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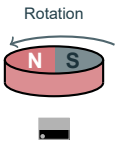
KTH5791

3D Hall Mouse Wheel Sensor

QFN3×3-16L



3-Axis Sensing

Application

- Mouse Wheel
- Rotary Encoder

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1 Overview

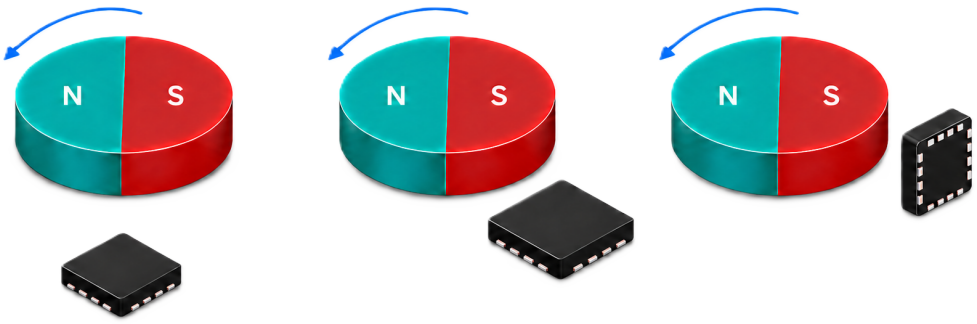
KTH5791 is a dedicated mouse wheel chip based on the 3D Hall magnetic sensing principle, primarily designed for mouse wheel rotation applications. Two dedicated quadrature outputs enable this product to directly replace mechanical and optical rotary encoder outputs, simplifying magnetic mouse wheel development while maintaining compatibility with common mouse interfaces.

2 Key Features

- Absolute 3D position detection, supports on-axis and off-axis mounting
- Simple magnetic circuit design with built-in adaptive algorithm
- Standard 24-detent for mouse applications (programmable up to 128 detents), supports flywheel function
- Quadrature AB output compatible with mouse applications
- Serial digital interface (UART)
- Operating voltage: 2.8 V to 5.5 V
- Operating temperature: $-40\,^{\circ}$C to $+85\,^{\circ}$C

