

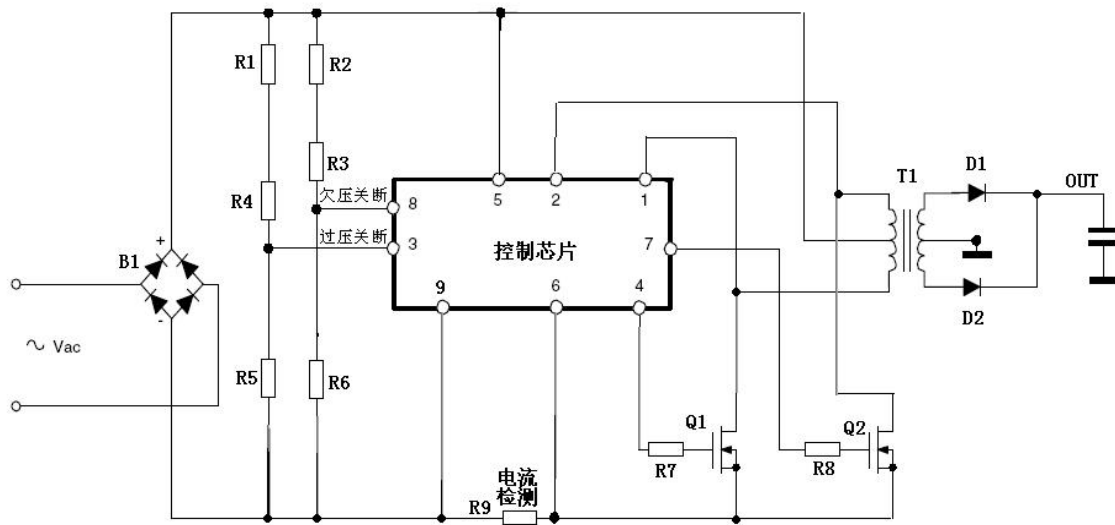
## **FHT100 Series High-temperature AC-DC Modules**

### **Features:**

- : High operating temperature (ambient temperature:  $-55^{\circ}\text{C} \sim +175^{\circ}\text{C}$  and max. shell temperature:  $+204^{\circ}\text{C}$ )
- : Small size (L: 80.0×W: 28.0×H: 20MM.)
- : High conversion efficiency (typically 95% ~ 97%)
- : Sealed metal casting (impact and moist resistance and electromagnetic radiation protection)
- : Input overvoltage shutdown
- : Wide input range (85~130V, 140~220V, 180~247V)
- : Multi-output routes (led out upon request)
- : High operating frequency (66.6KHZ)
- : Integrated LC EMI filter
- : Providing rated power without deduction at  $175^{\circ}\text{C}$  (shell); providing 50% of rated power at  $204^{\circ}\text{C}$  (shell)
- : Over-heat protection at  $210^{\circ}\text{C}$
- : Output circuit and overload turnoff protection
- : Input under-voltage and over-voltage turnoff protection

### **Description:**

At the place where AC/DC is required and the operating ambient temperature is relatively high, since the topology structure of conventional switch AC/DC converter circuit is required to withstand 400V large-capacity filter capacitor, the relationship between capacitance and output power is generally set as 1.2UF/1W. The features of large-capacity capacitor solution (Capable of resisting 200 degree of high temperature and withstanding 400V) include large size, high cost and long order cycle. All these factors synthetically make AC-DC in high-temperature switch mode fail to replace the traditional high-temperature linear AC-DC power supply. However, the current technological developments require that the output power of high-temperature power supply should be as high as possible while the size as small as possible. However, it is a task which analog power can not undertake. To this end, VAW Electronics innovatively develops high-efficiency high-temperature AC/DC without requiring to withstand 400 V large-capacity filter capacitor. ZCS-ZVS ZCS zero-voltage-zero-voltage switch (resonant soft-switch) is realized in the component with nothing much application of circuits. This technology has not only substantially reduced the voltage and current stress within each of components, and thus enabled the reliability of power supply to be increased at orders of magnitude, but also minimized EMI interference. The efficiency within the output range of 5W-100W reaches as high as 95% ~ 97%. Since the efficiency is extremely high and the heat emission at the maximum output of 100W is not more than 5W, it is unnecessary to give much consideration to the heat dissipation in power supply, and the size can be minimized, and even placed inside the thermos bottle.



