

Linear and Multi-Axis Hall-Effect Sensors

Selection Guide for Automotive Applications



MICRONAS

5 Billion
Sensors shipped



HALL



DISTANCE



ANGLE

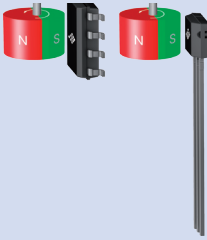
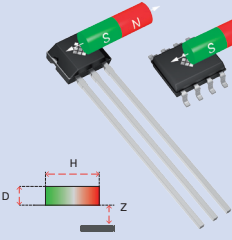
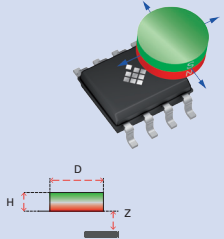


1. Selection by Application

		Recommended Solution	Comment	Alternative
Accelerator Pedal		HAL 835P	Smallest error by pedal idle position (0°)	HAL 3725 HAR 3725
		HAR 2425	Smallest error by pedal idle position (0°) and redundancy	
Adaptive Frontlight System		HAL 835P	High immunity against temperature variation	–
Adaptive Suspension System / Chassis Position		HAC 371y HAL/C 3930 HAL/C 3980	Flexible and easy assembly thanks to Modulo 90 feature	–
Brake Pedal Position		HAL/R 393y	Smallest error for small angles or linear movement / with digital output	HAL/R 2455 HAR 37xy
Clutch Cylinder		HAL/R 3930	Application requires measurement of 40 mm movement, highest accuracy achievable	HAL/R 37xy
EGR / Cut-Off Valve / Waste Gate Actuator		HAL 37xy HAC 37xy	1% full-scale error required by application	HAL 835 HAL 3930
Fuel Level Detection		HAL 835P HAL 3927 HAL 3960	Price-sensitive application – various output formats (analog, 2-wire PWM, PWM)	–
Gear Shift Selector		HAL 3900 HAL 3930	Usual angular range is above 120°. Two independent angles alpha and beta.	HAL 2425 HAL 37xy
Steering Angle		HAL 3930 HAL 3970	360° application & digital output	–
Throttle Position		HAR 37xy HAR 37xy HAC 37xy	Highest angle accuracy for 120° and simple magnetic circuit	HAC 830
Trans- mission	Neutral Detection Sensor	HAL 835P	High temperature stability and output signal flexibility (analog and PWM)	HAL 24xy
	Dual-Clutch Transmission Position	HAL 188y HAL 3930 HAL 373x	Application requires measurement of up to 40 mm movement.	HAL 83xP
	Transmission Range Sensor	HAL 373x HAC 373x HAL/C 3930	Application requires measurement of 40 mm movement, highest accuracy achievable with HAL 37xy / HAC 37xy	–
Neutral Gear Position		HAL 373x HAL 3930	2D required, because usual detection angle is >180°. Next step will be full gear detection.	HAL 835P
Turbo Charger Actuator		HAL 37xy HAC 373x HAC 3930	1% full-scale error required by application	HAL 835P

License Note: Sensors of the HAL 39xy family use licenses of Fraunhofer Institute for Integrated Circuits (IIS).

2. Selection of Magnet

End of Shaft	Type	Direct Angle 360°		
	HAL 37x5 HAR 37x5 HAC 37x5	D=10, H=2.5, Z=4 NL <±0.25% RT		
	HAL 39xy	D1 = 18 mm, D2 = 14 mm; H1 =1.5 mm, H2 = 2 mm, Z = 2 mm, NL <±0.25% RT		
Off-Axis	Type	Angle	Magnet	
	HAL 83xP HAC 830	<70°	D=15, H=6, Z=2.5 NL <±1% RT	
	HAL 24xy	<180°	D=15, H=6, Z=2.5 NL <±0.15% RT	
	HAL 37x6 HAL 37x7 HAR 37x6 HAR 37x7 HAC 37x6 HAC 37x7	360°	D=15, H=6, Z=2.5 NL <±0.15% RT	
Parallel	Type	12 mm Distance	20 mm Distance	40 mm Distance
	HAL 83xP HAC 830	D=8, H=26, Z=4 NL <±1% RT	D=8, H=43, Z=4 NL <±1% RT	D=8, H=86, Z=4 NL <±1% RT
	HAL 24xy	D=8, H=12, Z=4 NL <±0.15% RT	D=8, H=20, Z=4 NL <±0.15% RT	D=8, H=40, Z=4 NL <±0.15% RT
	HAL 37x6 HAL 37x7 HAR 37x6 HAR 37x7 HAC 37x6 HAC 37x7	D=6, H=4, Z=4 NL <±0.15% RT	D=12, H=4, Z=4 NL <±0.15% RT	D=16, H=8, Z=4 NL <±0.15% RT
	HAL 39xy	D=6, H=4, Z=4, NL <±0.15% RT	D=12, H=4, Z=4 NL <±0.15% RT	D=16, H=8, Z=4 NL <±0.15% RT
Orthogonal	Type	12 mm Distance	20 mm Distance	40 mm Distance
	HAL 83xP HAC 830	D=31, H=6, Z=4 NL <±1% RT	D=52, H=6, Z=4 NL <±1% RT	D=103, H=6, Z=4 NL <±1% RT
	HAL 24xy	D=12, H=6, Z=4 NL <±0.2% RT	D=20, H=6, Z=4 NL <±0.2% RT	D=40, H=6, Z=4 NL <±0.2% RT
	HAL 37x6 HAL 37x7 HAR 37x6 HAR 37x7 HAC 37x6 HAC 37x7	D=6, H=3, Z=4 NL <±0.2% RT	D=10, H=4, Z=4 NL <±0.2% RT	D=25, H=6, Z=4 NL <±0.2% RT
	HAL 39xy	D=6, H=3, Z=4 NL <±0.2% RT	D=10, H=4, Z=4 NL <±0.2% RT	D= 25, H= 6, Z=4 NL <±0.2% RT

Magnets SmCo, NeFeB, AlNiCo – Br = 900...1300 mT

All dimensions are given in mm.

D: Diameter,, H: Height, Z: Distance between magnet and the Hall sensor,

NL: Non-Linearity, RT: Room Temperature

3. Selection of Sensor Type ($T_J = -40...170\text{ °C}$)

Product Family	Product Variant	Field Component	Measurement				Redundancy	Integrated Caps	Stray-Field Compensation	Package		
			Linear	Angular						Leaded	SMD	
				End of Shaft	Off-Axis							
					up to 60°	up to 180°						up to 360°
HAL 8xy	HAL 830P	Z	•		•					TO92UT	–	
	HAL 835P	Z	•		•							
	HAC 830	Z	•		•			•		TO92UP		
HAL 18xy	HAL 1870	Z	•		•					TO92UA	–	
	HAL 188y	Z	•		•							
	HAL 1890	Z	•		•							
HAL 24xy	HAL 2420	Z	•		•					TO92UT	SOIC8	
	HAL 2421 ²⁾	Z	•		•						–	
	HAL 2425	Z	•			•					SOIC8	
	HAL 2455	Z	•			•						
	HAR 2425	Z	•			•		•		–	TSSOP14	
	HAR 2455	Z	•			•		•				
HAL 37xy	HAL 3715	X-Y		•						TO92UP	SOIC8	
	HAL 3725	X-Y		•								
	HAL 3726	Y-Z	•				•					
	HAL 3727	X-Z	•				•					
	HAL 3735	X-Y		•								
	HAL 3736	Y-Z	•				•					
	HAL 3737	X-Z	•				•					
HAR 37xy	HAR 3715	X-Y		•				•		–	SOIC8	
	HAR 3725	X-Y		•				•				
	HAR 3726	Y-Z	•				•	•				
	HAR 3727	X-Z	•				•	•				
	HAR 3735	X-Y		•				•				
	HAR 3736	Y-Z	•				•	•				
	HAR 3737	X-Z	•				•	•				
	HAR 3795	X-Y		•				•				
	HAR 3796	X-Y	•				•	•				
HAR 3797	X-Z	•				•	•					
HAC 37xy	HAC 3715	X-Y		•					•	TO92UF	–	
	HAC 3725	X-Y		•					•			
	HAC 3726	Y-Z	•				•		•			
	HAC 3727	X-Z	•				•		•			
	HAC 3735	X-Y		•					•			
	HAC 3736	Y-Z	•				•		•			
	HAC 3737	X-Z	•				•		•			
HAL 39xy	HAL 3900	X-Y-Z	•	•			•			•	–	SOIC8
	HAL 3927	X-Y-Z	•	•			•					
	HAL 3930	X-Y-Z	•	•			•			•		
	HAL 3960	X-Y-Z	•	•			•			•		
	HAL 3970	X-Y-Z	•	•			•			•		
	HAL 3980	X-Y-Z	•	•			•			•		
HAC 39xy	HAC 3930	X-Y-Z	•	•			•		•	•	TO92UF	–
	HAC 3960	X-Y-Z	•	•			•		•	•		
	HAC 3980	X-Y-Z	•	•			•		•	•		
HAR 39xy	HAR 3900	X-Y-Z	•	•			•	•		•		SSOP16
	HAR 3927	X-Y-Z	•	•			•	•				SOIC8
	HAR 3930	X-Y-Z	•	•			•	•		•		SSOP16
	HAR 3970	X-Y-Z	•	•			•	•		•		SOIC8



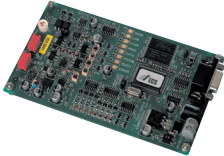

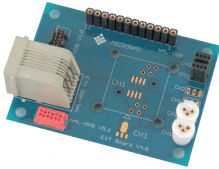
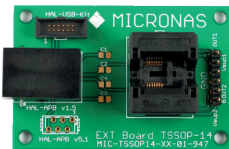
¹⁾Error in magnetic sensitivity









