



# US72/73

## Single Coil Fan Driver

### Features and Benefits

- Full Bridge Driver
- High Sensitivity Hall Sensor
- Locked Rotor Shutdown and Auto-Restart
- Power-Efficient CMOS and Power MOSFETs
- Integrated tachometer (US72) or alarm (US73) signal outputs

### Applications

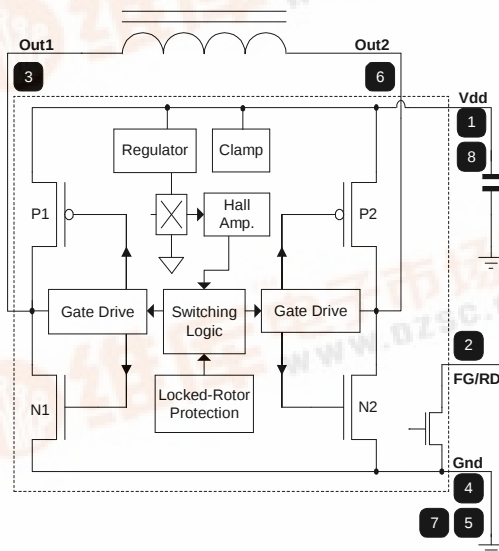
- For 12V/24V Fans

### Ordering Information

| Part No. | Temperature Suffix |
|----------|--------------------|
| US72     | E (-40°C to 85°C)  |
| US73     | E (-40°C to 85°C)  |

| Package Code           |
|------------------------|
| DC (8-Pin narrow SOIC) |
| DC (8-Pin narrow SOIC) |

### Functional Diagram



### Description

The US72 and US73 provide a monolithic solution for driving single-coil fans. The bridge drivers provide bi-directional current through the single phase motor winding.

US72: The tachometer/Frequency Generator (FG) version produces a logic signal, which is aligned with the Hall plate signal.

US73: The Rotation Detector (RD) / Alarm Signal version has a low output in the normal condition. When a locked rotor condition occurs the RD changes to a high state.

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### 1. Glossary of Terms

Full Bridge: Two output drivers that can both source or sink current. When a load is placed between the drivers, current can flow through the load in both directions.

FG: The Frequency Generator or tachometer signal; provides one pulse for every magnetic pole

RD: The Rotation detection or Lock Alarm signal is high when the rotor is blocked or spinning very slowly.

MilliTesla (mT), Gauss: Units of magnetic flux density; 1 milliTesla = 10 Gauss

Single Coil Fan: a fan with only one coil winding, usually requiring a bipolar or full-bridge driver

Locked rotor: The condition of a fan that has stopped spinning due to mechanical blockage

### 2. Absolute Maximum Ratings

|                                        |              |
|----------------------------------------|--------------|
| Supply Voltage, $V_{DD}$ (overvoltage) | 28V          |
| Output Voltage, FG or RD               | 28V          |
| Output Current, $I_{OUT}$              | 500mA        |
| Operating Temperature Range, $T_A$     | -40 to 85°C  |
| Junction Temperature, $T_J$            | 125°C        |
| Storage Temperature, $T_S$             | -55 to 150°C |
| ESD Sensitivity (AEC Q100 002)         | 2KV          |
| Magnetic Flux Density                  | No limit     |

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 3. US72/73 Electrical Specifications

DC Operating Parameters  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 12\text{V}$  (unless otherwise specified)

| Parameter                 | Symbol     | Test Conditions                    | Min | Typ  | Max | Units   |
|---------------------------|------------|------------------------------------|-----|------|-----|---------|
| Supply Voltage            | $V_{DD}$   | Operating                          | 4.5 |      | 28  | Volts   |
| Supply Current            | $I_{DD}$   | $V_{DD} = 24\text{V}$ , No Load    |     | 4    | 6   | mA      |
| On Resistance             | $R_{dson}$ | Full bridge, $R_{nmos} + R_{pmos}$ |     | 3    | 5.3 | Ohms    |
| Bridge Current            | $I_{load}$ | Peak                               |     |      | 500 | mA      |
| Bridge Current            | $I_{load}$ | Continuous                         |     |      | 350 | mA      |
| Thermal Resistance        | $R_{th}$   | one-sided PCB, zero LFPM           |     | 150  |     | °C/Watt |
| Locked-Rotor Period       | $t_{on}$   |                                    |     | 0.25 |     | S       |
| Locked-Rotor period       | $t_{off}$  |                                    |     | 1.25 |     | S       |
| Freewheel Switching delay | $t_{fw}$   |                                    |     | 200  |     | uS      |
| FG/RD Output Leakage      | $I_{off}$  | $V_{out} = 24\text{V}$             |     |      | 10  | uA      |
| FG/RD On voltage          | $V_{dson}$ | $I_{out} = 5\text{mA}$             |     |      | 0.5 | Volts   |

