

Features and Benefits

- Low cost
- High sensitivity Hall Sensor
- Locked rotor shutdown and auto-restart
- Power-efficient CMOS and power MOSFETs
- Built-in zener diodes protect outputs
- Integrated tachometer (US90) or alarm (US91) signal outputs

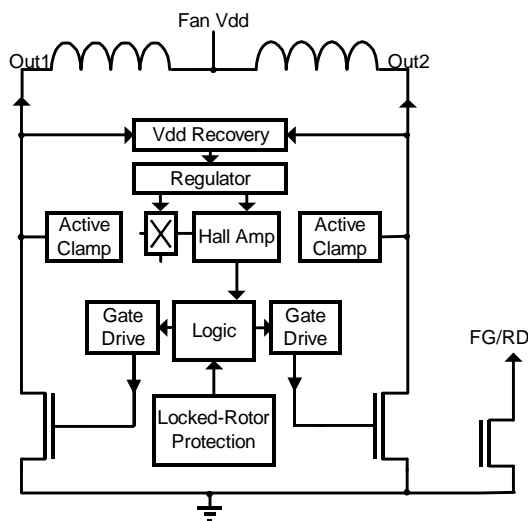
Applications

- For 24V fans
- Peak currents up to 500mA

Ordering Information

Part No.	Temperature Suffix	Package Code
US90	E (-40°C to 85°C)	VK (4-pin TO-92)
US90	E (-40°C to 85°C)	VK (4-pin TO-92)
US91	E (-40°C to 85°C)	DC (8-pin narrow SOIC)
US91	E (-40°C to 85°C)	DC (8-pin narrow SOIC)

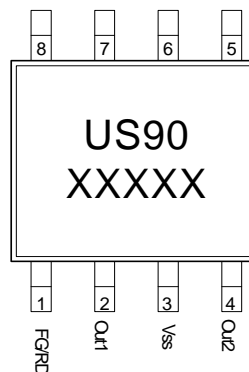
Functional Diagram



Description

The US90 and US91 provide one-chip solutions for driving two-coil brushless DC cooling fans. A novel Vdd recovery circuit allows the complete three-wire fan control circuit to fit in a small four-pin package. The US90 has an open-drain tachometer output (FG) that follows the Hall sensor latching output. The US91 has an open-drain rotation detection output (RD) that is normally low. It becomes high when the Hall switching drops below 4Hz.

DC Package



VK Package

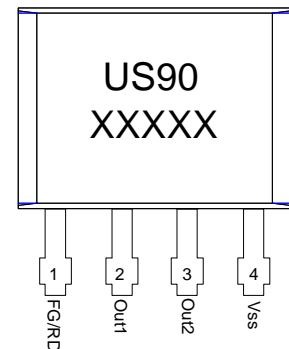


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1. Glossary of Terms

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

Two-Coil Fan: a fan with two coil windings, current alternates from 1 coil to the other depending on the polarity of the magnetic field.

Two-wire Fan: A fan that has only two connections for the power supply plus and minus.

Three-wire Fan: A fan that has the two power supply connections, plus a tachometer or alarm signal

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

FG: Frequency Generator, or tachometer output signal

RD: Rotation Detection, or alarm output signal

2. Absolute Maximum Ratings

Fan Supply Voltage, V_{DD} (overvoltage)	30V
Out1, Out2 Voltage	60V
FG / RD Voltage	28V
Peak Output Current, I_{OUT}	500mA
FG / RD Output Current	20mA
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)	1.5KV
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. US90 / US91 Electrical Specifications

DC Operating Parameters $T_A = 25^\circ\text{C}$, $V_{DD} = 24\text{V}$ (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Voltage	V_{DD}	Operating	5		30	Volts
Supply Current	I_{DD}			2	4	mA
Output Saturation Voltage	V_{dson}	$I_{out} = 150\text{mA}$		375		mV
Output Saturation Voltage	V_{dson}	$I_{out} = 250\text{mA}$		625		mV
Output Current	I_{load}	Average continuous			250	mA
Thermal Resistance	R_{th}	one-sided PCB, zero LFPM		200		$^\circ\text{C}/\text{Watt}$
Locked-Rotor Period	t_{on}			0.25		S
Locked-Rotor period	t_{off}			1.5		S
Logic output On Voltage	V_{low}	FG, RD sink current = 10mA		250	500	mV
Logic output Off Current	I_{off}	FG, RD $V_{out}=18\text{V}$		0	10	μA
Output Switching delay	T_{delay}	“dead time” when both drivers are off		200		μS

