2FS04P Series Product Specifications

Overview

The 2FS04P Series is a DC-DC converter specifically designed for isolated gate drivers, enabling efficient drive of power devices with only simple external circuitry. This series features high isolation and low cross-modulation, with dual-channel symmetrical voltage output capability, providing optimal drive efficiency for the system.The 2FS04P Series features high insulation voltage, high efficiency, and ultra-low isolation capacitance, along with long-duration, recoverable output overcurrent protection and output short-circuit protection.

Key Features:

- Two-channel output in an extremely compact size (15 mm × 21 mm)
- 7,000 V primary-to-secondary DC insulation withstand voltage; 5,700 V secondary-to-secondary DC insulation withstand voltage
- 5% cross-regulation
- Low isolation capacitance of 3.5 pF
- Recoverable output short-circuit protection and overcurrent protection
- Surface-mount design, reflow soldering compatible
- 12V & 15V input voltages
- Output voltages: 18V; 22V
- Operating temperature: -40°C to 85°C

Typical Applications:

- Industrial-grade motor drive
- Inverter circuits
- ESS

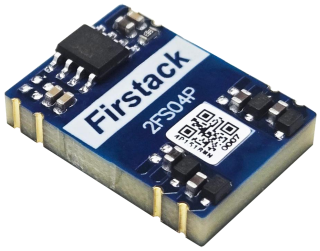
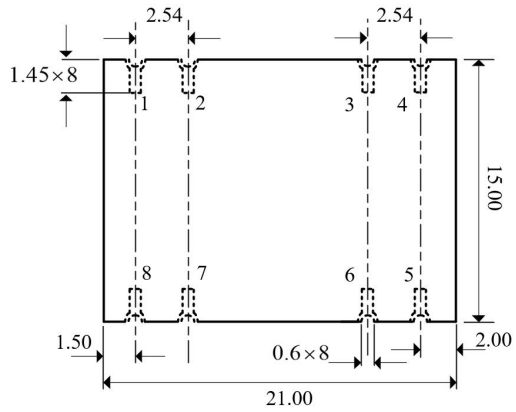
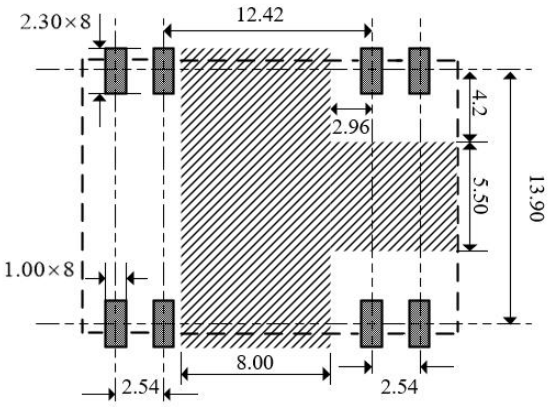


Fig1. 2FS04P

Pins and Pads



Top View of Pins



Recommended Pads

Note: 1. All dimensions are in mm

2. All dimensions are subject to a tolerance of ±0.2 mm

Pin Definitions

Pin	Function	Remarks	Pin	Function	Remarks
1	VIN+	Power Input Vin	5	VOB-	Second Output Ground
2	GND	Power Input Ground	6	VOB+	Second Output
3	VOT+	First Output	7	GND	Power Supply Ground
4	VOT-	First output ground	8	GND	Power Supply Input Ground

Typical Application Circuit

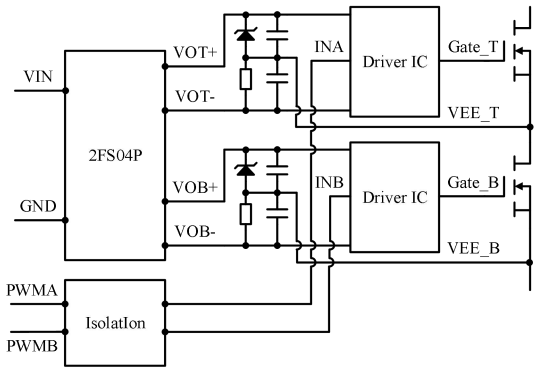


Figure 2: Recommended Peripheral Application Circuit

Selection Guide (Note 1)

