SIEMENS

Hall-Effect IC with Analog Output

TLE 4910 G

Preliminary Data

Bipolar IC

Features

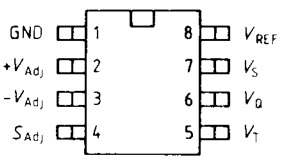
- Linear output characteristic
- Extended temperature range (–40 to 135 °C)
- Virtually independent of supply voltage and temperature fluctuations
- Reference voltage available (3 V)

P-DSO-8

Type	Ordering Code	Package
TLE 4910 G	Q67000-A9009	P-DSO-8 (SMD)

The Hall-effect IC TLE 4910 G generates at its output a voltage referred to ground that is directly proportional to the magnetic flux density passing vertically through the chip. A positive magnetic field (i.e. magnetic south pole facing the surface of the chip = stamped side) causes the output voltage to increase. The device is fully functional without any wiring. According to the application, the zero point (pin 2, 3) and the sensitivity (pin 4) can be varied over a wide range by external circuitry.

Pin Configuration

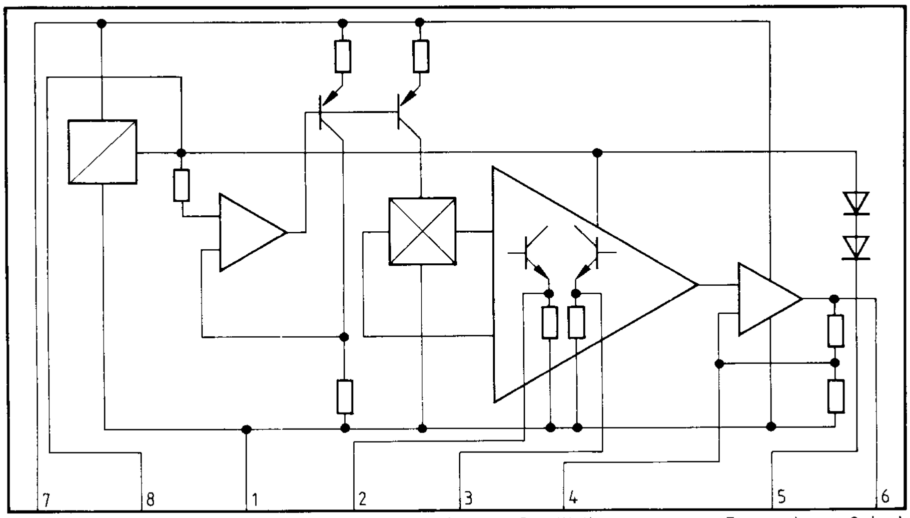


AEP 00756

Pin Definitions and Functions

Pin	Symbol	Function
1	GND	Ground
2	$+V_{Adj}$	+ Zero adjustment
3	$-V_{Adj}$	– Zero adjustment
4	S_{Adj}	Sensitivity adjustment
5	V_T	Temperature voltage
6	V_Q	Voltage output
7	V_S	Supply voltage
8	V_{REF}	Reference voltage

Block Diagram



Circuit Description

First a regulated voltage of 3 V is produced from the supply voltage. This voltage is brought out and feeds all parts of the circuitry whose accuracy is critical. The control current for the Hall generator is also derived from it. The Hall voltage is initially transformed by an transimpedance amplifier into a current referred to ground.

The zero point (offset) can be influenced from the exterior by way of the current balance (pin 2, 3). The signal is boosted further by a current amplifier and transformed back into a voltage on a resistor. An operational amplifier with variable gain produces a stable signal at the output.

The temperature voltage is derived from the 3 V reference voltage by subtracting two diode-forward voltages.

By adjusting the zero point:

- The manufacturing spread can be eliminated.
- The characteristic can be matched to the application so that both unipolar and bipolar magnetic fields can be detected with almost any conversion factors (magnetic field → voltage).

