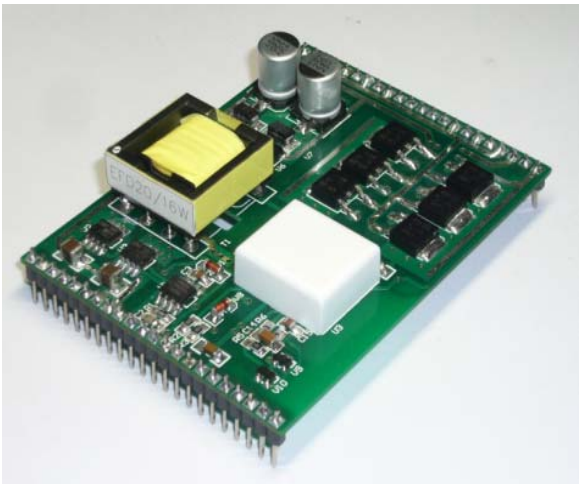
Description and Application Manual for PID1548 Single Channel IGBT drivers



WEPOWER series high power IGBT intelligent modules drivers 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 PID1548 single 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) Containing current limit circuit and under-voltage protection
(3) Soft switching
(4) Reliable and durable
(5) 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 circuit

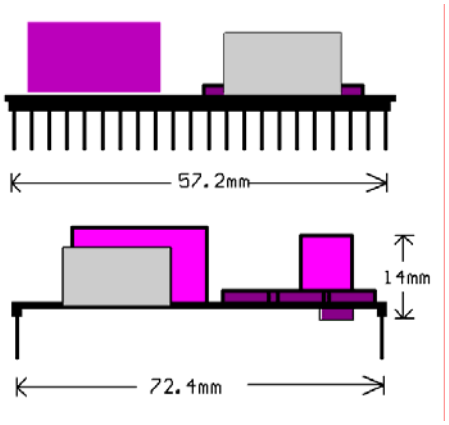
1.2 Technical Specifications

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		±48	A
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 to signal		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 (AC,RMS,2S)		2000	V
R_{Gmin}	Minimum rating for gate		0.333	Ω
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℃	

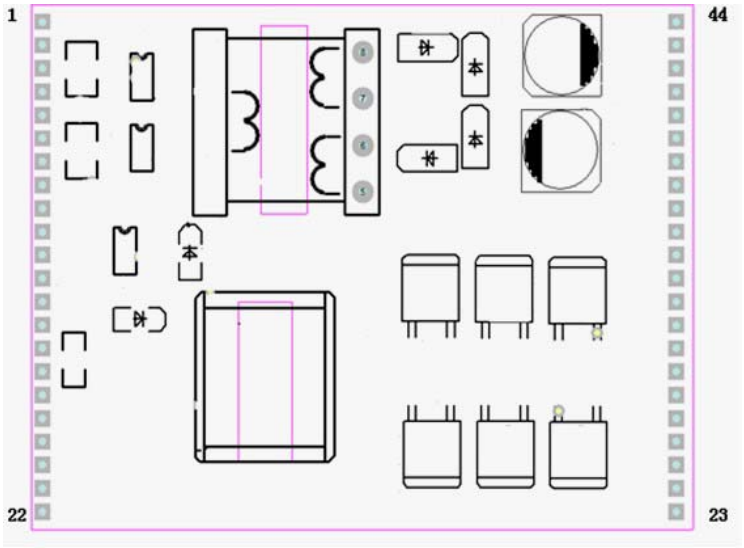
Electrical characteristics			
Symbol	Parameter	value	unit

		Min.	Typ.	Max.	
V_S	Supply voltage primary side	14.5	15	15.6	V
I_{SO}	Supply current primary side (no load)		80		mA
	Supply current primary side (max)			1200	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
C_{PS}	Coupling capacitance primary secondary		18		pF
W	weight		32		g
MTBF	Mean time between failure (Ta=40℃,max load)		1.6		10^6h

