Key Features

- AEC-Q100 qualified for automotive applications
  - Temperature grade 0: -40℃ to 150℃, T_A
- Device junction temperature range
  - -40℃ to 175℃, T_J
- 3.3 V to 24 V wide input voltage range
- Internal protection circuits enable 40V load dump compliance
- High EMC immunity
- Symmetrical latch switch points
- Choice of output polarity
- Open-drain output
- Solid-state reliability
- Integrated fault protection
  - Reverse-battery protection
  - Output short-circuit protection
  - Overvoltage protection
- Package Options
  - SOT23-3L
  - TO-92S

Applications

- Automotive and industrial safety systems
- Industrial motors/encoders
- Trunk/door/liftgate/wiper motors
- Electronic power steering
- Transmission actuators

Description

The RJM10xx series is Hall-effect latch designed for 24V automotive applications. The devices are temperature-stable and suited for operation over extended junction temperature ranges up to 175℃.

The RJM1023 features a vertical Hall-effect sensing element that is sensitive to magnetic flux parallel to the surface of the IC package.

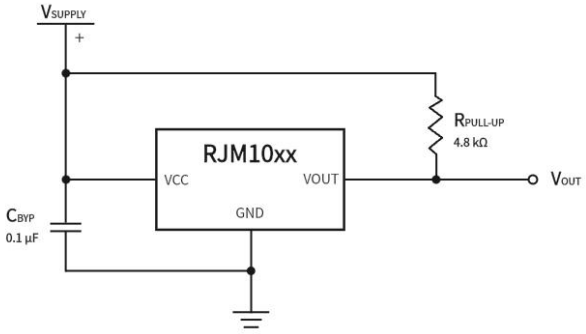
The RJM1013 features a planar Hall-effect sensing element that is sensitive to magnetic flux perpendicular to the surface of the IC package.

The devices include on-board reverse-battery and overvoltage protection, used for direct operation from an automobile battery, as well as preventing ground short circuits by limiting output current until the short circuit is eliminated.

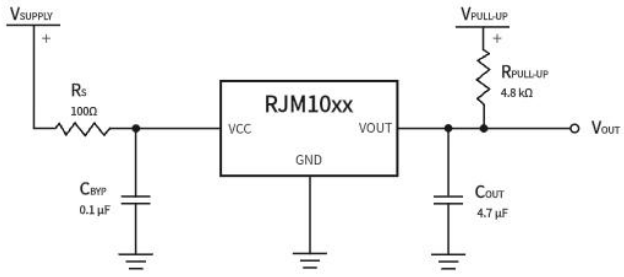
Device Information

Part Number	*Sensing Orientation*	*Package*	*Typical B_{OP}/B_{RP} Threshold (G)*
RJM1023-DSLA-QSTDR	X-Axis	SOT23-3L	±40
RJM1013-CSLA-QTOB	Z-Axis	TO-92S	±20

Typical Application



Typical Application Circuit



Typical and Enhanced Protection Application Circuit

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1 Pin Configuration and Functions

1.1 SOT23-3L

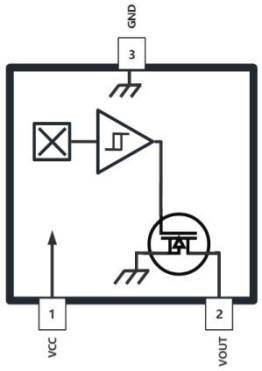


Figure 1 SOT23-3L, Pin-out, Top View

PIN NO.	SYMBOL	FUNCTION
1	VCC	Power supply pin
2	VOUT	Output from circuit
3	GND	Terminal for ground connection

1.2 TO-92S

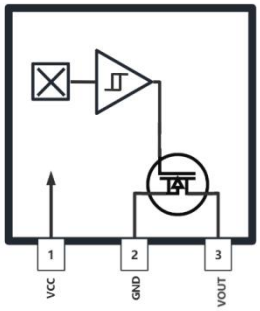


Figure 2 TO-92S, Pin-out, Top View

PIN NO.	SYMBOL	FUNCTION
1	VCC	Power supply pin
2	GND	Terminal for ground connection
3	VOUT	Output from circuit

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2 Absolute Maximum Ratings

Symbol	Parameter	Note	Rating	Units
V_{CC}	Supply Voltage		40	V
V_{RCC}	Reverse Supply Voltage		-18	V
V_{OUT}	Output Voltage		-0.3 to 32	V
I_{OUT}	Output Current		40	mA
I_{ROUT}	Reverse Output Current		-50	mA
B	Magnetic Flux Density		Unlimited	G
T_A	Operating Ambient Temperature		-40 to 150	℃
$T_{J(MAX)}$	Maximum Junction Temperature		165	℃
		For 1000 hours	175	℃
T_{stg}	Storage Temperature		-65 to 170	℃

3 ESD Ratings

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model	AEC Q100-002	±8	kV

4 Thermal Information

4.1 Thermal Information in SOT23-3L Package

Symbol	Parameter	Condition	Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	1-layer PCB with copper limited to solder pads	228	℃/W
		2-layer PCB with 0.463 in^2 of copper area each side connected by thermal vias	110	℃/W

4.2 Thermal Information in TO-92S Package

Symbol	Parameter	Condition	Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	1-layer PCB with copper limited to solder pads	165	℃/W

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5 Electrical Characteristics

All test conditions: V_{CC} = 3.3 to 24V, T_A = -40 to +150℃. Unless otherwise noted, typical value is at T_A = 25℃ and V_{CC} = 12V.

