

## Integrated Bipolar TMR Digital Latches

### FEATURES AND BENEFITS

- Sensitivity with  $B_{OP}$  as low as 10 G
- Ultra-low power consumption:  $\sim 2.4 \mu A @ V_{DD} = 3.3 V$  and  $f_S = 500 Hz$
- Supply voltage range: 1.7 V to 5.5 V
- Sensor polarity: bipolar
- Digital CMOS outputs:
  - Push-pull
- Undervoltage lockout (UVLO)
- 3-lead SOT23 package

### APPLICATIONS

- IoT devices
- Smartphones, tablets, and laptops
- Door or lid closure
- Reed switch replacement
- Tamper-proofing for utility smart meters
- Fluid level sensing/detection
- Proximity detection
- Motor controllers
- Gimbals for camera systems in drones/UAVs
- Industrial machinery/robots
- Medical devices

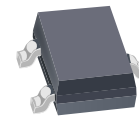
### DESCRIPTION

The CT812x series of bipolar tunnel magnetoresistance (TMR) digital latches are designed for consumer and industrial applications. The devices are based on Allegro patented XtremeSense™ TMR technology with integrated CMOS process to provide a monolithic solution for superior sensing performance. The CT812x digital latches offer stable magnetic operation over the operating temperature range.

This product family has very low power consumption—as low as  $2.2 \mu A$ —which is ideal for battery-operated products where minimal current consumption is required. The devices support magnetic fields down to 10 G for applications where there is a large air gap requirement.

The CT812x is available in an industry-standard 3-lead SOT-23 package to support high-volume manufacturing for industrial markets.

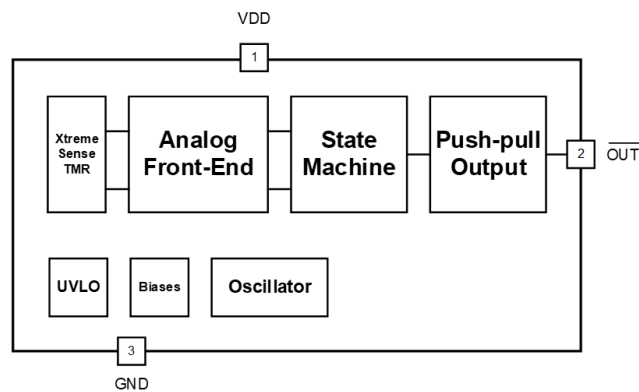
### PACKAGE:



3-lead SOT-23

*Not to scale*

### FUNCTIONAL BLOCK DIAGRAM



**Figure 1: CT8122 with Push-Pull Output Block Diagram for 3-Lead SOT23 Package**

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## SELECTION GUIDE

Part Number	Operating Temp. Range (°C)	Sensor Type	Output	B <sub>OP</sub> (G)	B <sub>RP</sub> (G)	f <sub>s</sub>	Package	Packing
CT8122AN-IS3	-40 to 85	Bipolar	Push-Pull	+10	-10	500 Hz	3-lead SOT23	Tape and Reel
CT8122AN-HS3	-40 to 125							
CT8122AM-IS3	-40 to 85	Bipolar	Push-Pull	+10	-10	2.5 kHz	3-lead SOT23	Tape and Reel
CT8122AM-HS3	-40 to 125							

## ABSOLUTE MAXIMUM RATINGS [1]

Characteristic	Symbol	Notes	Rating	Unit
Supply Voltage	$V_{DD}$		-0.3 to 6.0	V
Push-Pull Output (Active Low)	$V_{OUT\_PP}$		-0.3 to $V_{DD} + 0.3$ [2]	V
Open Drain Output (Active Low)	$V_{OUT\_OD}$		-0.3 to 6.0	V
Analog Input/Output Pins Maximum Voltage	$V_{I/O}$		-0.3 to $V_{DD} + 0.3$ [2]	V
Input and Output Current	$I_{IN}, I_{OUT}$		$\pm 20.0$	mA
Maximum External Magnetic Field	$B_{MAX}$	$T_A = 25^\circ\text{C}$	$\pm 600$	G
Electrostatic Discharge Protection Level	ESD	Human Body Model (HBM) per JESD22-A114	$\pm 4.0$ (min)	kV
		Charged Device Model (CDM) per JESD22-C101	$\pm 0.5$ (min)	kV
Junction Temperature	$T_J$		-40 to 150	$^\circ\text{C}$
Storage Temperature	$T_{STG}$		-65 to 150	$^\circ\text{C}$
Lead Soldering Temperature	$T_L$	10 seconds	260	$^\circ\text{C}$

[1] Stresses exceeding the absolute maximum ratings may damage the CT812x and may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Allegro does not recommend exceeding or designing to absolute maximum ratings

[2] The lower of  $V_{DD} + 0.3$  V or 6.0 V.

