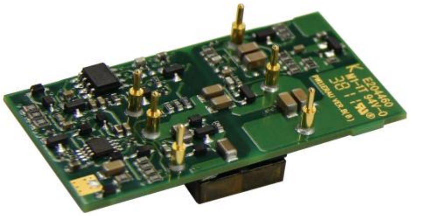
GAC15D12
DC-DC Converter Technical Manual V1.0

Date: 2012-02-03

Nonstandard- brick DC-DC Converter	36–75 V Input	±12 V Output	15W Power	Positive Logic

Description

The GAC15D12 is an isolated DC-DC converter that uses an industry nonstandard-brick structure, and features high efficiency and power density. It has the dimensions 10.5 mm x 25.4 mm x 50.8 mm (0.41 in. x 1.00 in. x 2.00 in.) and provides the rated output voltage of ±12 V and the rated output power of 15W.



GAC15D12

Operational Features

- Input voltage: 36–75 V
- Output power: 15 W
- Low output ripple and noise
- Efficiency: 88.4% (±12 V, 15W)

Mechanical Features

- Industry nonstandard-brick 10.5 mm x 25.4 mm x 50.8 mm (0.41 in. x 1.00 in. x 2.00 in.)
- Weight: about 30 g

Control Features

- Remote on/off

Protection Features

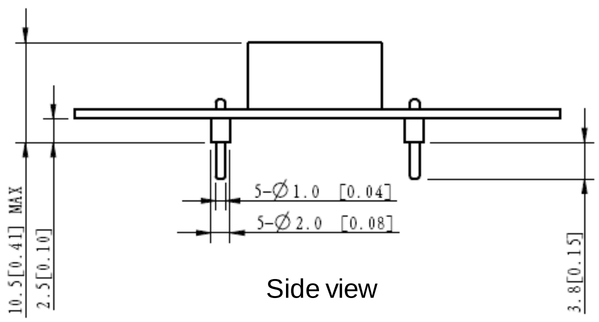
- Input undervoltage protection
- Output overcurrent protection (hiccup mode)
- Output short circuit protection (hiccup mode)
- Output overvoltage protection (hiccup mode)

Safety Features

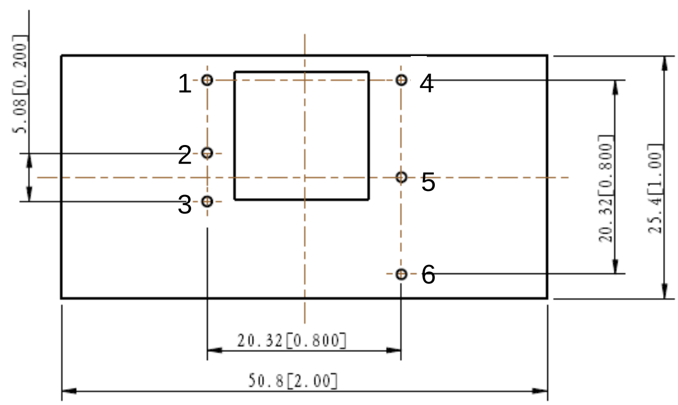
- UL60950-1 and IEC/EN60950
- Underwriters Laboratory (UL) certification
- Class A requirements in FCC and EN55022 (after connecting to an external filtering circuit)
- UL94V-0
- Restriction of the use of certain hazardous substance (RoHS) 6

Mechanical Diagram

Unit of measurement: mm (in.)



Side view



Top view

Pin description

Pin No.	Function
1	CNT
2	V_{in} (–)
3	V_{in} (+)
4	-12V
5	COM
6	+12V

Dimensions tolerance

.x	± 0.2 mm (0.008 in.)
.xx	±0.13 mm (0.006 in.)

Designation Explanation

G	A	C	15	D	12
1	2	3	4	5	6

1 — Isolated
2 — Analog
3 — Nonstandard
4 — Output power
5 — Double output
6 — Output voltage: ±12 V

Electrical Specifications

Conditions: T_A = 25°C (77°F), Airflow = 1.0 m/s (200 LFM), Vin = 48 V, Vout = ±12 V， unless otherwise specified.