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
SUPPLY AND STARTUP						
V_{CC}	Supply Voltage		3.3	12	24	V
I_{CC}	Supply Current	RJM1023	1	3.2	5	mA
		RJM1013	1	3.0	5	mA
t_{PO}	Power-On Time	$V_{CC} \geq V_{CC(min)}$	-	100	350	μs
POS	Power-On State	$V_{CC} \geq V_{CC(min)}$, $t < t_{PO}$	-	HIGH	-	-
V_{UVLO}	Undervoltage Lockout	Voltage threshold at which the device is fully disabled during power down	-	2.3	-	V
t_{POR}	UVLO Reset Time		-	80	-	μs
CHOPPER STABILIZATION AND OUTPUT MOSFET CHARACTERISTICS						
f_c	Chopping Frequency		-	800	-	kHz
I_{OUTOFF}	Output Leakage Current	$V_{OUT(OFF)}$ = 12V, T_A = -40℃ to 85℃, output off, $V_{CC} \geq V_{CC(min)}$, $t > t_{PO}$	-	-	0.1	μA
I_{OUTOFF}	Output Leakage Current	$V_{OUT(OFF)}$ = 24V, output off, $V_{CC} \geq V_{CC(min)}$, $t > t_{PO}$	-	-	1	μA
$I_{OUTOFF(PO)}$	Output Leakage Current, Power-On	$V_{CC} \geq V_{CC(min)}$, $t < t_{PO}$	-	-	95	μA
$V_{OUT(SAT)}$	Output Saturation Voltage	Output on, I_{OUT} = 5mA	-	150	500	mV
$V_{OUT(OFF)}$	Output Off Voltage		-	-	24	V
t_r	Output Rise Time	C_L = 20pF, $R_{PULL-UP}$ = 4.8kΩ	-	1.2	2	μs
t_f	Output Fall Time	C_L = 20pF, $R_{PULL-UP}$ = 4.8kΩ	-	0.1	2	μs
ON-BOARD PROTECTION						
I_{OM}	Output Short-Circuit Current Limit	Output on, $V_{PULL-UP} \leq$ 24V	-	25	-	mA
$V_{Z(OUT)}$	Output Zener Clamp Voltage	I_{OUT} = 1.5mA. T_A = 25℃	32	-	-	V
V_Z	Supply Zener Clamp Voltage	I_{CC} = I_{CC}(max) + 3mA, T_A = 25℃	40	-	-	V
V_{RZ}	Reverse Battery Zener Clamp Voltage	I_{CC} = -5mA. T_A = 25℃	-	-	-18	V
I_{RCC}	Reverse Battery Current	V_{CC} = -26V, T_A = 25℃	-5	-	-	mA

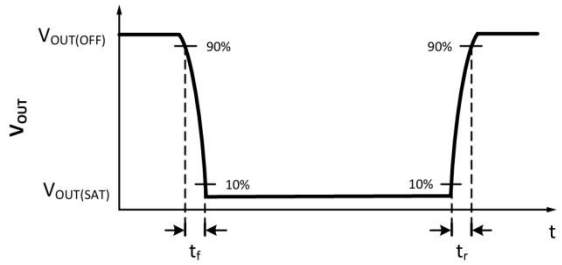


Figure 3 Definition of Output Rise and Fall time

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6 Magnetic Characteristics

All test conditions: V_{CC} = 3.3 to 24V, T_A = -40 to +150℃. Unless otherwise noted, typical value is at T_A = 25℃and V_{CC} = 12V.

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
RJM1023						
B_{OPS}	Operate Point		10	40	70	G
B_{RPS}	Release Point		-70	-40	-10	G
B_{HYS}	Hysteresis		20	80	140	G
RJM1013						
B_{OPS}	Operate Point		10	20	40	G
B_{RPS}	Release Point		-40	-20	-10	G
B_{HYS}	Hysteresis		20	40	80	G

