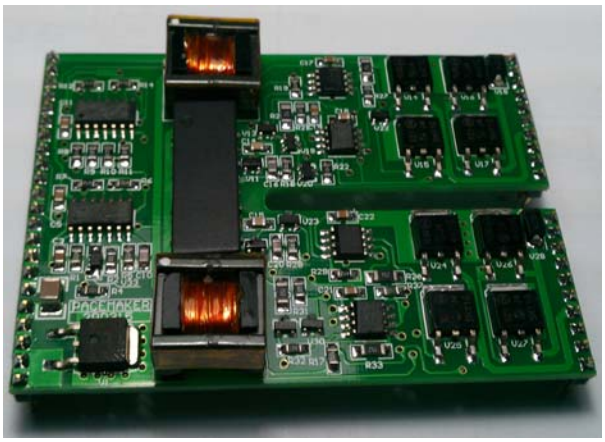
Description and Application Manual for 2PD315 Dual Channel IGBT driver

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 2PD315 dual channel high power IGBT intelligent module driver is second source for CONCEPT 2SD315.

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 and Converters
※ Railroad Traction
※ Switch Mould Power Supplies
※ Radiology and Laser Technology
※ Motor Drive Technology
※ UPS Power Supply

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) High electrical isolation
(6) Switching frequency: 0~150KHz
(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

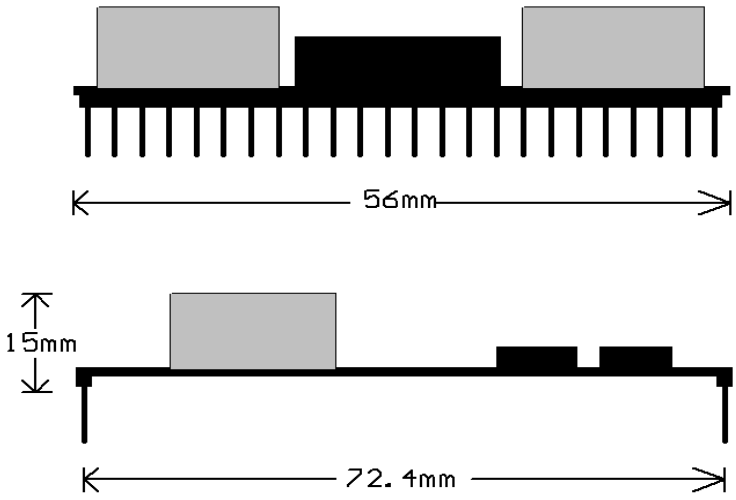
Drive channel number	2 channels
Suitable DC Bus bar Voltage	≤1700V
Rated Input Voltage	15V（±0.5V）
Max. Drive Current	±16A
Internal DC/DC Rated Power	2*4W
PWM Input electric level	0-16V (compatible with TTL & COMS)
Rated Drive Voltage	+15V/-15V

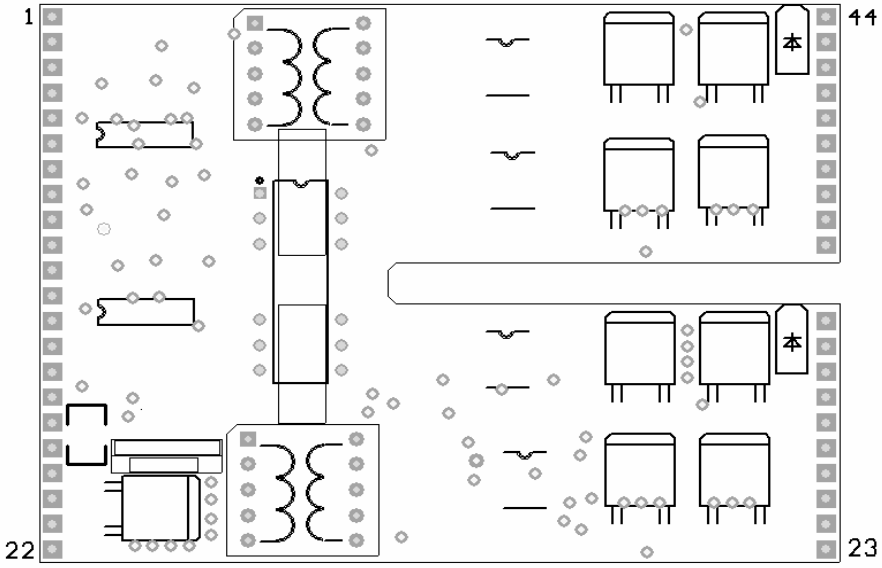
Maximum Ratings			
Symbol	Definition	Value	Unit
VDD	voltage supply electronics input side	16	V
VDC	voltage supply primary input side	15.6	V
V_{inH}	Input signal voltage (high)	VS+0.3	V
V_{inL}	Input signal voltage (low)	GND-0.3	V
$Iout_{PEAK}$	Output gate peak current	20	A
$Iout_{AVmax}$	Output average current	250	mA
f_{max}	Max switch frequency	150	kHz
V_{CE}	Collector emitter voltage sense across the IGBT	1700	V
dv/dt	Rate of rise and fall of voltage secondary	50	kV/us

