IST8505x

Nanopower Omnipolar TMR Switch with Anti-Magnetic Shielding

Datasheet

Table of Contents

1. General Description

IST8505x series is a family of advanced omnipolar Tunneling Magnetoresistive (TMR) switches, optimized for ultra-low power magnetic sensing applications requiring reliable digital output and strong drive capability. Each device in the IST8505x series integrates a high-sensitivity TMR sensor, precise analog signal processing, and low-power oscillator, providing stable switching performance across a wide supply voltage range of 1.0 V to 3.6 V.

The series is available in multiple fixed magnetic sampling frequency versions, enabling designers to fine-tune power consumption and response latency according to system requirements. It is ideal for portable, battery-operated devices where low power consumption is essential to maximize runtime.

The IST8505x series also features energy-efficient power gating, a Latch Pin for output control, and Under-Voltage Lockout (UVLO) for power stability. This design enhances immunity to environmental magnetic noise, making these sensors highly suitable for use in electrically and magnetically noisy environments.

Each variant is packaged in a 1.45 × 1.45 × 0.44 mm³ LGA-4 form factor, ideal for space-constrained designs.

IST8505x Product Variants

Part Number	Sensor Type	f_s	$I_{DD(AVG)}$ (nA)			Package
			@ 1V	@ 1.5V	@ 3.6V	
IST8505	Omnipolar	1 Hz	10	11	20	LGA
IST8505H2	Omnipolar	2 Hz	14	16	33	LGA
IST8505H4	Omnipolar	4 Hz	18	22	49	LGA
IST8505H8	Omnipolar	8 Hz	30	40	92	LGA

Key Features

- **Omnipolar Detection:** Detects both north and south magnetic poles
- **Push-Pull Output:** Provides strong drive capability for direct load control
- **Extremely Low Power Consumption:** Down to 10nA typ. at 1Hz
- **Wide Supply Range:** Operates from 1.0 to 3.6 V
- **High TMR Sensitivity:** Ensures accurate magnetic field detection
- **Energy-Efficient Power Gating:** Minimizes power consumption during standby
- **Latch Function:** Enhances noise immunity and output stability
- **Under Voltage Lockout (UVLO):** Prevents malfunction in low-power conditions
- **Compact Package:** 1.45 x 1.45 x 0.44 mm³ LGA-4 for space-constrained designs
- **Environmental Compliance:** RoHS, HF, and TSCA compliant

Applications

- **Battery-Powered Medical Devices** – Contactless detection
- **IoT & Smart Home** – Door/window sensors, proximity detection
- **Wearables** – Smartwatches, fitness trackers, and health monitors
- **Security Systems** – Intrusion detection and access control
- **Robotics** – Position and movement sensing
- **Consumer Electronics** – Smartphones, tablets, laptops, and other smart devices

2. Block Diagram, Package Dimensions, Pin Configuration, and Application Circuit

2.1. Block Diagram

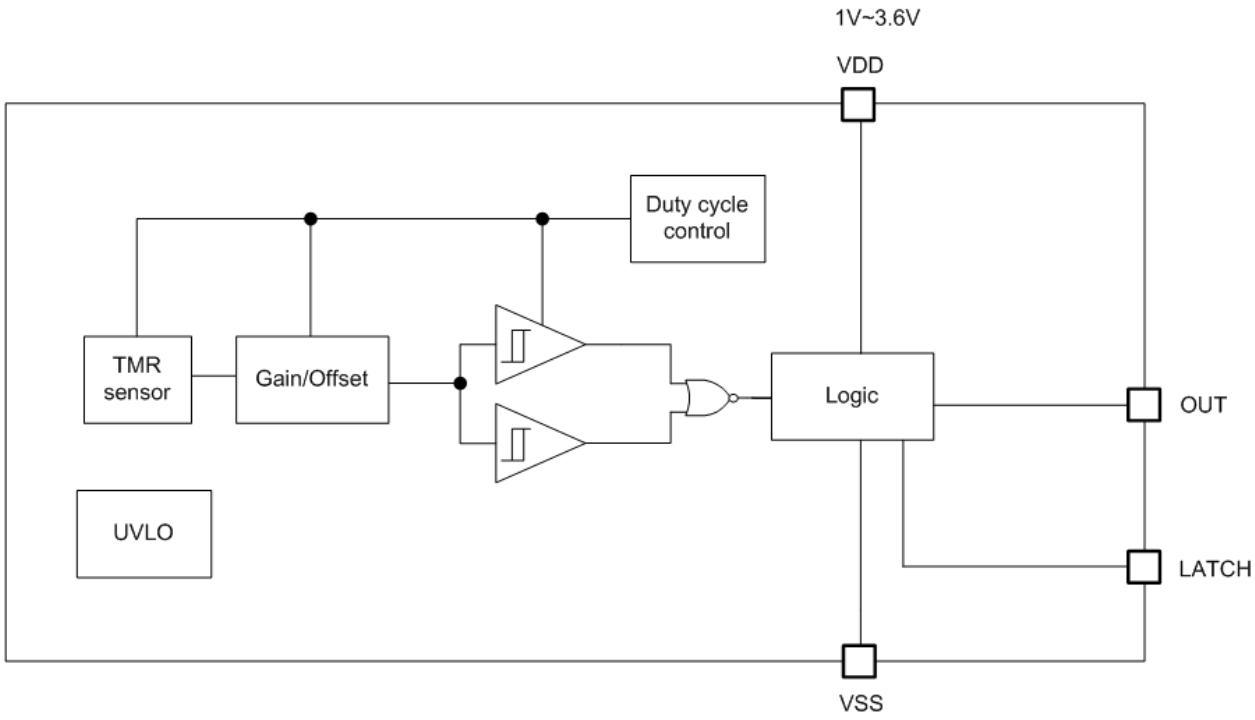

Figure 1. Block Diagram

2.2. Package Dimensions

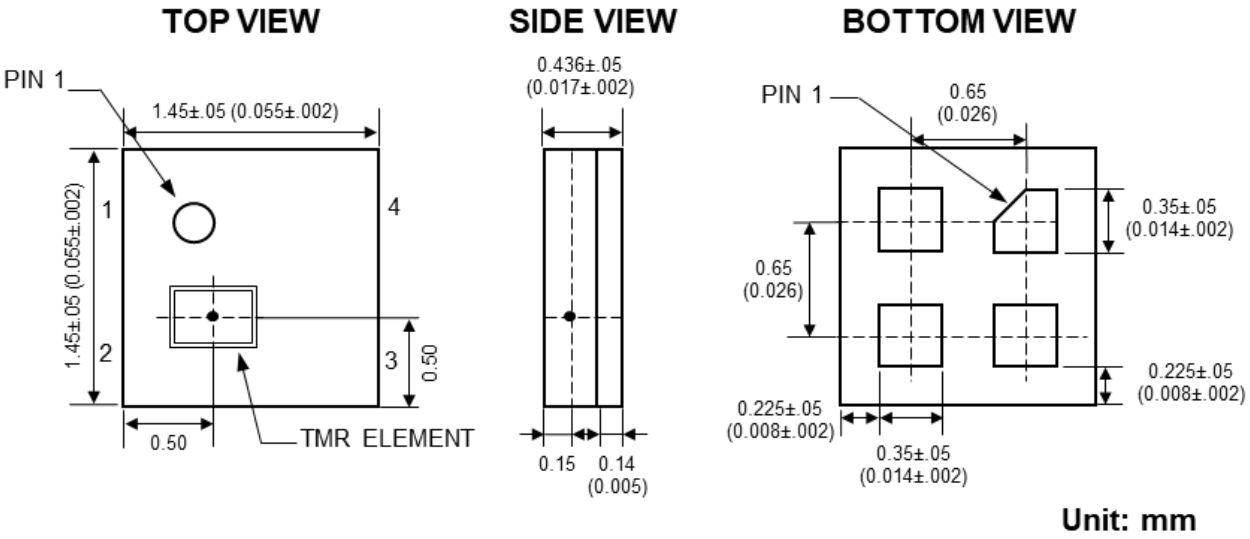

Figure 2. Package Dimension

2.3. Pin Configuration

Pin No.	Name	I/O Type	Description
1	LATCH	IO	Latch function
2	VDD	PWR	Power Supply Input
3	OUT	IO	Output
4	VSS	PWR	Ground

2.4. Axis of Sensitivity

The sensing axis lies parallel to the package surface and is aligned with the internal TMR sensor orientation. This defines the direction of magnetic field detection for BOP and BRP thresholds.

