Description and Application Manual for 2PD316 Dual Channel IGBT drivers

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

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

The 2PD316 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

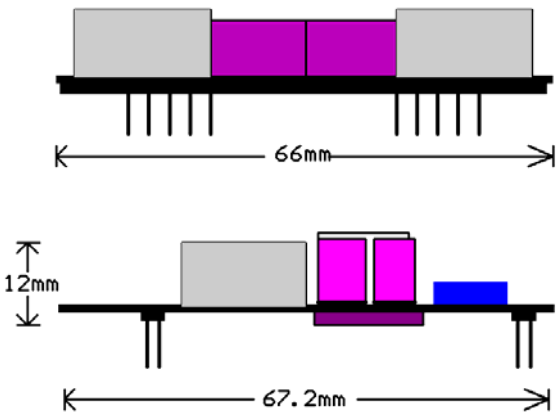
(1) Suitable for driving high power IGBT module
(2) Short circuit, over current and low-voltage protection.
(3) Soft switching
(4) Reliable and durable
(5) Electrical isolation of 4000V_{AC}
(6) Switching frequency: 0-100kHz
(7) Duty ratio: 0-100%
(8) Disturbance rejection property: dv/dt >100,000V/us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

1.2 Technical Specifications

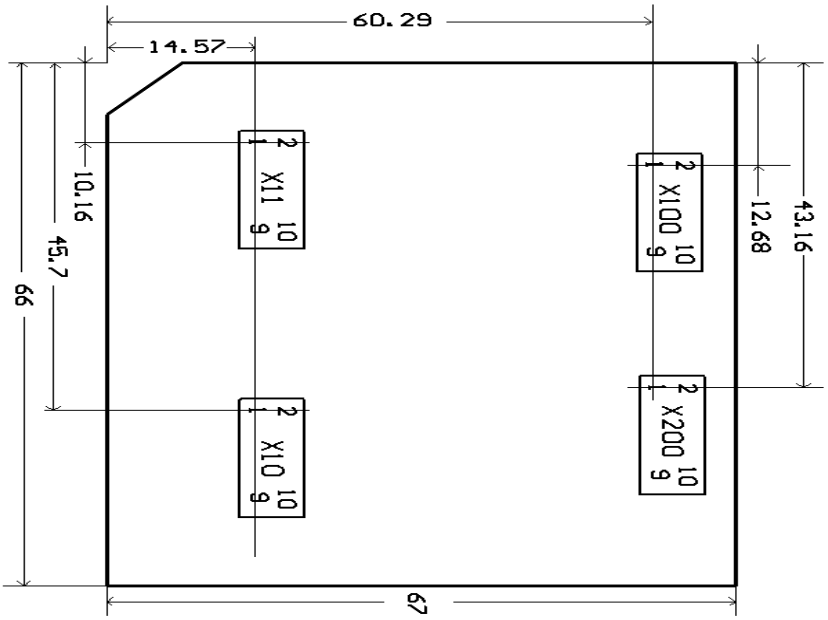
Absolute maximum Ratings				
Symbol	Parameter		Value	Unit
V_S	Power supply voltage		16	V
V_{iH}	Input signal voltage (high)		VS+0.3	V
V_{iL}	Input signal voltage (low)		GND-0.3	V
$Iout_{PEAK}$	Output peak current		16	A
$Iout_{AVmax}$	Output average current		100	mA
f_{max}	Max switching frequency		100	kHz
V_{CE}	Collector emitter voltage sense across the IGBT		1700	V
dv/dt	Rate of rise and fall of voltage secondary to primary side		50	kV/us
V_{isolIO}	Isolation test voltage input-output (AC,RMS,2S)		4000	V
V_{isolPD}	Partial discharge extinction voltage，RMS, Q_{PD}≤10PC		1500	V
V_{isol12}	Isolation test voltage output1-output2 (AC,RMS,2S)		1500	V
R_{Gonmin}	Minimum rating for R_{Gon}		1	Ω
$R_{Goffmin}$	Minimum rating for R_{Goff}		1	Ω
$Q_{out/pulse}$	Max. rating for output charge per pulse		12	uC
T_{op}	Operating temperature	2PD316I	-40℃～+85℃	℃
		2PD316J	-40℃～+105℃	
		2PD316M	-55℃～+125℃	
T_{stg}	Storage temperature	2PD316I	-55℃～+105℃	℃
		2PD316J	-55℃～+125℃	
		2PD316M	-60℃～+130℃	