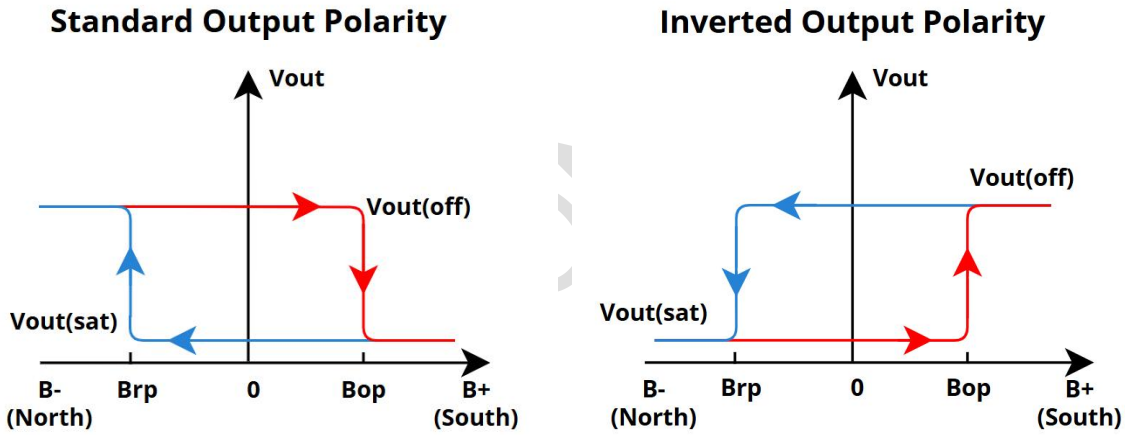
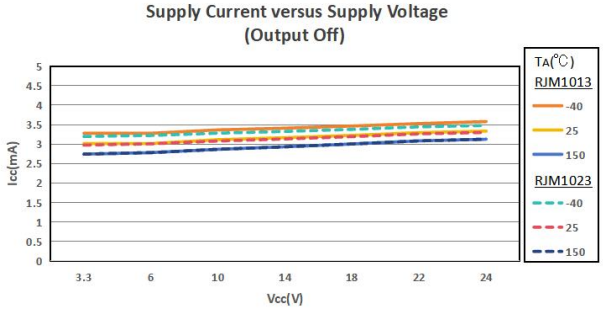


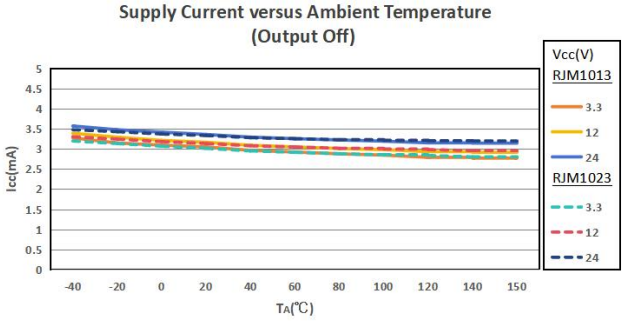
Figure 4 Hall Switch Output State vs. Magnetic Field

B- indicates increasing north polarity magnetic field strength, and B+ indicates increasing south polarity magnetic field strength.

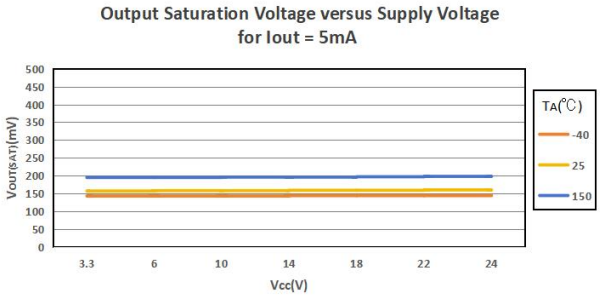
7 Characteristic Performance Data

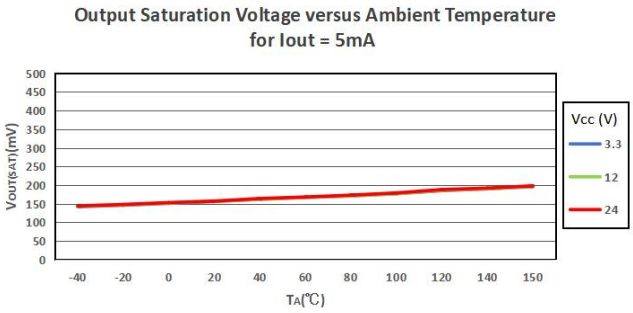
7.1 Electrical Characteristics





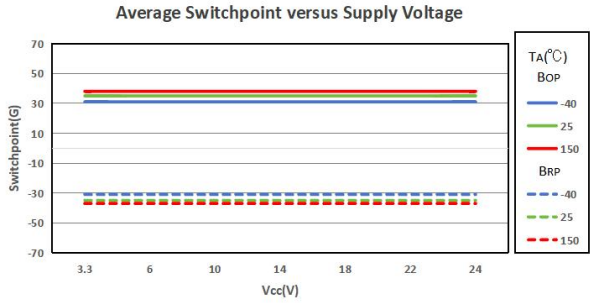
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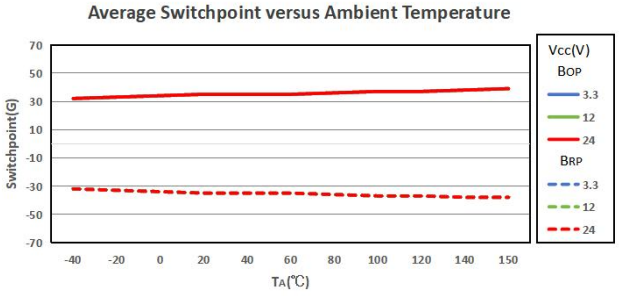