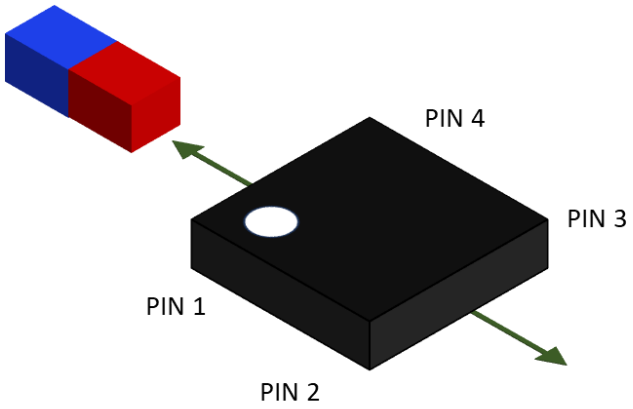

Figure 3. Axis of Sensitivity

2.5. Application Circuit

A typical application requires minimal external components. The output pin (OUT) is capable of directly driving logic inputs or small loads due to its strong push-pull driver.

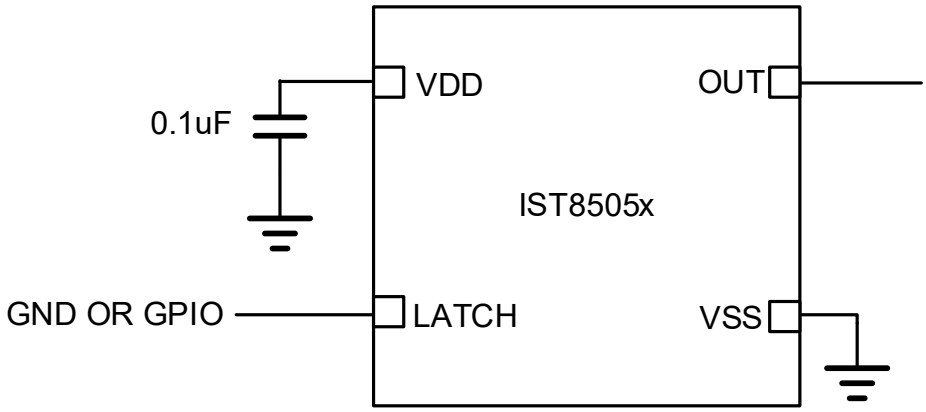

Figure 4. Application Circuit

Note on LATCH Pin Behavior: The LATCH pin can be:

- Actively driven to logic LOW or HIGH by a GPIO, or
- Directly connected to VSS (GND)

Important: If the LATCH Pin is not in use, it should not be left in a floating state to avoid potential misbehavior due to charge stored in the LATCH pin input capacitance

3. Electrical Specifications

3.1. Absolute Maximum Ratings

	MIN	MAX	UNIT
Power Supply Voltage	-0.3	3.6	V
Output Voltage	-0.3	V_{DD} + 0.3	V
Output Current		25	mA
Magnetic Flux Density		±3000	G
Junction Temperature		125	°C
Storage Temperature	-65	150	°C

Note: Exceeding the absolute maximum ratings specified for this device can result in permanent damage. Furthermore, prolonged exposure to conditions at or near these absolute maximum ratings may adversely affect the device's reliability. Users are strongly advised to design their systems to avoid such extreme conditions to ensure long-term performance and reliability.

3.2. ESD Ratings

Symbol	Parameter	Description	Value	Unit
VESD	Electrostatic Discharge	Human Body Model (HBM), ANSI/ESDA/JEDEC JS-001	±4000	V
		Charge-Device Model (CDM), JEDEC Specification & JEDEC JS-002	±500	V

3.3. Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Power Supply Voltage	1	1.5	3.6	V
V_O	Output Voltage	0		V_{DD}	V
I_O	Output Current			25	mA
T_A	Operating Ambient Temperature	-40		85	°C

3.4. Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{On}	PMOS Output Impedance			5	10	Ω
$I_{DD(PK)}$	Peak Current (active time)				200	μA
	Peak Current (output transition)	V_{DD} = 3.6V		7		mA
$I_{DD(ST)}$	Power up Current Consumption			60	100	μA
t_{ACTIVE}	Active Time Period			35		μs
	Temperature Drift of Sampling	-40 – 85ºC	-50		50	%
	V_{DD} Sensitivity	1 – 3.6 V	-20		20	%
P_{GT}	Power Gating Time	Start from UVLO		1	3	ms
$I_{DD(Idle)}$	Idle Current	Without Sampling		6		nA
	UVLO, Rising V_{DD}		0.856	0.945	1.0	V
	UVLO, Falling V_{DD}		0.796	0.868	0.919	V
	UVLO, Hysteresis		60	77	92	mV
V_{OH}	High Level Output Voltage	I_{OUT}=15 mA	0.91		3.55	V
V_{OL}	Low Level Output Voltage	I_{OUT}=50 μA			0.2	V
V_{IL}	Latch Pin Input Low Voltage				V_{DD} x 0.3	V
V_{IH}	Latch Pin Input High Voltage		V_{DD} x 0.6		V_{DD}	V

3.5. IST8505 Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
f_s	Frequency of Magnetic Sampling		0.5	1	2	Hz
T_s	Period of Magnetic Sampling			1000		ms
$I_{DD(AVG)}$	Average Current Consumption	V_{DD} = 1 V		10		nA
		V_{DD} = 1.5 V		11		
		V_{DD} = 3.6 V		20		

