

▼ General Description

The GA8542 is a voltage mode, step-down DC-DC converter that is designed to meet 3A output current and utilizes PWM control scheme that switches with 150KHz fixed frequency. This device includes a reference voltage source, error amplifier, oscillation circuit, NPN transistor, and etc.

The input voltage range of GA8542 is from 4.5V to 40V, and provides fixed or adjustable output voltage for customers in application. The fixed output voltage type is preset at an internally trimmed voltage 3.3V, 5V or 12V. The adjustable output voltage range is from 1.23V to 37V.

The GA8542 provides a shutdown function that can be controlled by external logic signal and excellent regulation during line or load transient due to the internal compensation. Other features of thermal protection and current limit are also included. The GA8542 guarantees $\pm 15\%$ tolerance on internal oscillator frequency and $\pm 4\%$ tolerance on output voltage under specified input voltage and output current.

The packages are available in a standard TO-252-5L, TO-263-5L and TO-220-5L.

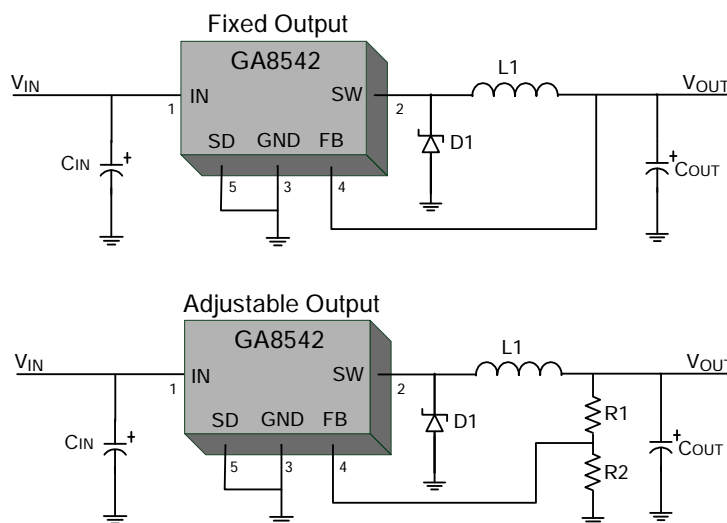
▼ Features

- Fixed Output Voltage: 3.3V, 5V, 12V
- Adjustable Output Voltage from 1.23V to 37V
- Operating Input Voltage up to 40V
- Great Output Capability: 3A
- Oscillation Frequency: 150KHz
- Built-in NPN transistor
- External ON/OFF Control Function
- Low Shutdown Current: 85uA
- Current Limit
- Thermal Protection
- TO-252-5L, TO-263-5L and TO-220-5L Packages
- All Products meet Rohs Standard

▼ Applications

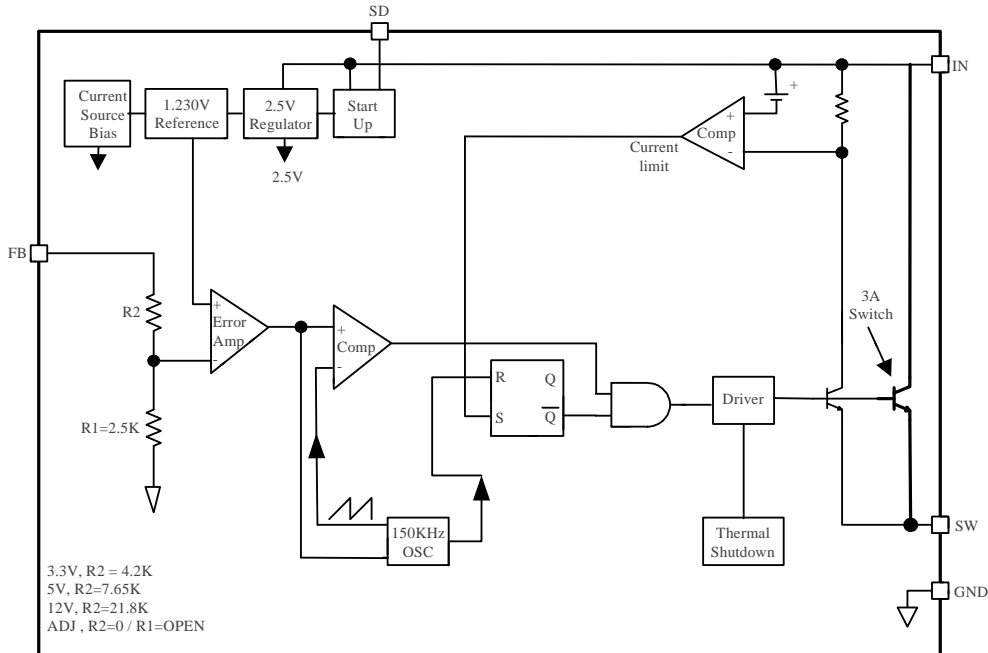
- Broadband Communication Device
- LCD TV / Monitor
- Storage Device
- Wireless Application

▼ Typical Application

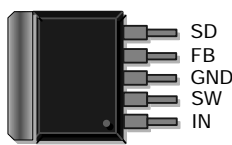


$$* V_{OUT} = V_{FB} \times (1 + R1 / R2)$$

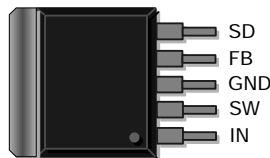
Functional Block Diagram



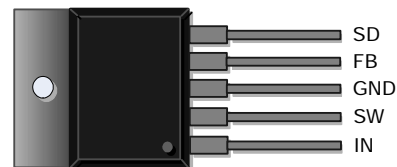
Pin Configurations



TO-252-5L



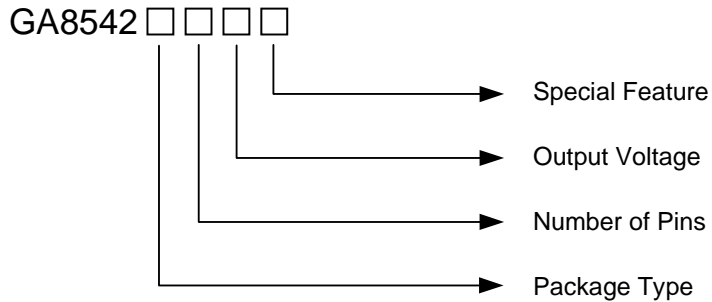
TO-263-5L



TO-220-5L

Pin No.	Name	Description
1	IN	The input pin of the step-down converter. A suitably large capacitor must be connected from this pin to ground to bypass noise on the input of the IC.
2	SW	The output pin of the step-down converter. This pin is the switching node that supplies power to the output. Connect a LC filter from this pin to the output load and a rectifier diode to the ground.
3	GND	The ground pin of the step-down converter. Connect this pin to the circuit ground.
4	FB	This pin senses the feedback voltage to regulate the output voltage. Connect this pin to a resistor divider to set the output voltage for adjustable version or connect to the positive side of load directly for fixed version.
5	SD	This pin allows an external logic control signal to turn-on/off this device. Float this pin or drive it to high level to turn-off this device, drive it to low level to turn-on this device. If this feature is not needed, connect this pin to ground directly.

Ordering Information



Package Type	Number of Pins	Output Voltage	Special Feature
G: TO-252 H: TO-263 I: TO-220	D: 5 pin	330: 3.3V 500: 5.0V 12A: 12V ADJ: Adjustable version	Blank: Original

Marking Information



* This rule is compatible with TO-252, TO-263 and TO-220 packages.