Product Code	Rated Input Voltage	Output Voltage	Output Current @ 2W	Input Current @2W	Output			
					Load regulation (typ)	Load regulation (max)	Cross-Regulation (typ)	Cross-adjustment ratio (max)
	V	V	mA	mA	%			
2FS04P1218MNA	12	18	113	406	11	13	4.3	5
2FS04P1222MNA	12	22	96	396	10	12	2.9	4
2FS04P1518MNA	15	18	112	316	10	12	2.3	3
2FS04P1522MNA	15	22	92	308	8	10	1.5	3

Selection Guide (Continued)

Product Code	Ripple Voltage, Note 2 (typ)	Efficiency, Note 3 (typ)	Isolation Capacitance (Max)
	mVp-p	%	pF
2FS04P1218MNA	112	82	3.5
2FS04P1222MNA	100	84	3.5
2FS04P1518MNA	108	84	3.5
2FS04P1522MNA	97	86	3.5

Note:

1. The power values listed above are per channel;
2. See the "Test Circuit" section for the test circuit used to measure ripple voltage data;
3. See the “Test Circuit” section for the test circuit used to measure efficiency data;

Technical Specifications

Input Characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
Recommended Supply Voltage Range	Continuous operation, 12V input series	11.5	12	12.5	V
	Continuous operation, 15V input series	14.5	15	15.5	

Output Characteristics

Parameters	Description	Min.	Typ.	Max.	Unit
Rated Power	Ambient temperature: -40°C to 85°C, per output channel			2	W
Voltage Setpoint Accuracy	See output voltage tolerance curve				
Linear regulation	Open-Loop Control Power Supply				
Load Regulation	12V/15V Input			13	%
Transient Response Voltage Drop, Note 1	50%–100% load	0.4	0.6	0.8	V

General Characteristics

Parameters	Description	Min.	Typ.	Max.	Unit
Switching Frequency, Note 2	12V Input Series		350		kHz
	15V Input Series		400		kHz
Start-up voltage, Note 3	Module operating supply voltage	7			V
Power-off voltage, Note 4	Module undervoltage lockout voltage			5.5	V

Isolation Characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
Isolation Withstand Voltage Test	Primary and secondary sides, 60-second DC certification test	7,000			V_{DC}
	Secondary side, 60-second DC certification test	5700			

Insulation Resistance	Test voltage: 1000 V_{DC}	1T		Ω
Partial Discharge Extinguishing Voltage (PDEV), Note 5	Refer to IEC 60270		1,300	V_{AC}
Clearance Distance and Creepage Distance	Primary and secondary clearance distances and creepage distances: 8 mm			
	Secondary-to-secondary clearance distance and creepage distance: 5.5 mm			

Temperature Characteristics

Parameters	Description	Min.	Typ.	Max.	Unit
Operating Temperature	All output series (see derating curves)	-40		85	°C
Storage Temperature		-40		125	
Product Temperature Rise, Note 6	Ambient temperature 25°C, rated power 2 W		29		
Cooling Method	Air convection cooling				

Electromagnetic Immunity Characteristics

Parameters	Description	Min.	Typ.	Max.	Unit
Electrostatic Discharge Immunity	ESD		8,000		V_{DC}
Electrical Fast Transient Burst Immunity	EFT	4,000			V
Common-Mode Transient Immunity	CMTI	200			kV/us

Absolute Maximum Ratings

Parameter	Description
Short-circuit protection	Continuous
Input Voltage, 2FS04P12	15 V
Input Voltage, 2FS04P15	18V

Unless otherwise specified, the following parameters were measured at an ambient temperature of 25°C and VCC = 12 V or 15 V

Note:

1. This voltage represents the output voltage drop when the load suddenly changes from 50% to 100%;
2. The switching frequency is determined by the power supply IC; when using the device, set the switching frequency

according to the performance of the driver;

3. This voltage is the threshold voltage at which the power supply begins operation;
4. This voltage represents the threshold at which the power supply stops operating;
5. According to the IEC 60270 standard, 1.875Upd–1.5Upd, <10 pC;
6. The data represents test results obtained with the module soldered onto the PCB;

Precautions

1. Isolation Voltage

All models in Firstack's 2FS04P series of DC-DC converters have undergone small-batch certification testing at a DC voltage of 7,000 V for 1 minute.

