

ASIC IC INTRODUCTION

Agenda

1. Introduction to iT1300E/iT8300T
2. Introduction to iT8320/iT8321
3. Introduction to iT8310/iT8311
4. Introduction to iT8330
5. Emulator connection and iNGUI software operation
6. Hall sensor placement position

1. iT1300E/iT8300T 介紹

1. iT1300E/iT8300T introduction

Digital Single Phase BLDC Motor Controller

Features

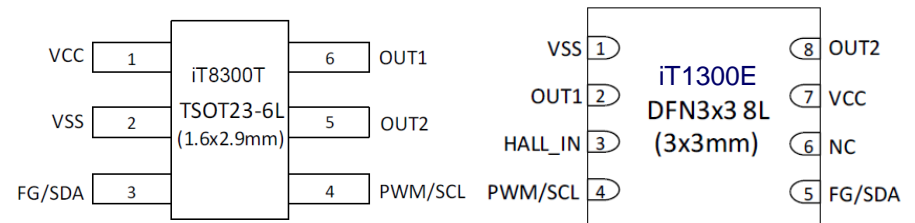
- Direct PWM control
- Embedded Hall Sensor
- Wide Range 3.5V to 16V Operating Input
- Integrated Power MOSFETs
- Programmable Speed Curve
- Adjustable Lead Angle $\pm 90^\circ$
- Adjustable Lockout Detection and Automatic Recovery
- Adjustable Silence Current Control
- Selectable FG/Alarm/RD Signal Output
- 1KHz~100KHz PWM Input Frequency Range
- 25K/50KHz Output Switching Frequency
- Cycle by Cycle Current Limit
- Selectable Open Loop and Close Loop
- Adjustable Input Duty and Output Duty Slope
- Soft Start and Kick Start
- TSD, OCP, OVP, UVP, and Automatic

