CROCUS TECHNOLOGY
Intelligence in Sensing™

CT812x

Integrated Bipolar TMR Digital Latches

Features

- Sensitivity with B_{OP} Range as low as 1.0 mT
- Ultra-low Power Consumption: ~2.4 µA @ 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
- Under-Voltage Lockout (UVLO)
- Package Options:
  - 3-Lead SOT23

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

Product Description

The CT812x series of bipolar Tunnel Magneto-resistance (TMR) digital latches are designed for consumer and industrial applications. It is based on Crocus Technology's 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 µA which is ideal for battery-operated products where minimal current consumption is required. It supports magnetic fields down to +1.0 mT for applications where there is a large air gap requirement.

For applications that require a very small form factor and low profile, the CT812x is assembled in an industry standard package 3-lead SOT-23 to support high volume manufacturing for industrial markets.

Ordering Information

Part Number	Operating Temperature Range	Sensor Type	Output	B_{OP} (mT)	B_{RP} (mT)	f_S	Package	Packing Method
CT8122AN-IS3	-40°C to +85°C	Bipolar	Push-pull	+1.0	-1.0	500 Hz	3-lead SOT23	Tape & Reel
CT8122AN-HS3	-40°C to +125°C							
CT8122AM-IS3	-40°C to +85°C	Bipolar	Push-pull	+1.0	-1.0	2.5 kHz	3-lead SOT23	Tape & Reel
CT8122AM-HS3	-40°C to +125°C							

