Description and Application Manual for PSD430-35 HV High Power IGBT Super Driver



PSD430-35 is a high power IGBT module driver specially designed for IGBT in series and parallel connection.It can be widely used for every kind of high power IGBT by series and parallel connection, like 3-level inverters.PSD430-35 adapts advanced high voltage transformer isolation technology, so its input signal do noes need to transfer by fiber optic isolation and Reduces the customer's cost and Simplifies the design. As it uses magnetic separation technology therefore its working temperature will not be limited by fiber optic. Its max working temperature range can be -55℃～+125℃.

PSD430-35 HV high power IGBT drive capability is 4W/±30A/3500V. PSD430-35 supports several pieces of 3300V or 1700V high-voltage IGBT modules in parallel connection, and two pieces of 1700V IGBT in series connection (multi-level) . Its package is compatible with CT-CONCEPT part IGD615,they can be replaced each other directly.

1. Main Features & Technical Specifications

1.1 Main Features

(1) Support IGBTs in series and in parallel connection
(2) Short circuit and over current and under-voltage protection.
(3) Reliable and durable
(4) High electrical isolation
(5) Switching frequency: 0~80KHz
(6) Duty ratio: 0~100%
(7)Strong anti-interference, dv/dt >100,000V/us
(8) Integrated internal DC/DC power supply

1.2 Technical Specifications

Drive channel number	1 channels
Suitable DC Bus bar Voltage	≤3500V
Rated Input Voltage	15V（±0.5V）
Max. Drive Current	±30A
Internal DC/DC Rated Power	4W
Rated Drive Voltage	+15V/-8V

Maximum Ratings				
Symbol	Definition		Value	Unit
VDC	voltage supply primary input side		15.6	V
V_{iH}	voltage supply primary input side		15	V
V_{iL}	voltage supply primary input side		0	V
$Iout_{PEAK}$	Output gate peak current		30	A
$Iout_{AVmax}$	Output average current		180	mA
f_{max}	Max switch frequency		80	kHz
V_{CE}	Collector emitter voltage sense across the IGBT		3500	V
dv/dt	Rate of rise and fall of voltage secondary to signal primary side		50	kV/us
V_{isolIO}	Isolation test voltage input-output (AC,RMS,60S)		8	kV
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		70	uC
T_{op}	Operation Temperature	PSD430-35I	-40℃～+85℃	℃
		PSD430-35J	-40℃～+105℃	
		PSD430-35M	-55℃～+125℃	
T_{stg}	Storage Temperature	PSD430-35I	-55℃～+105℃	℃
		PSD430-35J	-55℃～+125℃	
		PSD430-35M	-60℃～+130℃	

Electrical characteristics					
Symbol	Definition	Value			Unit
		Min.	Typ.	Max.	
VDC	voltage supply DC/DC converter	14.5	15	15.6	
I_{SO}	Supply current primary side (no load)		100		mA
	Supply current primary side (max)			450	mA
$V_{G(on)}$	Turn on gate voltage output		+15		V
$V_{G(off)}$	Turn off gate voltage output		-8		V
I_{OMAX}	Max drive current		30		A
$t_{d(on)}$	Turn-on propagation time		0.9		us
$t_{d(off)}$	Turn-off propagation time		0.7		us
$t_{r(out)}$	Output rise time		120		ns
$t_{f(out)}$	Output fall time		100		ns
$t_{d(err)}$	Error propagation time			850	ns
C_{PS}	Coupling capacitance primary secondary		10		pF
W	Weight		47		g
MTBF	Mean time between Failure (Ta=40℃,max load)		2.0		10^6h

