

## 2FHD420V Data Sheet

### Abstract

2FHD0420V series driver is a high-performance, dual-channel SiC gate driver developed in-house by Firstack based on ASIC platform, supporting single modules up to 1700V in the SiC EconoDual™ package with configurable gate voltage. The driver supports up to 4W output per channel and is suitable for high switching frequency applications (>50kHz) using SiC modules

#### Core Features:

- Support 4W per channel
- Support up to 1700V SiC module
- Short-circuit protection(soft shut down)
- Miller clamping
- Configurable drive voltage
- Intelligent fault feedback
- UVLO

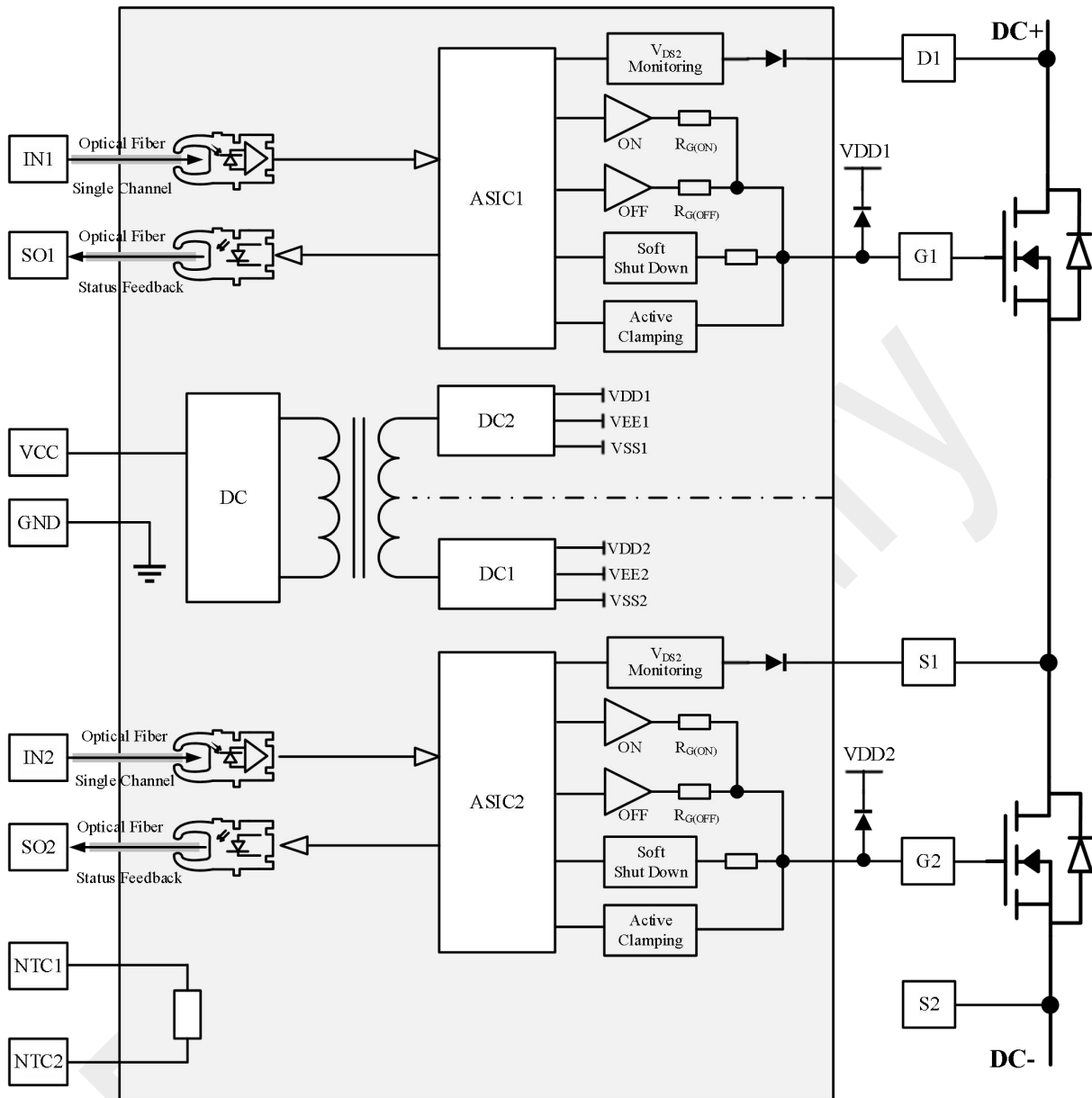
#### Typical Application:

- ESS
- Rail
- Motor drives

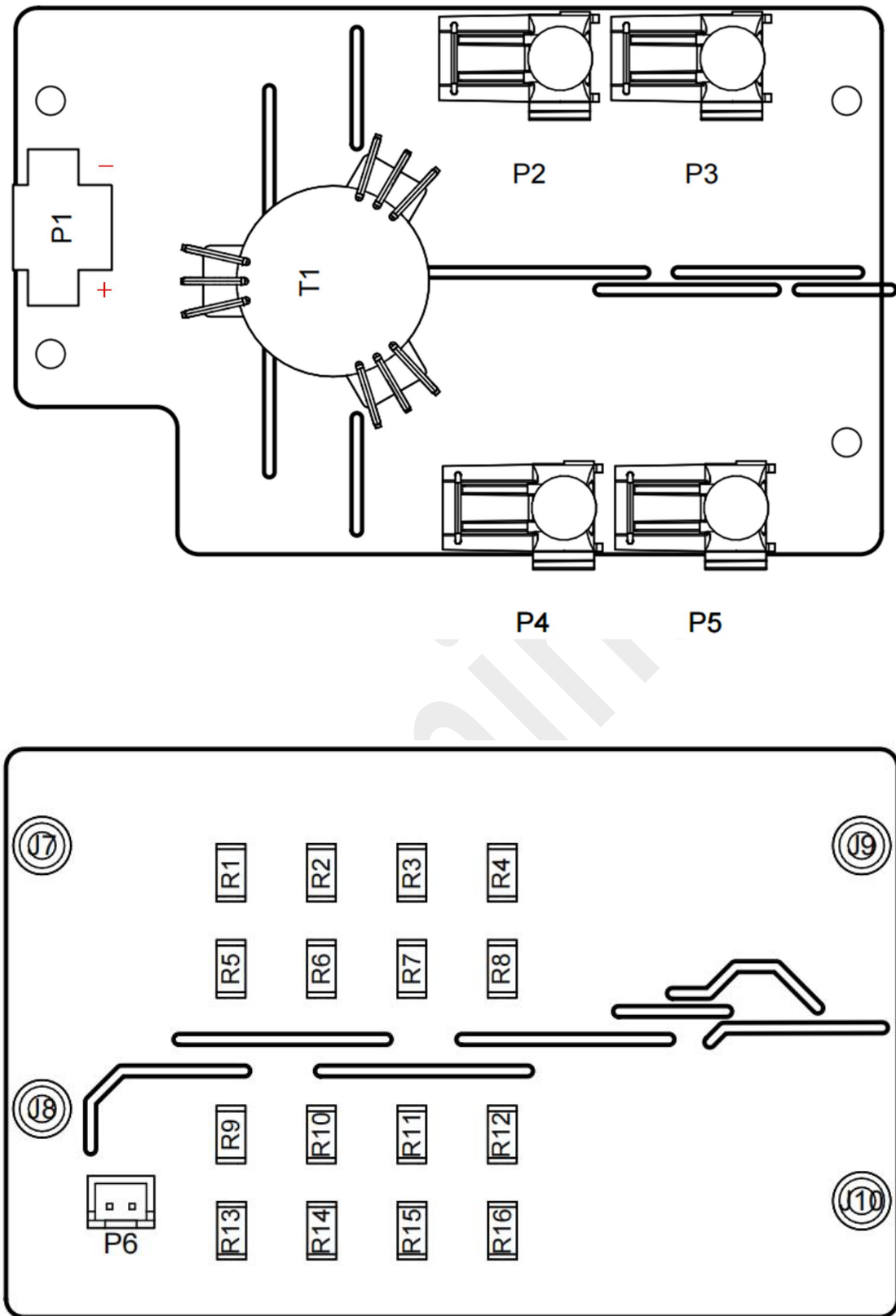


**Fig. 1** 2FHD0420V

## Functional Block Diagram



**Fig. 2** Functional block diagram



**Fig. 3** Connector interface location

## Resistors Replacement Instructions

Position	Definition
R1, R2, R3, R4 & R9, R10, R11, R12	ON
R5, R6, R7, R8 & R13, R14, R15, R16	OFF

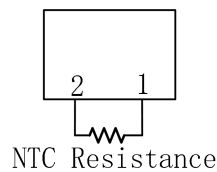
## Power Terminal

Position	Definition	Part Number
P1	15V Power Input	SERIE 3233 - 3.81MM

## Optical Fiber

Position	Definition	Part Number
P2,P4	BOT/TOP SOx Out	HFBR1531ETZ
P3,P5	BOT/TOP PWM In	HFBR2531ETZ

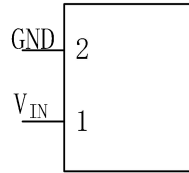
## NTC Interface



Definition	Vendor	Part Number	Recommend Terminal
NTC terminal	JST	(G)B2B-XH-A(LF)(SN)(P)	XHP-2

Note: NTC interface is not processed, need to design peripheral circuits

## Connector Interface Definition



### P1 terminal pin designation

Pin	Definition	Function	Pin	Definition	Function
1	$V_{IN}$	15V Input	2	GND	Primary side ground

## Technical Parameters

### Absolute Maximum Ratings

Parameter	Remarks	Min	Max	Unit
Supply voltage $V_{DC}$	$V_{DC}$ to GND	0	15.5	V
Gate peak current	@85°C	-20	20	A
Output power per channel	@85°C		4	W
Test voltage (50Hz/1min)	Primary to secondary side	6000		$V_{RMS}$