The above diagram is the schematic circuit diagram: FHT module input AC, B1 rectifies AC into DC pulse power. Chip 8,3 pin is used to configure low-voltage turn-off and over-voltage protection point of module, and its operating voltage range can be flexibly configured through R1,R2,R3,R4,R5, and R6. Meanwhile, the input voltage module outside the range does not operate so as to protect the module and enable it to operate in the optimum condition. The input current is less than 1mA at the time when the module is not in operation. 2,1 pin is used to detect the zero potential of switching tube, and ensure that Q1 and Q2 are opened at zero potential. Resistor R1 is used to detect the input current, with the first purpose of ensuring that Q1 and Q2 are turned off at zero potential, and the second purpose of detecting sudden abnormal current. If abnormal current is detected, the module enters into separation at first. After that, in case abnormal current still exists after a period of time, the module shall enter into the locked status. In this case, the input is turned off, the output is zero, and the locked status can be removed only after the input voltage has dropped below the under-voltage protection point. After the start-up, FHT transforms the input (66KHZ resonant frequency) at a certain amount of transformation ratio into secondary through a high-frequency transformer, and the secondary output is also DC pulse power. A low-capacity high-frequency non-polar capacitor exists in the module output. After the filtering, 66KHZ high frequency component disappears, and the DC pulse output power is identical with the input DC pulse output power, namely, there is only one proportional relation which is also the transformation ratio of high-frequency transformer. At this moment, it is required to supplement corresponding low-voltage filter capacitor. Under normal circumstances, if the output is 36V DC pulse power, and 48V input DC/DC module (produced by our company) is subsequently required to be configured, 1 watt of power should be matched with 5UF capacitance. 100W output should be matched with 470UF/125V tantalum capacitor. It is recommended that 134D series (produced by VISHAY and can withstand 200 degree) should be applied. The size of 150UF/125V capacity is merely 9.5\*27.0mm. In addition, CA53 model produced by Zhuzhou Hongda Electronic equals to 134D produced by VISHAY. However, we have not verified the reliability, and customers can consider it as optional. The independently-developed control chip (Operating temperature is -55℃~ +210℃) serves as the key component in this circuit. Q1 and DQ2 belong to the component at 250℃junction temperature. The total amount of circuit components are less than 30, which greatly simplifies the production and improves the reliability.

By the above description, it is nearly possible to consider FHT100 module as a rectified step-down transformer which can be transformed between AC and DC. Its efficiency is higher than that of common frequency transformer, and a small amount of components are supplemented in its circuit to enable 66KHZ input resonant to be stepped down via transformer. The main component of circuit is 66KHZ transformer, and its size is thousand-fold smaller than that of

frequency transformer while the efficiency is higher with operating frequency thousand-fold higher than that of power frequency.

Through this technology, we can provide one to multi-channel modules for 15W, 30W, 50W, 75W, and 100W outputs. Since it is not regulated isolation module, it is necessary to subsequently increase voltage regulator circuit. Its appearance, on one hand, helps eliminate the existing bulky and inefficient power frequency transformer, on the other hand, helps the formation of high-efficiency, small size, and heat-resistant AC/DC power supply, and completely solve the AC power supply problem under high-temperature working environment.

Here are some solutions :

1) If the customers do not want to make many changes in the existing power system, it is only necessary use FHT series to replace the existing transformer and the rectifier bridge. The amount of coils depends on the number of route of secondary voltage regulation. The transformer ration of all outputs should be in full accordance with the original transformer ratio.

2) If only one route of voltage regulation is outputted, it is necessary to add one DC/DC (not isolated). The efficiency of DC/DC (not isolated) can generally reach 95%, and the size is very small. Therefore, the size and efficiency of integrated AC/DC is superior to the conventional AC/DC.

3) If multiple routes of voltage regulation output are required, we recommend that FHT module output should be applied and 48V DC / DC module should be subsequently supplemented. Since ZCS-ZVS ZCS zero-current & zero-voltage switch (resonant soft-switch) is also realized in our 48V DC / DC module, the efficiency can thus reach as high as more than 90%. EMI interference and ripple can be similar to that of analog power. In this way, it can completely replace the traditional linear power supply, and save a large number of filter capacitors and high-temperature three-terminal voltage regulators.

4) In the field of low-voltage DC/DC modules, both military power supply (Input of 18V-36V) and communication power supply (Input of 36V-72V) are available. These two power supplies represent the state-of-art technology in power supply. There are also a large amount of matured products for selection. Since many power efficiency have reached more than 95%, and other indexes are close to the ideal power, it is thus possible to select them at the place where the thermos bottle is available to match with our FHT series products, and constitute the power system. Low-voltage DC/DC module is placed inside the thermos bottle, FHT can either be placed inside the thermos bottle, or placed outside the thermos bottle.

