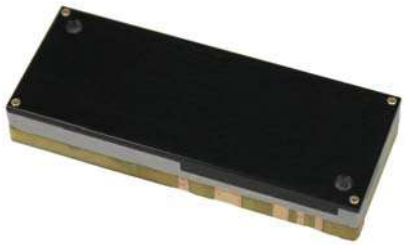
DC4812T20 DC-DC Converters
Technical Specification V1.0

Input 36V～75V, Output 12V/20A, Industry Standard Eighth Brick

Contents

DOSA Standard outline



RoHS

Features

- Eighth Brick Without baseplate （58.42mm×22.86mm×11.5max mm） With baseplate（58.42mm×22.86mm×12.7mm）
- Rated Power 240W
- Ultra-high power density Without baseplate：16.3W/cm^3 With baseplate： 14.2W/cm^3
- Input Under Voltage Protection（30V to 35.5V turn off）
- Input transient overvoltage 85V(≤100ms）
- Positive Logic Control（3.5V to 12V or floating turn on）
- Output Over Voltage Protection，Automatic Recovery（13.8V～16.8V）
- Output Voltage Adjust Range：0.75～1.1 of the rated output voltage
- Output Over Current Protection ,Output Short-circuit Protection （ hiccup mode, automatic recovery）
- High Efficiency up to 95% typ.（48V，full load）
- 1500Vdc Isolation Voltage
- Operation Ambient Temperature -40℃ to +85℃
- Operation Baseplate Temperature -40℃ to +100℃
- Over Temperature Protection 115℃ typ
- Applications：telecommunications, Electronic Data Processing, Distributed Power Architecture ,Industrial control equipments and Instrument.etc.

Ordering Information

See Contents for individual product ordering numbers.

Suffix	Description	Ordering No.
--	Positive Logic Control：3.5V～12V or floating,，turn on；0V～0.5V，turn off	DC4812T20
P	Negative Logic Control	DC4812T20P
B	Equipped with metal baseplate. A heatsink can be installed on the baseplate.	DC4812T20B
PB	Negative Logic Control Equipped with metal baseplate. A heatsink can be installed on the baseplate.	DC4812T20PB

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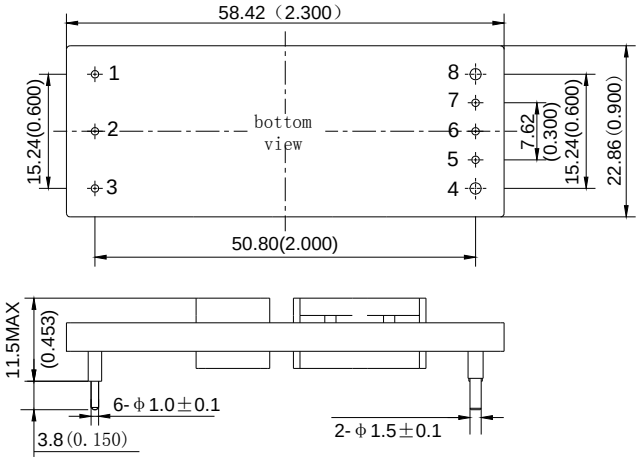
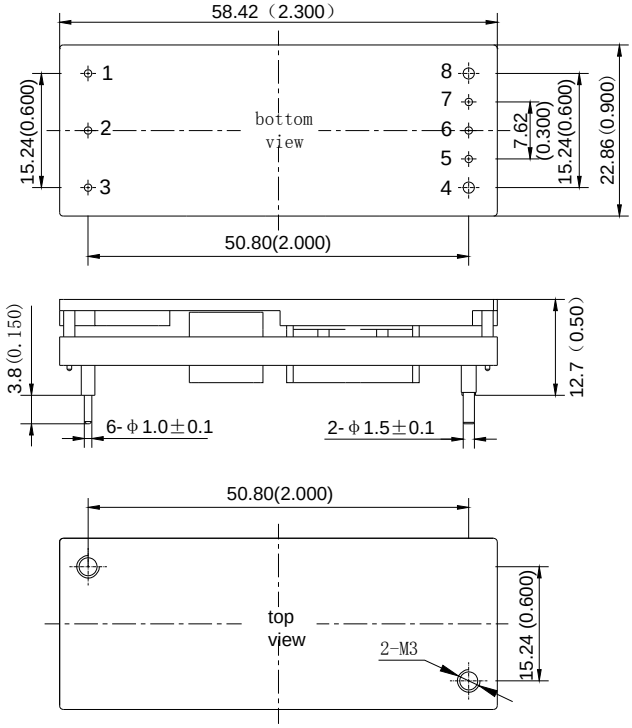
Outline Diagram

Outline Diagram without Baseplate



Outline Diagram with Baseplate



Pin	Symbol	Function
1	-Vin	Negative Input
2	CNT	Remote Control, turn on/off the converter. Output voltage on when CNT floating or high level applied.
3	+Vin	Positive Input
4	$+V_O$	Positive Output
5	+S	Positive Remote Sense, connected to $+V_O$ pin when not in use.
6	Trim	Output Voltage Trim, voltage be trimmed up or down by applying external resistor connected to +S or -S output
7	-S	Negative Remote Sense, connected to $-V_O$ pin if not used.
8	$-V_O$	Negative Output

Note: To avoid damaging components, do not exceed 3mm depth with the screw
Case Material: Multilayer PCB; Pin: Copper alloy with gold plating;
Baseplate Material: Aluminum
Notes： All dimensions in mm(inches)
Tolerances:X.X±0.5 (X.XX±0.02) X.XX±0.25 (X.XXX±0.010)

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Specification

Unless otherwise specified, all tests are at room temperature，standard atmosphere, pure resistive load，+S connected to +Vo、-S connected to –Vo，and at an additional wind speed of 2m/s. At the same time, it meets the basic application circuit requirements.

