Description and Application Manual for PID932 Single Channel IGBT drivers

WEPOWER series high power IGBT intelligent module 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 PID932 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

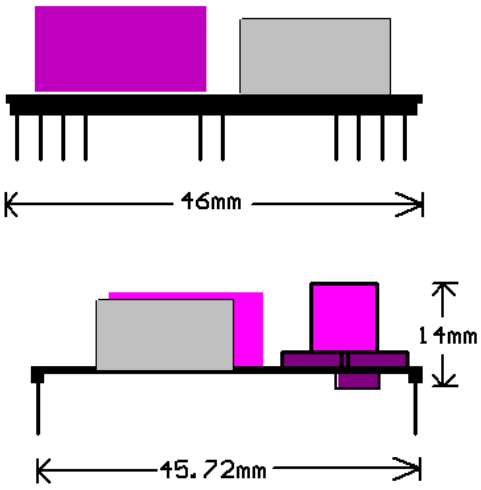
(1) Suitable for driving high power IGBT module
(2) Containing current limit circuit and under-voltage protection
(3) Soft switching
(4) Reliable and durable
(5) Electrical isolation
(6) Switching frequency: 0~150kHz
(7) Duty ratio: 0~100%
(8) Disturbance rejection property: dv/dt >100,000V/us
(9) Integrated internal DC/DC circuit

1.2 Technical Specifications

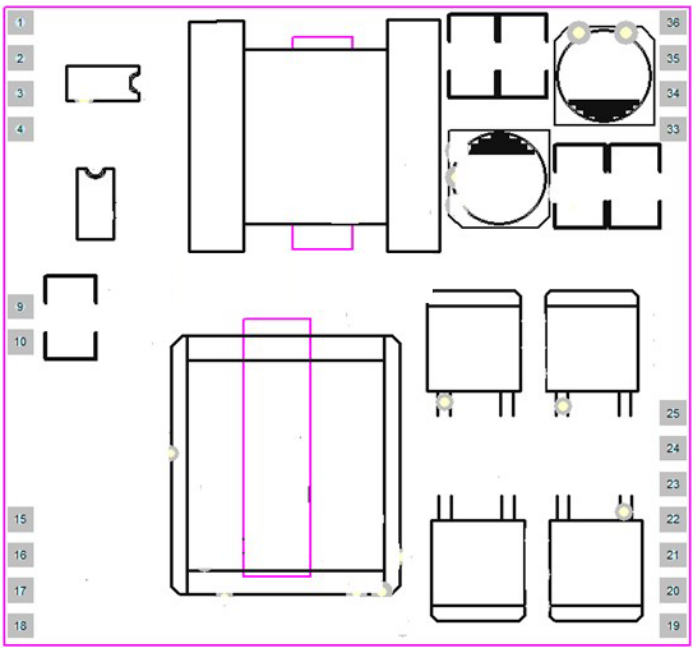
Absolute maximum Ratings				
Symbol	Parameter		Value	Unit
VCC	Power supply voltage		16	V
V_{inH}	Input signal voltage(high)		VCC+0.3	V
V_{inL}	Input signal voltage(low)		GND-0.3	V
$Iout_{PEAK}$	Output peak current		±32	A
f_{max}	Max switch frequency		150	kHz
V_{CE}	Collector emitter voltage sense across 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		0.5	Ω
T_{op}	Operating temperature	PID932I	-40℃～+85℃	℃
		PID932J	-40℃～+105℃	
		PID932M	-55℃～+125℃	
T_{stg}	Storage temperature	PID932I	-55℃～+105℃	℃
		PID932J	-55℃～+125℃	
		PID932M	-60℃～+130℃	

Electrical characteristics					
Symbol	Parameter	value			unit
		Min.	Typ.	Max.	
VDD	Supply voltage primary side	14.5	15	15.6	V
I_{SO}	Supply current primary side (no load)		55		mA
	Supply current primary side (max)			800	mA
V_{in}	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		12		pF
W	weight		20		g
MTBF	Mean time between failure (Ta=40℃,max load)		1.6		10^6h