Recovery

Applications

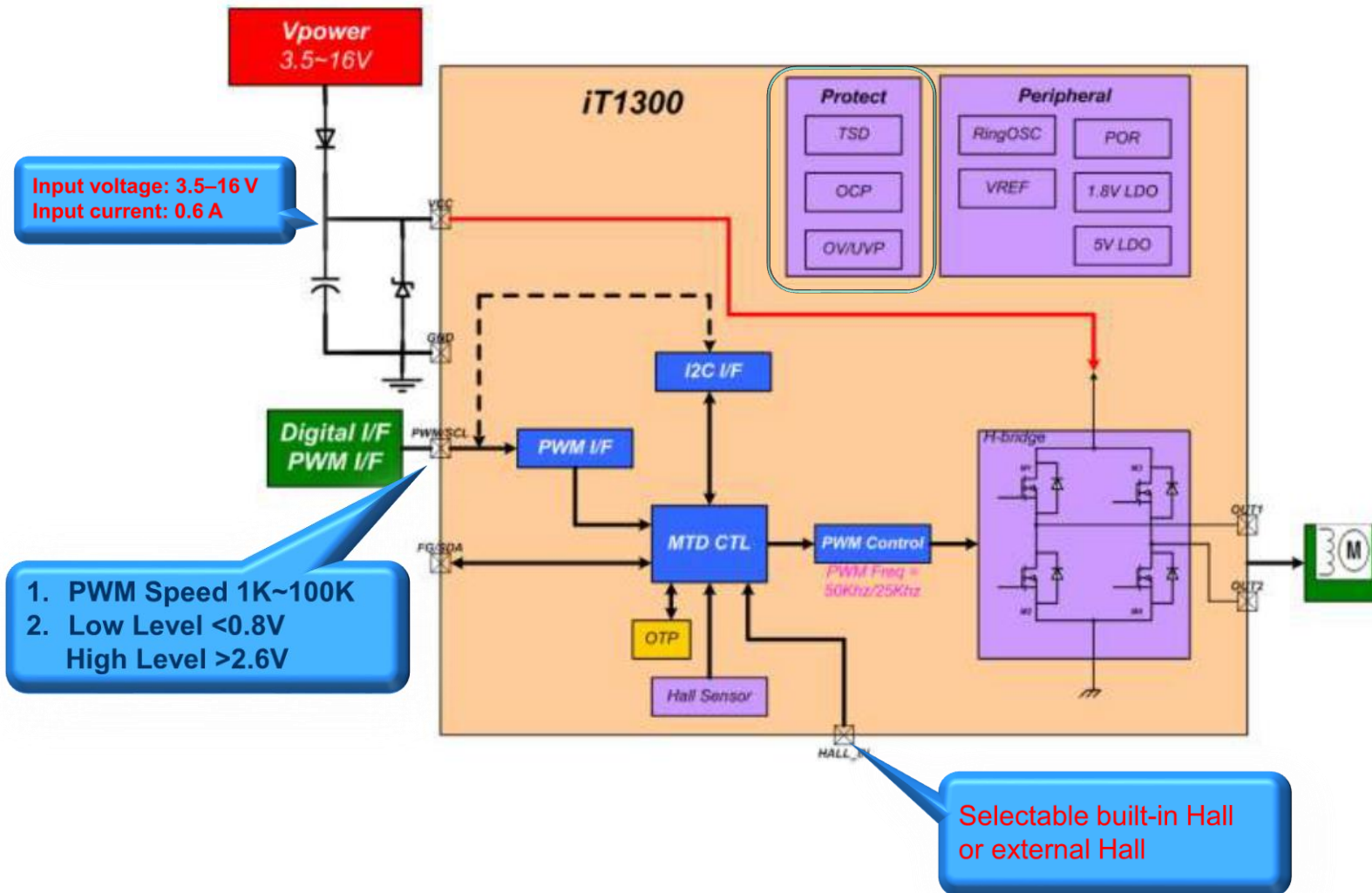
Cooling Fan

Pin Assignment



1.iT1300E/iT8300T introduction

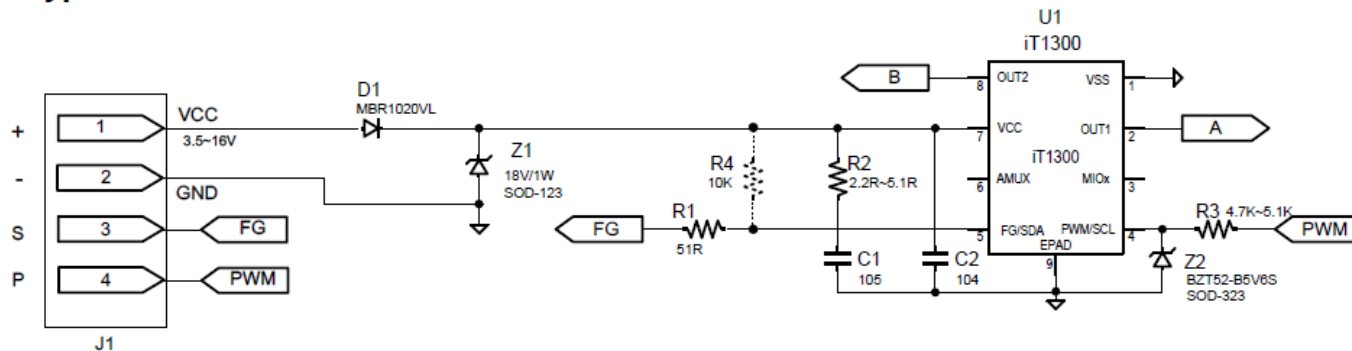
-- iT1300E Block Diagram



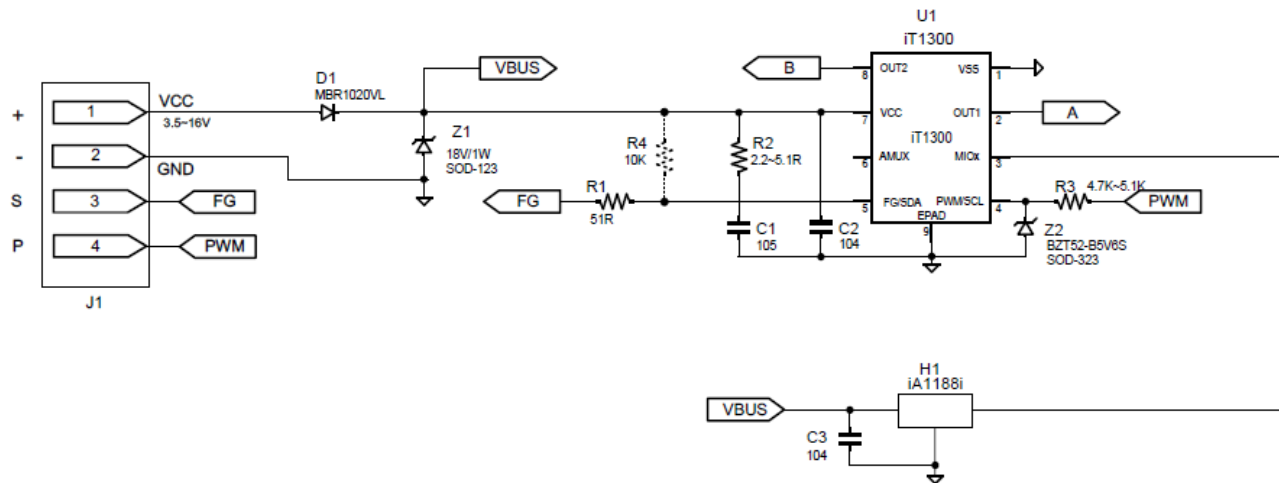
1. iT1300E/iT8300T introduction

-- iT1300E Application Scheme

<Typical>

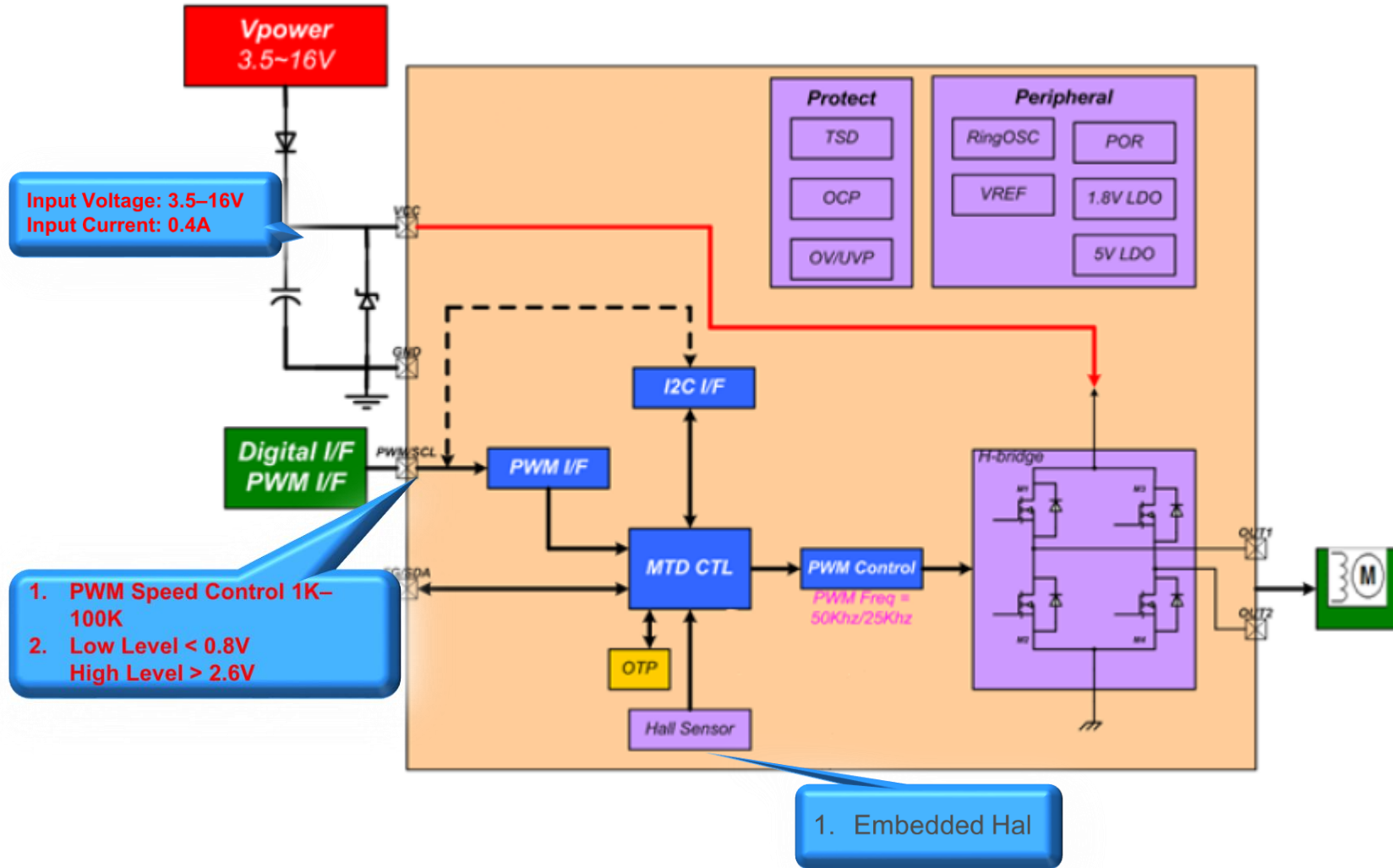


<To use external hall IC>



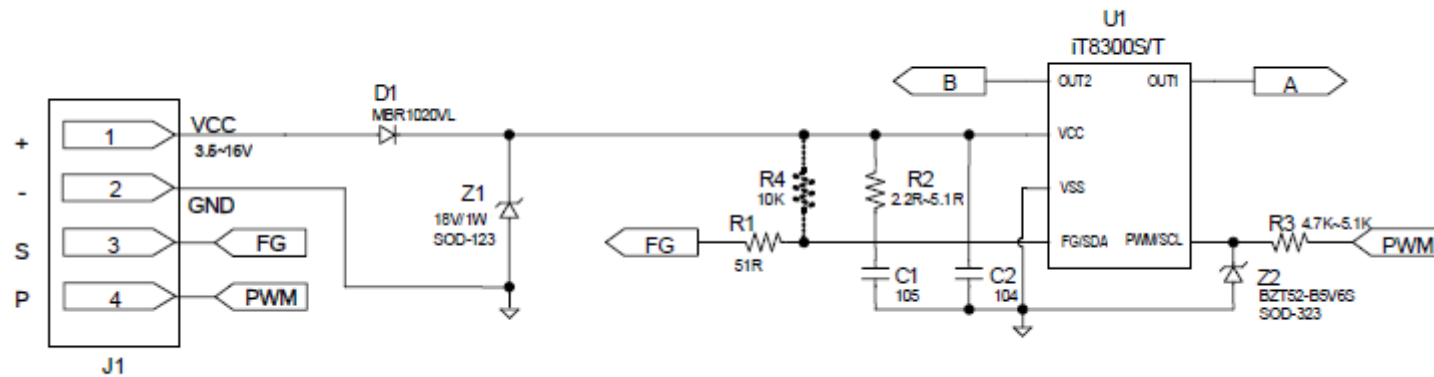
1.iT1300E/iT8300T introduction

-- iT8300T Block Diagram



1. iT1300E/iT8300T introduction

-- iT8300T Application Scheme



2. iT8320E / iT8321E Introduction

2. iT8320E / iT8321E introduction

Digital Single Phase BLDC Motor Controller

Features

- Direct PWM control
- Supports Hall IC(iT8320E)
- Wide Range 3.5V to 16V Operating Input
- Integrated Power MOSFETs
- Programmable Multi Points Speed Curve
- Adjustable Lead Angle $\pm 45^\circ$
- Adjustable Lockout Detection and Automatic

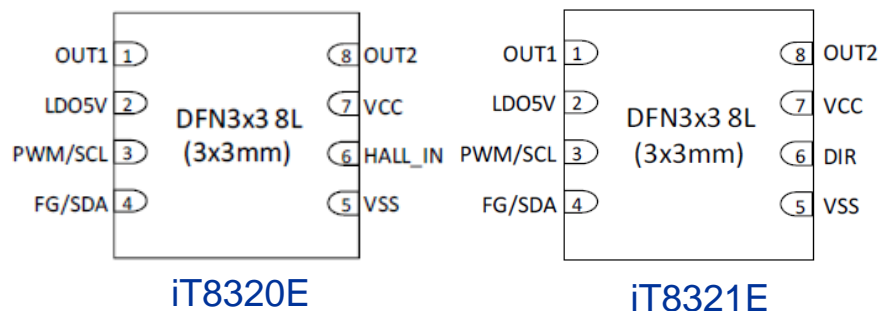
Recovery

- Adjustable Silence Current Control
- Selectable FG/Alarm/RD Signal Output
- 1KHz~100KHz PWM Input Frequency Range
- 25K/50KHz Output Switching Frequency
- Cycle by Cycle Current Limit
- Selectable Open Loop and Close Loop
- Adjustable Input Duty and Output Duty Slope
- Soft Start and Kick Start
- TSD, OCP, OVP and Automatic Recovery