	to signal primary side			
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_{Gonmin}	Minimum rating for R_{Gon}		0.5	Ω
$R_{Goffmin}$	Minimum rating for R_{Goff}		0.5	Ω
$Q_{out/pulse}$	Max. rating for output charge per pulse		23	uC
T_{op}	Operation Temperature	2PD315I	-40℃～+85℃	℃
		2PD315J	-40℃～+105℃	
		2PD315M	-55℃～+125℃	
T_{stg}	Storage Temperature	2PD315I	-55℃～+105℃	℃
		2PD315J	-55℃～+125℃	
		2PD315M	-60℃～+130℃	

Electrical characteristics					
Symbol	Definition	Value			Unit
		Min.	Typ.	Max.	
VDD	voltage supply electronics input side	14	15	16	V
VDC	voltage supply DC/DC converter	14.5	15	15.6	
I_{SO}	Supply current primary side (no load)		110		mA
	Supply current primary side (max)			600	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)	-	-	2	V
$V_{G(on)}$	Turn on gate voltage output		+15		V
$V_{G(off)}$	Turn off gate voltage output		-15		V
I_{OMAX}	Max drive current		16		A
$t_{d(on)}$	Turn-on propagation time		1.0		us
$t_{d(off)}$	Turn-off propagation time		1.2		us
$t_{d(err)}$	Error propagation time			1	us
T_{rst}	Error reset time		100		ms
t_{TD}	Top-Bot interlock dead time		2.2		us
C_{PS}	Coupling capacitance primary secondary		17		pF
W	Weight		30		g
MTBF	Mean time between failure (Ta=40℃,max load)		1.6		10^6h

2. 2PD315 Block Diagram





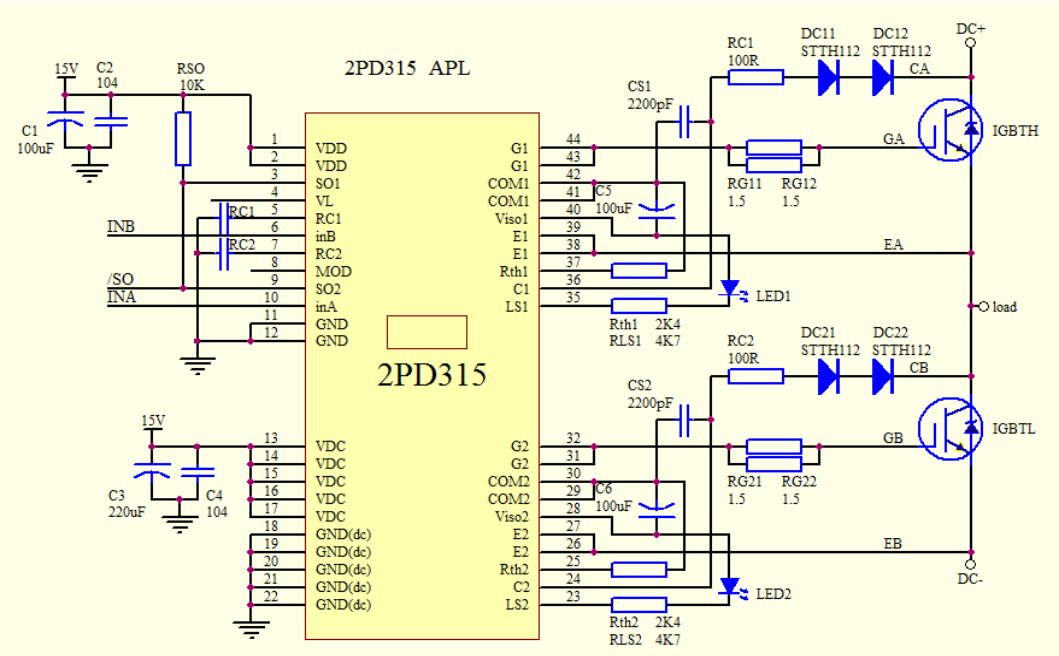
2PD315 Dimensional Diagram (Pin distance: 2.54mm)

