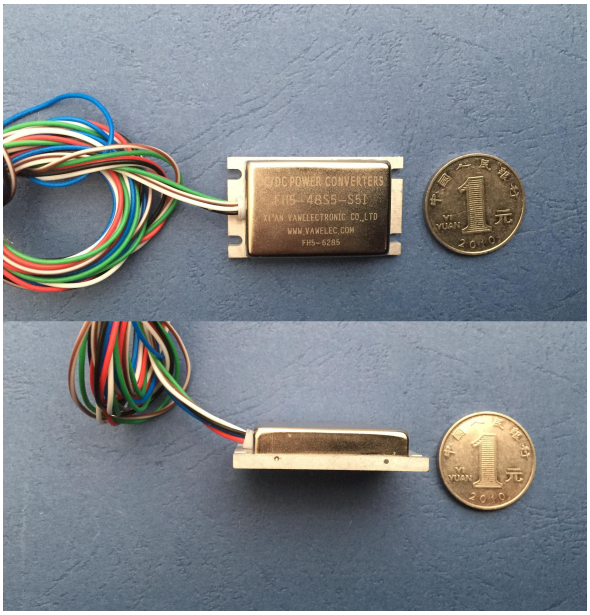
FH5 and FH5-L Low power Series High-temperature DC-DC Power Converters



Features:

: Working temperature: Ambient temperature:-55℃ ～+175℃, max. shell temperature up to +185℃

-L Series：Ambient temperature:-55℃～+175℃, max. shell temperature up to +185℃

-L Series：Output power：

shell temperature：150℃，5W；

shell temperature：175℃，3W。

: Dimension: 1. L: 33.0×W: 22.0×H:9.0MM;

2. L:64.0×W:16.0×H:8.5MM;

3. L:33.0×W:14.0×H:7.5MM

The three dimensions do not include the size of the mounting base

: Multiple outputs up to 3 and at most 2 isolated output ground circuits (3.3V,5V,7V,9V,12V,15V,18V,24V,36V,48V）

: Output ripple: Maximum 100mV, typical 30mV

: Conversion efficiency: Typical 78%

-L Series：Conversion efficiency: Typical 80%，Static power：0.25W

: Input range: 10～30V, 16～48V, 24～72V, 36～108V , 70～210V

: Integrated LC EMI filter

: Sealed metal casting: Impact and moist resistant and electromagnetic radiation protection

: Provide rated power without deduction at 175℃ (shell); provide 80% rated power at 185℃ (shell) and 50% rated power at 204℃ (shell)

-L Series：Provide rated power without deduction at 175℃ (shell);provide 60% rated power at 175℃ (shell)

: Isolation voltage between input and output: 1000V, isolation voltage between outputs: 500V

: Overvoltage and overcurrent fault cutoff delay restart

: Input undervoltage and overvoltage cutoff protection

: 100ms soft start function

: Over-heat protection at 210℃

Description

FH5 and FH5-L series 5W high-temperature DC-DC power converters are specially designed for electronic equipment working in the harsh environment. Based on the previous converters, we changed the former output common ground to isolation ground with two outputs through technical improvement.

FH5 series 5W high-temperature power converters can continuously work for 2,000 hours at shell temperature 150 ℃, for 750 hours at shell temperature 175 ℃ and for 400 hours at shell temperature 185 ℃. （FH5-L Low power Series for 48 hours at shell temperature 185 ℃） With features of being resistant to high temperature, impact and humidity, it is particularly suitable for being used as power supply for petroleum

prospecting logging tool, petroleum drilling instrument, geophysical detecting instrument, vehicles, telecommunication, network infrastructures, enterprise and high-performance calculation, etc.

FH5 series power converters provides five input ranges including 10～30V, 16～48V, 24～72V, 36～108V and 70～210V. The output voltage includes 3.3V, 5V, 7V, 9V, 12V, 15V, 18V, 24V, 36V, 48V. The output can be either of them and combinations of any two or three voltages. The output can provide at most two isolated ground circuits. During the use, they are allowed to be connected to form output combinations of different types as per requirement.

Within the entire temperature range and conversion between full load and no-load, the output voltage fluctuation is within 0.3V. The output accuracy of 3.3V is even within 0.15V. The working frequency of FH5 series power converters are up to 300KHz, which provide good filtering condition. In the condition without adding any filtering, their output voltage ripple is less than 100MV. The temperature stability of frequency within the entire range of temperature is ±8%.

MOUT is main output terminal and OUT is auxiliary output terminal. The MOUT and OUT terminals are generally symmetric of positive and negative, and it allows one output or two asymmetric outputs. Main outputs and auxiliary output are not isolated but outputs between MOUT and OUT can be isolated and non-isolated. It can work with only main output without auxiliary output. It there is auxiliary output, the number of channels of auxiliary output shall not exceed 3.

Voltage output from MOUT terminal is the most stable. If main output is symmetric of positive and negative, positive and negative outputs sample feedback regulated voltage which is required to be greater than or equal to 3.3V. Given that positive and negative outputs of main output are not symmetric, one samples 80% of feedback regulated voltage and the other samples 20% of feedback regulated voltage. There must be one output voltage that is greater than 5V. The output power of main output is required to be greater than that of auxiliary output and the output power of main sampling voltage in main output is required to be the highest.

The voltage and ripple wave outputted from main output terminal do not vary with the variation of itself and auxiliary output voltage power. In the condition that power output from main output terminal is constant, the voltage of auxiliary output terminals decrease with the rise of its output power, reaching 2% at most. If power outputted from auxiliary output terminals is constant, their output voltage increases with the increase of power outputted from main output terminal. For this feature, the output should be specified in using and selecting types. If the model is FH5-150S12S24-S5, it will output voltages 12V, 24V, and 5V, of which, 12V and 24V are from MOUT and 12V is main sampling voltage. 5V is from OUT. That is our model FH5-DCINSMOUT-SOUT. In this model, "-" means isolation. "-" may not appear in a model, which means that there is no isolation between outputs. S*** can also be represented with D***or S***S***. There are at most four S*** in a model. D*** represents two S***.

In the course of using multi-output converter, if the output (main or auxiliary) of an output dynamically changes, it will cause the auxiliary output voltage to fluctuate accordingly. If the fluctuation is greater than 50mV, measures must be taken. The voltage fluctuation above 50mV appears when output power varies between the rated power of above 10% and below 70%. The fluctuation increases along with the rise of proportion of high and low output power. The fluctuation frequency is equal to the frequency of power variation. At this time, the

secondary filtering is thus considered to be done. If the fluctuation frequency of power is less than 10KHz, there will be trouble in filtering. Then it is necessary to reduce the number of output channels of Main converter and add secondary DC/DC converter to re-convert additional voltage. If the fluctuation frequency of power is greater than 10KHz, the simple filtering is able to remove the fluctuation.

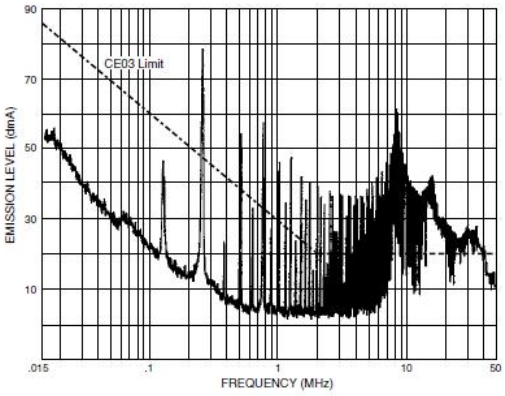
During service, when an output power (main or auxiliary) varies between the rated power of above 10% and below 70%, its voltage fluctuation generally is less than 50mV. This fluctuation is free from consideration in general.

FH5 series power converters provide synchronous function, allowing several converters of the same series to work at same frequency. As a result, switch interference can be effectively reduced. When the power of one converter is inadequate or the output modes are insufficient, it is possible to realize the synchronous operation of several converters. In other word, the synchronous terminals of all converters are bond together to enable the synchronous operation. The converters can automatically distribute the main and auxiliary converters. The converters which are the first to reach steady operation obtain the main control power, and the remaining converters are auxiliary converters which operate by following the frequency of main converters. It is also possible to arrange an external clock at SYNC pin to link up SYNC pins of several converters to realize synchronization. If an external master clock signal is applied, it recommended that the frequency of oscillator should be 250KHZ~350KHZ. If it is not within this range, the converter can work within the range 200KHZ-450KHZ, but working state is not stable. The external master clock signal should have an impulse width greater than 20ns. At this time, all converters can operate by following the external sync frequency. The level received by SYNC pin should be TTL5V. During use, if the external sync clock signal is not TTL level, it is necessary to convert by adding the level.

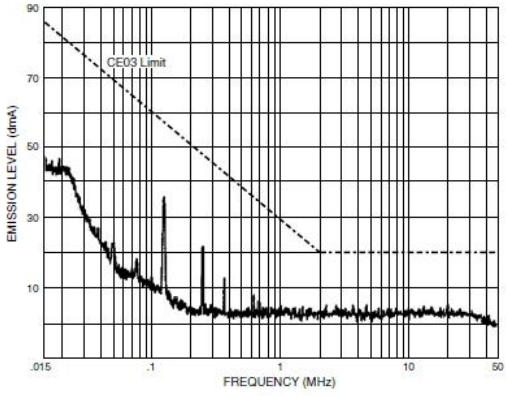
FH5 power converter's cut-off terminal SLEEP is high-level effective. When the voltage is 3.2~5.3V, the converter enters the resting state, all outputs are cut off, and the input current is less than 1mA. If multiple converters work synchronously, after cutting off main converter, auxiliary converter shall re-produce a main converter. The auxiliary converter shall follow the working frequency of main converter. If auxiliary converter is cut off, converters not cut off shall not be affected and shall follow the working frequency of main converter. When the voltage is 0~ 2.5V, or suspended, the converter operates properly. The input voltage of SLEEP terminal shall not exceed 5.5V.

FH5 series power converters contain an in-built LC network, which can effectively reduce the fluctuations of the input current and the output voltage. In the course of developing this series power converter, we established EMI authoritative R$S certification test system. We rationally and scientifically designed input LC network and output EMI filtering contained in FH5, which makes FH5 effectively reduce current and voltage fluctuation and interference. The below picture on the left shows the result tested with this system and the

picture on the right shows the result after using FMP filter. When working separately, it is clear that is slightly above CE03 standard and meets the CE03 standard after using FMP.



FH5



FH5+FMP

FH5 series power converters contain 100MS soft start circuit, able to slowly increase input current after converter is started and fault is removed for externally connecting large capacity output filtering capacitance and reducing start impact.

FH5 series power converters contain over-voltage and under-voltage cut-off functions, which enable the converters to stop working beyond the range of the input voltage to protect the converter. The under-voltage and over-voltage cut-off voltage is within 5V of extension of rated voltage. If the input range is rated at 36-72V, its under-voltage cut-off voltage will be 31-35.9V and over-voltage cut-off voltage will be 72.1-77V.

FH5 series power converters contain the output short circuit and overload automatic turn-off circuit. When the output lasts for 0.1s and exceeds 120% of the rated output power, the converter cuts off all outputs. After the over-current fault is eliminated, it automatically resumes the output voltage. If the overload duration of output is less than 0.1s, the converter will not act.

The working frequency of FH5 series power converters are up to 300KHz, which provides good filtering condition. In the condition without adding any filtering, its output voltage ripple is less than 100mV.

Key components used for FH5 series power converters are purchased in military level and completely pass the in-factory test in strict accordance with the national military product quality standard. The factory test includes 24~72-hour live aging and screening under the temperature of +175℃. All finished products have experienced 8-hour full-load operation under the temperature of +175 ℃ before delivery so as to fully check the damage to the components during the production process and hence ensure the reliability of products.

Technical parameters:

(1) Operating temperature: -55℃ ~ +175 ℃, Max. shell temperature: +204 ℃.

-L Series： Operating temperature: -55℃ ~ +175 ℃, Max. shell temperature: +185 ℃.