2. Repeated High-Voltage Isolation Testing

It is well known that repeated high-voltage isolation testing of barrier components can actually reduce their isolation capability to a greater or lesser extent, depending on the materials, structure, and environment. Therefore, we strongly recommend against repeating high-voltage isolation tests; however, if absolutely necessary, the voltage should be reduced by 20% from the specified test voltage.

3. Preventing Drops from Heights

Dropping this isolated power supply module from a height of 1 m onto a hard surface may damage the internal ferrite core; dropping the module from a height is strictly prohibited.

Compliance with RoHS, MSL, PSL, and Soldering Information

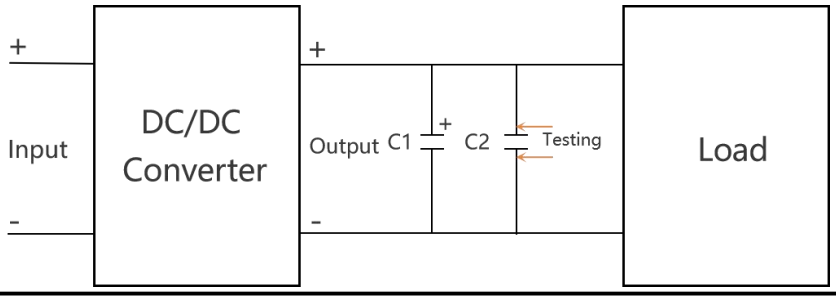
This series is compatible with lead-free soldering systems as well as Sn/Pb soldering systems. This series can be soldered in accordance with J-STD-020. The classification temperature for this series is 260°C, and the moisture sensitivity level is 2. The product's terminal surfaces are gold-plated with a plating thickness of 0.2 micrometers.

Environmental Validation Testing

Testing	Standard	Conditions
High-Temperature Operating Life	JEDEC JESD22-A108	85±5°C for ≥ 1,000 hours
Temperature cycling	JEDEC JESD22-A104	1,000 cycles between two temperature extremes set to -40°C and +85°C. 2 full cycles per hour
Temperature-Humidity Bias	JEDEC JESD22-A101D	85±2℃, 85±5% R.H. for 1,000 (-24/+168) hours
Storage life	JEDEC JESD22-A103, Condition A	125°C ±10°C for ≥ 1,000 hours
Vibration	BS EN 61373 with respect to BS EN 60068-2-64, Test Fh, Category 1, Class	5–150 Hz. Level at each axis—Vertical, Transverse, and Longitudinal: 5.72 m/s² rms. 5 hours on each axis. Crest factor: 3 Sigma. The device is secured using the pads.
Shock	BS EN 61373: Category 1, Class B	The test lasts 30 ms, with 3 shocks in each direction along 3 mutually perpendicular axes (18 shocks total). Level along each axis—Vertical, Transverse, and Longitudinal: 50 m/s². The device is secured using the pads.
Solvent Cleaning	Resistance to Cleaning Agents	Solvent—Novec 71, IPA, and Topklean EL-20A. Pulsed ultrasonic immersion at 45°C–65°C
Solvent resistance	MIL-STD-883 Method 2015	The parts and the bristle portion of the brush are immersed in isopropanol for at least 1 minute. The parts are brushed three times; after the third brushing, the parts are blown dry and inspected.