Current Consumption Characteristics Under Different Temperatures

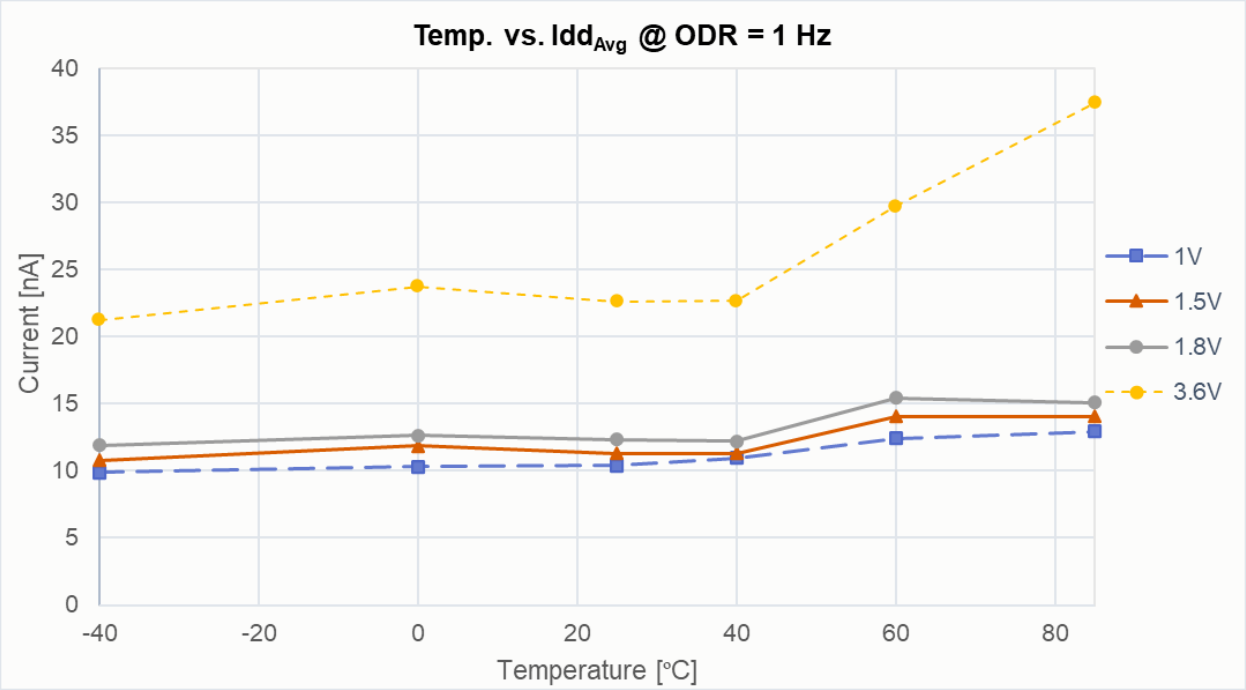

Figure 5. IST8505 current consumption at different temperatures, V_{DD} = 1 - 3.6V

3.6. IST8505H2 Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
f_s	Frequency of Magnetic Sampling		1	2	4	Hz
T_s	Period of Magnetic Sampling			500		ms
$I_{DD(AVG)}$	Average Current Consumption	V_{DD} = 1 V		14		nA
		V_{DD} = 1.5 V		16		
		V_{DD} = 3.6 V		33		

Current Consumption Characteristics Under Different Temperatures

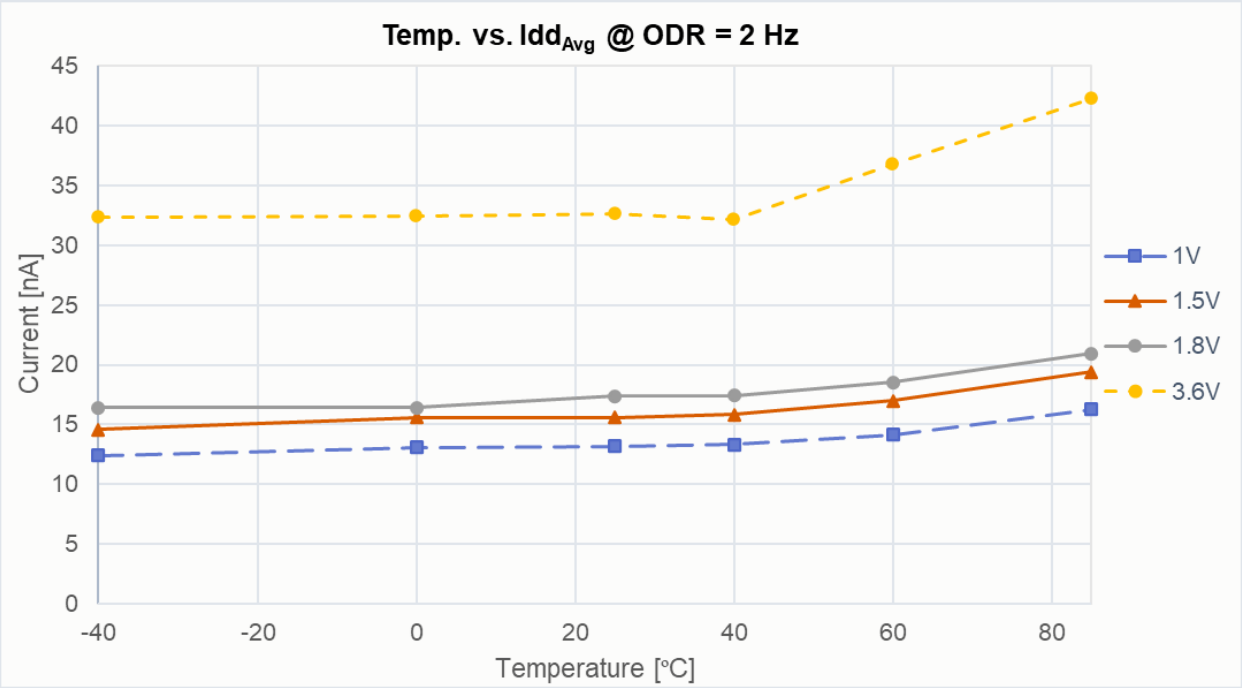

Figure 6. IST8505H2 current consumption at different temperatures, V_{DD} = 1 - 3.6V

3.7. IST8505H4 Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
f_s	Frequency of Magnetic Sampling		2	4	8	Hz
T_s	Period of Magnetic Sampling			250		ms
$I_{DD(AVG)}$	Average Current Consumption	V_{DD} = 1 V		18		nA
		V_{DD} = 1.5 V		22		
		V_{DD} = 3.6 V		49		