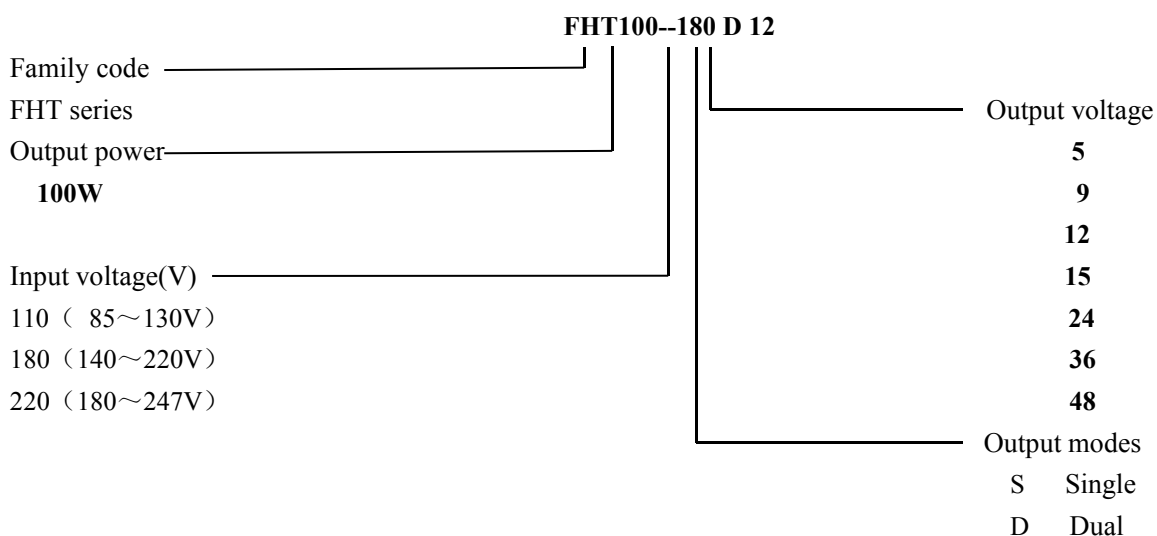
5) Only one piece of FHT module is used in the entire system to provide an internal non-regulated low-voltage power bus. At the place where stabilized voltage is required, it is necessary to observe the 5UF/1W principle, and connect with tantalum capacitor and apply the DC/DC with soft-switching technology. DC / DC module has a variety of remote control terminals to facilitate the flexible and easy control of the system.

The overall efficiency of #2, #3, and #4 scheme is not less than 85%, the cost of #4 scheme is the lowest, #5 scheme is the optimal. To sum up, our AC/DC scheme can realize ZCS-ZVS zero-current & zero-voltage switch (resonant soft-switching) in the entire process, and avoid the high-voltage large-capacity capacitor and power frequency transformer, it is therefore far superior to the power supply with power frequency transformer in terms of size, efficiency, and electrical indicator, and greatly reduces the space to be occupied by power supply system.

The FHT100 series 100W high-temperature AC-DC power module is designed for the electronic equipments working in the harsh environment. It is high temperature, impact and humid resistant and hence is particularly suitable for being used as power supply for the oil, geophysical exploration etc.

FHT100 components completely pass the in-factory test in strict accordance with the enterprise standards and GJB, which includes 24 ~ 72-hour live aging and screening at +175°C. All finished products have experienced 8-hour full-load operation at +175 °C before delivery so as to fully expose the damage to the components during the production process and hence ensure the reliability of products.

### Choice of Products:



### Main technical parameters:

- (一) Operating temperature: -55 °C ~ +175 °C    Maximum shell temperature: +204 °C.
- (二) Input voltage: 85~130V, 140~220V, 180~247V
- (三) Output voltage: free combination of multi-route (5, 9, 12, 15, 24, 36, 48)
- (四) Output ripple: 66.6KHZ ripple is less than 100MV, and the output and input of low frequency ripple is the transformation ratio relationship of transformer.
- (五) Output power: 100W
- (六) Temperature Stability: less than  $\pm 2.5\%$  (typical  $\pm 1\%$ )
- (七) Earthquake resistance: 25G, 0 ~ 300Hz
- (八) Conversion efficiency: 95% ~ 97%
- (九) Static power consumption: 0.2W Maximum
- (十) Mechanical dimensions: (1)L: 80.0MM  $\times$  W:28.0MM  $\times$  H:20.5MM
- (十一) Isolation voltage between input and output or between the outputs: 1000V
- (十二) Definition of the pinouts :    red pin: positive input      black pin: negative input      blue pin: output to FG  
white pin: positive output    gray pin: negative output      green pin: negative output

### Service Requirements:

As the modules have nearly 5W power consumption under the condition of full-load operation and their sizes are small, good medium need to be added between the shell of the power supply and the radiator so as to ensure the temperature of the module case to be less than 204 °C. The shell of the module is isolated from the input and output. The shell is directly connected with the shortest outgoing line terminal between the input and output to FG or connected through a 1000V/1000PF capacitor, which ensures the contact resistance between the inner part of the module and the shell is minimum one so as to effectively reduce the switching spikes.

### Outline diagram:

