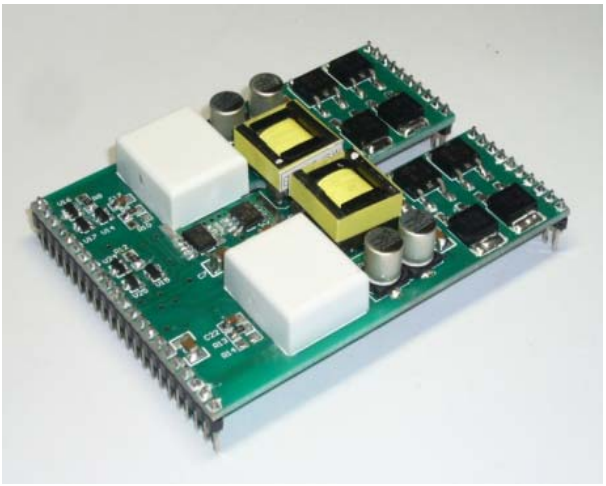
Description and Application Manual for 2PD632 Dual Channel IGBT drivers



WEPOWER series high power IGBT intelligent driving modules are specially designed for high power IGBT module with high reliability and security. The products series have been patented in China

The high power IGBT intelligent module driver released by WEPOWER is easy to use with smart design, high driving power and complete function.

The 2PD632 dual channel high power IGBT intelligent module driver is pin compatible to other common products completely and directly in the market.

The WEPOWER IGBT driver is a winning project of the competition organized by “China National Invention Association” in 2009.

The IGBT driver by distinguishing it as the “Bronze Medal” in the “National Exhibition of Inventions” in 2009.

Applications

※ Inverters
※ Converters
※ Railroad Traction
※ Switch Power Supplies
※ DC/DC Converters
※ Radiology and Laser Technology
※ Research
※ Motor Drive Technology
※ Weapon Equipage

1. Main Features & Technical Specifications

1.1 Main Features

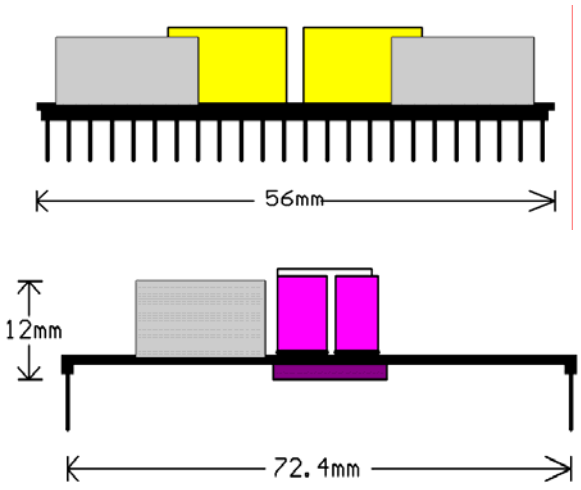
(1) Suitable for driving high power IGBT module
(2) Short circuit, over current and low-voltage protection.
(3) Soft switching
(4) Reliable and durable
(5) Electrical isolation of 4000V_{AC}
(6) Switching frequency: 0~100kHz
(7) Duty ratio: 0~100%
(8) Disturbance rejection property: dv/dt >100,000V/us
(9) Integrated internal DC/DC power supply

1.2 Technical Specifications

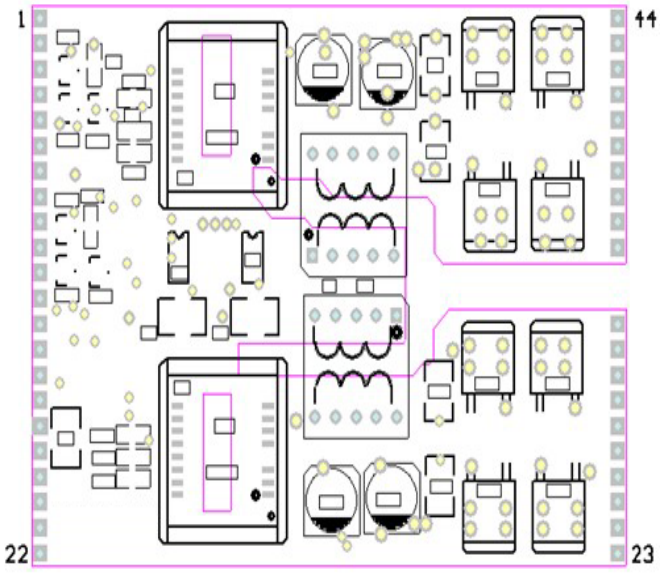
Absolute maximum Ratings				
Symbol	Parameter		Value	Unit
VDC	voltage supply DC/DC converter		15.6	V
VDD	voltage supply electronics input side		16	V
V_{inH}	Input signal voltage (high)		VDD+0.3	V
V_{inL}	Input signal voltage (low)		GND-0.3	V
$Iout_{PEAK}$	Output gate peak current		±32	A
$Iout_{AVmax}$	Output average current		250	mA
f_{max}	Max switch frequency		100	kHz
V_{CE}	Collector emitter voltage sense across the IGBT		1700	V
dv/dt	Rate of rise and fall of voltage secondary to signal primary side		60	kV/us
V_{isolIO}	Isolation test voltage input-output (AC,RMS,2S)		4000	V
V_{isolPD}	Partial discharge extinction voltage，RMS, Q_{PD}≤10PC		2000	V
V_{isol12}	Isolation test voltage output1-output2 (AC,RMS,2S)		2000	V
R_{Gmin}	Minimum rating for R_{Gon}		0.5	Ω
$Q_{out/pulse}$	Max. rating for output charge per pulse		23	uC
T_{op}	Operating temperature	2PD632I	-40℃～+85℃	℃
		2PD632J	-40℃～+105℃	
		2PD632M	-55℃～+125℃	
T_{stg}	Storage temperature	2PD632I	-55℃～+105℃	℃
		2PD316J	-55℃～+125℃	
		2PD316M	-60℃～+130℃	

Electrical characteristics					
Symbol	Parameter	value			unit
		Min.	Typ.	Max.	
VDC	voltage supply DC/DC converter	14.5	15	15.6	V
VDD	voltage supply electronics input side	14.5	15	15.6	V
I_{SO}	Supply current primary side (no load)		80		mA
	Supply current primary side (max)			1000	mA
V_i	Input signal voltage on/off		15/0		V
V_{iT+}	Input threshold voltage (High)	3.5	-	-	V
V_{iT-}	Input threshold voltage (Low)	-	-	1.5	V
$V_{G(on)}$	Turn on gate voltage output		+15		V
$V_{G(off)}$	Turn off gate voltage output		-10		V
$t_{d(on)}$	Turn-on propagation time		0.2		us
$t_{d(off)}$	Turn-off propagation time		0.22		us
$t_{d(err)}$	Error propagation time			2.5	us
t_{TD}	Top-Bot interlock dead time		0.5		us
C_{PS}	Coupling capacitance primary secondary		17		pF
W	weight		35		g
MTBF	Mean time between failure (Ta=40℃,max load)		1.6		10^6h