### 4. US72/73 Magnetic Specifications

DC Operating Parameters  $T_A = 25$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 12\text{V}$  (unless otherwise specified)

| Parameter     | Symbol | Test Conditions | Min  | Typ  | Max | Units |
|---------------|--------|-----------------|------|------|-----|-------|
| Operate Point | Bop    |                 |      | 3.0  | 6.0 | mT    |
| Release Point | Brp    |                 | -6.0 | -3.0 |     | mT    |
| Hysteresis    | Hys    |                 |      | 6.0  |     | mT    |

#### Note:

1 mT = 10 Gauss

### 5. General Description

The US72 / US73 provide a one-chip solution for 2-wire or 3-wire fans with a single coil winding. The chip contains the Hall-effect sensor, dynamic offset correction, and power drivers in a single package. The output drivers and supply pins are fully protected against switching transients. The FG or RD open-drain signal outputs are compatible with any TTL or CMOS logic input.

### 6. Unique Features

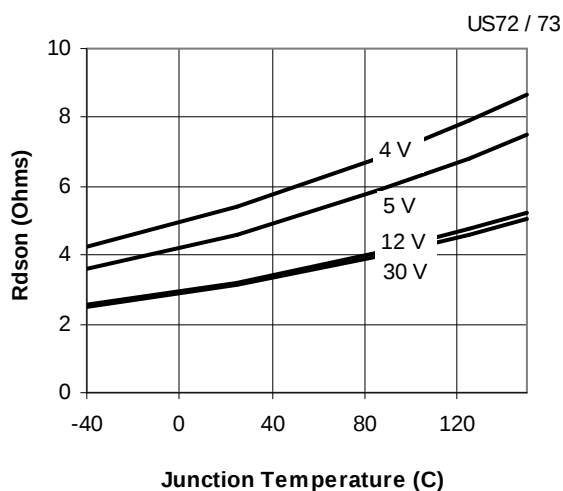
The switching of the load current is controlled to limit current slew-rate, and eliminate shoot-through currents. The 200uS (typical) recirculation allows the current to decay, reducing the switching noise.

The built-in locked-rotor protection will automatically shut off the coil current when the rotor is mechanically blocked, or the rotational speed drops below 60 RPM. The fan will try to restart every 1.5 seconds until the obstruction is clear. The On / Off cycling reduces the average stall current to 1/6 normal; this is enough to prevent overheating or damage to most fans.

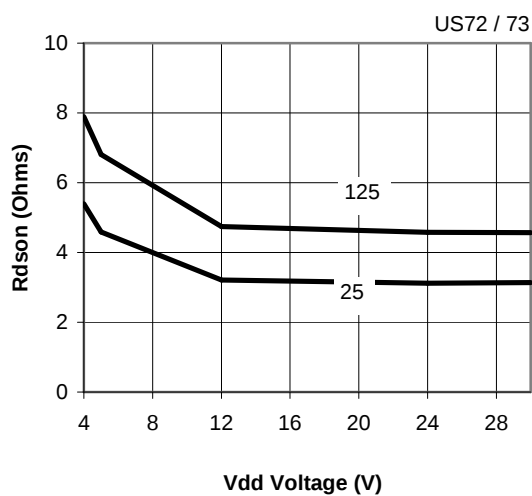
A common two-coil fan with unipolar drivers only uses half of the coil windings at any time. The one-coil design with full-bridge drivers uses all the windings all the time to generate torque. This generally allows for a smaller, more efficient stator design.