Parameter		Min.	Typ.	Max.	Units	Remarks
Absolute maximum ratings						
Input voltage						
Continuous		-	-	80	V	-
Transient (100 ms)		-	-	100	V	-
Operating ambient temperature		–40	-	85	ºC	See the thermal derating curve.
Storage temperature		–55	-	125	ºC	-
Operating humidity		-	-	95	% RH	Non-condensing
Input characteristics						
Operating input voltage		36	48	75	V	-
Maximum input current		-	-	0.55	A	Vin = 36V; Po = 15W
Input capacitance		47	100	-	µF	Electrolytic capacitor
Inrush transient		-	-	1.0	A^2s	-
Input reflected ripple current		-	20	30	mA	Oscilloscope bandwidth: 5–20 MHz
Output characteristics						
Output voltage set point	+12V	11.9	12.0	12.10	V	Vin = 48V;I_{o1} =0.62A; I_{o2} = 0.62A
	-12V	-11.5	-12.0	-12.5		
Output power	±12V	-	-	15	W	-
Output line regulation	+12V	-0.2	0.02	0.2	%Vo	V_{in} = 36–75 V; I_{o1} = I_{o2} = 0.62 A
	-12V	-2	0.04	2		
Output load regulation	+12V	-0.5	0.1	0.5	%Vo	V_{in} = 48V; I_{o1} = I_{o2} = 0.06–0.62 A
	-12V	-10	4	10		
Regulated voltage precision	+12V	-1	-	1	%Vo	The whole range of V_{in} , I_{out} and T_A
	-12V	-5	-	5		
Temperature coefficient	±12V	-	-	0.02	%Vo/°C	T_A = –40°C to +85°C (–40°F to +185°F)
External capacitance	±12V	22	-	220	µF	Electrolytic capacitor
Output current	±12V	0.06	-	0.62	A	-
Output ripple and noise	±12V	-	60	120	mV	The whole range of V_{in} , I_{out} and T_A

Electrical Specifications

Conditions: T_A = 25°C (77°F), Airflow = 1.0 m/s (200 LFM), Vin = 48 V, Vout = ±12 V， unless otherwise specified.

Parameter		Min.	Typ.	Max.	Units	Remarks
Output characteristics						
Out voltage overshoot	±12V	-	2	5	%Vo	The whole range of V_{in} , I_{out} and T_A
Output voltage rise time	±12V	-	15	30	ms	The whole range of V_{in} , I_{out} and T_A
Switching frequency	–	-	280	-	kHz	-
Protection Features						
Input undervoltage protection Startup threshold Shutdown threshold	–	31 30	34 32	36 35	V V	- -
Output overcurrent protection	–	0.7	1.1	1.2	A	Hiccup mode Between +12V and the -12V, link the load
Output short circuit protection	–	-	-	-		Hiccup mode
Output overvoltage protection	+12V	13.2	-	16.0	V	Hiccup mode -12V not possess the function of overvoltage protection.
Dynamic Characteristics						
Overshoot amplitude Recovery time	±12V	- -	240 100	600 200	mV µs	Current change rate: 0.1 A/µs load :Io1=25%–50%–25%,Io2=0.62A; load: Io1=50%–75%–50%,Io2=0.62A; load :Io2=25%–50%–25%,Io1=0.62A; load: Io2=50%–75%–50%,Io1=0.62A;
Efficiency						
100% load	±12V	-	88.4	-	%	V_{in} = 48 V; P_{out} = 15W;
50% load	±12V	-	87.0	-	%	V_{in} = 48 V; P_{out} = 7.5W;
20% load	±12V	-	78.9	-	%	V_{in} = 48 V; P_{out} = 3W;
Isolation characteristics						
Input-to-output Isolation voltage	±12V	-	-	1500	V DC	Basic Isolation
Reliability characteristics						
Mean time between failures (MTBF)	-	-	1.5	-	Million hours	Airflow = 1.5 m/s (300 LFM); TA = 40° C (104° F); 80% load; Telcordia SR332 Method 1 case 3

Electrical Specifications

Conditions: T_A = 25°C (77°F), Airflow = 1.0 m/s (200 LFM), Vin = 48 V, Vout = ±12 V， unless otherwise specified.