4. US90 / US91 Magnetic Specifications

DC Operating Parameters $T_A = 25^\circ\text{C}$, $V_{DD} = 24\text{V}$ (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

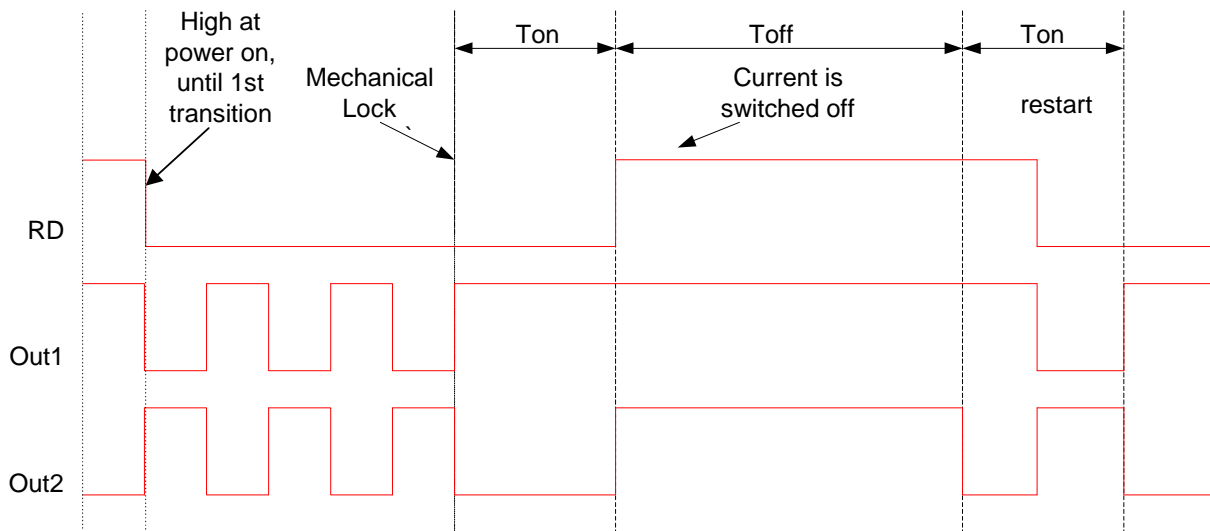
5. General Description

The US90 and US91 provide a one-chip solution for 3-wire fans with two unipolar coil windings. The chip contains the Hall-effect sensor, dynamic offset correction, and power drivers in a single package. The output drivers pins are fully protected against switching transients. The logic output pin (FG or RD) is an open-drain output.

6. Unique Features

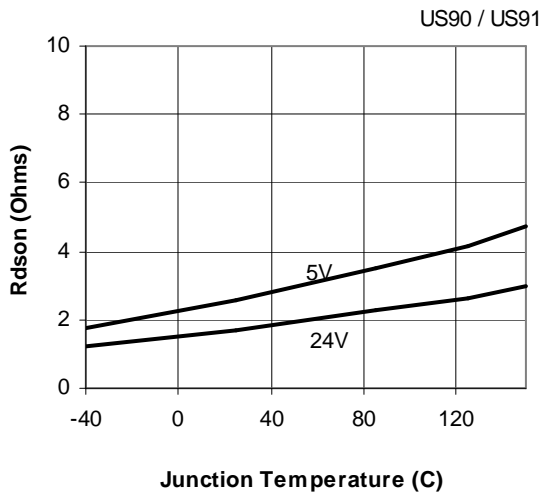
The absence of a Vdd pin allows the chip to fit in a four-pin package, with two output drivers for the fan coils and 1 logic output driver. The lack of a Vdd pin also provides some protection against reverse voltage polarity of the power supply. The reverse current is limited by the resistance of the fan coils; the reverse current will be double the normal stall current. In some fan designs this may be tolerable.