Characteristic Test Circuit

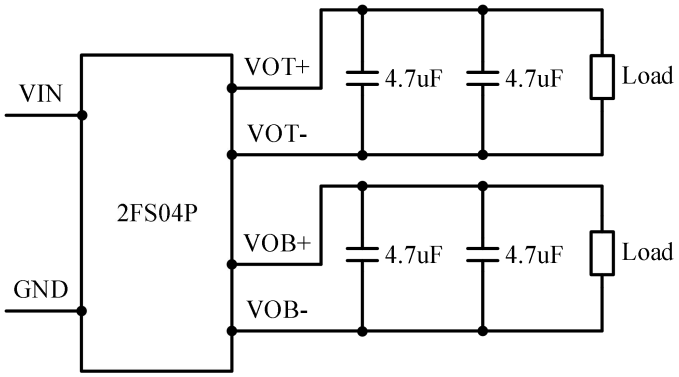
Ripple Test Circuit



C1	10uF electrolytic capacitor with a rated voltage of at least 1.5 times the output voltage of the DC-DC converter, and the ESR of the capacitor needs to be less than 100m at 100kHz.
C2	1uF X7R ceramic capacitor， Rated voltage at least 3 times the output voltage of the module

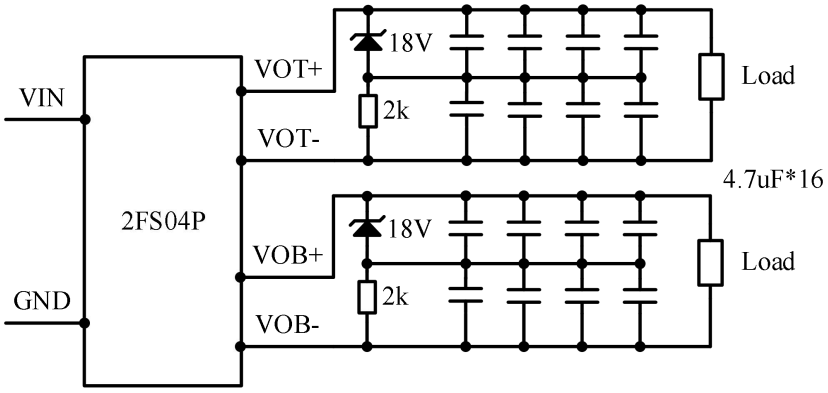
Note: The ripple test bandwidth is 20 MHz

Efficiency Test Circuit



Note: The capacitors used are ceramic chip capacitors

Typical Performance Test Circuit

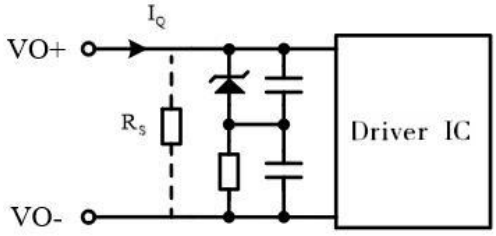


Note: The capacitors used are ceramic chip capacitors

Application Notes

1. Minimum Quiescent Load Current

The 2FS04P series isolated DC-DC converters feature an open-loop design. To ensure the converter operates within the linear region and to prevent excessively high output voltages, the minimum quiescent load current $I_Q$must be no less than 4 mA in actual applications. To ensure that the external support capacitor can discharge quickly when power is turned off, it is recommended to connect a dummy load $R_S$of at least 20 kΩ in parallel across the output terminals.

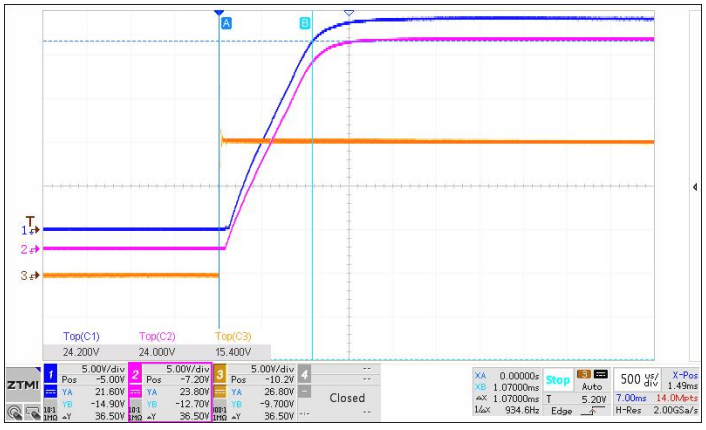


2. Capacitive Load Startup

Series Models	Start-up Time ms
2FS04P1218MNA	1.1
2FS04P1222MNA	1.5
2FS04P1518MNA	0.7
2FS04P1522MNA	1.1