Applications

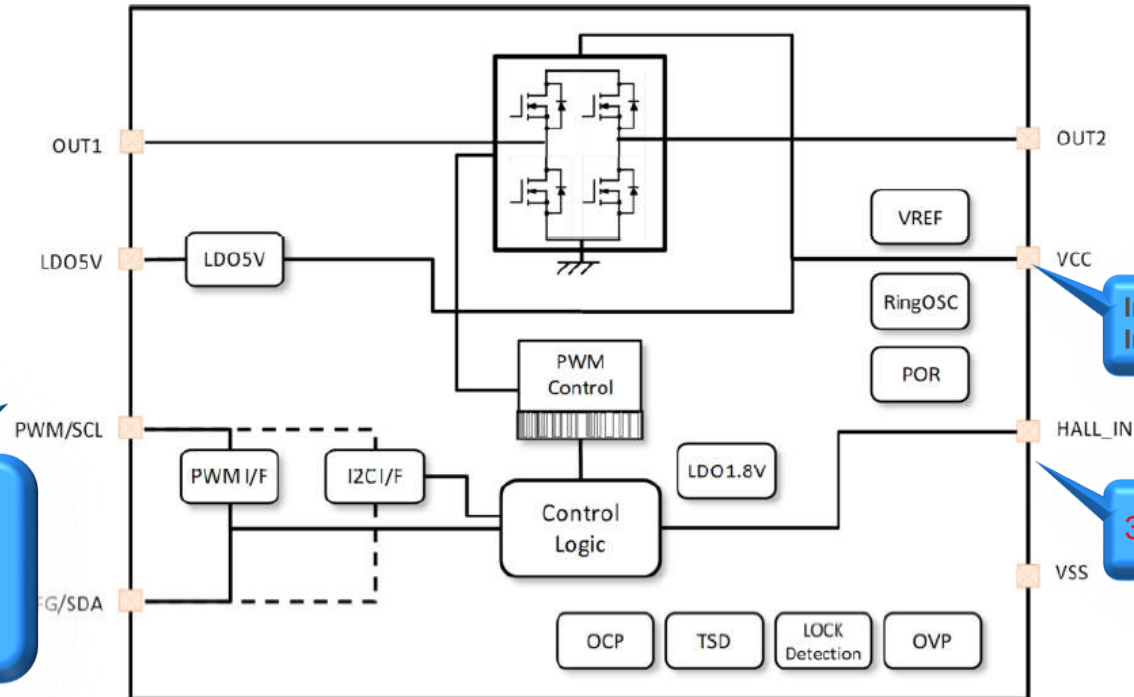
Cooling Fan

Pin Assignment



2. iT8320E / iT8321E introduction

-- iT8320E Block Diagram



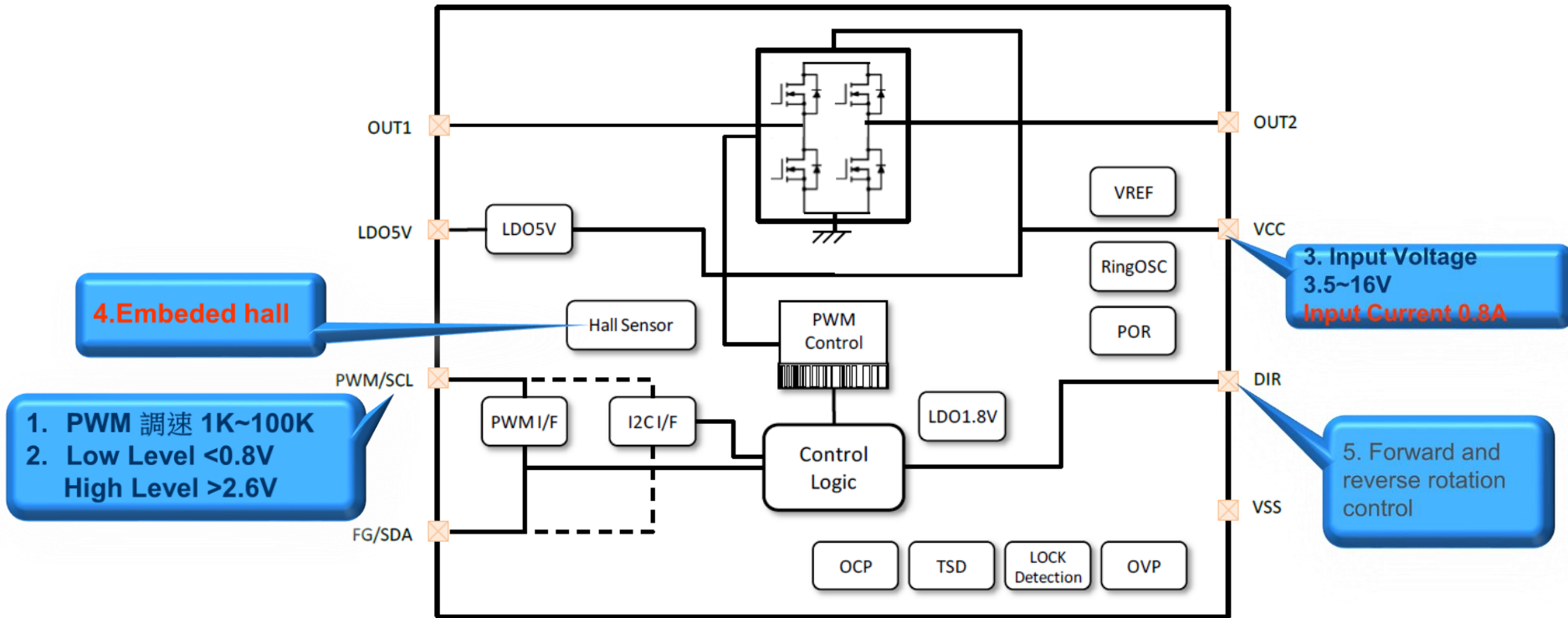
1. PWM Speed Control
1K–100K
2. Low Level < 0.8V High
Level > 2.6V

Input Voltage: 3.5–16V
Input Current: 0.8A

3. External Hall

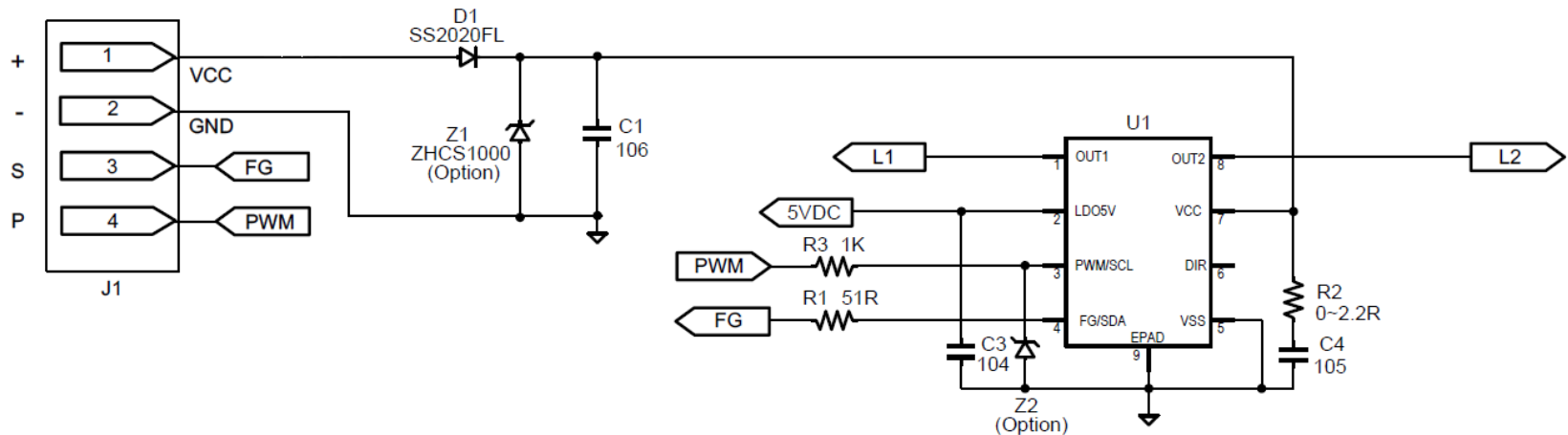
2. iT8320E / iT8321E introduction

-- iT8321E Block Diagram



2. iT8320E / iT8321E introduction

-- iT8321E Application Scheme



3. iT8310/iT8311 Introduction

3. iT8310/iT8311 introduction

Digital Single Phase BLDC Motor Controller

Features

- Direct PWM control
- Supports Hall IC(iT8311E)
- Wide Range 3.5V to 16V Operating Input
- Integrated Power MOSFETs
- Programmable Multi Points Speed Curve
- Adjustable Lead Angle $\pm 45^\circ$
- Adjustable Lockout Detection and Automatic

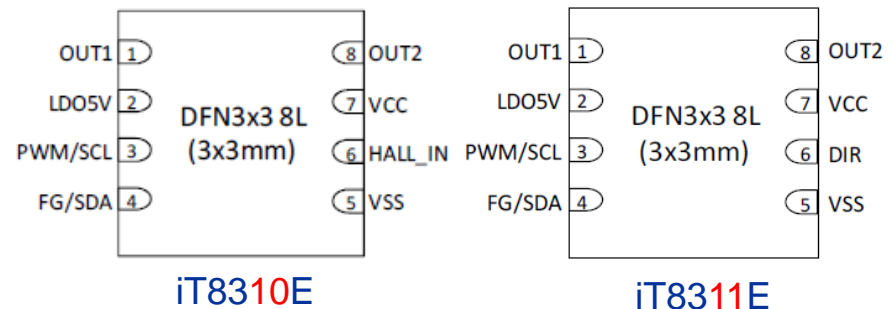
Recovery

- Adjustable Silence Current Control
- Selectable FG/Alarm/RD Signal Output
- 1KHz~100KHz PWM Input Frequency Range
- 25K/50KHz Output Switching Frequency
- Cycle by Cycle Current Limit
- Selectable Open Loop and Close Loop
- Adjustable Input Duty and Output Duty Slope
- Soft Start and Kick Start
- TSD, OCP, OVP and Automatic Recovery