Block Diagram

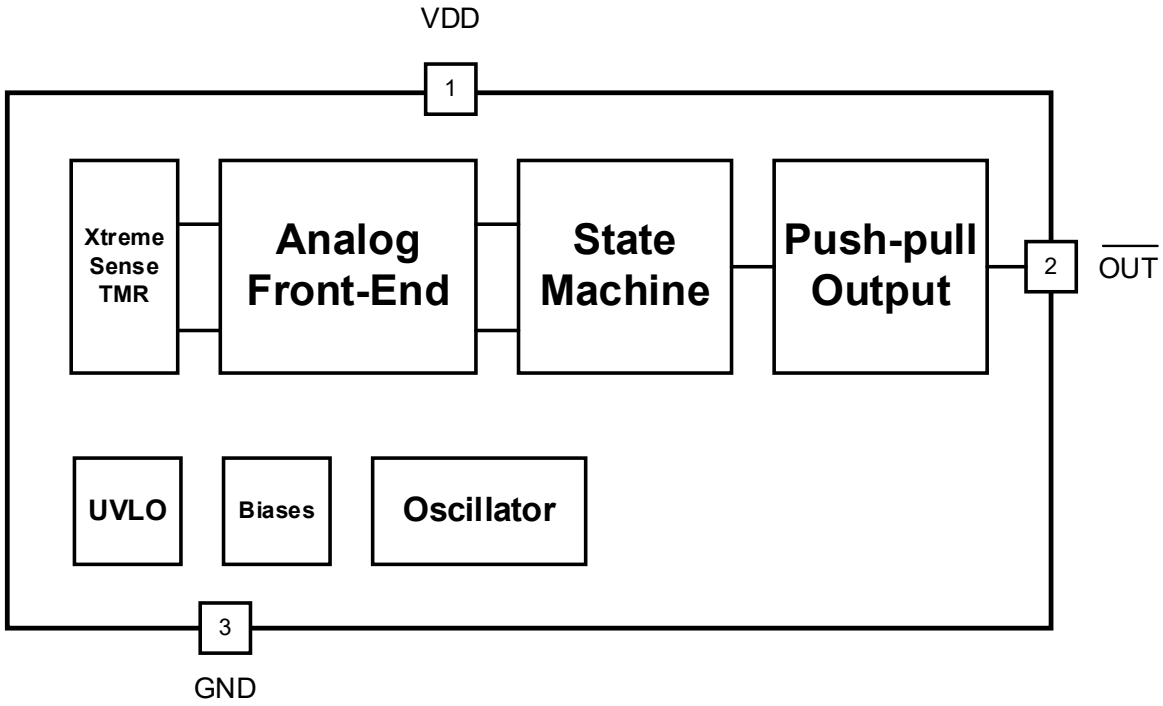


Figure 1. CT8122 with Push-pull Output Block Diagram for 3-lead SOT23 Package

SOT23 Pin Configuration

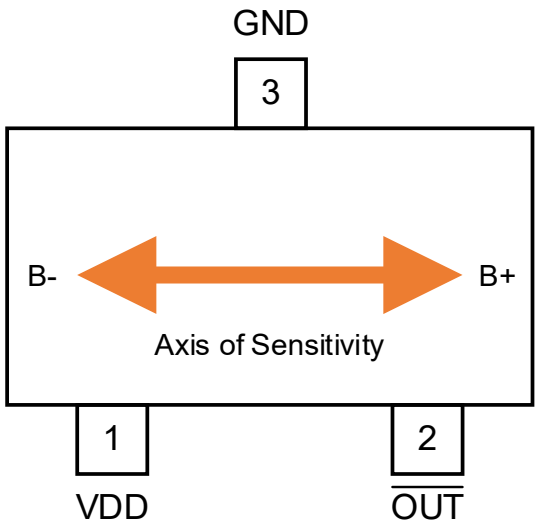


Figure 2. CT812x: 3-Lead SOT23 Package for Digital Output

Pin Definitions

Pin #	Pin Name	Pin Description
1	VDD	Supply Voltage
2	$\overline{\text{OUT}}$	Output Signal (Active LOW)
3	GND	Ground

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the CT812x. The CT812x products 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. Crocus Technology does not recommend exceeding or designing to absolute maximum ratings.

Symbol	Parameter		Min.	Max.	Unit
V_{DD}	Supply Voltage		-0.3	6.0	V
V_{OUT_PP}	Push-pull Output (Active LOW)		-0.3	V_{DD} + 0.3*	V
V_{OUT_OD}	Open Drain Output (Active LOW)		-0.3	6.0	V
$V_{I/O}$	Input/Output Pins Maximum Voltage		-0.3	V_{DD} + 0.3*	V
I_{IN} / I_{OUT}	Input and Output Current			±20.0	mA
B_{MAX}	Maximum External Magnetic Field @ T_A = +25°C			±60	mT
ESD	Electrostatic Discharge Protection Level	Human Body Model (HBM) per JESD22-A114	±4.0		kV
		Charged Device Model (CDM) per JESD22-C101	±0.5		
T_J	Junction Temperature		-40	+150	°C
T_{STG}	Storage Temperature		-65	+150	°C
T_L	Lead Soldering Temperature, 10 Seconds			+260	°C

*The lower of V_{DD} + 0.3 V or 6.0 V.

Recommended Operating Conditions

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. Crocus Technology does not recommend exceeding or designing to absolute maximum ratings.

Symbol	Parameter		Min.	Typ.	Max.	Unit
V_{DD}	Supply Voltage Range		1.7	3.3	5.5	V
V_{OUT}	OUT Voltage Range		0		V_{DD}	V
B_{OP}	Operating Magnetic Flux				30	mT
I_{OUT}	OUT Current				±3.0	mA
C_{BYP}	Bypass Capacitor			1.0		µF
T_A	Operating Ambient Temperature	Industrial	-40	+25	+85	°C
		Extended Industrial	-40	+25	+125	

Thermal Properties

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). Special attention must be paid to not exceed junction temperature $T_{J(MAX)}$ at a given ambient temperature T_A.

Symbol	Parameter	Min.	Typ.	Max.	Unit
θ_{JA}	Junction-to-Ambient Thermal Resistance, SOT23-3		202		°C/W

Electrical Specifications

General Parameters

Unless otherwise specified: V_{DD} = 1.7 V to 5.5 V, C_{BYP} = 1.0 µF and T_A = -40°C to +125°C. Typical values are V_{DD} = 3.3 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Push-pull Output						
V_{OH}	Output Voltage High $\overline{OUT}$ (1)		0.9 × V_{DD}			V
V_{OL}	Output Voltage LOW $\overline{OUT}$ (1)				0.1 × V_{DD}	V
I_{OUT}	Current for $\overline{OUT}$ (1)			±2.0		mA
Timings						
t_{ON}	Power-On Time (1)	V_{DD} ≥ 1.7 V		50	75	µs
t_{ACTIVE}	Active Mode Time (1)			2.6		µs
Protection						
V_{UVLO}	Under-Voltage Lockout (1)	Rising V_{DD}		1.60	1.64	V
		Falling V_{DD}	1.44	1.53		V
V_{UV_HYS}	UVLO Hysteresis (1)			70		mV

(1) Guaranteed by design and characterization; not tested in production.

