

ZH6350Athree-phase PN half-bridge pre-driver

Features:

- Up to 40V, three-phase PN half-bridge drive
- Driving capability of 100mA
- Hot plug shoot-through protection
- Logic shoot-through protection
- Adaptive dead-time
- Undervoltage protection
- Available in SOP-16 and QFN-16 package

Applications:

- Fans
- Water pumps
- Massage guns
- Power tools under 20A
- Other three-phase motor drivers

| Pin Diagram | NO | Symbol | I/O | Function Description |
|--------------------|----|--------|-----|-----------------------------|
| | 1 | GND | Р | Ground |
| | 2 | NC | | No connection |
| | 3 | LI1 | Ι | Channel 1 Low-side Input |
| | 4 | HI1 | Ι | Channel 1 High-side Input |
| GND O VM | 5 | LI2 | Ι | Channel 2 Low-side Input |
| | 6 | HI2 | Ι | Channel 2 High-side Input |
| | 7 | LI3 | Ι | Channel 3 Low-side Input |
| | 8 | HI3 | Ι | Channel 3 High-side Input |
| HI2 HO2 | 9 | НОЗ | 0 | Channel 3 High-side Output |
| | 10 | LO3 | 0 | Channel 3 Low-side Output |
| | 11 | HO2 | 0 | Channel 2 High-side Output |
| | 12 | LO2 | 0 | Channel 2 Low-side Output |
| SOP-16 (ZH6350AEC) | 13 | HO1 | 0 | Channel 1 High-side Output |
| | 14 | LO1 | 0 | Channel 1 Low-side Output |
| | 15 | NC | | No connection |
| | 16 | VM | Р | Power |

Pin Diagram and Pin Descriptions:



ZH6350A DS ZH6350A-2022-11

| Pin Diagram | NO | Symbol | I/O | Function Description |
|--------------------|----|--------|-----|----------------------------|
| | 1 | LI1 | Ι | Channel 1 Low-side Input |
| | 2 | HI1 | Ι | Channel 1 High-side Input |
| NC GND VM NC | 3 | LI2 | Ι | Channel 2 Low-side Input |
| | 4 | HI2 | Ι | Channel 2 High-side Input |
| | 5 | LI3 | Ι | Channel 3 Low-side Input |
| HI1 2 11 HO1 | 6 | HI3 | Ι | Channel 3 High-side Input |
| LI2 3 10 LO2 | 7 | НОЗ | Ι | Channel 3 High-side Output |
| | 8 | LO3 | Ι | Channel 3 Low-side Output |
| | 9 | HO2 | 0 | Channel 2 High-side Output |
| 5 6 7 8 | 10 | LO2 | 0 | Channel 2 Low-side Output |
| | 11 | HO1 | 0 | Channel 1 High-side Output |
| QFN-16 (ZH6350ANC) | 12 | LO1 | 0 | Channel 1 Low-side Output |
| | 13 | NC | | No connection |
| | 14 | VM | Р | Power |
| | 15 | GND | Р | Ground |
| | 16 | NC | | No connection |

Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|--------------------------|-------------------|-----------|------|
| Power Supply Voltage | VM | 40 | V |
| Operating Junction Temp | T_{J} | -40~150 | °C |
| High-side Output Voltage | VO _{HI} | VM-6~VM+1 | V |
| Low-side Output Voltage | VO _{LOW} | -1~6 | V |
| Control Input Voltage | VI | -1~6 | V |
| Peak Output Current | I _{PEAK} | 1 | А |

Recommended Operating Conditions

| Parameter | Symbol | Value | Unit |
|-----------------------|------------------|---------|------|
| Power Supply Voltage | VM | 2.8~40 | V |
| Control Input Voltage | V _{INX} | 0~5 | V |
| Ambient Temperature | TA | -40~125 | °C |



Ordering Information

| Full Name | Package | Packaging | Quantity |
|-----------|---------|-----------|----------|
| ZH6350ANC | QFN-16 | Reel | 5000 |
| ZH6350AEC | SOP-16 | Reel | 4000 |