2. 2PD632 Block Diagram



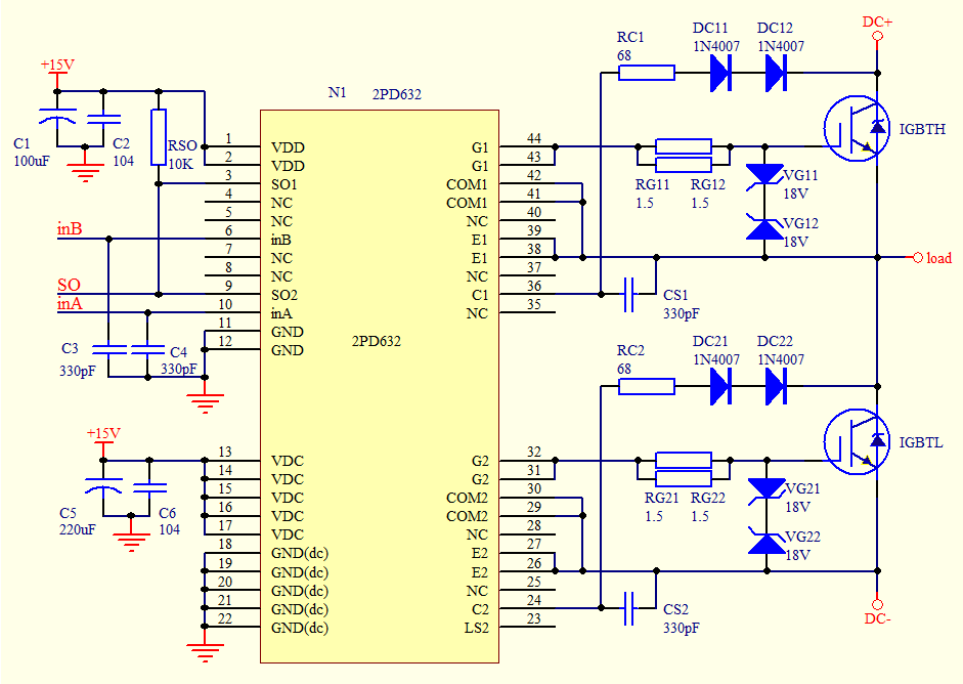
2PD632 Dimensional Diagram



Pin Des.	Function	Pin Des.	Function
1 VDD	+15V for electronic input side	44 G1	Gate channel 1
2 VDD	+15V for electronic input side	43 G1	Gate channel 1
3 SO1	Status output channel 1	42 COM1	Virtual common channel 1
4 NC		41 COM1	Virtual common channel 1
5 NC		40 NC	
6 inB	Input B	39 E1	Emitter channel 1
7 NC		38 E1	Emitter channel 1
8 NC		37 NC	
9 SO2	Status output channel 2	36 C1	Collector sense channel 1
10 inA	input A	35 NC	
11 GND	GND for electronic input side	34 NC	
12 GND	GND for electronic input side	33 NC	
13 VDC	+15V for DC/DC converter	32 G2	Gate channel 2
14 VDC	+15V for DC/DC converter	31 G2	Gate channel 2
15 VDC	+15V for DC/DC converter	30 COM2	Virtual common channel 2
16 VDC	+15V for DC/DC converter	29 COM2	Virtual common channel 2
17 VDC	+15V for DC/DC converter	28 NC	
18 GND(dc)	Ground DC/DC converter	27 E2	Emitter channel 2
19 GND(dc)	Ground DC/DC converter	26 E2	Emitter channel 2
20 GND(dc)	Ground DC/DC converter	25 NC	
21 GND(dc)	Ground DC/DC converter	24 C2	Collector sense channel 2
22 GND(dc)	Ground DC/DC converter	23 NC	

3. Application example

Reference connection schematic of 2PD632 is shown in the following figure. It shows that WEPOWER series of high-power IGBT drive module needs less peripheral device, driving circuits is simple and high integration. In order to improve its reliability, the parameters of the selection of electric level and the protection voltage are pre-set in the module.



2PD632 Connection Schematic

4. Overview of WEPOWER series High Power IGBT Intelligent Driving Module

(1) More reliable operation (Gate bipolar power supply with +15V/-10V is suitable for IGBT of any manufacturer. The gate is driven by negative voltage which increases capacity of anti-interference and more Parallel IGBTs can be driven.)

