CT81x

Digital Unipolar TMR Latch for Consumer & Industrial Applications

Product Description

The CT811 and CT812 are integrated unipolar magnetic latches that are designed for consumer and industrial switching applications. It is based on Crocus Technology's patented Magnetic Logic Unit™ (MLU™) technology with integrated CMOS process to provide a monolithic solution for superior sensing performance.

SOT-23 Package

This unipolar magnetic latch features an industry leading low power consumption as low as 230 nA. It is capable of handling large air gap applications with low magnetic fields down to 1.5 mT with best in class high frequency performance. For design flexibility, the CT811 and CT812 are offered in active-low open drain and push-pull configurations respectively. These latches are available in a 3-lead TO-92S package and a low profile yet small form factor 3-lead SOT-23 package, providing cost effective and space-saving solutions for high volume manufacturing.

TO-92S Package

Features and Benefits

- High sensitivity, B_{OP} as low as 1.5 mT
- Resistant to mechanical stress
- Ultra-low power consumption as low as 230 nA
- Digital CMOS push-pull and open drain options
- Low profile and small form factor packaging
- RoHS Compliant

Application Examples

- IoT devices
- Smartphones, tablets, and laptops
- Door or lid closure detection
- Reed switch replacement
- Motor controllers
- Proximity detection
- Power switch or open-close detection
- Tamper-proofing for utility meters
- Fluid level detection

Figure 1: CT81x Block Diagram

CT81x (SOT23 Package) Block Diagram

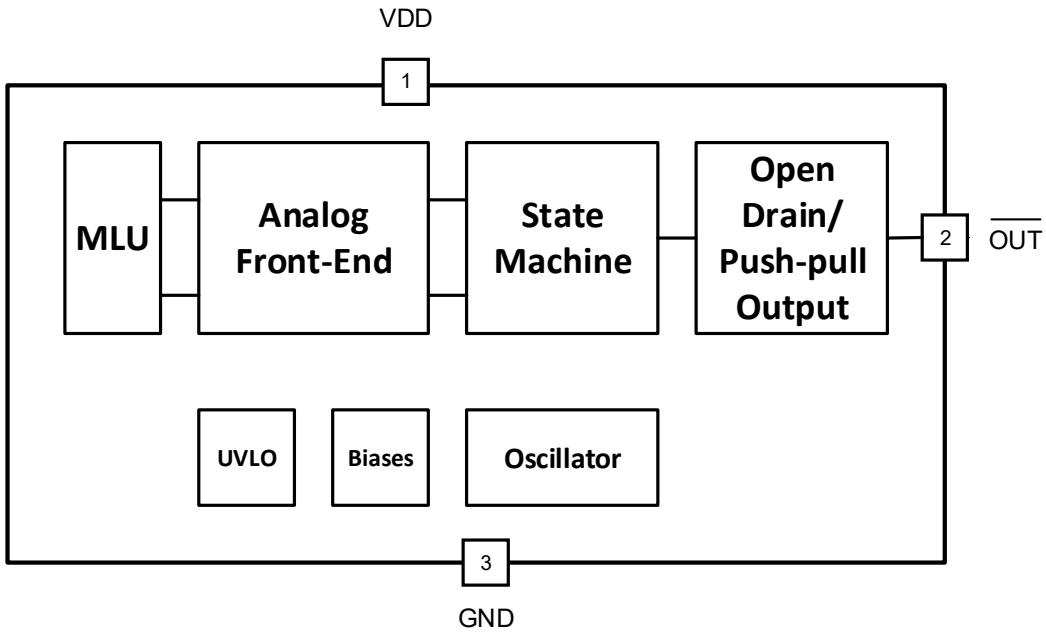
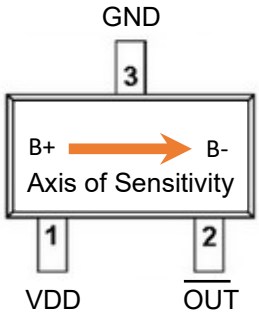
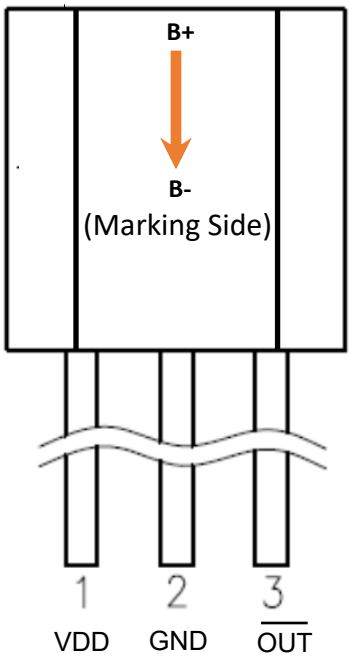