Applications

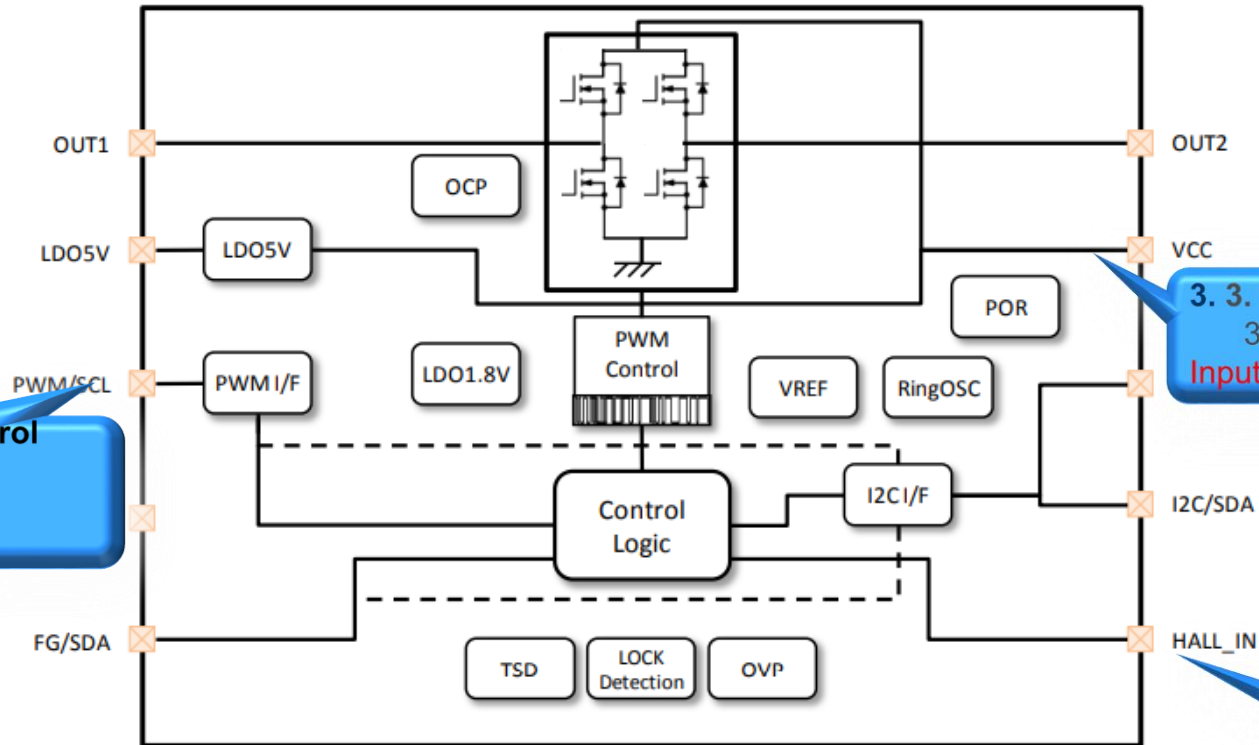
Cooling Fan

Pin Assignment



3. iT8310/iT8311 introduction

-- iT8310E Block Diagram



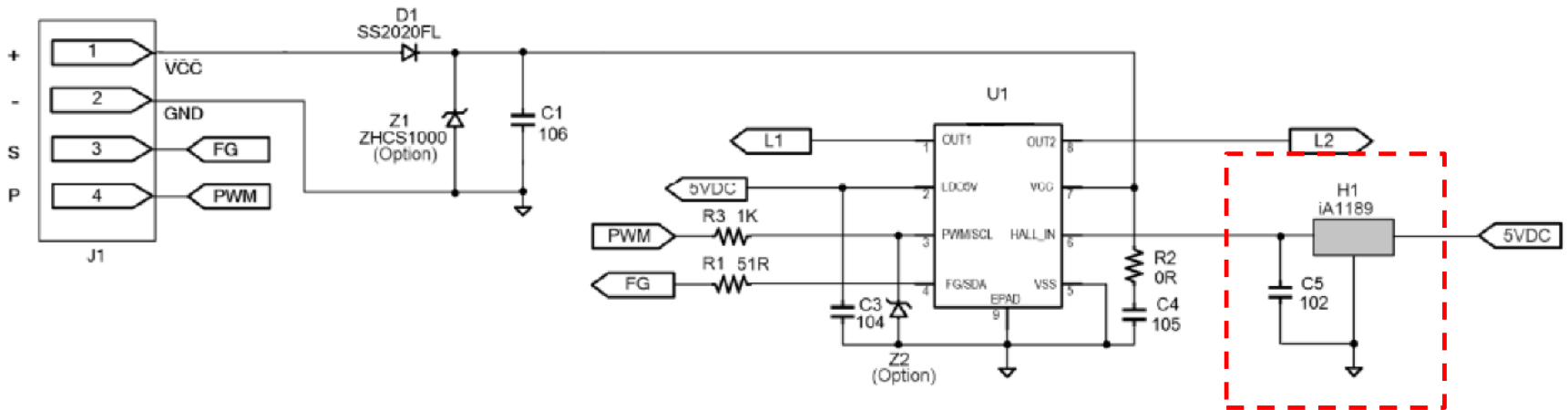
1. PWM Speed Control
1K~100K
2. Low Level <0.8V
High Level >2.6V