①②③ - Product Code

Part Number	Output Voltage	Package Type	Product Code
GA8542GDADJ	ADJ	TO-252	AAV
GA8542GD330	3.3V	TO-252	AAW
GA8542GD500	5.0V	TO-252	AAX
GA8542GD12A	12V	TO-252	AAY
GA8542HDADJ	ADJ	TO-263	AAZ
GA8542HD330	3.3V	TO-263	ABA
GA8542HD500	5.0V	TO-263	ABB
GA8542HD12A	12V	TO-263	ABC
GA8542IDADJ	ADJ	TO-220	ABD
GA8542ID330	3.3V	TO-220	ABE
GA8542ID500	5.0V	TO-220	ABF
GA8542ID12A	12V	TO-220	ABG

④⑤ - Date Code

Year Week	xxx0	xxx1	xxx2	xxx3	xxx4	xxx5	xxx6	xxx7	xxx8	xxx9
01	AA	CA	EA	GA	IA	KA	MA	OA	RA	TA
02	AB	CB	EB	GB	IB	KB	MB	OB	RB	TB
03	AC	CC	EC	GC	IC	KC	MC	OC	RC	TC
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.
.
24	AX	CX	EX	GX	IX	KX	MX	OX	RX	TX
25	AY	CY	EY	GY	IY	KY	MY	OY	RY	TY
26	AZ	CZ	EZ	GZ	IZ	KZ	MZ	OZ	RZ	TZ
27	BA	DA	FA	HA	JA	LA	NA	PA	SA	UA
28	BB	DB	FB	HB	JB	LB	NB	PB	SB	UB
29	BC	DC	FC	HC	JC	LC	NC	PC	SC	UC
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.
.
50	BX	DX	FX	HX	JX	LX	NX	PX	SX	UX
51	BY	DY	FY	HY	JY	LY	NY	PY	SY	UY
52	BZ	DZ	FZ	HZ	JZ	LZ	NZ	PZ	SZ	UZ

✓ Absolute Maximum Ratings

Parameter	Rating
Input Voltage	45V
SW Pin Voltage Range	-1V ~ 37V
FB Pin Voltage Range	-0.3V ~ 25V
SD Pin Voltage Range	-0.3V ~ 25V
Storage Temperature Range	-65°C ~ 150°C
Junction Temperature	150°C
Lead Soldering Temperature (10 sec)	300°C

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

✓ Recommended Operating Conditions

Parameter	Rating
Input Voltage Range	4.5V ~ 40V
Junction Temperature Range	-40°C ~ 125°C

These are conditions under which the device functions but the specifications might not be guaranteed. For guaranteed specifications and test conditions, please see the *Electrical Specifications*.

✓ Package Information

Parameter	Package	Symbol	Maximum	Unit
Thermal Resistance (Junction to Case)	TO-252	θ_{JC}	10	°C / W
	TO-263		4	
	TO-220		3	
Thermal Resistance (Junction to Ambient)	TO-252	θ_{JA}	50	°C / W
	TO-263		30	
	TO-220		25	

▼ Electrical Specifications

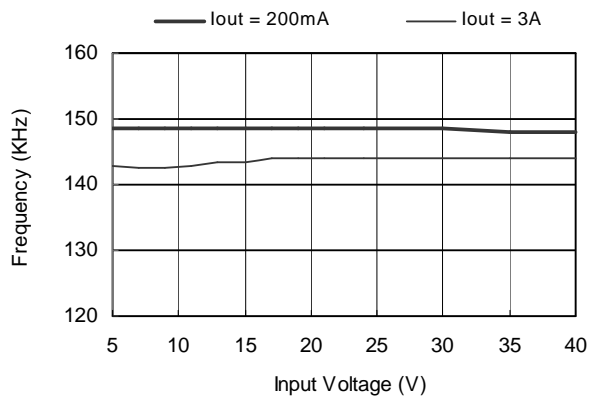
$I_{LOAD}=500mA$, $V_{IN}=12V$ for the 3.3V, 5V, and adjustable version and $V_{IN}=15V$ for the 12V version, unless otherwise noted. The **boldface type** denotes specifications which apply over the full operating temperature range, otherwise specifications are $T_A=25^{\circ}C$.

Parameter	Symbol	Test Condition		Min	Typ	Max	Units
Feedback Voltage	V_{FB}	GA8542xxADJ	$V_{OUT}+3V \leq V_{IN} \leq 40V$, $I_{LOAD}=0.2A \sim 3A$ (For Adjustable version, V_{OUT} set to 3V)	1.193	1.23	1.267	V
				1.18		1.28	
Output Voltage	V_{OUT}	GA8542xx330		3.168	3.3	3.432	
				3.135		3.465	
		GA8542xx500		4.8	5	5.2	
				4.75		5.25	
		GA8542xx12A	11.52	12	12.48		
			11.4		12.6		
Efficiency	η	GA8542xxADJ	$I_{LOAD}=3A$ (For Adjustable version, V_{OUT} set to 3V)		76		%
		GA8542xx330			78		
		GA8542xx500			81		
		GA8542xx12A			90		
Oscillation Frequency	F_{OSC}			127	150	173	KHz
			110	173			
Duty Cycle	DC	$V_{FB}=0V$ force driver on				100	%
		$V_{FB}=12V$ force driver off		0			
Switch Saturation Voltage	V_{SAT}	$I_{OUT}=3A$, $V_{FB}=0V$ force driver on Without external circuit			1.16	1.4	V
Current Limit	I_{LIM}	Peak current, $V_{FB}=0V$ force driver on Without external circuit		3.6		6.9	A
Switch Leakage Current	I_{SL}	Output=0V	$V_{IN}=40V$, $V_{FB}=12V$ force driver off Without external circuit			50	μA
		Output=-1V			5	30	mA
Quiescent Current	I_Q	$V_{FB}=12V$ force drive off			5	10	mA
Shutdown Current	I_S	SD pin = 5V, $V_{IN}=40V$			85	200	μA
SD Pin Input Threshold Voltage	V_{SD}	Regulator ON			1.3	0.6	V
		Regulator OFF		2.0			
SD Pin Bias Current	I_{SD}	$V_{SD} = 0.5V$ (Regulator ON)			0.02	5	μA
		$V_{SD} = 2.5V$ (Regulator OFF)			6	15	
FB Pin Bias Current	I_{FB}	GA8542xxADJ	$V_{FB}=1.3V$		40	100	nA
Over Temperature Shutdown	T_{SD}				140		$^{\circ}C$
Over Temperature Shutdown Hysteresis	T_{HYS}				15		$^{\circ}C$

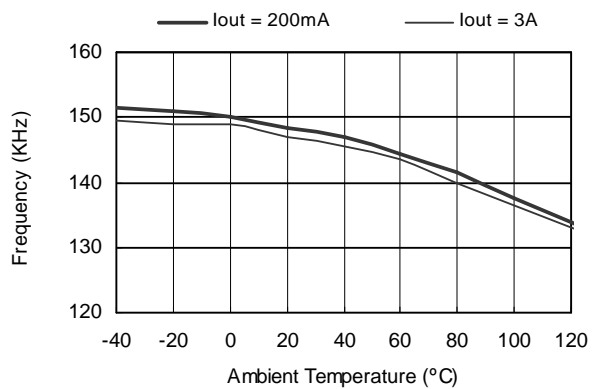
▼ Typical Performance Characteristics

$V_{IN}=12V$, V_{OUT} set to 3.3V, $T_A=25^{\circ}C$, unless otherwise noted.