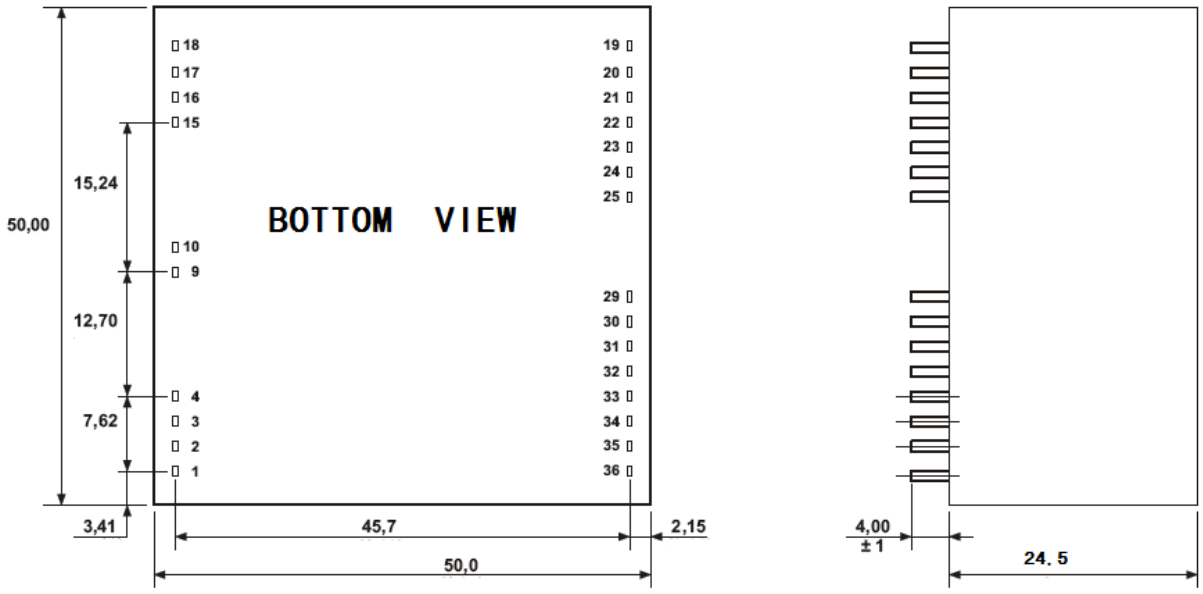
1.3 Applications

* High Voltage Inverter
* Motor drive
* Railway power supply system
* Power Engineering
* Radar and laser technology