2. PID932 Block Diagram



PID932 Dimensional Diagram



Pin Designation Diagram

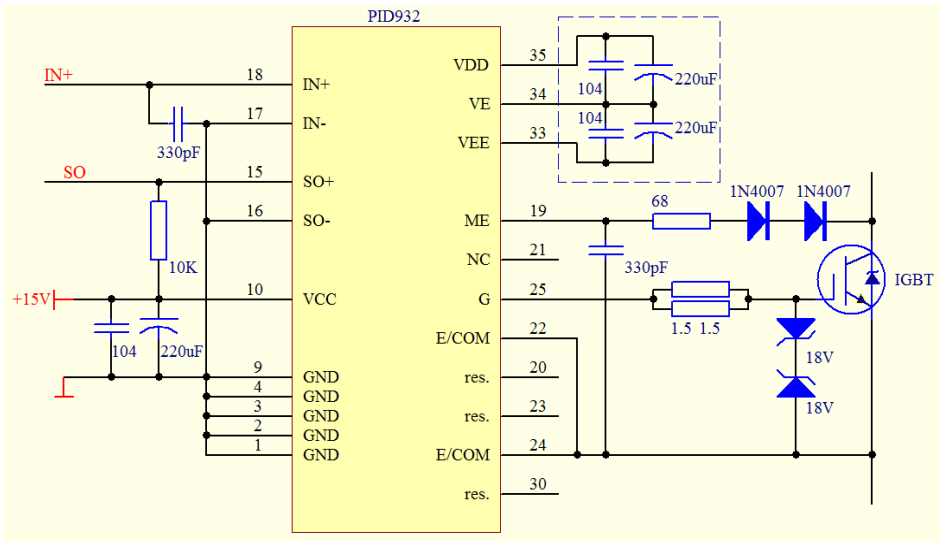
PID932Pin Description

Pin	Pin-Name	Function	Explaination
1	GND	Common GND	Power supply and logic ground
2	GND	Common GND	Power supply and logic ground
3	GND	Common GND	Power supply and logic ground
4	GND	Common GND	Power supply and logic ground
9	GND	Common GND	Power supply and logic ground
10	VCC	Power supply input	Power supply positive voltage referenced to pin GND
15	SO+	Status output positive	Status output positive voltage referenced to pin SO-, I_{MAX}=50mA
16	SO-	Status output negative	Status output negative voltage referenced to pin SO+, I_{MAX}=50mA
17	IN-	Logic low signal input	Inverting input referenced to GND When the signal input is connected to the in+ terminal, the in- must be connected to GND.
18	IN+	Logic high signal input	Non-inverting input referenced to GND When the signal input is connected to the in- terminal, the in+ must be connected to VCC.
19	ME	OVER-CURRENT MONITORING	IGBT collector voltage monitoring input referenced to pin E
20	reserved	reserved	

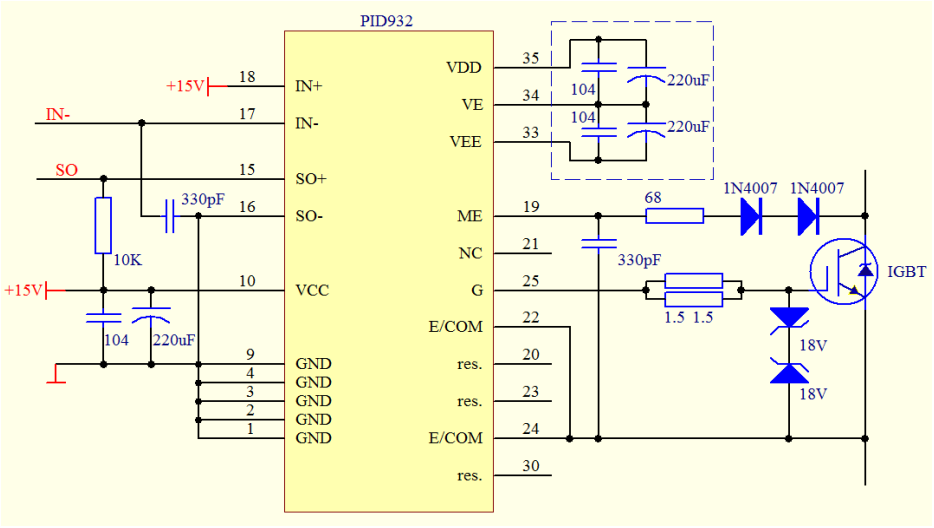
21	reserved	Reserved	
22	E/COM	IGBT Emitter terminal	The pin is emitter terminal of IGBT and common terminal (secondary side ground)
23	reserved	reserved	
24	E/COM	IGBT Emitter terminal	The pin is emitter terminal of IGBT and common terminal (secondary side ground)
25	G	IGBT gate terminal	The pin is gate terminal of IGBT
33	VEE	Output -10V	Secondary side -10V output terminal or no connection。
34	VE	Output COM	Secondary side common terminal or no connection。
35	VDD	Output +15V	Secondary side 15+V output terminal or no connection
36	reserved	reserved	