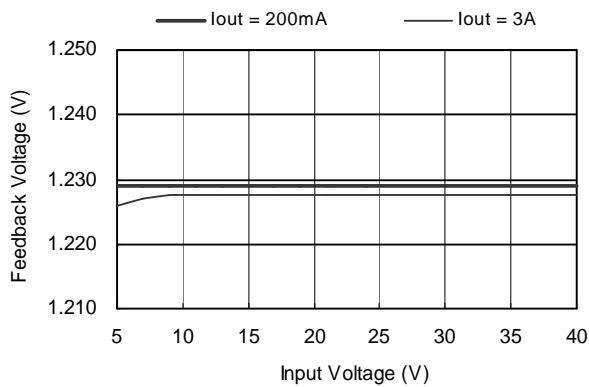
Frequency vs. Input Voltage



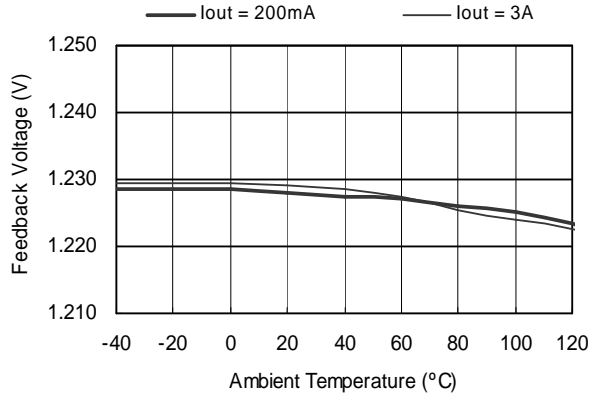
Frequency vs. Temperature



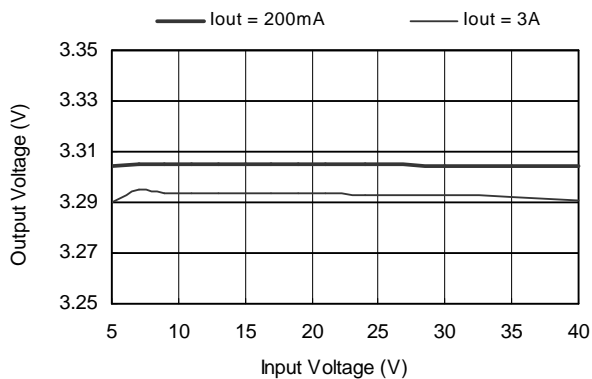
Feedback Voltage vs. Input Voltage



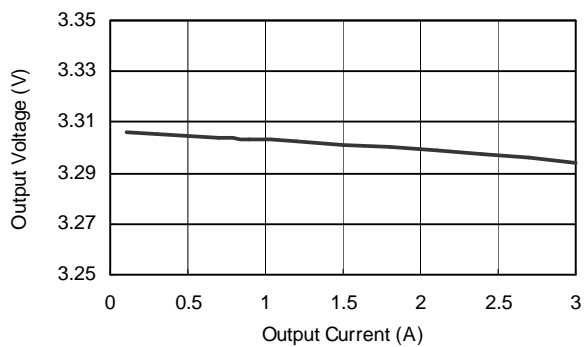
Feedback Voltage vs. Temperature



Line Regulation

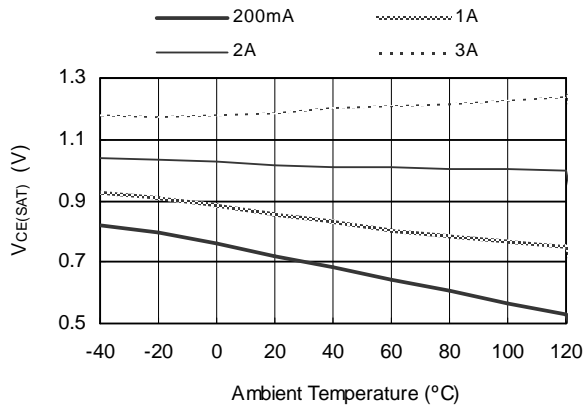


Load Regulation

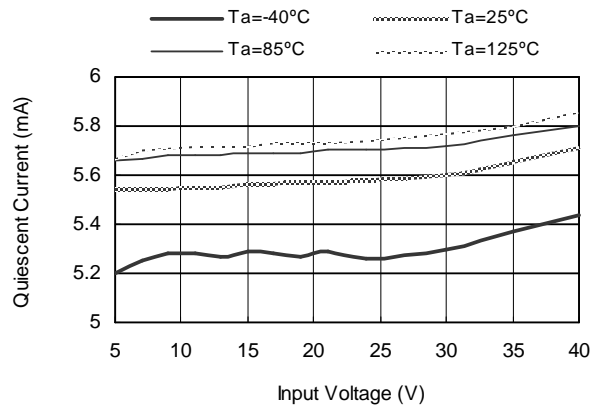


▼ **Typical Performance Characteristics (Contd.)**

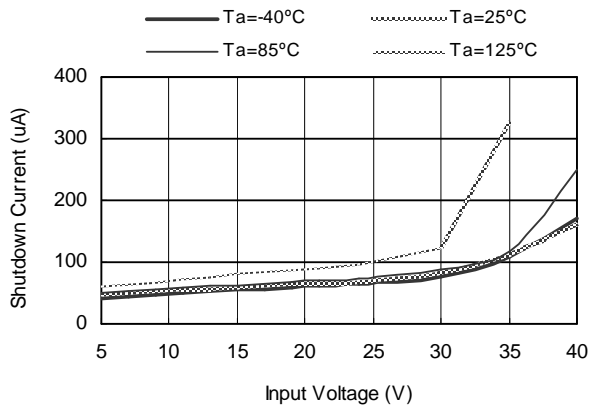
Saturation Voltage vs. Temperature



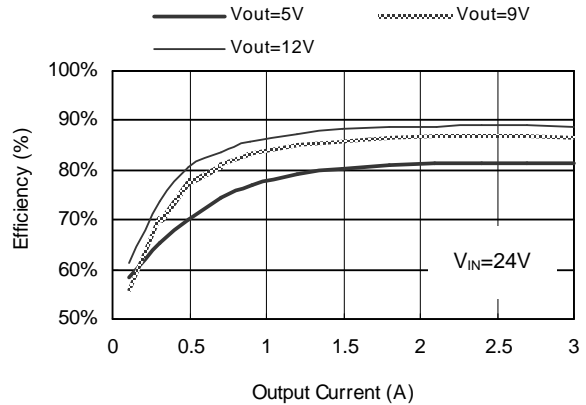
Quiescent Current vs. Input Voltage



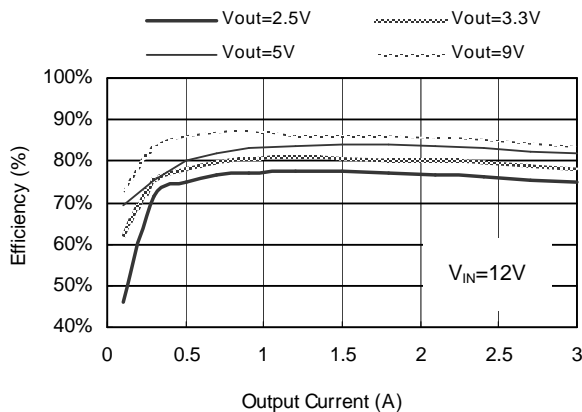
Shutdown Current vs. Input Voltage



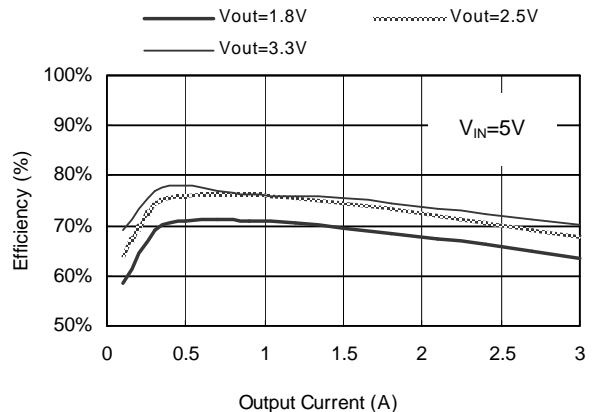
Efficiency



Efficiency

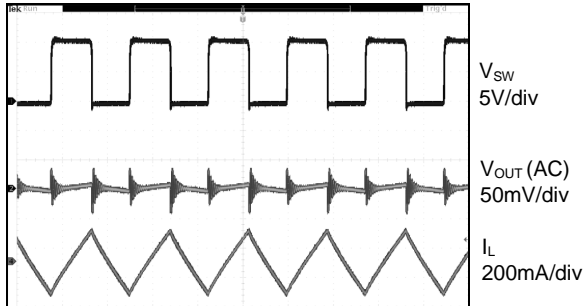


Efficiency



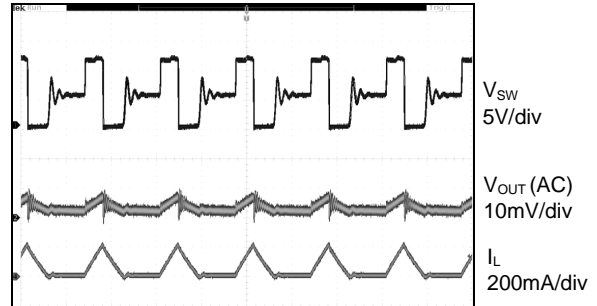
✓ Typical Performance Characteristics (Contd.)

Output Voltage Ripple-CCM (12V to 5V/ 3A)



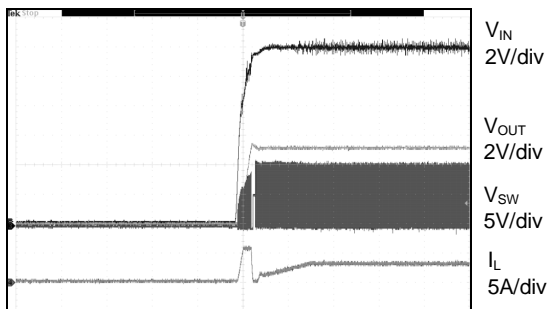
Time Base: 4us/div

Output Voltage Ripple-DCM (12V to 5V/ 0.05A)



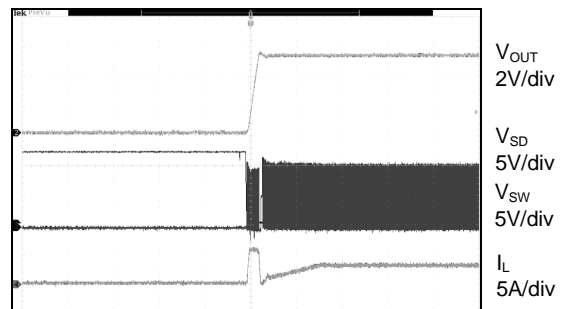
Time Base: 4us/div

Start-up (12V to 5V/ 3A)



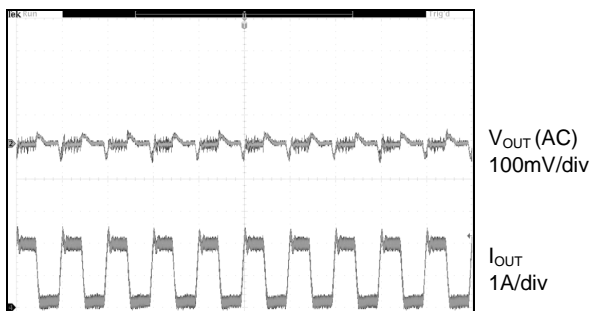
Time Base: 2ms/div

Start-up From Enable (12V to 5V/ 3A)



Time Base: 2ms/div

Load Transient (12V to 5V/ 0.2A~3A with 1ms, Tr=Tf=0.1A/us)



Time Base: 2ms/div

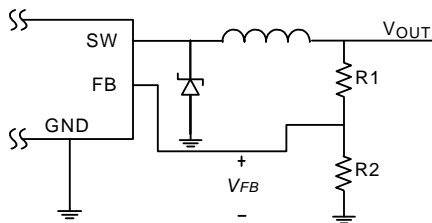
Application Information

Output Voltage Programming

This device develops a band-gap between the feedback pin and ground pin. For the adjustable version, the output voltage can be formed by R1 and R2. Use 1% metal film resistors for the lowest temperature coefficient and the best stability. Select lower resistor value to minimize noise pickup in the sensitive feedback pin, or higher resistor value to improve efficiency.

The output voltage is given by the following formula:

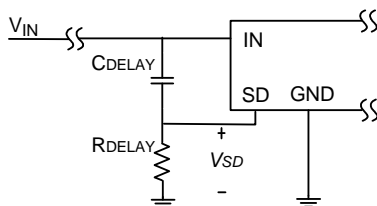
$$V_{OUT} = V_{FB} \times (1 + R1 / R2) \quad \text{where } V_{FB} = 1.23V$$



For the fixed version, R1 and R2 are integrated into the devices.

Delay Start-up

The following circuit uses the SD pin to provide a time delay between the input voltage is applied and the output voltage comes up. As the instant of the input voltage rises, the charging of capacitor C_{DELAY} pulls the SD pin high, keeping the device off. Once the capacitor voltage rises and the voltage of R_{DELAY} below the SD pin threshold voltage, the device will start to operate.