## RECOMMENDED OPERATING CONDITIONS [1]

Characteristic	Symbol	Notes	Min.	Typ.	Max.	Unit
Supply Voltage Range	$V_{DD}$		1.7	3.3	5.5	V
Output Voltage Range	$V_{OUT}$		0	-	$V_{DD}$	V
Operating Magnetic Flux	$B_{OP}$		-	-	300	G
Output Current	$I_{OUT}$		-	-	$\pm 3.0$	mA
Bypass Capacitor	$C_{BYP}$		-	1.0	-	$\mu\text{F}$
Operating Ambient Temperature	$T_A$	Industrial	-40	25	85	$^\circ\text{C}$
		Extended Industrial	-40	25	125	$^\circ\text{C}$

[1] The Recommended Operating Conditions table defines the conditions for actual operation of the CT812x. Recommended operating conditions are specified to ensure optimal performance to the specifications. Allegro does not recommend exceeding them or designing to absolute maximum ratings.

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Value	Unit
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$	Junction-to-ambient thermal resistance is a function of application and board layout and is determined in accordance to JEDEC standard JESD51 for a four (4) layer 2s2p FR-4 printed circuit board (PCB) with 2 oz. of copper (Cu) and 4 oz. of copper (Cu) or more for 65 A. Special attention must be paid not to exceed junction temperature $T_{J(MAX)}$ at a given ambient temperature $T_A$ .	202	$^\circ\text{C/W}$

PINOUT DIAGRAM AND TERMINAL LIST

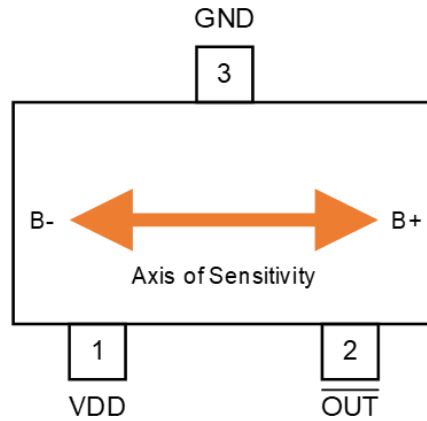


Figure 2: CT812x 3-Lead SOT23 Package for Digital Output (Top-Down View)

Terminal List

Number	Name	Function
1	VDD	Supply Voltage
2	$\overline{\text{OUT}}$	Output Signal (Active Low)
3	GND	Ground

**ELECTRICAL CHARACTERISTICS:** Valid for  $V_{DD} = 1.7$  to  $5.5$  V,  $C_{BYP} = 1.0$   $\mu$ F, and  $T_A = -40^\circ$ C to  $125^\circ$ C, typical values are  $V_{DD} = 3.3$  V and  $T_A = 25^\circ$ C, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>PUSH-PULL OUTPUT</b>						
Output Voltage High $\overline{OUT}$ [1]	$V_{OH}$		$0.9 \times V_{DD}$	–	–	V
Output Voltage Low $\overline{OUT}$ [1]	$V_{OL}$		–	–	$0.1 \times V_{DD}$	V
$\overline{OUT}$ Current [1]	$I_{OUT}$		–	$\pm 2.0$	–	mA
<b>TIMINGS</b>						
Power-On Time [1]	$t_{ON}$	$V_{DD} \geq 1.7$ V	–	50	75	$\mu$ s
Active Mode Time [1]	$t_{ACTIVE}$		–	2.6	–	$\mu$ s
<b>PROTECTION</b>						
Undervoltage Lockout [1]	$V_{UVLO}$	Rising $V_{DD}$	–	1.60	1.64	V
		Falling $V_{DD}$	1.44	1.53	–	V
UVLO Hysteresis [1]	$V_{UV\_HYS}$		–	70	–	mV

[1] Guaranteed by design and characterization; not tested in production.

