ADVANCE INFORMATION

HAL114
Hall Effect Sensor IC

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6251-456-1AI

MICRONAS
INTERMETALL

Hall Effect Sensor IC
in CMOS technology

Features:

– operates from 4.5 V to 24 V supply voltage

– overvoltage and reverse-voltage protection

– short-circuit protected open-drain output switch

– operates with magnetic fields from DC to 20 kHz

– 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 ignition timing, anti-block brake systems and speed measurement in hostile automotive and industrial environments

– EMC corresponding to DIN 40839

Specifications

– switching type: unipolar

– output low with magnetic southpole on branded side of package

– output turns high if magnetic field is removed

Marking Code

Type	Temperature Range		
	A	E	C
HAL114S HAL114UA	114A	114E	114C

Operating Junction Temperature Range

A: T_J = –40 °C to +170 °C

E: T_J = –40 °C to +100 °C

C: T_J = 0 °C to +100 °C

Designation of Hall Sensors

HAL XXXPP-T

Temperature Range: A, E, or C

Package: UA for TO-92UA,
S for SOT-89A

Type: 114

Example: **HAL 114UA-E**

→ Type: 114
→ 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

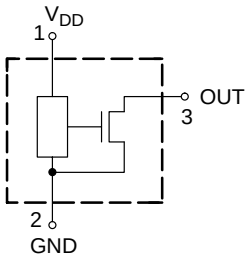


Fig. 1: Pin configuration

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 VDD-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.

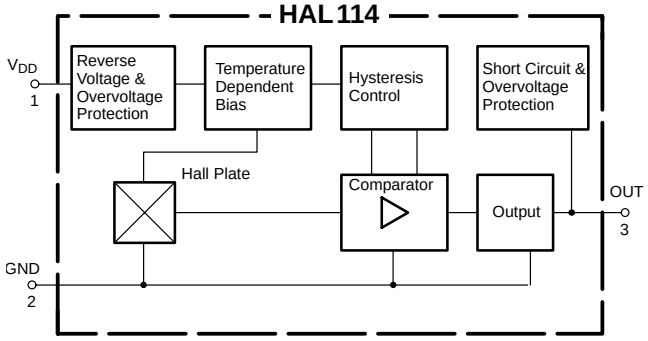


Fig. 2: HAL 114 block diagram

Outline Dimensions

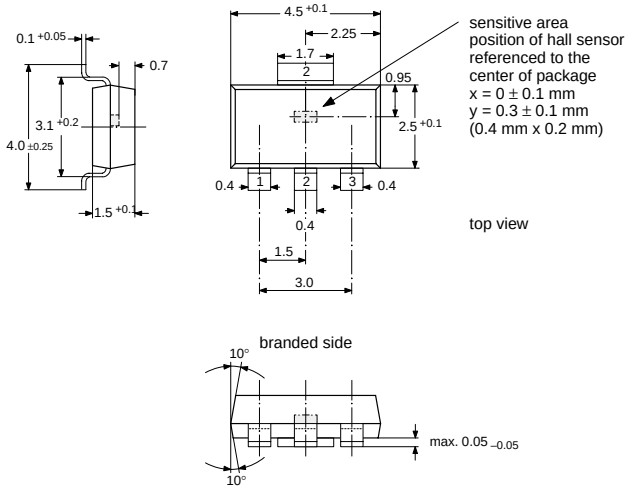


Fig. 3:
Plastic Small Outline Transistor Package
(SOT-89A)
Weight approximately 0.04 g
Dimensions in mm

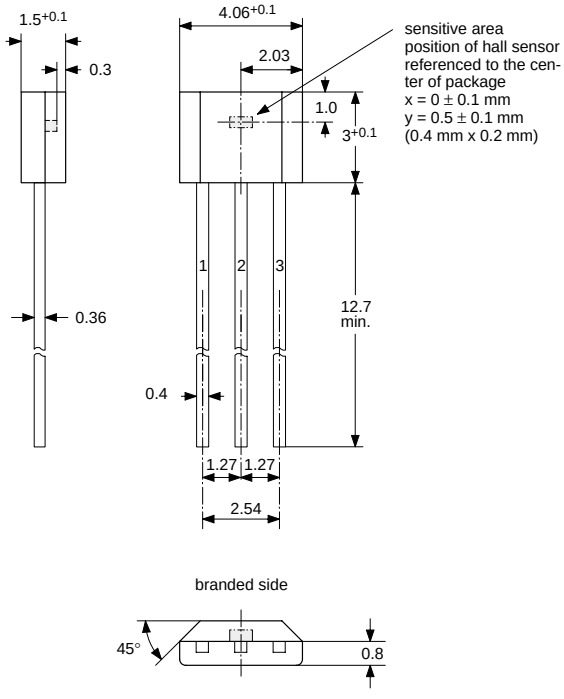


Fig. 4:
Plastic Transistor Single Outline Package
(TO-92UA)
Weight approximately 0.12 g
Dimensions in mm