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 1/7 normal; this is enough to prevent overheating or damage to most fans. Both the US90 and US91 have this feature.

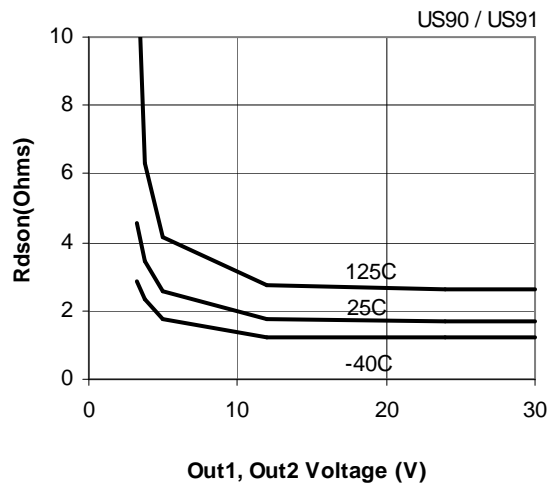


7. Performance Graphs

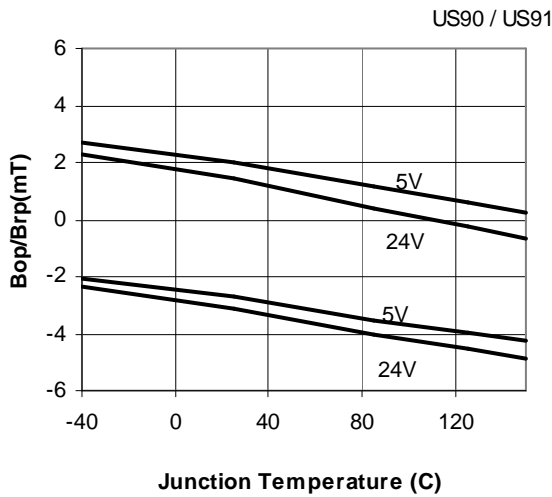
Rdson
vs.
Vdd, Temperature



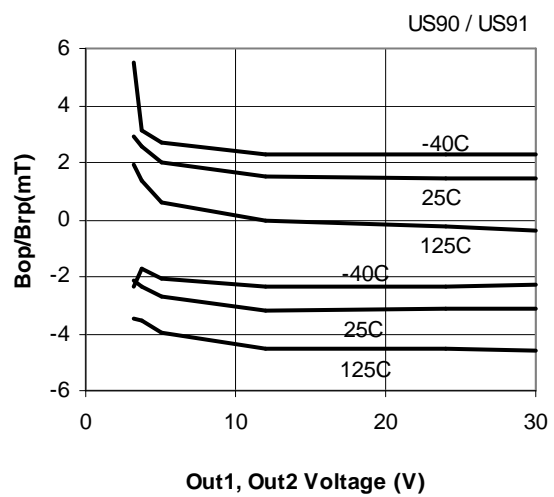
Rdson
vs.
Vdd, Temperature



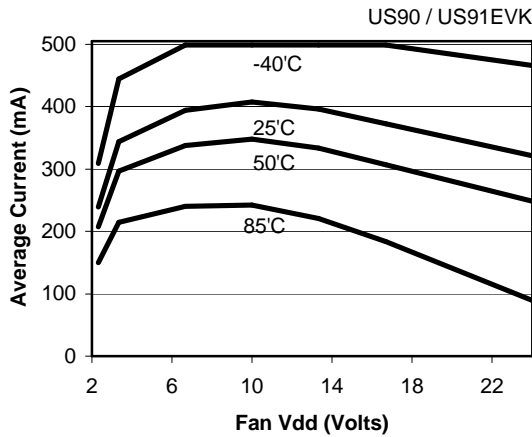
Bop, Brp
vs.
Vdd, Temperature



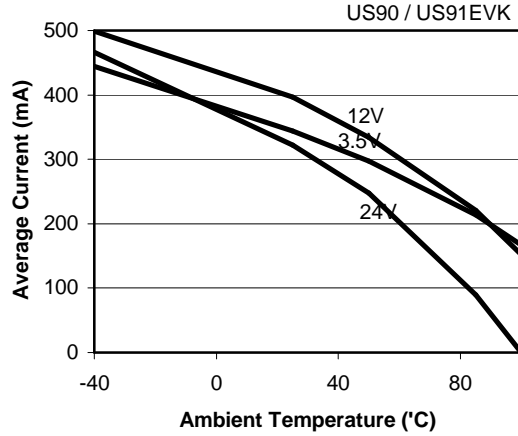
Bop, Brp
vs.
Vdd, Temperature



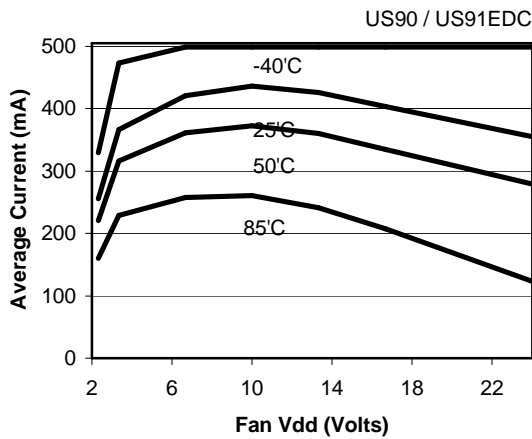
Typical Maximum Continuous Current vs. Temperature, Fan Voltage



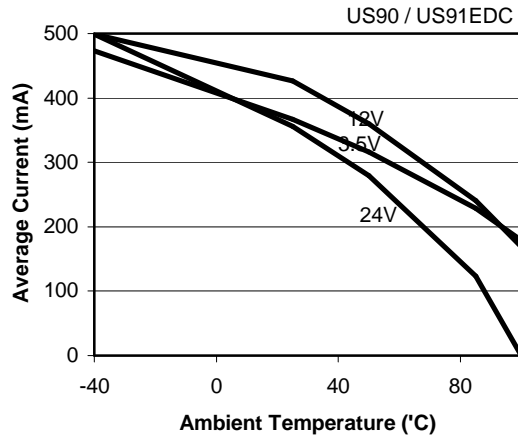
Typical Maximum Continuous Current vs. Voltage, Temperature



Typical Maximum Continuous Current vs. Temperature, Fan Voltage