(2) Input voltage: 10～30V, 16～48V, 24～72V, 36～108V, 70～210V

(3) Output voltage: multiple outputs up to 3 and at most 2 isolated output ground circuits: 3.3V, 5V, 7V, 9V,

12V, 15V, 18V, 24V, 36V, 48V

(4) Output ripple: Less than 100mVp-p, typical 30mVp-p

(5) Output power: 5W

-L Series： Output power：

shell temperature：150℃，5W；

shell temperature：175℃，3W。

(6) Output accuracy: Less than 5%

(7) Load regulation: Less than 5%

(8) Temperature stability: Less than ±2.5% , typical ±1%

(9) Linear regulation: ±0.1% (10% linear change)

(10) Shock resistance: 25G, 0 ~ 300Hz

(11) Conversion efficiency: 70％～82％

(12) Static power consumption: 0.4W Max.

(13) Overheat cutoff at 210℃

(14) Dimension: 1. L: 33.0MM × W: 22.0MM × H:9.0MM; 2. L: 64.0×W: 16.0×H: 8.5MM
3. L: 33.0×W: 14.0×H: 7.5MM

The three dimensions do not include the size of the mounting base

(15) Isolation voltage between input and output: 1000V, isolation voltage between outputs: 500V

(16) Output form of voltage: high-temperature lead wire

Type selection:

Model FH5-DCINSMOUT-SOUT

FH5 --28D12—S5 I--L

Series code

FH series

Output power

5W

Input voltage

15（10～30V）

28（16～48V）

48（24～72V）

50（36～108V）

150（70～210V）

L：Low power

I：wide NC：NarrowS：shot

Auxiliary output voltage

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

Main output voltage

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

Output mode

S Single

D Dual

NOTE: "-" in model refers to isolation. It is always isolated between input and output. For this reason, the first "-" is necessary. If it is not isolated between main and auxiliary outputs, there is no the second "-". If there is no auxiliary output, there is no –SOUT.

Model example: FH5-150D15-S5, where MOUT outputs ± 15V and OUT outputs 5V. It is isolated between main and auxiliary outputs

FH5-50S15S3.3-S5, where MOUT outputs ± 15V and +3.3V, OUT outputs 5V. In the condition that MOUT has two outputs, when module stably outputs voltage, feedback sampling takes 80% of front voltage and 20% of back voltage.

FH5-50S15-S3.3S5 outputs non-isolated common ground voltages ±15V, +3.3V and +5V. Stabilize +15V and +3.3V, +15V stabilizes 80% and +3.3V stabilizes 20%.

Service requirement

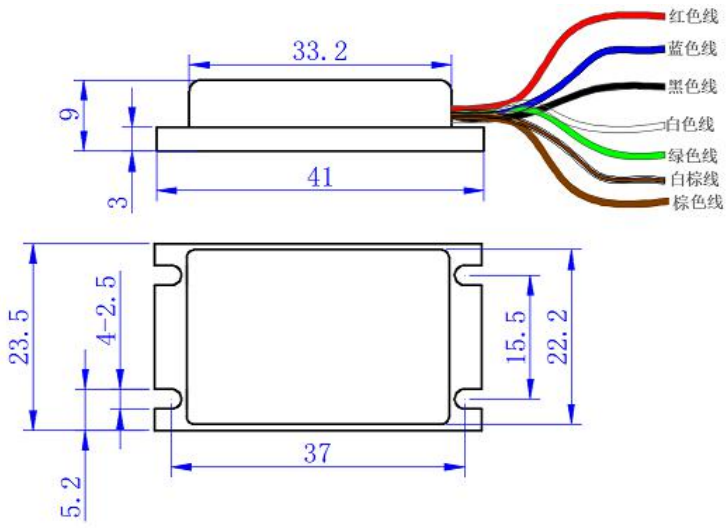
As the power converter has nearly 1W power consumption under the condition of full-load operation and its size are small, good medium is necessary to be added between the shell of the power converter and the radiator so as to ensure the temperature of the converter shell to be less than 204℃.