Current Consumption Characteristics Under Different Temperatures

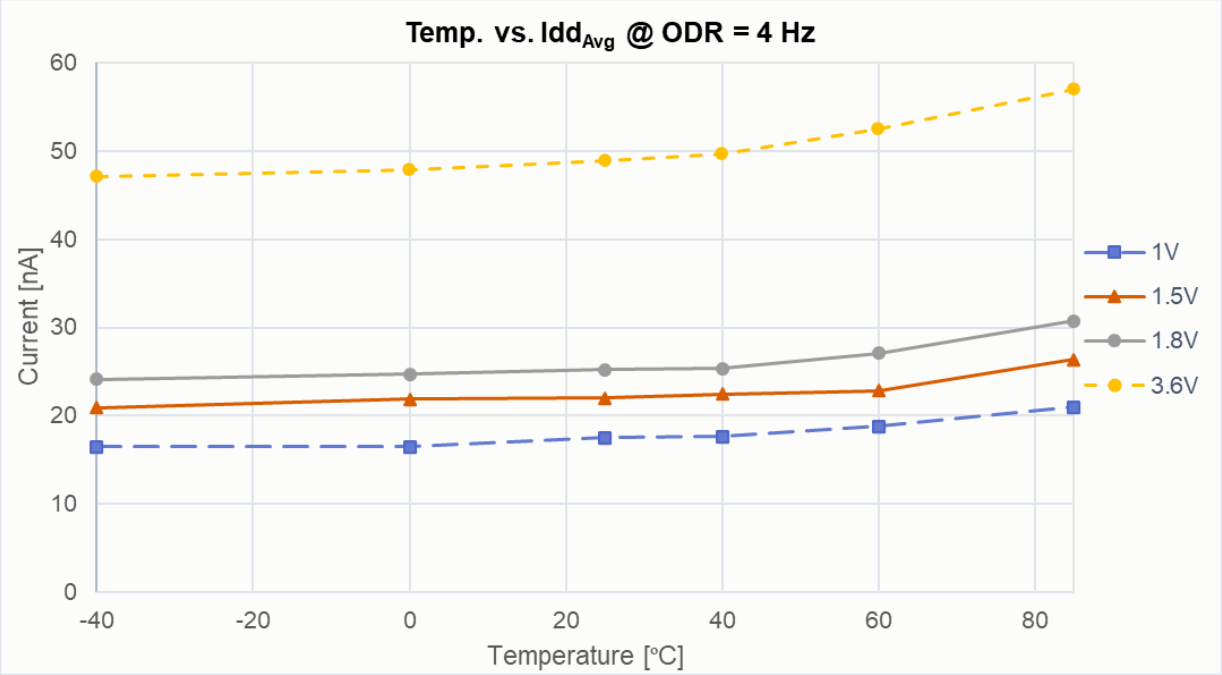

Figure 7. IST8505H4 current consumption at different temperatures, V_{DD} = 1 - 3.6V

3.8. IST8505H8 Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
f_s	Frequency of Magnetic Sampling		4	8	16	Hz
T_s	Period of Magnetic Sampling			125		ms
$I_{DD(AVG)}$	Average Current Consumption	V_{DD} = 1 V		30		nA
		V_{DD} = 1.5 V		40		
		V_{DD} = 3.6 V		92		

Current Consumption Characteristics Under Different Temperatures

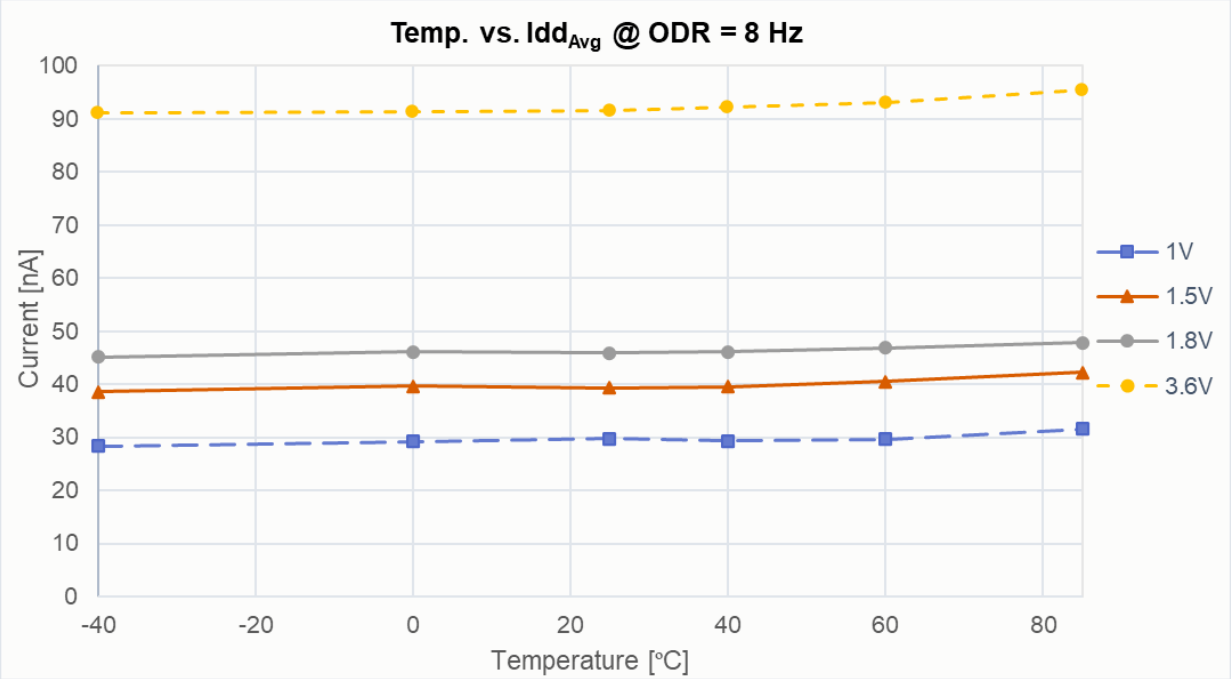

Figure 8. IST8505H8 current consumption at different temperatures, V_{DD} = 1 - 3.6V

3.9. IST8505x Magnetic Characteristics

Unless otherwise noted, V_{DD} = 1.5 V, TA = 25 °C

Symbol	Parameter	Min.	Typ.	Max.	Unit
B_{OP}	Magnetic Threshold Operate Point	±5	±7	±10	G
B_{RP}	Magnetic Threshold Release Point	±2	±3	±6	G
B_{HYS}	Magnetic Hysteresis: $\|B_{OP}-B_{RP}\|$	3	4		G