Input		Symbol	Min	Typ	Max	Unit	Conditions
Input Voltage		V_{in}	36	48	75	V	I_o：0～20A
Input voltage transient range		–	-0.3	–	85	V	transient <100ms 72～85Vdc，P_o≤120W
Maximum Input Current		$I_{in,max}$	–	–	7.25	A	$V_{in,min}$，$I_{o,max}$
Input Idling Current		$I_{in,nl}$	–	100	200	mA	$V_{in,nom}$，I_o=0A
Input reflected ripple current		–	–	100	300	mA	20MHz，connect one inductor (12μH，≥8A)in series
Input reflected ripple voltage		–	–	300	500	mV	$V_{in,nom}$，$I_{o,max}$ (20MHz)
Positive Logic Control	On	–	3.5	–	12.0	V	Refer to -V_{in}; Turn on when CNT floating.
	Off	–	0	–	0.5	V	Refer to -V_{in}
Negative Logic Control	On	–	0	–	0.5	V	Refer to -V_{in}
	Off	–	3.5	–	12.0	V	Refer to -V_{in}; Turn off when CNT floating.
Start-up Delay Time		T_{delay}	–	10	–	ms	$V_{in,nom}$，$I_{o,max}$
Under Voltage Threshold		V_{UVLO}	30.0	32.0	35.5	V	I_o：0～10A
Under Voltage Protection Hysteresis		$\triangle V_{UVLO}$	1	3	–	V	—

Output		Symbol	Min	Typ	Max	Unit	Conditions
Output power		–	0	–	240	W	V_{in}：36～72V，I_o：0～20A
Output Voltage		V_O	11.76	12.00	12.24	V	V_{in}：36～72V，I_o：0～20A T_A=25℃
			11.64	12.00	12.36	V	V_{in}：36～72V，I_o：0～20A T_A=-40～85℃
Output voltage accuracy		–	–	1	2	%V_O	V_{in}：36～72V，I_o：0～20A
Output Current		I_O	–	–	20	A	V_{in}：36～72V
Output Voltage Adjust Range		V_{trim}	9	–	13.2	V	V_{in}：36～72V，Trim up：P_o≤240W Trim down：I_o≤20A
Line Regulation		S_V	–	–	±0.5	%V_O	V_{in}：36～72V, $I_{o,max}$
Load Regulation		S_I	–	–	±1.0	%V_O	$V_{in,nom}$，I_o：0～20A
Capacitive Load		C_O	470	–	10000	μF	V_{in}：36～72V， I_o：0～20A
Remote Sense Compensation Range		V_{sense}	0	–	0.6	V	V_{in}：36～72V，I_o：0～20A +S and -S twisted Pair， length is less than 20cm
Load Transient	Recovery Time	$\triangle V_{tr}$	–	–	400	μs	25%～50%～25%$I_{o,nom}$ or 50%～75%～50%$I_{o,nom}$; 0.1A/μs
	Voltage Deviation	t_{tr}	–	–	±600	mV	

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Continue

Output	Symbol	Min	Typ	Max	Unit	Conditions
Output Over Voltage Protection Set Point	$V_{ov,set}$	13.8	–	16.8	V	$V_{in,nom}$; $I_o \leq 8A$, $P_o \leq 120W$ Clamp mode, self-recovery
Output Over Current Protection Range	$I_{O,lim}$	22	–	40	A	V_{in}: 36～72V, $V_{o,nom}$ Hiccup mode, self-recovery
Output Short-circuit Protection	–	Hiccup mode, automatic recovery				V_{in}: 36～72V It is not recommended to work in this condition for a long time
Peak to Peak Ripple and Noise	$\triangle V_{pp}$	–	–	240	mV	20MHz bandwidth, V_{in}: 36～72V, $I_{o,max}$, Meet the basic application of the circuit connection requirements
Rise Time	T_{rise}	–	5	25	ms	$V_{in,nom}$, $I_{o,max}$
Output Overshoot	V_{TO}	–	–	1.2	V	$V_{in,nom}$, $I_{o,max}$
Pre-bias start	This feature is available					

General	Symbol	Min	Typ	Max	Unit	Conditions
Efficiency	η	93	95	–	%	$V_{in,nom}$, $I_{o,max}$
Switching Frequency	f_s	150	180	210	kHz	—
Isolation Resistance	R_{iso}	1000	–	–	MΩ	Input ~ Output, Input ~ substrate, Output ~ substrate, Test voltage:500Vdc
Isolation Voltage	V_{iso}	1500	–	–	Vdc	Input ~ Output, Input ~ substrate, Output ~ substrate, time:60s ,Leak Current: 1mA
MTBF	–	–	2×10^6	–	h	BELLCORE TR-332, T_A=25℃
Operating Ambient Temperature	–	-40	–	+85	℃	Heat dissipation measures are required and Refer to the derating curve
Operating PCB Board Temperature	–	-40	–	100	℃	
Storage Temperature	–	-55	–	+125	℃	—
Temperature Coefficient	S_T	–	±0.03	±0.05	%/℃	T_A=-40～85℃, $I_{o,max}$
Over Temperature Protection Reference Point	T_{ref}	100	115	125	℃	—
Over Temperature Protection Hysteresis	$\triangle T_{ref}$	–	10	–	℃	—
Cooling method	Natural cooling or forced air cooling					
Vibration	Sine, Frequency: 10Hz-55Hz, Amplitude:0.35mm, 30 min in each of 3 perpendicular directions					
Shock	Half sine, peak acceleration:300m/s², duration:6 ms ; continuous 6 times of pulse in each of 3 perpendicular directions					
Hand Soldering	Maximum soldering Temperature < 425℃, and duration < 5s					
Wave Soldering	Maximum soldering Temperature < 255℃, and duration < 10s					
Weight	–	–	34	–	g	DC4812T20
	–	–	49	–	g	DC4812T20B