Operating temperature		-40	85	°C
Storage temperature		-40	85	°C

### Recommended Operating Conditions

Parameter	Remarks	Min	Typ	Max	Unit
Supply voltage $V_{DC}$	$V_{DC}$ to GND	14.5	15	15.5	V
Supply current $I_{DC}$	Without load		0.16		A
Coupling capacitor $C_{IO}$	Primary to secondary side		/		pF
Primary side undervoltage threshold	Supply voltage		12.5		V

### Gate Driver Parameters

Output voltage	Remarks	Min	Typ	Max	Unit
Total gate voltage	Turn on (ON) - off (OFF) voltage	19.5	20	24.5	V
Gate positive voltage $V_{GSon}$	Turn on (ON)	14.5	15	19.5	V
Gate negative voltage $V_{GSoff}$	Turn off (OFF)	-9.5	-5	-0.5	V

### Short-circuit protection

Parameter	Remarks	Min	Typ	Max	Unit
$V_{DS}$ monitoring threshold	Short-circuit protection monitoring	Configurable	11	Configurable	V
Response time	CH1, Note 1	Configurable	2	Configurable	$\mu s$

	CH2, Note 1	Configurable	2	Configurable	μs
Soft shut down time	Soft shut down action time	Configurable	4.16	Configurable	μs

## Miller Clamping

Parameter	Remarks	Min	Typ	Max	Unit
Time from drive signal turn-off to clamp turn-on		Configurable	1.04	Configurable	μs
Time from clamp turn-off to drive signal turn-on			700		ns
Clamp voltage			V <sub>ss</sub>		