2.PSD430-35 Block Diagram



PSD430-35 TOP VIEW



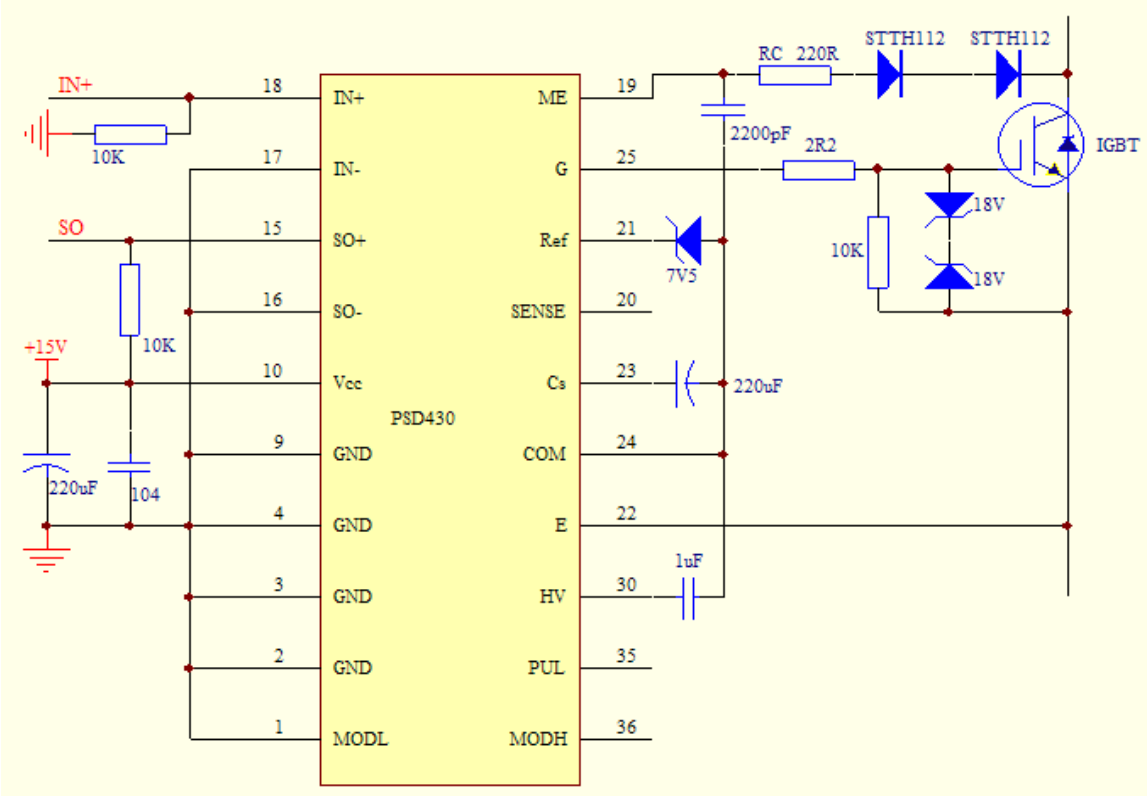
PSD430-35 Dimensional Diagram

Pin	Function	Pin	Function
1 MODL	Low power selection Mode	8 NC	
2 GND	Low end power ground	9 GND	Low end power ground
3 GND	Low end power ground	10 VCC	Low end 15V power supply
4 GND	Low end power ground	11 NC	
5 NC		12 NC	
6 NC		13 NC	
7 NC		14 NC	

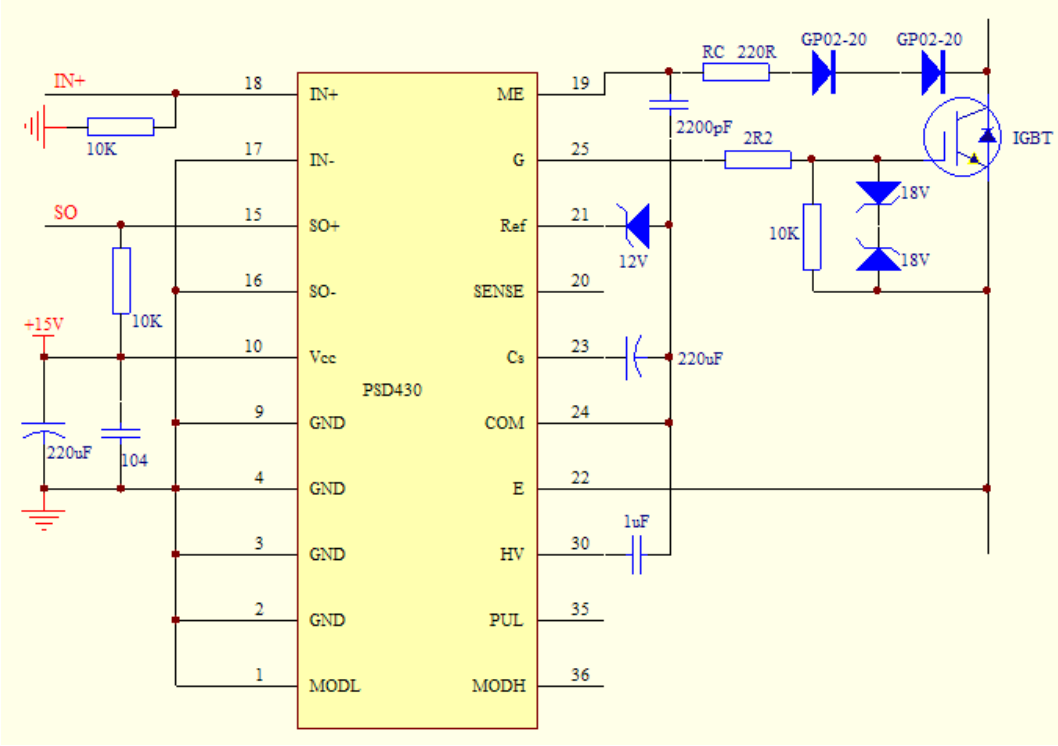
15 SO+	Fault output +	29 NC	
16 SO-	Fault output -	28 NC	
17 IN-	Signal input -	27 NC	
18 IN+	Signal input +	26 NC	
		25 G	G Pole output
36 MODH	High end selection Mode	24 COM	Common
35 PUL	DC/DC pulse output	23 CS	15V
34 NC		22 E	E Pole
33 NC		21 REF	Over current threshold setting
32 NC			
31 NC		20 Sense	Active clamp input
30 HV	High voltage power supply output terminal checking	19 ME	V_{CE}