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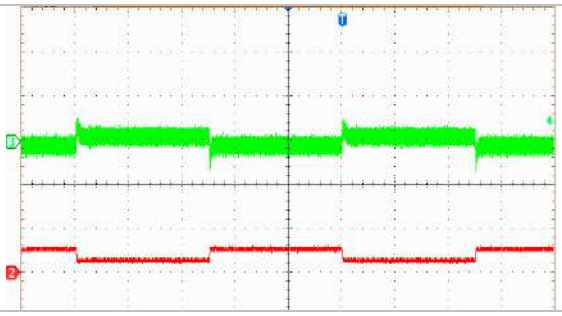
Note:
① The power density of the module is relatively high, and additional cooling measures are required when the customer uses it. The der curve varies under different wind speed conditions. For specific derating standards, please refer to the derating curve description in the characteristic curve.
② Under any working condition，the voltage applied to the input port "CNT" and the output port "Trim" with respect to their respective reference grounds must not exceed 14V otherwise irreversible damage will occur.
③ DC4812T20 （without baseplate）：only perform the Isolation Resistance test and the Isolation Voltage test on the input-output. DC4812T20B （with baseplate）：the Isolation Resistance test and the Isolation Voltage test are according to the table requirements.

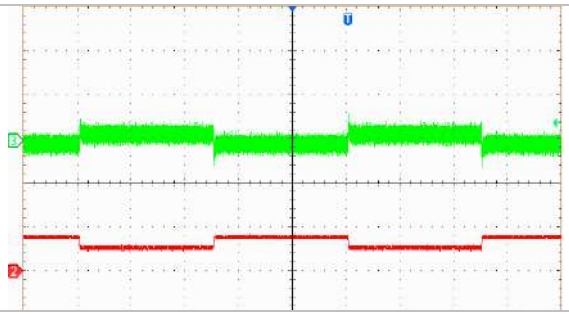
Characteristic Curves

Load Transient Response 1



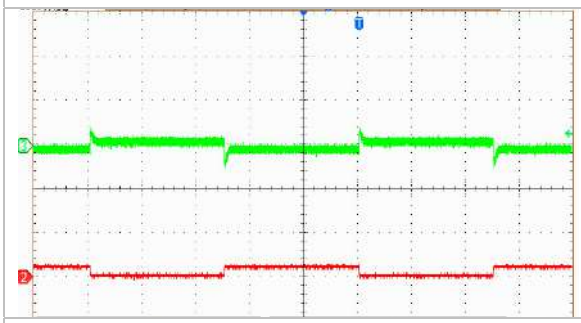
Load change:25%～50%～25% $I_{o,nom}$, 0.1A/μs
Vin=48Vdc
Trace1: 200mV/div
Trace2: 20A/div
Time scale: 2ms/div

Load Transient Response 2



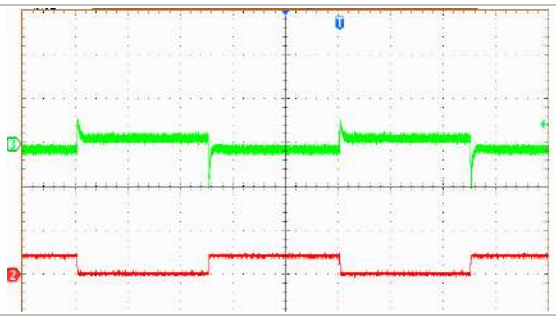
Load change: 50%~75%～25% $I_{o,nom}$, 0.1A/μs
Vin=48Vdc
Trace1: 200mV/div
Trace2: 20A/div
Time scale: 2ms/div

Load Transient Response 3



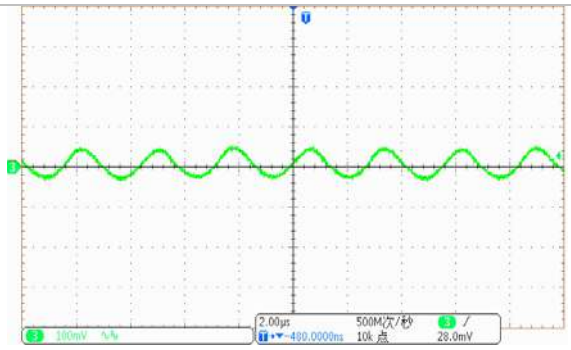
Load change:0%～50%～0% $I_{o,nom,}$ 0.1A/μs
Vin=48Vdc
Trace1: 500mV/div
Trace2: 50A/div
Time scale: 2ms/div

Load Transient Response 4



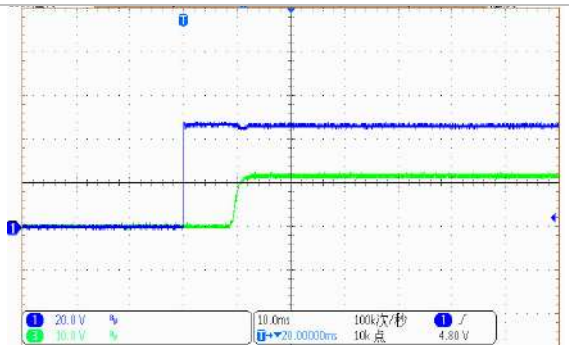
Load change: 0%~100%～0% $I_{o,nom}$, 0.1A/μs
Vin=48Vdc
Trace1: 500mV/div
Trace2: 50A/div
Time scale: 2ms/div