## TYPICAL TIMING CHARACTERISTICS

$V_{DD} = 3.3$  V,  $T_A = 25^\circ$ C, and  $C_{BYP} = 1.0$   $\mu$ F (unless otherwise specified)

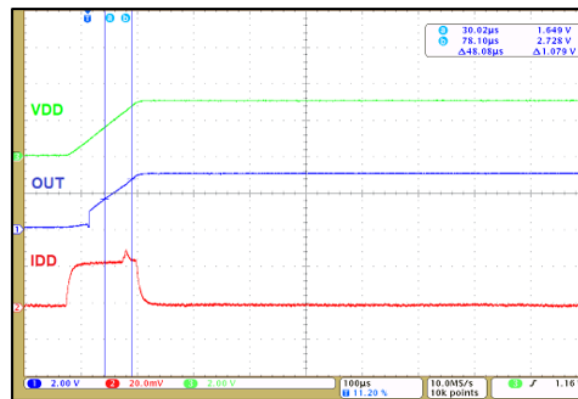


Figure 3: Power-On Time for Push-Pull Output

**CT8122AN – ELECTRICAL CHARACTERISTICS and MAGNETIC SPECIFICATIONS:** Unless otherwise specified, valid for  $V_{DD} = 1.7$  to  $5.5$  V,  $C_{BYP} = 1.0$   $\mu$ F, and  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$ , typical values are  $V_{DD} = 3.3$  V and  $T_A = 25^\circ\text{C}$

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Average Supply Current	$I_{DD(AVG)}$	$t \geq 10$ seconds	–	2.4	4.0	$\mu$ A
	$I_{DD(AVG)\_1.8V}$	$t \geq 10$ seconds, $V_{DD} = 1.8$ V	–	2.2	2.8	$\mu$ A
Sampling Frequency	$f_S$		300	500	700	Hz
Idle Mode Time	$t_{IDLE}$	$f_S = 500$ Hz	1.4	2.0	3.3	ms
Operate Point, B+	$B_{OPS}$		7	10	13	G
Release Point, B–	$B_{RPN}$		–13	–10	–7	G

**CT8122AM – ELECTRICAL CHARACTERISTICS and MAGNETIC SPECIFICATIONS:** Unless otherwise specified, valid for  $V_{DD} = 1.7$  to  $5.5$  V,  $C_{BYP} = 1.0$   $\mu$ F, and  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$ , typical values are  $V_{DD} = 3.3$  V and  $T_A = 25^\circ\text{C}$

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Average Supply Current	$I_{DD(AVG)}$	$t \geq 10$ seconds	–	11.5	15.0	$\mu$ A
	$I_{DD(AVG)\_1.8V}$	$t \geq 10$ seconds, $V_{DD} = 1.8$ V	–	10.5	12.0	$\mu$ A
Sampling Frequency	$f_S$		1.5	2.5	3.5	kHz
Idle Mode Time	$t_{IDLE}$	$f_S = 2.5$ kHz	285	400	667	$\mu$ s
Operate Point, B+	$B_{OPS}$		7	10	13	G
Release Point, B–	$B_{RPN}$		–13	–10	–7	G

## TYPICAL MAGNETIC CHARACTERISTICS FOR CT8122Ax

$V_{DD} = 3.3$  V,  $T_A = 25^\circ\text{C}$ , and  $C_{BYP} = 1.0$   $\mu$ F (unless otherwise specified)

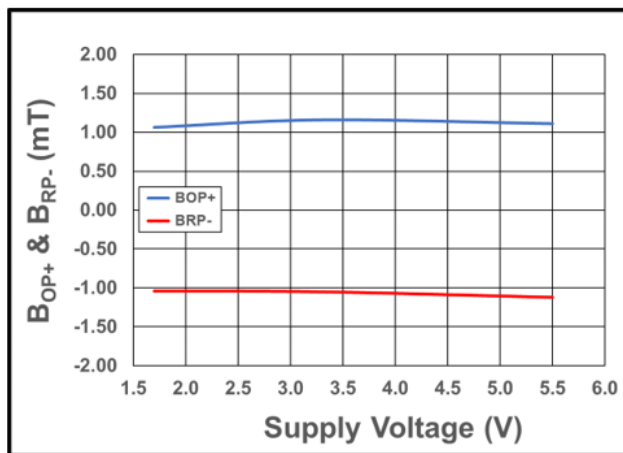


Figure 4:  $B_{OP}$  (Blue) and  $B_{RP}$  (Red) vs. Supply Voltage at  $T_A = 25^\circ\text{C}$

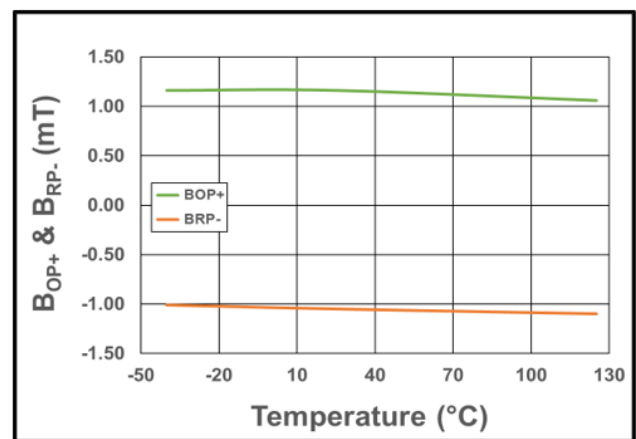


Figure 5:  $B_{OP}$  (Green) and  $B_{RP}$  (Orange) vs. Temperature at  $V_{DD} = 3.3$  V