3 Applications

- Mouse wheel
- Rotary encoder

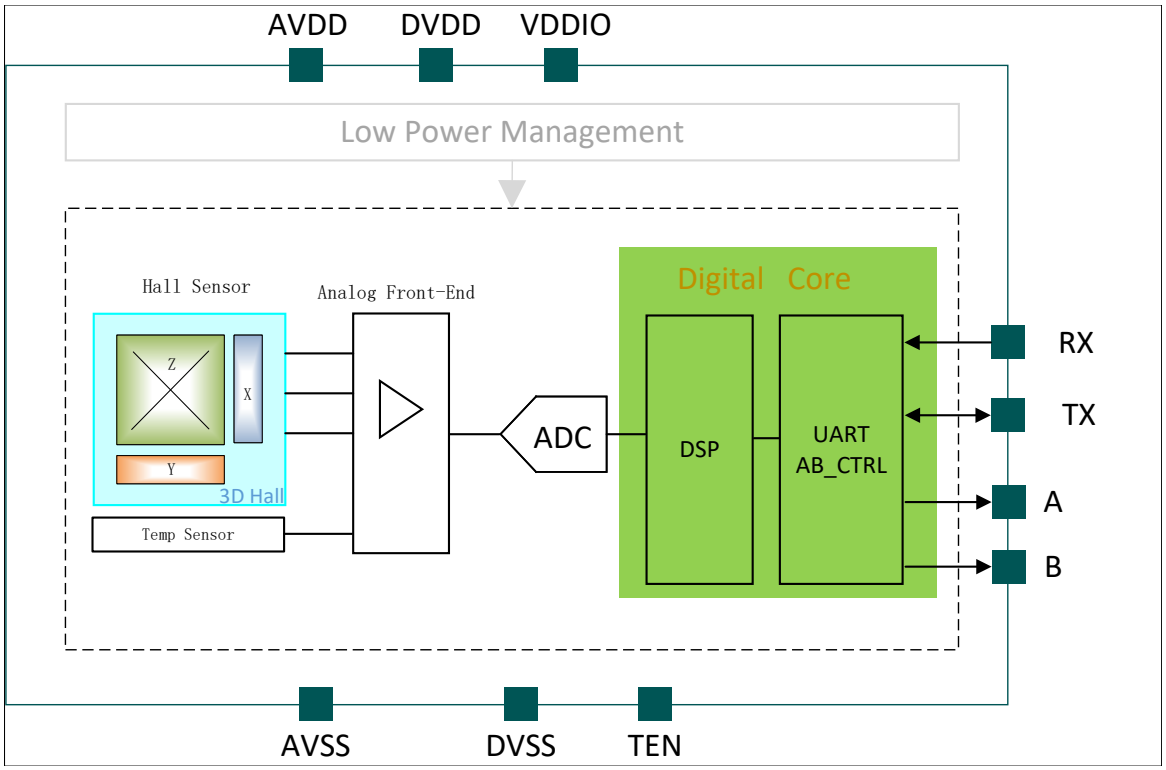


4 Device Information

Model	Package	Package Size (Nominal)
KTH5791	QFN3×3-16L	3.0 mm × 3.0 mm (body, nominal)

Note: Exposed thermal pad TAP shall be connected to AVSS. Package has 16 pins plus center thermal pad (Pin 1–16 and Pin 17/TAP).

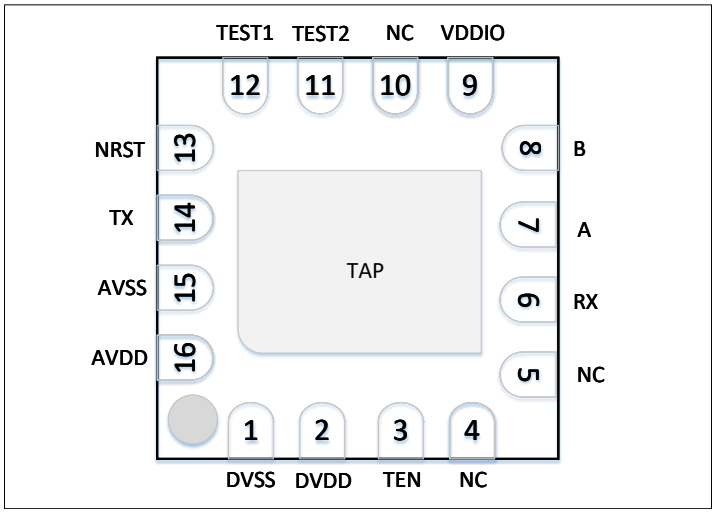
5 Functional Block Diagram



The chip integrates 3D Hall sensing, signal processing and quadrature AB output, and provides UART digital communication. Power supply is divided into analog (AVDD/AVSS) and digital (DVDD/DVSS, VDDIO).

6 Pin Configuration

6.1 Package Pinout



6.2 Pin Description

Pin	Name	Type	Description
1	DVSS	GND	Digital Ground
2	DVDD	PWR	Digital Power Supply
3	TEN	Input	Test Enable Pin
4	NC	—	No function, tie to GND
5	NC	—	No function, tie to GND
6	RX	I/O	UART RX
7	A	Output	Quadrature output A
8	B	Output	Quadrature output B
9	VDDIO	PWR	Digital I/O Supply
10	NC	—	No function, tie to GND
11	TEST2	—	Internal test pin, tie to GND
12	TEST1	—	Internal test pin, tie to GND
13	NRST	Input	Reset, external pull-up
14	TX	I/O	UART TX
15	AVSS	GND	Analog Ground
16	AVDD	PWR	Analog Power Supply
17 (TAP)	TAP	GND	Thermal pad (AVSS)

7 Specifications

7.1 Absolute Maximum Ratings

Warning: Stresses beyond absolute maximum ratings may cause permanent damage. Operating near these limits for extended periods may affect reliability.