Typical Timing Characteristics

V_{DD} = 3.3 V, T_A = +25°C and C_{BYP} = 1.0 µF (unless otherwise specified)

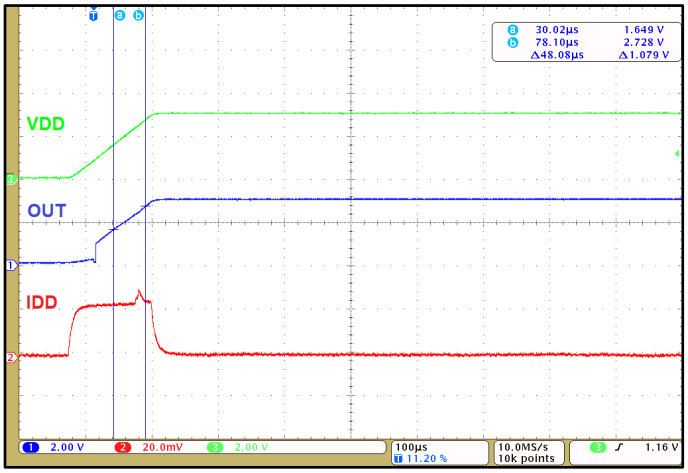


Figure 3. Power-On Time for Push-pull Output

CT8122AN Electrical & Magnetic Specifications

Unless otherwise specified: V_{DD} = 1.7 V to 5.5 V, C_{BYP} = 1.0 µF and T_A = -40°C to +125°C. Typical values are V_{DD} = 3.3 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$I_{DD(AVG)}$	Average Supply Current	t ≥ 10 s		2.4	4.0	µA
$I_{DD(AVG)\_1.8V}$	Average Supply Current @ V_{DD} = 1.8 V	t ≥ 10 s, V_{DD} = 1.8 V		2.2	2.8	µA
f_S	Sampling Frequency		300	500	700	Hz
t_{IDLE}	Idle Mode Time	f_S = 500 Hz	1.4	2.0	3.3	ms
B_{OPS}	Operate Point, B+		+0.7	+1.0	+1.3	mT
B_{RPN}	Release Point, B-		-1.3	-1.0	-0.7	mT

CT8122AM Electrical & Magnetic Specifications

Unless otherwise specified: V_{DD} = 1.7 V to 5.5 V, C_{BYP} = 1.0 µF and T_A = -40°C to +125°C. Typical values are V_{DD} = 3.3 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$I_{DD(AVG)}$	Average Supply Current	t ≥ 10 s		11.5	15.0	µA
$I_{DD(AVG)\_1.8V}$	Average Supply Current @ V_{DD} = 1.8 V	t ≥ 10 s, V_{DD} = 1.8 V		10.5	12.0	µA
f_S	Sampling Frequency		1.5	2.5	3.5	kHz
t_{IDLE}	Idle Mode Time	f_S = 2.5 kHz	285	400	667	µs
B_{OPS}	Operate Point, B+		+0.7	+1.0	+1.3	mT
B_{RPN}	Release Point, B-		-1.3	-1.0	-0.7	mT

Typical Magnetic Characteristics for CT8122Ax

V_{DD} = 3.3 V, T_A = +25°C and C_{BYP} = 1.0 µF (unless otherwise specified)