Magnetic Response Characteristics Under Different Temperatures

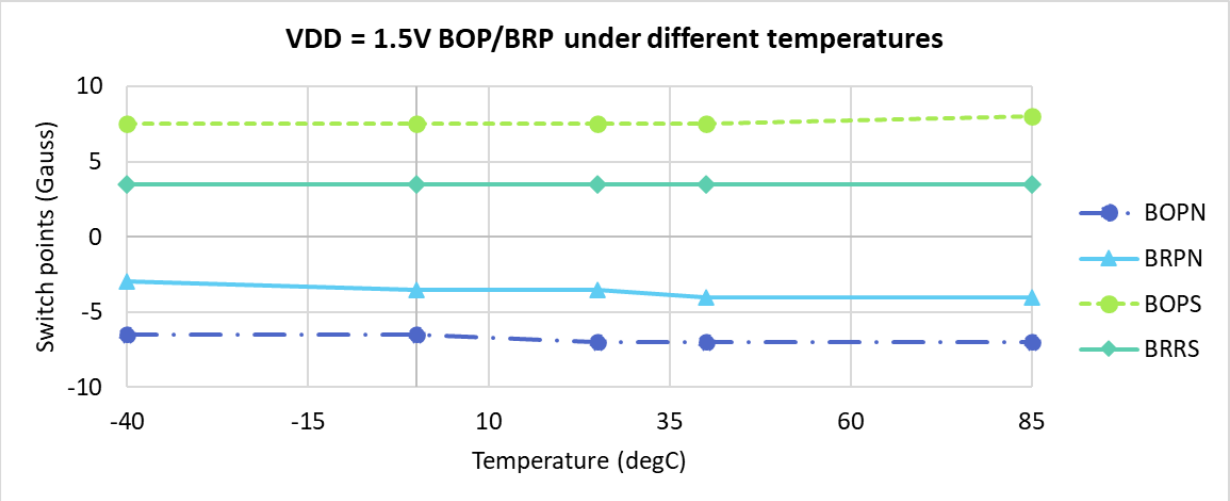

Figure 9. BOP/BRP at different temperatures, V_{DD} = 1.5V

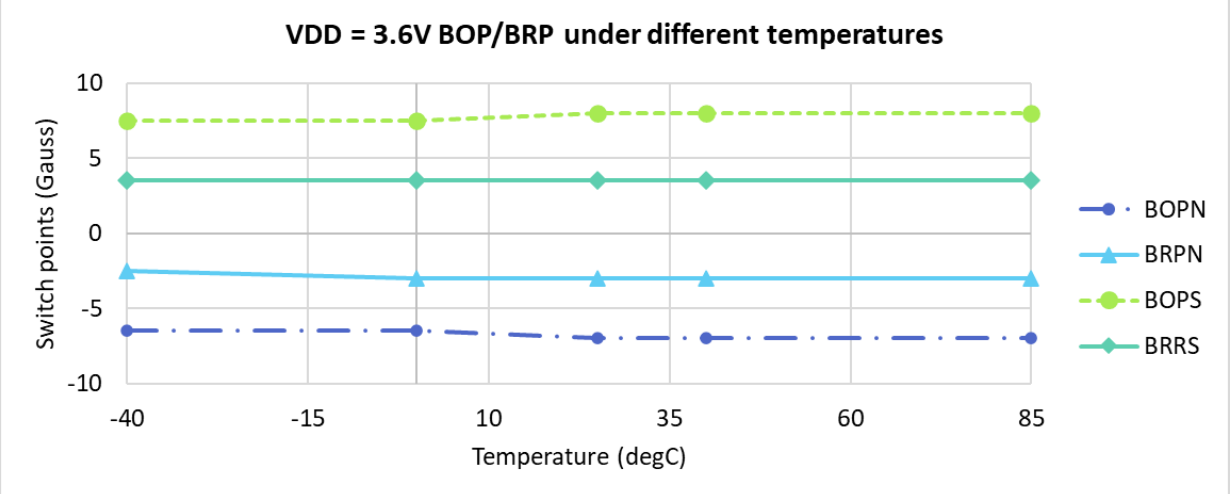

Figure 10. BOP/BRP at different temperatures, V_{DD} = 3.6V

Magnetic Response Characteristics at Different Supply Voltages

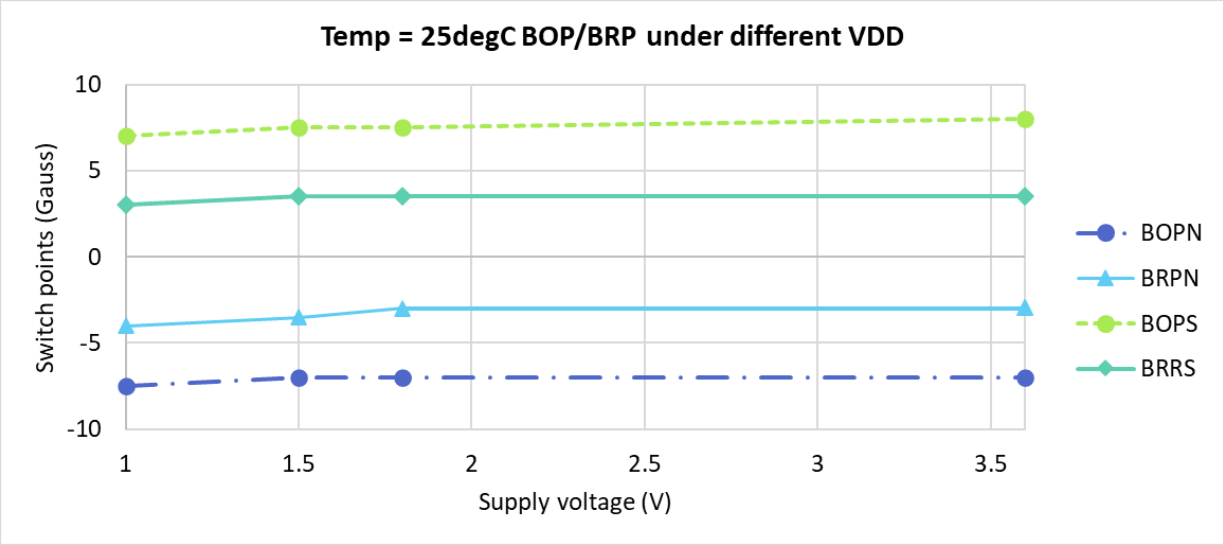

Figure 11. BOP/BRP at V_{DD} = 1 - 3.6V, T = 25ºC

3.10. Voltage and Current Output at Logic High

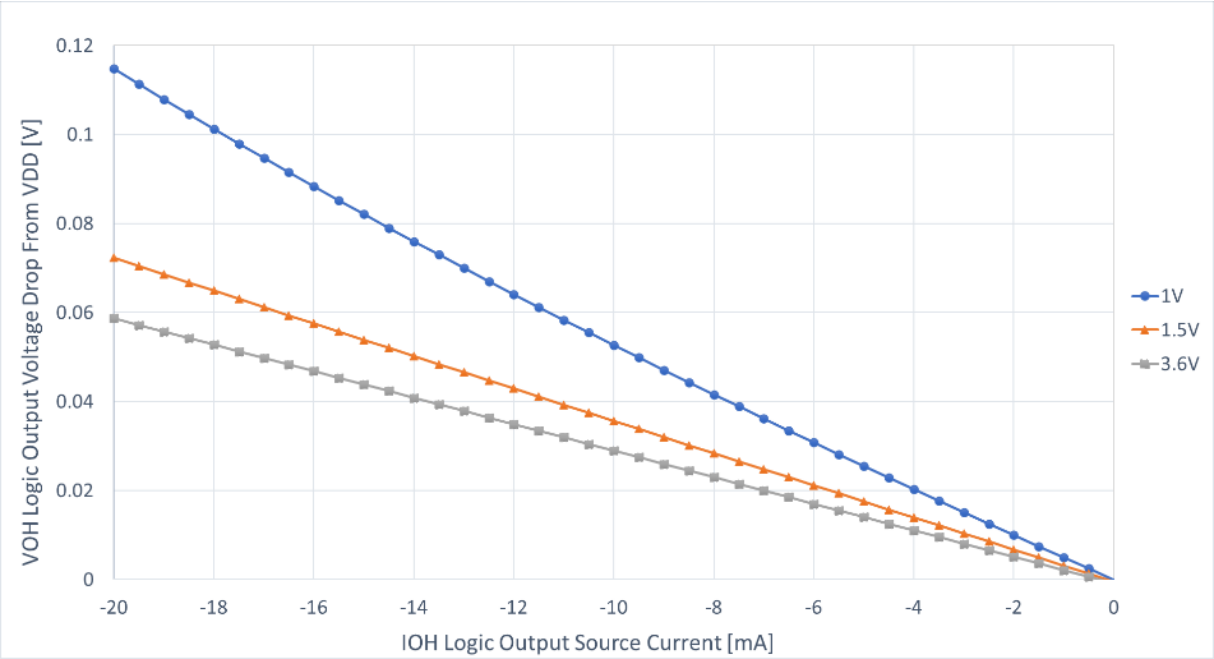

Figure 12. Voltage (VOH) and current (IOH) at logic high output for supply voltages ranging from 1V to 3.6V at 25ºC ambient temperature