Note: Capacitive load is 9.4 μF per output channel

Typical Start-up Waveform

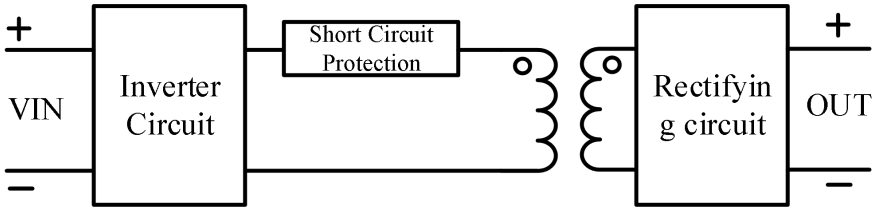


Note: CH1: VOT CH2: VOB CH3: VIN

3. Output Configuration

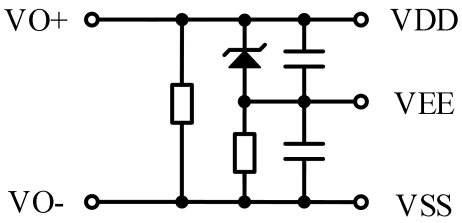
The 2FS04P series is a dual-channel output DC-DC converter designed specifically for gate driver applications. Additionally, by connecting the load between VOT+ and VOT-, the 2FS04P series can also be used as a general-purpose isolated DC-DC converter.

The 2FS04P series provides short-circuit and overcurrent protection by controlling the current on the bus, ensuring that all external electrical networks connected to the outputs are protected.

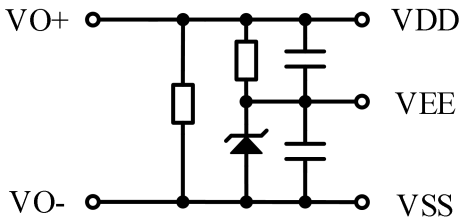


Gate Driver Configuration Options:

An external zener diode network provides a stable voltage output. Select Configuration 1 for a stable positive voltage output; select Configuration 2 for a stable negative voltage output.



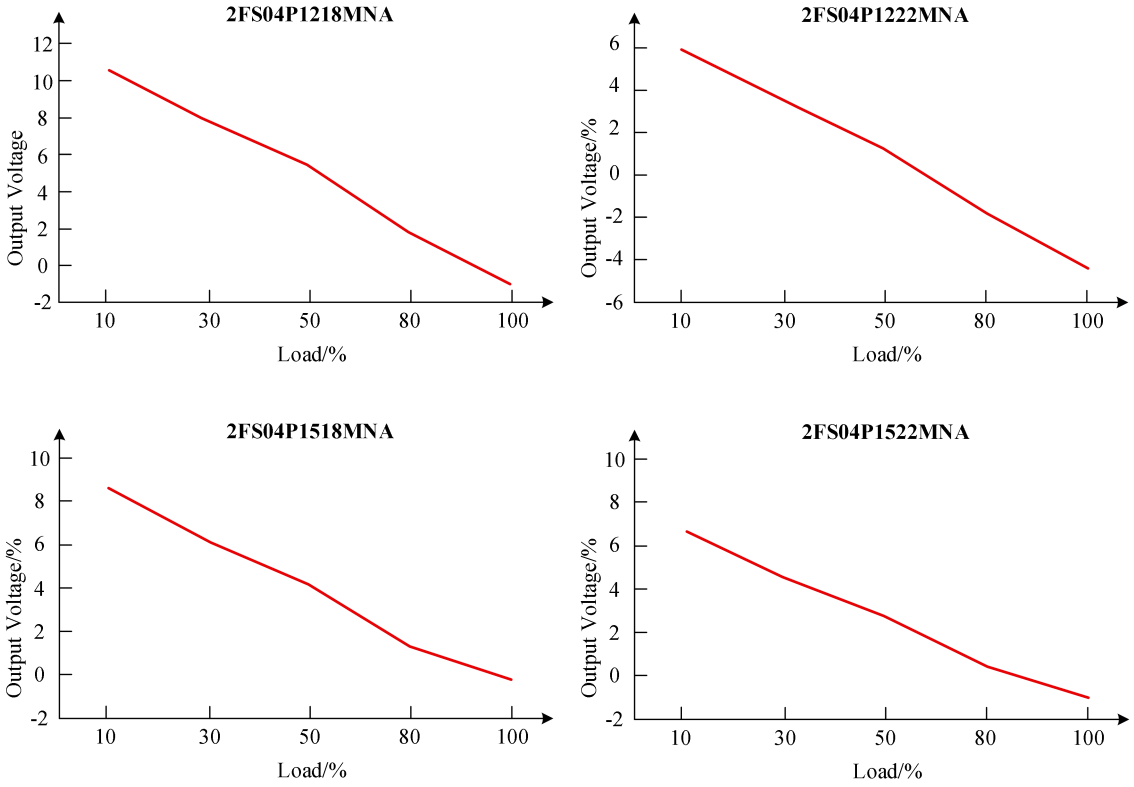
External Zener Diode Network Configuration 1



