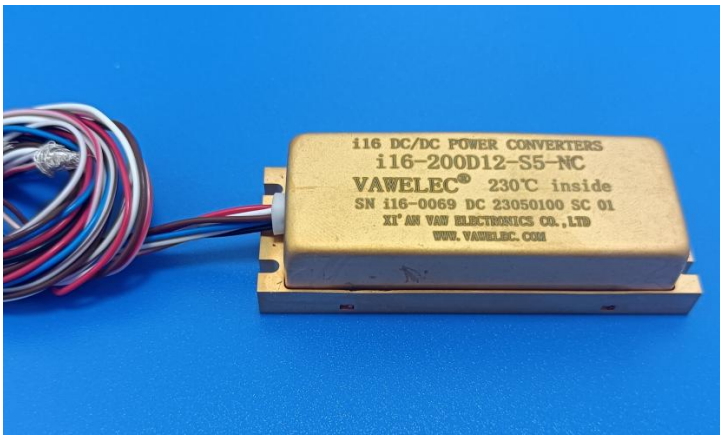
i16 Series Multi-channel Isolated Output Ultra-high Temperature DC-DC Power Converters



Features

- Working temperature: ambient temperature:-55℃～+175℃ and shell temperature up to: +215℃
- Output power: 16W
- Size: L62×W25.2×H16.8mm, excluding base plate mounting dimensions
- Output channels up to four and up to three isolated outputs (3.3V, 5V, 7V, 9V, 12V, 15V, 18V, 24V, 36V, 48V)
- Output ripple: max. 100mV, typical 50mV
- Conversion efficiency: typical 75%
- Input range: 10～30V, 16～48V, 24～72V, 36～108V , 70～210V, 120～360V
- Integrated LC EMI filter
- Sealed metal encapsulation (resistant to impact and damp environments, electromagnetic radiation protection)
- Remote cut-off function
- Provide rated power without deduction at 200℃ (shell), provide 70% of rated power at215℃
- Isolation voltage between input and output: 500V; isolation voltage between outputs: 500V
- Over-voltage and over-current fault cut-off delayed restart
- Input under-voltage and over-voltage cut-off protection
- 100MS soft start
- Overheat protection at 237℃

Description

The i-series multi-channel isolated output ultra-high temperature power converters are specifically designed for electronic devices operating in environments with temperatures exceeding 200℃. Our purpose in designing this series is to increase the operating temperature range of the FH series to -55℃～+210℃, while simultaneously improving and enhancing electrical performance without increasing the volume. The i16 is benchmarked against the FH18, and in environments below 175℃, the two series of products are interchangeable in terms of electrical and mechanical installation, without requiring changes to electrical and mechanical design.

The FH series has been mass-produced for 14 years, and the actual application of a large number of products has provided us with a large amount of useful data and we have accumulated rich experience in the production. At the same time, thanks to the rapid development of technology, this series has continuously adopted new technologies, and we have also adopted customers' opinions to improve it.

With continuous improvements to the FH series, we finally broke through the shell temperature of 200℃ in 2017 and developed a full range of high-temperature power supplies with component temperature

resistance of 230℃. In the following three years, we continuously optimized the products and did a lot of work in improving reliability, reducing costs, improving mass production processes, and perfecting quality control. Finally, in August 2020, we officially started mass production and supply.

The i16 can operate for 500 hours at a case temperature of 215℃, 1,500 hours at 200℃, and 5,000 hours at 185℃. It has actually passed reliability verification. Currently, it has been proven that the failure rate at 215℃ case temperature for 750 hours is less than 3%! Due to its high temperature resistance, impact resistance, and moisture resistance, it is particularly suitable for use in the power supply systems of oil exploration downhole instruments, oil drilling downhole instruments, geophysical exploration instruments, vehicles and transportation tools, telecommunications and network infrastructure, enterprises, and high-performance computing, etc.

The i16 series 16W multi-channel isolated output extra-high temperature DC-DC power converters are designed with six input ranges of 10~30V, 16~48V, 24~72V, 36~108V, 70~210V, 120~360V. The output voltages designed include 3.3V, 5V, 7V, 9V, 12V, 15V, 18V, 24V, 36V and 48V. The output can be either of them and combinations of any two, three or four voltages. MOUT is main output terminal and OUT1 and OUT2 are auxiliary output terminals.