(2) True electrical isolation. (The *non-core transformer* isolation technology is used for each channel of drivers to reach better insulation properties and lower coupling capacitance.）

(3) Reliable transmission characteristics （ non-core pulse transformer transmission signal is used to reduce delay time, improve the service life and it can generate various levels of isolation voltage. It has strong anti-interference level at least 100kV/ms. It is suitable for the circuit in which potential difference between control circuit and main circuit is peculiarly large.）

(4) Delay characteristics (The delay time through the entire driver is within 100-300ns, delays of both rising and falling edges are symmetric. There is consistency among delay times of different drivers, paralleled circuits are reliable.）

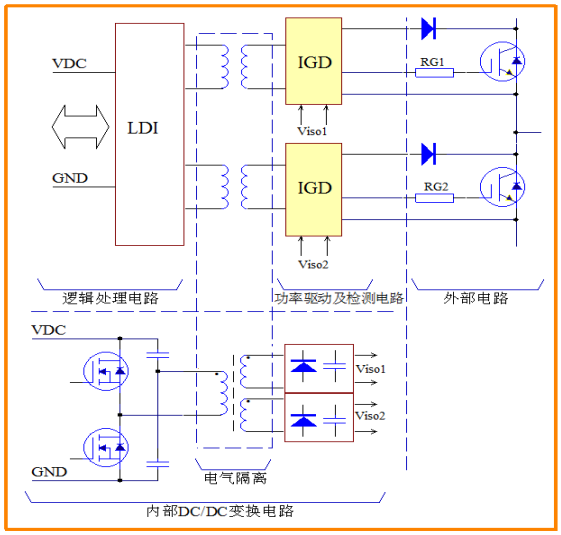
(5) State recognition (Pulse transformer works on two-way style. It can transmit drive signals and also transmit state identification signals.)

5. Operation Principle

5.1 Block diagram

2PD632 high-power IGBT intelligent driving module mainly consists of internal DC / DC converting circuit and IGBT Intelligent driving circuit which is formed by a logic processing circuit, a power drive and detection circuits. The block diagram is shown below.

LDI is a logic signal processing circuit. IGD is an intelligent gate driver and power expansion circuit. The non-core pulse transformer is used to transmit signals and feedback the signal between LDI and IGD.



Block diagram

IGD intelligent gate driver circuit

For each driving channel, there is an intelligent gate driver circuit IGD in which all function circuits such as intelligent drive, overload and short circuit protection, temporal logic blocking the signal, state identification, power supply and output monitoring circuits are integrated.

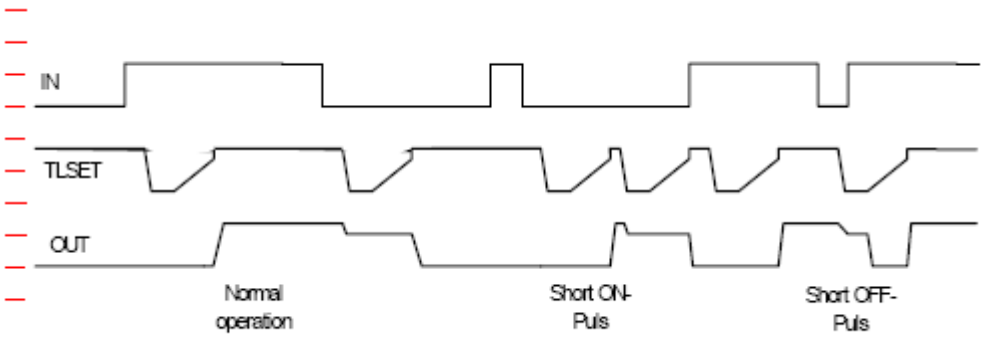
Integrated DC / DC power supply

All of the standard series of WEPOWER high-power IGBT intelligent drive module includes a DC / DC converter for each channel to provide drive voltage. Therefore, drivers need only a stable 15V DC power supply. As for different application, especially the different switching frequency and power valve gate charge, WEPOWER offers different driving power. Internal DC/DC drive power of 2PD632 is 2 * 3W.

5.2 Protection Features

The IGBT V_{CE} detection circuit is set in each channel of WEPOWER intelligent driver .Once the fault of Over current or low-voltage is detected, shutdown signal will generated by the module. The drive board begins to turn off the power device (With soft switch-off function), and it does not receive drive signals, the "failure" message will feedback to the LDI, the status is output through the pin SOX So the driver will not accept any driving signal until the "blocking" time has elapsed.

