Differential Two-Wire Hall Effect Sensor-IC for Wheel Speed Applications

TLE4941-1
TLE4941-1C

Sensors

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N e v e r   s t o p   t h i n k i n g .

Differential Two-Wire Hall Effect Sensor IC

For all parameters not specified in this document the TLE4941 Data Sheet is valid.
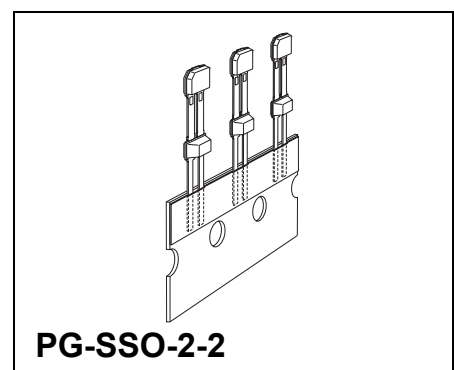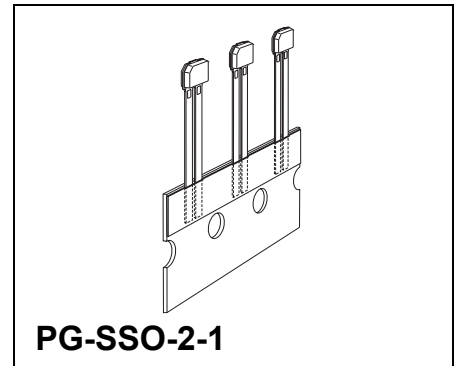
PG-SSO-2-1

PG-SSO-2-2

Type	Marking	Ordering Code	Package
TLE4941-1	4101R	Q62705-K719	PG-SSO-2-1
TLE4941-1C	41C1R	Q62705-K712	PG-SSO-2-2

Functional Description
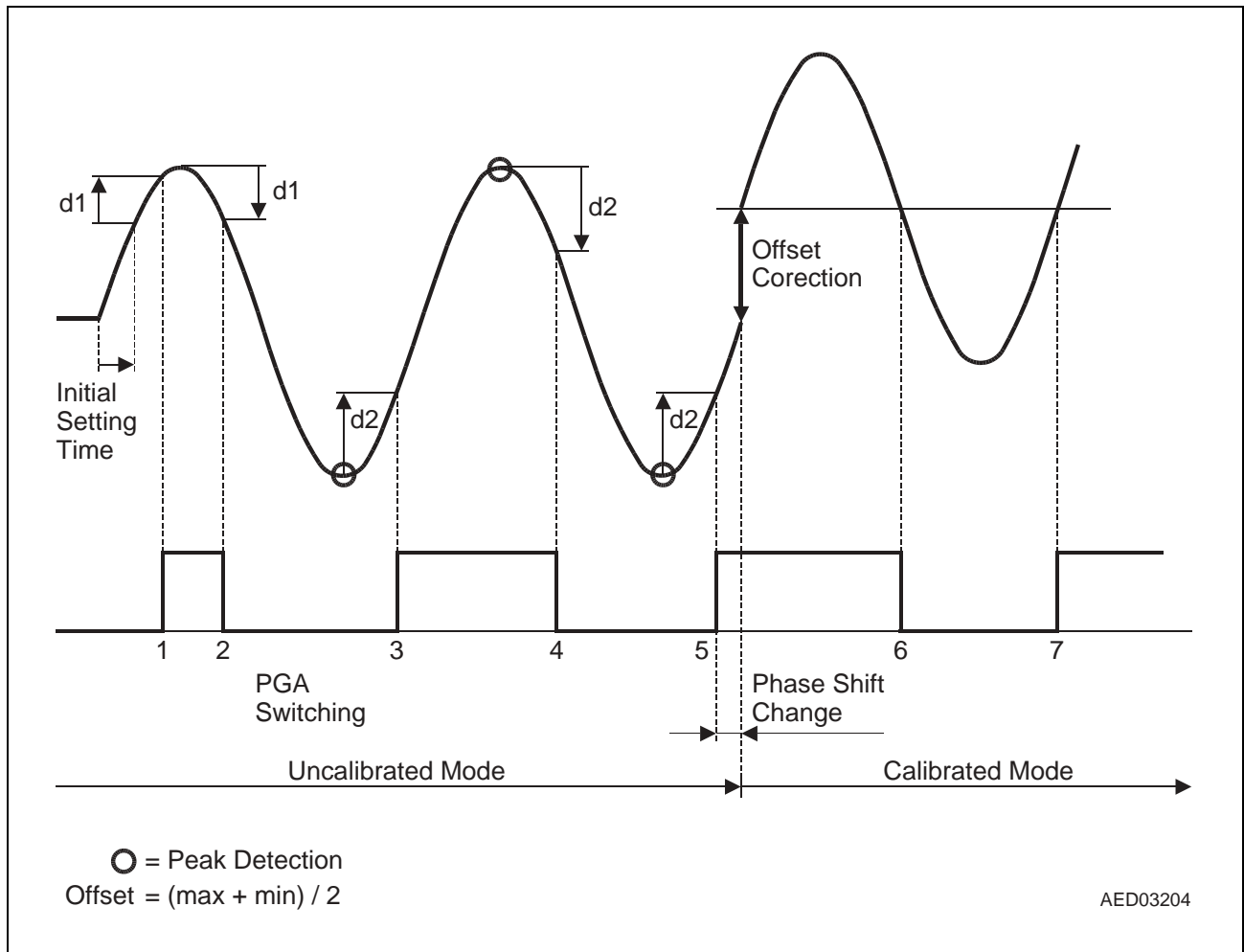
Figure 1   Example for Start-up Behavior