Absolute Maximum Ratings

Symbol	Parameter	Pin No.	Min.	Max.	Unit
V_{DD}	Supply Voltage	1	–15	28[1)]	V
$-V_P$	Test Voltage for Supply	1	–24[2)]	–	V
$-I_{DD}$	Reverse Supply Current	1	–	50[1)]	mA
I_{DDZ}	Supply Current through Protection Device	1	–300[3)]	300[3)]	mA
V_{OH}	Output High Voltage	3	–	28[1)]	V
I_O	Continuous Output On Current	3	–	30	mA
I_{Omax}	Peak Output On Current	3	–	250	mA
I_{OZ}	Output Current through Protection Device	3	–300[3)]	300[3)]	mA
T_S	Storage Temperature Range		–65	150	°C
T_J	Junction Temperature Range		–40 –40	150 170[4)]	°C

[1)] as long as $T_J$max is not exceeded
[2)] with a 220 Ω series resistance at pin 1 corresponding to test circuit 1
[3)] t<2 ms
[4)] t<1000h

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	4.5	–	24	V
I_O	Continuous Output On Current	3	0	–	20	mA
R_S	Series Resistor	1	–	–	270	Ω

Electrical Characteristics at T_J = –40 °C to +170 °C , V_{DD} = 4.5 V to 24 V, as not otherwise specified
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	–	120	250	mV	I_O = 12.5 mA, T_J = 25 °C
V_{OL}	Output Voltage over Temperature Range	3	–	120	400	mV	I_O = 12.5 mA
V_{OL}	Output Voltage over Temperature Range	3	–	190	500	mV	I_{OL} = 20 mA
I_{OH}	Output Leakage Current	3	–	–	1	µA	B < B_{off}, V_{OH} = 24 V, T_J = 25 °C
I_{OH}	Output Leakage Current over Temperature Range	3	–	–	10	µA	B < B_{off} V_{OH} = 24 V, T_J < 150 °C
I_{DD}	Supply Current	1	6.6	8.3	11	mA	T_J = 25 °C
I_{DD}	Supply Current over Temperature Range	1	3.9	8.3	12	mA	
$t_{en(O)}$	Enable Time of Output after Setting of V_{DD}	3	–	6	10	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 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 +170 °C, V_{DD} = 4.5 V to 24 V,
Typical Characteristics for 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	–40 °C			25 °C			100 °C			170 °C			Unit
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
On point B_{ON}	7.5	22.8	36.0	7.0	21.3	34.0	6.3	19.3	31.5	6.0	18.3	31.0	mT
Off point B_{OFF}	4.3	19.2	33.2	4.0	17.8	31.2	3.6	16.0	28.9	3.6	15.1	28.8	mT
Hysteresis B_{HYS}	2.8	3.6	4.3	2.8	3.5	4.2	2.6	3.3	4.0	2.2	3.2	3.9	mT