The circuit also provides

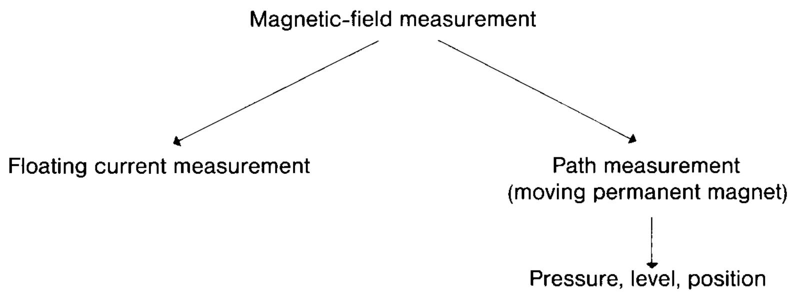
- a precise reference voltage of 3 V,
- a temperature-dependent voltage for measuring chip temperature.

The latter can be used for individual temperature compemsation of the device if very high demands are made for temperature stability (pin 2, 3).

The output characteristic begins very close to 0 V (V_{Qmin} is typically 0.005 V), so that measurement can start practically at zero with just one supply voltage. The output voltage can be loaded with up to 5 mA without degrading the accuracy.

To minimize the piezoresistive effect (change in the zero point through mechanical tension) four Hall probes are configured in a suitable manner. Even after extreme temperature cycling (–65 to 150 °C), leading to changes in the tension of the chip, there are only slight shifts in the magnetic zero B_0 of maximally ± 3 mT.

The main areas of application are:



Absolute Maximum Ratings

$T_A = -40\,°C$ to $180\,°C$, $t < 50$ h

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Supply voltage	V_S	−0.8	30	V
Output current	I_Q		10	mA
Current at reference (pin 8)	I_{VREF}		10	mA
Zero-adjustment current	I_{Adj}	−1	1	mA
Junction temperature	T_j			
$t < 3400$ h			150	°C
$t < 1000$ h			170	°C
$t < 75$ h			210	°C
Thermal resistance	R_{th}		170	K/W

Operating Range

Parameter	Symbol	min.	max.	Unit
Supply voltage	V_S	4.75	18	V
Output current	I_Q		5	mA
Ambient temperature	T_A	−40	150	°C

Characteristics

$V_S = 4.75 \leq 15$ V, $T_A = -40\,°C$ to $150\,°C$

Parameter	Symbol	Limit Values			Unit	Test Circuits
		min.	typ.	max.		
Total current $R_L = 10$ kΩ; $B < -20$ mT	I_S			10	mA	1
Output voltage	V_Q					
$R_L = 10$ kΩ; $B < -20$ mT			5	20	mV	1
$R_L = 10$ kΩ; $B > 300$ mT		V_S-2	$V_S-1.5$		V	1
Sensitivity $T_A = 25\,°C$	S	22	30	38	V/T	1
Magnetic offset	B_0	−20		20	mT	1
Reference voltage $T_A = 25\,°C$	V_{REF}	2.9	3.0	3.1	V	1

Characteristics

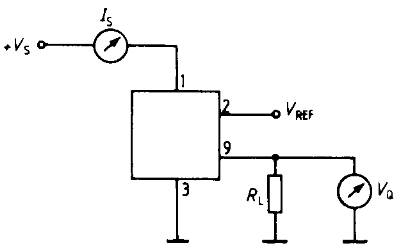
$V_S = 4.75 \leq 15$ V, $T_A = -40$ °C to 150 °C

Parameter	Symbol	Limit Values min.	Limit Values typ.	Limit Values max.	Unit	Test Circuits
Output voltage/adjustment current (pin 2, 3) $T_A = 25$ °C	V_Q/I_{Adj}		±0.3		V/µA	2
Voltage at pin 2, 3 $T_A = 25$ °C	V_{Adj}	50	70	90	mV	2
Temperature voltage $R = 5$ kΩ; $T_A = 25$ °C	V_T	1.4		1.7	V	3
Temperature coefficient of V_T $R = 5$ kΩ	TC_T	3.2	3.5	3.7	mV/K	3
Output impedance $V_S = 5$ V; $I_Q = 5$ mA	R_Q			10	Ω	1
Sensitivity change due to V_S changes $T_A = 25$ °C	$\Delta S/\Delta V_S$			0.2	%/V	1
Magnetic offset due to V_S changes	$\Delta B_0/\Delta V_S$	−20		20	µT/V	1
Magnetic offset change after high temperature endurance test 1000 h / 150 °C	ΔB_0			±3	mT	
Thermal cycling −65 °C / 150 °C (1000 x)				±3	mT	
Humidity test 85 °C / 85%				±3	mT	

For temperature changes due to magnetic offset and sensitivity, **see diagrams.**

Hall ICs may change their magnetic offset slightly after climatic stress.