The shell of the converter is isolated from the input and output. During the use, the converter is usually mounted on instrument or its framework with the framework as a radiator. If the ripple cannot be filtered with capacitance or LC network, then this ripple is electro-magnetic interference (EMI). Thus, an EMI filtering converter is necessary to be added to input and output terminals of FH5. To function properly, 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. As we have added EMI network to input and output terminals inside converter, so long as the shell is suspended, it will function. If the ripple is still large, it needs to externally connect input or output EMI filter outside the shell. 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 after the internal EMI functions, it is necessary to connect input or output EMI filtering outside the converter. Input and output of the converter at most have three ground circuits and if they are needed to be connected together, connection should be done at the point less than 1cm where the lead wires go out of the converter. The closer that wire at connection point is to the converter, the less the intervention will be.

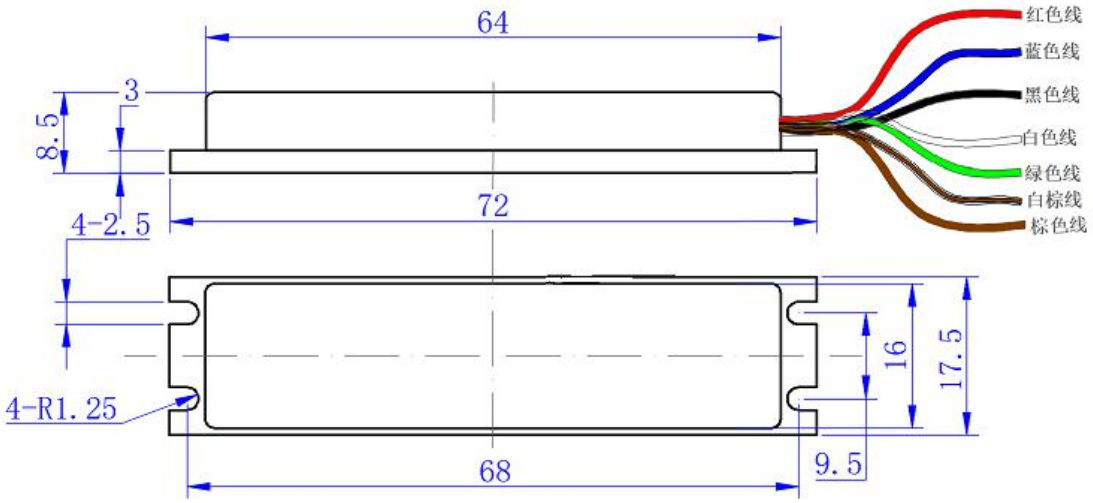
If isolation is needed between output and input, and not needed between outputs, but isolated type converter is selected, there is no requirement on connection between output grounds.

The no-load current of converter is 12MA and the current after cutoff is 2MA. The working frequency is 300±20 KHZ at +25℃ and 310±20KHZ at +175℃.

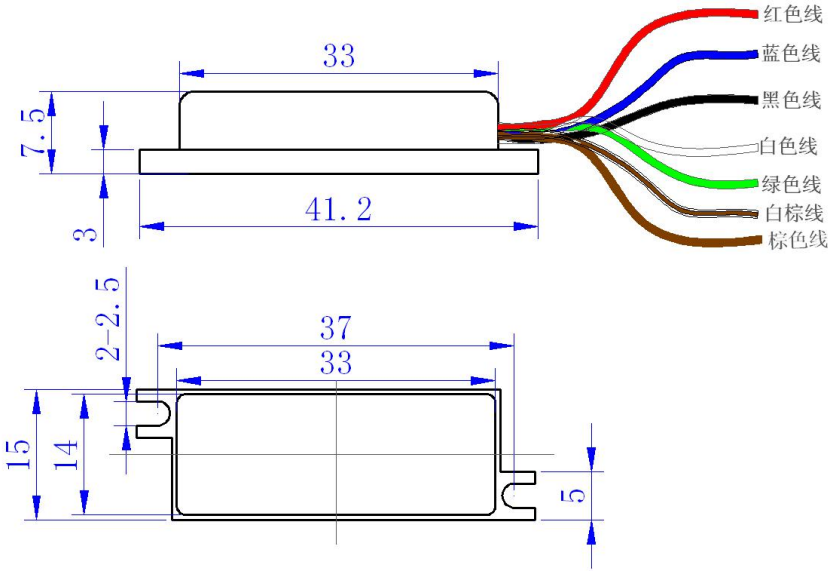
Outline diagram



"I"type



"NC" type



Note: 1、Mounting hole and mounting hole spacing dimension tolerance is ±0.1mm
2、The tolerance of external dimension is ±0.2mm