Parameter		Min.	Typ.	Max.	Units	Remarks
Other features						
Remote on/off voltage Low level High level	-	 –0.7 3.0	 - -	 1.2 10	 V V	 - -
On/Off current Low level High level	-	 - -	 - -	 1.0 -	 mA μA	 - -

Qualification Testing

Parameter	Units	Condition
High accelerated life test (HALT)	4	Lowest operating temperature: –60°C (–76°F); highest operating temperature: 110°C (230°F); vibration limit: 40 G
Thermal shock	32	500 temperature cycles between –40°C (–40°F) and +125°C (+257°F) with the temperature change rate of 20°C (68°F) per minute Lasting for 30 minutes both at –40°C (–40°F) and +125°C (+257° F)
Temperature humidity bias	16	85°C (185°F); 85% RH; 1000 operating hours under lowest load
High Temperature Operation Life (HTOL)	16	Rated input voltage; Airflow :2.0 m/s (400 LFM); Ambient temperature: 50°C(122°F) ;1000 operating hours under 50%–80% load

Characteristic Curves

Figure 1: Efficiency
(T_A = 25°C or 77°F)

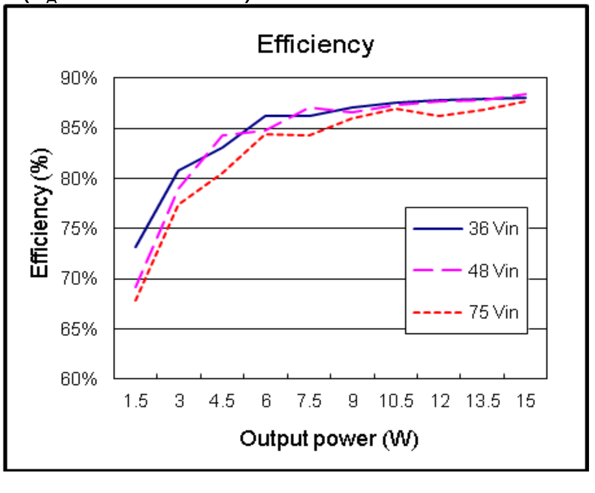


Figure 2: Power dissipation
(T_A = 25°C or 77°F)

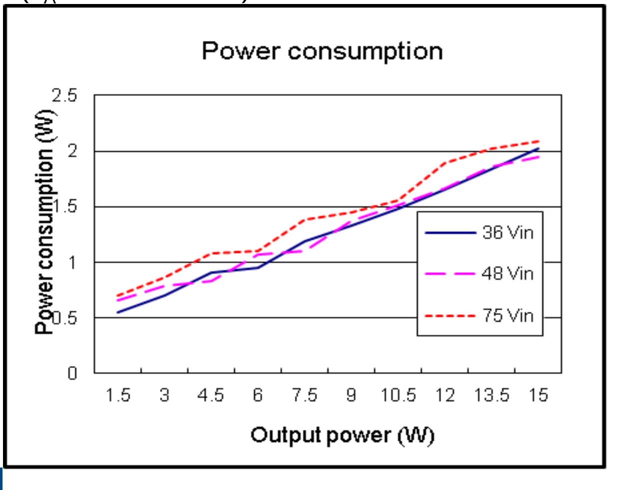


Figure 3: Thermal derating air is flowing from Vin to Vout (V_{in} = 48 V; V_{out} = ±12V)