Test Circuit 1



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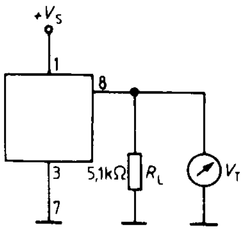
Test Circuit 3



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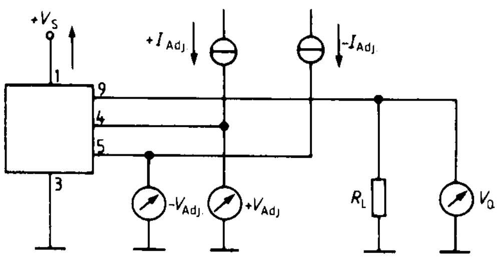
Test Circuit 2



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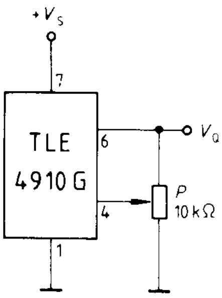
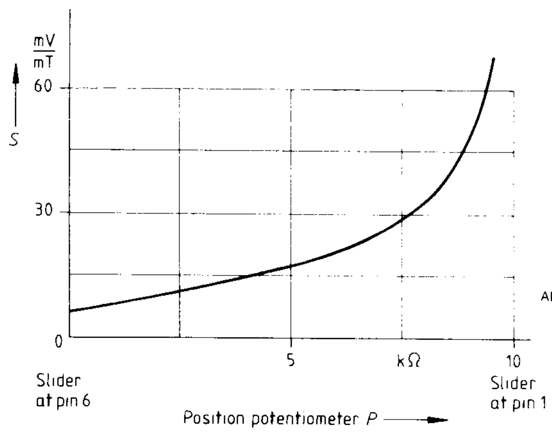
Diagrams

Position Characteristics of Sensitivity Adjustment





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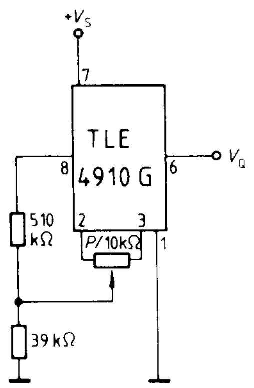
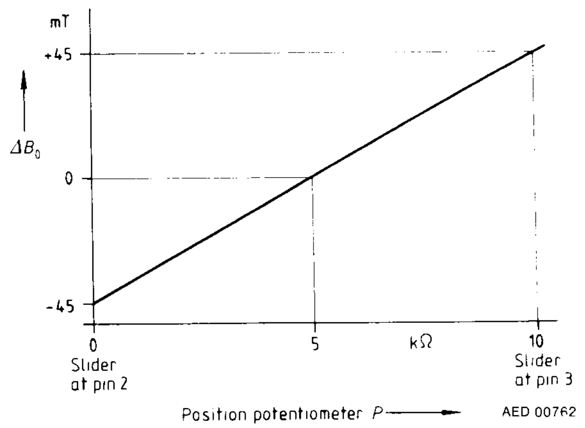
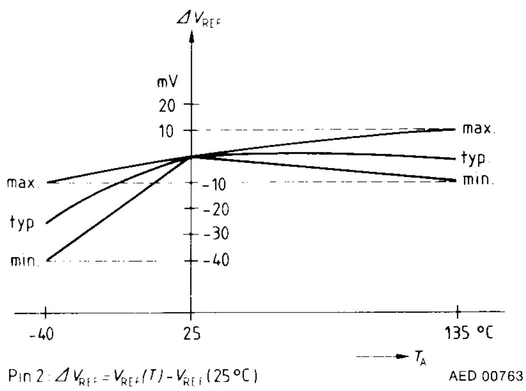
Diagrams
Position Characteristics at Magnetic Offset