Parameter	Description	Min	Max	Unit
$AVDD_{\text{MAX}}$	Chip supply limit	-0.3	6	V
$DVDD_{\text{MAX}}$	Chip supply limit	-0.3	6	V
$VDDIO_{\text{MAX}}$	Digital I/O supply limit	-0.3	6	V
T_{STORAGE}	Storage temperature	-50	150	°C
V_{ESD}	ESD (HBM)	—	±5k	V

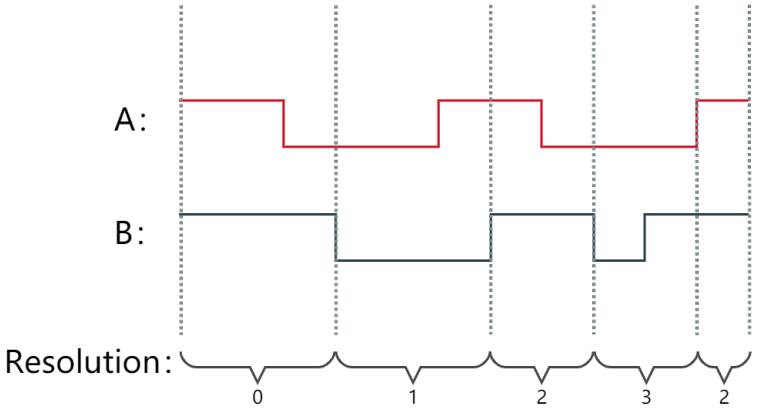
7.2 Recommended Operating Conditions

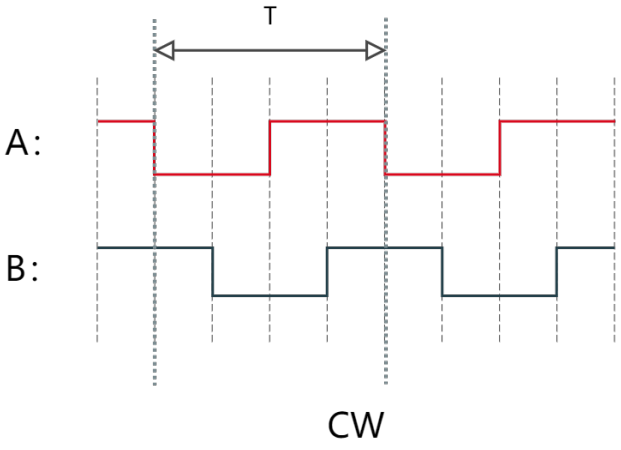
Parameter	Description	Min	Typ	Max	Unit
V_{AVDD}	Analog supply	2.8	3.3	5.5	V
V_{DVDD}	Digital supply	1.8	—	$\leq V_{\text{AVDD}}$	V
V_{DDIO}	Digital I/O supply	1.8	—	$\leq V_{\text{AVDD}}$	V
$I_{DD,\text{run}}$	Continuous mode current	—	4	—	mA
$I_{DD,\text{stby}}$	Standby mode current	—	20	—	μA
V_{IH}	Input high level	0.75	—	V_{DDIO}	V
V_{IL}	Input low level	—	—	$0.25\,V_{\text{DDIO}}$	V
V_{OH}	Output high level	$V_{\text{DDIO}} - 0.5$	—	—	V
V_{OL}	Output low level	—	—	0.5	V
$T_{\text{OPERATION}}$	Operating temperature	-40	25	85	°C

