



# Linear and Multi-Axis Hall-Effect Sensors

Selection Guide for Automotive Applications



[www.micronas.tdk.com](http://www.micronas.tdk.com)



## Packages

Package	Marking Code	MOQ / MSQ Quantity			Package Drawing	RoHS compliant
		Reel	Ammopack <sup>1), 2)</sup>	Bulk <sup>2)</sup>		
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
TSSOP16	BK/BH	3,500 MOQ = 7,000	-	-		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"

<sup>1)</sup> Pin configuration inline, spread      <sup>2)</sup> Pin configuration inline, not spread

## TDK-Micronas Contact

Contact	Information available
<a href="http://www.micronas.tdk.com">www.micronas.tdk.com</a>	General
<a href="http://www.service.micronas.com">www.service.micronas.com</a> (registration needed)	Data sheets, application notes, programming guides, software...
<a href="mailto:mic-product-support@tdk.com">mic-product-support@tdk.com</a>	Technical support
<a href="mailto:mic-sales@tdk.com">mic-sales@tdk.com</a>	Worldwide sales contact

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## Development Tools

Laboratory Programmers		Production Programmer	
<b>TDK MAGNETIC SENSOR PROGRAMMER V1.2</b>	Mat.No.: 99900052	<b>ISCM TDK-Micronas</b>	via CGS GmbH <a href="http://www.cgs-gruppe.de">www.cgs-gruppe.de</a>
HAL 18xy HAL/R/C 24xy HAL/R/C 3xyz HAL/R/C 37xy  HAL/R/C 39xy		HAL 18xy HAL/R 24xy HAL/R 3550 HAL/R/C 37xy  HAL/R/C 39xy	
<b>TDK SPI PROGRAMMER V1.0</b>	Mat.No.: 99900053	<b>Extension Board</b>	
HAL/R 3900		<b>EXTENSION BOARD V.5.0</b>	Mat.No.: 99900203
<b>HAL-USB KIT</b>	Mat.No.: 99900201	SOIC-8 (8-pin) package  TO-92 (3 & 4-pin) package	
HAL 18xy HAL/R 24xy HAL/R/C 37xy HAL/R 39xy (x= 2,3,7) HAL/R 3550 HAL 302x		<b>Adapter Board</b>	
<b>HAL APB V5.10</b>	Mat.No.: 99900001	<b>TDK_ADPT.BRD_R01/C01</b>	Mat.No.: 99900034
HAL/C 8xy		Use to interface TDK MAGNETIC SENSOR PROGRAMMER V1.2 or HAL-USB KIT to Card Edge Connector	

Extension PCBs					
<b>TDK_EXT.PCB_SDDJ-R01/C00</b>	Mat.No.: 99900054	<b>TDK_EXT.PCB_SDDJ-R01/C01</b>	Mat.No.: 99900055	<b>TDK_EXT.PCB_DDGU-R01/C00</b>	Mat.No.: 99900056
HAL 39xy, (x ≠ 7)		HAL 397x		HAR 39xy	
HAL 37xy HAL 302x					
<b>TDK_EXT.PCB_SDDJ-R01/C02</b>	Mat.No.: 99900072	<b>TDK_EXT.PCB_DDBH-R01/C01</b>	Mat.No.: 99900073	<b>TDK_EXT.PCB_DDBH-R01/C00</b>	Mat.No.: 99900074
HAR 3550		HAR 3550 BK		HAR 3550 BH	

## About TDK Corporation

TDK Corporation (TSE:6762) is a global technology company and innovation leader in the electronics industry, based in Tokyo, Japan. With the tagline "In Everything, Better" TDK aims to realize a better future across all aspects of life, industry, and society. For over 90 years, TDK has shaped the world from within; from the pioneering ferrite cores to cassette tapes that defined an era, to powering the digital age with advanced components, sensors, and batteries, leading the way towards a more sustainable future. United by TDK Venture Spirit, a start-up mentality built on visions, courage and mutual trust, TDK's passionate team members around the globe pursue better—for ourselves, customers, partners, and the world. Today, the state-of-the-art technologies of TDK are in everything, from industrial applications, energy systems, electric vehicles, to smartphones and gaming, at the core of modern life. TDK's comprehensive, innovative-driven portfolio includes cutting-edge passive components, sensors and sensor systems, power supplies, lithium-ion and solid-state batteries, magnetic heads, AI and enterprise software solutions, and more—featuring numerous market-leading products. These are marketed under the product brands TDK, EPCOS, InvenSense, Micronas, Tronics, TDK-Lambda, TDK SensEI, and ATL. Positioning the AI ecosystem as a key strategic area, TDK leverages its global network across the automotive, information and communication technology, and industrial equipment sectors to expand its business in a wide range of fields. In fiscal 2025, TDK posted total sales of USD 14.4 billion and employed about 105,000 people worldwide.