Electrical characteristics					
Symbol	Parameter	value			unit
		Min.	Typ.	Max.	
V_S	Supply voltage primary side	14.5	15	15.6	V
I_{SO}	Supply current primary side (no load)	50			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)	-	-	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
$T_{pERRRESET}$	Error reset time	3	5		us
t_{TD}	Top-Bot interlock dead time		0.5		us
C_{PS}	Coupling capacitance primary secondary		13		pF
W	weight		30		g
MTBF	Mean time between failure (Ta=40℃,max load)		1.6		10^6h

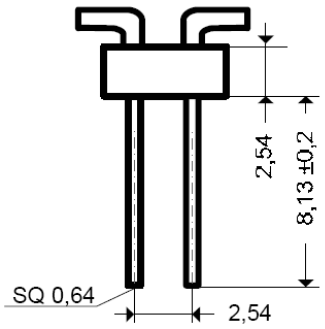
2. 2PD316 Mechanical Dimensions



2PD316 Mechanical Dimensions



2PD316 connector dimensions in mm（bottom view）



X11/X10/X100/X200 connector dimensional in mm

Pin	Signal	Function	Specification
X10:01	reserved	Pin reserved	
X10:02	reserved	Pin reserved	
X10:03	PRIM_HALT_OUT	Driver core status output	Digital 15V logic max.50mA; LOW=ready to operate HIGH=not ready to operate
X10:04	PRIM_HALT_IN	Driver core status input	Low=enable driver High=disable/reset (the module will restart with low logic input)
X10:05	PRIM_PWR_GND	GND for power supply and GND for digital	

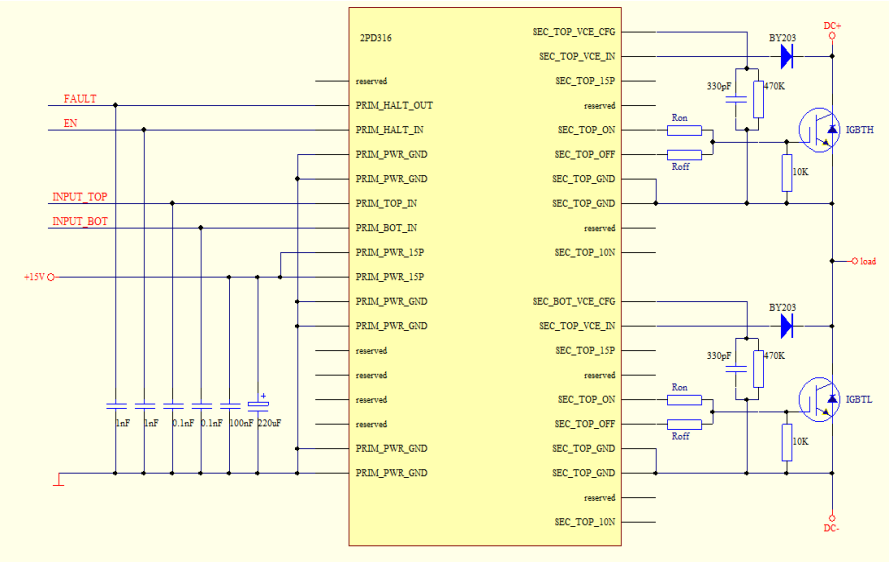
X10:06	PRIM_PWR_GND	GND for power supply and GND for digital	
X10:07	PRIM_TOP_IN	Switch signal input (TOP-switch)	Digital 15V logic; LOW= TOP switch off; HIGH= TOP switch on
X10:08	PRIM_BOT_IN	Switch signal input (BOTTOM switch)	Digital 15V logic; LOW= TOP switch off; HIGH= TOP switch on
X10:09	PRIM_PWR_15P	Drive core power supply	Stabilized +15V±4%
X10:10	PRIM_PWR_15P	Drive core power supply	Stabilized +15V±4%
X11:01	reserved	Pin reserved	
X11:02	reserved	Pin reserved	
X11:03	PRIM_PWR_GND	GND for power supply and GND for digital	
X11:04	PRIM_PWR_GND	GND for power supply and GND for digital	
X11:05	reserved	Pin reserved	
X11:06	reserved	Pin reserved	
X11:07	reserved	Pin reserved	
X11:08	reserved	Pin reserved	
X11:09	PRIM_PWR_GND	GND for power supply and GND for digital signal	
X11:10	PRIM_PWR_GND	GND for power supply and GND for digital signal	