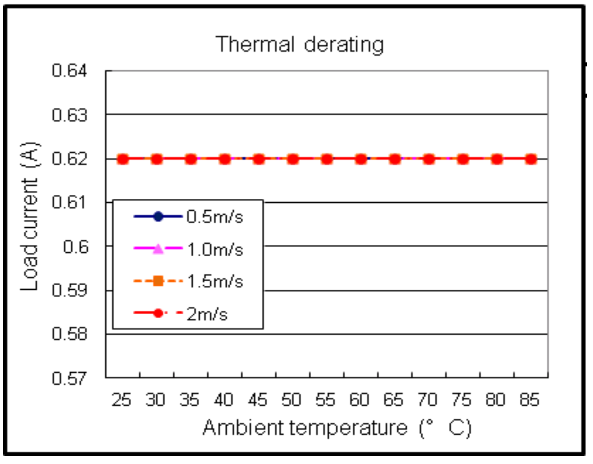


Figure 4: Thermal derating air is flowing from Vin(-) to Vin(+) (V_{in} = 48 V; V_{out} = ±12V)

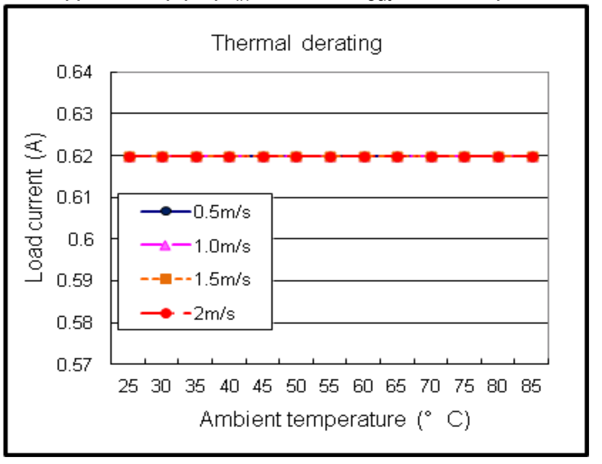


Figure 5: Thermal plot air is flowing from Vin to Vout(T_A = 25°C (77°F); Airflow = 1.5 m/s (300 FLM); Vin = 48 V; Vout = ±12 V; Pout = 15 W)

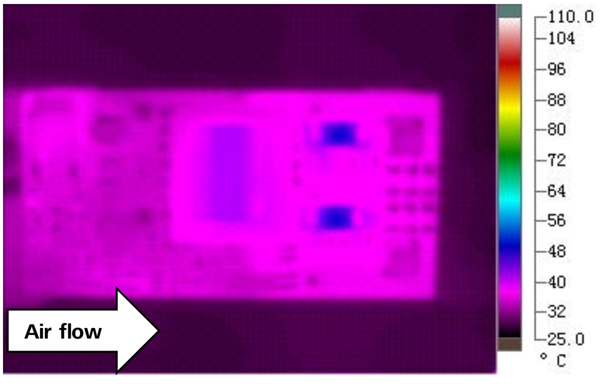
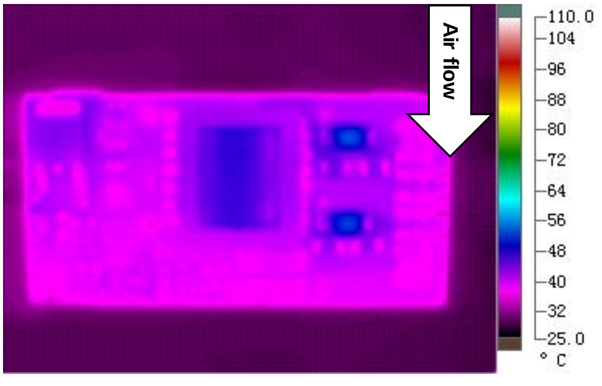


Figure 6: Thermal plot air is flowing from Vin(-) to Vin(+)(T_A = 25°C (77°F); Airflow = 1.5 m/s (300 FLM); Vin = 48 V; Vout = ±12 V; Pout = 15W)



Typical Waveforms

Conditions: T_A = 25°C (77°F), Vin = 48 V.