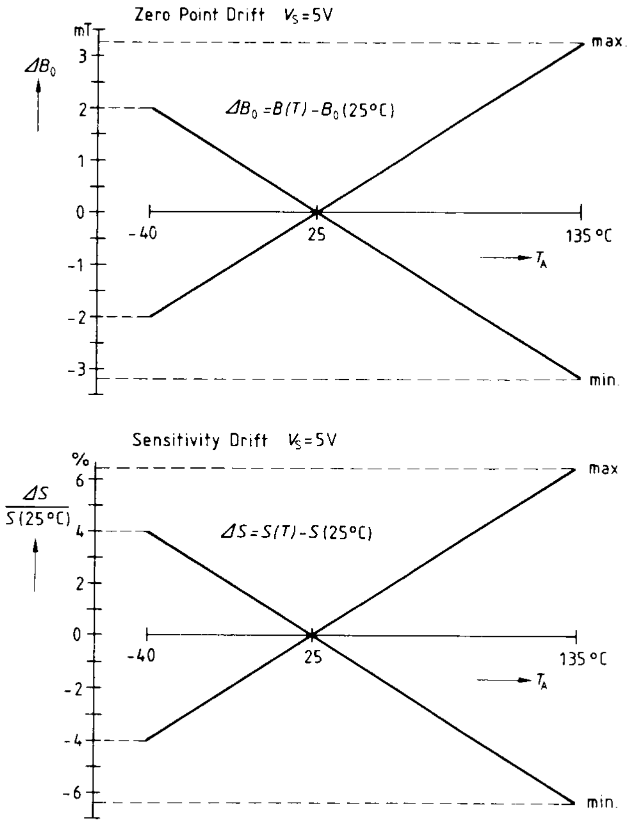




Diagrams
Temperature Dependence of Reference Voltage



Diagrams
Temperature Dependence of Zero Point and Sensitivity



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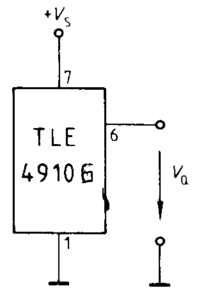
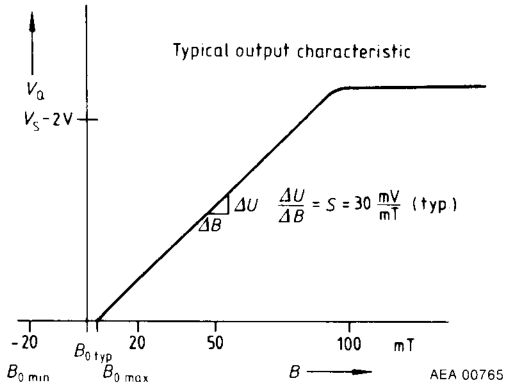
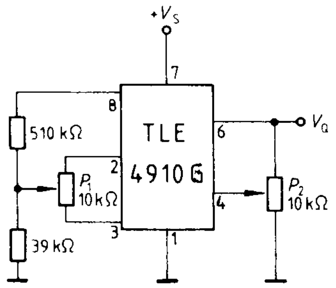
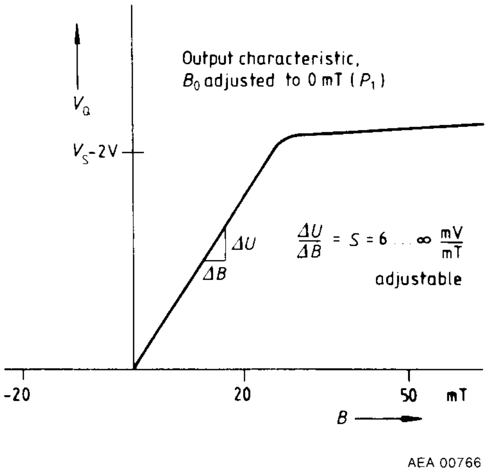
Application Circuit 1
Measuring Positive Magnetic Field without Electrical Adjustment