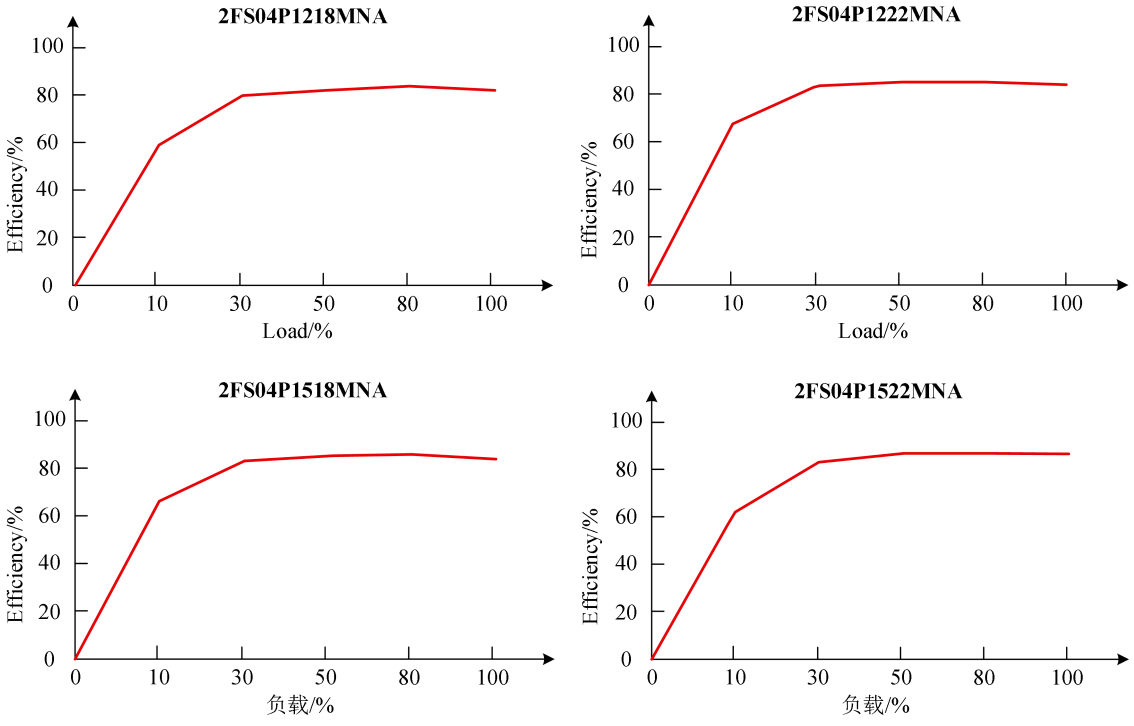
External Zener Diode Network Configuration 2