**TYPICAL ELECTRICAL CHARACTERISTICS FOR CT8122AN**

$V_{DD} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , and  $C_{BYP} = 1.0\ \mu\text{F}$  (unless otherwise specified)

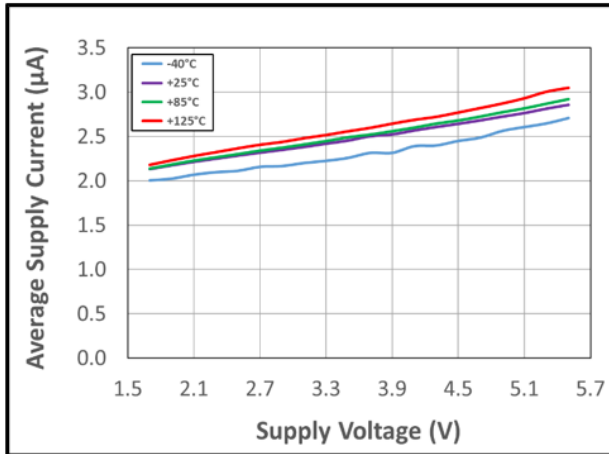


Figure 6: Average Supply Current vs. Supply Voltage vs. Temperature

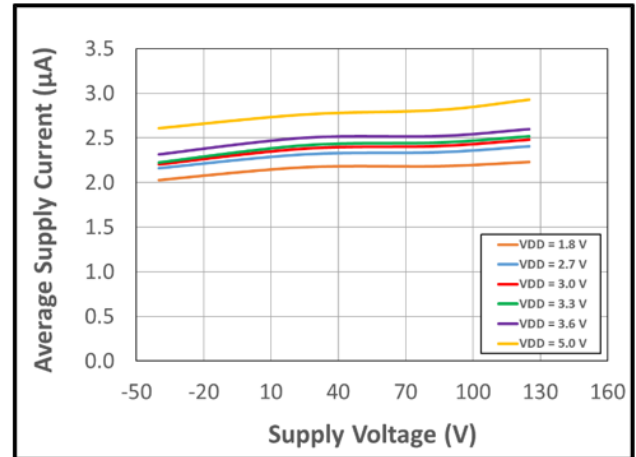


Figure 7: Average Supply Current vs. Temperature vs. Supply Voltage

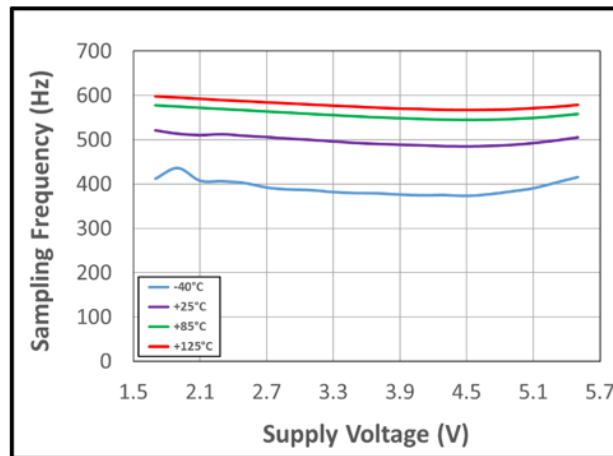


Figure 8: Sampling Frequency vs. Supply Voltage vs. Temperature

**TYPICAL ELECTRICAL CHARACTERISTICS FOR CT8122AM**

$V_{DD} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , and  $C_{BYP} = 1.0\ \mu\text{F}$  (unless otherwise specified)