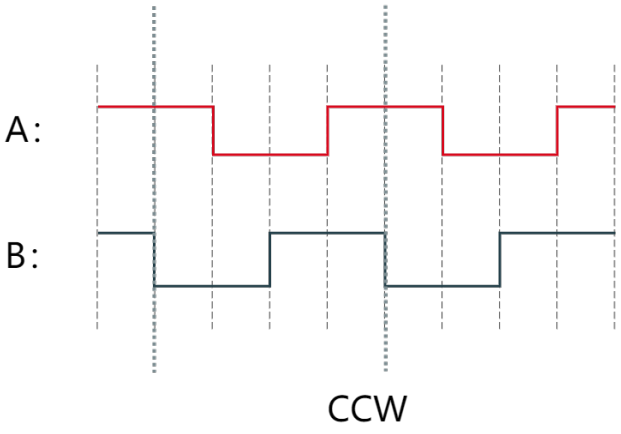
7.3 AB Output Timing

The quadrature signals A/B, rotation direction, and resolution (24/128 etc.) are determined by the on-chip algorithm and configuration. Once the resolution is set, the chip performs a ”tooth alignment” at each power-on, aligning the currently detected magnetic angle to the center of the active step.

Thereafter, whenever the magnet enters a new step region, the levels of A and B signals each toggle once, with the toggle sequence corresponding to the rotation direction (forward/reverse).







7.4 Performance vs Power Trade-off

KTH5791 supports multiple sampling frequencies and sleep sampling period configurations, allowing users to balance performance and power consumption based on application requirements.

Operating State Performance and Power

In operating state, the chip power consumption is directly related to the sampling frequency. The following table lists performance and power data for different sampling frequencies ($V_{DD} = 3.3$ V).

Sampling Rate	Max Non-reversal Speed	Response Delay	Operating Current	Note
100 Hz	2300 rpm	10 ms	1.43 mA	Low Power
150 Hz	3600 rpm	6.7 ms	1.54 mA	Balanced (Recommended)
200 Hz	4800 rpm	5 ms	1.65 mA	Medium Performance
500 Hz	>6000 rpm	2 ms	2.33 mA	High Performance

Sleep State Performance and Power

In sleep state, the chip operates in periodic sampling mode, and power consumption is related to the sleep sampling period configuration. (SleepMeasureTime configuration, 1LSB = 20 ms).

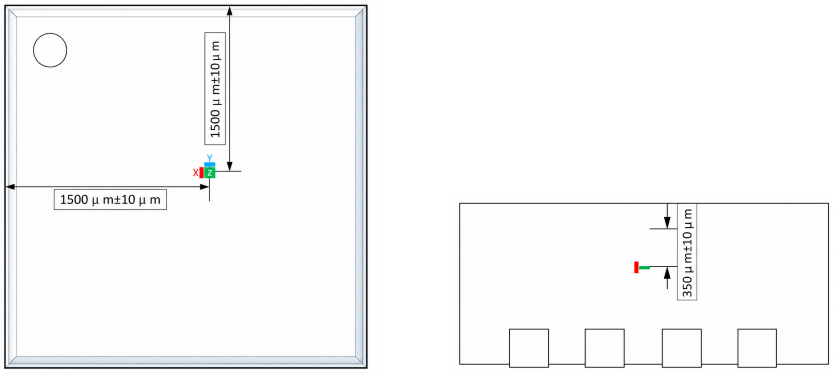
SleepMeasureTime	Sampling Interval	Sleep Current	Note
5	100 ms	32 μA	Higher power, faster response
15	300 ms	13.5 μA	Balanced configuration
31	620 ms	8.8 μA	Low power configuration

Note:

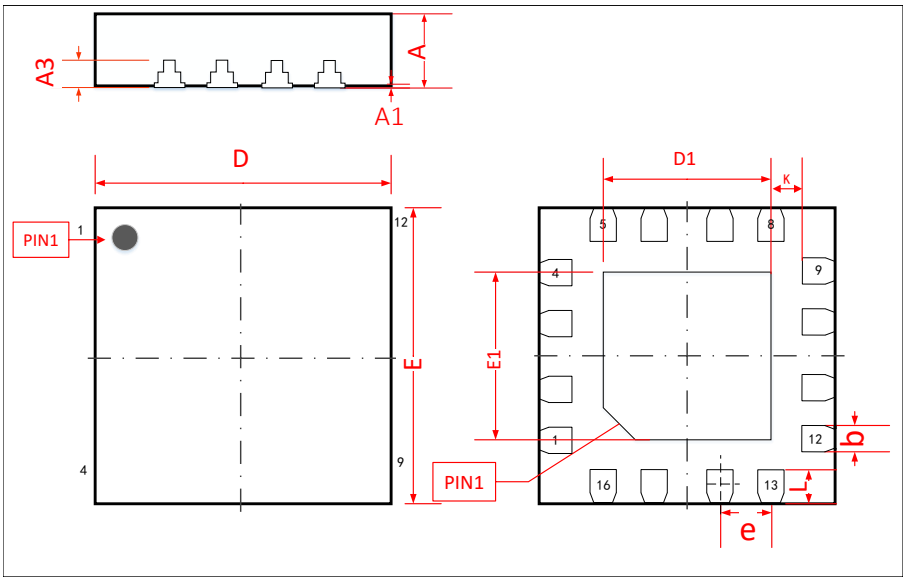
- High Performance Mode (500 Hz/SleepMeasureTime=5): For high-speed wheel applications (>6000 rpm), operating current 2.33 mA, sleep current 32 μA.
- Balanced Mode (150 Hz/SleepMeasureTime=15): For medium-speed wheel applications ($\leq$3600 rpm), operating current 1.54 mA, sleep current 13.5 μA.
- Low Power Mode (100 Hz/SleepMeasureTime=31): For low-speed wheel applications ($\leq$2300 rpm), operating current 1.43 mA, sleep current 8.8 μA.