For example, setting at $V_{IN}=12V$, $R_{DELAY}=10K\Omega$, $C_{DELAY}=0.1\mu F$, the start-up delay time is calculated as below:

$$V_{IN} - V_C = V_{IN} \times e^{-T/\tau} < V_{SD}$$

$$T > 2.223mS$$

Where:

V_C is Capacitor Voltage

$V_{SD} = 1.3V$ (Typ.); SD Pin Threshold Voltage

T = Delay Time

$$\tau = R_{DELAY} \times C_{DELAY}$$

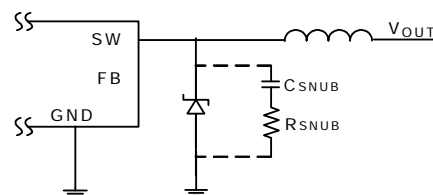
This feature is useful in situations where the input power source is limited in the amount of current it can deliver. It allows the input voltage to rise to a higher voltage before the device starts operating.

Snubber Circuit

The simple RC snubber is used for voltage transient and ringing suppression. The high frequency ringing and voltage overshooting at the SW pin is caused by fast switching transition and resonating circuit parasitical elements in the power circuit. It maybe generates EMI and interferes with circuit performance.

Reserve a snubber circuit in the PC board is preferred to damp the ringing due to the parasitical capacitors and inductors of layout.

The following circuit is a simple RC snubber:



Choose the value of RC network by the following procedure:

- (1) Measure the voltage ringing frequency (f_R) of the SW pin.
- (2) Find a small capacitor and place it across the SW pin and the GND pin to damp the ringing frequency by half.

- (3) The parasitical capacitance (C_{PAR}) at the SW pin is 1/3 the value of the added capacitance above. The parasitical inductance (L_{PAR}) at the SW pin is:

$$L_{PAR} = \frac{I}{(2\pi f_R)^2 \times C_{PAR}}$$

- (4) Select the value of C_{SNUB} that should be more than 2~4 times the value of C_{PAR} but must be small enough so that the power dissipation of R_{SNUB} is kept to a minimum. The power rating of R_{SNUB} can be calculated by following formula:

$$P_{RSNUB} = C_{SNUB} \times V_{IN}^2 \times f_S$$

- (5) Calculate the value of R_{SNUB} by the following formula and adjust the value to meet the expectative peak voltage.

$$R_{SNUB} = 2\pi \times f_R \times L_{PAR}$$

Thermal Considerations

Thermal protection limits total power dissipation in this device. When the junction temperature reaches approximately 140°C, the thermal sensor signals the shutdown logic turning off this device. The thermal sensor will turn this device on again after the IC's junction temperature cools by 15°C.