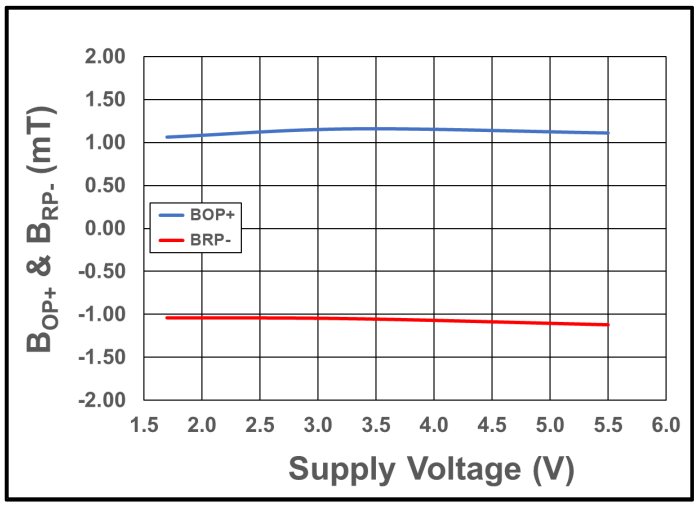


Figure 4. B_{OP+} (Blue) and B_{RP-} (Red) vs. Supply Voltage at T_A = +25°C

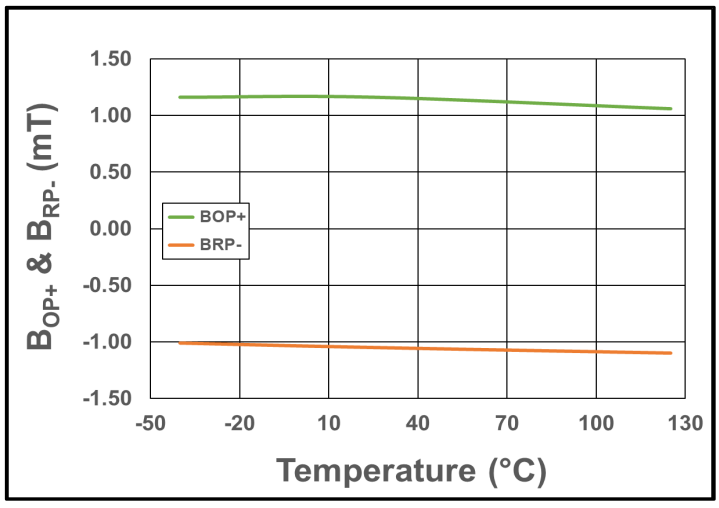


Figure 5. B_{OP+} (Green) and B_{RP-} (Orange) vs. Temperature at V_{DD} = 3.3 V.

Typical Electrical Characteristics for CT8122AN

V_{DD} = 3.3 V, T_A = +25°C and C_{BYP} = 1.0 µF (unless otherwise specified)

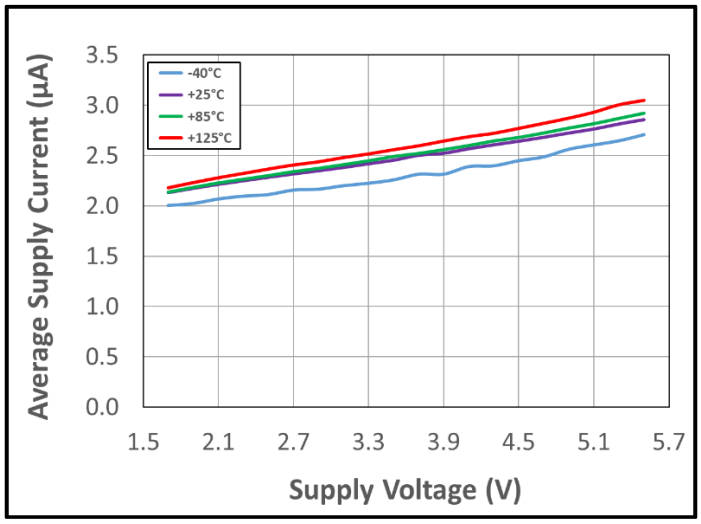


Figure 6. Average Supply Current vs. Supply Voltage vs. Temperature

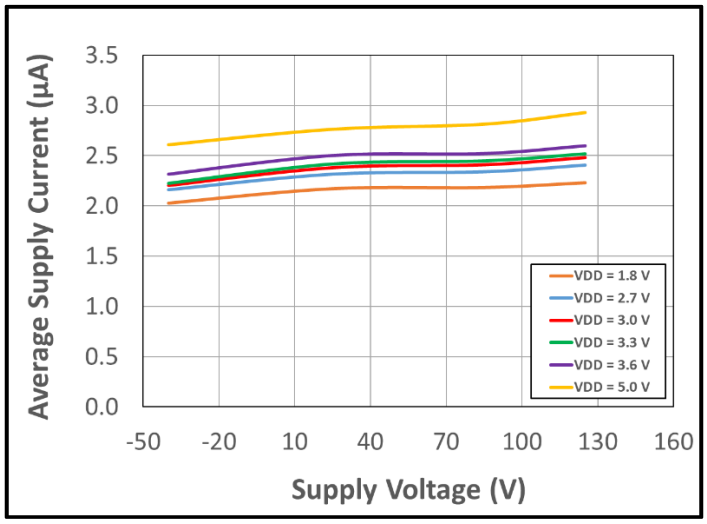


Figure 7. Average Supply Current vs. Temperature vs. Supply Voltage

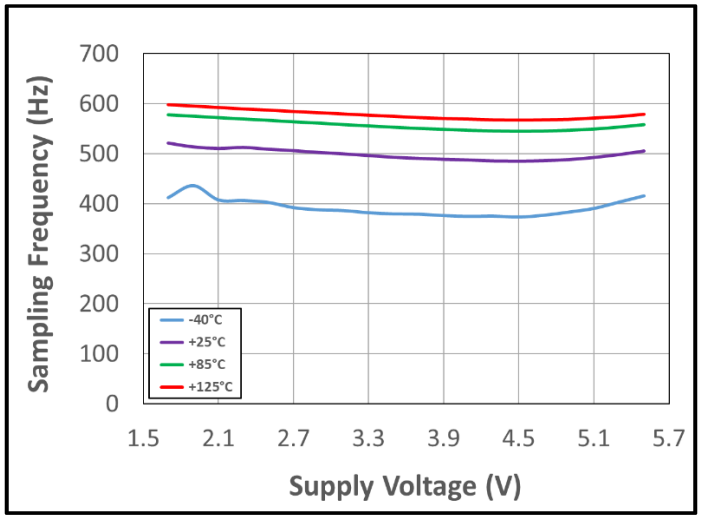


Figure 8. Sampling Frequency vs. Supply Voltage vs. Temperature

Typical Electrical Characteristics for CT8122AM

V_{DD} = 3.3 V, T_A = +25°C and C_{BYP} = 1.0 µF (unless otherwise specified)