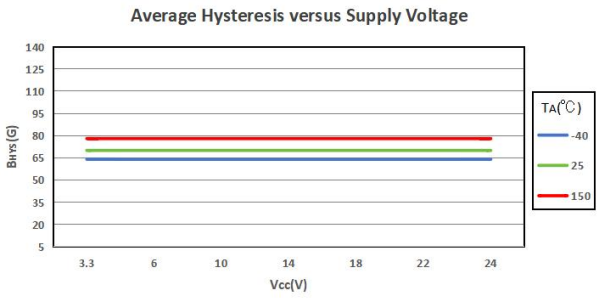


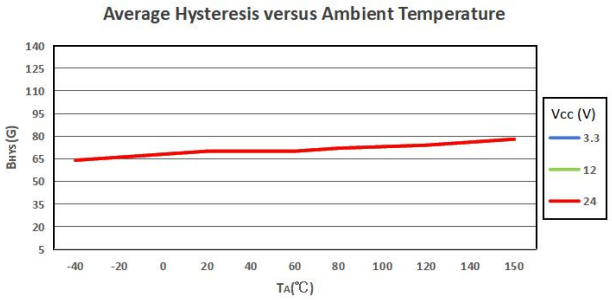
7.2 Magnetic Characteristics

RJM1023

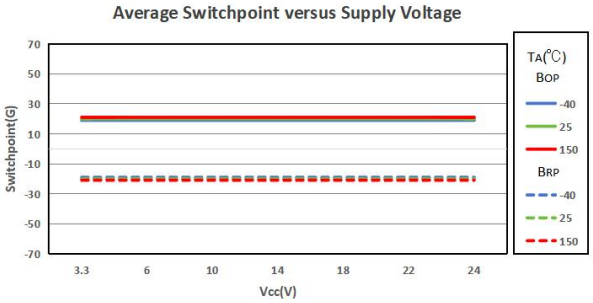


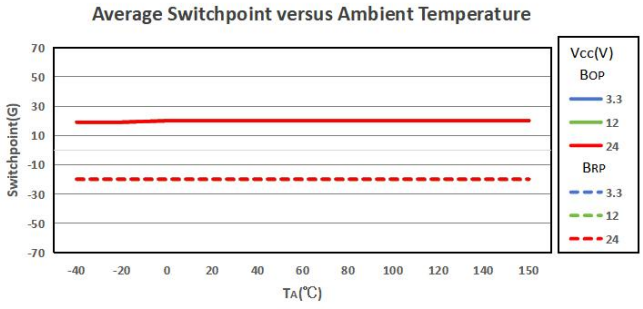




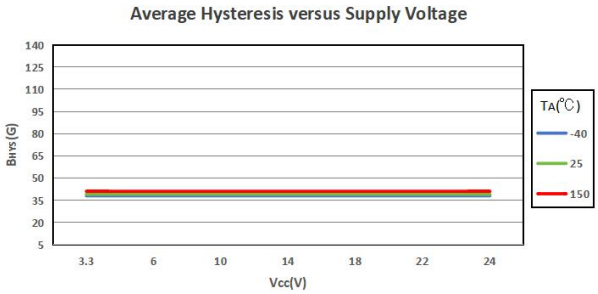


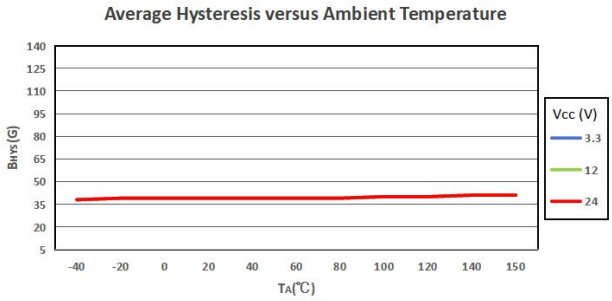
RJM1013





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8 Detailed Description

8.1 Block Diagram

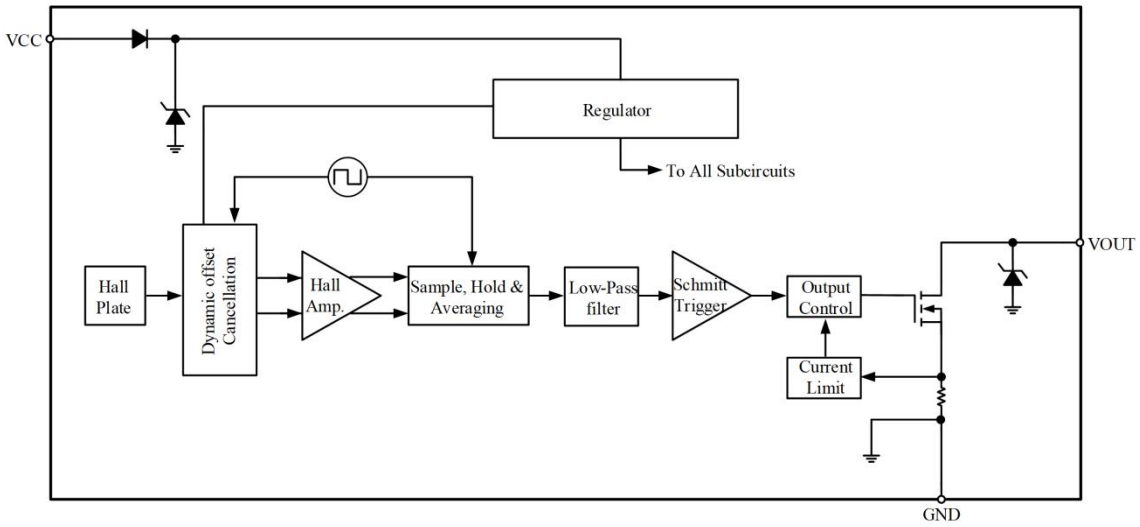


Figure 5 Function block diagram

8.2 Feature Description

8.2.1 Power-On Behavior

When the supply voltage reaches $V_{CC}(min)$, the device initiates power-on. During the power-on period, t_{PO}, device output remains off with only leakage current $I_{OUTOFF(PO)}$ present. The use of a larger pull-up resistor $R_{PULL-UP}$ can affect the Power-On State (POS) voltage level on the output pin during the t_{ON}. The output voltage level during POS is determined by both the pull-up resistor and pull-up voltage. This level can be calculated by subtracting the voltage drop caused by $R_{PULL-UP}$ and $I_{OUTOFF(PO)}$ from the pull-up voltage. To ensure the power-on output voltage level remains above $V_{PULL-UP}/2$, a pull-up resistor ⩽20 kΩ is recommended. After power-on completes and t_{PO} elapses, the device output corresponds to the applied magnetic field under the conditions $B > B_{OP}$ and $B < B_{RP}$. Powering-on