Figure 2: Package Pin-out with Axis of Sensitivity Diagrams



SOT-23 Package for CT811/CT812



TO-92S Package for CT811/CT812

Table 1: Pin-out Information

Pin # for SOT23 Package	Pin # of TO-92S Package	Pin Name	Pin Description
1	1	VDD	Supply Voltage
2	3	$\overline{OUT}$	Output Signal (Active LOW).
3	2	GND	Ground

Table 2: Absolute Maximum Ratings

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{DD}	-0.3	4.0	V
Push-pull Output (Active LOW)	V_{OUT_PP}	-0.3	V_{DD} + 0.3	V
Open Drain Output Voltage (Active LOW)	V_{OUT_OD}	-0.3	5.5	V
Input and Output Current	I_{IN} / I_{OUT}	-10	+10	mA
Junction temperature	T_J	-40	+125	°C
Storage temperature	T_{STG}	-65	+150	°C
Soldering temperature	T_{SOL}		+260	°C
ESD Level, Human Body Model per JESD22-A114	V_{ESD_HBM}	±4.0		kV

Table 3: Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for the actual device operation. Recommended operating conditions are specified to ensure optimal performance to the data sheet specifications. Crocus Technology does not recommend exceeding them or designing to absolute maximum ratings.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		2.7	3.0	3.6	V
Output Voltage	V_{OUT}				3.6	V
Operating Magnetic Flux	B				12	mT
Ambient Temperature	T_A	SOT23 Package	-40	+25	+125	°C
		TO-92S Package	-40	+25	+85	°C

Table 4: 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). Special attention must be paid not to exceed junction temperature $T_{J(MAX)}$ at a given ambient temperature.

Parameter	Symbol	Min	Typ	Max	Unit
Junction-to-Ambient Thermal Resistance for SOT23 Package	$\theta_{JA(SOT23)}$		202		°C/W
Junction-to-Ambient Thermal Resistance for TO-932S Package	$\theta_{JA(TO-92S)}$		160		°C/W

Table 5: Electrical Characteristics for CT81x

Unless otherwise specified: V_{DD} = 2.7 V to 3.6 V, T_A = -40°C to +125°C. Typical values are V_{DD} = 3.0 V and T_A = +25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Power-On Time	t_{ON}	V_{DD} > 2.7 V		500		µs
Under-voltage Lockout Threshold, Rising V_{DD}	V_{UVLO_RISE}	Rising V_{DD}		2.20	2.60	V
Under-voltage Lockout Threshold, Falling V_{DD}	V_{UVLO_FALL}	Falling V_{DD}	1.90	2.15		V
Under-voltage Lockout Hysteresis	V_{UV_HYST}			50		mV
Push-Pull Output						
Output Voltage High $\overline{OUT}$	V_{OH}	I_{OUT} = -2 mA	0.9 × V_{DD}			V
Output Voltage Low $\overline{OUT}$	V_{OL}	I_{OUT} = +2 mA			0.1 × V_{DD}	V
Current for $\overline{OUT}$	I_{OUT}			±2		mA
Open Drain Output						
High Level Output Voltage	V_{OH}				5.5	V
Low Level Output Voltage	V_{OL}	I_{OUT} ≤ 20 mA	0		0.5	V
High Impedance Output Leakage Current (1)	I_{LEAK}	V_{OH} = 5.5 V, B = 0		20		pA

(1) Guaranteed by design and bench characterization.