3. 3. Input voltage:
3.5~16 V
Input current: 1.2 A

4. External
Hall Sensor

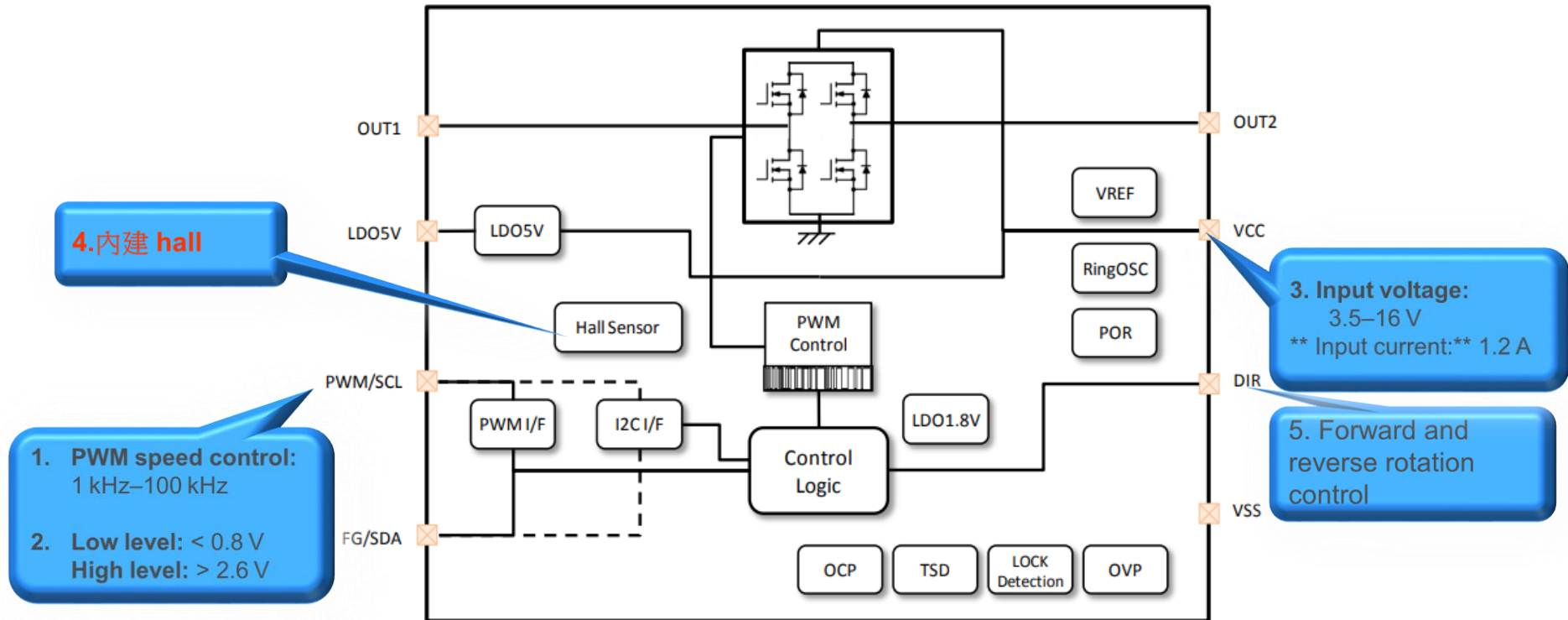
3. iT8310/iT8311 introduction

-- iT8310E Application Scheme



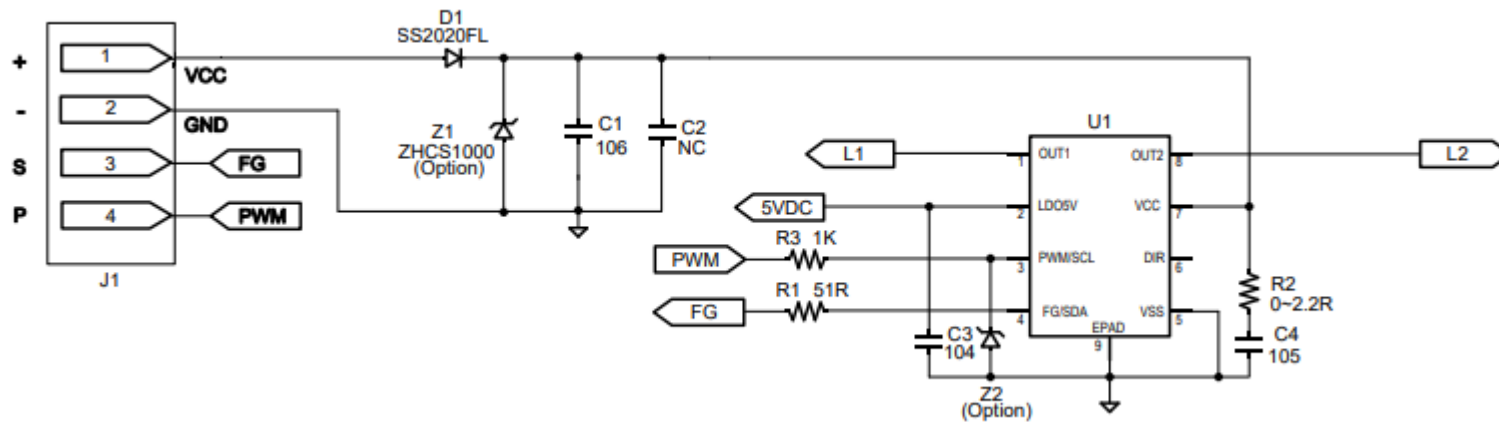
3. iT8310/iT8311 introduction

-- iT8311E Block Diagram



3. iT8310/iT8311 introduction

-- iT8311E Application Scheme



4. iT8330 Introduction

4. iT8330E introduction

Features **Digital Single Phase BLDC Motor Controller**

Direct PWM control

DC **VSP control 0.2V~3.3V**

Supports Hall IC (DFN8)

Wide Range **3.0V to 28V** Operating Input

Integrated Power MOSFETs

Programmable Multi Points Speed Curve

Adjustable Lead Angle $\pm 45^\circ$

Selectable Lockout Detection Time and Automatic Recovery Time

Adjustable Silence Current Control

Selectable FG/Alarm/RD Signal Output

1KHz~100KHz PWM Input Frequency Range

25K/50KHz Output Switching Frequency

Cycle by Cycle Current Limit

Selectable Open Loop and Close Loop

Adjustable Input Duty and Output Duty Slope

Soft Start and Kick Start

Low Voltage Kick Duty Compensation

TSD, OCP, OVP and Automatic Recovery

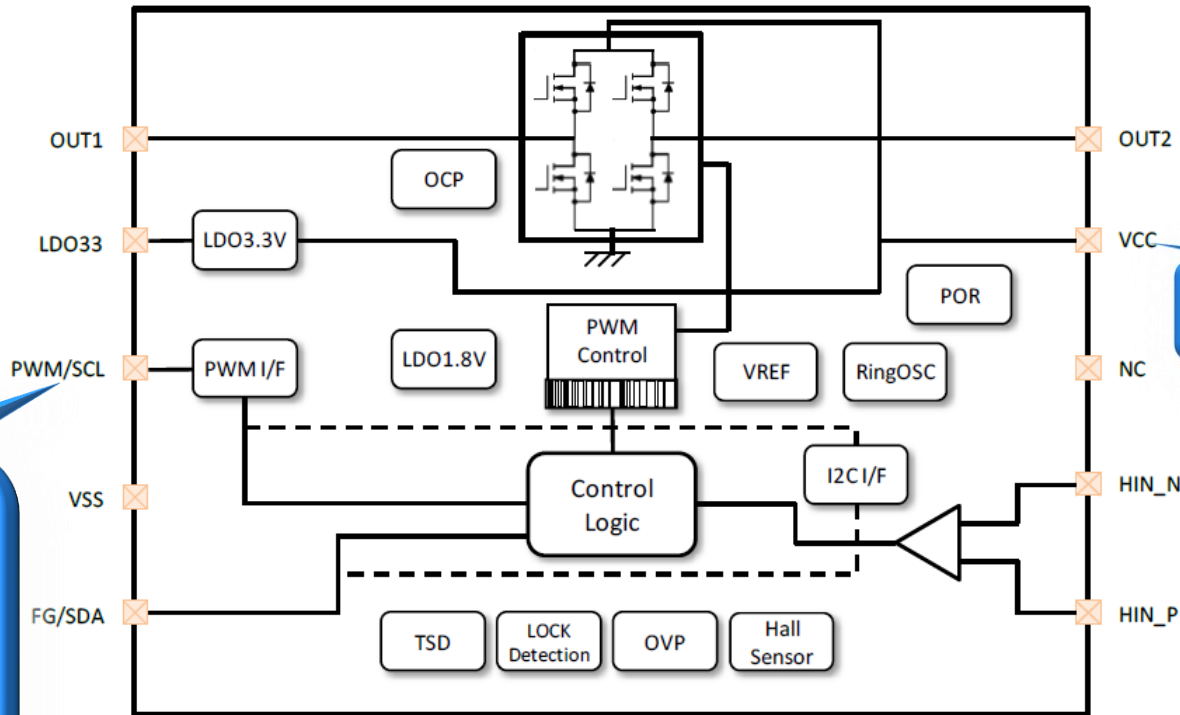
Pin Assignment

Applications

Cooling Fan

4. iT8330E introduction

-- iT8330E Block Diagram



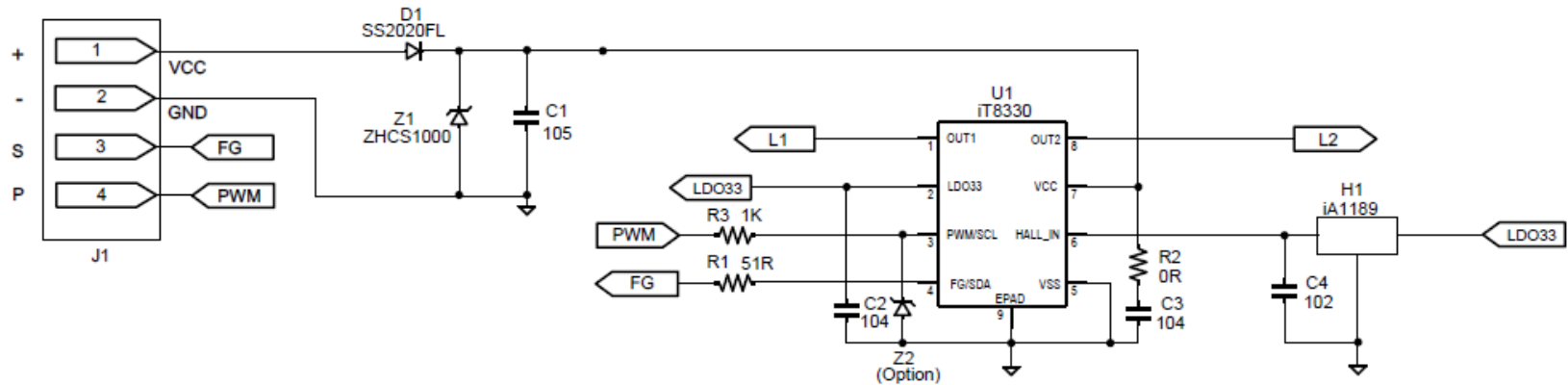
5. Voltage: 3.0–28.0 V
 ** Current:** 0.4 A