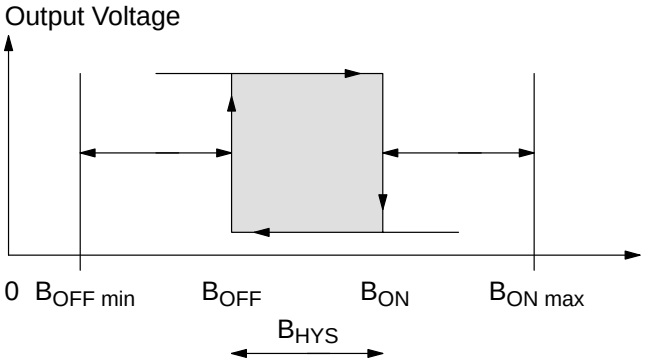


Fig. 5: Definition of switching points and hysteresis

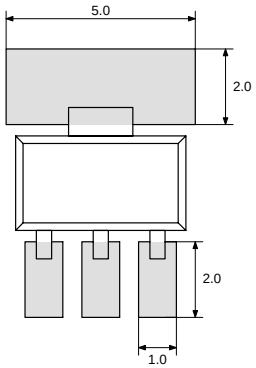
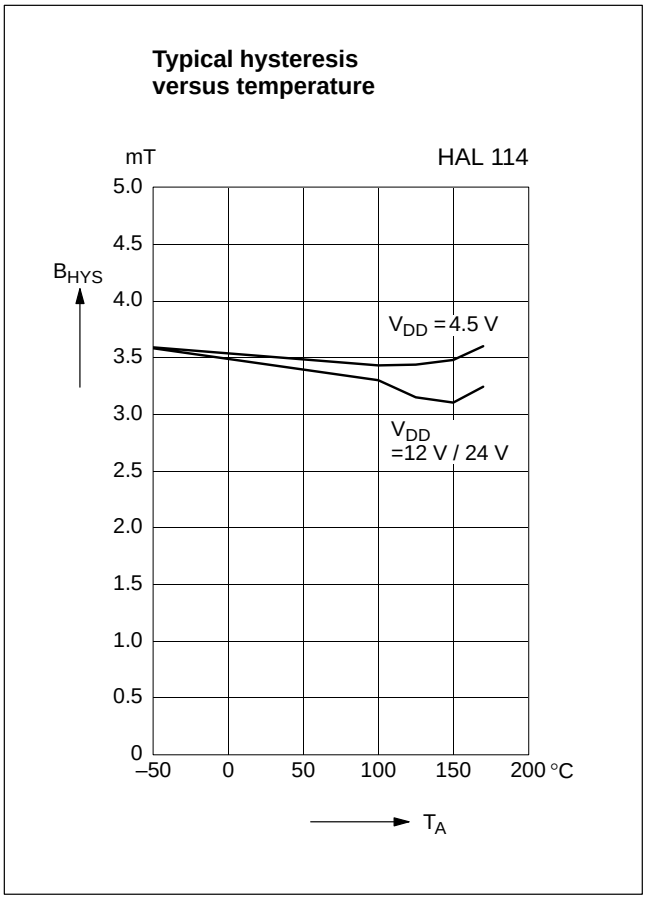
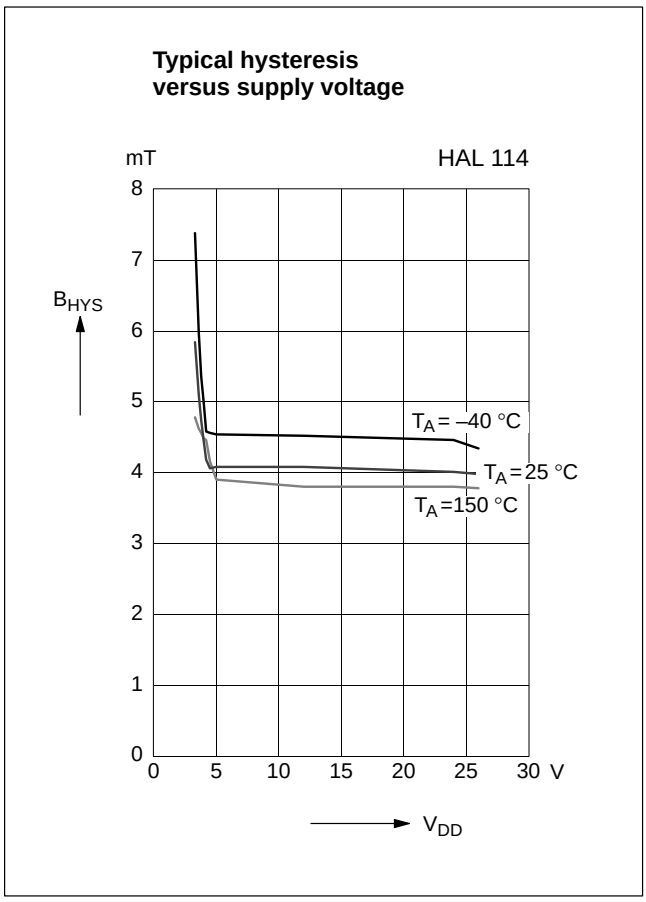
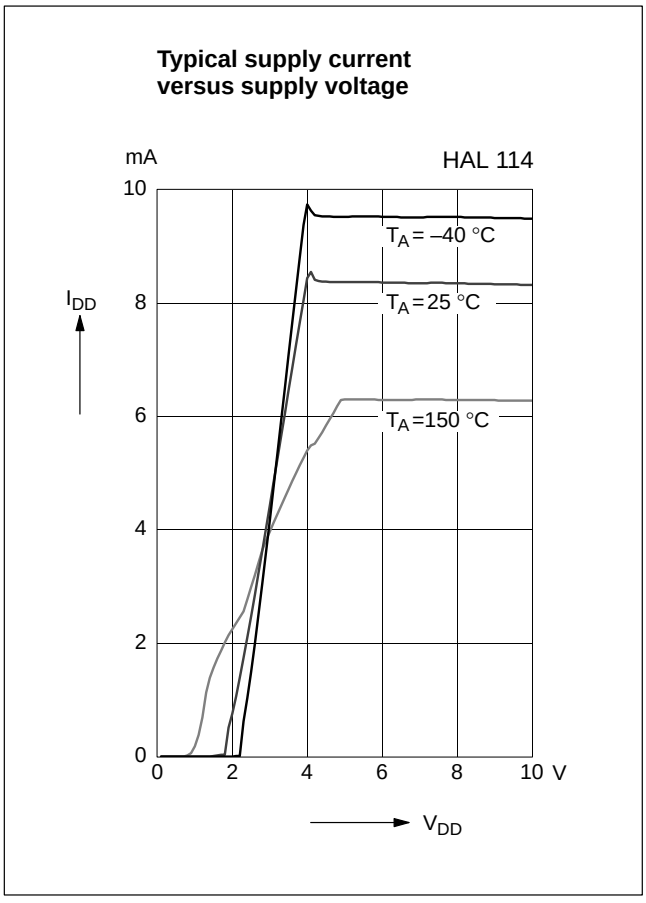