For continuous operation, do not exceed the maximum operation junction temperature 125°C. The power dissipation across this device can be calculated by the following formula:

$$P_D = I_{LOAD} \times V_{SAT} \times D + 1/2 \times V_{IN} \times I_{OUT} \times (t_r + t_f) \times f_S + V_{IN} \times I_Q$$

Where:

V_{SAT} : Power Switch Saturation Voltage

D: Duty Cycle

t_r / t_f : Power Switch Rising Time / Falling Time

f_S : Switching Frequency

I_Q : Quiescent Current

The maximum power dissipation of this device depends on the thermal resistance of the IC package and PCB layout, the temperature difference between the die junction and ambient air, and the rate of airflow. The maximum power dissipation can be calculated by the following formula:

$$P_{D(MAX)} = (T_J - T_A) / \theta_{JA}$$

Where $T_J - T_A$ is the temperature difference between the die junction and surrounding environment, θ_{JA} is the thermal resistance from the junction to the surrounding environment.

The value of junction to case thermal resistance θ_{JC} is also popular to users. This thermal parameter is convenient for users to estimate the internal junction operated temperature of packages while IC operating. The operated junction temperature can be calculated by the following formula:

$$T_J = T_C + P_D \times \theta_{JC}$$

T_C is the package case temperature measured by thermal sensor. Therefore it's easy to estimate the junction temperature by any condition.

There are many factors affect the thermal resistance. Some of these factors include trace width, copper thickness, total PCB copper area, and etc. For the best thermal performance, wide copper traces and generous amounts of PCB copper should be used in the board layout. If further improve thermal characteristics are needed, double sided and multi-layer PCB with large copper areas and airflow will be recommended.

Layout Considerations

PC board layout is very important, especially for switching regulators of high frequencies and large peak currents. A good layout minimizes EMI on the feedback path and provides best efficiency. The following layout guides should be used to ensure proper operation of this device.

- (1) The power charge path that consists of the IN trace, the SW trace, external inductor and the GND trace should be kept wide and as short as possible.

(2) The power discharge path that consists of the SW trace, external inductor, external diode and the GND trace should be kept wide and as short as possible.

(3) The feedback path of voltage divider should be close to the FB pin and keep noisy traces away; also keep them separate using grounded copper.

(4) The (+) plates of input capacitors should be close to the regulator.

(5) Keep the (-) plates of input and output capacitors as close as possible.

✓ Component Selection

1. Inductor Selection

The conduction mode of power stage depends on input voltage, output voltage, output current, and the value of the inductor. Select an inductor to maintain this device operating in continuous conduction mode (CCM). The minimum value of inductor can be determined by the following procedure.

(1) Calculate the minimum duty ratio:

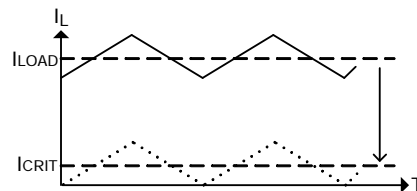
$$D_{(MIN)} = \frac{V_{OUT} + I_{LOAD} \times R_L + V_F}{V_{IN(MAX)} - V_{SAT} + V_F} = \frac{T_{ON}}{T_S}$$

Where R_L is the DC resistance of external inductor, V_F is the forward voltage of external diode, and T_s is the switching period.

This formula can be simplified to

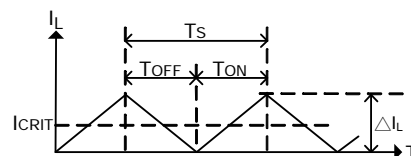
$$D_{(MIN)} = \frac{V_{OUT}}{V_{IN(MAX)}} = \frac{T_{ON}}{T_S} ; 0 \leq D \leq 1$$

(2) Define a value of minimum current that is approximately 10% of full load current to maintain continuous conduction mode, usually referred to as the critical current (I_{CRIT}).



$$I_{CRIT} = \delta \times I_{LOAD} ; \delta = 0.1 \sim 0.3$$

(3) Calculate the inductor ripple current (ΔI_L). In steady state conditions, the inductor ripple current increase, (ΔI_{L+}), during the ON time and the current decrease, (ΔI_{L-}), during the OFF time must be equal.



$$\Delta I_L = 2 \times I_{CRIT}$$

(4) Calculate the minimum value of inductor use maximum input voltage. That is the worst case condition because it gives the maximum ΔI_L .

$$L \geq \frac{[V_{IN(MAX)} - I_{LOAD} \times R_L - V_{SAT} - V_{OUT}] \times D_{(MIN)}}{\Delta I_L \times fs}$$

This formula can be simplified to

$$L \geq \frac{(V_{IN(MAX)} - V_{OUT}) \times D_{(MIN)}}{\Delta I_L \times fs}$$

The higher value inductor results in lower output ripple current and ripple voltage. It also reduces the conduction loss. But higher value inductor requires larger physical size and price.

(5) Calculate the inductor peak current and choose a suitable inductor to prevent saturation.

$$I_{L(PEAK)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Coil inductors and surface mount inductors are all available. The surface mount inductors can reduce the board size but they are more expensive and its larger DC resistance results in more conduction loss. The power dissipation is due to the DC resistance can be calculated as below:

$$P_{D_INDUCTOR} = I_{LOAD}^2 \times R_L$$

2. Output Rectifier Diode Selection

The rectifier diode provides a current path for the inductor current when the internal power switch of the converter turns off. The best solution is Schottky diode, and some parameters about the diode must be take care as below:

(1) The forward current rating of diode must be higher than the continuous output current.

(2) The reverse voltage rating of diode must be higher than the maximum input voltage.

(3) The lower forward voltage of diode will reduce the conduction loss.

(4) The faster reverse recovery time of diode will reduce the switching loss, but it is very small compared to conduction loss.

(5) The power dissipation can be calculated by the forward voltage and output current for the time that the diode is conducting.

$$P_{D_DIODE} = I_{LOAD} \times V_F \times (1 - D)$$

3. Output Capacitor Selection

The functions of the output capacitor are to store energy and maintain the output voltage. The low ESR (Equivalent Series Resistance) capacitors are preferred to reduce the output ripple voltage (ΔV_{OUT}) and conduction loss. The output ripple voltage can be calculated as below:

$$\Delta V_{OUT} = \Delta I_L \times (ESR_{_COUT} + \frac{I}{8 \times fs \times C_{OUT}})$$

(1) When low ESR ceramic capacitor is used as output capacitor, the output ripple voltage due to the ESR can be ignored results in all the output ripple voltage is due to the capacitance. Choose suitable capacitors must define the expectative value of output ripple voltage first.

The minimum capacitance can be determined by the switching frequency, the output ripple current, and the expectative output ripple voltage. The above formula can be simplified to:

$$C_{OUT(MIN)} \geq \frac{\Delta I_L}{8 \times fs \times \Delta V_{OUT}}$$

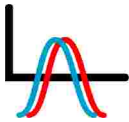
Besides, the compensation components must be used to stabilize the control loop in some applications, such as using a 1nF ceramic capacitor across the high side resistor of the output voltage divider.