## Timing Characteristics

Parameter	Remarks	Min	Typ	Max	Unit
Turn-on delay	Note 2		430		ns
Turn-off delay	Note 3		560		ns
Rise time	Note 4		9		ns
Fall time	Note 5		9		ns
Fault blocking time		200		250	μs
Fault return time	Note 6	77		80	ms
Edge Feedback			700		ns

## Electrical Isolation

Parameter	Remarks	Min	Typ	Max	Unit
Creepage distance	Primary to secondary side, Note 8		15		mm
	Secondary to secondary side, Note 8		12		mm
Clearance distance	Primary to secondary side		8		mm
	Secondary to secondary side		4.5		mm

Unless otherwise specified, all data are based on tests at +25°C ambient temperature and V<sub>DC</sub>=15V.

Note:

1. Response time: the time from the occurrence of the fault to the start of soft shut down;
2. Turn-on delay: the time required to transmit the rising edge of the PWM signal input from the primary side to the rising edge of the secondary side of the gate driver;
3. Turn-off delay: the time required to transmit the falling edge of the PWM signal input from the primary side to the falling edge of the secondary side of the gate driver;
4. Rise time: the amount of time from 10% of the gate turn-off voltage to 90% of the gate turn-on voltage;
5. Fall time: the amount of time from 90% of the gate turn-on voltage to 10% of the gate turn-off voltage;
6. Fault return time: short-circuit 10ms, secondary side undervoltage 20ms, primary side undervoltage 40ms;



## ■ Fault Output Logic (2-level/3-level)

During the use of fiber optic, there are phenomena such as fiber optic port snaps are not secure/fell off, and fiber optic cable turning radius is not enough. In order to ensure the normal communication of fiber optic, Firstack Smart Driver is configured with a fiber optic port answer function, as follows:

1、 When the driver board is working normally, every time a PWM command is received, the lights of the return fiber header will go out for a short 700ns on both the rising and falling edges of the PWM command as an answer to the received command.

2、 When the driver board detects a fault, the driver will adopt different fault shutdown control strategies depending on whether the driver board is in two- or three-level mode, as depicted in Figures 4b and 4c below