## TDK-Micronas Sites

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 eight 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.



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

Design Centers, Germany  
• Freiburg  
• Munich

Production Site, Germany  
• Freiburg

# 1. Selection by Application

	Recommended Solution	Comment	Alternative	
<b>Accelerator Pedal</b>	HAR 3550 HAR 3725	Smallest error by pedal idle position (0°) and redundancy	HAR 3920 HAR 2425 HAL 835P	
<b>Adaptive Suspension System / Chassis Position</b>	HAL 3550 HAL/HAC 3930 HAL/HAC 3980	Flexible and easy assembly thanks to Modulo 90 feature	HAC 37xy	
<b>Brake Pedal Position</b>	HAL/HAR 3550 HAL/HAR 393x	Smallest error for small angles or linear movement / with digital output	HAR 37xy	
<b>Charging-Plug Lock</b>	HAC 37xy HAC 3930	Application requires rotary or linear position to detect the secured locking of the charging plug. Stray-field robust.	HAL 15xy	
<b>EGR / Cut-Off Valve / Waste Gate Actuator</b>	HAL/HAC 37xy HAL/HAC 3930	1% full-scale error required by application	HAL 835P	
<b>Fuel Level Detection</b>	HAL 835P HAL 3927 HAL 3960	Price-sensitive application – various output formats (analog, 2-wire PWM, PWM)	–	
<b>Gear Shift Selector</b>	HAL/HAR 3550 HAL/HAR 3900 HAL/HAR 3930	Usual angular range is above 120°. Two independent angles alpha and beta.	HAL 37xy	
<b>Steering Angle</b>	HAL/HAR 3550 HAL/HAR 3930 HAL/HAR 3970	360° application & digital output. Stray-field robust and 2-pole ferrite magnet support	–	
<b>Throttle Position</b>	HAL 37xy HAR 37xy HAC 37xy HAR 3920	Highest angle accuracy for 120° and simple magnetic circuit	HAC 830	
<b>Transmission</b>	<b>Parklock Actuator/ Position</b>	HAL 3900 HAL 3930	Accurate rotary position detection and robustness against mechanical tolerances. Stray-field robust.	–
	<b>Dual-Clutch Transmission Position</b>	HAL 188y HAL/HAR 3550 HAL 3930	Application requires measurement of up to 40 mm movement.	HAL/HAR 37xy
	<b>Transmission Range Sensor</b>	HAL/HAR 3550 HAL/HAC 3930	Application requires measurement of 40 mm movement, highest accuracy achievable with HAL 37xy / HAC 37xy	HAL/HAC 37xy
<b>Thermal Expansion Valve / Coolant Valve</b>	HAL 3550 HAL 3900 HAL 37xy	Linear movement detection of valve to control coolant distribution (for battery cooling or HVAC systems)	–	
<b>Turbo Charger Actuator</b>	HAR 3550 HAR 3725 HAC 373x HAC 3930	1% full-scale error required by application	HAL 835P	

License Note: HAL/HAR 3550, HAL/HAC/HAR 37xy and HAL/HAC/HAR 393x use licenses of Fraunhofer Institute for Integrated Circuits IIS.