Typical Timing Characteristics for CT81x

V_{DD} = 3.0 V and T_A = +25°C, C_{DD} = 1.0 µF (unless otherwise specified).

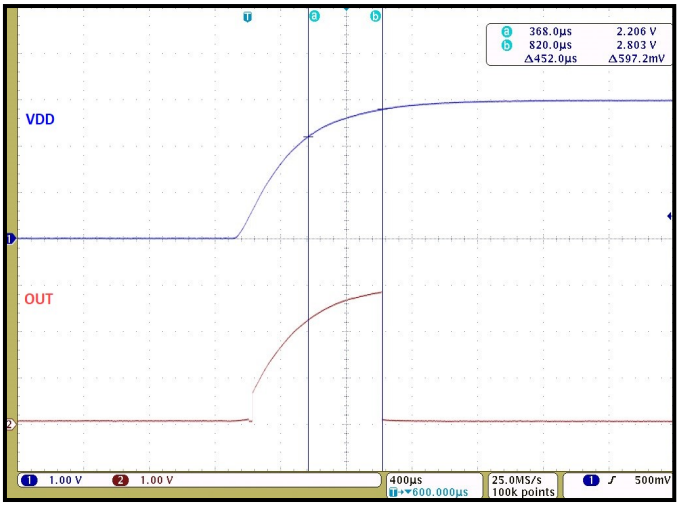


Figure 3. Power-On Time for Push-pull Output (V_{DD} and $\overline{OUT}$)

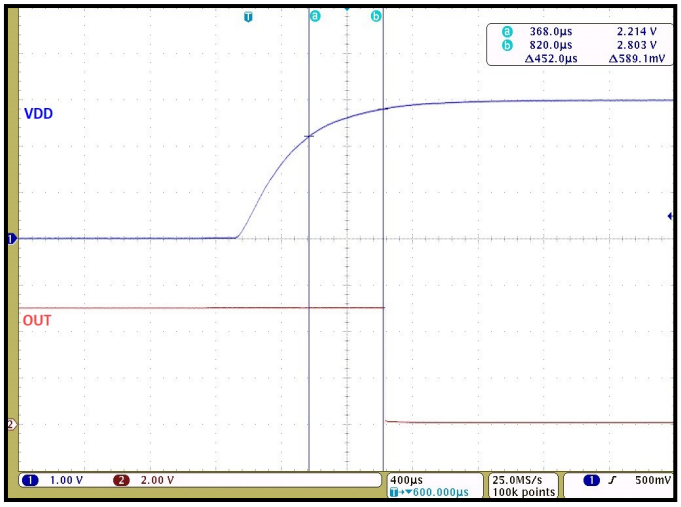


Figure 4. Power-On Time for Open Drain Output (V_{DD} and $\overline{OUT}$)

Table 6: Electrical & Magnetic Characteristics for CT811DK & CT812DK

Unless otherwise specified: V_{DD} = 2.7 V to 3.6 V, T_A = -40°C to +125°C. Typical values are V_{DD} = 3.0 V and T_A = +25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Average Supply Current	$I_{DD(AVG)}$	t = 10 s		230	700	nA
Sampling Frequency	f_S		6	10	14	Hz
Active Mode Time	t_{ACT}			1.4		µs
Idle Mode Time	t_{IDLE}		71	100	167	ms
Operate Point	B_{OP}		1.3	1.5	1.8	mT
Release point	B_{RP}		0.8	1.0	1.3	mT
Hysteresis	B_{HYST}	$B_{HYST} = B_{OP} - B_{RP}$	0.3	0.5		mT

Typical Electrical Characteristics for CT811DK

V_{DD} = 3.0 V and T_A = +25°C, C_{DD} = 1.0 µF (unless otherwise specified).