3. Application example

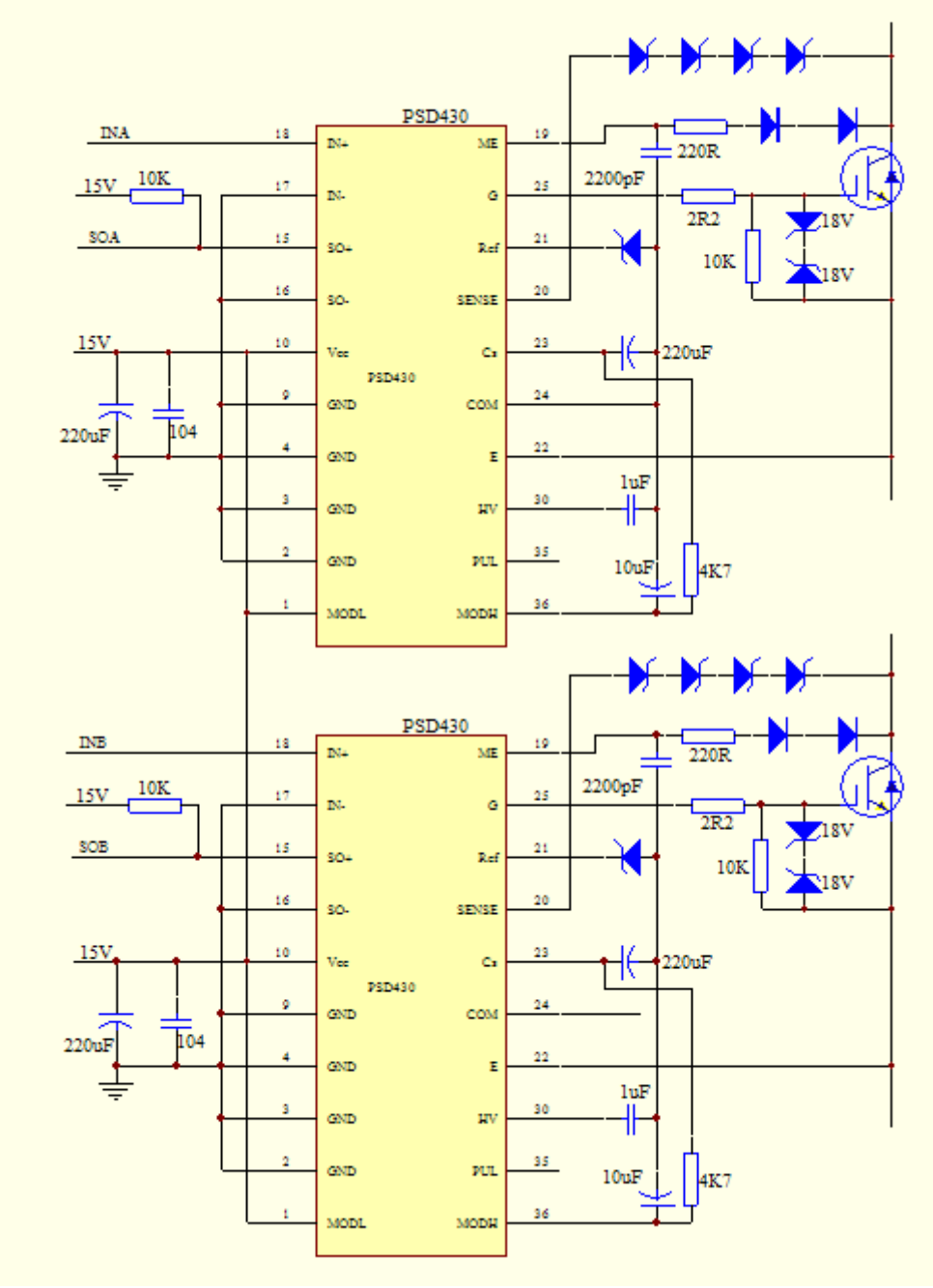
Below is the typical application circuit for PSD430-35. Circuit 1 is the drive circuit for 1700V high power IGBT module, circuit 2 is the drive circuit for 3300V high power IGBT module,and circuit 3 is used to drive IGBTs in series and parallel connection (multi-leve).