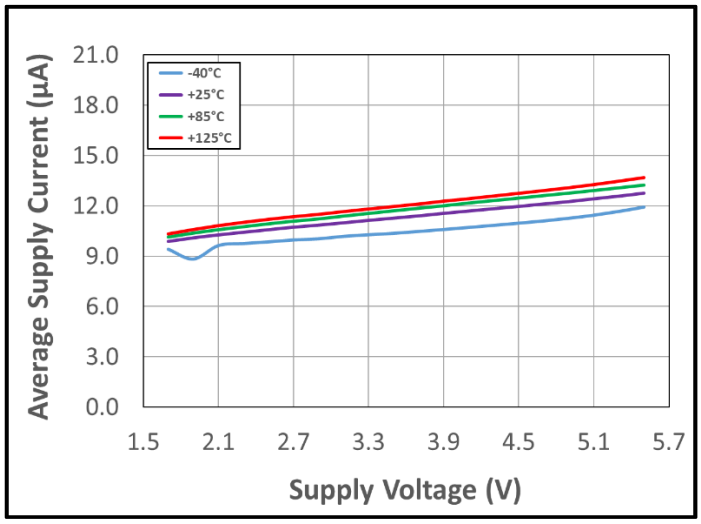


Figure 9. Average Supply Current vs. Supply Voltage vs. Temperature

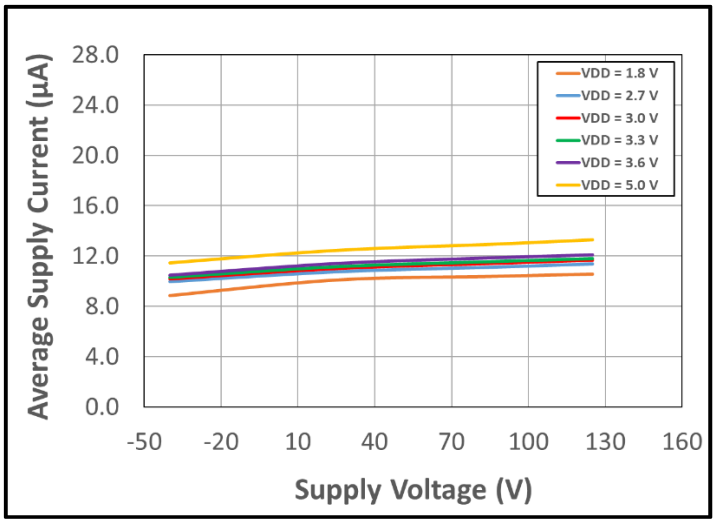


Figure 10. Average Supply Current vs. Temperature vs. Supply Voltage

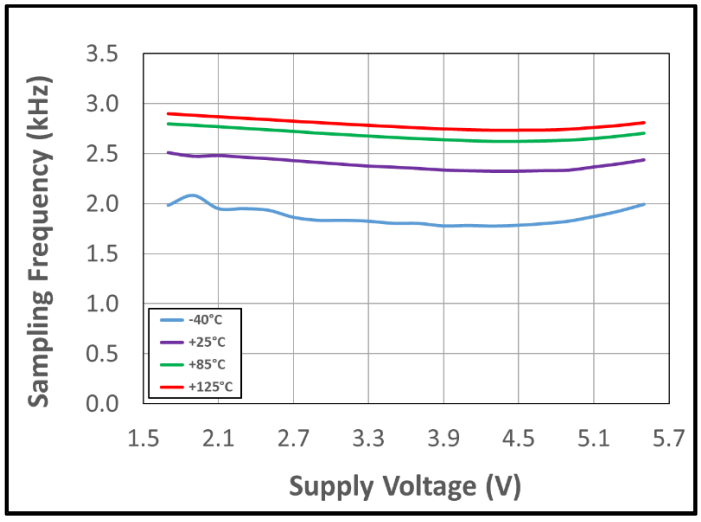


Figure 11. Sampling Frequency vs. Supply Voltage vs. Temperature

Circuit Description

Overview

The CT812x is a product family of bipolar TMR magnetic latches that supports a wide operating voltage range of 1.7 V to 5.5 V and is capable of providing two (2) digital output configurations: open drain or push-pull. 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.