(2) The ESR of the aluminum electrolytic or tantalum output capacitor is an important parameter to determine the output ripple voltage. But the manufacturers usually do not specify ESR in the specifications. Assuming the capacitance is enough results in the output ripple voltage is due to the capacitance can be ignored, the ESR should be limited to achieve the expectative output ripple voltage. The maximum ESR can be calculated as below:

$$ESR_{_COUT} \leq \frac{\Delta V_{OUT}}{\Delta I_L}$$

Choose the output capacitance by the average value of the RC product as below:

$$C_{OUT} \approx \frac{50 \sim 80 \times 10^{-6}}{ESR_{_COUT}}$$



(3) The ESR and the ripple current results in power dissipation in the capacitor. It will increase the internal temperature. Usually, the capacitors' manufacturers specify ripple current ratings and should not be exceeded to prevent excessive temperature shorten the life time. Choose a smaller inductor causes higher ripple current which maybe result in the capacitor overstress. The RMS ripple current flowing through the output capacitor and power dissipation can be calculated as below:

$$I_{RMS_COUT} = \frac{\Delta I_L}{\sqrt{12}} = \Delta I_L \times 0.289$$

$$P_{D_COUT} = (I_{RMS_COUT})^2 \times ESR_COUT$$

(4) Besides, the capacitor's ESL (Equivalent Series Inductance) maybe causes ringing in the low MHz region. Choose low ESL capacitors, limiting lead length of PCB and capacitor, and parallel connecting several smaller capacitors to replace with a larger one will reduce the ringing phenomenon.

4. Input Capacitor Selection

The input capacitor is required to supply current to the regulator and maintain the DC input voltage. Low ESR capacitors are preferred those provide the better performance and the less ripple voltage.

(1) The input capacitors need an adequate RMS current rating. It can be calculated by following formula and should not be exceeded.

$$I_{RMS_CIN} = I_{LOAD(MAX)} \times \sqrt{D \times (1 - D)}$$

This formula has a maximum at $V_{IN}=2V_{OUT}$. That is the worst case and the above formula can be simplified to:

$$I_{RMS_CIN} = \frac{I_{LOAD(MAX)}}{2}$$

Therefore, choose a suitable capacitor at input whose ripple current rating must greater than half of the maximum load current.

(2) The input ripple voltage (ΔV_{IN}) mainly depends on the input capacitor's ESR and its capacitance. Assuming the input current of the regulator is constant, the required input capacitance for a given input ripple voltage can be calculated as below:

$$C_{IN} = \frac{I_{LOAD(MAX)} \times D \times (1 - D)}{f_S \times (\Delta V_{IN} - I_{LOAD(MAX)} \times ESR_CIN)}$$

If using aluminum electrolytic or tantalum input capacitors, parallel connecting a 0.1uF ceramic capacitor as close to the IN pin of regulator as possible. If using ceramic capacitor, make sure the capacitance is enough to prevent the excessive input ripple current.

(3) The power dissipation of input capacitor causes a small conduction loss can be calculated as below:

$$P_{D_CIN} = (I_{RMS_CIN})^2 \times ESR_CIN$$

✓ Quick Design Table

For 3A output current, $\Delta I_L=0.6A$, continuous mode operation

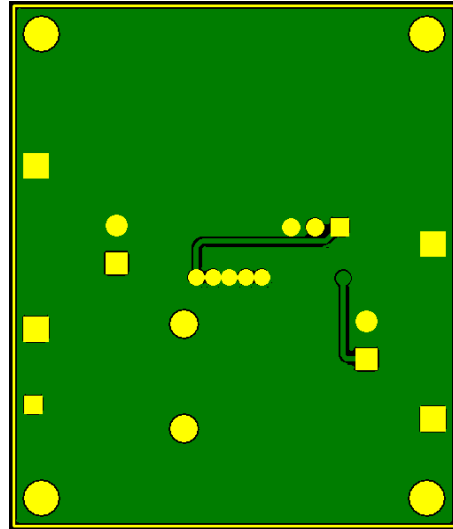
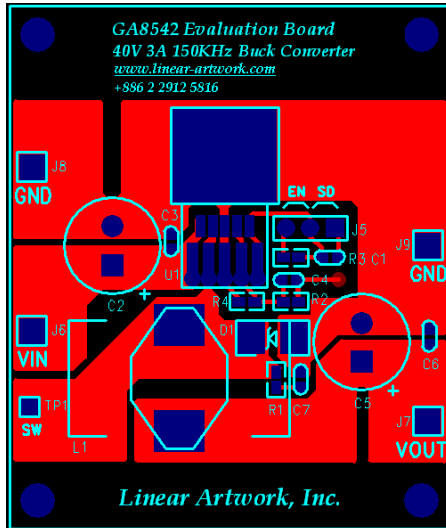
A: Inductor value

B: High side resistor of the output voltage divider

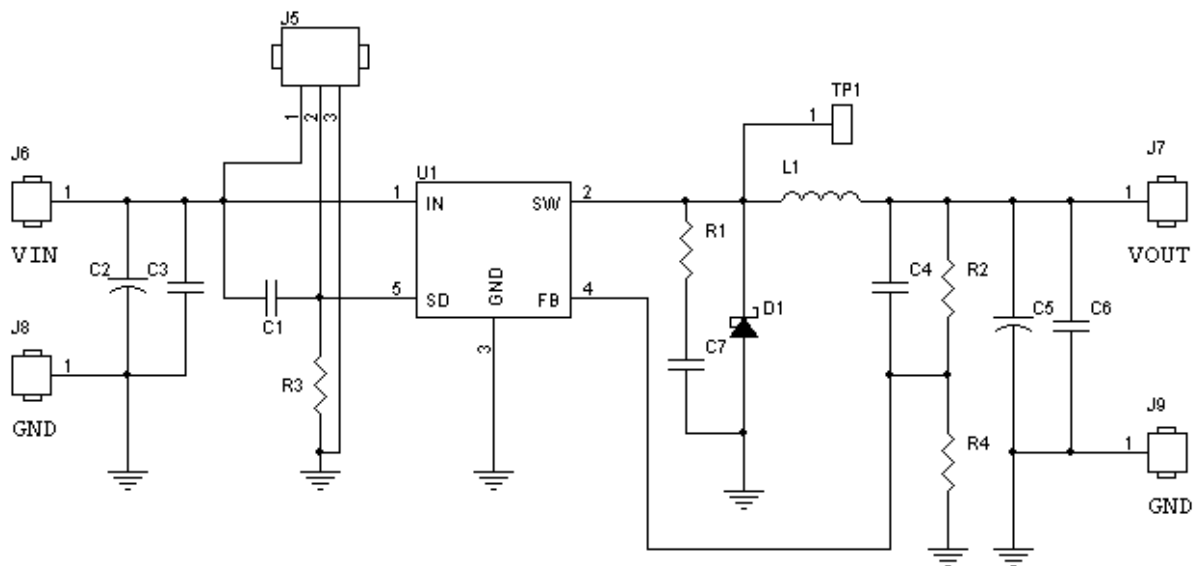
C: Low side resistor of the output voltage divider

$V_{IN} \backslash V_{OUT}$	5V	9V	12V	18V
1.5V	A: 15uH B: 1.5KOhm C: 6.8KOhm	A: 18uH B: 1.5KOhm C: 6.8KOhm	A: 18uH B: 1.5KOhm C: 6.8KOhm	A: 18uH B: 1.5KOhm C: 6.8KOhm
1.8V	A: 15uH B: 1.8KOhm C: 3.9KOhm	A: 22uH B: 1.8KOhm C: 3.9KOhm	A: 22uH B: 1.8KOhm C: 3.9KOhm	A: 22uH B: 1.8KOhm C: 3.9KOhm
2.5V	A: 18uH B: 2.3KOhm C: 2.2KOhm	A: 27uH B: 2.3KOhm C: 2.2KOhm	A: 27uH B: 2.3KOhm C: 2.2KOhm	A: 33uH B: 2.3KOhm C: 2.2KOhm
3.3V	A: 15uH B: 3.9KOhm C: 2.3KOhm	A: 27uH B: 3.9KOhm C: 2.3KOhm	A: 33uH B: 3.9KOhm C: 2.3KOhm	A: 39uH B: 3.9KOhm C: 2.3KOhm
5V		A: 33uH B: 3.1KOhm C: 1KOhm	A: 39uH B: 3.1KOhm C: 1KOhm	A: 47uH B: 3.1KOhm C: 1KOhm
9V			A: 33uH B: 8.2KOhm C: 1.3KOhm	A: 56uH B: 8.2KOhm C: 1.3KOhm
12V				A: 56uH B: 20KOhm C: 2.3KOhm