When in use, the voltage output from the main output port (MOUT) is the most stable. The main output is generally symmetrical with positive and negative outputs, and it can also be asymmetrical with one or two circuits. The main outputs are not isolated from each other, but the main and auxiliary outputs, as well as the auxiliary and auxiliary outputs, are isolated from each other.

If the main output is symmetrical with positive and negative, both positive and negative circuits should be sampled for feedback voltage regulation, and the voltage requirement is greater than or equal to 3.3V. If the main output is asymmetric in two circuits, one circuit should be sampled at 80% for feedback voltage regulation, while the other circuit should be sampled at 20% for feedback voltage regulation. One of the circuits must have a voltage greater than 5V!

The output power of the main output is required to be the largest of the four outputs. The output voltage and ripple of the main output does not vary with its own power or that of the auxiliary output voltage. With constant output power at the main output MOUT, the voltages at the auxiliary outputs OUT1 and OUT2 decrease as its output power increases, maximum 2 %. If the output power of the auxiliary outputs OUT1 and OUT2 is constant, their output voltage increases as the output power of the main output MOUT terminal increases. Because of this feature, it is important to specify the main and auxiliary outputs when using and selecting the model. For example, the module model i16-150S12-S24-S5 outputs three mutually isolated 12V, 24V and 5V, where 12V from MOUT, 24V from OUT1 and 5V from OUT2. That is, the model is named i16-DCINSMOUT-SOUT1-SOUT2. When multiple outputs are used, if the power of one of the outputs

(main or auxiliary) changes dynamically during use, it will cause the voltage of the auxiliary output to fluctuate with it, and if the fluctuation is greater than that, measures must be taken. Voltage fluctuations greater than 50mV occur only when the output power varies between less than 10 per cent and more than 70 per cent of the rated power, with larger fluctuations occurring the greater the ratio of high to low output power. The fluctuation frequency is equal to the frequency of the power change! This is where secondary filtering has to be considered. If you add to this the fact that the power fluctuates at a frequency of less than 10K Hz, then filtering is troublesome. It is then necessary to consider reducing the number of outputs from the primary module and adding a secondary DC/DC module to reconvert the extra voltage. If the power fluctuates at a frequency greater than 10K Hz, a simple filter can be used to suppress this fluctuation. If, in the course of use, the power output of one of the outputs (main or auxiliary) varies between more than 10% and less than 70% of the rated power, its voltage fluctuation is generally less than 50mV, and this fluctuation is generally not to be taken into account.

Our design concept is that if more than four output voltages are required, then the i16 selects OUT2 to output 24V, 36V, or 48V, and connects OUT2 to our DC/DC module with 28V (16-48V) or 48V (24-72V) inputs to reconvert it twice!

The output voltage fluctuates within 2 % over the entire operating temperature range and under full/no load conversion conditions. The i16 series operates at frequencies up to 300KHZ, providing excellent filtering conditions. Its output voltage ripple is less than 100MV without any filtering, and the temperature stability of the frequency is ±8% over the whole temperature range.

The i16 includes an LC network to effectively reduce input current fluctuations and output voltage fluctuations. When we were developing this series, we had already established the most authoritative R$S certification test system for EMI certification in the industry, and we used it to design the i16's built-in input/output LC network, so that the input current fluctuation and output voltage fluctuation and interference ratio are the same as those of the FH series.

The i16 contains a 10MS soft-start circuit, which can slowly increase the input current after the module is started and the fault is removed, facilitating the connection of large-capacity output filter capacitors and reducing the start-up shock.

The i16 contains an under-voltage/over-voltage shutdown, which protects the module by stopping it from operating when the input voltage is out of range. The under-voltage shutdown voltage is 2V outside the rated voltage and the over-voltage shutdown voltage is within 5V outside the rated voltage. If the rated input range is 24 to 72V, it has an under-voltage shutdown voltage of 21~23.9V and an over-voltage shutdown voltage of 72.1~77V.

The SLEEP, shutdown terminal of the i16, is high level and effective. When the voltage is 3.2~5.3V, the

module enters the SLEEP state and cut off all outputs with the input current less than 1MA. When the voltage is 0~2.5V or suspended, the module works normally. The input voltage at the SLEEP terminal should not exceed 12.0V.