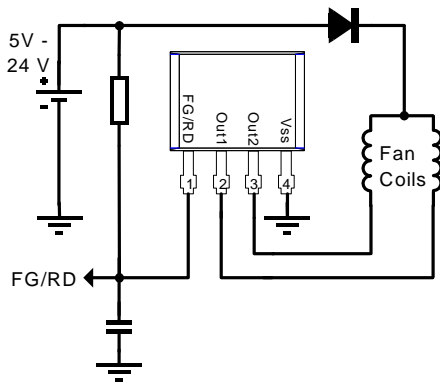


Typical Maximum Continuous Current vs. Voltage, Temperature

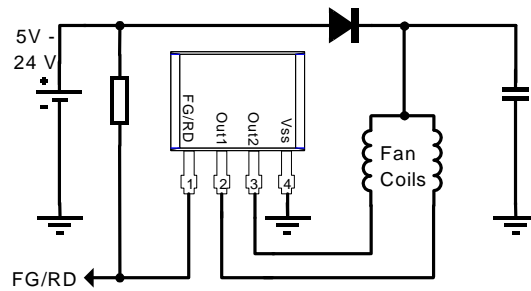


8. Applications Information

Configuration with optional cap for pin1 EOS / ESD protection



Configuration with optional capacitor for EOS / hot switch protection



9. Application Comments

The FG / RD output driver can be susceptible to EOS damage from hot-switching the power supply ground. If there is capacitance outside the fan between the logic output and ground, and a series diode blocking the Vdd pin, and the ground connection is hot-switched, the external capacitance provides a path to ground for the coil current. An optional Vdd-Vss bypass capacitor will also normally solve this problem.

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.