4. External Hall

1. PWM speed control:
 1 kHz–100 kHz
 2. Low level: < 0.8 V
 High level: > 2.6 V
 3. VSP: 0.2–3.3 V
 speed control

4. iT8330E introduction

-- iT8330E Application Scheme



Performance Comparison Matrix

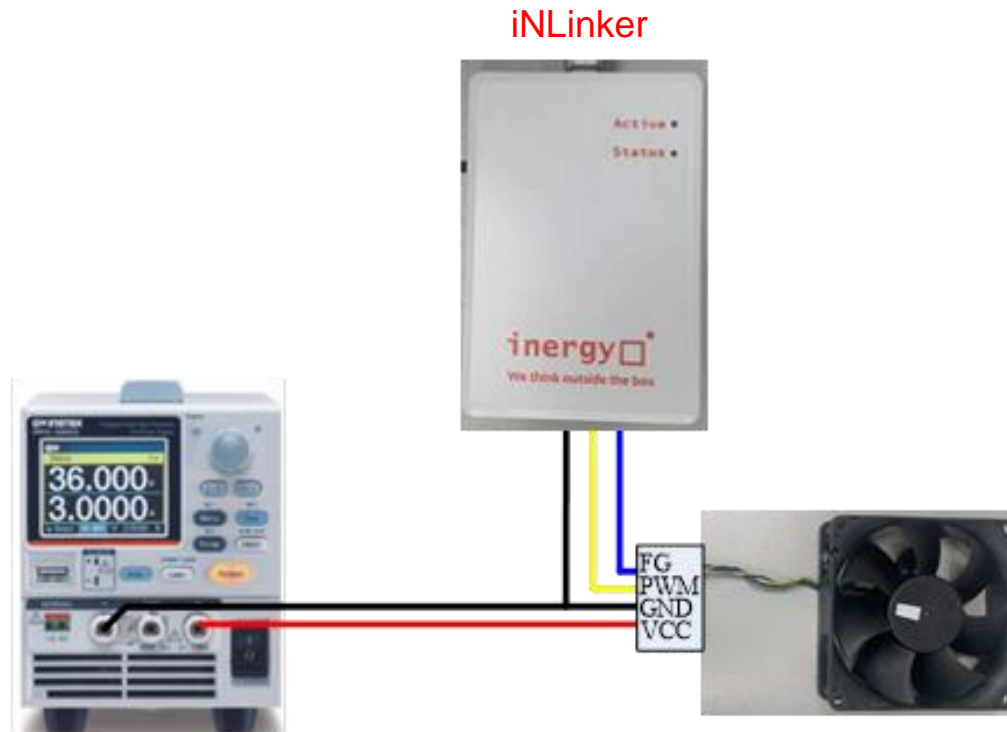
Part No.	IT1300E	IT8310E	IT8311E	IT8320E	IT8321E	IT8300T	IT8330E
Package	DFN8 3x3	DFN8 3x3	DFN8 3x3	DFN8 3x3	DFN8 3x3	TSOT23-6	DFN8 3x3
Hall sensor	Embedded	Hall IC	Embedded	Hall IC	Embedded	Embedded	Hall IC/Element
Input Voltage (V)	3.5-16	3.5-16	3.5-16	3.5-16	3.5-16	3.5-16	3- 24
Max. Voltage (V)	20	22	22	22	22	20	35
Driving MOS	N+N	N+N	N+N	N+N	N+N	N+N	N+N
Tuning I/F	I2C	I2C	I2C	I2C	I2C	I2C	I2C
Motor	Single	Single	Single	Single	Single	Single	Single
Continuous Current (A)	0.6	1.2	1.2	0.8	0.8	0.4	0.6A@12V
Speed Command	Direct PWM	Direct PWM	Direct PWM	Direct PWM	Direct PWM	Direct PWM	Direct PWM VSP
Speed Control	Close loop Open loop	Close loop Open loop	Close loop Open loop	Close loop Open loop	Close loop Open loop	Close loop Open loop	Close loop Open loop (feedback)
Speed Curve Fitting	X	3 points	3 points	3 points	3 points	X	3 points
PWM ON /OFF Duty	○	○	○	○	○	○	○
PWM Pull UP/DOWN	○	○	○	○	○	○	○
Soft start	Current limit	Current limit PWM step	Current limit PWM step	Current limit PWM step	Current limit PWM step	Current limit	Current limit KP, KI PWM step
Kick Start	6.25%~100%	6.25%~100%	6.25%~100%	6.25%~100%	6.25%~100%	6.25%~100%	6.25%~100%
Phase Angle	Fixed/Linear	Fixed/Linear	Fixed/Linear	Fixed/Linear	Fixed/Linear	Fixed/Linear	Fixed/Linear
Cycle by Cycle current limit	○	○	○	○	○	○	○
Waveform Adjustment	○	○	○	○	○	○	○
FG output	8 kinds	8 kinds	8 kinds	8 kinds	8 kinds	8 kinds	8 kinds
Over Voltage Protection	○	○	○	○	○	○	○
Over Current Protection	○	○	○	○	○	○	○
Thermal Shutdown Protection	○	○	○	○	○	○	○
Lock Detection	0.25s/0.5s	0.25s/0.5s	0.25s/0.5s	0.25s/0.5s	0.25s/0.5s	0.25s/0.5s	0.25s/0.5s
Lock Restart	2.5/5/7.5/10sec	2.5/5/7.5/10sec	2.5/5/7.5/10sec	2.5/5/7.5/10sec	2.5/5/7.5/10sec	2.5/5/7.5/10sec	2.5/5/7.5/10sec
OTP	2 banks	2 banks	2 banks	2 banks	2 banks	2 banks	2 banks

5. Emulator connection and iNGUI software operation

5. Emulator connection and iNGUI software operation

5-1. iNLinker Tuning Mode:

Applicable when the ASIC IC has not been programmed. You can use iNLinker alone for tuning. The DC power can be supplied directly to the motor, without any voltage drop in the circuit.



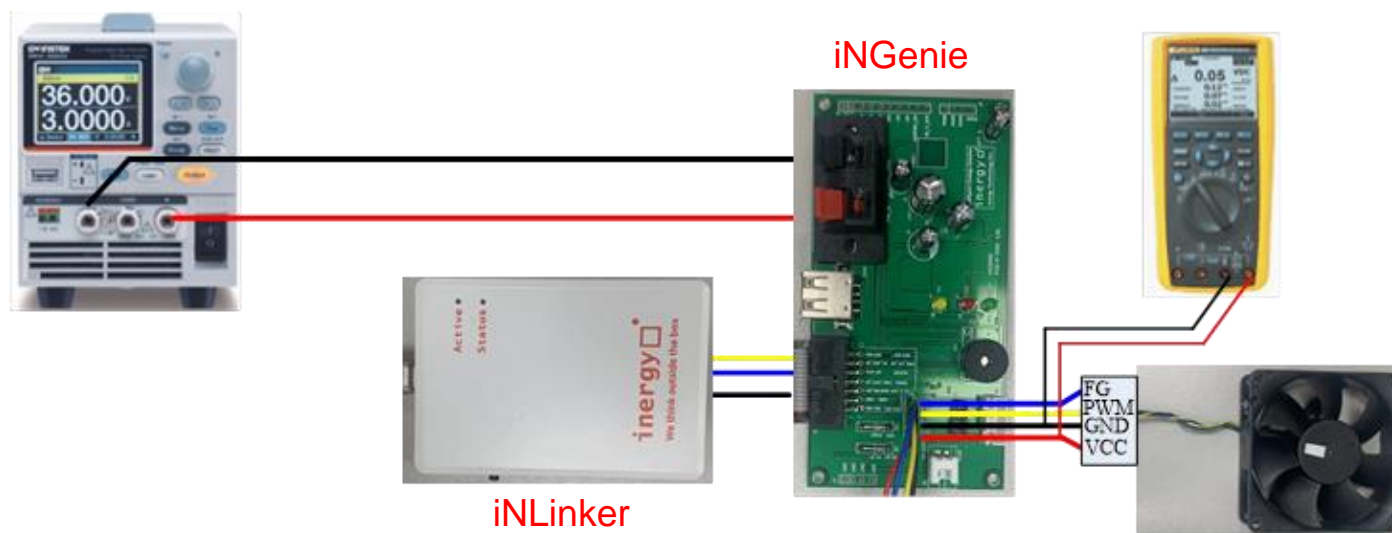
Note: During programming, the input voltage must be manually set to 7.5 V before proceeding.

5. Emulator connection and iNGUI software operation

5-2. iNLinker + iNGenie Tuning Mode:

Connect the DC source to the iNGenie input. Since iNGenie has a built-in production-line programming

control circuit, this circuit includes a MOSFET switch and a reverse-protection diode, which cause a voltage drop. When tuning, it is recommended to connect a multimeter to the motor input lines and manually fine-tune the input voltage under various loads to compensate for the voltage drop in the circuit, preventing differences in motor speed.



5. Emulator connection and iNGUI software operation

5.3-1 Launching the iNGUI Simulation Software: After unzipping, open “iNGUI.exe” to enter the simulator.

XML	2023/2/24 上午 11:36	檔案資料夾	
B00D.bin	2023/2/24 上午 11:36	BIN 檔案	488 KB
iENERGY.ini	2023/2/24 上午 11:37	組態設定	13 KB
iNGUI.exe	2023/2/24 上午 11:36	應用程式	2,858 KB

5.3-2 iNLinker Firmware Update:

After running iNGUI.exe, it will automatically check the iNLinker firmware. If the firmware is outdated, an update screen will appear. Please perform the update to ensure normal usage.



System prompt: iNLinker firmware is outdated.



Perform iNLinker firmware update.

