ITT INTERMETALL
semiconductors

HAL115
Hall Effect Sensor IC

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ITT INTERMETALL

Hall Effect Sensor IC
in CMOS technology

Features:

- operates from 4.3 to 24 V supply voltage with reverse voltage protection
- operates with magnetic fields from DC to 20 kHz
- overvoltage and reverse-voltage protection
- on-chip temperature compensation circuitry minimizes shifts in on and off points and hysteresis over temperature and supply voltage
- the decrease of magnetic flux density caused by rising temperature in the sensor system is compensated by a built-in negative temperature coefficient of hysteresis
- ideal sensor for speed measurement, revolution counting, positioning, and DC brushless motors
- short-circuit protection

Specifications

- switching type: bipolar
- output turns low with magnetic south pole on branded side of package
- output can change, if magnetic pole is removed

Marking Code

Type	Temperature Range	
	E	C
HAL 115UA	115E	115C
HAL 115S	115E	115C

Operating Junction Temperature Range

E: T_J = –40 °C to +100 °C

C: T_J = 0 °C to +100 °C

Designation of Hall Sensors

HALXXXPP-T
- Temperature Range: E or C
- Package: UA for TO-92UA, S for SOT-89A
- Type: 115

Example: **HAL 115UA-E**

→ Type: 115
→ Package: TO-92UA
→ Temperature Range: T_J = –40 °C to +100 °C

Solderability

- Package SOT-89A: according to IEC68-2-58
- Package TO-92UA: according to IEC68-2-20

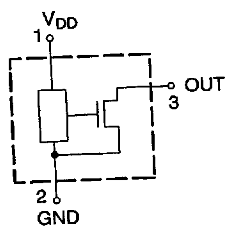


Fig. 1: Pin configuration

Functional Description

This Hall effect sensor is a monolithic integrated circuit that switches in response to magnetic fields. If a magnetic field with flux lines at right angles to the sensitive area is applied to the sensor, the biased Hall plate forces a Hall voltage proportional to this field. The Hall voltage is compared with the actual threshold level in the comparator. The temperature-dependent bias increases the supply voltage of the Hall plates and adjusts the switching points to the decreasing induction of magnets at higher temperatures. If the magnetic field exceeds the threshold levels, the open drain output switches to the appropriate state. The built-in hysteresis eliminates oscillation and provides switching behavior of output without bounce. The output is short-circuit protected by limiting high currents and by sensing excess temperature. Shunt protection devices clamp voltage peaks at the Output-Pin and V_{DD}-Pin together with external series resistors. Reverse current is limited at the V_{DD}-Pin by an internal series resistor up to –15 V. No external reverse protection diode is needed at the V_{DD}-Pin for values ranging from 0 V to –15 V.

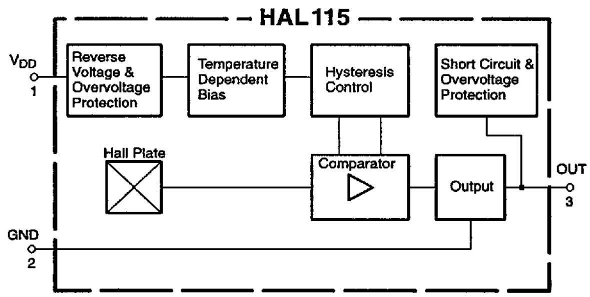


Fig. 2: HAL115 block diagram

Outline Dimensions

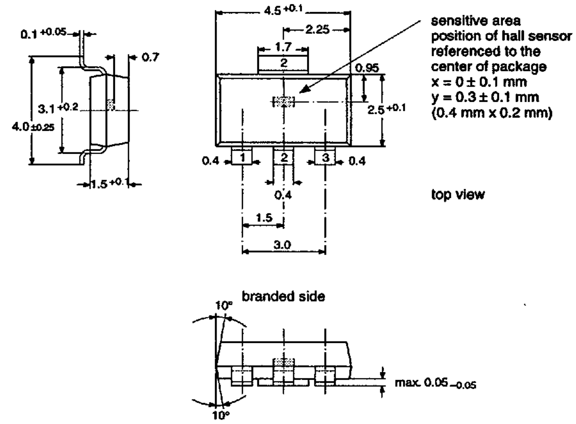


Fig. 3:
Plastic Small Outline Transistor Package
(SOT-89A)
Weight approximately 0.04 g
Dimensions in mm