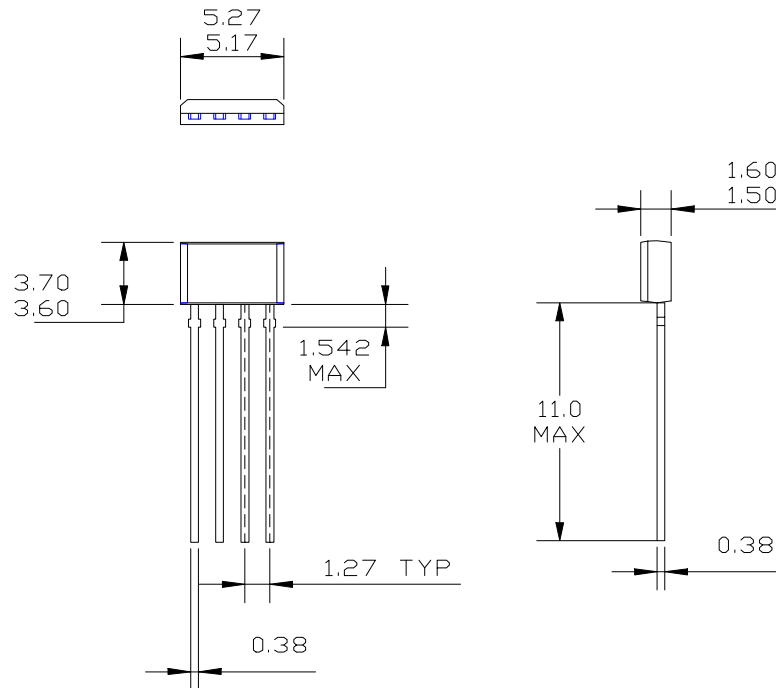
Based on Melexis commitment to environmental responsibility, European legislation (Directive on the Restriction of the Use of Certain Hazardous substances, RoHS) and customer requests, Melexis has installed a Roadmap to qualify their package families for lead free processes also. Various lead free generic 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. VK Package Information (4-pin TO-92)



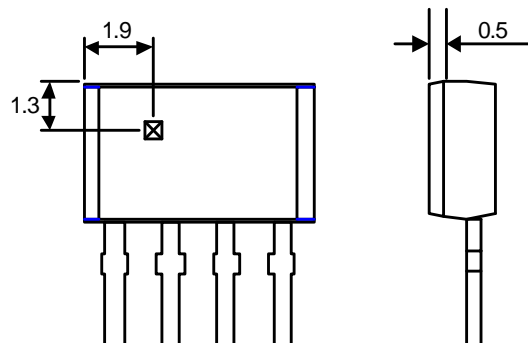
NOTES:

1. ALL DIMENSIONS IN MILLIMETERS.
2. MOLD & PACKAGE TO LEAD FRAME TOLERANCE IS 0.005 BOTH HORIZONTAL & VERTICAL
3. MOLDING DIMENSIONS INCLUDE END FLASH.