3.11. Voltage and Current Output at Logic Low

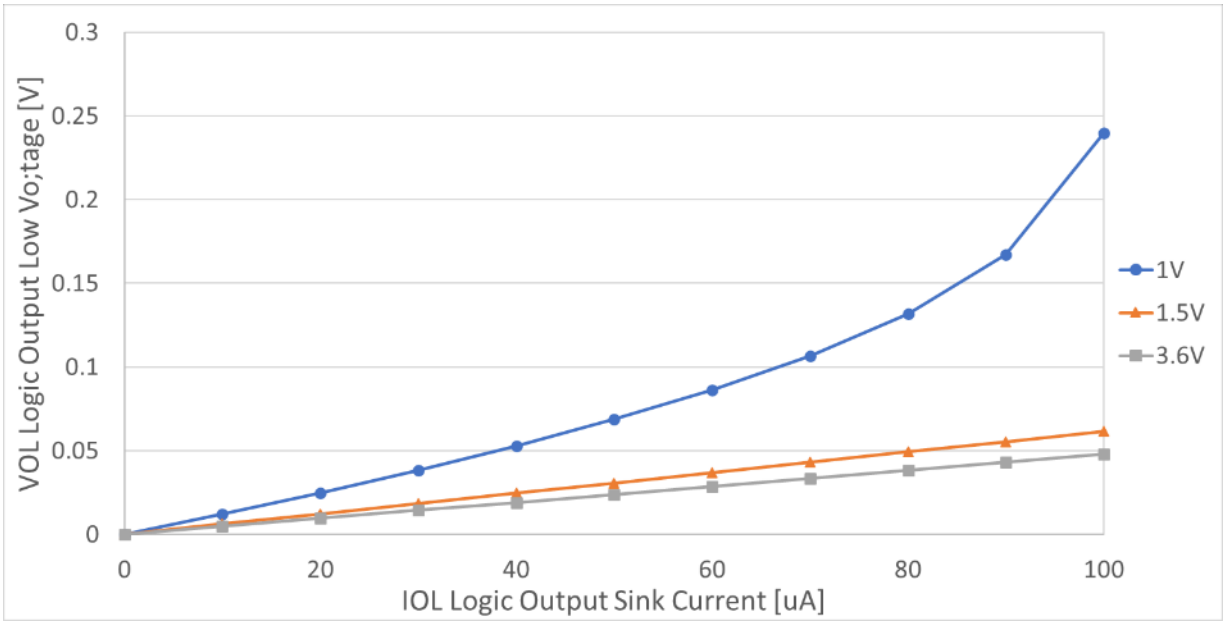

Figure 13. Voltage (VOL) and current (IOL) at logic low output for supply voltages ranging from 1V to 3.6V at 25ºC ambient temperature

4. Recommended Reflow Profile

Based on the IPC/JEDEC joint industry standard, J-STD-020D-01, below is the temperature profile for moisture sensitivity characterization that is recommended.

Profile Feature	SnPb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (Tsmax to Tp)	3°C/s maximum	3°C/s maximum
Preheat/Soak Temperature minimum (Tsmin) Temperature maximum (Tsmax) Time	 100°C 150°C 60 s to 120 s	 150°C 200°C 60 s to 180 s
Liquidous temperature(TL) Time (tL) maintained above TL	183°C 60 s to 150 s	217°C 60 s to 150 s
Peak/classification temperature (Tp)	235°C	260°C
Number of allowed reflow cycles	3	3
Time within 5 °C of actual peak temperature	10 s to 30 s	20 s to 40 s
Ramp-down rate	6°C/s max.	6°C/s max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

* Pb-free assembly using SnAg3.8Cu0.7 (SAC) solder

* Tolerance for peak temperature (T_p): Defined as supplier minimum and user maximum

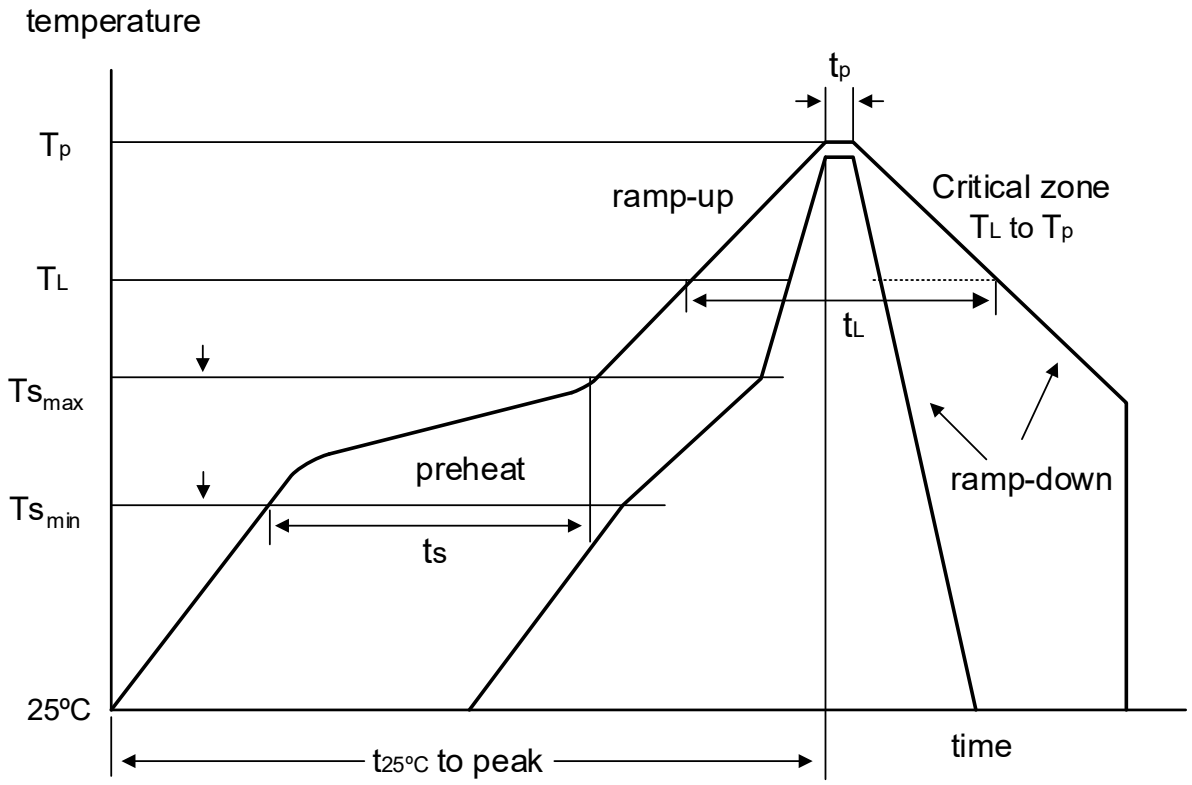

Figure 14. Suggested reflowing profile

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5. Protocol

5.1. Magnetic Response

IST8505x features an omnipolar TMR switch, which outputs a logic LOW when a magnetic field is detected:

- Magnetic field present → Output = LOW
- Magnetic field removed → Output = HIGH, enabled by the sensor's strong drive capability.

