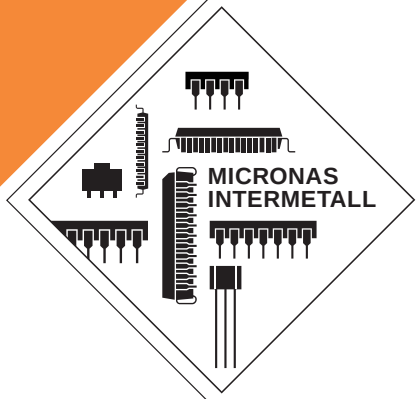


PRELIMINARY DATA SHEET

HAL556, HAL566
Hall Effect Sensor ICs

Edition April 29, 1997
6251-425-1PD

MICRONAS
INTERMETALL

Hall Effect Sensor IC
in CMOS technology

Features:

– current output for two-wire application

– operates from 4 V to 24 V supply voltage

– switching offset compensation at 120 kHz

– overvoltage and reverse-voltage protection

– extremely robust against mechanical stress

– operates with magnetic fields from DC to 10 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

– EMC corresponding to DIN 40839

Specifications

HAL556

– switching type: unipolar, two-wire sensor

– turns to high current with magnetic south pole on branded side, turns to low current if magnet removed

HAL566

– switching type: unipolar, two-wire sensor

– turns to low current with magnetic south pole on branded side, turns to high current if magnet removed

Marking Code

Type	Temperature Range	
	E	C
HAL556S, HAL556UA	556E	556C
HAL566S, HAL566UA	566E	566C

Operating Junction Temperature Range

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: E or C
- Package: UA for TO-92UA, S for SOT-89A
- Type: 556,566

Example: **HAL566UA-E**

→ Type: 566
→ 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

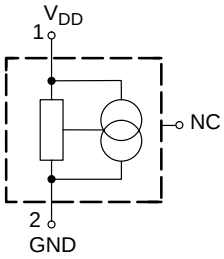


Fig. 1: Pin configuration

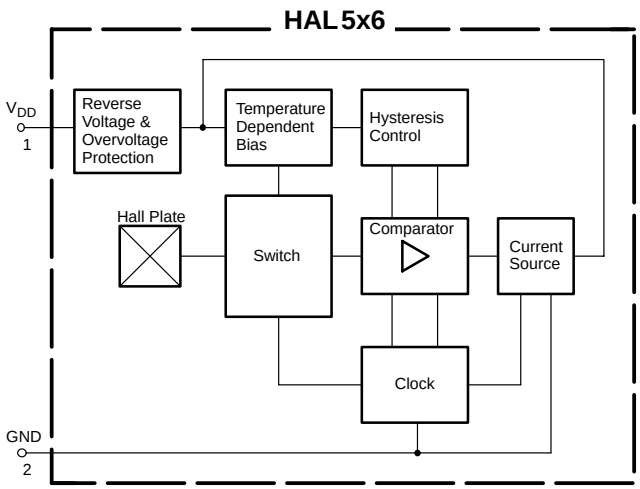


Fig. 2: HAL5x6 block diagram

Functional Description

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. Magnetic offset caused by mechanical stress is compensated for by using the “switching offset compensation technique”. Therefore, an internal oscillator provides a two phase clock. The hall voltage is sampled at the end of the first phase. At the end of the second phase, both sampled and momentary hall voltages are averaged and compared with the actual switching point. Subsequently, the supply current level switches to the appropriate state. The amount of time elapsed from crossing the magnetic switch level to switching of the current level can vary between zero and $1/f_{osc}$. Shunt protection devices clamp voltage peaks at the 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.