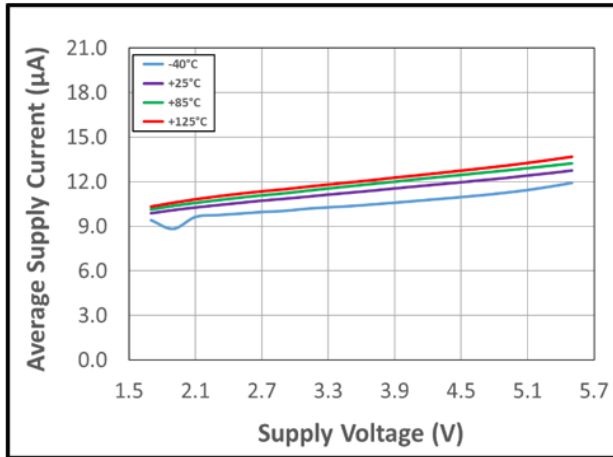


Figure 9: Average Supply Current vs. Supply Voltage vs. Temperature

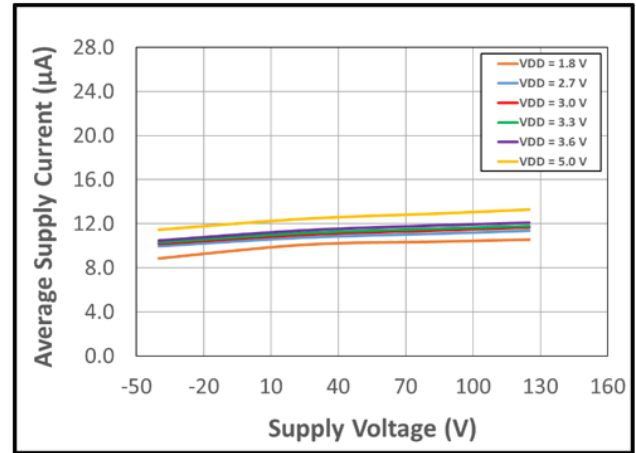


Figure 10: Average Supply Current vs. Temperature vs. Supply Voltage

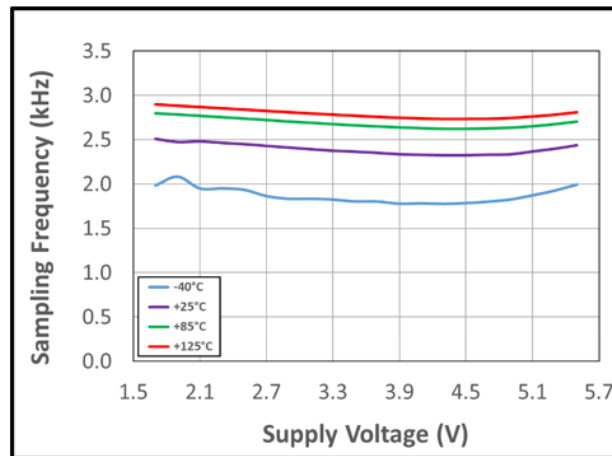


Figure 11: Sampling Frequency vs. Supply Voltage vs. Temperature



## FUNCTIONAL DESCRIPTION

### Overview

The CT812x is a product family of bipolar TMR magnetic latches that supports a wide operating voltage range of 1.7 to 5.5 V and is capable of providing a digital push-pull output. These bipolar TMR digital latches are designed to consume a minimal amount of current which is ideal for battery-operated products. It also supports a wide range of sensitivity levels for various applications.

### Undervoltage Lockout (UVLO)

The Undervoltage Lockout protection circuitry of the CT812x is activated when the supply voltage ( $V_{DD}$ ) falls below 1.53 V. The CT812x remains in a low quiescent state and the  $\overline{OUT}$  output is not valid until  $V_{DD}$  rises above the UVLO threshold (1.60 V).

### Power-On Time ( $t_{ON}$ )

The Power-On Time ( $t_{ON}$ ) of 50  $\mu s$  is the amount of time required by the CT812x to start up, power-on, and acquire the first sample. The chip is fully powered up and operational from the moment the supply voltage passes the rising UVLO point (1.60 V). This time includes the ramp-up time and the settling time (within 10% of steady-state voltage under an applied magnetic field) after the power supply have reach the minimum  $V_{DD}$ .