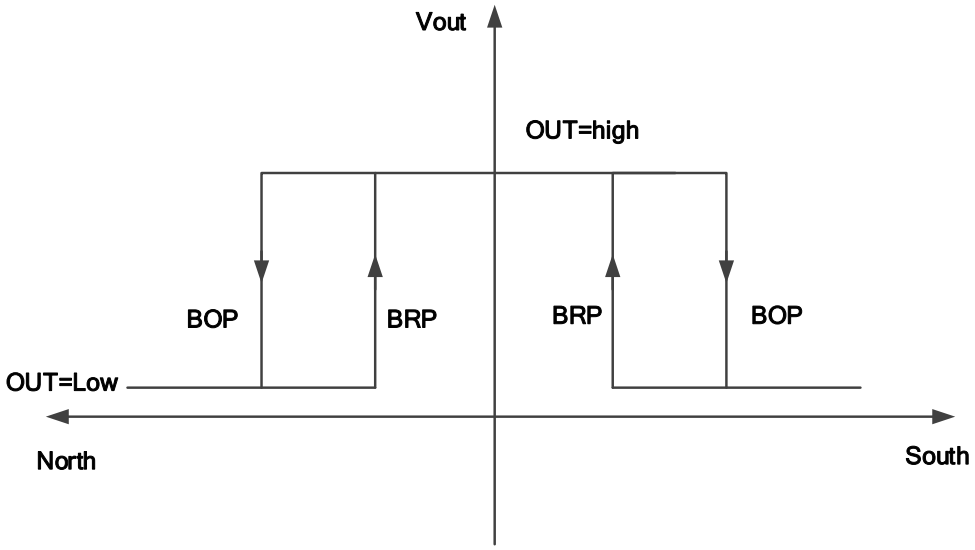


Figure 15. Magnetic Response

5.2. Output Type

The device features a push-pull CMOS output, providing strong drive capability for direct interfacing with digital circuits and loads.

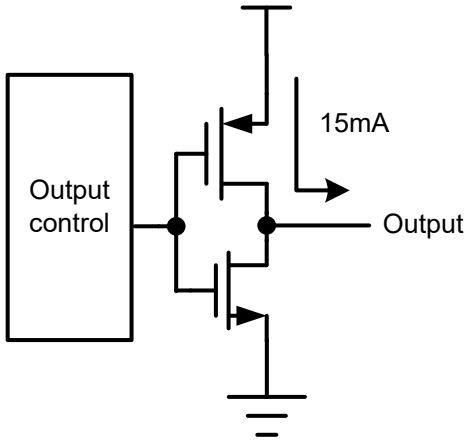


Figure 16. Output Type

5.3. Timing

Power Gating is a low-power operation mode that minimizes energy consumption. This function activates automatically after the UVLO phase ends, ensuring optimal power efficiency. The transition time is defined by the Power Gating Time ($\mathbf{P_{GT}}$) parameter.

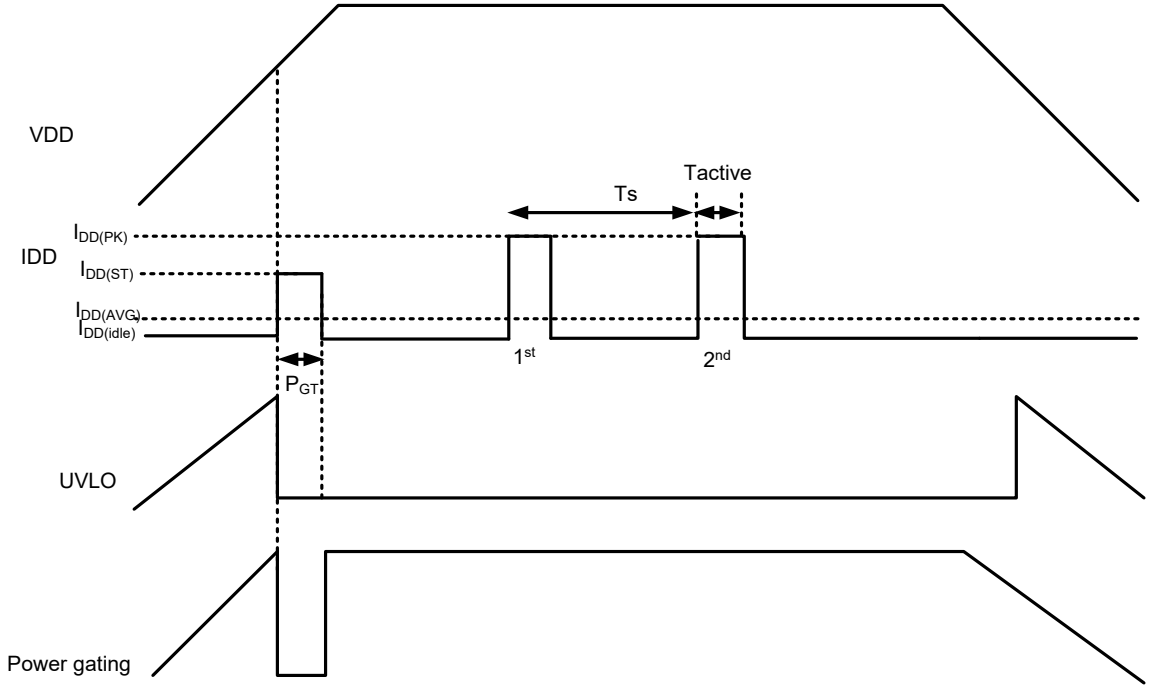


Figure 17. Normal Operation

5.4. Latch Function

Latch Pin is a key function that enhances output stability by preventing unintended state changes due to external magnetic fluctuations. When activated, the Latch function locks the sensor's output state, ensuring a consistent response in applications requiring stable signal behavior.

Latch Pin Operation

- **Latch Pin Control:** The Latch Pin can be controlled via a General-Purpose Input/Output (GPIO) signal, allowing users to enable or disable output locking as needed.
- **Output Locking:** When the Latch Pin transitions from Low to High, the sensor's output state is locked, preventing further changes even if the external magnetic field varies.
- **Output Reversion:** To restore normal sensor operation, allowing the output to respond dynamically to changes in the magnetic field, set the Latch Pin from High to Low.

This function improves noise immunity and signal integrity, making the IST8505x ideal for applications that demand precise and reliable magnetic switching performance.

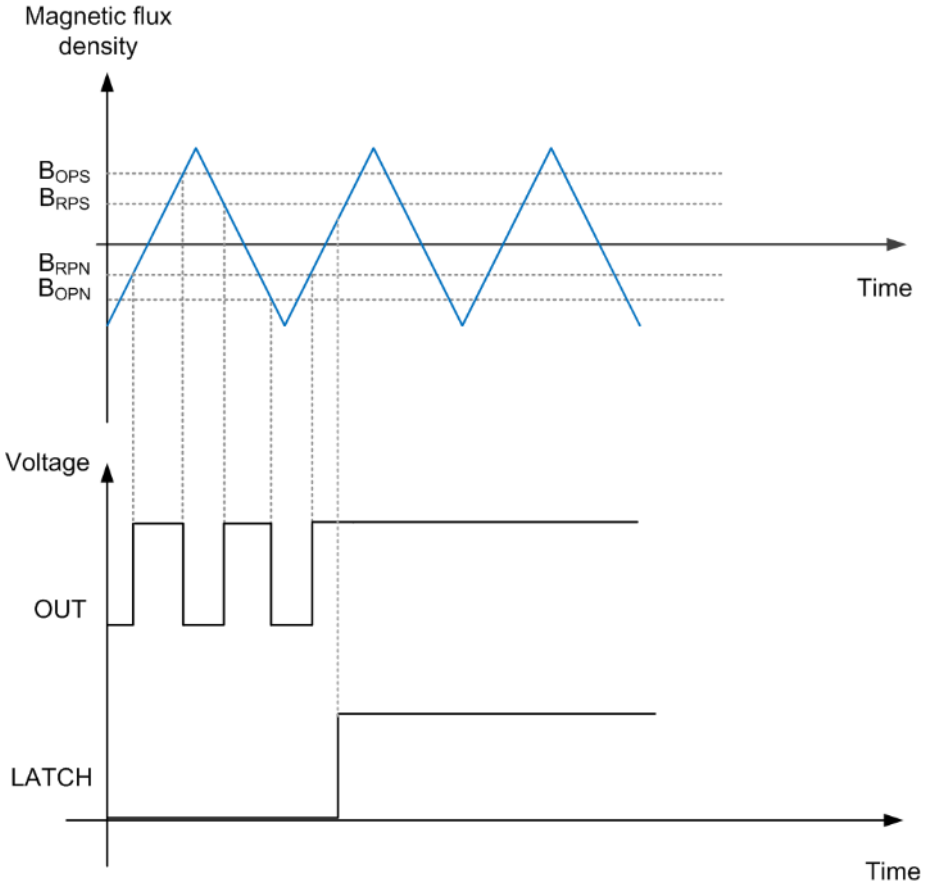


Figure 18. Latch Pin Operation

5.5. UVLO Operation

UVLO is a **power management feature** that prevents erratic behavior or potential damage caused by insufficient supply voltage.