Uncalibrated Mode

Occasionally a short initial offset settling time $t_{d,input}$ might delay the detection of the input signal (the sensor is "blind").

The magnetic input signal is tracked by the speed ADC and monitored within the digital circuit. For detection the signal transient needs to exceed a threshold (digital noise constant d1). When the signal slope is identified as a rising edge (or falling edge), a trigger pulse is issued to a comparator. A second trigger pulse is issued as soon as a falling edge (or rising edge respectively) is detected (and vice versa).

Between the start-up of the magnetic input signal and the time when its second extreme is reached, the PGA (programmable gain amplifier) will switch to its appropriate position. This value is determined by the signal amplitude and initial offset value. The digital noise constant value is changing accordingly (d1 → d2, related to the corresponding PGA states), leading to a change in phase shift between magnetic input signal and output

signal. After that consecutive output edges should have a nominal delay of about 180°. In rare cases one further switching of PGA can occur (see Appendix B).

During the uncalibrated mode the offset value is calculated by the peak detection algorithm as described in the TLE4941 Data Sheet.

Transition to Calibrated Mode

In the calibrated mode the output will switch at zero-crossing of the input signal. The phase shift between input and output signal is no longer determined by the ratio between digital noise constant and signal amplitude. Therefore a sudden change in the phase shift may occur during the transition from uncalibrated to calibrated mode.

Calibrated Mode

See TLE4941 Data Sheet.

Additional Notes

Unlike the TLE4941 the first output edge might occur before the first zero-crossing of the magnetic input signal. However, referring to the input signal the delay between start-up of the signal and first calibrated output signal is identical with TLE4941.

Typically the phase error due to PGA-transition reduces the error caused by switching the mode from uncalibrated to calibrated. PGA-transition usually takes place on the first full magnetic edge.

The summed up change in phase error from the first output edge issued to the output edges in calibrated mode will not exceed ± 90°.

Circuit Description

See TLE4941 Data Sheet.