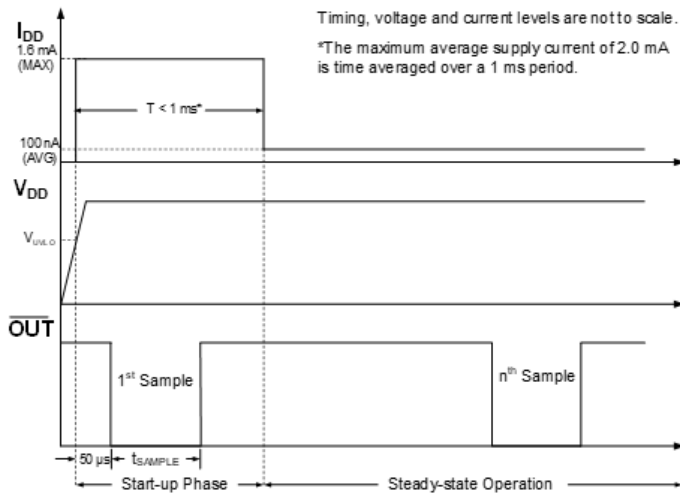


Figure 12: CT812x Power-On Timing Diagram

### Bipolar Magnetic Flux

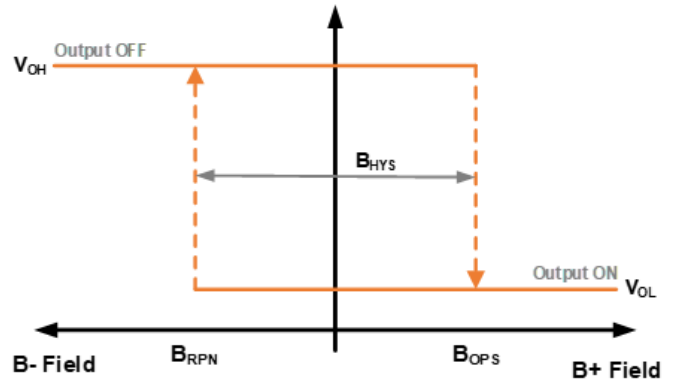


Figure 13: CT812x Output Behavior vs. Magnetic Field

Table 1: CT8121 Output Behavior

Magnetic Field	Condition	Output
Positive Field	$B > B_{OPS}$	Low (ON)
Negative Field	$B < B_{OPN}$	High (OFF)

**APPLICATIONS INFORMATION**

The CT812x products require a 1.0  $\mu\text{F}$  (ceramic) bypass capacitor to be connected between the supply voltage and ground.

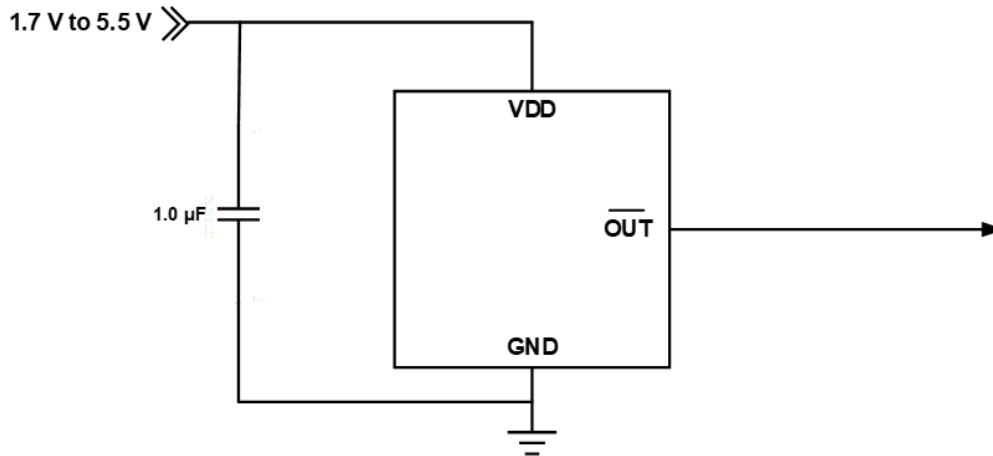
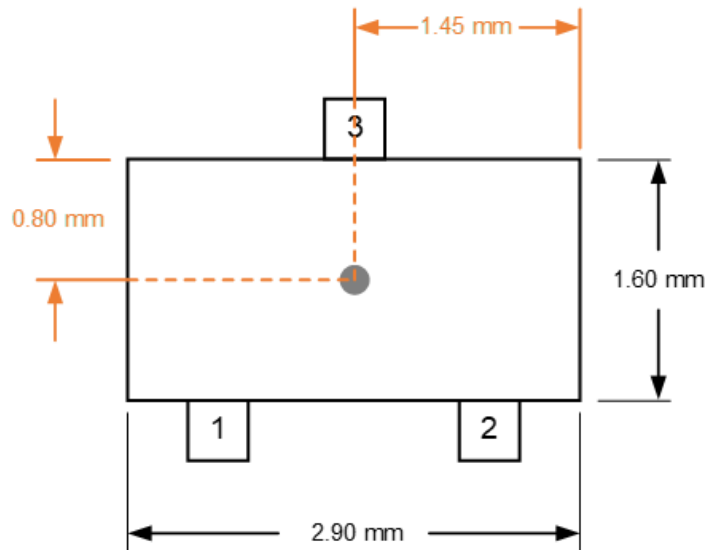


Figure 14: CT8121 Application Block Diagram

**XtremeSense TMR Current Sensor Location**

The XtremeSense TMR sensor location for the CT812x products are shown in Figure 15. The dimensions shown are typical values.