## 7. Performance Graphs

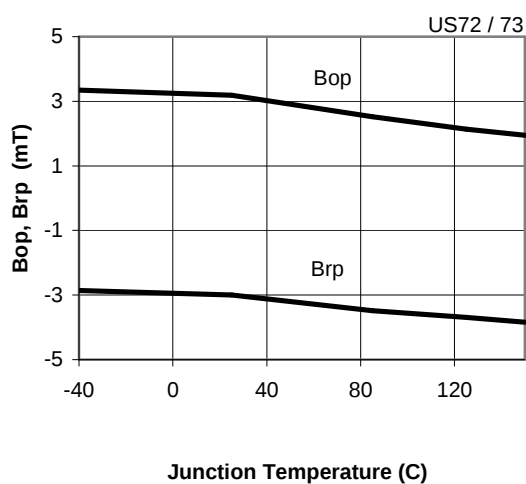
**Rdson (NMOS + PMOS)  
vs.  
Vdd, Temperature**



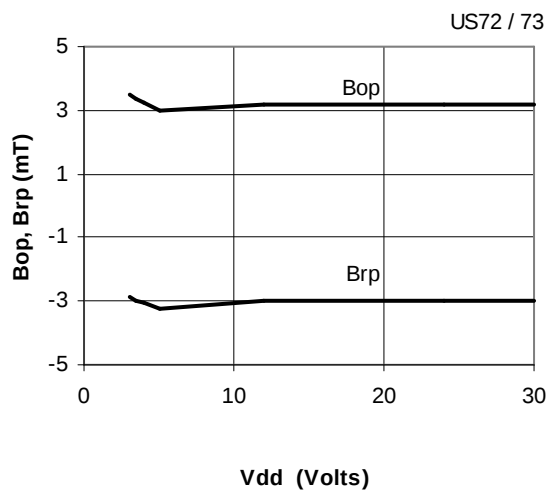
**Rdson (NMOS + PMOS)  
vs.  
Vdd, Temperature**



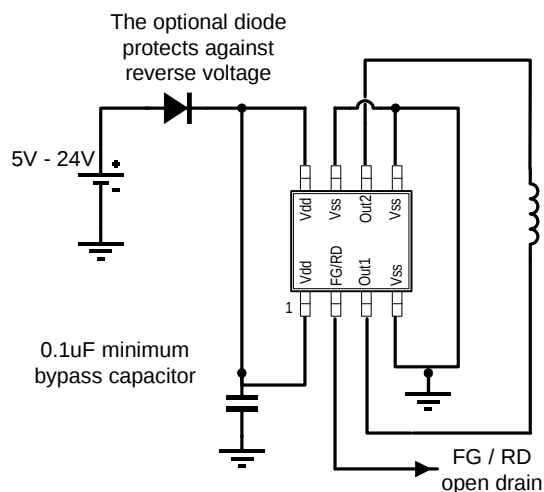
**Bop, Brp  
vs.  
Temperature**



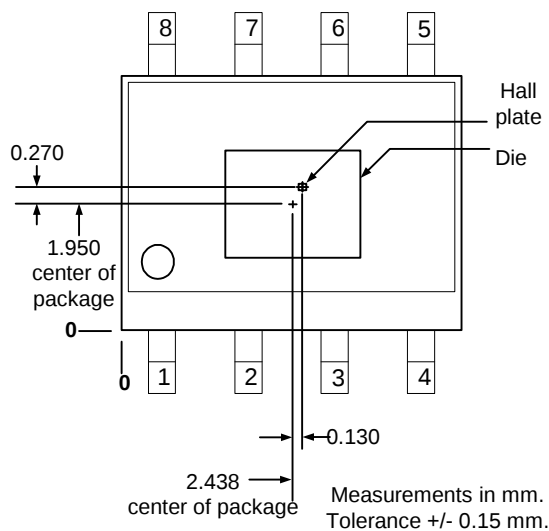
**Bop, Brp  
vs.  
Vdd Voltage**



## 8. Applications Information



### Hall Sensor Location



## 9. Application Comments

It is advisable to use a Vdd – ground bypass capacitor of at least 0.1uF, located close to the device. Ceramic / monolithic types are preferable. This capacitor is necessary to maintain a stable power supply during the switching transients – especially if there is a series diode in the circuit.