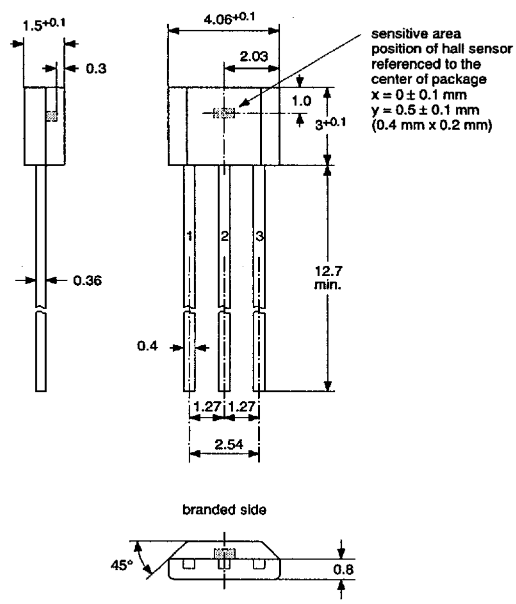


Fig. 4:
Plastic Transistor Single Outline Package
(TO-92UA)
Weight approximately 0.12 g
Dimensions in mm

Absolute Maximum Ratings

Symbol	Parameter	Pin No.	Min.	Max.	Unit
V_{DD}	Supply Voltage	1	–15	28[1)]	V
V_{OH}	Output Off Voltage	3	–	28[1)]	V
I_O	Continuous Output On Current	3	–	20	mA
I_O	Peak Output On Current	3	–	250[2)]	mA
$-I_{DD}$	Reverse Supply Current	1		25[1)]	mA
T_s	Storage Temperature Range		–65	150	°C
T_J	Junction Temperature Range		–40	150	°C

1) as long as $T_J$max is not exceeded
2) t<2 ms

Stresses beyond those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only. Functional operation of the device at these or any other conditions beyond those indicated in the "Recommended Operating Conditions/Characteristics" of this specification is not implied. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Pin No.	Min.	Typ.	Max.	Unit
V_{DD}	Supply Voltage	1	4.3	–	24	V
I_O	Continuous Output On Current	3	0	–	12.5	mA
R_S	Series Resistor	1	–	–	270	Ω

Electrical Characteristics at T_J = –40 °C to +100 °C, V_{DD} = 4.3 V to 24 V,
Typical Characteristics for T_J = 25 °C and V_{DD} = 12 V

Symbol	Parameter	Pin No.	Min.	Typ.	Max.	Unit	Test Conditions
V_{OL}	Output Voltage	3	–	125	250	mV	I_O = 12.5 mA, T_J = 25 °C
V_{OL}	Output Voltage over Temperature Range	3	–	125	400	mV	I_O = 12.5 mA
I_{OH}	Output Leakage Current	3	–	–	1	µA	$B < B_{OFF}$, T_J = 25 °C $V_{DD} \leq 20$ V
I_{OH}	Output Leakage Current over Temperature Range	3	–	–	10	µA	$B < B_{OFF}$
I_{DD}	Supply Current	1	6.5	8.3	11	mA	T_J = 25 °C, V_{DD} = 12 V
I_{DD}	Supply Current over Temperature Range	1	5.5	8.3	12	mA	

Electrical Characteristics, continued

Symbol	Parameter	Pin No.	Min.	Typ.	Max.	Unit	Test Conditions
$t_{en(O)}$	Enable Time of Output after Setting of V_{DD}	3	–	6	50	µs	V_{DD} = 12 V
t_r	Output Rise Time	3	–	85	400	ns	V_{DD} = 12 V, RL = 820 Ohm, CL = 20 pF
t_f	Output Fall Time	3	–	60	400	ns	V_{DD} = 12 V, RL = 820 Ohm, CL = 20 pF
R_{thJSB} case SOT-89A	Thermal Resistance Junction to Substrate Backside		–	150	200	K/W	Fiberglass Substrate, 30 mm x 10 mm x 1,5mm pad size see Fig. 6
R_{thJA} case TO-92UA	Thermal Resistance Junction to Soldering Point		–	150	200	K/W	Leads at ambient temperature at a distance of 2 mm from case

Magnetic Characteristics at T_J = –40 °C to +100 °C, V_{DD} = 4.3 V to 24 V,
Typical Characteristics for T_J = 25 °C and V_{DD} = 12 V

Magnetic flux density values of switching points.
Positive flux density values refer to the magnetic south pole at the branded side of the package.