Figure 7: Startup from CNT

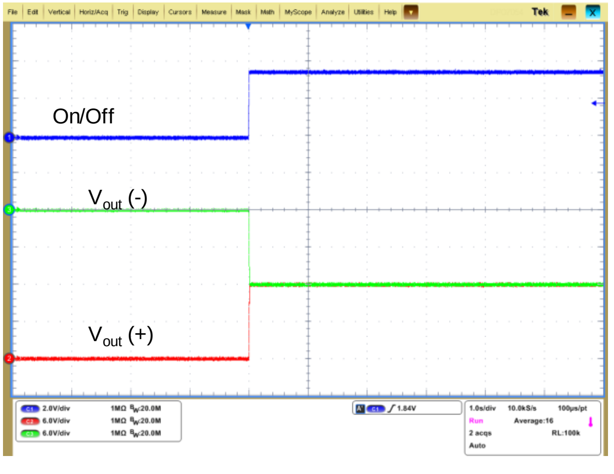


Figure 8: Shutdown from CNT

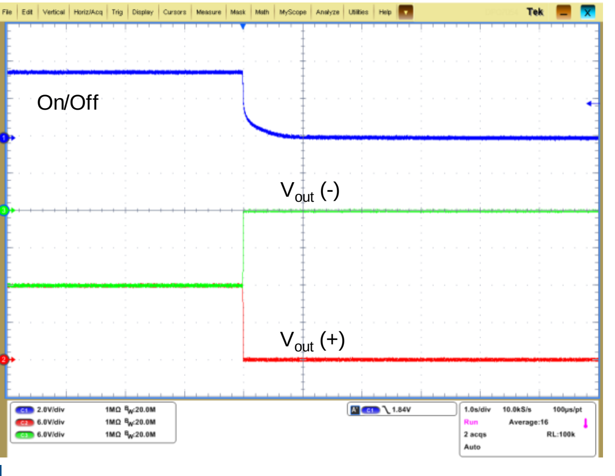


Figure 9: Startup from power on

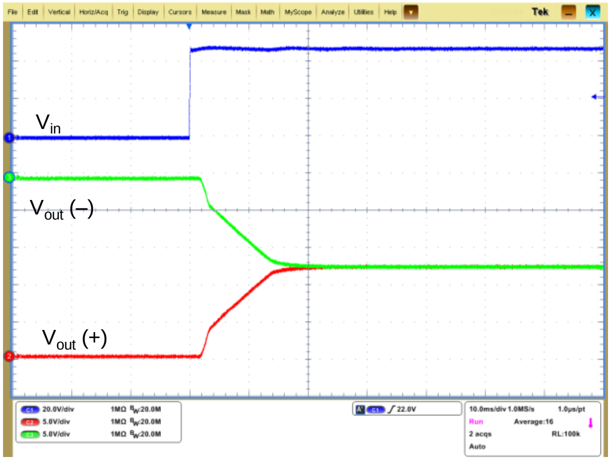


Figure 10: Shutdown from power off

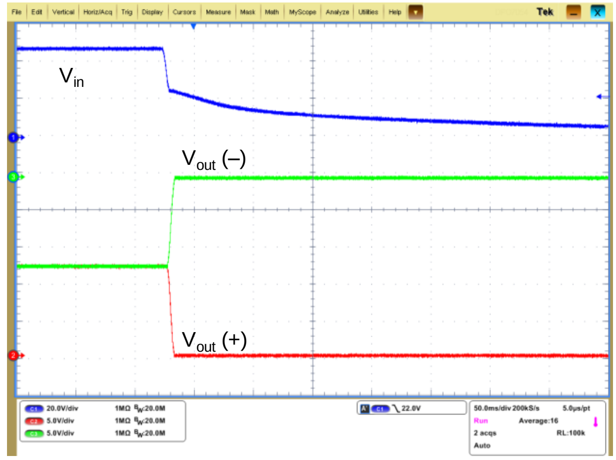


Figure 11: Output voltage response
(Load : Io1=25%–50%–25%,Io2=0.62,A
dI/dt=0.1 A/µs)