## **10. Reliability Information**

This Melexis device is classified and qualified regarding soldering technology, solderability and moisture sensitivity level, as defined in this specification, according to following test methods:

- IPC/JEDEC J-STD-020  
Moisture/Reflow Sensitivity Classification For Nonhermetic Solid State Surface Mount Devices (classification reflow profiles according to table 5-2)
- EIA/JEDEC JESD22-A113  
Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing (reflow profiles according to table 2)
- CECC00802  
Standard Method For The Specification of Surface Mounting Components (SMDs) of Assessed Quality
- EIA/JEDEC JESD22-B106  
Resistance to soldering temperature for through-hole mounted devices
- EN60749-15  
Resistance to soldering temperature for through-hole mounted devices
- MIL 883 Method 2003 / EIA/JEDEC JESD22-B102  
Solderability

For all soldering technologies deviating from above mentioned standard conditions (regarding peak temperature, temperature gradient, temperature profile etc) additional classification and qualification tests have to be agreed upon with Melexis.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

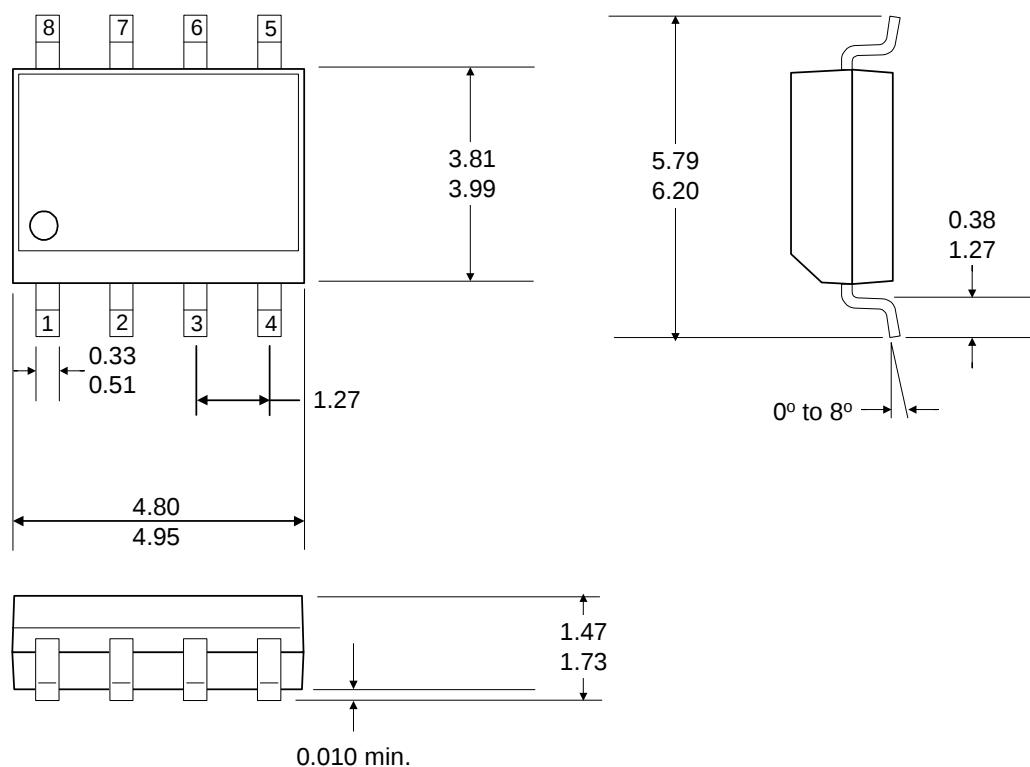
Based on Melexis commitment to environmental responsibility, European legislation (Directive on the Restriction of the Use of Certain Hazardous substances, RoHS) and customer requests, Melexis has installed a Roadmap to qualify their package families for lead free processes also. Various lead free generic qualifications are running, current results on request.

For more information on manufacturability/solderability see quality page at our website:  
<http://www.melexis.com/html/pdf/MLXleadfree-statement.pdf>

## **11. ESD Precautions**

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

## 12. DC Package Information (SOIC-8)



### Notes:

1. Measurements in millimeters.
2. Body dimensions do not include mold flash, protrusions, or burrs - not to exceed 0.15mm .
3. Lead frame material: copper 194.
4. Tolerances: +/- 0.25 mm unless otherwise indicated.

### **13. Disclaimer**

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Or for additional information contact Melexis Direct:

**Europe and Japan:**

Phone: +32 13 67 04 95  
E-mail: [sales\\_europe@melexis.com](mailto:sales_europe@melexis.com)

**All other locations:**

Phone: +1 603 223 2362  
E-mail: [sales\\_usa@melexis.com](mailto:sales_usa@melexis.com)