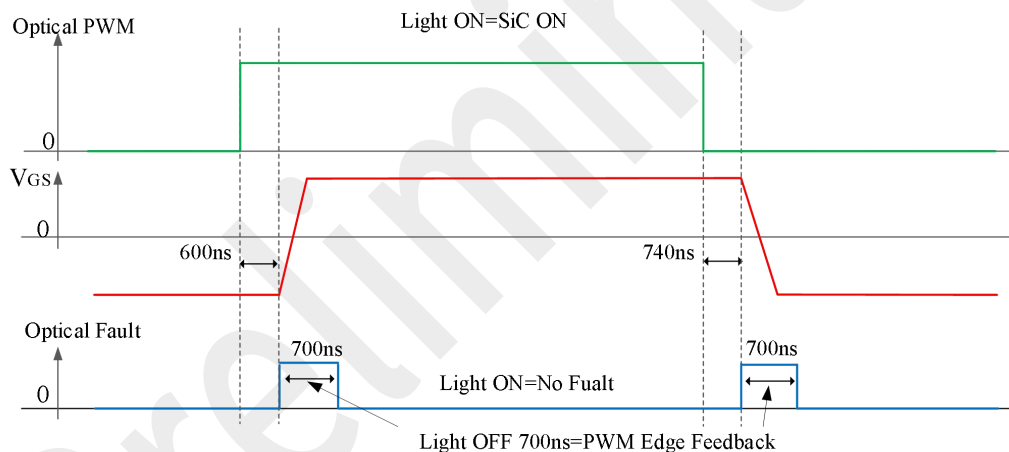
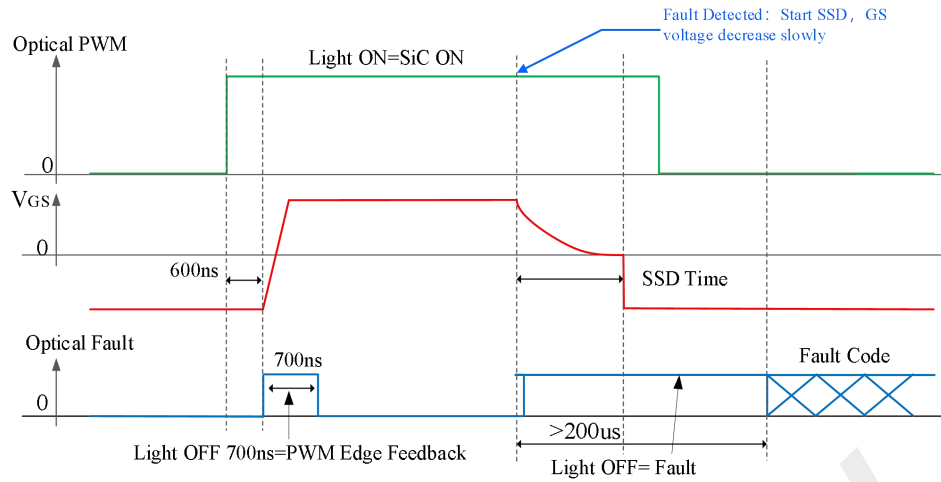
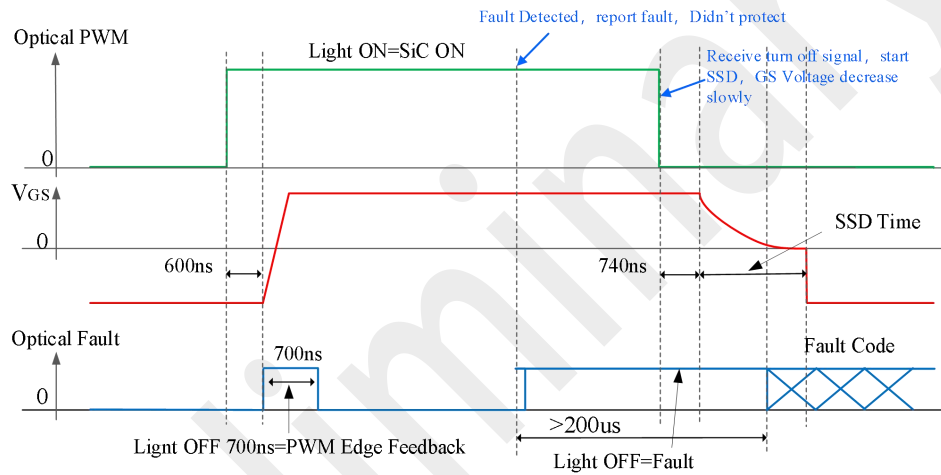


Fig. 4a Normal Operation

At the same time, the light of the faulty fiber optic head will be extinguished for more than 200us, as a fault signal to notify the host computer, after 200us, through the fiber optic head the length of time of the extinguished light, the fault information will be informed to the host computer using the serial fault code, the host computer can accurately distinguish between the response information and the fault information according to the corresponding protocols, refer to the introduction of the fault code return.



**Fig. 4b Fault Condition (2-level)**



**Fig. 4c Fault Condition (3-level)**

Note1: Soft Shut Down (SSD)

Mode	Status in Fault	Treatment
2-level	ON	SSD
	OFF	Keep OFF
3-level	ON	Keep open, wait for the host computer command, such as about the off command to perform soft shutdown
	OFF	Hold shutdown, wait for host computer command

## ■ Fault Code Transport

The drive has intelligent fault management, which allows customers to determine the type of failure of the drive by identifying faulty fiber optic fault codes, thus enabling rapid

fault location. Its serial fault coding protocol code is shown below:

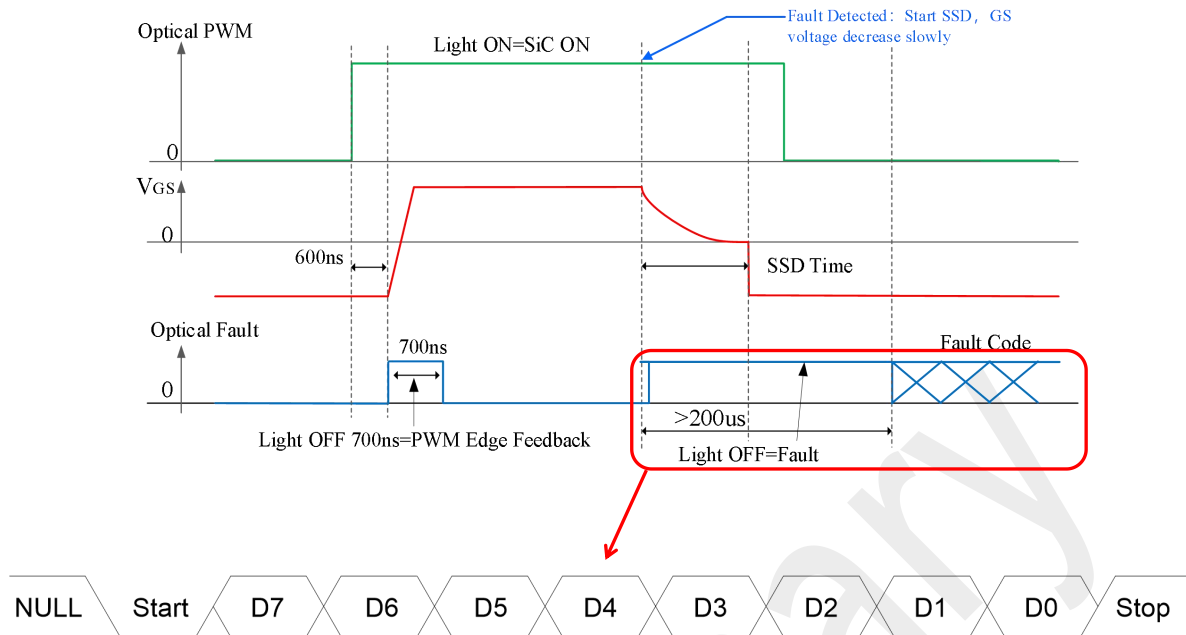


Fig. 5 Fault Protocol Code Schematic

The fault protocol code consists of a start bit (default value “0”, the fault fiber has light), 8 data bits and a stop bit (default value “1”, the fault fiber has no light). The interpretation of each fault code is shown in the table below (“0” = light on fault fiber = no fault):

Bit	Fault Type	Remarks
Start	Start Bit	Default “0”, Light ON
D7	internal register malfunction	“0” = No Fault, “1” = Fault
D6	Off due to Heat	“0” = No Fault, “1” = Fault
D5	External Fault	“0” = No Fault, “1” = Fault
D4	Gate Monitor	“0” = No Fault, “1” = Fault
D3	Undervoltage - Basic Voltage	“0” = No Fault, “1” = Fault
D2	Undervoltage - Negative	“0” = No Fault, “1” = Fault
D1	Undervoltage - Positive	“0” = No Fault, “1” = Fault
D0	Short Circuit	“0” = No Fault, “1” = Fault
Stop	Stop Bit	Default “1”, Light OFF

Fault Code - Short Circuit:

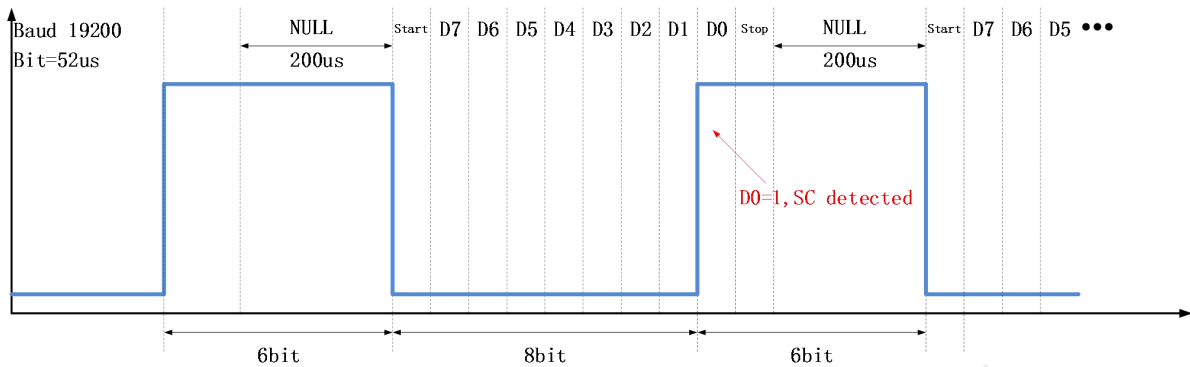


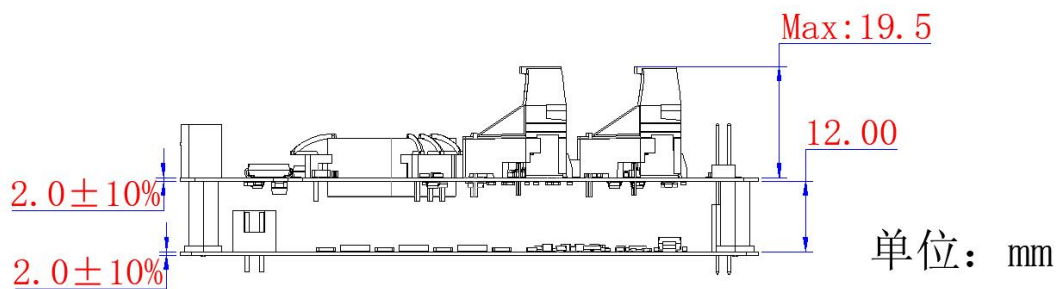
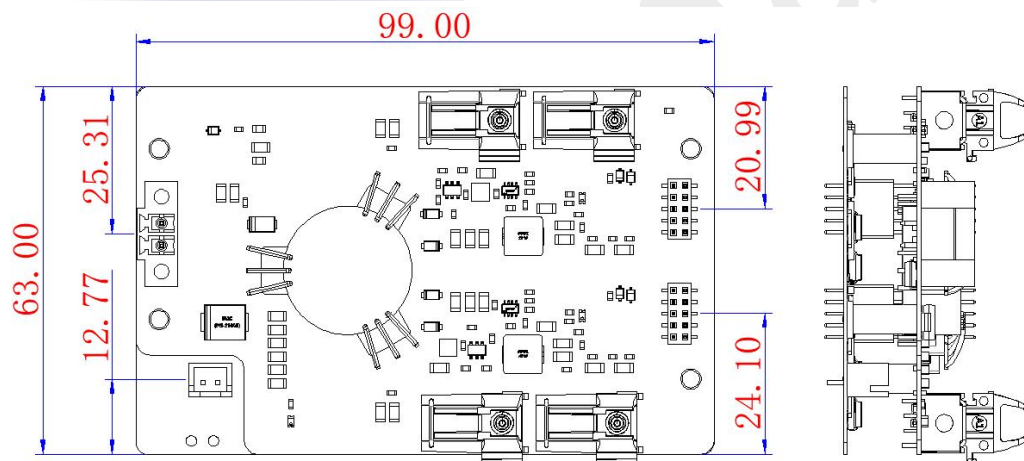
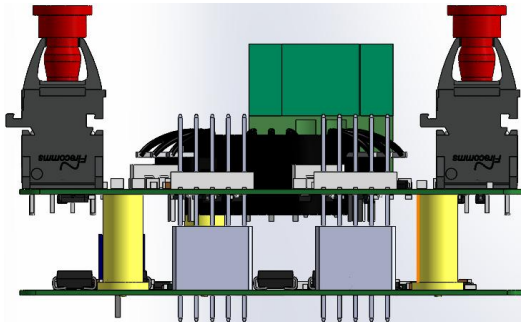
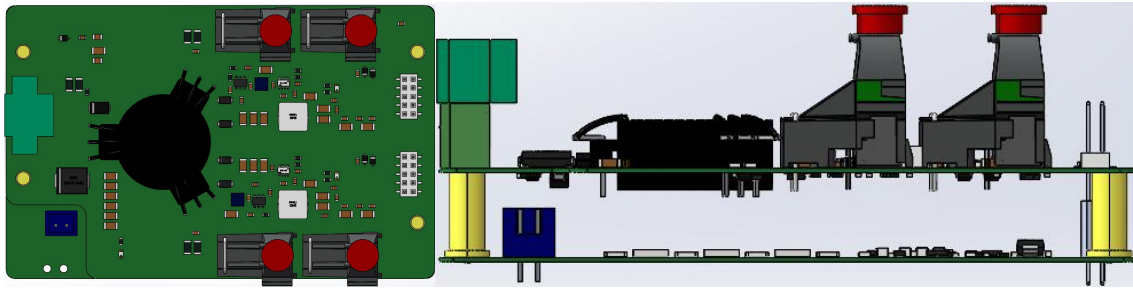
Fig. 6 Example of  $V_{DS}$  short-circuit fault