5. Emulator connection and iNGUI software operation

5.3-3 Introduction to iNGUI Software

The screenshot displays the iNGUI software interface with five main pages highlighted by red numbers 1 through 5. The interface is divided into several sections:

- Page 1 (IC OTP):** Includes a 'Load Parameters' section with 'From' options (Setting File, AP Buffer, IC OTP, iNLinker, Clear All) and a 'Burn and Compare' section with 'Burn' and 'Compare' buttons. The 'Burn and Compare' section has 'Source' and 'Target' radio button options.
- Page 2 (Speed Curve):** Not visible in the screenshot.
- Page 3 (Output PWM and Waveform):** Not visible in the screenshot.
- Page 4 (Motion Control):** Not visible in the screenshot.
- Page 5 (Protection):** Not visible in the screenshot.

The 'Info Window' section includes a 'Setting File Name' field (set to 'None') and a 'Checksum' section with four buttons: File (None), Buffer (None), OTP (None), and iNLinker (None).

The 'Read IC Info' and 'Write IC Info' section includes a table with the following data:

Read IC Info	Write IC Info
IC ID:	IT1300
IC Version:	AB
IC Code:	F

Below the table is a list of addresses and their corresponding parameters:

Address	File	AP Buffer	IC OTP	iNLinker B00D
TUNEPAM0.8008_0004.1[7:0]h				
TUNEPAM1.8008_0005.1[7:0]h				
TUNEPAM2.8008_0006.1[7:0]h				
TUNEPAM3.8008_0007.1[7:0]h				
TUNEPAM4.8008_0008.1[7:0]h				
TUNEPAM5.8008_0009.1[7:0]h				
TUNEPAM6.8008_000A.1[7:0]h				
TUNEPAM7.8008_000B.1[7:0]h				
TUNEPAM8.8008_000C.1[7:0]h				
TUNEPAM9.8008_000D.1[7:0]h				
TUNEPAM10.8008_000E.1[7:0]h				
TUNEPAM11.8008_000F.1[7:0]h				
TUNEPAM12.8008_0010.1[7:0]h				
TUNEPAM13.8008_0011.1[7:0]h				
TUNEPAM14.8008_0012.1[7:0]h				
TUNEPAM15.8008_0013.1[7:0]h				

iNGUI is divided into 5 main pages, as follows:

- File Information
- Speed Curve Settings
- Output Waveform Settings
- Settings for Advance Angle, Rotation Direction, Startup, Simulation, etc.
- Protection Settings

5. Emulator connection and iNGUI software operation

5.3-4 Introduction to iNGUI Software — Page 1: File Information

When iNLinker and iNGUI are properly connected, the software will show a **green light**. If iNLinker is not connected, it will show a **red light**.

Step 1: A green light indicates a successful connection.

Step 2: Click "Read Info" to read the IC model information.

Step 3: Load Parameters From:

1. Setting file
2. AP Buffer
3. IC OTP
4. iNLinker
5. Clear All

Step 4: Burn and Compare

Source	Target
<input checked="" type="radio"/> From File	<input type="radio"/> To File
<input type="radio"/> From AP Buffer	<input checked="" type="radio"/> To AP Buffer
<input type="radio"/> From IC OTP	<input type="radio"/> To IC OTP
<input type="radio"/> From iNLinker	<input type="radio"/> To iNLinker

Step 5: Check the Checksum and model information.

File	Buffer	OTP	iNLinker
0x179F	0x179F	None	None

Address	File	AP Buffer	IC OTP	iNLinker B00D
TUNEPAM0.8008_0004.1[7:0]h	0xE0	0xE0		
TUNEPAM1.8008_0005.1[7:0]h	0x50	0x50		
TUNEPAM2.8008_0006.1[7:0]h	0x05	0x05		
TUNEPAM3.8008_0007.1[7:0]h	0x29	0x29		

Step3: Load Parameters

From:

1. Setting file
2. AP Buffer
3. IC OTP
4. iNLinker
5. Clear All

Step4: Burn and Compare

Source:

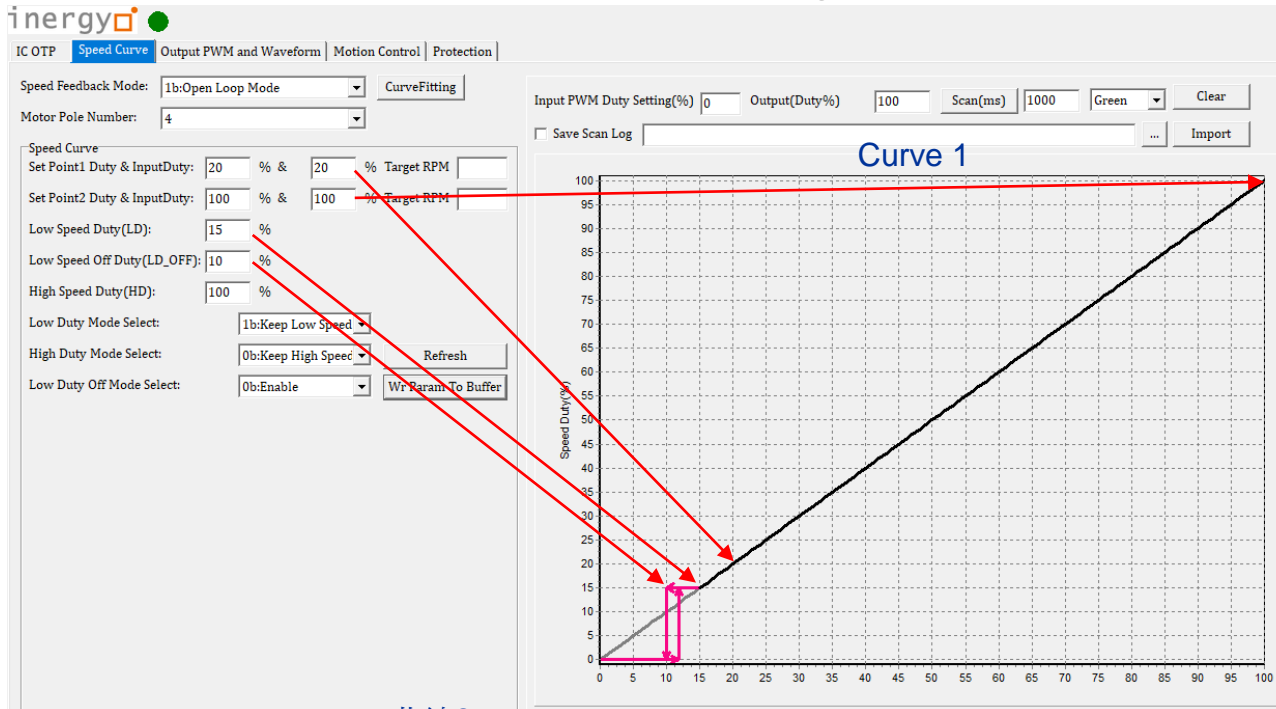
- From file
- From AP Buffer
- From IC OTP
- From iNLinker

Target:

- To File
- To AP Buffer
- TO IC OTP
- To iNLinker

5. Emulator connection and iNGUI software operation

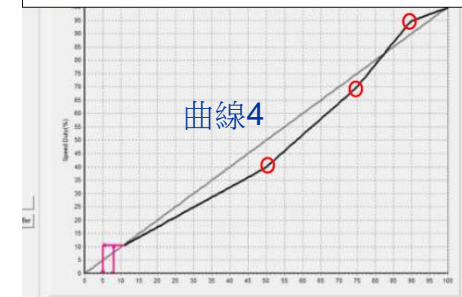
5.3-5 Introduction to iNGUI Software — Page 2: Speed Curve



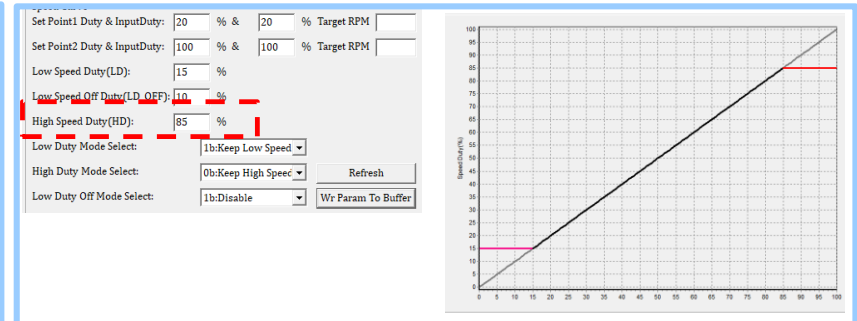
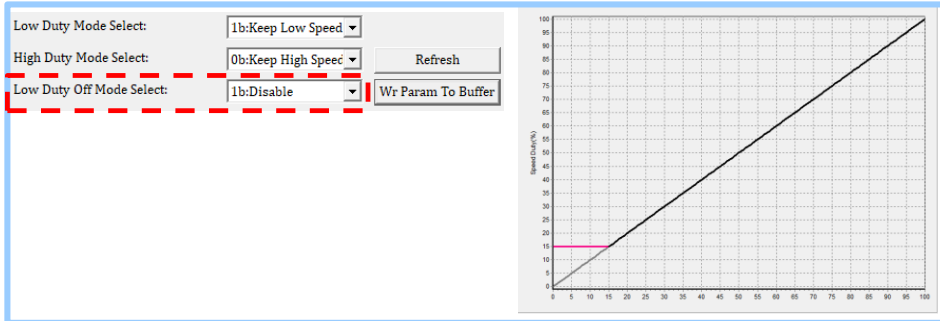
曲線2

1iT1300 & iT8300 support a 2-point slope curve. iT832x & iT831x support a 2-point slope curve and allow adding 3 additional breakpoints to the curve.