Parameter	Min.	Typ.	Max.	Unit
On point B_{ON}	–10.7	1.2	12.5	mT
Off point B_{OFF}	–12.5	–1.2	10.7	mT
Hysteresis B_{HYS}	1.8	2.4	7	mT

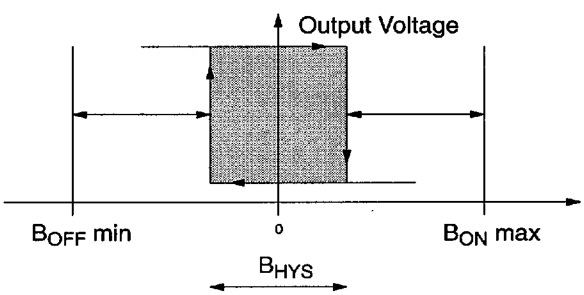


Fig. 5: Definition of magnetic switching points and hysteresis

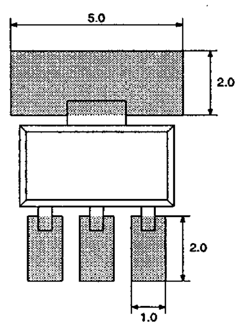
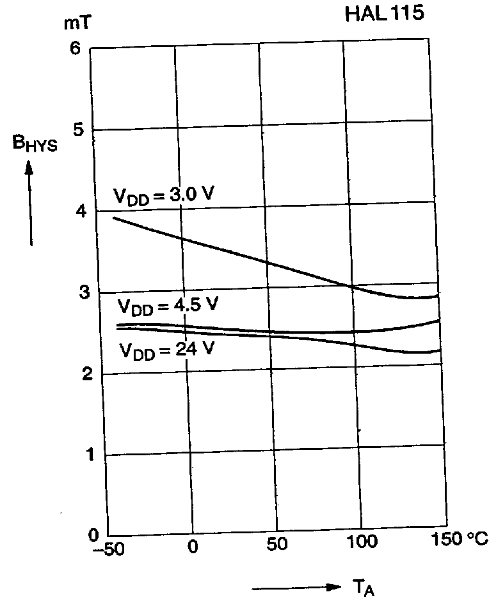


Fig. 6: Recommended pad size SOT-89A
Dimensions in mm

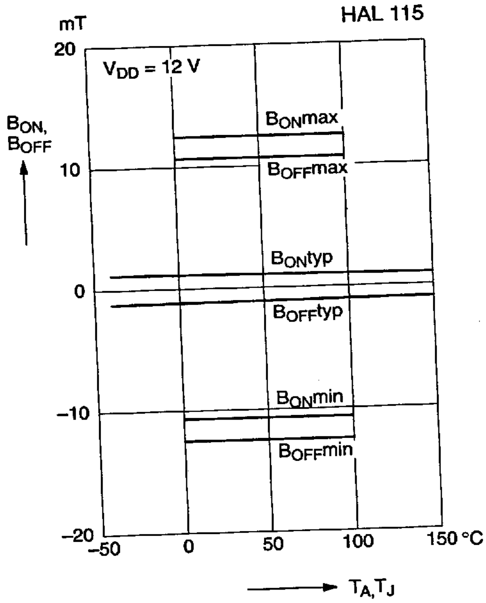
Note 1: In the following diagrams "Magnetic switch points versus ambient temperature", the curves for B_{ON}min, B_{ON}max, B_{OFF}min, and B_{OFF}max refer to junction temperature, whereas typical curves refer to ambient temperature.

Note 2: The dropping characteristic of the supply current versus the supply voltage is caused by the internal power dissipation.