8 Package Information

8.1 Magnetic Sensitive Center Position

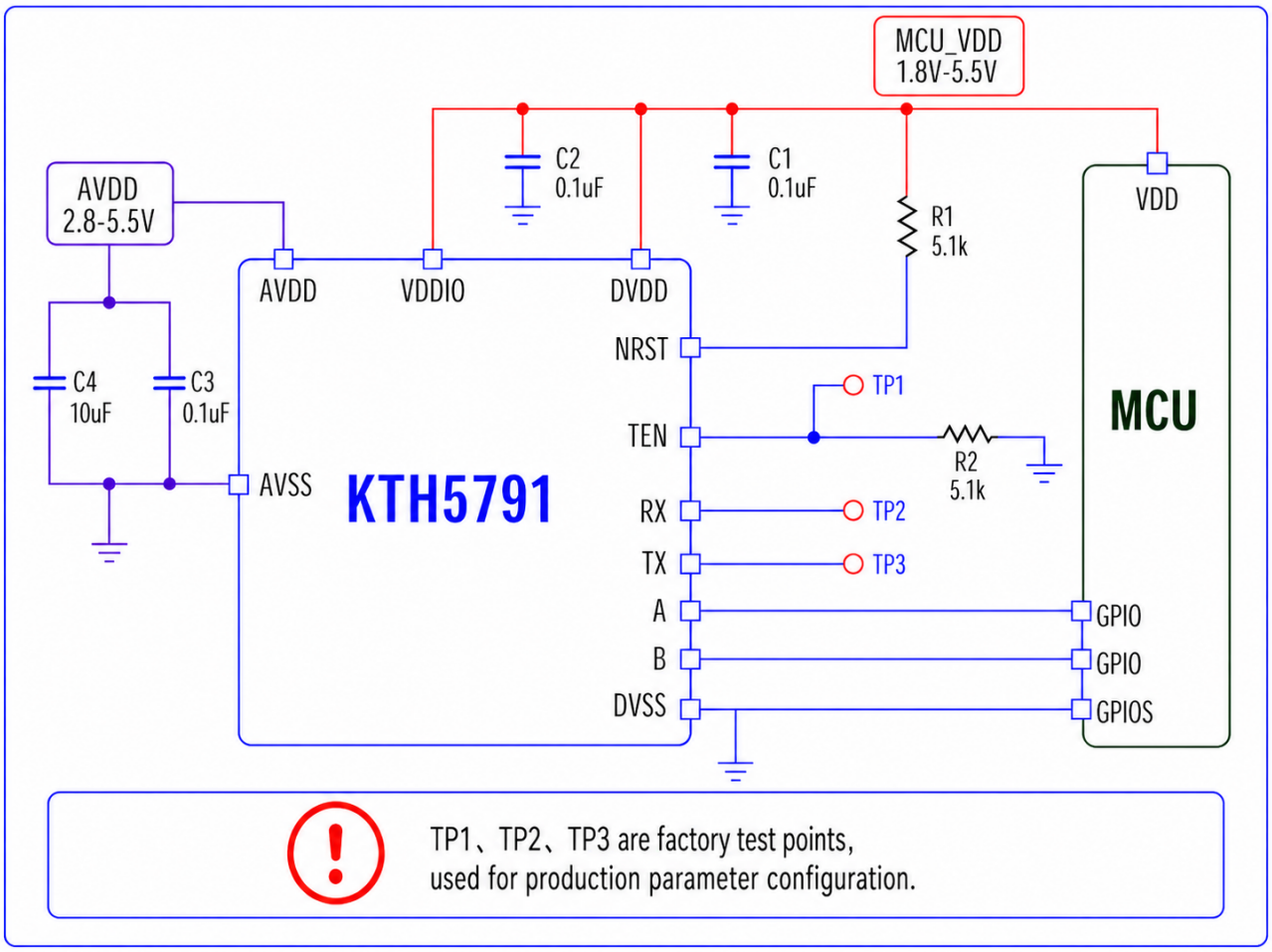


8.2 Package Dimensions —QFN3×3-16L



Symbol	Min	Nom	Max
A	0.7	0.75	0.8
A1	0	0.02	0.05
A3		0.203 REF	
D		3.00 BSC	
E		3.00 BSC	
D1	1.5	1.65	1.8
E1	1.5	1.65	1.8
k		0.385 BSC	
b	0.18	0.24	0.30
e		0.5 BSC	
L	0.19	0.29	0.39