the device in the hysteresis range (less than B_{OP} and higher than B_{RP}) will cause the device output to remain off. A valid output state is attained after the first excursion beyond B_{OP} or B_{RP}.

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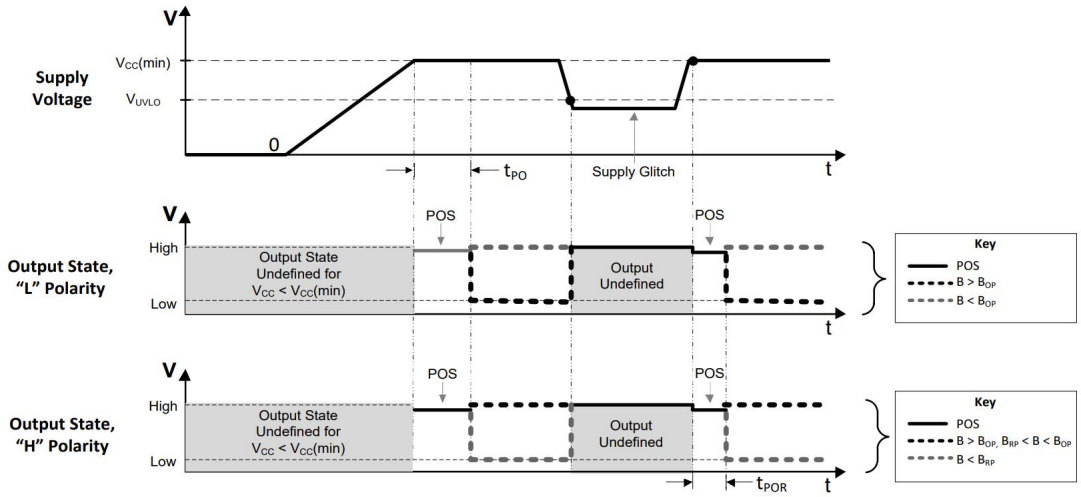


Figure 6 Power-On and Undervoltage Lockout Behavior

8.2.2 Undervoltage Shutdown

These devices integrate a power supply voltage diagnostic function (i.e., an undervoltage lockout regulator). When the power supply voltage drops below the undervoltage lockout threshold voltage V_{UVLO}, the device enters a reset state, and the output state becomes undefined until the power supply voltage V_{CC} rises back to the minimum operating voltage $V_{CC(min)}$. Once the power supply voltage reaches the $V_{CC(min)}$ threshold, the power-on sequence initiates immediately. After the power-on reset time t_{POR} expires, if the applied magnetic field strength B is greater than the operate point magnetic field B_{OP} or less than the release point magnetic field B_{RP}, the output state will match the magnetic field strength. If the power supply voltage fails to recover within the aforementioned operating voltage range, or if the applied magnetic field strength falls within the hysteresis window, the device output will maintain the initial power-on state.