“+” and “-” are only available when the IC supports multi-points speed curve.
“+”和“-”只有當 IC 有支援多點速度曲線才會出現。



曲線3



5. Emulator connection and iNGUI software operation

5.3-6 Introduction to iNGUI Software — Page 3: Waveform Settings

Asymmetrical 非对称式	ASY001	3 point + 13 points 前 3 点, 后 13 点	
	ASY002	Square 方波	
Symmetrical 对称式	SYN001	Sinusoid 正弦波	
	SYN002	Root Sinusoid 根号正弦波	
	SYN003	Trapezoid 梯形波	
	SYN004	3rd harmonic Sinusoid 三次谐波正弦波	

Right-click inside the red box to display six built-in waveform parameters. After confirming, click **“Write To Buffer”** to download them to the simulator.

5. Emulator connection and iNGUI software operation

5.3-7 iNGUI 軟件介紹 ---第四頁 轉向,FG訊號,進角調整和線上實測模式.

The screenshot shows the iNGUI software interface with the following sections and highlighted features:

- PI Parameter:** KP: 10000b:1.000x, KI: 00000b:0.000x
- Hall Interface:** Hall Input: 0b:Internal Hall, Hall Polarity: 1b:Invert
- FG & PWM Pin Setting:** Input PWM Duty Polarity: 1b:ON Duty, PWM Pull-Up Resistor: 1b:PWM Pin Default Pull-Up, FG Output: 011b:AL + FG
- Soft Start:** Enable InitBrake: 0b:Disable, Kick-Start Duty: 1001b:62.5%, FG Output Hall Count: 0b:2 Hall Cycle Count
- Test Mode:**
 - Buttons: Disable All Test Mode, Enable Duty Test Mode, Duty Mode, Real Time Monitor
 - Set Input Duty: 50 %
 - Lead Angle:
 - Linear Phase Angle: 1b:Enable Auto Lead Angle
 - Phase Angle Polarity: 1b:Lead Angle
 - Linear Phase StartSpeed: 10
 - Linear Phase StartAngle: 0000000b:0
 - Linear Phase SpeedInterval: 11
 - Set Max Speed & Phase Angle: 3050 RPM, 15
 - Set Min Speed & Phase Angle: 600 RPM, 0
 - Buttons: Calculate, Send
- Monitor:** EQ Monitor Select: 00b:Speed Error(rps_error) Signed Value (def), EQ Monitor Value: 0, Read Back EQ
- Protection Flags:**
 - Over Current Flag: 0b:Normal (default), Read Back Flag
 - Under Voltage Flag: 0b:Normal (default), Clear Error Flag
 - Over Voltage Flag: 0b:Normal (default)
 - TSD Error Flag: 0b:Normal (default)
 - TSD Alarm Flag: 0b:Normal (default)
- Speed and Angle Readings:**
 - Current/Target Speed: RPM, Err-Rate, %
 - Read Back Speed, Average Speed
 - Current Lead Angle: Read Back Angle

1-1. Built-in Hall or External Hall option
1-2. Polarity option

2-1. PWM pull-up resistor 20 kΩ and pull-down resistor 800 kΩ options
2-2. FG has 8 signal output options

3. Kick Start duty setting

4. Advance angle adjustment: Currently, the IC only supports forward angle adjustments from 0 upwards.

5. Real-time simulation control

7. Protection flag reading

6. Speed reading

5. Emulator connection and iNGUI software operation

5.3-8 Introduction to iNGUI Software — Page 5: Protection Settings

The screenshot shows the 'Protection' settings page in the iNGUI software. The interface includes a navigation bar with tabs for 'IC OTP', 'Speed Curve', 'Output PWM and Waveform', 'Motion Control', and 'Protection'. The 'Protection' tab is active. The settings are organized into four main sections:

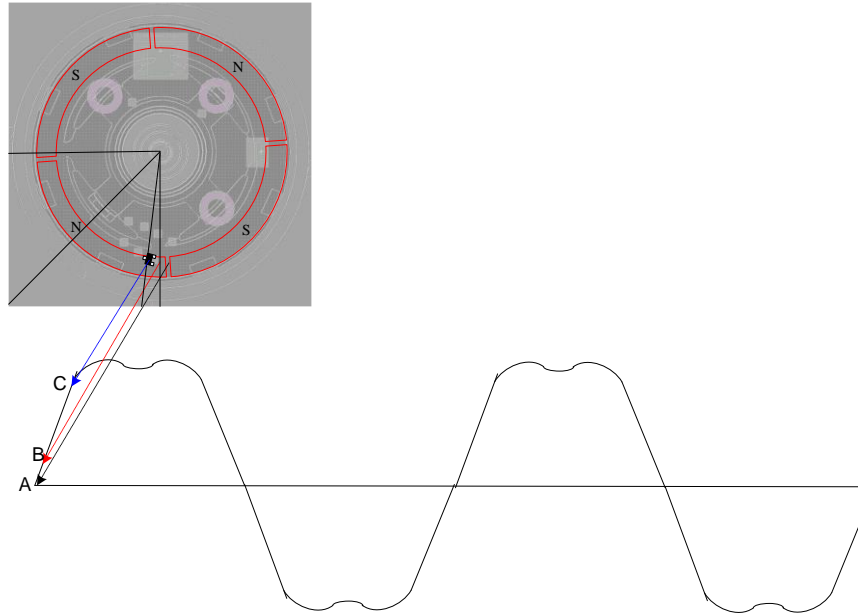
- Current Protect Parameter:**
 - Current Limit Gain: 1b:Enable
 - Current Limit Level: 0010b:0.6A
 - OverCurrent Protect: 1b:Enable
 - OverCurrent Level: 0101b:1.2A
- TSD Protect Parameter:**
 - TSD Protect: 1b:Enable
 - TSD Error Level: 0b:150 degree C
 - TSD Alarm Level: 1b:125 degree C
- Lock Control Parameter:**
 - Error Retry Mode: 1b:Forever
 - Lock Detect Time: 1b:0.5Sec
 - Error Retry IntervalTime: 01b:5 sec
- Voltage Protect Parameter:**
 - OverVoltage Protect: 0b:Disable
 - OverVoltage Level: 0b:19.5v trigger and 18.5v release

Four red callout boxes with arrows point to specific settings:

1. Overcurrent protection setting. (points to 'OverCurrent Protect')
2. Overtemperature protection setting. (points to 'TSD Protect')
3. Lock protection setting. (points to 'Error Retry Mode')
4. Overvoltage protection setting. (points to 'OverVoltage Protect')

4. Overvoltage protection setting

6. Hall sensor placement position



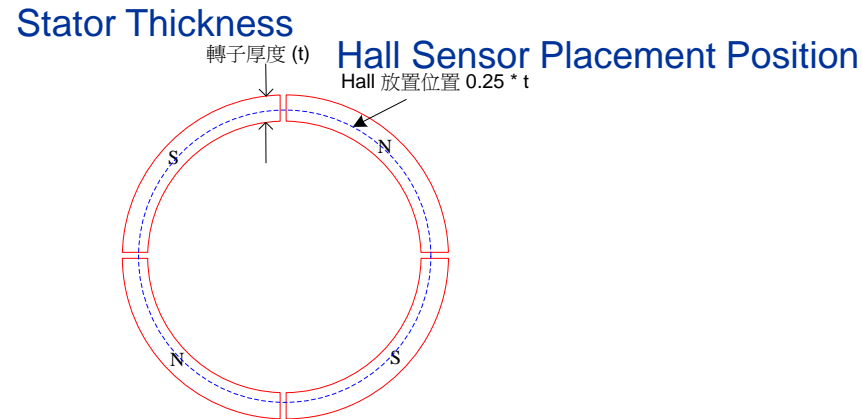
Hall Sensor Placement: Explained by magnetic field strength. In the diagram, points A, B, and C are shown.

At **point A**, the sensed magnetic field is near the null point, where the field is almost zero, which can easily cause poor detection.

At **point B**, the sensed field is relatively better.

The **optimal placement is point C**, where the magnetic field is at a relatively high level, ensuring the Hall sensor can reliably detect and trigger commutation.

6. Hall sensor placement position



To ensure that the Hall sensor detects the magnetic field from the magnet, it is recommended to place the Hall sensing point **under the rotor**. This ensures a stable magnetic field for reliable detection.

- If placed near the outer edge of the silicon steel sheets, the Hall sensor may be influenced by the stator's magnetic field, causing large variations in current.
- It is recommended to place the Hall sensor at approximately **0.25 x rotor thickness** (blue circle in the diagram). At this position, the magnetic field is stable and less affected by the stator field.

Q & A.

Thank You.