9 Reference Circuit

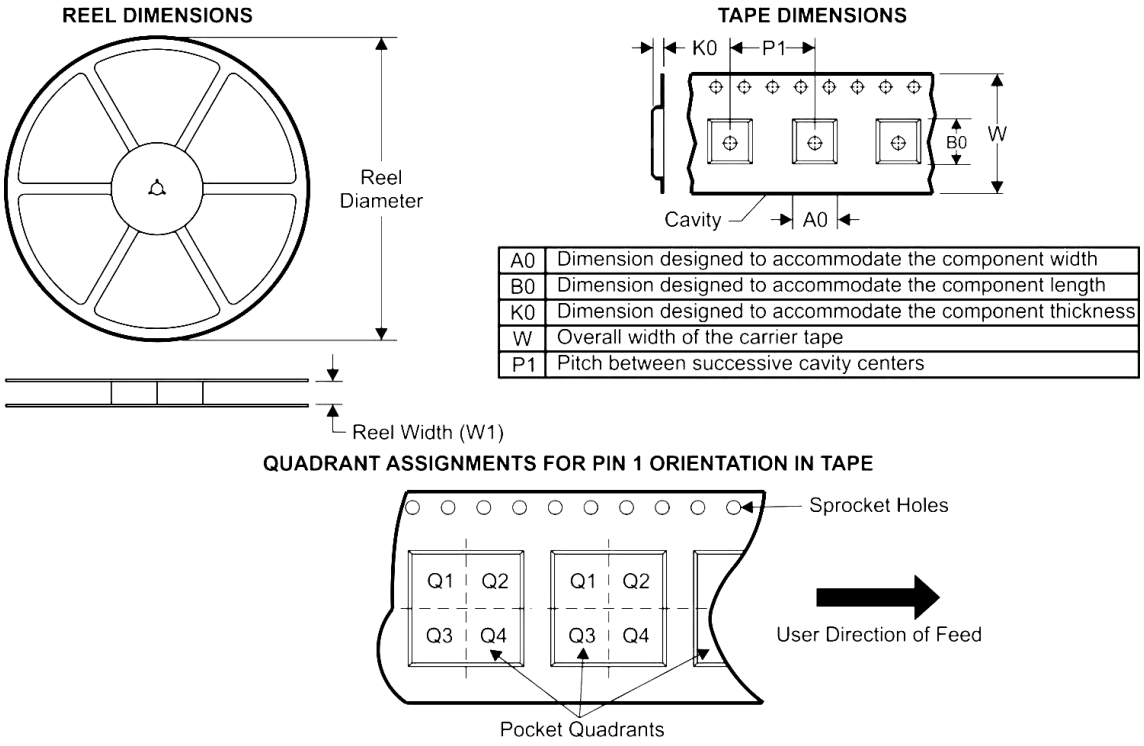


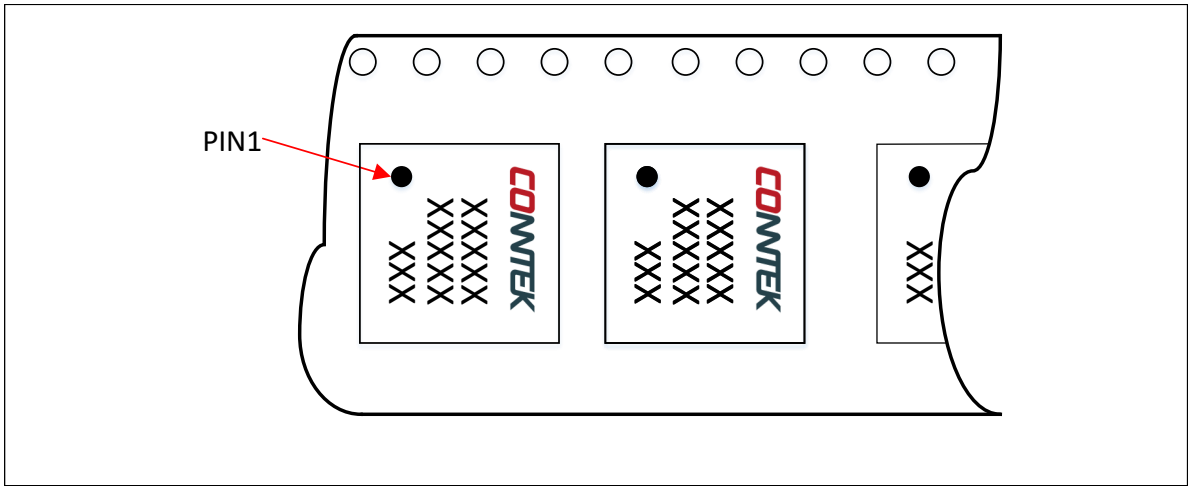
Place AVDD/DVDD/VDDIO decoupling capacitors close to the chip, and route NRST pull-up, TEST1/TEST2 per the datasheet.

10 Tape, Reel & Ordering

10.1 Carrier Tape and Reel

Package	Pins	SPQ	Reel ϕ	Reel Width	A_0	B_0	K_0	P_1	W	Pin1
QFN3×3-16L	16	5000	330 mm	12.4 mm	3.35	3.35	1.13	8.00	12.00	Q1





10.2 Ordering Information

Model	Package	Operating Temperature	Pins
KTH5791AQ3QNS	QFN3×3-16L	−40 °C ~ +85 °C	16

11 Revision History

Version	Date	Description
Rev. 2.0	2026-04-24	Datasheet layout optimization

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Important Notice

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