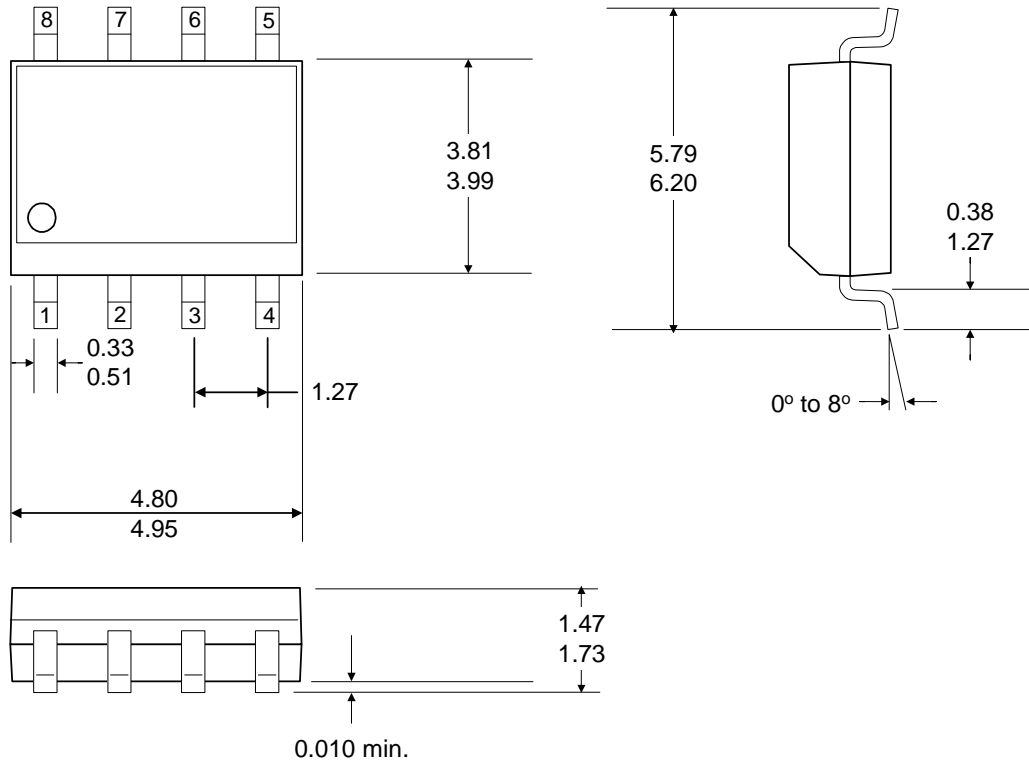
METRIC TOLERANCES

.X	± 0.1
.XX	± 0.05
.XXX	± 0.025
X°	± 0° 30'

13. VK Hall Sensor Location



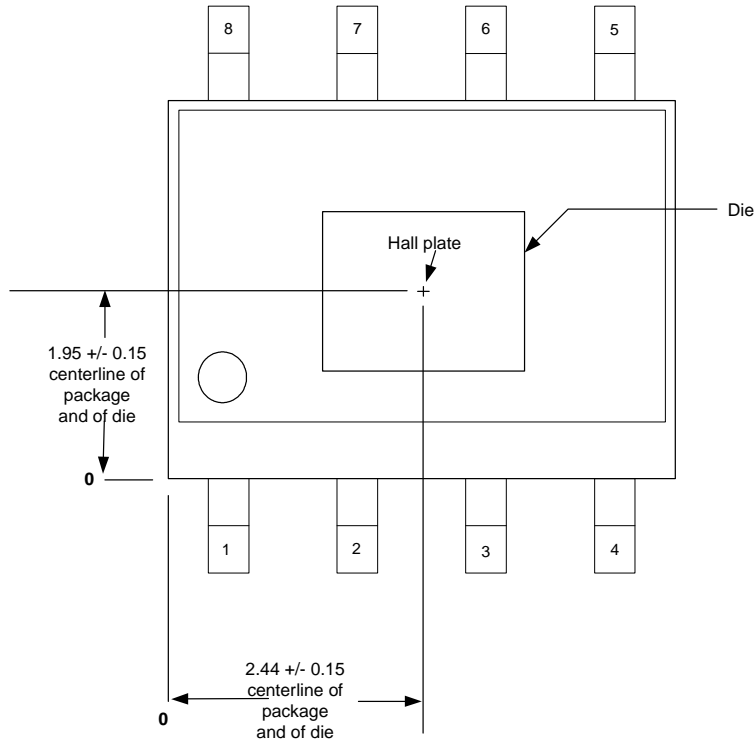
14. DC Package Information (8-pin narrow SOIC)



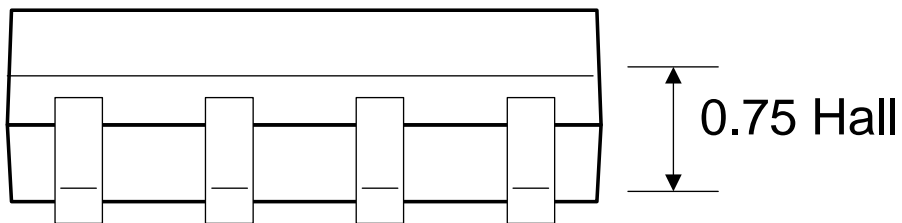
Notes:

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.

15. DC Hall Sensor Location



Notes:
1. Measurements in millimeters (mm).



16. Disclaimer

Devices sold by Melexis are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. Melexis makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. Melexis reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with Melexis for current information. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional processing by Melexis for each application.

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