Output Ripple and noise



V_{in}=48V； I_o=20A

Start-up Delay Time



V_{in}=48V； I_o=20A

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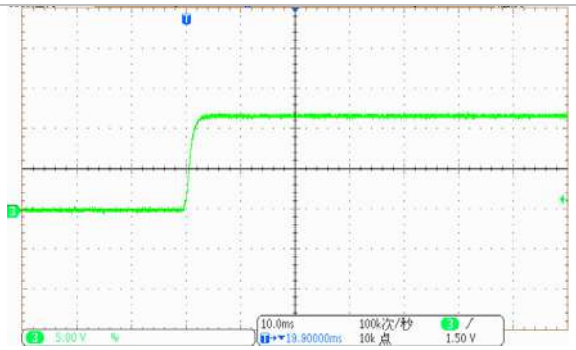
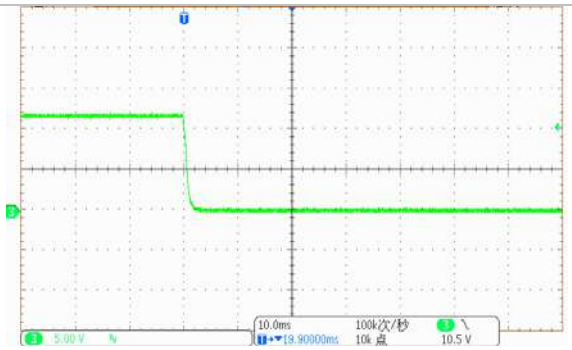
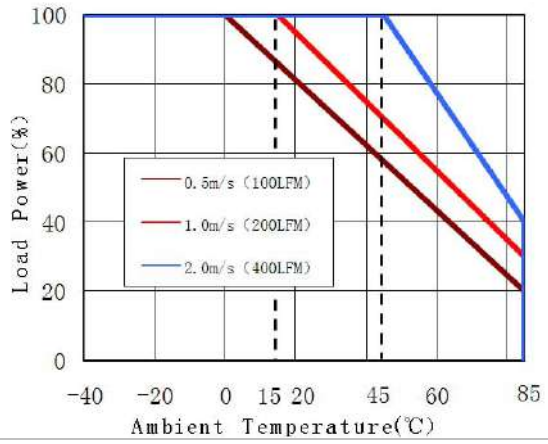
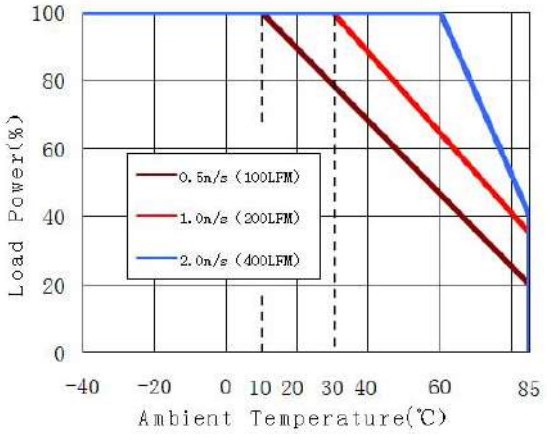
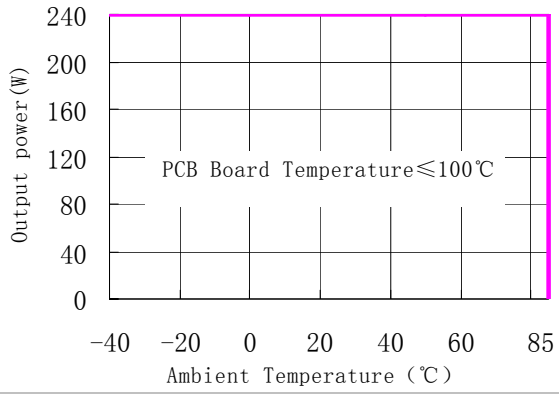
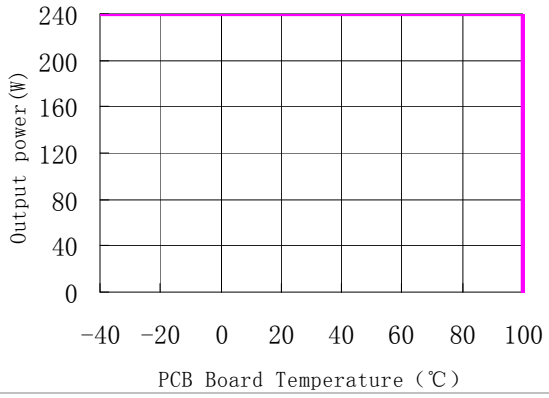
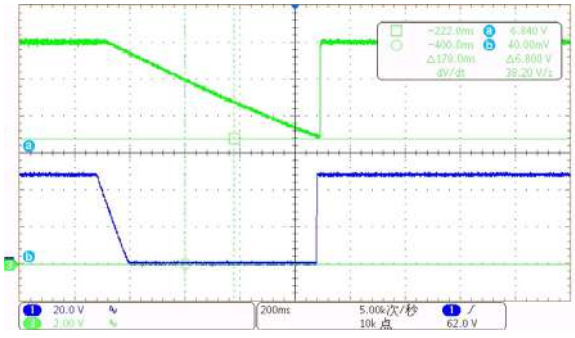
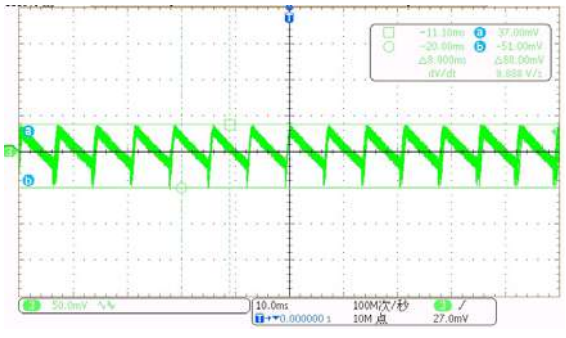
Rise Time	**Turn-off**
	
V_{in}=48V； I_o=20A	V_{in}=48V； I_o=20A
Derating Curve 1　DC4812T20	**Derating Curve 2　DC4812T20B**
	