**Figure 15: XtremeSense TMR Sensor Location for CT812x products in 3-lead SOT23 Package**

## PACKAGE OUTLINE DRAWING

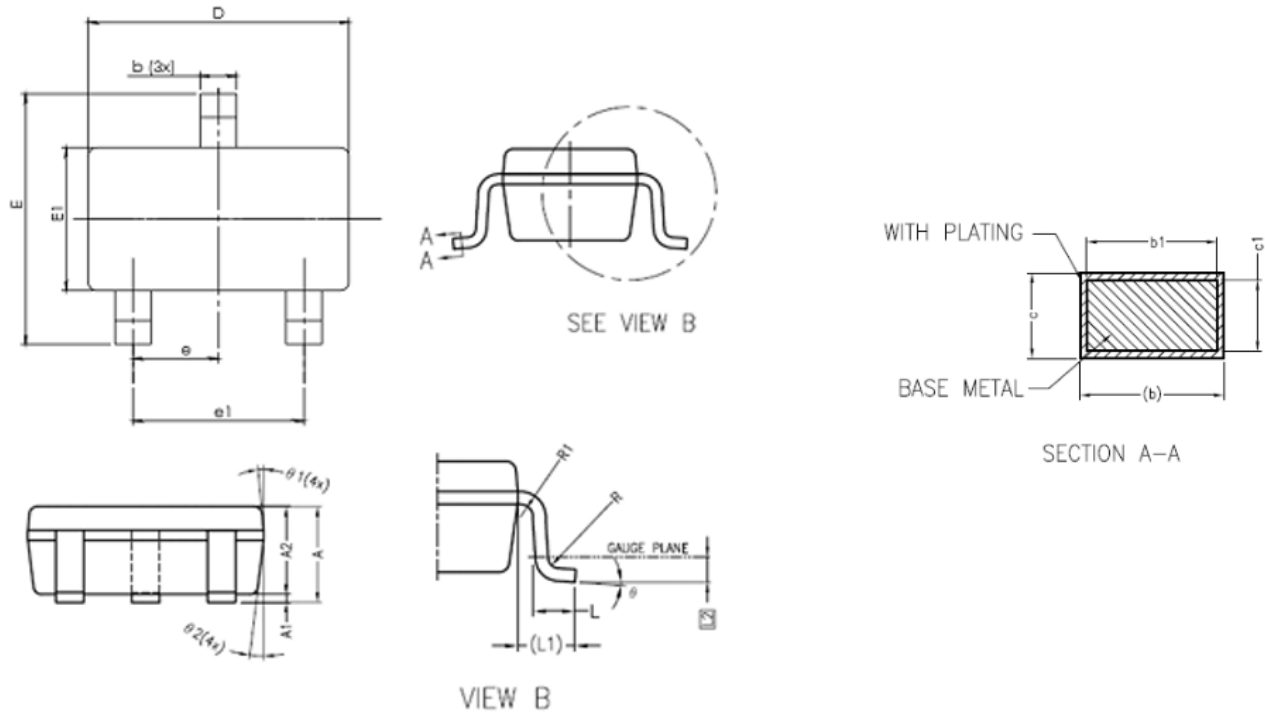


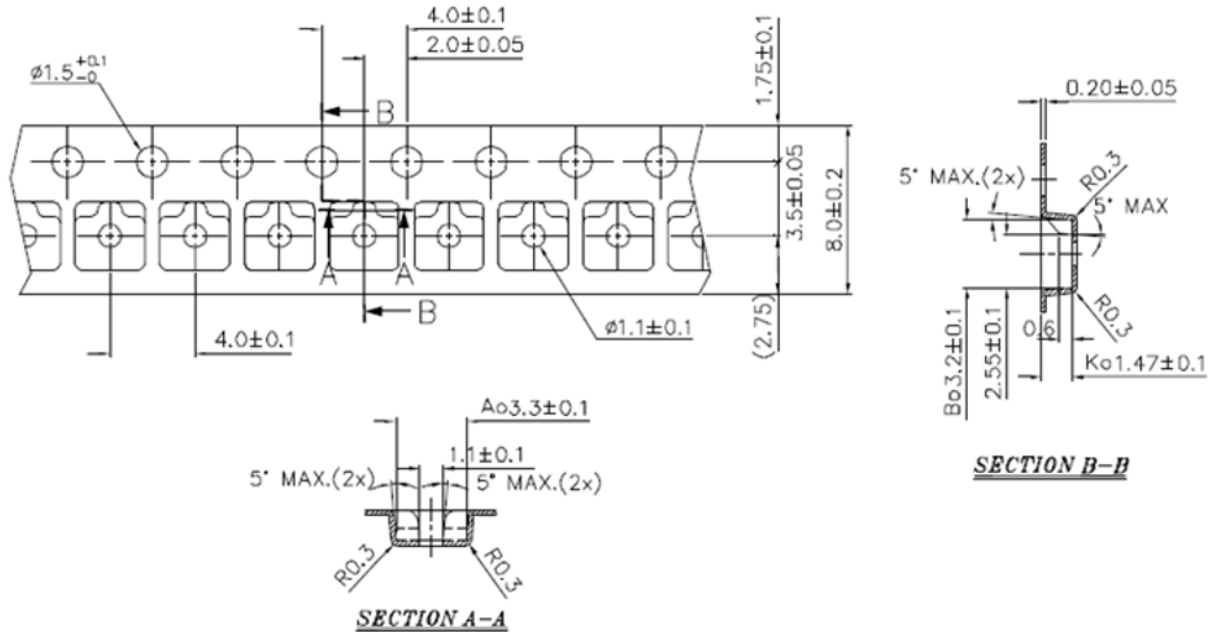
Figure 16: 3-Lead SOT23 Package Drawing

Table 2: CT812x 3-Lead SOT23 Package Dimensions

Symbol	Dimensions in Millimeters (mm)		
	Min.	Typ.	Max.
A	1.05	1.20	1.35
A1	0.00	0.10	0.15
A2	1.00	1.10	1.20
b	0.30	—	0.50
b1	0.30	0.35	0.45
c	0.08	—	0.22
c1	0.08	0.13	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70

Symbol	Dimensions in Millimeters (mm)		
	Min.	Typ.	Max.
e	0.95 BSC		
e1	1.90 BSC		
L	0.35	0.43	0.60
L1	0.50 REF		
L2	0.25 BSC		
R	0.10	—	—
R1	0.10	—	0.25
θ	0°	4°	8°
θ1	5°	6°	15°
θ2	5°	8°	15°

TAPE AND REEL POCKET DRAWING AND DIMENSIONS



NOTES:

1. Material: Conductive Polystyrene.
2. Dimensions in mm.
3. 10 sprocket hole pitch cumulative tolerance  $\pm 0.20$  mm.
4. Camber not to exceed 1 mm in 100 mm.
5. Pocket position relative to sprocket hole measured as true position of pocket and not pocket hole.
6. (S.R.  $\Omega/\text{sq}$ ) means surface electric resistivity of the carrier tape.

Figure 17: Tape and Pocket Drawing for 3-lead SOT23 Package

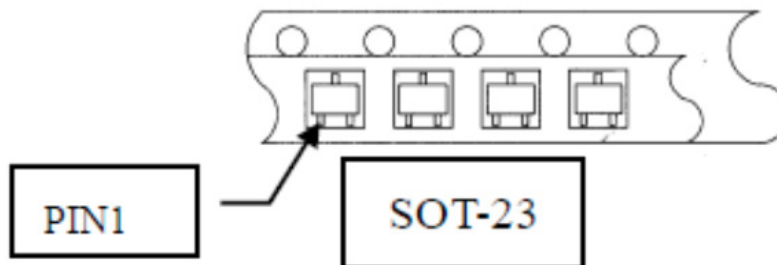


Figure 18: SOT23 Orientation in Tape Pocket