The i16 contains the output short circuit and overload automatic cut-off circuit. When the output lasts for 0.1s and exceeds 150% of the rated output power, the converter will cut off all outputs. After the over-current fault is eliminated, it will automatically resume the output voltage. If the overload duration of output is less than 0.1s, the converter will not act.

Key components used for the i16 completely pass the in-factory test in accordance with the national military product quality standard, including live aging for 72 hours under the temperature of +230℃. All finished products have experienced full-load operation for 6 hours under the temperature of +210℃ before delivery so as to fully check the damage to the components during the production process and hence ensure the reliability of products.

Model Naming Rules

i16-DCINSMOUT-SOUT1-SOUT2

i 16—200 S12—S12—S36

Series code
I Series

Output power
16W

Input voltage

15 （10～30V）
28 （16～48V）
48 （24～72V）
50 （36～108V）
150 （70～210V）
200 （120～360V）

output voltage
OUT2 (3.3,5,7,9,12,15,18,24,36,48)

output voltage
OUT1 (3.3,5,7,9,12,15,18,24,36,48)

output voltage
MOUT (3.3,5,7,9,12,15,18,24,36,48)

Output channels

S single
D Dual

Note: "—" in the above model means isolation, that is input is always isolated from output, so the first "—" is required. The following three "—" may not appear or just only appear one to three "—", which means no isolation or there is isolation between outputs. S*** can also be D***or S***S***. There are four S*** at most in a model. D*** means two S***.

Model example: In i16-150D15S5, MOUT outputs + 15V, OUT1 outputs -15V and OUT2 outputs +5V. The outputs are commonly grounded.

In i16-50S15S3.3-S5, MOUT outputs +15V , OUT1 outputs +3.3V, and OUT 2 outputs 5V. MOUT and OUT1 are commonly grounded and isolation from OUT2.

In i16-50S15-S3.3-S5-S24, the outputs are isolated from each other. MOUT outputs 15V ,OUT1 outputs +3.3V, OUT 2 outputs 5V, and OUT 3 outputs 24V

Main Technical Parameters

(1) Working temperature: -55℃～+210 ℃, Max. shell temperature: +215 ℃.
(2) Input voltage: 10～30V, 16～48V, 24～72V, 36～108V, 70～210V, 120～360V
(3) Multiple output channel and up to four isolated outputs 3.3V, 5V, 7V, 9V, 12V, 15V, 18V, 24V, 36V, 48V
(4) Output ripple: 100mVp-p, typical 50mVp-p

(5) Output power: 16W
(6) Output precision: less than 4%
(7) Load regulation: less than 4%
(8) Temperature stability: Less than ±2.5% , typical ±1%
(9) Line regulation: ±0.1%(10% linear variation)
(10) Shock resistance: 25G, 0 ~ 300Hz
(11) Conversion efficiency: 75%
(12) Static power consumption: 0. 8W Max.
(13) Isolation voltage between input and output or between outputs: 500V
(14) 100MS soft start
(15) Dimension: L62.0×W25.2×H16.8mm
(16) Voltage output type: high-temperature lead