Derating Curve 3	**Derating Curve 4**
	
Pre-biased start-up diagram	**Burst Mode Output Ripple**
	

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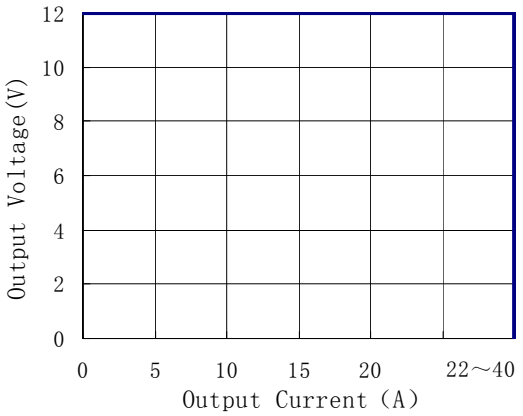
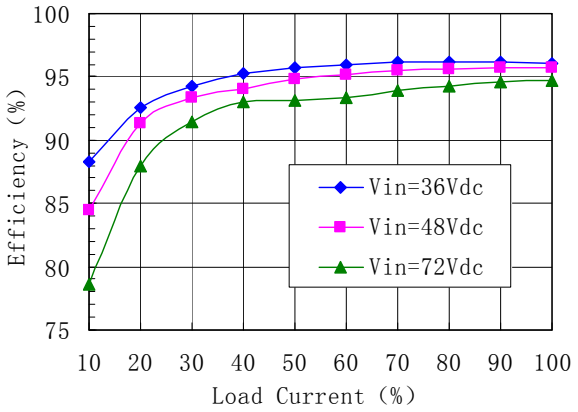
Output Voltage and Current Characteristic



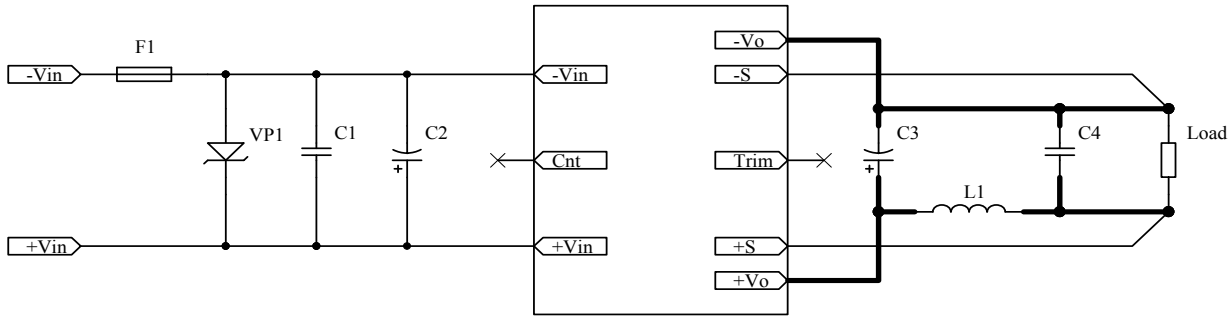
Efficiency vs Load Current



Note:
①During product installation, attention should be paid to the direction of hot air flow to ensure smooth heat exchange between the heat generated by losses and the ambient temperature. Additionally, to achieve better heat dissipation conditions, for modules without an attached heatsink structure, it is necessary to place the non-pin-out side upwards.
②Under a certain ambient temperature (85℃), customers can improve heat dissipation conditions by appropriately increasing wind speed or further installing heat sinks on the heat sink.
③Deriated curves 1 and 2 are derated curves at different wind speeds without heat sink panels and with heat sink panels (the pin is in non-welding mode). Only for customer thermal design reference use, in the actual use due to the application environment, wind speed and other factors are not the same. Please give enough deriated in the hot design according to the actual usage situation.
④Burst mode output ripple. This diagram is when the pre-bias start-up triggers the module's mode, at this time, the ripple may be greater than 240mV. Just load about 0.1A appropriately, you can exit mode. If customers have 0%～100%～0% load variation requirements and pre-bias usage requirements in use, it is recommended to add 0.1A load at the output.

Design Considerations

Basic Connection



Note: This figure only indicates the basic conditions for normal product output voltage and rated power.＋S should be connected to ＋V_O and -S be connected to -V_O when no voltage compensation is needed. For detailed design information, please refer to the description later in this article, and please read and fully understand the content and meaning of this manual before using the product.
Parameter description:

Part No.	Components	Part No.	Components
F1	18～22A insurance	C3	Electrolytic or solid-state capacitor -40℃～-55℃ 470uF/25V （connected to the output pin）
VP1	1.5KE82A	L1	A inductor of 0.22~0.33uH and ≥20A is

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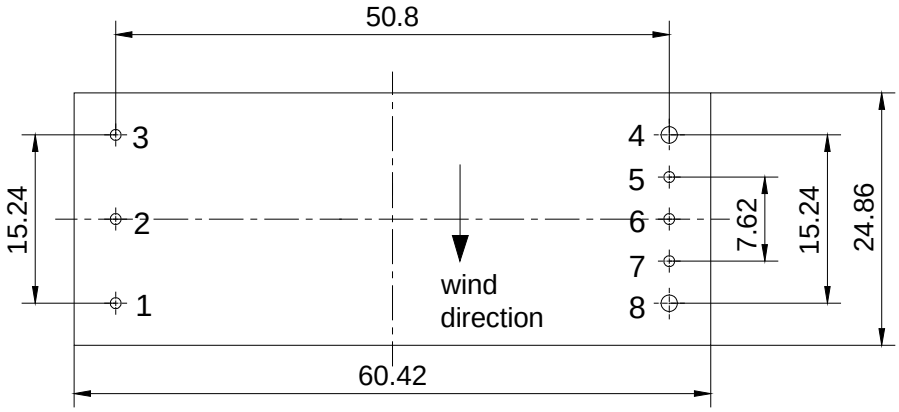
C1	Ceramic capacitor 4.7uF/100V		recommended for applications that require lower ripple Note: The values in the performance parameters were not used with this inductor
C2	Electrolytic or solid-state capacitor -40℃～-55℃ 200uF/100V	C4	Ceramic or tantalum capacitor 22uF/25V (When there are special customer requirements, the external storage capacitor needs to be connected in parallel with C4)

Recommended Layout



NO.	Recommendation & Notes
Pad Design	Pad hole 4&8: 2.0mm，pad diameter including hole: 3.5mm；the rest are 1.5mm and 2.5 mm respectively.
Airflow Direction	As the figure shown or the opposite direction, perpendicular direction is not recommended.
Safety	Isolated Converters, care to the spacing ≥ 2.0 mm.between input and output
Electrical	The Vin(-) and Vo(-) planes should be placed under of the converter separately. Avoid routing sensitive signal or high disturbance AC signal under the converter. Due to the large input and output current, the current density of the lines connected to the input and output pins is to be less than 6A/mm².

Input Voltage Range

The input voltage range of the DC/DC converter is 36V to 72V. In order to suppress the pulse spikes from the input voltage, it is recommended to connect a electrolytic capacitor or solid-state capacitance（≥200uF，-40℃～-55℃）at input. The input impedance of the converter looks like a negative resistor, which can interact with the reactance of the power bus (including any filter elements that have been added to the input of the converter), causes an unstable condition. Depending on the internal transformer's impedance, the external impedance should be required to have low source impedance.When source impedance of the power bus is high, the output voltage or ripple may be unstable.

The method to determine whether the impedance of the power bus too high or not is to decrease the converter's input voltage from higher to lower gradually, If input lower voltage to the converter which works normally when the input voltage is high,then the output voltage of the converter can decrease or be unstable and it can return to normal after reducing the load current, it will be considered the impedance too large. The method for further confirmation is to connect a electrolytic capacitor or solid-state capacitance(≥200uF/100V -40℃)to the module power pin in parallel after the module power is powered off (Individual cases may require a ceramic capacitor（4.7uF/100V）to be connected between the electrolytic capacitor and the module pin), if the output getting better, it will be sure that the impedance is too large.

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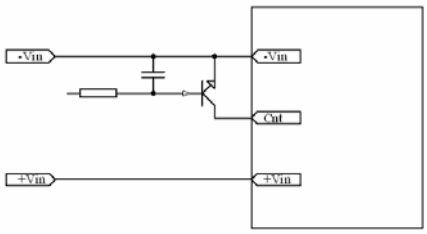
Remote Control

This function is obtained by applying the correct control level (or floating, high-impedance state) to the CNT pin. Positive logic remote control and negative logic remote control function is optional, DC4812T20 is a positive logic control product, when the applied level is 3.5~12V or floating ,the module power is on, when the applied level is 0~0.5V, the module power is off. When an external low level is applied, the output current of the CNT pin is less than 5mA and when an external high level (3.5～12V) is applied, the input current of the CNT pin is less than 5mA.



Recommended circuit diagram of remote control circuit

Due to the logic comparator is semiconductor integrated chip with low resistance to surge,care should be taken to prevent CNT from surge, like application of TVS. In practical applications, if a voltage source that may surge voltage is introduced, attention should be paid to the surge protection of CNT, such as adding a TVS diode or bypass ceramic capacitor, etc., ensure that the CNT pin is not damaged by surge voltage. The above figure is a recommended circuit for transistor control. If there is an isolation requirement for remote control the customer's application, the transistor can be replaced with an optocoupler to achieve isolated control.

DC4812T20P is provided with negative logic remote control. It has the same characteristic as DC4812T20, except control logic. When the level applied is less than 0.5V, the converter will be turned on, When the level is 3.5V-12V or be left floating, the converter will be off .Like positive logic control converters, care should be taken to prevent CNT from surge.

The remote control function can provide for users in terms of control. For example: using the remote control function to realize the remote control switch function; when multiple devices are started at the same time, module output voltage can also be synchronized controlled by the signal sent by the system.

When the signal from the system is beyond 3.5V～12V, or it can be enabled only within a very narrow control level, the aux circuit will be required. Please contact us for more information.

External Capacitance

Unless special purpose (i.e. prolonging hold-up time, input impedance matching), the recommended input filter's capacitance ranges 220μF-470μF, which not only offers a stable system, and reduces the cost, but also lessens the inrush current when the power supplies.

When larger capacitance is required, a circuit of suppressing the inrush current is recommended when the regulator start-up and a discharge circuit is recommended when the output dropped, ensuring the reliability and safety of other equipments in the system.

The maximum capacitive load capacity of the power supply itself is 10000uF. If it is necessary to reduce the output ripple or reduce the current impact on the power supply when the load changes suddenly, the output filter electrolytic can be appropriately increased. If there is no special requirement, it is recommended to add a capacitor of 470 to 4700uF.

Since the capacitance of the electrolytic capacitor decreases and the ESR value increases at low temperature, if a lower output ripple is required within the full working temperature (-40 to 85℃), it is recommended to use a solid capacitor with better low temperature characteristics for the output capacitor. At the same time, differential mode inductor of 0.22 to 0.33uH and ≥20A is added before the output energy storage filter electrolytic, which is conducive to obtaining a lower output ripple requirement (see the basic application connection).

Remote Sense

The remote sense can be used to compensate for the voltage drop between the output pins of the converter and the load input pins by +S、-S pins. The +S and –S pins should be connected to the input pins of the load respectively. The remote sense circuit will compensate for up to 5% voltage drop(about 0.6V) between the sense voltage and the voltage at the output pins. If this compensation voltage is still lower than the customer's demand, the output voltage can be further by adjusting the resistor. However, the maximum output voltage at the root of the module pin is not allowed to exceed 13.2V.

The anti-interference design should be considered when the +S、-S pins are connected to the pins to be

compensated. The +S、-S traces should be located close to a ground trace or ground plane, and the area they surrounded should be minimized (just for electrical isolation); If cable connection presents, twisted pair wires should be used, EMI core are equipped with the twisted pair wires to reduce common mode noise when necessary, the sense leads should not be longer than 200mm,or the system characteristics may not be assured.
The sense leads only can carry very little current, and are not used for converter power output. Care should be taken in operation to avoid damaging the converter. If the remote sense is not needed, the –S should be connected to -Vo and +S should be connected to +Vo.