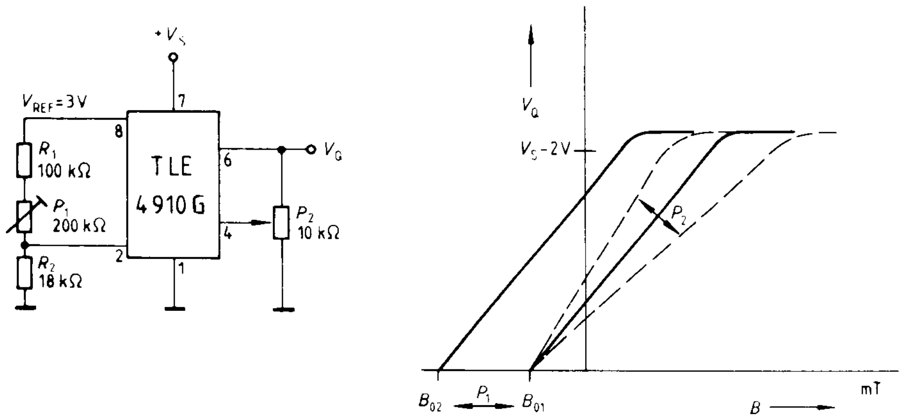


Application Circuit 2
Measuring Positive Magnetic Field with Adjustment of Offset and Sensitivity





Application Circuit 3
Measuring Bipolar Magnetic Field by Shifting "Starting Point" to Negative Field



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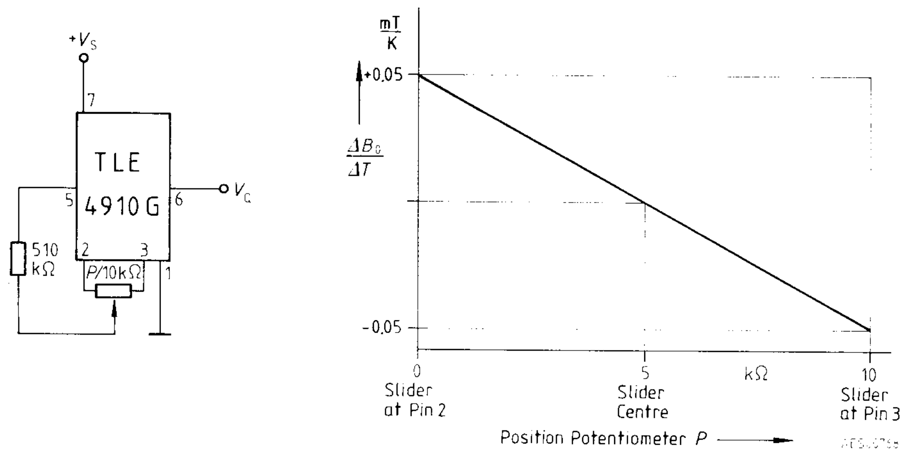
Application Circuit 4
Application Circuit for Individual Compensation of B_0 Temperature Drift



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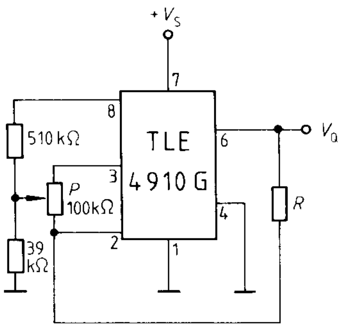
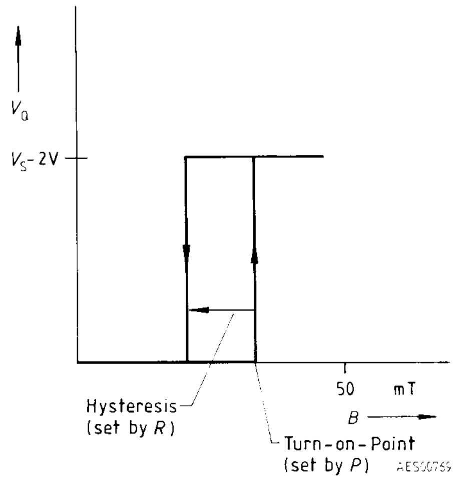
Application Circuit 5
Switching Mode with Adjustable Threshold





$$R = \frac{V_S - 2}{B_{Hy} \times 10^{-5}}$$

B_{Hy} in mT
R in