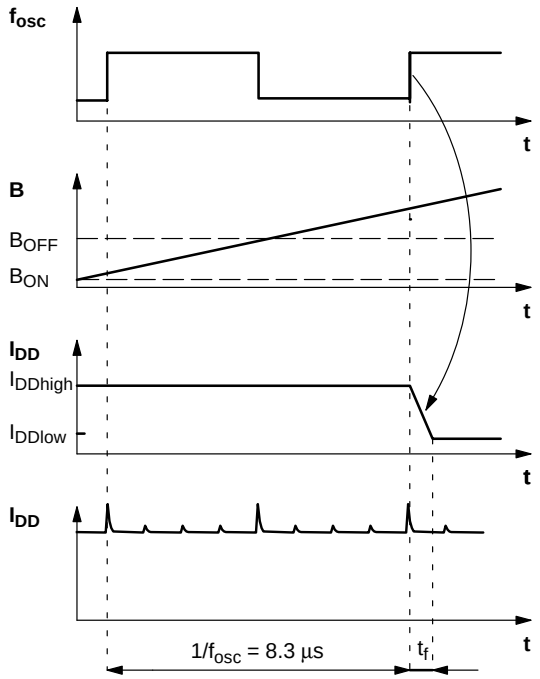


Fig. 3: Timing diagram (example: HAL566)

Outline Dimensions

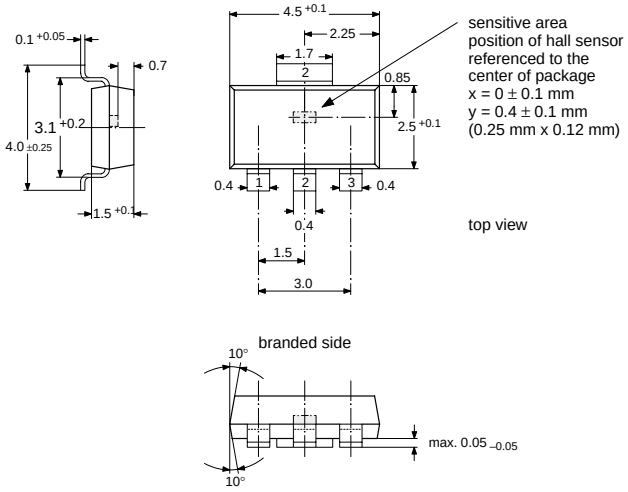


Fig. 4:
Plastic Small Outline Transistor Package
(SOT-89A)
Weight approximately 0.04 g
Dimensions in mm

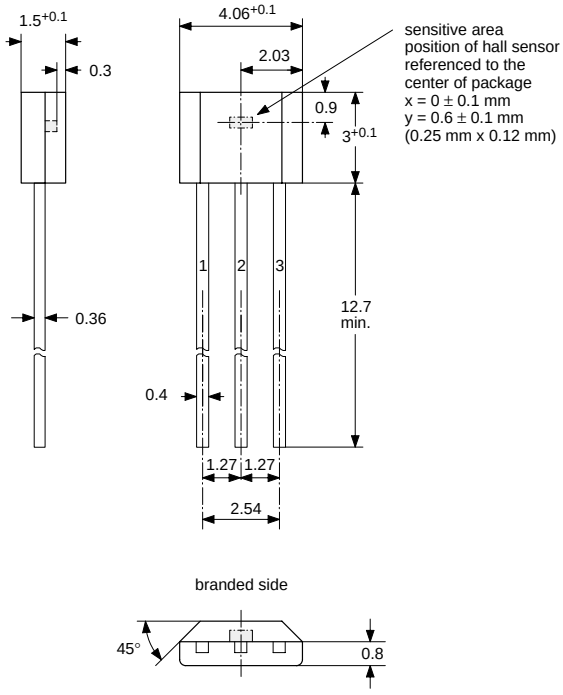


Fig. 5:
Plastic Transistor Single Outline Package
(TO-92UA)
Weight approximately 0.12 g
Dimensions in mm

Absolute Maximum Ratings

Symbol	Parameter	Pin No.	Min.	Max.	Unit
V_{DD}	Supply Voltage	1	–15[1)]	28[2)]	V
I_{DDZ}	Supply Current through Protection Device	1	–50[2)] –300[3)]	50[2)] 300[3)]	mA mA
T_S	Storage Temperature Range		–65	150	°C
T_J	Junction Temperature Range		–40	150	°C