Circuit 1 PSD430-35 drive 1700V IGBT



Circuit 2 PSD430-35 drive 3300V IGBT



Circuit 3 PSD430-35 drive series and parallel connection (multi-leve)

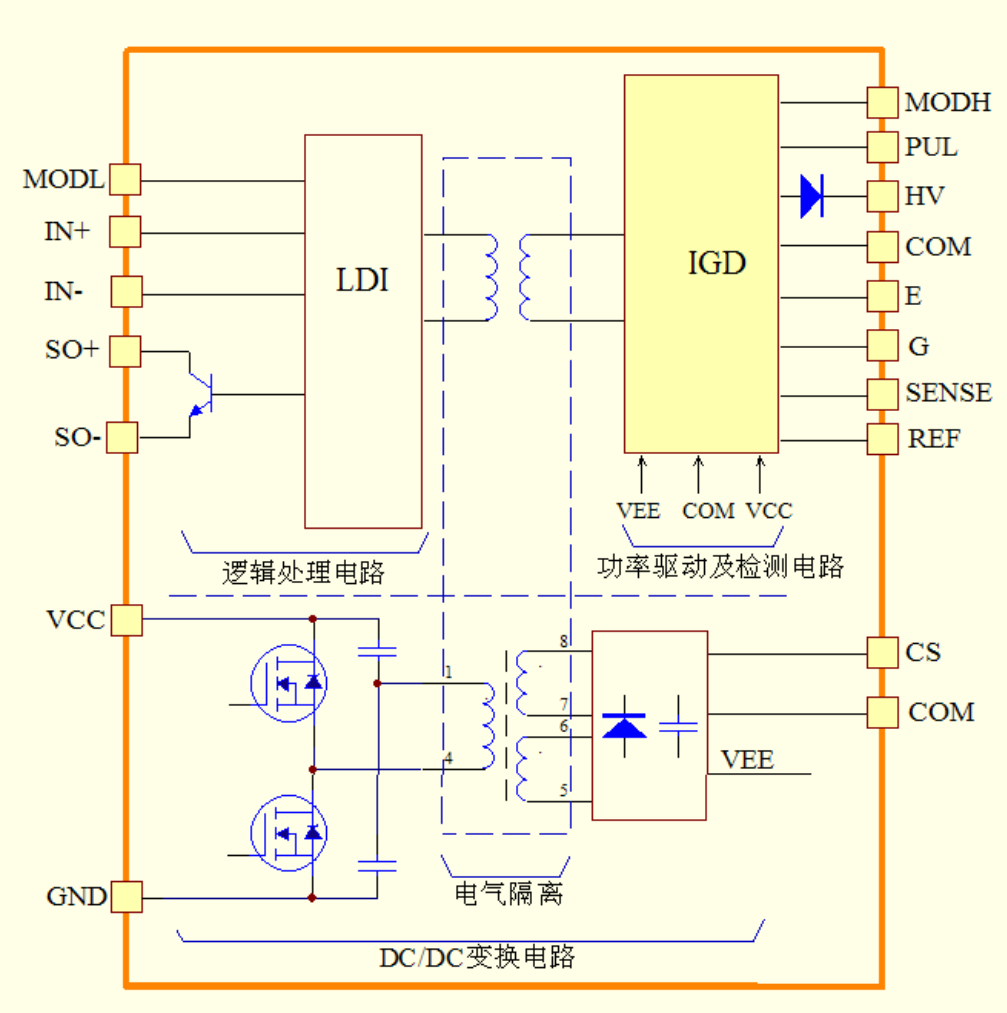
4.Working Principle

4.1 Structure

PSD430-35 high power IGBT driver is mainly composed by inside DC/DC conversion circuit, logic processing circuit, power driver and Detection circuit.

Integrated DC/DC:All standard WEPOWER series of high-power IGBT intelligent drive module includes a DC / DC converter to provide isolation power supply for each drive channel. So just to provide a stable 15V DC power supply to the drive. PSD430-35 The inside DC/DC drive capability is 4W.

PSD430-35 Internal structure shown below：



PSD430-35 Schematic

4.2 Protection Features

PSD430-35 drive module is with V_{CE} detection circuit,Once detected V_{CE} exceeds the set threshold or drive voltage under-voltage fault, the module will immediately generate a fault signal in the low pressure side. When it is in error status, the module is under work mode, and shut-off the IGBT immediately and generate an error signal at the low end. If the module is under series and parallel connection,it will not shut-off the IGBT, and generate an error signal and will shut-off the IGBT under in series and parallel connection by the customer control circuit.

4.3 Work Mode

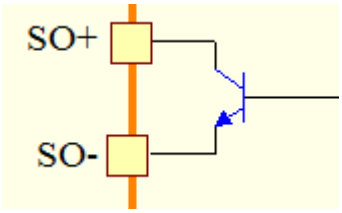
PSD430-35 with series and parallel connection work mode to select. When pin MODL and pin MODH are high level, it is under series and parallel connection work mode (multi-leve). It will be common mode when pin MODL connected to low level or not connected,and pin MODH is not connected. When it under series and parallel connection work mode (multi-leve), if over-current or under-voltage error appear,PSD430-35 will not shut-off the IGBT, it will immediately generate an error signal at the low end and will let the customer control circuit to shut-off the IGBT at the same time,and immediately generate an error signal at the low end.

4.4 Pin Description

4.4.1 Low pressure side pin

Pin GND: Low pressure side power supply
Pin VCC: Low pressure side +15V
It is recommended to connect 220uF/25V Filter capacitor between VCC and GND
Pin IN-: Low pressure side signal input -
Pin IN+: Low pressure side signal input +
Pin SO+: Low pressure side error output +
Pin SO-: Low pressure side error output -

Pin SO+ and SO- is separately connected to the Collector and Emitter of the internal error output transistor, detailed as below:

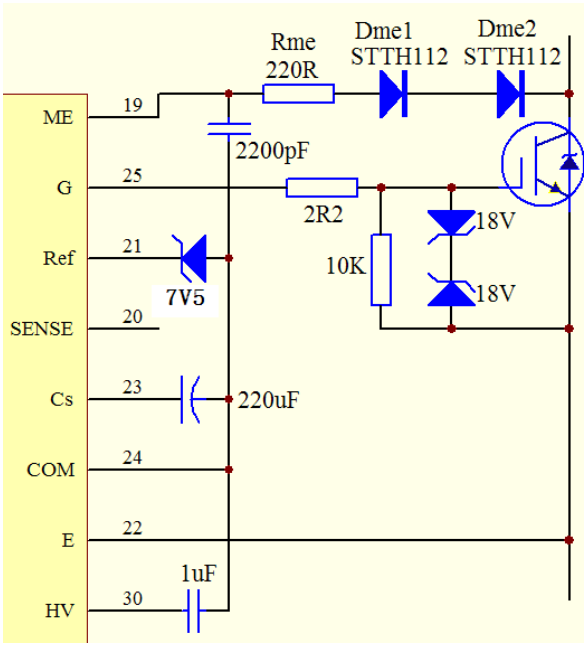


Internal circuit fault output structure

Pin MODL: Low pressure side mode selection
When pin MODL connect to low level or not connected and pin MODH is not connected,PSD430-35 is under common mode. When MODL and MODH are high level, PSD430-35 is under series and parallel connection work mode (multi-leve).

4.4.2 High pressure side pin

Pin ME: V_{CE} Voltage monitoring terminal



This pin is used to measure the voltage drop when the IGBT module is open to ensure the protection circuit works properly if short circuit and overload appear. Please note NOT directly connect to the Drain and Source poles of the transistor in order to avoid the monitoring terminal receive high drain or collector voltage when the power device shut-off, it should be connected to a few high-impedance diodes.

The pull-up resistor in the drive will ensure there will be current flow the measuring diodes (Dme) ,Divider resistor (Rme) and power semiconductor when the transistor turn-on. The forward voltage drop and diode drop of the voltage drop across resistor can be measured at the measuring end when the transistor opened. Rme will reduce the peak current of the reverse direction on Dme. Rme could be 100-220 Ohm. Please note the power transistor will not turn-on immediately,therefore, access to external pull up resistor and a capacitor in the power tube after

the opening to be delayed for a short time ta before measurements. This delay is called the response time.This response time is inversely proportional to the speed of opening the power.The response time ta usually take 5-10uS. The response time calculated as following:

$$C_{me} = \frac{t_a}{4.7\,k\Omega \ \ln\left(\frac{V_{cc}}{V_{cc} - V_{ref}}\right)}$$

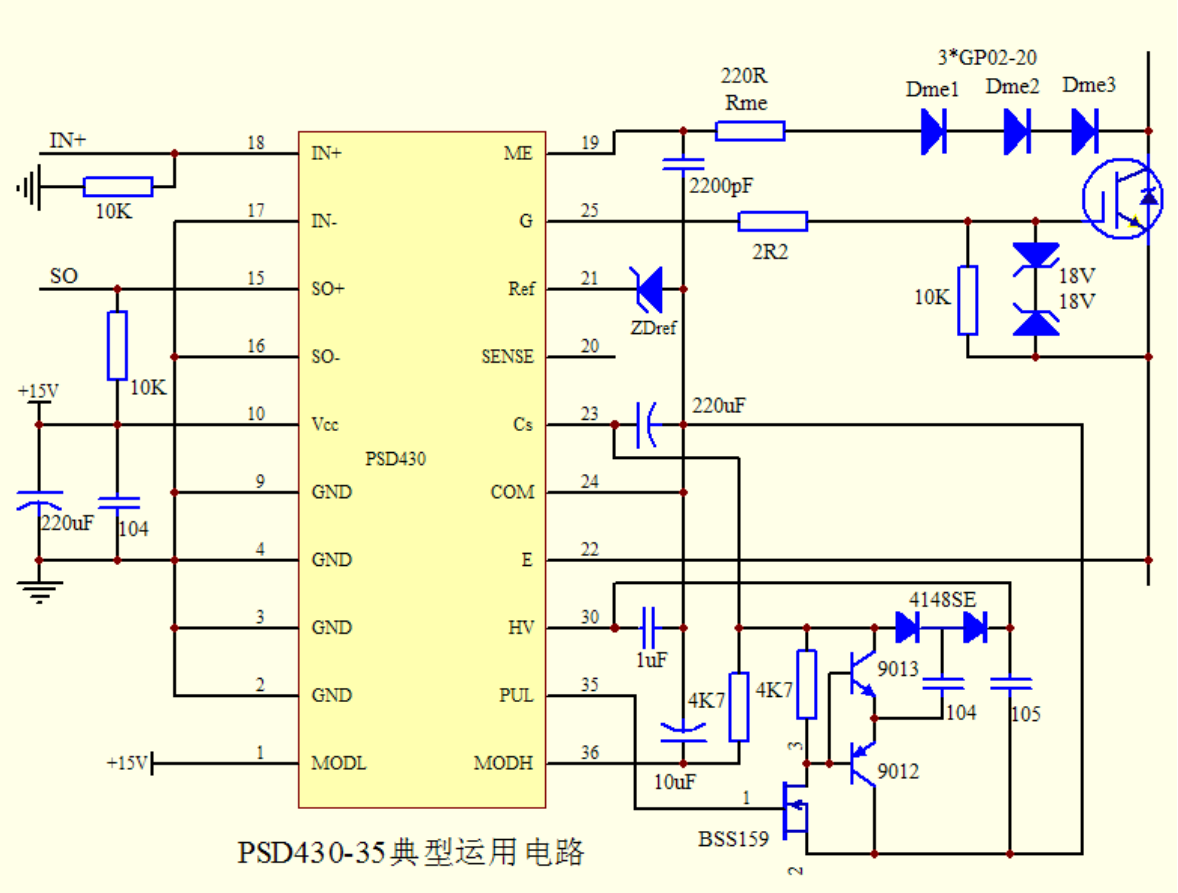
Pin SENSE: Active clamp input terminal
Pin REF: Over current threshold setting terminal
Through an external connection of voltage regulator diode to set the over current threshold of the Module.