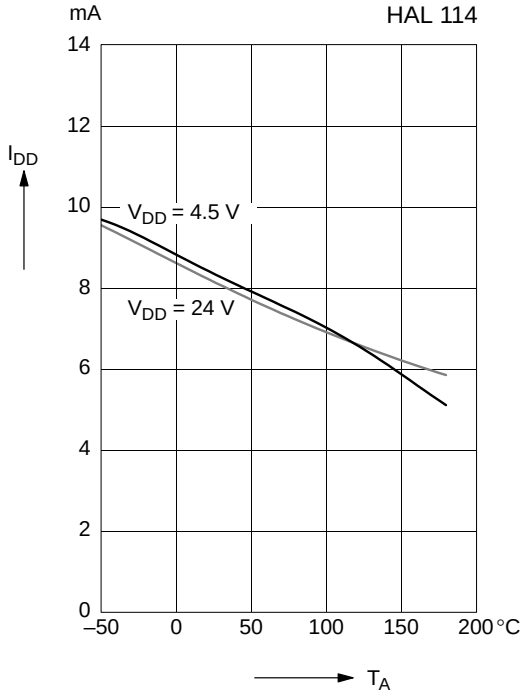
Fig. 6: Recommended pad size SOT-89A
Dimensions in mm



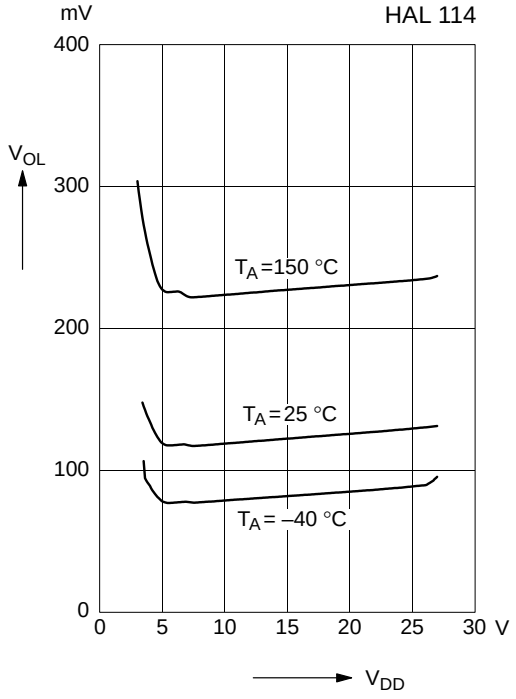




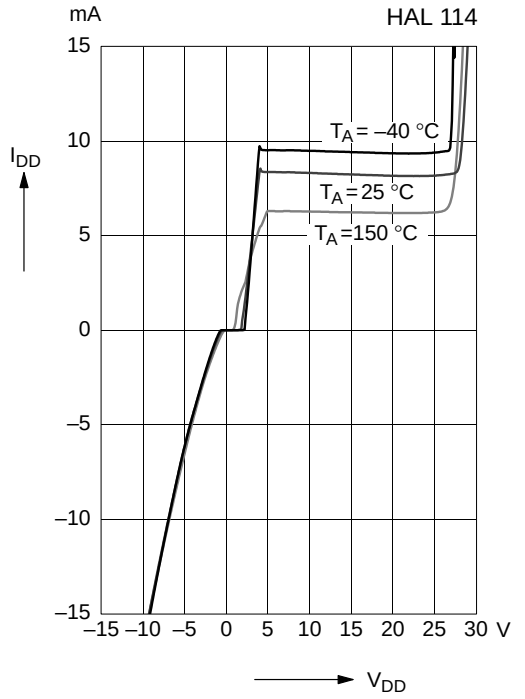
Typical supply current versus temperature



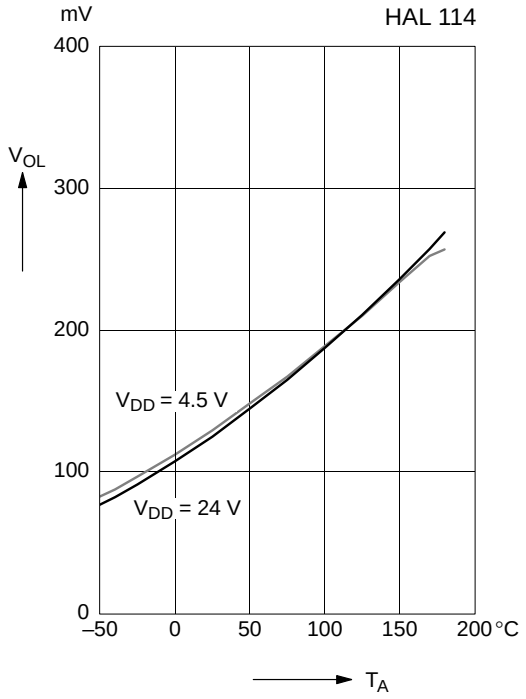
Typical output low voltage versus supply voltage
I_O = 12.5 mA



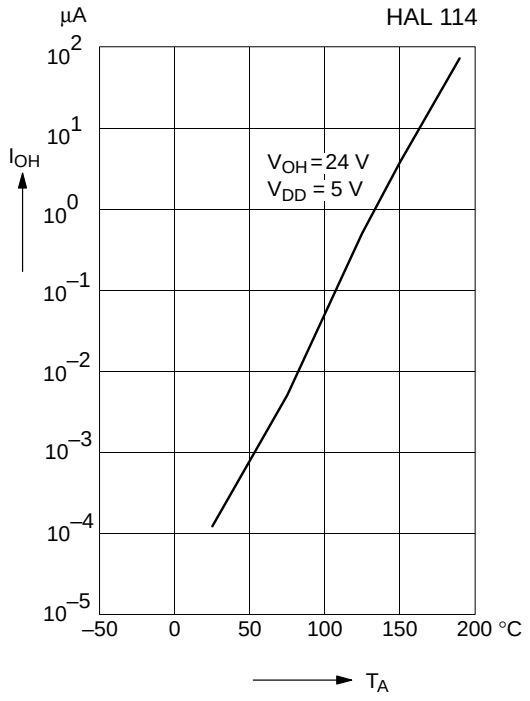
Typical supply current versus supply voltage



Typical output low voltage versus temperature
I_O = 12.5 mA



Typical output leakage current versus temperature



Application Note

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} (pin1) and Ground (pin 2) is recommended.

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.

Test Circuits for Electromagnetic Compatibility

Test pulses V_{EMC} corresponding to DIN 40839.

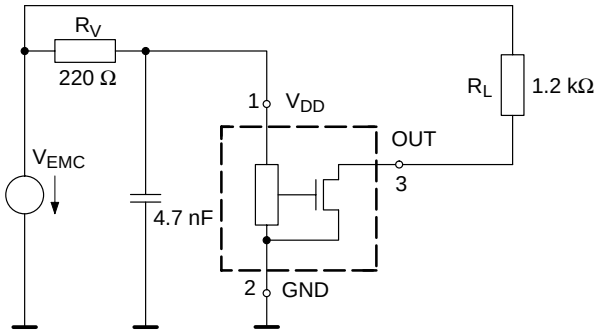


Fig. 7: Test circuit 1: test procedure for class C

Data Sheet History

1. Advance Information: “HAL114 Hall Effect Sensor IC”, May 5, 1997, 6251-456-1AI: First release of the advance information.

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