[1)] –18 V with 100 Ω series resistor at pin 1 (–16 V with 30 Ω series resistor) as long as T_{jmax} is not exceeded.
[2)] as long as $T_J$max is not exceeded
[3)] 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	–	24	V
t_v	Duty Cycle				1/100	
t_{on}	Supply Time		30		–	µs
T_A	Ambient Temperature		–40		85[1)]	°C

Pulsed mode of supply is recommended for operation at high ambient temperatures to keep junction temperature low.
[1)] with pulsed mode of supply, $t_v \geq 1/6$ and $t_{on} \leq 1$ ms (see also application note)

Electrical Characteristics at T_J = –40 °C to +100 °C , V_{DD} = 4 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
I_{DDlow}	Supply Current	1	2.6	3.5	5	mA	T_J = 25 °C, B > B_{OFF} 1) T_J = 25 °C, B < B_{OFF} 2)
I_{DDlow}	Supply Current	1	1.9	3.5	6	mA	B > B_{OFF} 1) B < B_{OFF} 2)
I_{DDhigh}	Supply Current	1	12	15.5	19	mA	B < B_{ON} 1) B > B_{ON} 2)
f_{osc}	Internal Oscillator Chopper Frequency	–	90	120	150	kHz	T_J = 25 °C, V_{DD} = 4.5 V to 24 V
f_{osc}	Internal Oscillator Chopper Frequency over Temperature Range	–	75	120	165	kHz	T_J = –30 °C to 100 °C, V_{DD} = 4 V to 24 V
$t_{en(O)}$	Enable Time of Output after Setting of V_{DD}	1		20	30	µs	3)
t_r	Output Rise Time	1		400	1600	ns	V_{DD} = 12 V, R_S = 30 Ω
t_f	Output Fall Time	1		400	1600	ns	V_{DD} = 12 V, R_S = 30 Ω
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. 7
R_{thJA} case TO-92UA	Thermal Resistance Junction to Soldering Point	–	–	150	200	K/W	

1) B_{OFF} > B_{ON} for HAL566
2) B_{ON} > B_{OFF} for HAL556
3) B < B_{ON} – 2mT; B > B_{OFF} + 2mT for HAL566
B < B_{OFF} – 2mT; B > B_{ON} + 2mT for HAL556

Magnetic Characteristics at T_J = –40 °C to +100 °C, V_{DD} = 4 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			Unit
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
On point B_{ON}										
HAL556	3.4	5.9	7.7	3.4	5.5	7.2	3.25	5.1	7	mT
HAL566	2.1	3.8	5.9	2	3.5	5.7	1.85	3.3	5.7	mT
Off point B_{OFF}										
HAL556	2.1	3.8	5.9	2	3.5	5.7	1.85	3.3	5.7	mT
HAL566	3.4	5.9	7.7	3.4	5.5	7.2	3.25	5.1	7	mT
Hysteresis B_{HYS}										
HAL556	0	1.9	2.8	0	1.3	2.7	0	0.7	2.6	mT
HAL566	0	1.9	2.8	0	1.3	2.7	0	0.7	2.6	mT
Magnetic Offset $(B_{ON} + B_{OFF})/2$										
HAL556	–	4.8	–	3	4.5	6.2	–	4.18	–	mT
HAL566	–	4.8	–	3	4.5	6.2	–	4.18	–	mT