Under-Voltage Lockout (UVLO)

The Under-Voltage Lock-out 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 µs 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}.

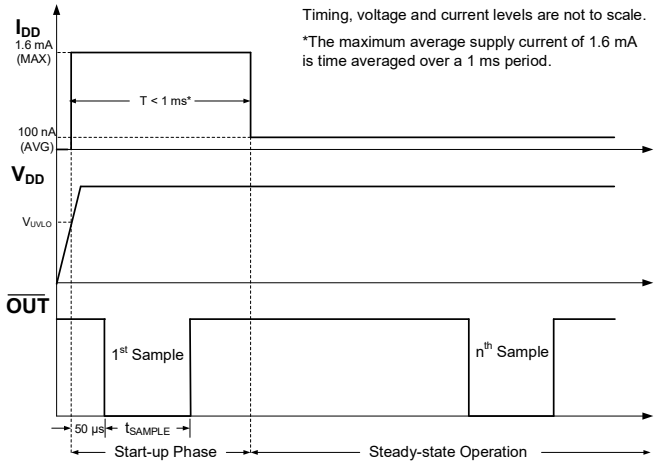


Figure 12. CT812x Power-On Timing Diagram

Bipolar Magnetic Flux

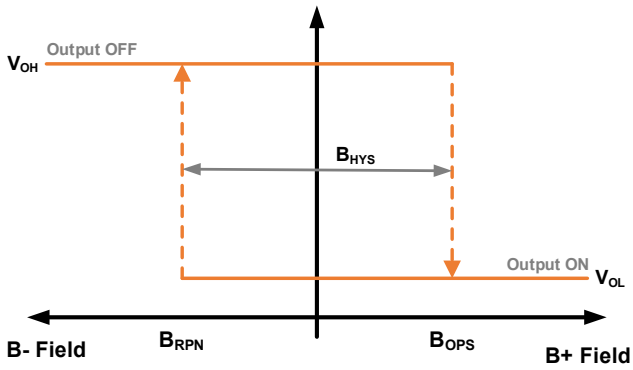


Figure 13. CT812x Output Behavior vs. Magnetic Field

Table 1. CT812x 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 µF (ceramic) bypass capacitor to be connected between the supply voltage and ground.