▼ **Evaluation Board Layout**



▼ **Evaluation Board Schematic**



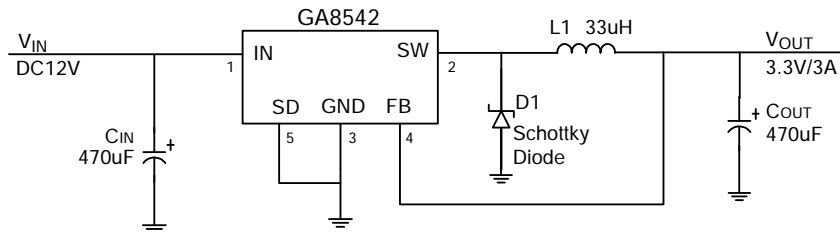
▼ Bill of Materials

 Fixed Output Version; $V_{IN}=12V$, $V_{OUT}=3.3V$, $I_{OUT}=3A$

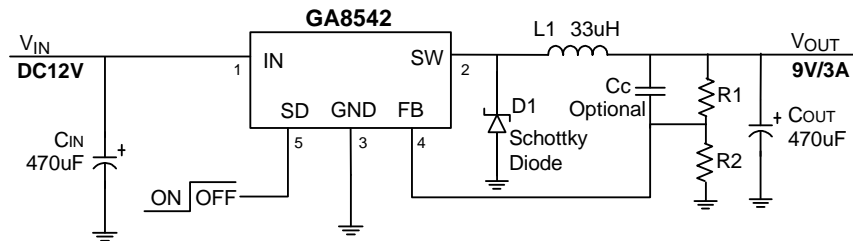
Designation	Descriptions	Manufacturer Part #	Manufacturer	Manufacturer Website
U1	150KHz, 3A Step-Down DC-DC Converter TO-263-5L Package	GA8542HD330	Linear Artwork	www.linear-artwork.com
L1	Choke 33uH, 5A, 0.025Ohm	744151	WE	www.we-online.com
	Choke 33uH, 5.5A, 0.029Ohm	TDH1920T-330K-N	Chilisin	www.chilisin.com.tw
D1	Schottky 40V, 3A, 0.5V _F , SMB Package	SK34B	TSC	www.taiwansemi.com
C2,C5	Low ESR E/C 470uF, 25V, 10x16mm	EKY-250EXX471MJ16S	NCC	www.chemi-con.co.jp
C3,C6	MLCC 0.1uF, 0805, X7R, 50V	CC0805KRX7R9BB104	Yageo	www.yageo.com
	MLCC 0.1uF, 0805, X7R, 50V	UMK212BJ104KG	Taiyo Yuden	www.yuden.co.jp
	MLCC 0.1uF, 0603, B, 50V	C1608JB1H104K	TDK	www.tdk.com
C1,C7	Optional Parts			
C4	No Connection			
R2	Short			
R1,R3	Optional Parts			
R4	No Connection			
J5	Male Header 180° 3*1P 2.54mm			
J6,J7,J8,J9	Terminal Binding Post 1.6mm			
TP1	Male Header 180° 1P 2.54mm			