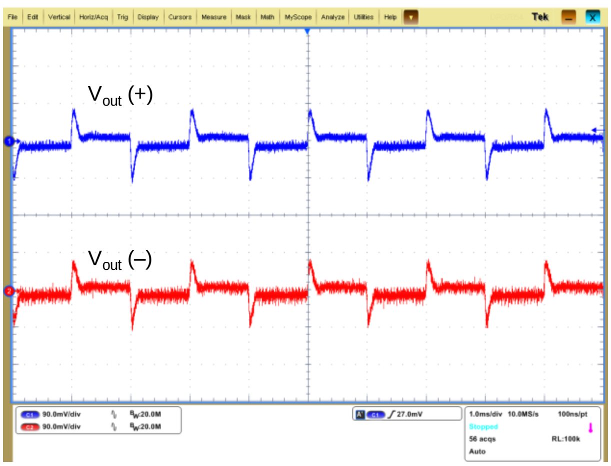


Figure 12: Output voltage response
(Load : Io1=50%–75%–50%,Io2=0.62,A
dI/dt=0.1 A/µs)

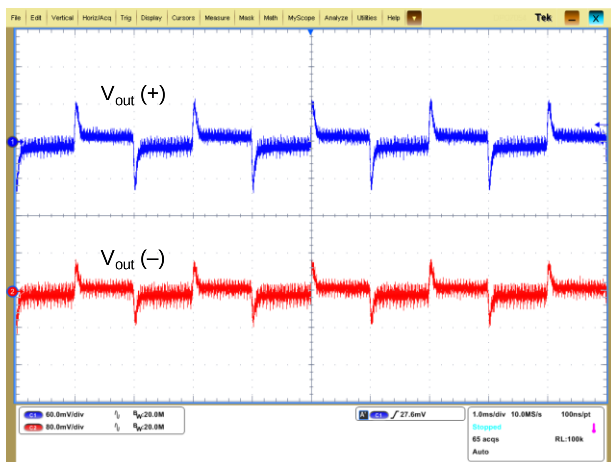
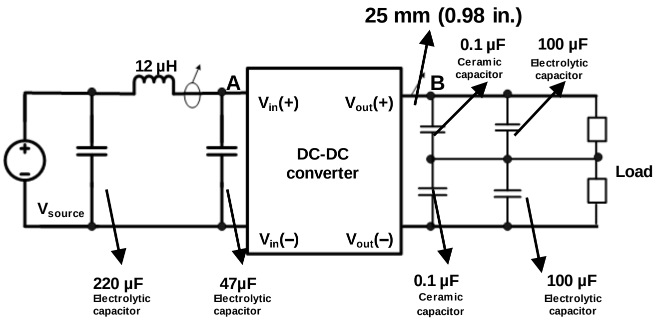


Figure 13: Test set-up diagram



> **NOTE**
>
> 1. During the test of input reflected ripple current, the input terminal must be connected to a 12 μH inductor and a 220 μF electrolytic capacitor.
> 2. Point B, which is for testing the output voltage ripple, is 25 mm (0.98 in.) away from the $V_{out}(+)$ pin.

Conditions: T_A = 25°C (77°F) ,Vin = 48 V, Vout = ±12 V, Po = 15W.