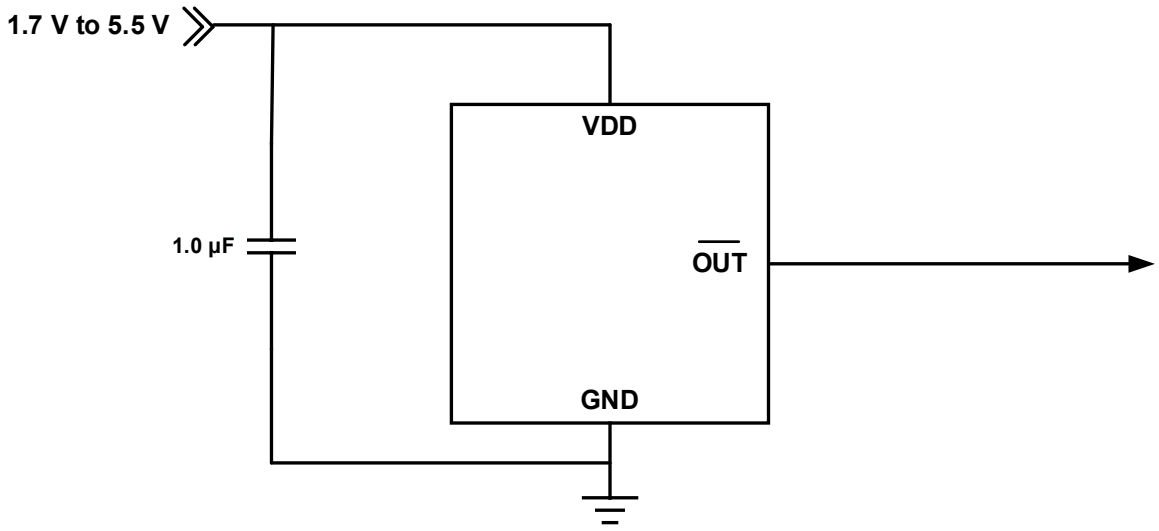


Figure 14. CT8122 Application Block Diagram

Applications Information

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

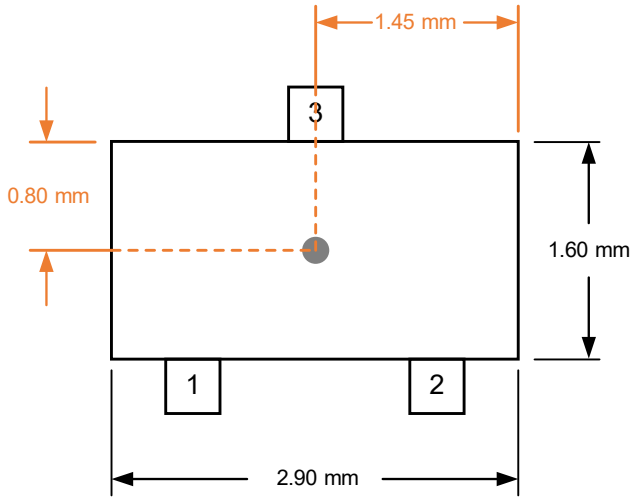


Figure 15. XtremeSense TMR Sensor Location for CT812x products in 3-lead SOT23 Package