"S"type

Definition of lead wires:

Lead color / Output category (model)	Red	Black	White	Blue	Brown	Green	White & brown	Yellow (if any)	Purple (if any)	Remark
	Input +	Input -	Output +	Output -						
1single output (e.g. FH5-28S5I)	IN+	IN-	MOUT Main output	MGND	/	/	/	on/off lead	sync lead	1 main output
2 single outputs share the ground (e.g. FH5-28S5S12I)	IN+	IN-	the first output MOUT main output	The first and second output share the ground MGND	/	The second output +OUT2 auxiliary outputs	/	on/off lead	sync lead	1 main and 1 auxiliary output

2 single outputs isolate（e.g. FH5-28S5-S12I）	IN+	IN-	the first output MOUT main output	The first output MGND	/	The second output +OUT2 auxiliary outputs	The second output GND2	on/off lead	sync lead	1 main and 1 auxiliary outputs
2 positive and negative symmetric outputs（e.g. FH5-28D5I）	IN+	IN-	The first output MOUT main output	The first and second output share the ground MGND	The second output -OUT2 auxiliary outputs may also be main output	/	/	on/off lead	sync lead	2 main outputs and 1 main, 1 auxiliary output
Three outputs: three-way single outputs share the ground (e.g. FH5-28S5S12S15I)	IN+	IN-	The first output MOUT main output	Three outputs share the ground MGND	The second output +OUT2 auxiliary outputs	The third output +OUT3 auxiliary outputs	/	on/off lead	sync lead	1 main and 2 auxiliary outputs
Three outputs: 2 single outputs share the ground + 1 isolated single output（e.g. FH5-28S5S12-S15I）	IN+	IN-	The first output MOUT main output	The first and second output share the ground MGND	The third output GND3 auxiliary outputs	The second output +OUT2 auxiliary outputs	The third output +OUT3 auxiliary outputs	on/off lead	sync lead	1 main and 2 auxiliary outputs
Three outputs: 1 isolated single output + 2 single outputs share the ground（e.g. FH5-28S5-S12S15I）	IN+	IN-	The second output +OUT2 auxiliary outputs	The first output MGND	The second and third outputs share the ground GND2	The first output MOUT main output	The third output +OUT3 auxiliary outputs	on/off lead	sync lead	1 main and 2 auxiliary outputs
Three outputs: 2 positive and negative symmetric outputs share the ground + 1 isolated single output（e.g. FH5-28D5-S12I）	IN+	IN-	The first output MOUT main output	The first and second output share the ground MGND	The second output -OUT2 auxiliary outputs may also be main output	The third output +OUT3 auxiliary outputs	The third output GND3	on/off lead	sync lead	1 main , 2 auxiliary outputs and 2 main outputs, 1 auxiliary output
Three outputs: 2 positive and negative symmetric outputs + 1 single output shares the ground（e.g. FH5-28D5S12I）	IN+	IN-	the first output MOUT main output	Three outputs share the ground MGND	The second output -OUT2 auxiliary outputs may also be main output	The third output +OUT3 auxiliary outputs	/	on/off lead	sync lead	1 main, 2 auxiliary outputs and 2 main outputs, 1 auxiliary output
Three outputs: 1 single output + 2 positive and negative symmetric outputs share the ground (e.g. FH5-28S5-D12I）	IN+	IN-	The second output +OUT 2 auxiliary outputs	The first output MGND	The third output -OUT3 auxiliary outputs	the first output MOUT main output	The second and third outputs share the ground GND2	on/off lead	sync lead	1 main and 2 auxiliary outputs
Three outputs: 1 single output + 2 positive and negative symmetric outputs share the ground (e.g. FH5-28S5D12I）	IN+	IN-	The second output +OUT2 auxiliary outputs	Three outputs share the ground MGND	The third output -OUT3 auxiliary outputs	the first output MOUT main output	/	on/off lead	sync lead	1 main and 2 auxiliary outputs

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

June 11,2022