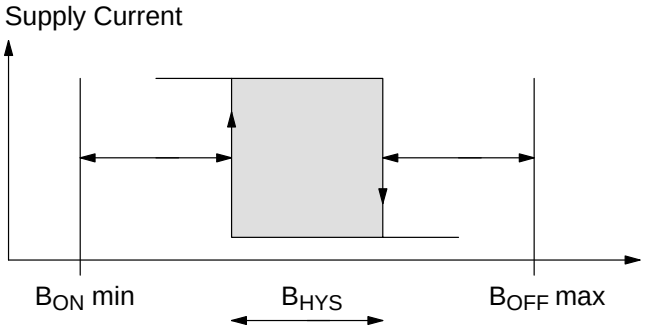


Fig. 6: Definition of magnetic switching points and hysteresis (example: HAL566)

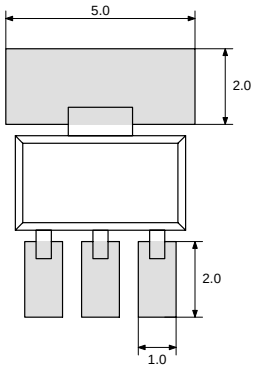
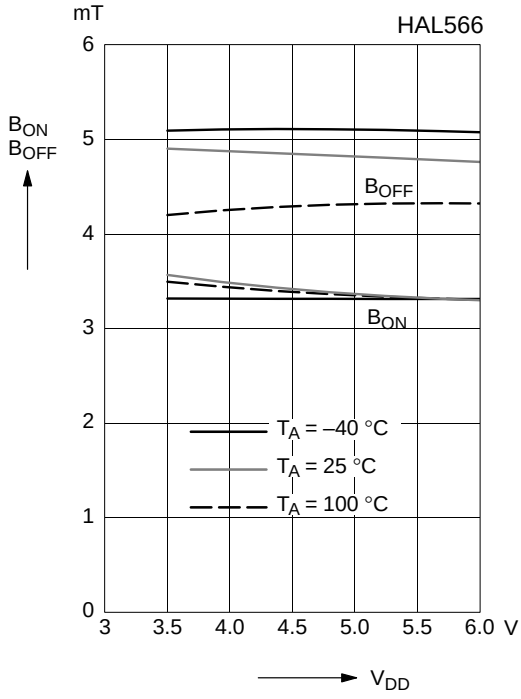


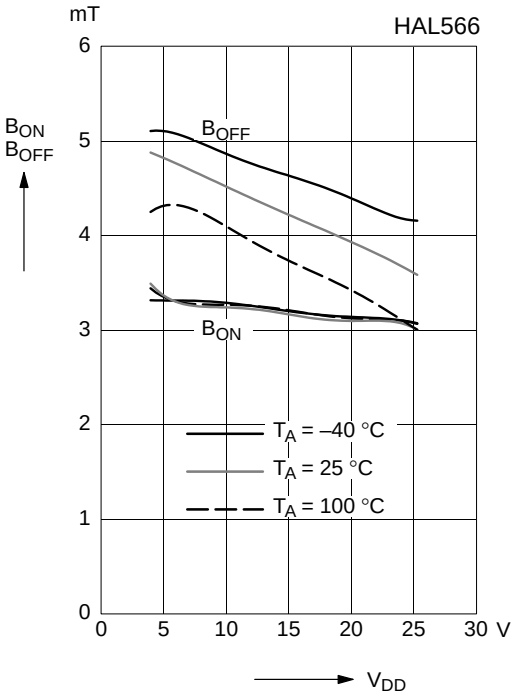
Fig. 7: Recommended pad size SOT-89A
Dimensions in mm

Note: In the following diagrams “Magnetic switch points versus ambient temperature” on pages 7 and 8, the curves for B_{ON}, B_{ON}, B_{OFF}, I_{DD}, and f_{osc} refer to ambient temperature.