Figure 14: Input reflected ripple current
(for point A in the test set-up diagram)

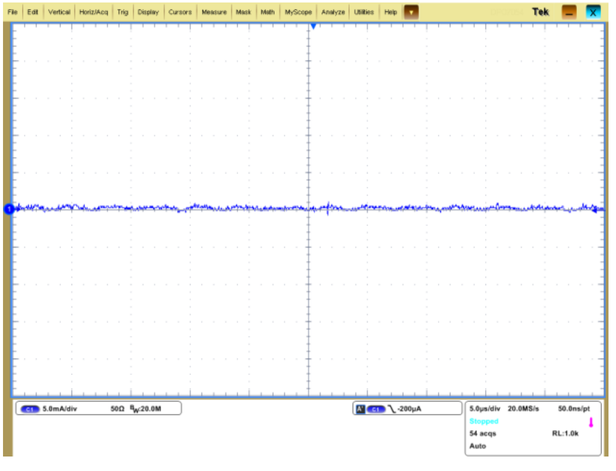
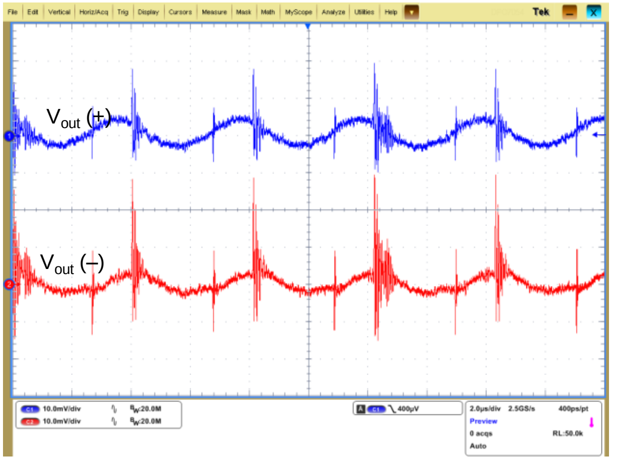


Figure 15: Output voltage ripple
(for point B in the test set-up diagram)

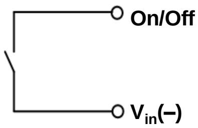


Feature Description

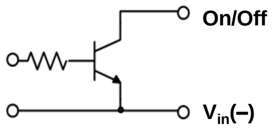
Remote On/Off

Logic Enable	On/Off Pin Level	Status
Positive logic	Low level	Shut down
	High level or left open	Started

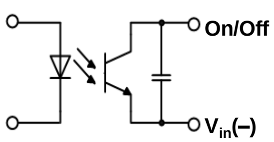
The following are some circuits for driving the on/off pin.



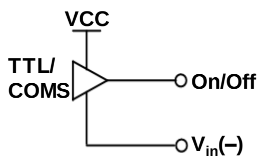
Simple control



Transistor control



Isolation control



Direct logic drive

Input Undervoltage Protection

The GAC15D12P is shut down after the input voltage drops below the undervoltage protection threshold for shutdown. The GAC15D12 starts to work again after the input voltage reaches the input undervoltage protection threshold for startup.

Output Overcurrent Protection

When the output current exceeds the overcurrent protection threshold, the GAC15D12 works in hiccup mode until overcurrent disappears. After the output current drops to the specified range, the GAC15D12 starts to work in normal mode.

Output Overvoltage Protection

When the output voltage exceeds the overvoltage protection threshold, the GAC15D12 works in hiccup mode. Only the 12V output possess the function of overvoltage protection.

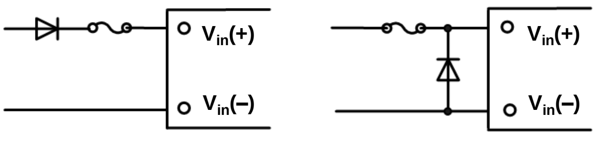
MTBF

The MTBF is calculated according to the Telcordia, SR332 Method 1 Case3.
If the GAC15D12 is used at 40° C (104° F), the airflow over it can be increased to retain the MTBF.

Recommended Reverse Polarity Protection Circuit

Reverse polarity protection is recommended under installation and cabling conditions where reverse polarity across the input may occur.

Figure 16: Recommended reverse polarity protection circuits



Recommended Fuse

The GAC15D12 has no internal fuse, but connects to an external fuse in actual use. To meet safety and regulatory requirements, a 1 A fuse is recommended.