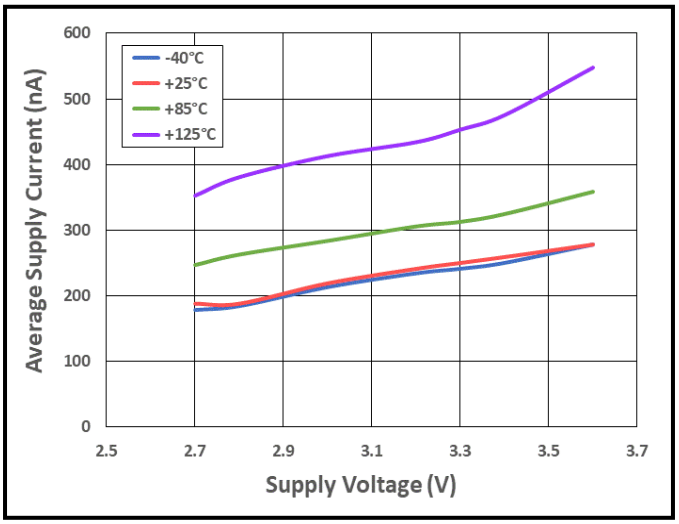


Figure 5. Average Supply Current vs. Supply Voltage vs. Temperature

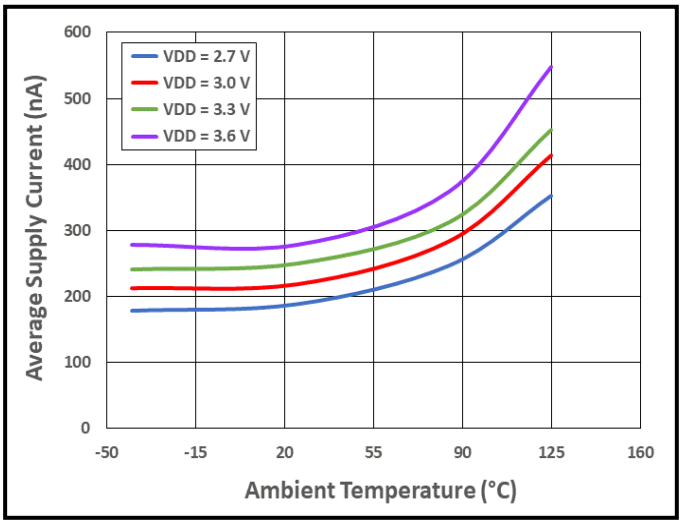


Figure 6. Average Supply Current vs. Temperature vs. Supply Voltage

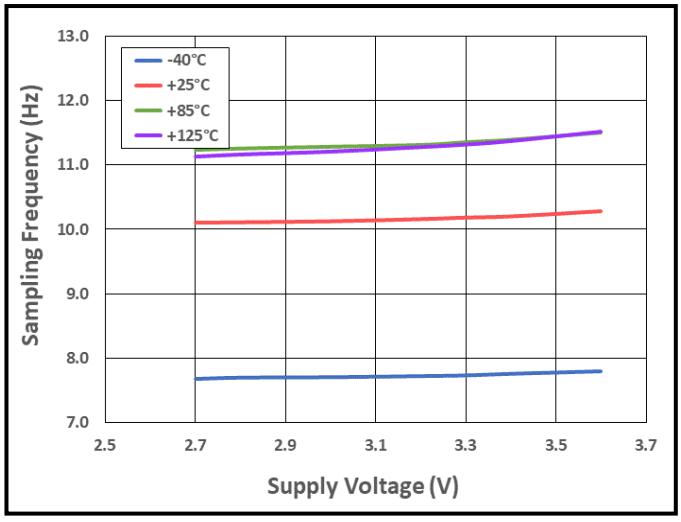


Figure 7. Sampling Frequency vs. Supply Voltage vs. Temperature

Typical Magnetic Characteristics for CT811DK

V_{DD} = 3.0 V and T_A = +25°C, C_{DD} = 1.0 µF (unless otherwise specified).