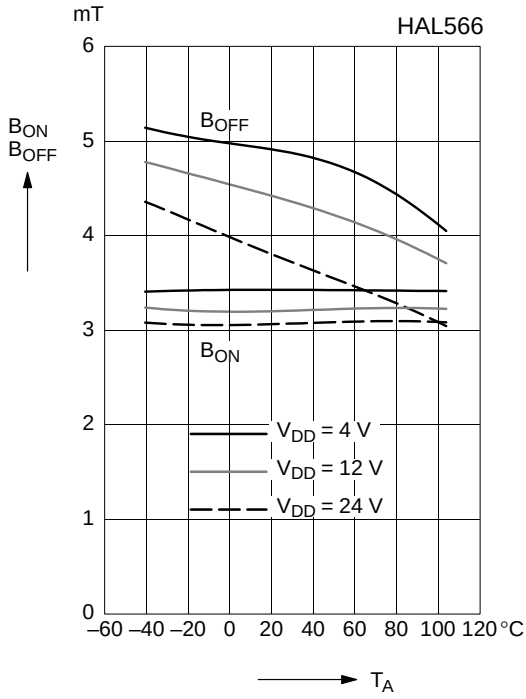
Magnetic switching points versus supply voltage



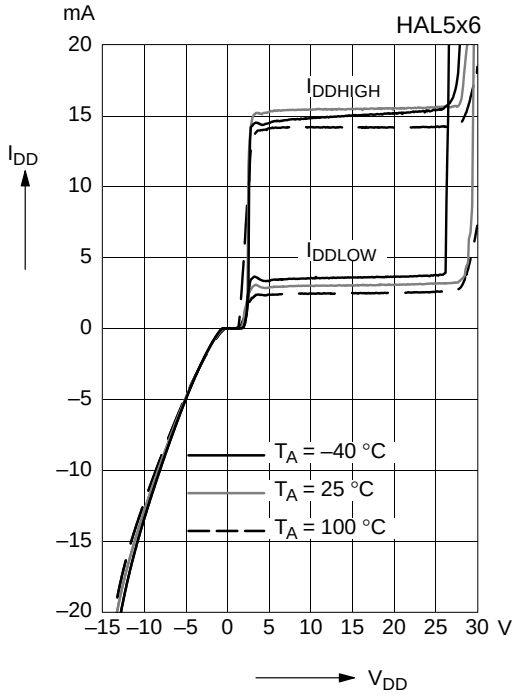
Magnetic switching points versus supply voltage



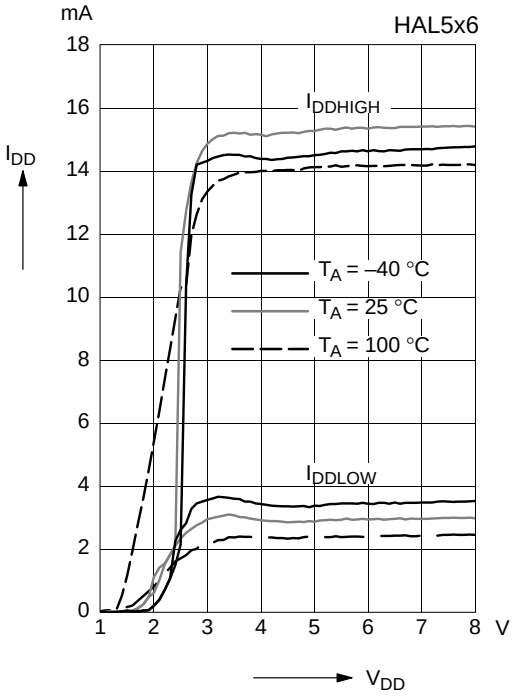
Magnetic switching points versus temperature