8.2.3 Operation

The RJM1023 and RJM1013 are integrated Hall-effect sensor ICs featuring open-drain outputs. For devices with the -xSL configuration, the output polarity is Low under a south-polarity magnetic field ($B > B_{OP}$) and High under a north-polarity magnetic field ($B < B_{RP}$). The -xSH variant operates complementarily, where the output becomes High for $B > B_{OP}$ (south polarity) and Low for $B < B_{RP}$ (north polarity). The open-drain output is driven by an NMOS transistor actuated by the applied magnetic field. For the RJM1013(Right), the applied magnetic field must be perpendicular to the branded face of the package, while for the RJM1023(Left), it must be parallel to the branded face.



Figure 7 The applied magnetic field of RJM1023(Left) and RJM1013(Right)

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9 Typical Application

9.1 Application circuit

The RJM10xx series is s Hall-effect latch designed for 24V automotive applications. Figure 5 shows a typical application circuit for the RJM10xx series.

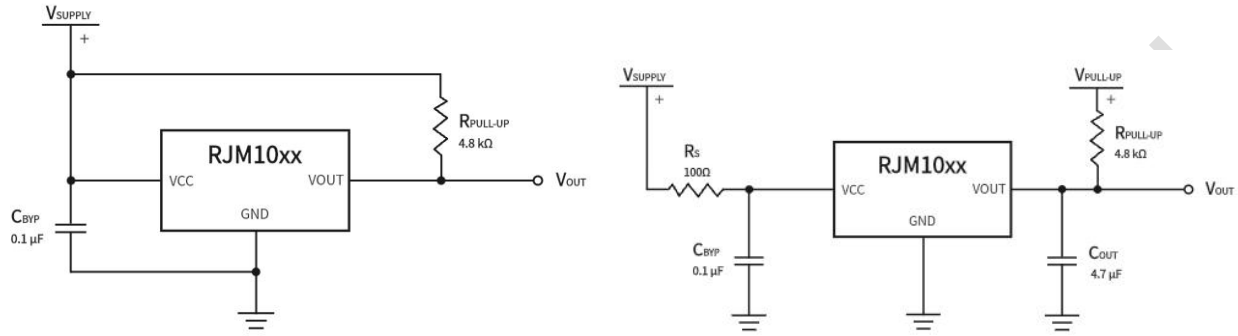


Figure 8 Typical application circuit of RJM10xx series

9.1.1 Bypass Capacitor

It is highly recommended to connect an external bypass capacitor (in close proximity to the Hall element) between the device's power supply and ground terminals, so as to ensure the device operates properly under harsh environmental conditions and reduce noise generated by the internal circuitry. As shown in Figure 7, a capacitor with a specification of 0.1 µF is required.

9.1.2 Pull-up Resistor

The pull-up resistor supplies high-level driving capability. Given that open-drain pins are incapable of actively sourcing current to output a high-level signal, the pin will be in a floating state with an undefined voltage level when the internal transistor is turned off. Meanwhile, the pull-up resistor suppresses electromagnetic interference and improves overall circuit stability by eliminating the floating state of the pin, which would otherwise render the pin vulnerable to ambient electrical noise and signal fluctuations, thus ensuring the generation of a reliable and stable high-level signal in the off state of the internal transistor.

9.1.3 Optional Series Resistor and Output Capacitor

When the RJM1023 or RJM1013 is powered by an unregulated power supply such as an automotive battery, or when the application scenario has higher requirements for the device's anti-interference capability, additional protective measures can be adopted. The specifications of such transient parameters vary depending on the application scenario, so the design of the protection circuit needs to be optimized for specific application scenarios. For example, the circuit shown in Figure 7 includes an optional series resistor and output capacitor, which can enhance the device's performance in electrostatic discharge (ESD) power-on testing (ISO 10605) and bulk current injection (BCI) testing (ISO 11452-4).