Pin Des.	Function	Pin Des.	Function
1 VDD	+15V for electronic input side	8 NC	
2 VDD	+15V for electronic input side	9 SO2	Status output channel 2
3 SO1	Status output channel A	10 inA	Input A
4 NC		11 GND	GND for electronic input side
5 RC1	Dead time set for Channel 1	12 GND	GND for electronic input side
6 inB	Input B	13 VDC	+15V for DC/DC converter
7 RC2	Dead time set for Channel 2	14 VDC	+15V for DC/DC converter

15	VDC	+15V for DC/DC converter	
16	VDC	+15V for DC/DC converter	
17	VDC	+15V for DC/DC converter	
18	GND(dc)	Ground DC/DC converter	
19	GND(dc)	Ground DC/DC converter	
20	GND(dc)	Ground DC/DC converter	
21	GND(dc)	Ground DC/DC converter	
22	GND(dc)	Ground DC/DC converter	
44	G1	Gate channel 1	
43	G1	Gate channel 1	
42	COM1	Virtual common channel 1	
41	COM1	Virtual common channel 1	
40	VH1	Power + for channel 1	
39	E1	Emitter for channel 1	
38	E1	Emitter for channel 1	
37	Rth1	Gate protect set of Channel 1	
36	C1	Collect check terminal for channel 1	
35	LS1	HV side error input for channel 1	
34	NC		
33	NC		
32	G2	Gate channel 2	
31	G2	Gate channel 2	
30	COM2	Virtual common channel 2	
29	COM2	Virtual common channel 2	
28	VH2	Power + for channel 2	
27	E2	Emitter for channel 2	
26	E2	Emitter for channel 2	
25	Rth2	Gate protect set of Channel 2	
24	C2	Collect check terminal for channel 2	
23	LS2	HV side error input for channel 1	

3. Application example

Reference connection schematic of 2PD315 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.



2PD315 Connection Schematic

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

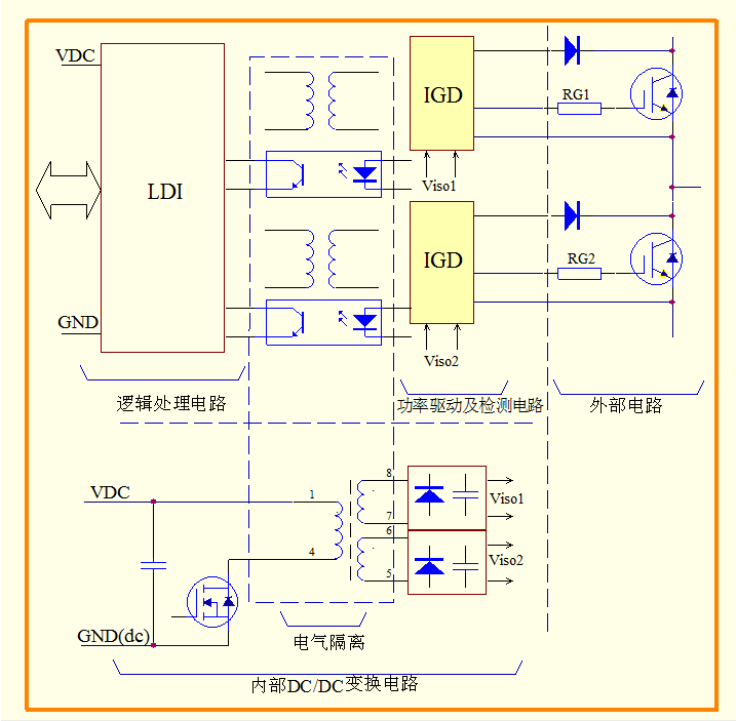
(1) More reliable operation (Gate bipolar power supply with +15V/-15V is suitable for IGBT of any manufacturer. The gate is driven by negative voltage which increases capacity of anti-interference and more Parallel IGBTs can be driven.)

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

5. Operation Principle

5.1 Block diagram

2PD315 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.



2PD315 Block diagram

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

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 2PD315 is 2 * 4W.