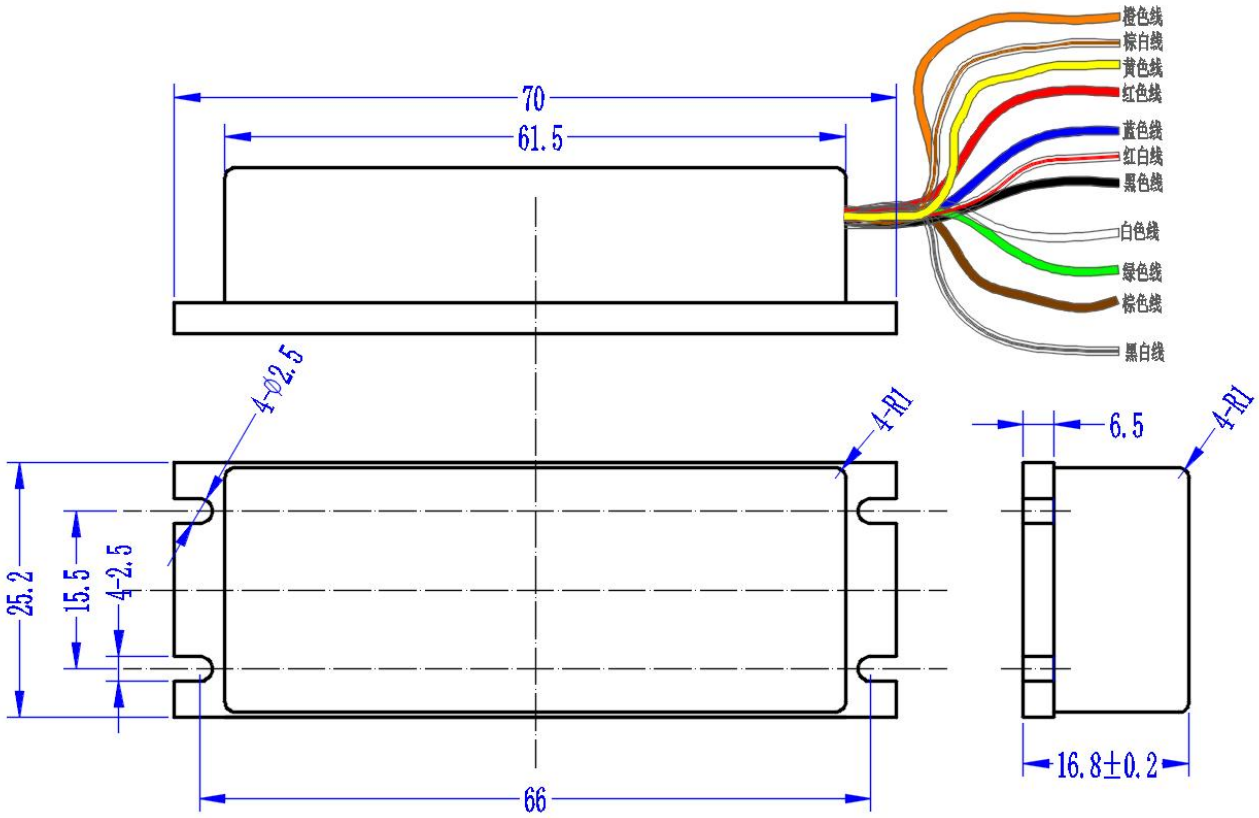
Service Requirement

As the power converter has nearly 5W power consumption under the condition of full-load operation and its size are small, good medium is necessary to be added between the shell of the power converter and the radiator so as to ensure the temperature of the converter shell to be less than 215℃.

Module shell is isolated from input and output. In the use of the module, it is generally installed directly on the framework of the instrument or equipment. The framework is used as a radiator. At the time, if the ripple cannot continue to be filtered by the electricity capacity or LC network, then the ripple that cannot be filtered is EMI interference. EMI filtering module should be added to the input and output terminals of i16. As we have added EMI network to input and output terminals inside converter, so long as the shell is suspended, it will function. To make internal EMI function, the shell of filtering converter should be suspended not to connect with radiator, input and output ground wires. If it is connected to either of them, EMI filtering converter will not function properly. To suspend shell, it usually puts heat-conducting pad, ceramics backing or silicon rubber pad between the shell and radiator. If the ripple is still large, it is needed to externally connect input or output EMI filter outside the shell. The input and output of the module shall have a maximum of four ground wires. If any of them need to be connected together, they must be connected at a place less than 1CM from the outgoing module. The shorter the line of the connection point from the module, the less interference.

In practice, if the load is less than 4W, the case temperature can reach 225℃.

Outside view:



Note: 1. Tolerance of mounting holes and spacing dimensions is ±0.1mm;
2. Tolerance of external dimensions is ±0.2mm;

Definition of Lead Wires

Red： input +	Black：input-	Yellow： Cut-off
White：MGND	White：MOUT1	Brown： +OUT2
Green：+OUT2	Orange：-OUT2	
White/green：+OUT1	White/red：-OUT1	

Note: If the orange wire is not available for individual power modules with two isolated outputs, replace it with the brown wire.

Product performance, reliability and information are subject to change without prior notice.

July 26th, 2024