## PACKAGE INFORMATION

**Table 3: CT812x Package Information**

Part Number	Package Type	# of Leads	Package Quantity	Lead Finish	Eco Plan [1]	MSL Rating [2]	Operating Temperature (°C) [3]	Device Marking [4]
CT8122AN-IS3	SOT23	3	3000	Sn	Green & RoHS	1	-40 to 85	MS YWWS
CT8122AN-HS3	SOT23	3	3000	Sn	Green & RoHS	1	-40 to 125	MS YWWS
CT8122AM-IS3	SOT23	3	3000	Sn	Green & RoHS	1	-40 to 85	MR YWWS
CT8122AM-HS3	SOT23	3	3000	Sn	Green & RoHS	1	-40 to 125	MR YWWS

[1] RoHS is defined as semiconductor products that are compliant to the current EU RoHS requirements. It also will meet the requirement that RoHS substances do not exceed 0.1% by weight in homogeneous materials. Green is defined as the content of chlorine (Cl), bromine (Br), and antimony trioxide based flame retardants satisfy JS709B low halogen requirements of  $\leq 1,000$  ppm.

[2] MSL Rating = Moisture Sensitivity Level Rating as defined by JEDEC standard classifications.

[3] Package will withstand ambient temperature range of  $-40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$  and storage temperature range of  $-65^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ .

[4] Device Marking for SOT23 is defined as XZ YWWS where XZ = part number, Y = year, WW = work week, and S = sequential number.

## Revision History

Number	Date	Description
2	December 11, 2023	Document rebranded and minor editorial updates

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