Pin	Signal	Function	Specification
X100:01	SEC_TOP_VCE_CFG	Input reference voltage adjustment	
X100:02	SEC_TOP_VCE_IN	Input V_{CE} monitoring	
X100:03	SEC_TOP_15P	Output power supply	Stabilised +15V/max.20mA
X100:04	reserved	Pin reserved	
X100:05	SEC_TOP_ON	Switch on signal Top IGBT	
X100:06	SEC_TOP_OFF	Switch off signal Top IGBT	
X100:07	SEC_TOP_GND	GND for power supply and GND for digital signals	

X100:08	SEC_TOP_GND	GND for power supply and GND for digital signals	
X100:09	reserved	Pin reserved	
X100:10	SEC_TOP_10N	Output power supply	- Stabilised 10V/max.20mA
X200:01	SEC_BOT_VCE_CFG	Input reference voltage adjustment	
X200:02	SEC_BOT_VCE_IN	Input VCE monitoring	
X200:03	SEC_ BOT_15P	Output power supply	Stabilised +15V/max.20mA
X200:04	reserved	Pin reserved	
X200:05	SEC_ BOT_ON	Switch on signal BOT	
X200:06	SEC_ BOT_OFF	Switch off signal BOT IGBT	
X200:07	SEC_ BOT_GND	GND for power supply and GND for digital signals	
X200:08	SEC_ BOT_GND	GND for power supply and GND for digital signals	
X200:09	reserved	Pin reserved	
X200:10	SEC_TOP_10N	Output power supply	Stabilised -10V/max.20mA

3. Application example

Reference connection schematic of 2PD316 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.



2PD316 Connection Schematic

4. Overview of WEPOWER series High Power IGBT intelligent drive 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.)

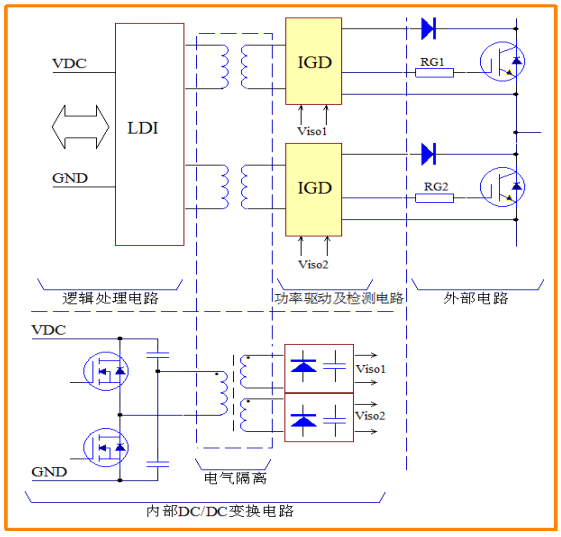
(5) State recognition (Pulse transformer works on two-way style. It can transmit drive signals and also transmit state identification signals.)

5. Operation Principle

5.1 Block diagram

2PD316 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.



2PD316 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.

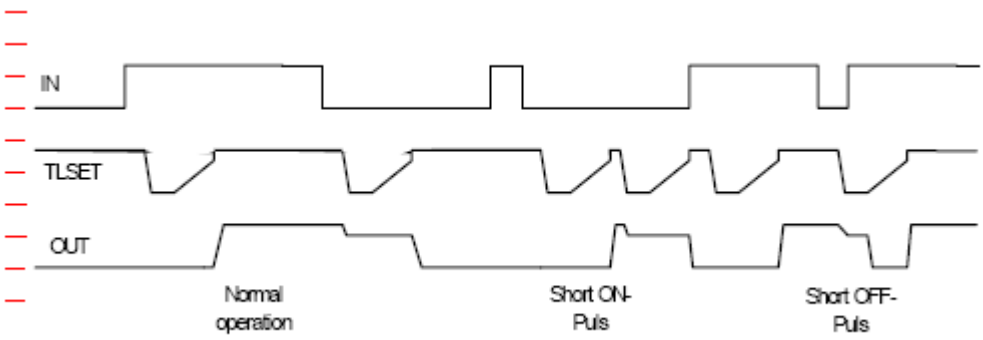
Integrated DC / DC power supply

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 2PD316 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 PRIM_HALT_OUT. 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 PRIM_TOP_IN and PRIM_BOT_IN 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 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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