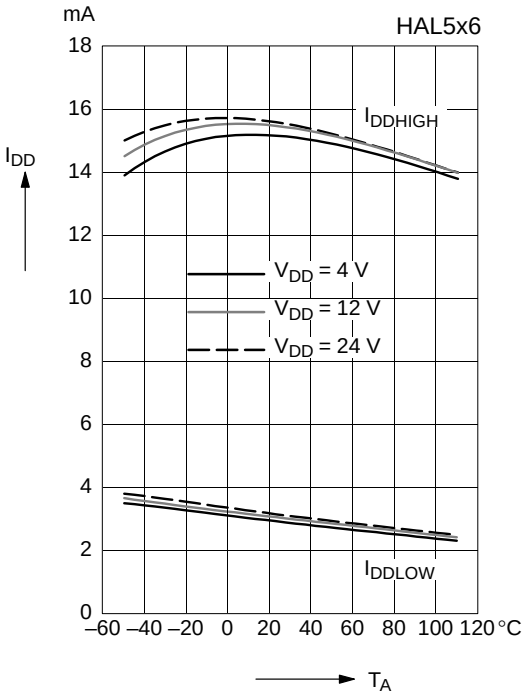
Supply current versus supply voltage



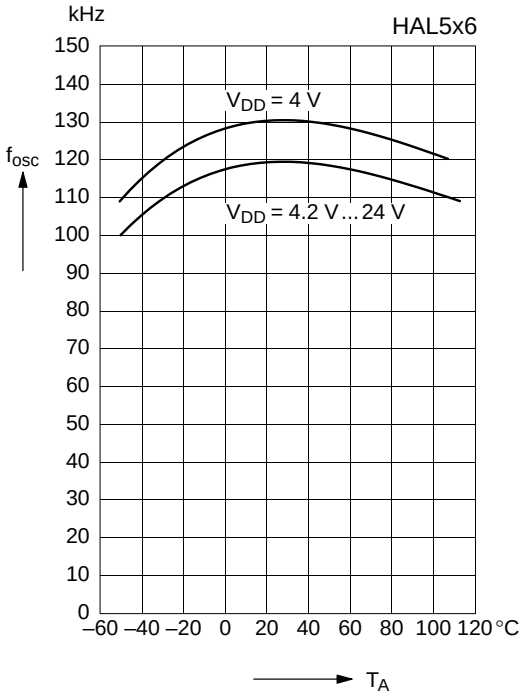
Supply current versus supply voltage



Supply current versus ambient temperature



Internal chopper frequency versus ambient temperature



Application Note

For electromagnetic immunity, it is recommended to apply a 4.7 nF capacitor between V_{DD} (pin 1) and Ground (pin 2).

For automotive applications, a 100 Ω series resistor to pin 1 is recommended; 30 Ω of resistance should be placed close to pin 1.

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 and continuous supply, 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.

Due to the range of I_{DDhigh}, self-heating can be critical. The junction temperature can be reduced with pulsed supply voltage. For supply time in the range of 30 µs to 1 ms, the following equation can be used:

$\Delta T = I_{DD} * V_{DD} * R_{th} * t_V$

Test Circuits for Electromagnetic Compatibility

Test pulses V_{EMC} corresponding to DIN 40839

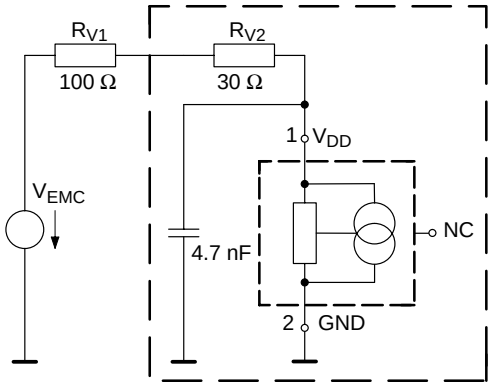


Fig. 8: Test circuit

Data Sheet History

1. Preliminary data sheet: “HAL556, HAL566 Two-Wire Hall Effect Sensor ICs”, April 29, 1997, 6251-425-1PD. First release of the preliminary data sheet.

MICRONAS INTERMETALL GmbH
Hans-Bunte-Strasse 19
D-79108 Freiburg (Germany)
P.O. Box 840
D-79008 Freiburg (Germany)
Tel. +49-761-517-0
Fax +49-761-517-2174
E-mail: docservice@intermetall.de
Internet: http://www.intermetall.de

Printed in Germany
by Systemdruck+Verlags-GmbH, Freiburg (04/97)
Order No. 6251-425-1PD