Table 1   Additions/Changes for TLE4941-1 versus TLE4941
(All values are valid for constant amplitude and offset of input signal,
f < 2500 Hz)

Parameter	Symbol	Limit Values			Unit	Conditions
		min.	typ.	max.		
Signal behavior after undervoltage or standstill > t_{Stop} Number of magnetic edges where the first switching may occur [1]	$n_{DZ\text{-}Start}$	–	–	1	edge	Magnetic edge amplitude according to $\Delta\hat{B}_{Limit,early\ startup}$ $t_{d,input}$ has to be taken into account
Systematic phase error of output edges during start-up and uncalibrated mode		38	–	–	µs	Shortest time delay between input signal edge 1 and 2 $t_{d,input}$ has to be taken into account
		– 88	–	+ 88	°	Systematical phase error of "uncal" edge; n^{th} vs. n + 1th edge (does not include random phase error)
Phase shift change during PGA switching		0	–	80	°	after the 2nd edge
Phase shift change during transition from uncalibrated to calibrated mode	$\Delta\Phi_{switch}$	– 90	–	+ 90	°	
Number of edges in uncalibrated mode	$n_{DZ\text{-}Startup}$	–	–	6	edges	
In rare cases (see **"Appendix B" on page 6**)	$n_{DZ\text{-}Startup}$	–	–	8	edges	
Jitter during uncalibrated mode 1 Hz < f < 2500 Hz	$S_{JitClose}$ (1σ-value)	–	–	± 3	%	$-40°C \leq T_{amb} \leq 150°C$
		–	–	± 4		$150°C \leq T_{amb} \leq 170°C$

Table 1   Additions/Changes for TLE4941-1 versus TLE4941
(All values are valid for constant amplitude and offset of input signal,
$f < 2500$ Hz) (cont'd)

Parameter	Symbol	Limit Values			Unit	Conditions
		min.	typ.	max.		
	S_{JitFar} (1σ-value)	–	–	± 5	%	$-40°C \leq T_{amb} \leq 150°C$
		–	–	± 7		$150°C \leq T_{amb} \leq 170°C$
	S_{JitAC} (1σ-value)	–	–	± 3	%	See TLE4941 Data Sheet
Magnetic differential field change necessary for early startup of the - 1 Versions $\Delta \hat{B}_{Limit, early\ startup}$ 1 Hz $< f <$ 2500 Hz 2500 Hz $< f <$ 10000 Hz	$\Delta \hat{B}_{Limit, early\ startup}$	– 0.7 –	– 1.76 –	– 3.3 3.9	mT	Magnetic field (peak to peak value) change necessary for startup with the first edge
Permitted time for edges to exceed $\Delta \hat{B}_{Limit, early\ startup}$	$\Delta t_{Limit, slow\ early\ startup}$	–	–	590	ms	Necessary for startup with the second edge $f < 1$ s

1) Due to defined power on state (low current) the IC can not provide the first edge if it would lead as well to a low state

Behavior at Magnetic Input Signals Slower than T_{stop} (self-calibration time period)

Unlike the TLE4941 magnetic changes exceeding $\Delta \hat{B}_{Limit, early\ startup}$ can cause output switching of the TLE4941-1, even at f significantly lower than 1 Hz. Depending on their amplitude edges slower than $\Delta t_{Limit, slow\ early\ startup}$ might be detected. If the digital noise constant ($\Delta \hat{B}_{Limit, early\ startup}$) is not exceeded before a new initial self-calibration is started, the output of the corresponding edge will be inhibited. This depends on signal amplitude and initial phase.

Additional Remarks

All additional parameters for TLE4941-1 are not subject to production test - verified by design/characterization. For series production additional to the parameters of TLE4941 (standard type) only $n_{DZ-start}$ is tested.

Revision History:2005-02, V2.1

Previous Version: 2004-01, V2.0

Page	Subjects (major changes since last revision)
3	Package name changed from P-... to PG-...
-	new format of data sheet

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feedback.sensors@infineon.com

VAKAT