2. PID1548 Block Diagram



PID1548 Dimensional Diagram



PID1548 Pin Diagram

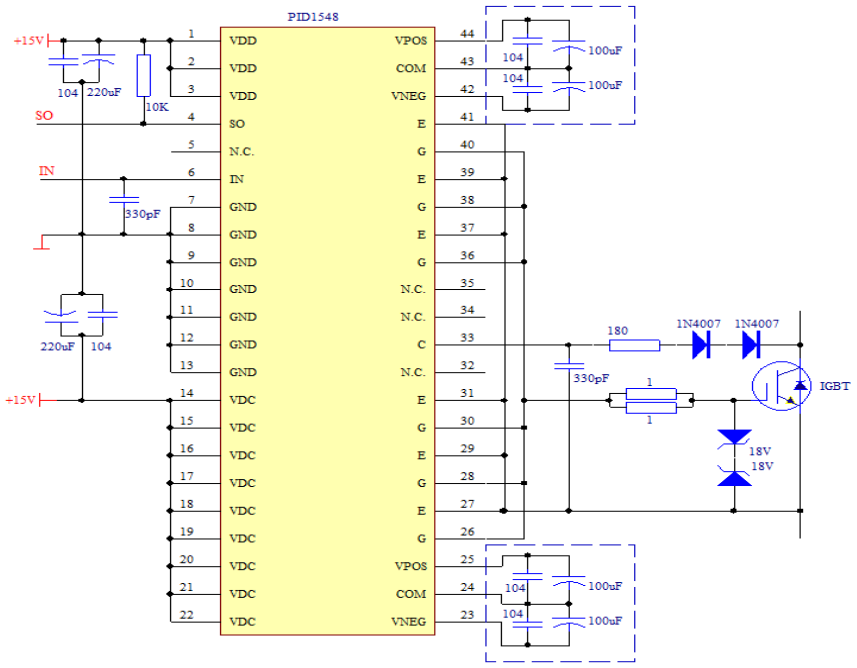
PID1548 Pin Designation

Pin	Des.	Function
1	VDD	+15V for electric input side
2	VDD	+15V for electric input side
3	VDD	+15V for electric input side
4	SO	Status output
5	reserved	reserved
6	IN	Signal input
7	GND	Ground
8	GND	Ground
9	GND	Ground
10	GND	Ground
11	GND	Ground
12	GND	Ground
13	GND	Ground
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	VDC	+15V for DC/DC converter
19	VDC	+15V for DC/DC converter
20	reserved	reserved
21	VDC	+15V for DC/DC converter

22	VDC	+15V for DC/DC converter
23	VNEG	Blocking capacitor -10V
24	COM	common
25	VPOS	Blocking capacitor +15V
26	G	Gate
27	E	Emitter
28	G	Gate
29	E	Emitter
30	G	Gate
31	E	Emitter
32	reserved	reserved
33	C	Collector sense
34	reserved	reserved
35	reserved	reserved
36	G	Gate
37	E	Emitter
38	G	Gate
39	E	Emitter
40	G	Gate
41	E	Emitter
42	VNEG	Blocking capacitor -10
43	COM	Common
44	VPOS	Blocking capacitor +15V

3. Application example

Reference connection schematic of PID1548 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, 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 and Components within the dotted box do not needed.



PID1548 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.)

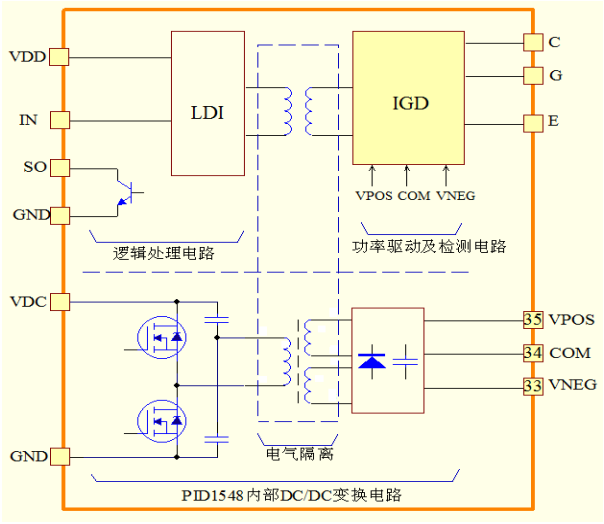
(5) State recognition (Pulse transformer works on two-way style. It can transmit drive signals and also transmit state identification signals.)

5. Operation Principle

5.1 Block diagram

PID1548 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.



PID1548 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.

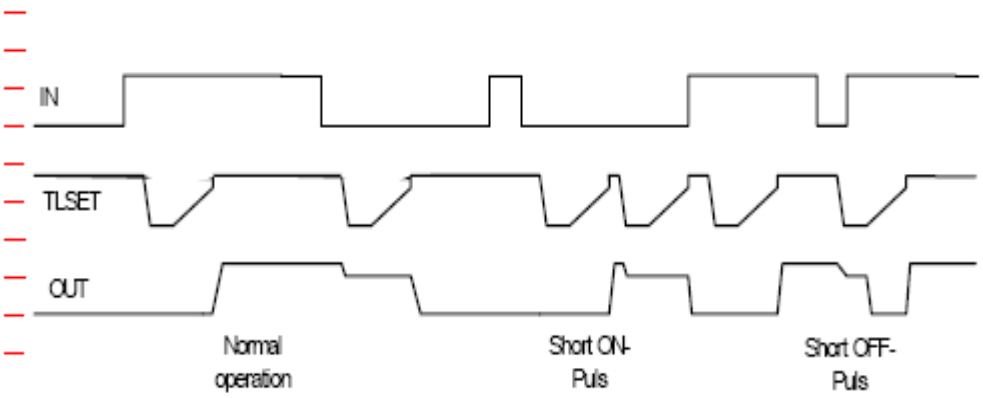
Integrated DC / DC power supply

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 PID1548 is 15W.

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 SO. 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 The Pin Designation

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

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 IN (signal input)
The signal input has a TLL and COMS positive logic: a Hi level switches the power semiconductor on ,a Lo level means a switch-off state. The signal input has been pulled to GND via a pull-down resistor in the driver internal.

Pin SO (status output)
The output stage SO consists of an open-collector transistor. A current of 50mA can be applied to the output SO if the status output can be pulled to +15V via a pull-up resistor. The output is pulled to GND if an error has been detected in channel. The transistor goes high when no error is present.

5.3.2 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 can be obtained from the data sheet of WEPOWER driver used.

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 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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