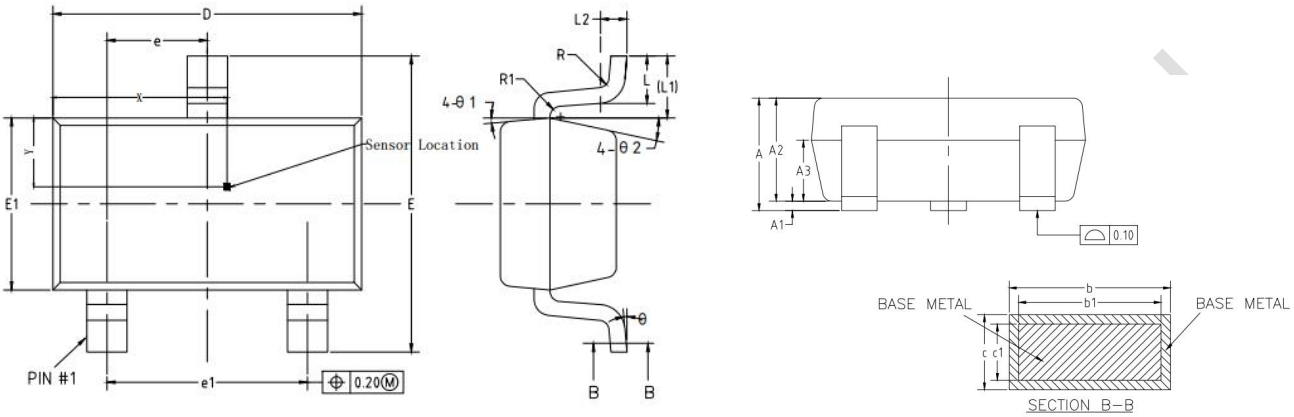
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10 Package Information

10.1 SOT23-3L

SOT23-3L



TOP VIEW SIDE VIEW SIDE VIEW

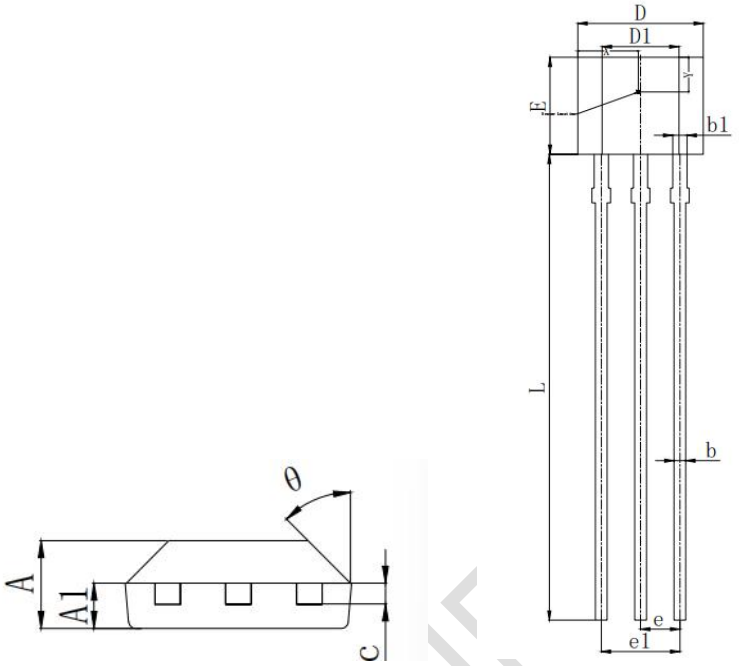
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	-	1.250	-	0.049
A1	0.000	0.150	0.000	0.006
A2	1.050	1.150	0.041	0.045
A3	0.600	0.700	0.024	0.028
b	0.360	0.500	0.014	0.020
b1	0.360	0.450	0.014	0.018
c	0.140	0.200	0.006	0.008
c1	0.140	0.160	0.006	0.007
D	2.826	3.026	0.111	0.119
E1	1.526	1.726	0.059	0.068
E	2.600	3.000	0.102	0.118
e	0.900	1.000	0.035	0.039
e1	1.800	2.000	0.071	0.079
L	0.350	0.600	0.014	0.024
L1	0.590REF		0.024REF	
L2	0.250BSC		0.010BSC	
R	0.050	-	0.002	-
R1	0.050	0.200	0.002	0.008
θ	0°	8°	0°	8°
θ1	3°	7°	3°	7°
θ2	6°	14°	6°	14°
X	1.500	1.800	0.060	0.071
Y	0.500	0.800	0.020	0.032

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10.2 TO-92S

TO - 92S



TOP VIEW SIDE VIEW

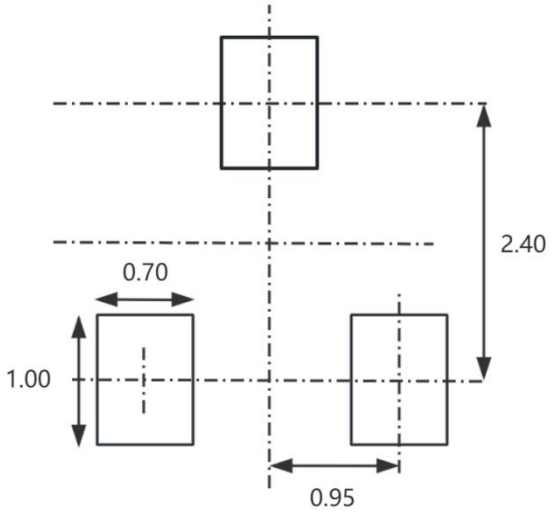
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.420	1.620	0.056	0.064
A1	0.660	0.860	0.026	0.034
b	0.330	0.480	0.013	0.019
b1	0.400	0.510	0.016	0.020
c	0.330	0.510	0.013	0.020
D	4.000	4.100	0.157	0.161
D1	2.280	2.680	0.090	0.106
E	3.050	3.250	0.120	0.128
e	1.270 TYP.		0.050 TYP.	
e1	2.440	2.640	0.096	0.104
L	15.100	15.500	0.594	0.610
θ	45° TYP.		45° TYP.	
X	1.800	2.100	0.071	0.083
Y	0.973	1.273	0.038	0.050