# 2. Selection of Sensor Type (T<sub>J</sub> = -40...170 °C)

Product Family	Product Variant	Field Component	Measurement				Redundancy	Integrated Caps	Stray-Field Compensation	Package		Output								Set-points	Error at Full Temperature Range			Resolution	Response Time Typ.	
			Linear	Angular						Leaded	SMD	Analog	Modulo	PWM	PSi5	SENT SAE J2716	SPI	SPC	Switch		Low Power Mode	Min.	Max.			Remark
				End of Shaft	70°	180°																				
HAL 8xy	HAL 830P	Z	*	*	*	*			TO92UT	–	*	*	*	*	*	2	-4%	4%	1)	12 bit	0.9 ms					
	HAL 835P	Z	*	*	*	*				–	*	*	*	*	*	2	-1%	1%								
	HAC 830	Z	*	*	*	*	*		TO92UP	–	*	*	*	*	*	2	-4%	4%								
HAL 18xy	HAL 1870	Z	*	*	*	*			TO92UA	–	*	*	*	*	*	2	-6%	6%	1)	10 bit	0.5 ms					
	HAL 188y	Z	*	*	*	*				–	*	*	*	*	*	2	-6%	6%								
	HAL 1890	Z	*	*	*	*				–	*	*	*	*	*	2	-6%	6%								
HAL 24xy	HAL 2420	Z	*	*	*	*			TO92UT	SOIC8	*	*	*	*	*	2	-1%	1%	1)	12 bit	0.5 ms					
	HAL 2421 <sup>2)</sup>	Z	*	*	*	*				–	*	*	*	*	*	2	-2%	2%								
	HAL 2425	Z	*	*	*	*				SOIC8	*	*	*	*	*	16	-1%	1%								
	HAL 2455	Z	*	*	*	*				–	*	*	*	*	*	16										
	HAR 2425	Z	*	*	*	*			–	TSSOP14	*	*	*	*	*	16										
	HAR 2455	Z	*	*	*	*				–	TSSOP14	*	*	*	*	*	16									
HAL 30xy	HAL 302x	Z	*	*	*	*			–	SOIC8	*	*	*	*	*	–	-0.65°	0.65°	4)		4.6 μs					
HAL 35xy	HAL 3550	X-Y-Z	*	*	*	*			–	SOIC8	*	*	*	*	*	7/17	-0.5°	0.5°	3)	12 bit	0.2 ms					
HAR 35xy	HAR 3550	X-Y-Z	*	*	*	*			–	TSSOP16	*	*	*	*	*	7/17	-0.5°	0.5°	3)	12 bit	0.2 ms					
HAL 37xy	HAL 3715	X-Y	*	*	*	*			TO92UP	SOIC8	*	*	*	*	*	33	-1.8°	1.8°	3)	up to 12 bit	0.5 ms					
	HAL 3725	X-Y	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3726	Y-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3727	X-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3735	X-Y	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3736	Y-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3737	X-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3795	X-Y	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3796	X-Y	*	*	*	*				–	*	*	*	*	*	33										
	HAL 3797	X-Z	*	*	*	*				–	*	*	*	*	*	33										
HAC 37xy	HAC 3715	X-Y	*	*	*	*			TO92UF	–	*	*	*	*	*	33										
	HAC 3725	X-Y	*	*	*	*				–	*	*	*	*	*	33										
	HAC 3726	Y-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAC 3727	X-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAC 3735	X-Y	*	*	*	*				–	*	*	*	*	*	33										
	HAC 3736	Y-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAC 3737	X-Z	*	*	*	*				–	*	*	*	*	*	33										
	HAC 3795	X-Y	*	*	*	*				–	*	*	*	*	*	33										
HAL 39xy	HAL 3900	X-Y-Z	*	*	*	*			–	SOIC8	*	*	*	*	*	17/33	-0.5°	0.5°	3)	up to 16 bit	0.2 ms					
	HAL 3927	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 12 bit						
	HAL 3930	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 13 bit						
	HAL 3935	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 13 bit						
	HAL 3936	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 12 bit						
	HAL 3960	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 12 bit						
	HAL 3970	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 12 bit						
	HAL 3980	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 16 bit						
	HAR 39xy	HAR 3900	X-Y-Z	*	*	*	*				SSOP16	*	*	*	*	*	17/33				up to 16 bit					
		HAR 3920	X-Y-Z	*	*	*	*				SSOP16	*	*	*	*	*	17/33				up to 12 bit					
HAR 3927		X-Y-Z	*	*	*	*				SOIC8	*	*	*	*	*	17/33				up to 12 bit						
HAR 3930		X-Y-Z	*	*	*	*				SSOP16	*	*	*	*	*	17/33				up to 13 bit						
HAR 3935		X-Y-Z	*	*	*	*				SSOP16	*	*	*	*	*	17/33				up to 13 bit						
HAR 3936		X-Y-Z	*	*	*	*				SSOP16	*	*	*	*	*	17/33				up to 13 bit						
HAR 3970		X-Y-Z	*	*	*	*				SSOP16	*	*	*	*	*	17/33				up to 12 bit						
HAC 39xy	HAC 3930	X-Y-Z	*	*	*	*			TO92UF	–	*	*	*	*	*	17/33				up to 13 bit						
	HAC 3980	X-Y-Z	*	*	*	*				–	*	*	*	*	*	17/33				up to 16 bit						