²⁾Low output noise voltage, $T_J = -40$ to 140 °C

Output							Setpoints	Error at Full Temperature Range			Resolution	Response Time					
Analog	Modulo	PWM	PSi5	SENT SAE J2716	SPI	SPC		Min.	Max.	Remark		Typ.					
•							2	−4%	4%	1)	12 bit	0.9 ms					
•		•					2	−1%	1%								
•							2	−4%	4%								
		•					2	−6%	6%	1)	10 bit	0.5 ms					
•							2	−6%	6%								
				•			2	−6%	6%								
•							2	−1%	1%	1)	12 bit	0.5 ms					
•							2	−2%	2%								
•							16	−1%	1%								
		•					16										
•							16										
		•					16										
•	•						33	−1.8°	1.8°	3)	up to 12 bit	0.5 ms					
•							33										
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•	•				•		17/33						−0.5°	0.5°	3)	up to 16 bit	0.2 ms
•				•			17/33									up to 12 bit	
	•	•		•			17/33	up to 13 bit									
	•	•					17/33	up to 12 bit									
	•					•	17/33	up to 12 bit									
	•		•				17/33	up to 16 bit									
	•	•		•			17/33	up to 16 bit									
	•	•					17/33	up to 12bit									
	•		•				17/33	up to 16 bit									
	•				•	•	17/33	up to 16 bit									
•				•			17/33	up to 12bit									
	•	•		•			17/33	up to 13 bit									
	•					•	17/33	up to 12 bit									

³⁾ Angle error after CORDIC, valid for ideal sine and cosine magnetic components

Development Tools

	Magnetic Sensor Programmer MSP v.1.0 Supported Sensors: HAL 18xy, HAL 24xy, HAR 24xy HAL 28xy HAL 3xyz, HAR 3xyz, HAC 3xyz stand-alone tool
	CGS Production Programmer v.1.0 Supported Sensors: HAL 18xy, HAL 24xy, HAR 24xy HAL 28xy HAL 3xyz, HAR 3xyz, HAC 3xyz stand-alone tool
	HAL APB 5.1 Application & Programming Board Supported Sensors: HAL 8xy stand-alone tool
	HAL USB Programming Tool v.1.0 Supported Sensors: HAL 186y HAL 24xy HAL 37xy in combination with Extension Board v.4.0
	Micronas Extension Board v.4.0 Connectable Sensor Packages: TO-92 (3-pin) package TO-92UP (4-pin) package SOIC-8 (8-pin) package Connectable Programming Tool: HAL USB-Kit
	Micronas Extension Board TSSOP-14 Connectable Sensor Packages: TSSOP-14 (14-pin) package Connectable Programming Tool: HAL USB-Kit

Package	Marking Code	MOQ / MSQ Quantity			Package Drawing	RoHS compliant
		Reel	Ammopack ^{1), 2)}	Bulk ²⁾		
SOIC8	DJ	3,500 MOQ = 7,000	–	–		Yes
TO92UA	UA	–	2,000	2,000		Yes
TO92UP	UP	–	2,000	–		Yes
TO92UP with caps	CV	–	2,000	2,000		Yes
TO92UT	UT	–	2,000	2,000		Yes
TSSOP14	GP	4,000 MOQ = 8,000	–	–		Yes
SSOP16	GU	3,500 MOQ = 7,000	–	–		Yes
TO92UF	CX	2,400 MOQ = 4,800	–	–		Yes
For additional information please read or ask for our documentation “Sensors and Controllers Ordering Codes, Packaging, Handling”						
¹⁾ Pin configuration inline, spread			²⁾ Pin configuration inline, not spread			

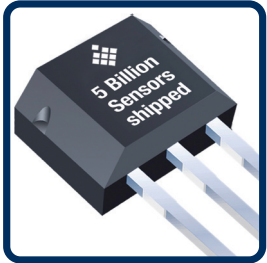
TDK-Micronas Contact

Contact	Information available
www.micronas.tdk.com	General
www.service.micronas.com (registration needed)	Data sheets, application notes, programming guides, software...

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TDK-Micronas Company Profile

TDK-Micronas is the center of competence for magnetic-field sensors and CMOS integration within the TDK group. TDK-Micronas has gained operational excellence for sensors and actuators production in over 25 years of in-house manufacturing. It has been the first company to integrate a Hall-effect based sensor into CMOS technology in 1993. Since then, TDK-Micronas has shipped over five billion Hall sensors to the automotive and industrial market. The operational headquarters are located in Freiburg im Breisgau (Germany). Currently, TDK-Micronas employs around 1,000 people.



Global Presence



● Production + R&D ● Marketing, Sales, FAE



Design-Centers

Freiburg – Germany
Munich – Germany

Production Site

Freiburg – Germany