Thermal Consideration

The converters operate in a variety of thermal environments; however, sufficient cooling should be provided to ensure reliable operation of the unit. Heat is removed by conduction, convection and radiation to the surrounding environment.
To illustrate how to select the required minimum velocity (without a heat sink), if the power module operates at an ambient temperature of 80℃, Vin=48V, and the output current is 8A, according to the above derating curve 1, the required minimum air velocity is approximately 2.0 m/s.
To illustrate to select the required minimum air velocity (with a heat sink, no additional radiator), if the power module operates at an ambient temperature of 60℃, Vin=48V, and the output current is 20A, according to the above derating curve 2, the required minimum air velocity is approximately 2.0m/s.
The advantage of having no heat sink is when the customer has forced air cooling and has higher requirements for product height (only 11 total height). As long as the PCB board temperature is kept below 100℃, the load capability at 85℃ ambient temperature can also enhanced by further increasing the air velocity and increasing the heat dissipation capacity of the pins. When the air velocity is much greater than 2 m/s, the der curve approaches the derating curve 3 indefinitely.
The advantage of having a heat sink is when the customer has no forced air cooling conditions and the height of 12.7mm meets the customer's use requirements. As long as the PCB board temperature is kept below 100℃ (additional radiator required), without forced air cooling, it can operate fully loaded at 85℃ ambient temperature. This is equivalent to being able to widen the load capability of the der curve 2. When the additional heat sink is large enough, even forced air cooling is not required. The derating curve under this cooling state can be referred to derating curve 3 and the derating curve 4. Therefore, the power module with a heat sink is more advantageous for applications that can be mounted on a heat sink.
The derating curves 1 and 2 in this datasheet are the results of simulated test data, and the test connection method is similar to of plugging the module pins into the test board. In actual use, the customer solders it onto the motherboard, and the soldering of the pins can reduce thermal resistance. The thermal performance will be significantly improved. Since the current in the power loop is relatively large, it is recommended that the current density of the PCB be less than 6A/mm². Therefore, the derating curve 1 and derating curve 2 are for reference only. The actual thermal resistance related to thermal conduction, convection, radiation, and whether there are nearby heat sources, and accurate evaluation is required in actual use according to the specific heat dissipation situation.
When adding forced air cooling, attention should be paid to the design of the air duct to avoid blockage or the generation of eddy currents that affect the heat dissipation; when adding a heat sink, the power module's heat sink and the heat sink should be tightly connected, and thermal grease or thermal insulation double-sided tape thermal silicone gel pads can be used to reduce the thermal resistance of heat dissipation.
Therefore, customers should optimize the heat dissipation design of the module as much as possible actual applications, leaving sufficient design margin for the PCB board temperature to avoid the module entering the over-temperature protection state. Thus, the reliability and lifespan of power supply can be improved.

Over Temperature Protection

The series of products provide over-temperature protection function, due to the different structure of products, test over-temperature point location and temperature is slightly different.
The locations of the test points of the products with and without baseplate are shown in the diagram below. The typical temperature of the over-temperature protection point of the without baseplate is 115℃. The typical temperature of the over-temperature protection point with the heat sink baseplate is 100°C(the typical temperature of the center of the heat sink plate is 100℃when the temperature sensor is 115℃ over-temperature protection because of the heat resistance of the pouring sealant to the center of the heat sink plate).

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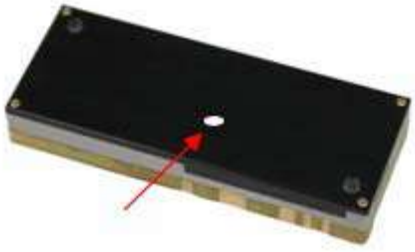
No matter what structure is chosen for the series，make sure the test point is less than 100℃ with enough temperature drop(it is recommended to use with than 15℃ derating) to avoid over-temperature protection when in use. When the over-temperature protection occurs, the module power supply will turn off the output, after the temperature drops about 10°C, the module power supply will start the restart process, the over-temperature protection duration depends on the surrounding cooling environment, from a few seconds to a few minutes, if the high temperature environment can not be improved, the restart process will continue.

Location of heatless substrate test points



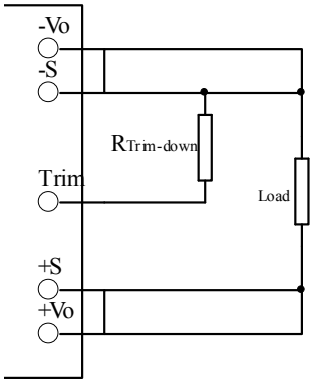
Test point location with thermal baseplate

Also note that the maximum temperature of the device at the red dot in the module diagram without a heat sink is 130℃. When the uses it, it should be avoided to use it above 130℃.

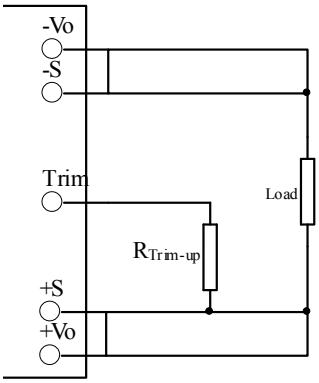
Output Voltage Adjust

The converters have an Output Voltage adjust pin (Trim). This pin can be used to adjust the output voltage above or below Output voltage initial setting. The maximum value of the trimmed up is 10%, even +S and –S pins are used to compensate the voltage simultaneously, the sum of the trimmed up and the compensation should not be more than 10%, or the characteristics will not be assured in compliant with the specification, even the over voltage protection may be triggered. The output power can not exceed 240 W at increased output voltages, and the output current can not exceed 20A. When the trim pins are not used, they should be floated.

External circuit is connected as the figure shown, the resistance is calculated as the formula below, please note that the formula will be invalid when $R_{Trim-up}$、$R_{Trim-down}$ are used simultaneously, users adjust the value based on the resistance applied.