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 (thru Rthx to set), 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 any drive signals, the "failure" message will feedback to the LDI, SOX input low level, the status is output through the pin SOX. So the driver will not accept any driving signal until the "blocking" time (100ms) has elapsed and then to restart.

5.3 Operation Mode

A working mode is set in the drive module (i.e. a mode with dead time half bridge). The module has the direct conduct protection function .When two input signals INA and INB are high level, the outputs of the two channels G1 & G2 are closed in the meantime (the output voltage is -15V).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(+15V voltage supply DC/DC converter)
Filtering capacitor is suggested to be connected between VDC and ground.

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

Pin InA (signal input A)
Pin InA is the signal input terminal for gate channel 1.
High level-turn on power tube, low level-turn off power tube
(compatible with TTL & COMS)

Pin InB (signal input B)
Pin InB is the signal input terminal for gate channel 2.
High level-turn on power tube, low level-turn off power tube
(compatible with TTL & COMS)

Pin Sox (status output)
The “x” in “Sox” stands for the number of the drive channel in multi-channel drivers. Sox output stage is a transistor with open-loop Collector, if Sox connect to +15V power supply thru a Pull-up resistor and once any error is detected with gate channel, the transistor will breakover and Sox will be Pull-down. Under normal condition, the transistor output will not breakover. The driver capacity for output terminal is 50mA.

Pin RCx (dead time setting)
“x” stands for driver channel number. To configure the dead time for two channels thru connection of external capacitor. The typical setting parameter for dead time is: dt=RCx/330。（dt：us, RCx: pF）

5.4.2 The Power Side

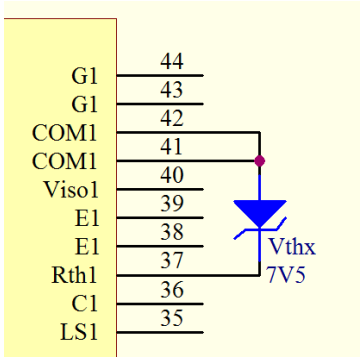
Pin Gx (gate output)
“x” stands for driver channel number. The corresponding gate drive voltage is +15V/-15V for WEPOWER series IGBT drivers. The maximum permissible gate current for 2PD315 is ±15A.

Pin COMx (common port)
"x" stands for driver channel number. Power supply common port for Channel 1 and channel 2.

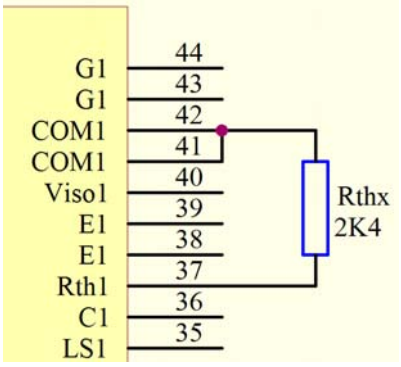
Pin VHx (power supply port of power side)
"x" stands for driver channel number. 15V power output for channel 1 and channel 2.

Pin Ex (Emitter output port)
"x" stands for driver channel number.It will be connected to E of IGBT.

Pin Rthx (gate voltage setting for over current)
"x" stands for driver channel number. To set the over current protection value for gate voltage thru connection external Zener diode or resistor. Thru external connection of Zener diode is suggested to get reliable gate voltage.



External Zener diode



External resistor

$$Vth \approx 15 * \frac{\frac{10 * Rth}{10 + Rth}}{1.5 + \frac{10 * Rth}{10 + Rth}}$$

Rth: KΩ

Pin Cx (collector sense)
"x" stands for driver channel number. This pin is used to check the breakover voltage drop for the power tube and protect short circuit and over load. It can not be connected to C of IGBT directly. To use high voltage diode to check big leakage current or collector voltage when turn off. For 1200V and 1700V IGBT modules, it is recommended to connect 2 or 3 pieces of fast diodes, and the voltage of these diodes will be selected to remain at least 40% withstand voltage margin.

Pin LSx (error output port of power side)
"x" stands for driver channel number. When error happened this Pin output is low. A led light can be connected to display error.

5.4.3 Layout and wiring
The driver can be placed as close as possible to the power tube when wiring, and gate lead wire is not exceed 10cm. It is better to use twist lead wire. It is recommended to place two zener diodes connected back to back between the gate and emitter of the IGBT to stable gate voltage.

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:

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

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

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

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