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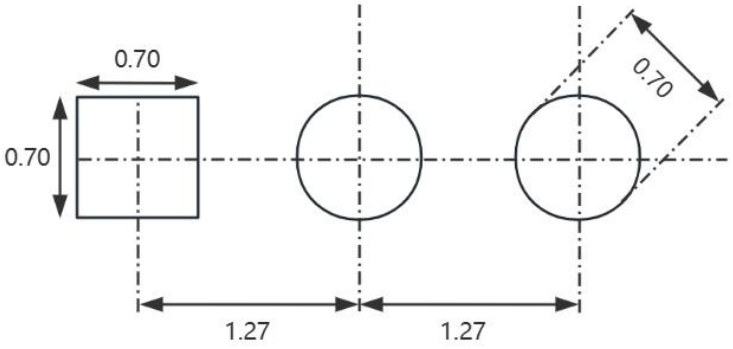
11 Recommended Soldering Footprint

11.1 SOT23-3L



DIMENSIONS : MILLIMETERS

11.2 TO-92S



DIMENSIONS : MILLIMETERS

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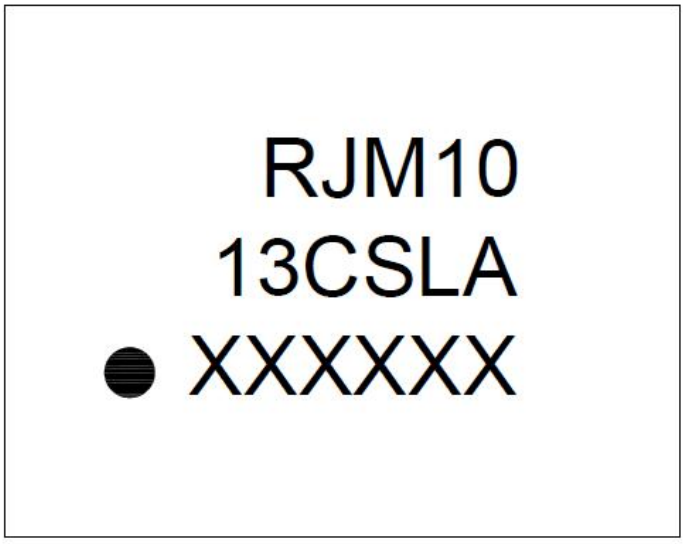
12 PrintForm Information

12.1 RJM1023



Line1: Part number, fixed
Line2: 3-digit Date Code&2 bit flow code

12.2 RJM1013

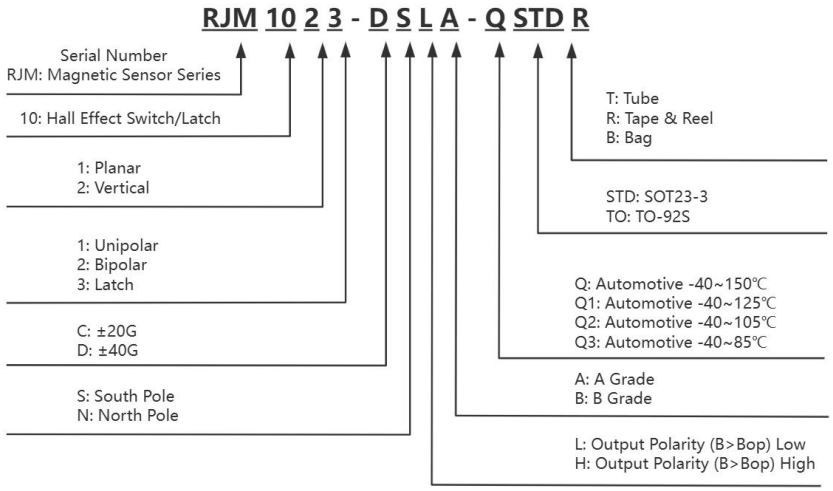


Line1, 2: Part number, fixed
Line3: 4-digit Date Code&2 bit flow code

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13 Order Information

Orderable Device	Field	BOP/BRP	Package Type	Package Qty
RJM1013-CSLA-QTOB	Planar	±20G	TO-92S	500
RJM1023-DSLA-QSTDR	Vertical	±40G	SOT23-3L	3000



14 Revision history

Revision	Description	Date
0.1	Initial version	2026/03
0.2	Modify the package information of TO92S : the maximum and minimum of symbol D、E、L; Modify the part number and order information of RJM1013; Modify the typical B_{OP}/B_{RP} threshold of RJM1023;	2026/08

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