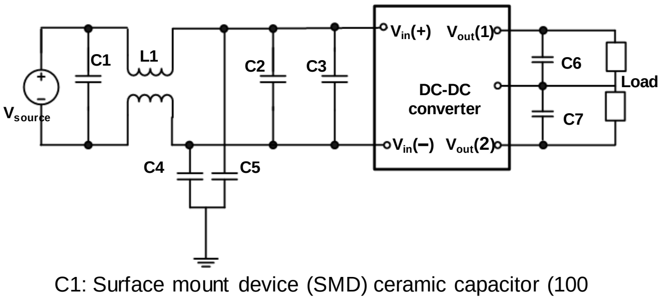
NOTE

The fuse current should be 1.5 to 2 times the maximum operating current in actual use.

EMC

For the acceptance standard, see the *DC-DC Converter EMC Acceptance Manual.*

Figure 18: EMC test set-up diagram



C1: Surface mount device (SMD) ceramic capacitor (100 V/1000 nF/X7R/1210)

C2: SMD ceramic capacitor (100 V/100 nF/±10%/X7R/1206)

L1: Common-mode inductor (single phase, 1320 μH/±25%/4 A/R5K/ 21 mm x 21 mm x 12.5 mm [0.83 in. x 0.83 in. x 0.49 in.]). The chip component with the same specifications can also be used.

C4: Plug-in film safety regulation capacitor (0.022 μF/250 V), meeting the 1 kV pressure resistance requirement.

C5: High-pressure resistant chip ceramic capacitor (22 nF/1000 V/X7R/1210). Chip ceramic capacitors are preferred.

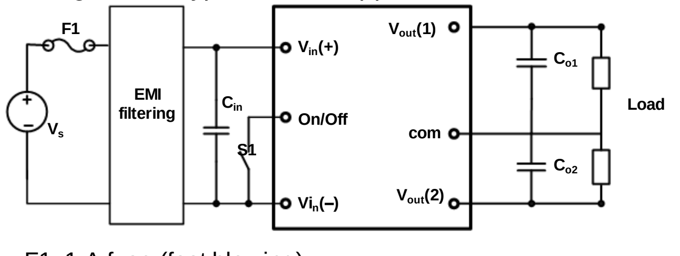
C3: Electrolytic capacitor (47 μF/100 V)

C6: Electrolytic capacitor (100 μF)

C7: Electrolytic capacitor (100 μF)

Typical Application

Figure 19: Typical circuit applications



F1: 1 A fuse (fast blowing)
C_{in}: The high-frequency, low equivalent series resistance (ESR) electrolytic capacitor (100 uF/100 V) is recommended.
C_{o1}: The 100 uF electrolytic capacitor isrecommended.
C_{o2}: The 100 uF electrolytic capacitor is recommended.

NOTE

GAC15D12s cannot be connected in parallel.

Power Dissipation

The GAC15D12 power dissipation is calculated based on efficiency. The following formula reflects the relationship between the consumed power (P_d), efficiency (η), and output power (P_o):

$$P_d=P_o(1-\eta)/\eta$$

Mechanical Considerations

Installation

Although the GAC15D12 can be mounted in any direction, free airflow must be taken. Normally power components are always installed at the end of the airflow path or have separate airflow paths. The installation mode helps keep other system equipment cooler and increase component service life.

Soldering

The GAC15D12 is compatible with standard wave soldering techniques. During wave soldering, the setting parameters should base on the speciality of using flux, such as the preheating temperature and time, the soldering temperature and time and so on. To improve the soldering heighten, it is allowed to improve the preheating and soldering temperature, prolong the preheating and soldering time as the larger thermal capacity of the module. However, it is not allowed to excess the high temperature limitation of the components that belong to the module.

When soldering the GAC15D12, ensure that the soldering iron is at 425°C (797°F) and contacts pins for a maximum of 3 seconds, because long-time soldering at high temperatures may cause the GAC15D12 interior to be damaged.

The GAC15D12 can be rinsed using the isopropyl alcohol (IPA) solvent or other proper solvents.

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