<sup>1)</sup> Error in magnetic sensitivity, <sup>2)</sup> Low output noise voltage, T<sub>J</sub> = -40 to 140 °C

<sup>3)</sup> Angle error after CORDIC, valid for ideal sine and cosine magnetic components, <sup>4)</sup> Can be improved by external dynamic error compensation

# 3. Selection of Magnet

End of Shaft	Type	Direct Angle 360°		
	HAL/R 3550 <sup>1)</sup>	D=10, H=2.5, Z=4 NL <±0.25% RT		
	HAL/R/C 37x5	D1 = 18, D2 = 14, H1 = 1.5, H2 = 2, Z = 2, NL <±0.1% RT		
	HAL/R/C 39xy <sup>1)</sup>			
Off-Axis	Type	Angle	Magnet	
	HAL 83xP HAC 830	<70°	D=15, H=6, Z=2.5 NL <±1% RT	
	HAL/R 24xy	<180°	D=15, H=6, Z=2.5 NL <±0.15% RT	
	HAL/R 3550	360°	D=15, H=6, Z=2.5, NL <±0.1% RT SFI	
	HAL/R/C 37x6/ 37x7	360°	D=15, H=6, Z=2.5 NL <±0.15% RT	
	HAL/R/C 39xy	360°	D=15, H=6, Z=2.5, NL <±0.1% RT SFI	
Parallel	Type	12 mm Distance	20 mm Distance	40 mm Distance
	HAL 83xP HAC 830	D=8, L=26, Z=4 NL <±1% RT	D=8, L=43, Z=4 NL <±1% RT	D=8, L=86, Z=4 NL <±1% RT
	HAL/HAR 24xy	D=4, L=6, Z=4 NL <±0.15% RT	D=4, L=12, Z=4 NL <±0.2% RT	D=4, L=16, Z=4 NL <±0.4% RT
	HAL/R 3550	D=6, L=3, Z=4 NL <±0.1% RT SFI	D=10, L=4, Z=4 NL <±0.2% RT SFI	D=25, L=3, Z=4 NL <±0.4% RT SFI
	HAL/R/C 37x6/ 37x7	D=4, L=6, Z=4 NL <±0.15% RT	D=4, L=12, Z=4 NL <±0.15% RT	D=8, L=16, Z=4 NL <±0.15% RT
	HAL/R/C 39xy	D=6, L=3, Z=4 NL <±0.1% RT SFI	D=10, L=4, Z=4 NL <±0.1% RT SFI	D=25, L=3, Z=6 NL <±0.15% RT SFI
Orthogonal				
	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/R 24xy	D=6, H=3, Z=4 NL <±0.15% RT	D=10, H=6, Z=4 NL <±0.2% RT	D=25, H=6, Z=4 NL <±0.3% RT
	HAL/R 3550	D=6, H=3, Z=4 NL <±0.15% RT SFI	D=10, H=4, Z=4 NL <±0.2% RT SFI	D=25, H=6, Z=6 NL <±0.6% RT SFI
	HAL/R/C 37x6/ 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/R/C 39xy	D=6, H=3, Z=4 NL <±0.1% RT SFI	D=10, H=4, Z=4 NL <±0.15% RT SFI	D=25, H=6, Z=4 NL <±0.4% RT SFI

List of abbreviations:

D: Diameter

L: Length

H: Height

Z: Distance between magnet and the Hall sensor

NL: Non-Linearity

RT: Room Temperature

Dimensions D, L, H, Z, are given in mm.

SFI = Stray-Field Immunity

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

<sup>1)</sup> SFI = Stray-Field Immunity