The timing diagram of WEPOWER intelligent driver beginning to turn off the power device in two stages when IGBT is over current or short circuit is shown below.



The timing diagram with Short circuit and over current protection

5.3 Operation Mode

A working mode is set in the drive module (the independent model) the two channels work independently. The module has the direct conduct protection function .When two input signals INA and INB are high level, the outputs of the two channels are closed in the meantime (the out put voltage is -10V).This will effectively prevents the IGBT direct conduct damage caused by the interference or control failure.

5.4 The Pin Designation

5.4.1 The Input Side

Pin GND
Pin GND is connected to the ground of the electronic power supply, if several GNDs are present, all GNDs should be connected to ground.

Pin VDC (voltage supply DC/DC converter)

A stabilized voltage supply of +15V with respect to GND is connected to terminal VDC. This input supplies the internal DC/DC converter. It is recommended that a blocking capacitor is inserted between VDC and GND.

Pin VDD (voltage supply electronics input side)
A stabilized voltage supply of +15V with respect to GND is connected to terminal VDD.

Pin InA (signal input A)
In direct mode, terminal InA drives channel 1 directly. The input has a Schmitt trigger characteristic and corresponds to positive logic: a High level switches the power semiconductor on, a Low level means a switch-off state. In half-bridge mode, the PWM signal for the phase branch is connected to InA.
Inputs InA and InB can be operated with 5V…15V levels.
During the build-up of the supply voltage, both inputs InA and InB or input VL/reset should be on GND, so that no uncontrolled drive signals are generated.

Pin InB (signal input B)
In direct mode, terminal InB controls channel 2 directly. The input has a Schmitt trigger characteristic and corresponds to positive logic (like InA)
In hald-bridge mode, the release signal for the phase branch is connected to InB. High level means release, Low level means that all channels are blocked.

Pin Sox (status output)
The "x" in "Sox" stands for the number of the drive channel in multi-channel drivers. The output stage Sox consists of an open-collector. The output is pulled to GND if an error has been detected in channel x. The transistor goes high when no error is present.

5.4.2 The Power Side

Pin Gx (gate terminal)
The output G is the output for the gate drive. When the WEPOWER driver is supplied with 15V, the gate is with +15V/-10V, the negative gate voltage is generated internally. The maximum permissible gate current is ±32A
Pin Ex (emitter terminal)

This terminal should be connected to the emitter of IGBT. The connected must be as short as possible and be run directly to emitter of IGBT. And the terminal is also the COM terminal of the power side.

Pin Cx (collector sense)
This terminal is used to measure the voltage drop across the turned-on power transistor in order to ensure protection from short circuit and overload. It should be noted that it must never be connected directly to the drain or collector of the power transistor. A circuit with a high-blocking diode must be included to protect the measuring terminal from the high drain or collector voltage of the turned-off power element. For 1200V and 1700V modules, a circuit made up of two or three diodes of type 1N4007 connected in series has proved its worth in place of exotic higher-blocking elements. It is recommended that the voltage of these diodes be over dimensioned by at least 40%. Fast diodes are not required here. Standard line diodes are quite sufficient.

5.4.3 Layout and wiring

Drivers should as a rule to be placed as close as possible to the power semiconductors so that the leads from the driver to the transistors are as short as possible .lead lengths of more than 10 cm must be avoided. When the power semiconductors are connected by stranded wires, it is recommended always to twist the three associated leads G_X, C_X and E_X .of the IGBT.

It is also recommended to place two zener diodes connected in counter-series immediately between the gate and emitter of the IGBT. It is possible that the two zener diodes are 15V zener diodes.

6. Calculation of driving power

Gate input capacitance (Cin) can be found in the data sheet. The total power need to drive IGBT can be calculated by the following simple formula:

$P=f*Cin*\triangle V^2$ OR $P=f*Q*\triangle V$

Gate charge $Q=\int idt=C*\triangle V$

(Note: P represents the real driving power not including the losses in drive channel and drive power supply.)

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Sustainable Power Solutions

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