Electrical Characteristics

| Parameter | Symbol | Test Conditions | Min | Typical | Max | Unit |
|---------------|-----------------------|------------------------|-----|---------|-----|------|
| Standby | I _{STANDBY} | Hix=0, Lix=0 | | 50 | 100 | uA |
| Current | | | | 50 | 100 | |
| Operating | Icc | Hix=0, Lix=1 | | 220 | 400 | uA |
| Current | | Hix=1, Lix=0 | | 270 | 400 | uA |
| Input High | V _{INH} | | 1.6 | 2.0 | 2.4 | V |
| Voltage | | | | | | |
| Input Low | V _{INL} | | 0.6 | 0.8 | 1.0 | V |
| Voltage | | | | | | |
| Pull-down | R _{PD} | | | 200 | | kΩ |
| Resistor | | | | | | |
| Output | Roh | Hix=0, Hox=VM-0.2V | | 3 | | Ω |
| Impedance | R _{OL} | Lix=0, Lox=0.2V | | 2 | | Ω |
| Strong | V_{STRONG_H} | VM-H _{OX} | | 1.1 | | V |
| Shutdown | V _{STRONG_L} | Lox-GND | | 1 1 | | V |
| Threshold | | | | 1.1 | | |
| Drive Current | $I_{H_{ON}}$ | Hix=1, Hox=VM | | 100 | | mA |
| | I _{H_OFF} | Hix=0, Hox=VM-5V | | 100 | | mA |
| | IL_ON | Lix=1, Lox=0V | | 25 | | mA |
| | I_{L_OFF} | Lix=0, Lox=5V | | 50 | | mA |
| Undervoltage | | | 1.3 | 1.8 | 2.2 | V |
| Point | | | | | | |
| Output Delay | T _{LR} | Low-side output rise | | 52 | | ns |
| | T_{LF} | Low-side output fall | | 36 | | ns |
| | T _{HR} | High-side output rise | | 75 | | ns |
| | T _{LF} | High-side output fall | | 50 | | ns |

Test Conditions



Detailed Description

Power-on Shoot-through Protection: During power-on, especially during hotswapping operations, the gate voltage of the power transistor may couple to a high voltage due to the Miller capacitance (as shown in the left figure below). If the voltage exceeds the conduction voltage of the power transistor, it may cause a false conduction and damage the power transistor. The ZH6350A is designed with logic to prevent false conduction during power-on (as shown in the right figure below), ensuring that neither the chip nor the power transistor is damaged during rapid power-on.



Logic Shoot-through Protection: If LIx and Hix are both set to 1 simultaneously, all upper and lower outputs will be off to prevent shoot-through.

Adaptive Dead-time: The rise and fall times of the gate voltage may vary under different load power transistors, operating voltages, and operating temperatures.



Traditional fixed dead-time generation methods cannot adapt to these parameter changes. Under light load, excessive dead-time can waste space and cause output waveform distortion, while under heavy load, insufficient dead-time can cause shoot-through of the upper and lower transistors. The ZH6350A uses feedback-based adaptive dead-time control. During the turn-off process of the upper transistor, the driver chip continuously monitors the status of the upper transistor. Once turn-off is complete, it notifies the lower transistor, the driver chip continuously monitors the status of the upper transistor the status of the upper transistor. The ZH6350A uses feedback-based adaptive dead-time control. During the turn-off process of the upper transistor, the driver chip continuously monitors the status of the upper transistor. Once turn-off is complete, it notifies the lower transistor. Once turn-off is complete, it notifies the upper transistor's drive signal to turn on. This design minimizes dead-time width while ensuring safety.



Application Reference Circuit





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2.B2

Input-Output Waveforms

LI1 - LO1 Input-Output Waveform:



Note: HO1 experimental waveforms were collected using an isolation probe, with one end of the probe connected to VM and the other end to HO.

1 = 2.00 V 2

Freq=-----= 2.50 V / 3 = 1.00 V / 4 = 2.00 V



MAX

0.2

0.

6.2 4.00

0.80

0.50 8* 10*

Package Dimensions

SOP-16





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1 E

QFN-16

SIDE VIEW

0.08



COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX | | |
|--------|------|---------|------|--|--|
| A | 0.70 | 0.75 | 0.80 | | |
| A1 | 0.00 | 0.02 | 0.05 | | |
| A3 | | 0.20REF | | | |
| b | 0.20 | 0.25 | 0.30 | | |
| D | 2.90 | 3.00 | 3.10 | | |
| E | 2.90 | 3.00 | 3.10 | | |
| D2 | 1.80 | 1.90 | 2.00 | | |
| E2 | 1.80 | 1.90 | 2.00 | | |
| e | 0.40 | 0.50 | 0.60 | | |
| К | 0.15 | 0.25 | 0.35 | | |
| L | 0.20 | 0.30 | 0.40 | | |
| R | 0.10 | - | - | | |

NOTES: ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSION.



Revision History

| Version | Modification Date | Modification Details | |
|---------|----------------------|--|--|
| V1.4 | 2024.06.13 | Generates the English Version Datasheet. | |