▼ Typical Application Circuits

◆ Fixed Version: 12V->3.3V Application Circuit

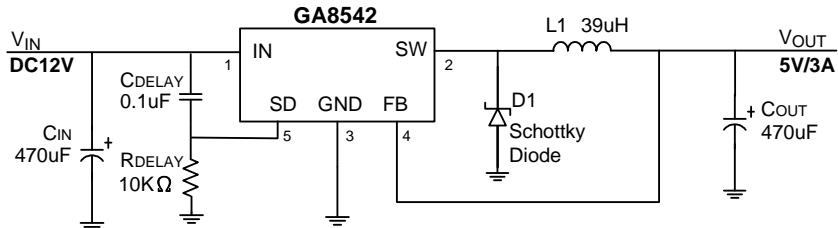


◆ Adjustable Version: 12V->9V With ON/OFF Control Circuit

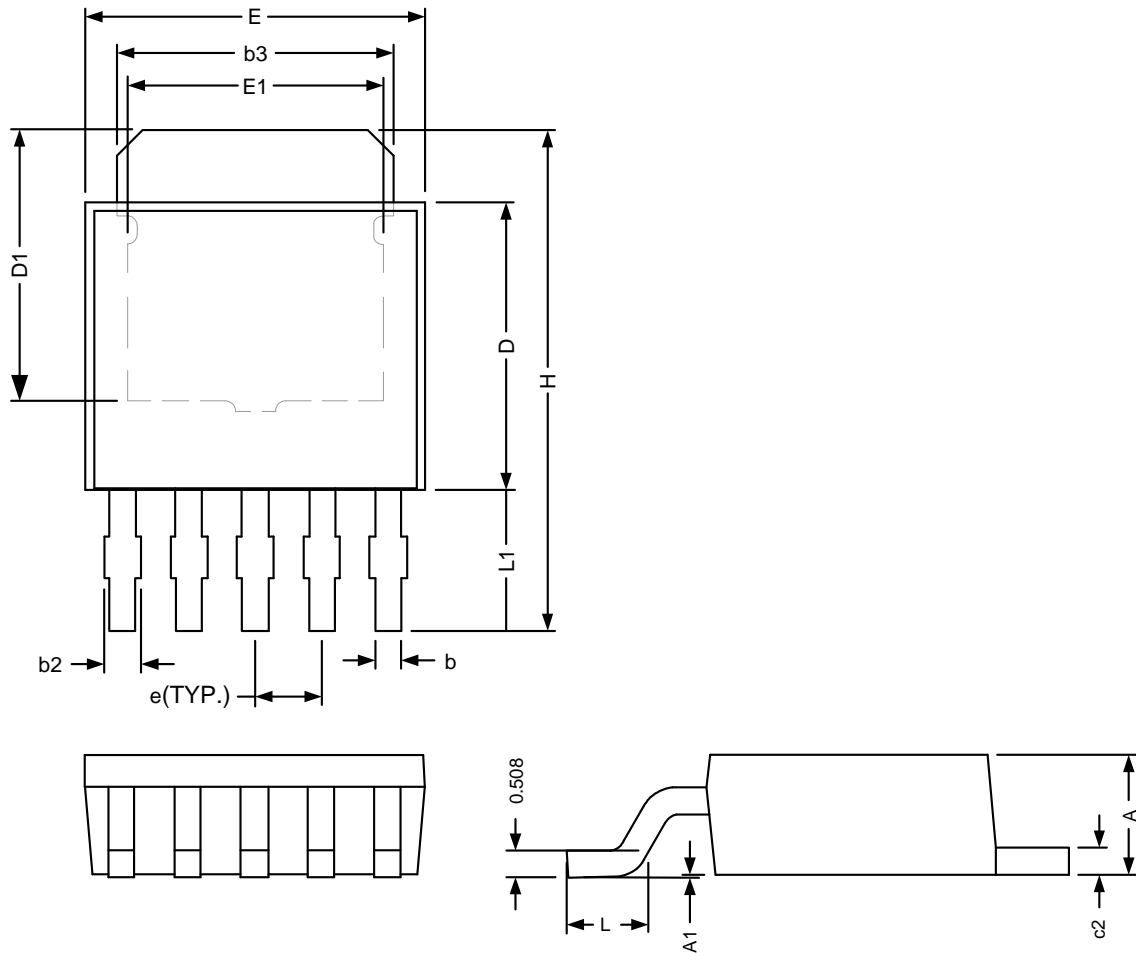


$$V_{OUT} = V_{FB} \times (1 + R1 / R2); R1=8.2K\Omega, R2=1.3K\Omega$$

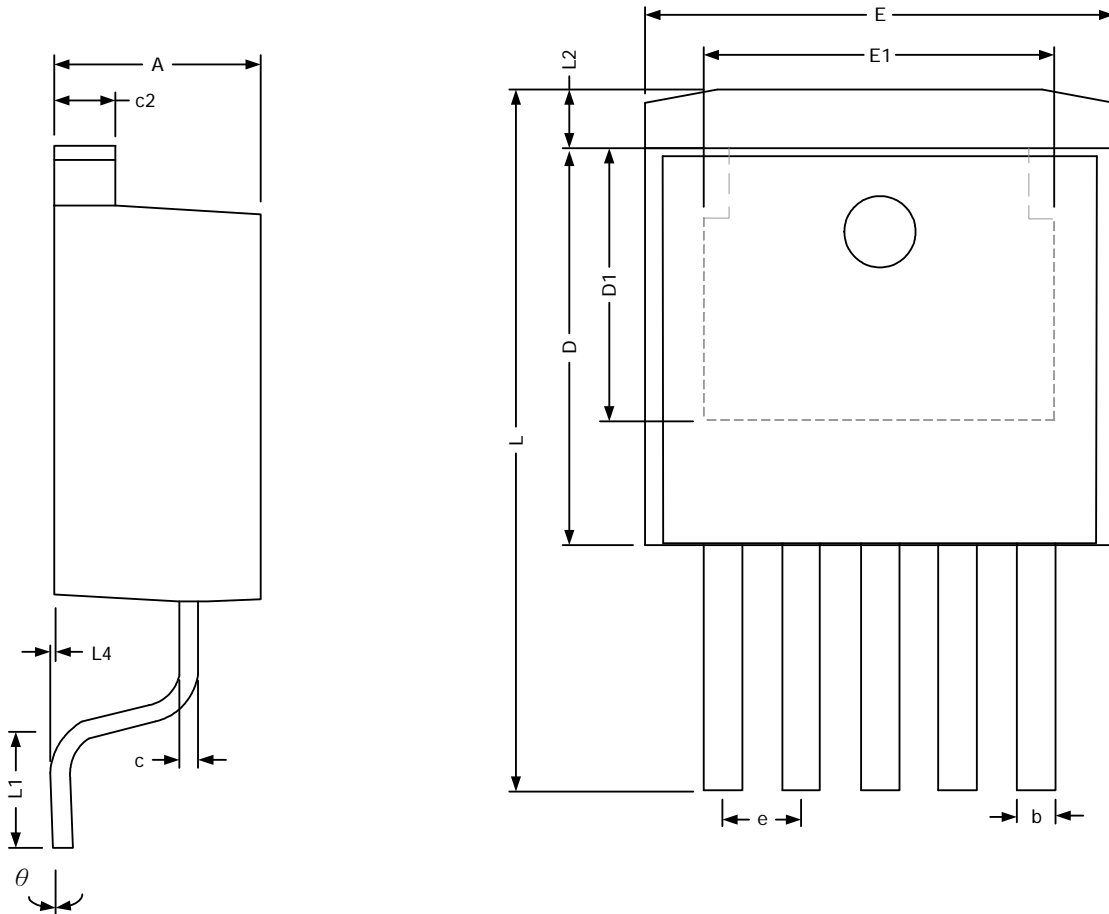
◆ Fixed Version: 12V->5V with Delay Start-up Circuit



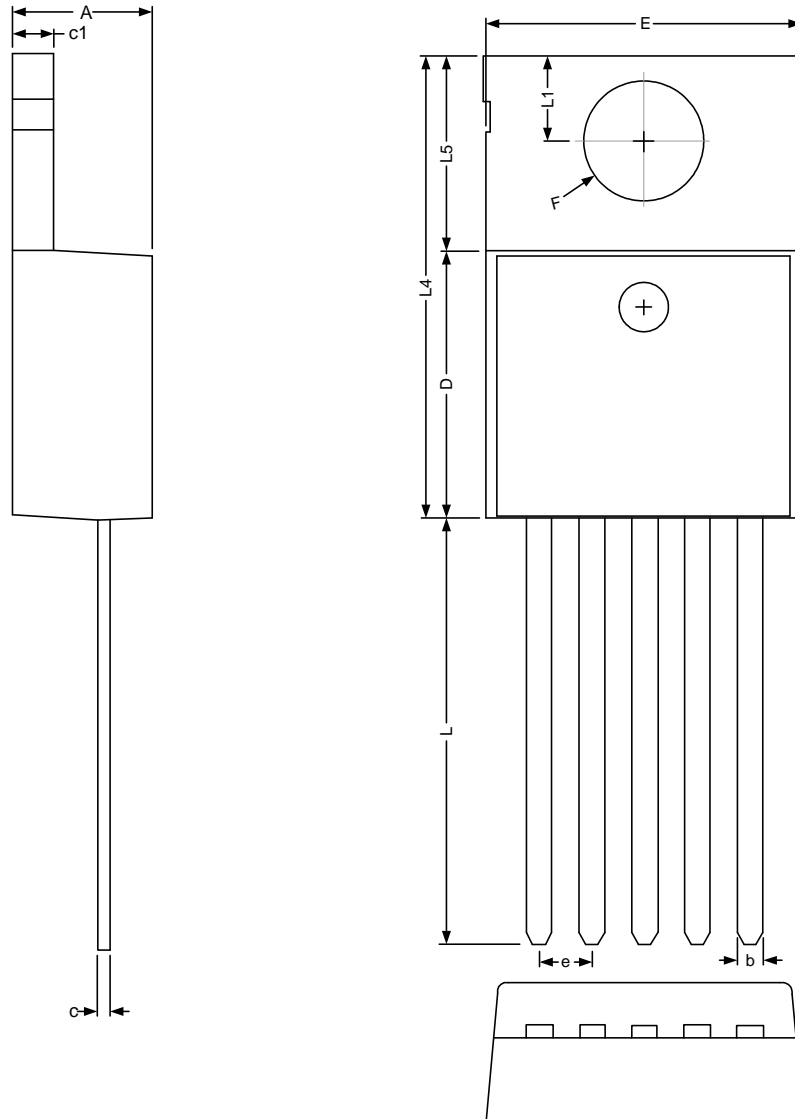
$$T_{DELAY} \approx 2.223mS$$

Package Outline
TO-252-5L


DIMENSIONS					
REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	2.20	2.40	D1	4.57	...
A1	0.00	0.15	E	6.35	6.73
b	0.45	0.60	E1	3.81	...
b2	0.50	0.80	e	1.27 REF.	
b3	5.21	5.46	H	9.40	10.20
c2	0.46	0.58	L	1.40	1.77
D	5.40	5.59	L1	2.40	3.00

Package Outline (Contd.)
TO-263-5L


DIMENSIONS					
REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.40	4.80	c2	1.25	1.45
b	0.66	0.91	L2	1.27 REF.	
L4	0.00	0.30	D	8.60	9.00
c	0.36	0.50	D1	5.90 REF.	
L1	2.29	2.79	e	1.70 REF.	
E	9.80	10.40	L2	14.60	15.80
E1	7.60 REF.		theta	0°	8°

Package Outline (Contd.)
TO-220-5L


DIMENSIONS					
REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.40	4.80	c1	1.25	1.45
b	0.76	1.00	L5	6.20	6.60
D	8.60	9.00	L	13.25	14.25
c	0.36	0.50	e	1.70 REF.	
E	9.80	10.40	L1	2.60	2.89
L4	14.70	15.30	F	3.71	3.96

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