SOT23-3 Package Drawing and Dimensions

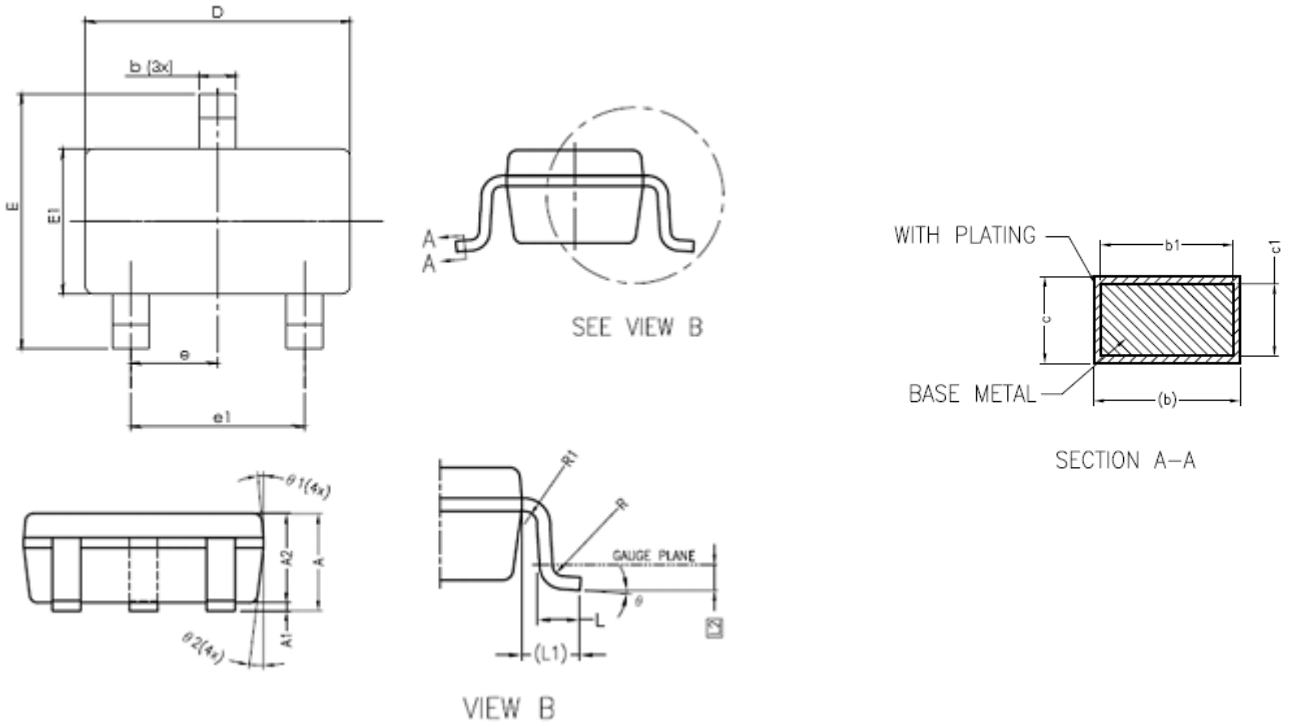


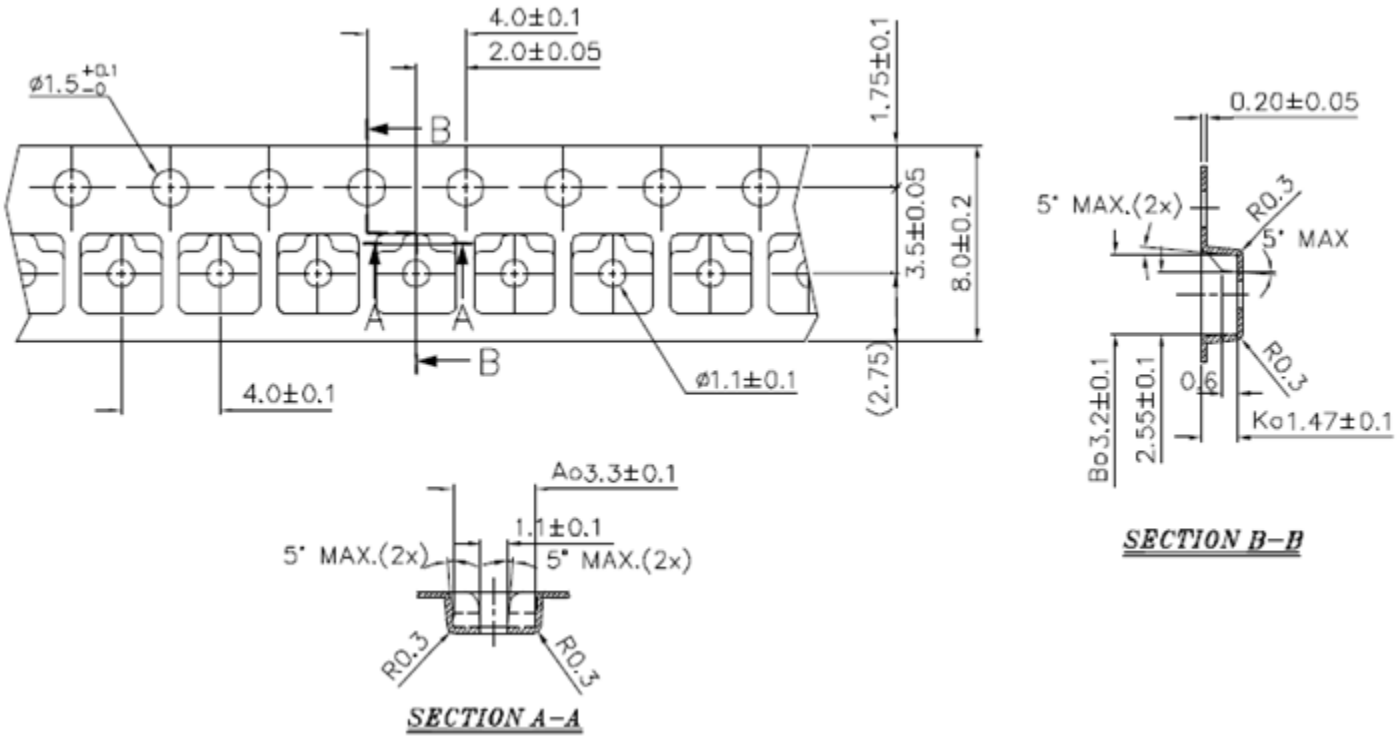
Figure 16. 3-Lead SOT23 Package Drawing

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
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°

Crocus Technology provides package drawings as a service to customers considering or planning to use Crocus products in their designs. Drawings may change without notice. Please note the revision and date of the data sheet and contact a Crocus Technology representative to verify or obtain the most recent version. The package specifications do not expand the terms of Crocus Technology's worldwide terms and conditions, specifically the warranty therein, which covers Crocus Technology's products.

SOT23 Tape & Pocket Drawing and Dimensions



NOTES:

1. Material: Conductive Polystyrene
2. Dimensions in mm.
3. 10 sprocket hole pitch cumulative tolerance ±0.20 mm.
4. Camber bot 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. Ω/sq) means surface electric resistivity of the carrier tape.

Figure 17. Tape and Pocket Drawing for SOT23 Package

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 (3)	Device Marking
CT8122AN-IS3	SOT23	3	3,000	Sn	Green & RoHS	1	-40°C to +85°C	MS YWWS
CT8122AN-HS3	SOT23	3	3,000	Sn	Green & RoHS	1	-40°C to +125°C	MS YWWS
CT8122AM-IS3	SOT23	3	3,000	Sn	Green & RoHS	1	-40°C to +85°C	MR YWWS
CT8122AM-HS3	SOT23	3	3,000	Sn	Green & RoHS	1	-40°C to +125°C	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 ≤ 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°C to +150°C and storage temperature range of -65°C to +150°C.

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

Product Status Definition

Data Sheet Identification	Product Status	Definition
Objective	Proposed New Product Idea or In Development	Data sheet contains design target specifications and are subject to change without notice at any time.
Preliminary	First Production	Data sheet contains preliminary specifications obtained by measurements of early samples. Follow-on data will be published at a later date as more test data is acquired. Crocus reserves the right to make changes to the data sheet at any time.
None	Full Production	Data sheet contains final specifications for all parameters. Crocus reserves the right to make changes to the data sheet at any time.
Obsolete	Not in Production	Data sheet for a product that is no longer in production at Crocus. It is for reference only.