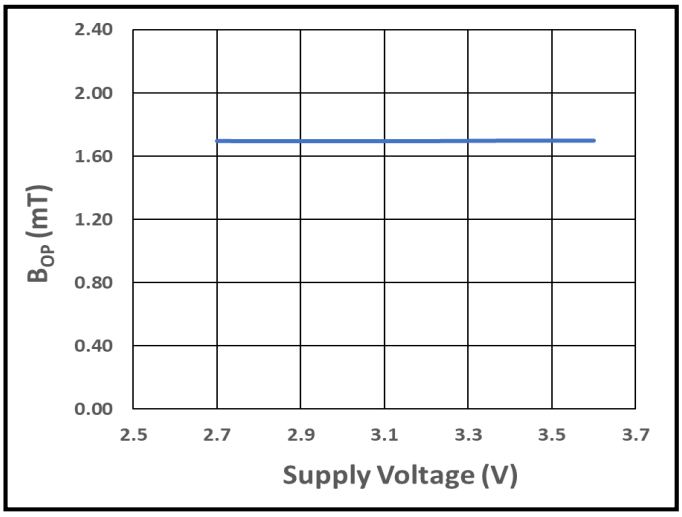


Figure 8. B_{OP} vs. Supply Voltage at +25°C

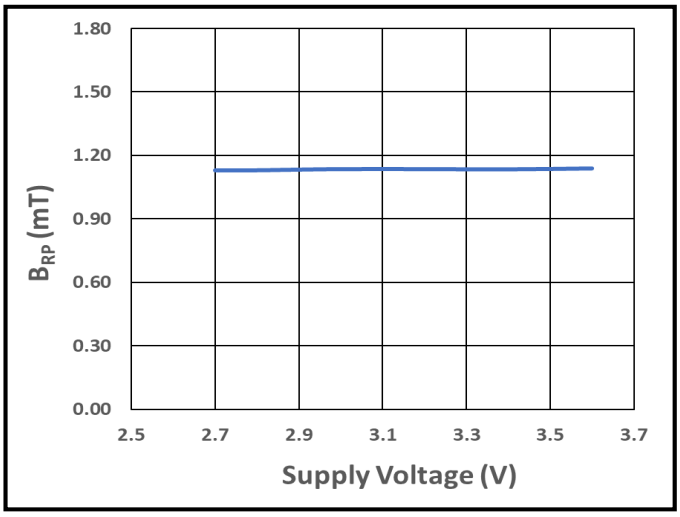


Figure 9. B_{RP} vs. Supply Voltage at +25°C

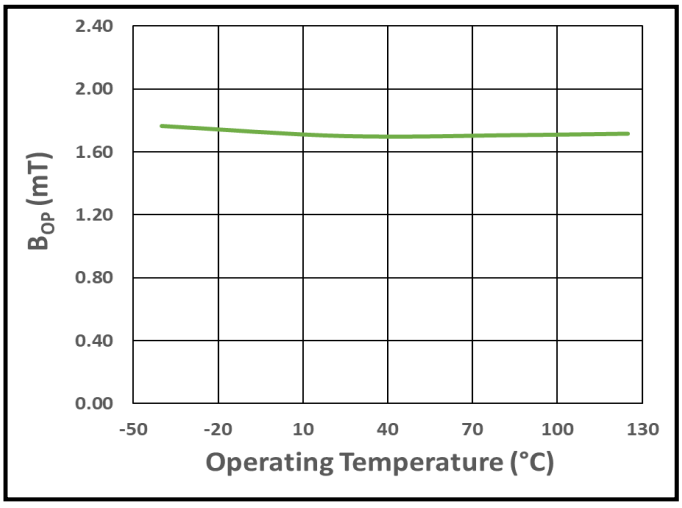


Figure 10. B_{OP} vs. Operating Temperature at V_{DD} = 3.0 V

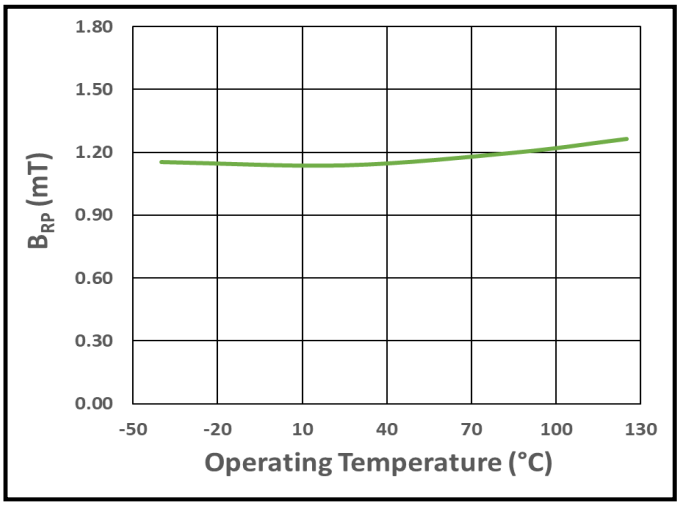


Figure 11. B_{RP} vs. Operating Temperature at V_{DD} = 3.0 V

Table 7: Electrical & Magnetic Characteristics for CT811BK & CT812BK

Unless otherwise specified: V_{DD} = 2.7 V to 3.6 V, T_A = -40°C to +125°C. Typical values are V_{DD} = 3.0 V and T_A = +25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Average Supply Current	$I_{DD(AVG)}$	t = 10 s		230	700	nA
Sampling Frequency	f_S		6	10	14	Hz
Active Mode Time	t_{ACT}			1.4		µs
Idle Mode Time	t_{IDLE}		71	100	167	ms
Operate Point	B_{OP}		2.7	3.0	3.8	mT
Release point	B_{RP}		1.8	2.0	2.7	mT
Hysteresis	B_{HYST}	$B_{HYST} = B_{OP} - B_{RP}$	0.5	1.0		mT

Typical Electrical Characteristics for CT811BK & CT812BK

V_{DD} = 3.0 V and T_A = +25°C, C_{DD} = 1.0 µF (unless otherwise specified).