UVLO Operation:

- When V_{DD} falls **below** the UVLO threshold (Falling V_{DD}), the device halts operation, and the output remains in a logic HIGH state.
- When V_{DD} rises **above** the UVLO threshold (Rising V_{DD}), the device automatically resumes normal operation.

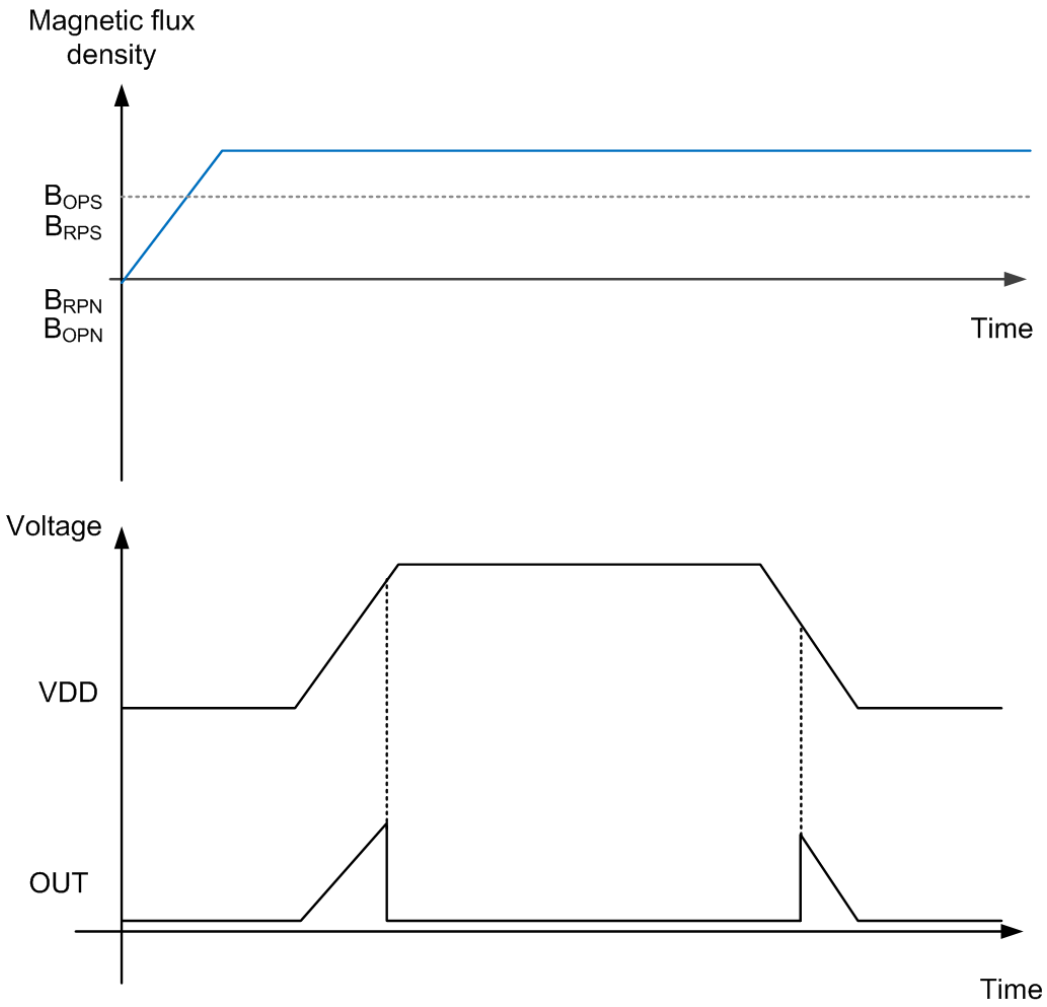


Figure 19. UVLO Operation

The UVLO function provides the following benefits:

- **Protection:** Prevents the device from malfunctioning due to low supply voltage, ensuring stable operation.
- **Low-Power Mode:** Reduces power consumption by entering a low-power state during UVLO conditions.
- **Automatic Recovery:** The sensor resumes normal operation without manual intervention when the supply voltage stabilizes

6. Marking Information

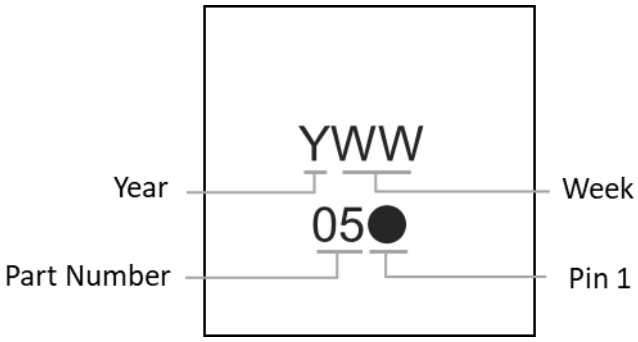
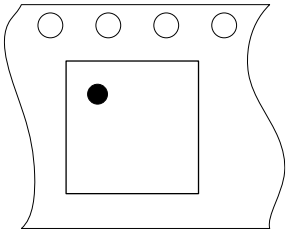
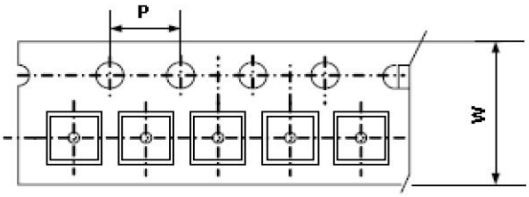


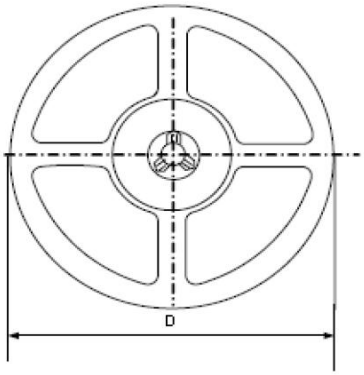
Figure 20. Product Code

7. Packing Information



Reel tape with the round hole facing up, Pin 1 positioned at the top left.
Moisture Sensitivity Level (MSL): 3





Package Type	Carrier Width (W)	Pitch (P)	Reel Size (D)	Packaging Minimum
LGA-4	8.0 ± 0.3 mm	4.0 ± 0.1 mm	178 ± 1 mm	Tape and Reel: 3K pcs per reel

For more information on iSentek's magnetic sensors, please send an email to sales@isentek.com or visit our website at www.isentek.com.

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Revision History

Revision Version	Date	Description
1.0	March 24th, 2025	Initial release