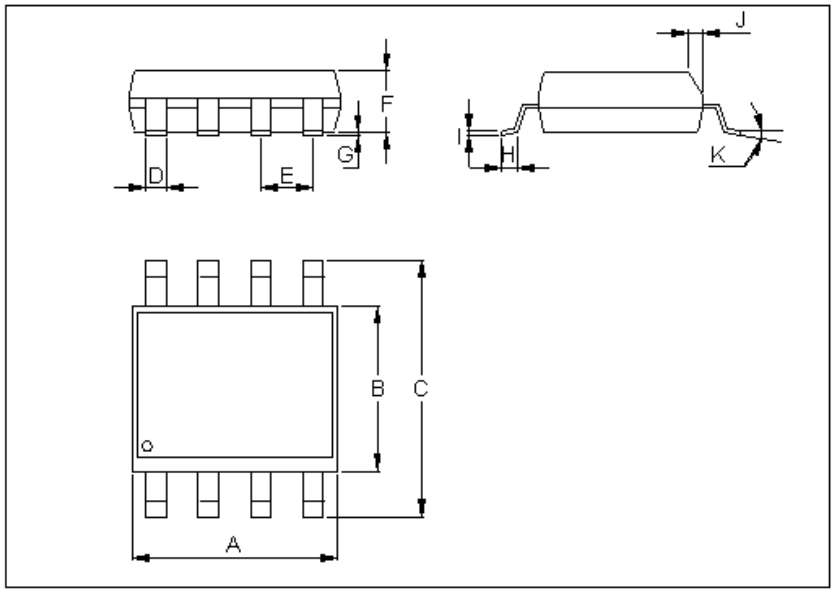
Figure 4: The PCB layout of Car Charger with A2102V controller

Package Information

Package Dimensions

SOP-8 Mechanical Data							
Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.7	4.9	5.1	H	0.4	0.715	0.83
B	3.7	3.9	4.1	I	0.19	0.22	0.26
C	5.8	6	6.2	J	0.25	0.375	0.5
D	0.33	0.445	0.51	K	0°	4°	8°
E		1.27		L			
F	1.2	1.375	1.62	M			
G	0.08	0.175	0.28	N			

Weight : 0.083 ∓ 0.003 g / pcs

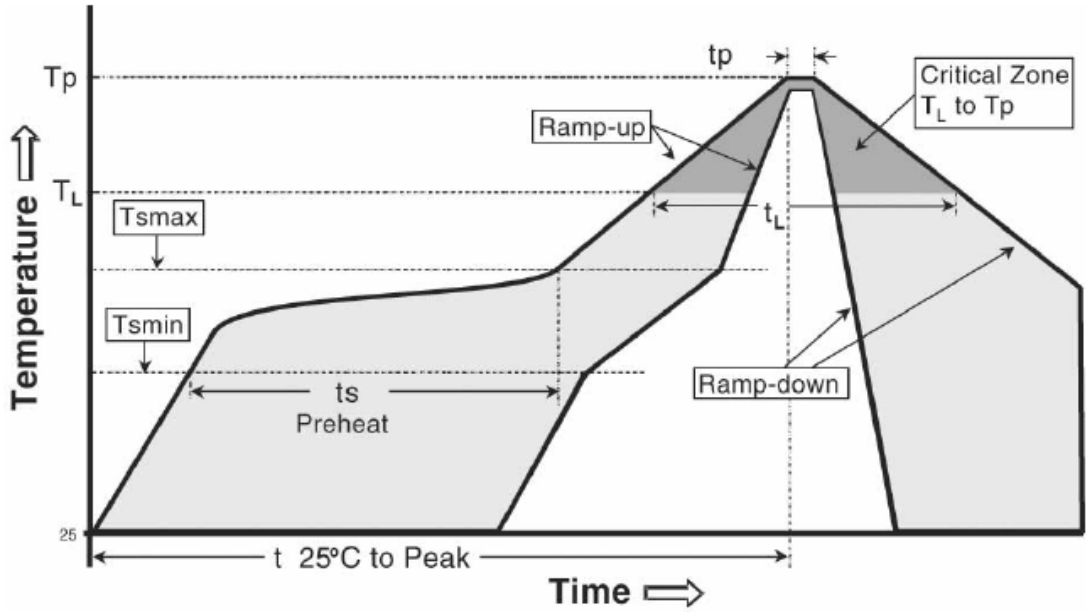


Storage Condition and Period for Package

Package	MSL	Max. Reflow Temp.	Floor Life Storage Condition	Dry Pack
SOP8	LEVEL 3	260 -5/+0 °C	168hrs @ ≦30 °C/60% RH	YES

NOTE: Please refer to IPC/JEDEC J-STD-020 standard.

Recommended SMT Temperature Profile



Source: JEDEC org. http://www.jedec.org/sites/default/files/docs/jstd020d-01.pdf

NOTE: For detailed information, please refer to J-STD-020 standard on JEDEC website.

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