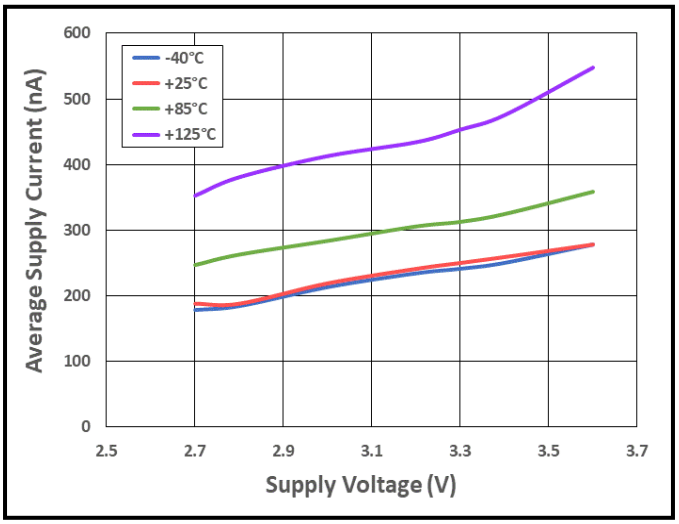


Figure 12. Average Supply Current vs. Supply Voltage vs. Temperature

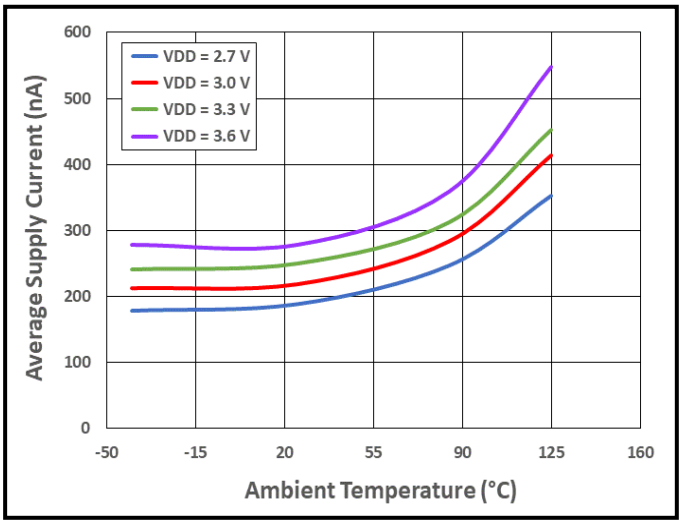


Figure 13. Average Supply Current vs. Temperature vs. Supply Voltage

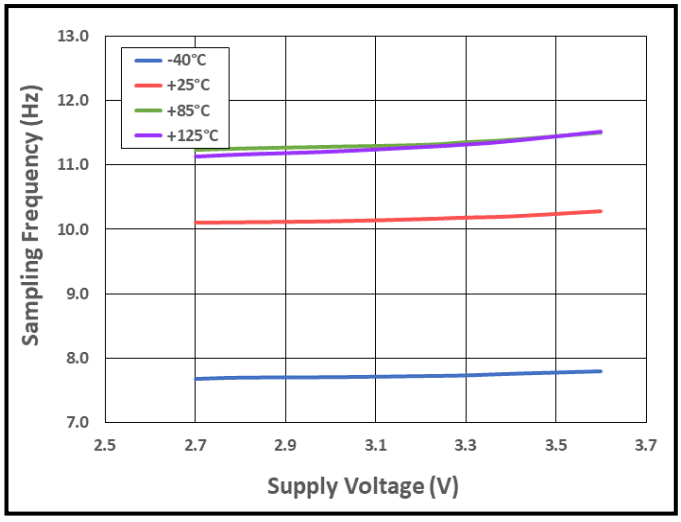


Figure 14. Sampling Frequency vs. Supply Voltage vs. Temperature

Typical Magnetic Characteristics for CT811BK & CT812BK

V_{DD} = 3.0 V and T_A = +25°C, C_{DD} = 1.0 µF (unless otherwise specified).