D0 = "1" in the above figure, indicating that the driver has detected a  $V_{ds}$  short-circuit fault, and it is necessary to troubleshoot whether the PWM signals of the upper and lower tubes have straight-through problems or whether the module has failed to short-circuit.

Note:

- 1: "NULL" is static 200us;
- 2: The default baud rate of the drive is 19200, i.e. 1Bit=52us, if you have special requirements for the baud rate, please contact Fei Shi Dai technical staff.
- 3: Because there is a drive clock frequency switching at the moment of the fault, it is recommended to start recognizing the fault type from the second fault code in order to ensure the correct identification of the fault type.

## 3D and Mechanical Dimensions



Unit: mm

Note: 1. The thickness tolerance of the board is  $\pm 10\%$ ;

2. Other dimensional tolerances refer to GB/T1804-m.

## Updates

Date	Description	Version
2025.04.10	Preliminary	V0.1

## Ordering Information

2FHD0420V can support different models of package modules from multiple manufacturers. When purchasing, please add the module model number after the driver model number so that we can provide the driver that best meets your needs.

Part Number	Voltage	$R_{GON} (\Omega)$	$R_{GOFF} (\Omega)$	$R_{SSD} (\Omega)$	Coating
2FHD0420V17A1-S0001	1700V	10/4	10/4	47	W/O

## Technical Support

Firstack's professional team will provide you with business consultation, technical support, product selection, price, lead time and other related information, and guarantee to answer your questions within 48 hours.

## Legal Disclaimer

The instruction manual provides a detailed description of the product but does not commit to providing specific parameters regarding the delivery, performance, or applicability of the product. This document does not offer any express or implied warranties or guarantees.

Firstack reserves the right to modify technical data and product specifications at any time without prior notice. The general delivery terms and conditions of Firstack apply.

## Contact Information

Tel: +86-571 8817 2737

Fax: +86-571 8817 3973

Website: [www.firstack.com](http://www.firstack.com)

Email: [fsales@firstack.com](mailto:fsales@firstack.com)

Address: 4-5/F, Building/5, Xizi Wisdom Industrial Park, No.1279 Tongxie Road, Hangzhou, China