Connection for Trimming Down



Connection of Trimming Up

Resistance for trimming up ： $R_{Trim-up}=\left(\frac{5.11\times Vo(100(\%)+\Delta(\%))}{1.225\times\Delta(\%)}-\frac{5.11\times100(\%)}{\Delta(\%)}-10.22\right)(k\Omega)$

Resistance for trimming down： $R_{Trim-down}=\left(\frac{5.11\times100(\%)}{\Delta(\%)}-10.22\right)(k\Omega)$

Vo：rated output voltage，12V；

$R_{Trim-up}$、$R_{Trim-down}$ ： Resistance for trimming up or down，kΩ；

△（%）：Change rate, divide output voltage by rated output voltage；

For example, trimmed down voltage to 9.6V(adjusted down by 20%)， then

$$\Delta(\%)=\left(\frac{12-9.6}{12}\times 100\%\right)=20\% \qquad R_{Trim-down}=\left(\frac{5.11\times 100(\%)}{20\%}-10.22\right)=15.33(k\Omega)$$

it can be taken as 15kΩ.When trimmed down voltage to 9V(adjusted down by 25%), it can be taken as 9.5 kΩ by calculation.

Trimmed up voltage to 13.2V(adjusted up by 10%).then

$$\Delta(\%)=\left(\frac{13.2-12}{12}\times 100\%\right)=10\%$$

$$R_{Trim-up}=\left(\frac{5.11\times 12(100\%+10\%)}{1.225\times 10\%}-\frac{5.11\times 100(\%)}{10\%}-10.22\right)=489.3(k\Omega)$$

it can be taken as 487kΩ.

Similarly, overvoltage protection test can also be realized by an external resistor, and a 140KΩ resistor can be selected calculation.

Output Over Voltage Protection

The converter is designed with clamped over voltage protection, when output voltage exceeds 115% to 140% of the rated output voltage (the set point is between 115% to 140%, there is the difference based on the specific parameters, but not beyond the range), the output voltage will be clamped. At this time, the output will have large ripple, and it is that users use the remote control CNT pin function to turn off the module if they cannot maintain it in time. If the output overvoltage abnormality disappears, module can automatically enter the normal working state. Although the module has this protection function, it is not recommended for customers to use this state.

Safety Consideration

The converter, as a component for the end user, should be installed into the equipment, and all the safety considerations are achieved under certain condition. It is required to meet safety requirements in system design. The converter output is considered SELV, and the expected input is considered TNV2, the primary to secondary is basic insulation to EN62368.The maximum operating temperature for PCB is 170 ℃.

To avoid fire and be protected when short circuit occurred, it is recommended that a fast blow fuse with rating 2.5 to 3 times of converter's continuous input peak current is used at the input terminal.

ESD Control

The converters are processed and manufactured in an ESD controlled environment and supplied in conductive packaging to prevent ESD damage from occurring before or during shipping. It is essential that they are unpacked and handled using an ESD control procedures. Failure to do so affects the lifetime of the converter.

Cleaning Notice

This product is coated with a three-proof paint on the surface, and it is strictly prohibited to clean it with detergent again in principle. the customer can ensure that the performance of its material will not affect the three-proof paint that has been coated. Even if the detergent does not cause a chemical, it is not recommended to soak and clean. Since there is an isolation transformer inside the product, once it has been soaked and cleaned, it must be baked at temperature of 100 degrees for more than half an hour. Otherwise, it will affect its insulation performance index and even has the risk of damage

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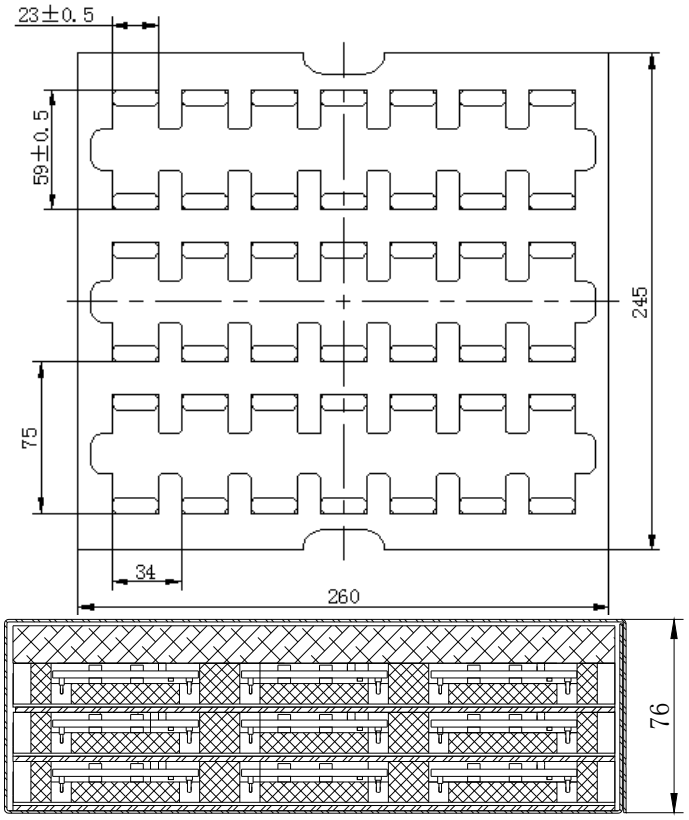
Delivery Package Information



Package material is multiple wall corrugated，internal material is anti-static foam，it's surface resistance is from $10^5\,\Omega$ to $10^{12}\,\Omega$.
Substrate module without heat dissipation: small package is 3×21=63 pieces per box, weighing about 2.22kg; 4×63=252 pieces per large package, weighing about 9.5kg.

Module with heat dissipation substrate: small package is 3×21=63 pieces per box, weight about 3.17kg; 4×63=252 pieces per large package, weighing about 13kg.

Quality Statement

The converters are manufactured in accordance with ISO-9001 system requirements, and are monitored 100% by auto-testing system, 100% burn in.
The warranty for the converters is 5-year.