3. Application example

Reference connection schematic of PID932 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 can do not need



PID932 Application Circuit 1



PID932 Application Circuit 2

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.)

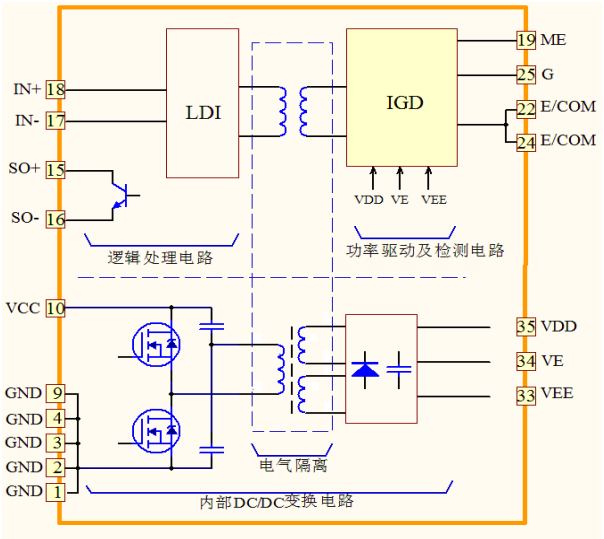
(5) State recognition (Pulse transformer works on two-way style. It can transmit drive signals and also transmit state identification signals.)

5. Operation Principle

5.1 Block diagram

PID932 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.

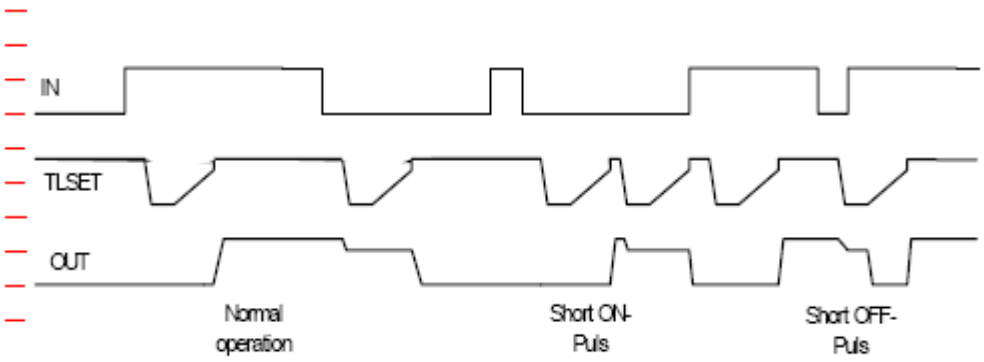
Integrated DC / DC power supply

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 PID932 is 9W.

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 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 VCC (voltage supply DC/DC converter and electronics input side)

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

Pin in+ (inverting input referenced to GND)

The inverting input has a TLL and COMS positive logic: a Hi level switches the power semiconductor on, a Low level means a switch-off state. The inverting input has been pulled to GND via a pull-down resistor in the driver internal. When the signal input is connected to the in+ terminal, the in- must be connected to GND.

Pin in- (non-inverting input referenced to GND)

The non-inverting input has a TLL and COMS positive logic: a Lo level switches the power semiconductor on, a Hi level means a switch-off state. The non-inverting input has been pulled to VCC via a pull-up resistor in the driver internal. When the signal input is connected to the in- terminal, the in+ must be connected to VCC

Pin SO+ (status output positive voltage referenced to pin SO-)

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.

Pin SO-(status output negative voltage referenced to pin SO+)

The output stage SO- consists of an open-emitter transistor. A current of 50mA can be applied to the output SO if the status output can be pulled to GND via a pull-down resistor. The output is pulled to +15V 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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