Output Voltage-Current Curves

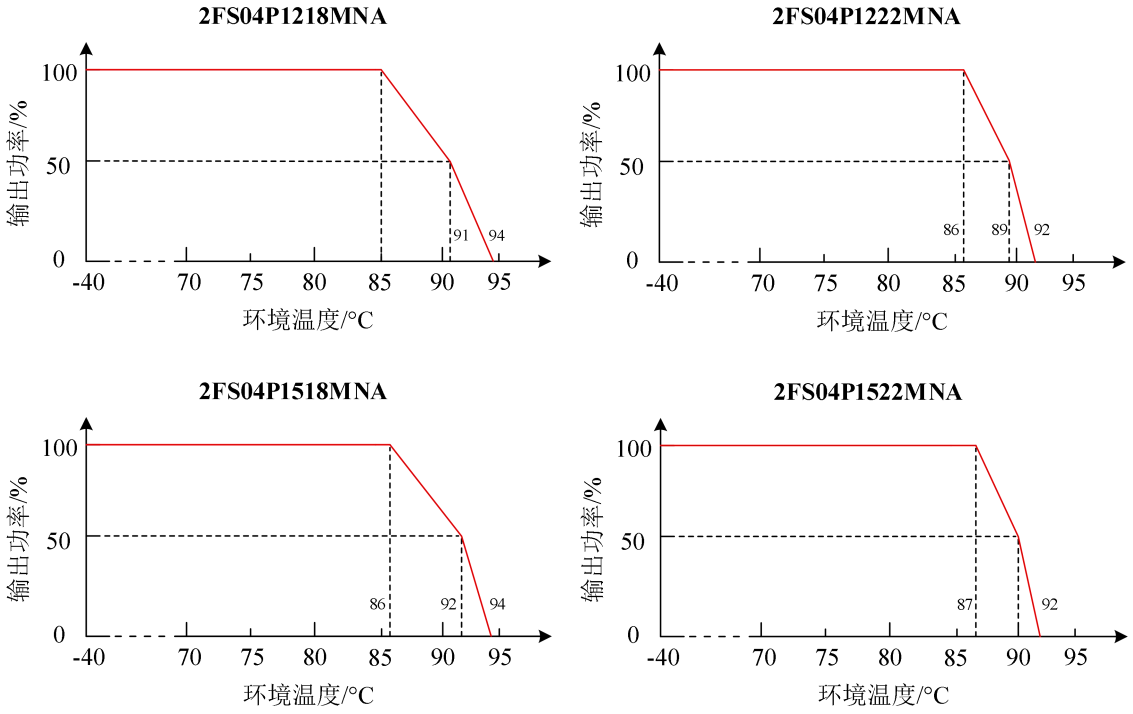
The output voltage-current curve illustrates the typical output voltage accuracy and typical load regulation characteristics resulting from load variations.



Efficiency vs. Load



Temperature Derating Curve



Note: The temperature derating curve shows test results obtained with the power module soldered to the PCB

Update Information

Date	Update Details	Version
May15, 2026	Initial Release	V1.0

Ordering Information

The 2FS04P series consists of compact power supply modules for SiC-MOSFETs and Si-MOSFETs, supporting a variety of drive voltage configurations. If you are interested in purchasing, please contact our staff, and we will provide the power supply module that best meets your needs.

Product Model	Input Voltage (V)	Output Voltage (V)
2FS04P1218MNA	12	18
2FS04P1222MNA	12	22
2FS04P1518MNA	15	18
2FS04P1522MNA	15	22

Technical Support

Firstack's professional team is here to provide you with business consulting and technical support. If you have any needs, please contact the Firstack technical sales team to request application manuals and learn more about technical applications.

Legal Disclaimer

1.All parameters listed in this Specification Sheet were measured under specific laboratory conditions and are provided for reference only. Due to variations in installation conditions and operating environments, the actual performance of the Product may deviate from the nominal values. Users are advised to conduct independent verification under their own operating conditions.

2.This Specification Sheet reflects the product characteristics as of the date of issuance, based on the then-existing condition and to the best of our knowledge. No representation or warranty is made that all performance characteristics under all operating conditions have been exhaustively tested or verified.

3.We reserve the right to modify this Specification Sheet and technical parameters for product improvement without prior notice. Products already sold shall be governed by the Sales Contract between

the parties and the Specification Sheet effective at the time of delivery.

4.This Specification Sheet is a technical descriptive document. Its binding effect is limited to the Sales Contract, and it shall not create any independent warranty obligation outside the Contract.

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