Pin E: Emitter output terminal
Pin Cs: +15V output terminal
It is recommended to connect 220uF/25V Filter capacitor between Cs and COM.

Pin G: G pole output terminal
Try to use short wire as possible to connect pin G and pin 25 of the module. Connect reverse zener diode (18V) between the gate and emitter in order to prevent parasitic voltages exceeding the rated voltage of the gate and to damage the IGBT.Pin G is connected to the G and E of the IGBT,the wire can be as short as possible, possibly directly connect to the pin 22 of the IGBT. The connection wire for G,E and C of IGBT could be stranded wire.

Pin COM: high pressure terminal power ground
Pin HV: high pressure terminal positive power supply detection circuit
It is recommended to connect 1uF Filter capacitor between HV and COM.

Pin PUL:high pressure terminal internal DC/DC pulse output terminal
Through the pulse signal of this pin to compose a simple boost circuit to provide power supply to the detection circuit (HV) of the module.Specific circuit as shown below:



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The setting equation of IGBT module over current threshold protection as:

$V_{th} = V_{ZDref} - V_{Rm\,e} - V_{Dme}$ (Rme is about 0.5V)

In the circuit, $V_{th} = V_{ZDref}$ - 0.5V - 3*1.5，that is $V_{th} = V_{ZDref}$ - 5V, when choose a high value of V_{th}, it needs to increase the voltage of HV. The default value of pin HV is 15V, and it can be increased to 26V through above schematic.

Pin MODH: high pressure terminal work mode selection

When pin MODH is not connected and pin MODL connected to low level or not connected,PSD430 is under common mode. When pin MODH and MODL are connected to high level,PSD430 is under series and parallel connection work mode (multi-leve)

4.5 Precautions

(1) The capacitance value between pin 10 VCC and pin 9 GND can not be less than between pin 23 Cs and pin 24 COM, and its value should less

than 20μF.

(2)The connection wire between the drive module and IGBT module should be as short as possible. It can not over 10cm. The wire connected to the Gate,Emitter,Measuring foot (Drain and collector) must use **stranded wire.**

(3)Try to minimize parasitic inductance of the circuit.In our design modulator,the driving circuit and the equalizing circuit is designed by PCB and fixed on the pin of IGBT directly,in this way to reduces the distributed inductance caused by the phenomenon of excessive EMF.

5. 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 stands for the real driving power not including the losses in drive channel and drive power supply.)

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