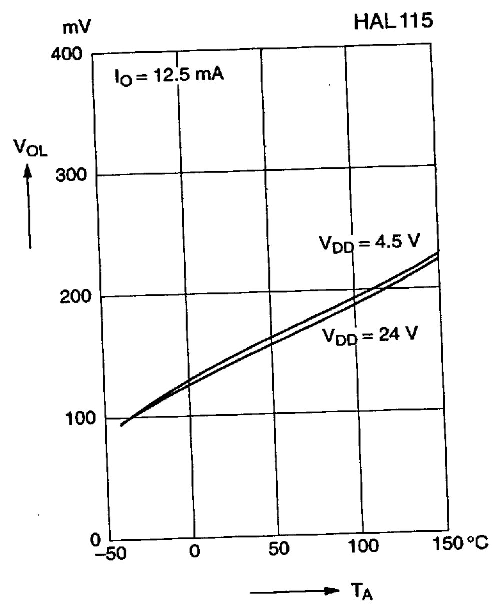
Typical hysteresis versus ambient temperature



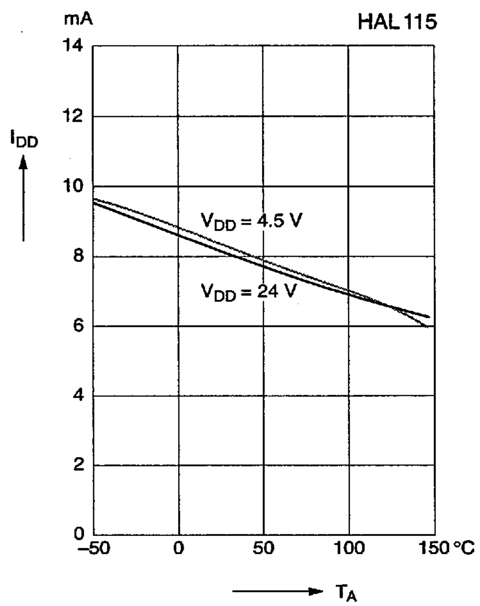
Magnetic switching points versus ambient temperature



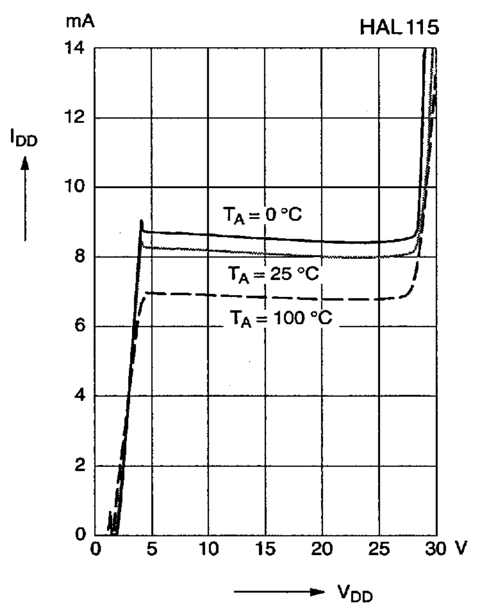
Typical output low voltage versus ambient temperature



Typical supply current versus ambient temperature



Typical supply current versus supply voltage



see note 2

Application Note

Because of inherent reverse voltage protection, no diode is needed at pin 1 for reverse voltages ranging from 0 V to –15 V.

For electromagnetic immunity, it is recommended to apply a 330 pF minimum capacitor between V_{DD} (pin 1) and Ground (pin 2).

For applications requiring robustness to conducted disturbances (transients), a 220 Ω series resistor to pin 1 and a 4.7 nF capacitor between V_{DD} (pin 1) and Ground (pin 2) is recommended.

Because of the I_{DD} peak at 4.1 V, the series resistor should not be greater than 270 Ω.

The series resistor and the capacitor should be placed as close as possible to the IC.

Ambient Temperature

Due to the internal power dissipation, the temperature on the silicon chip (junction temperature T_J) is higher than the temperature outside the package (ambient temperature T_A).

$T_J = T_A + \Delta T$

At static conditions, the following equations are valid:

– for SOT-89A: $\Delta T = I_{DD} * V_{DD} * R_{thJSB}$

– for TO-92UA: $\Delta T = I_{DD} * V_{DD} * R_{thJA}$

For typical values, use the typical parameters. For worst case calculation, use the max. parameters for I_{DD} and R_{th}, and the max. value for V_{DD} from the application.

Recommended Application Circuit for DC Fans