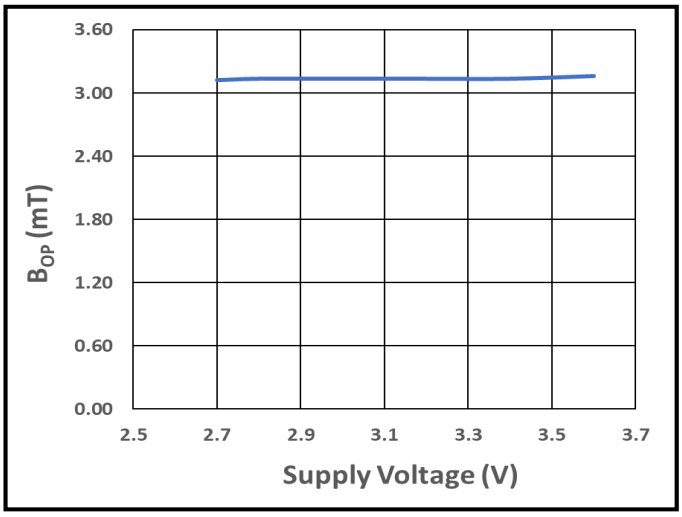


Figure 15. B_{OP} vs. Supply Voltage at +25°C

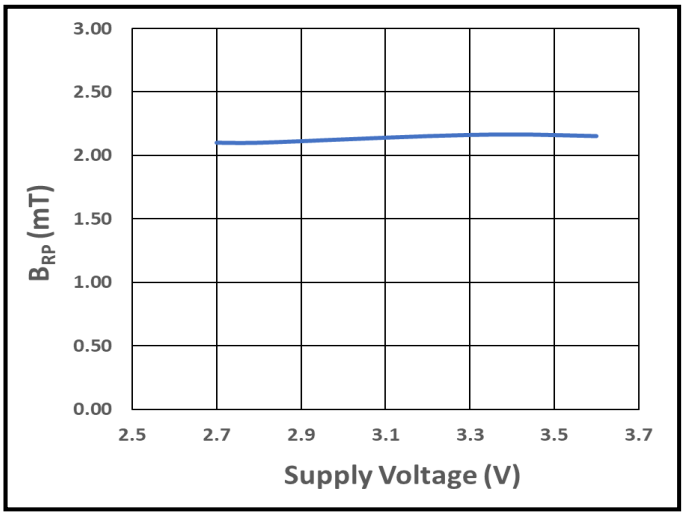


Figure 16. B_{RP} vs. Supply Voltage at +25°C

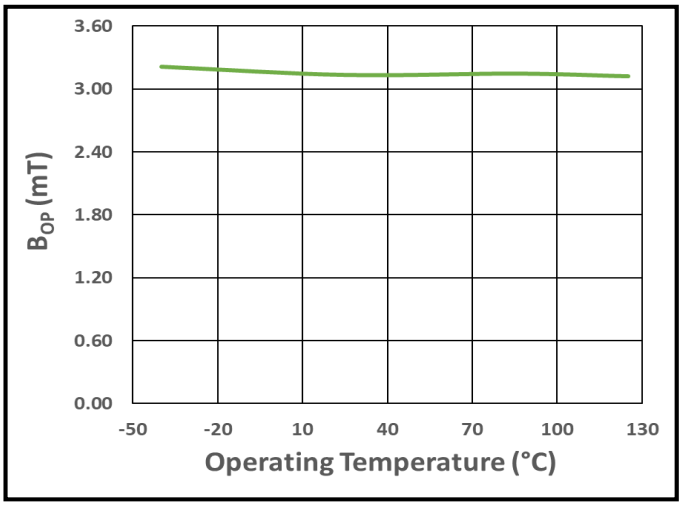


Figure 17. B_{OP} vs. Operating Temperature at V_{DD} = 3.0 V

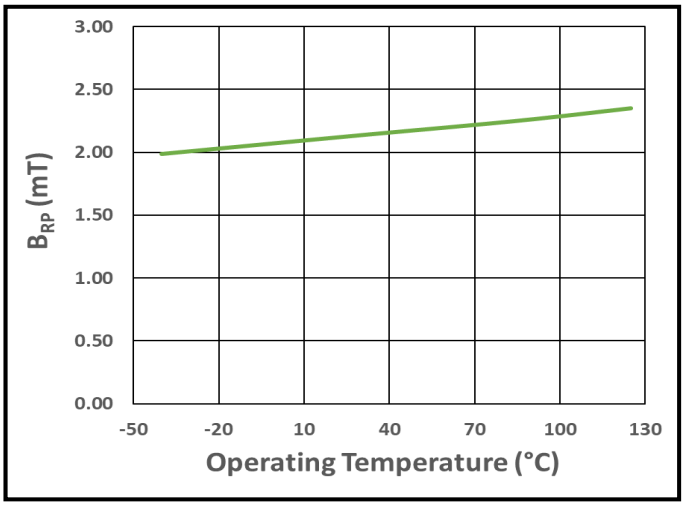
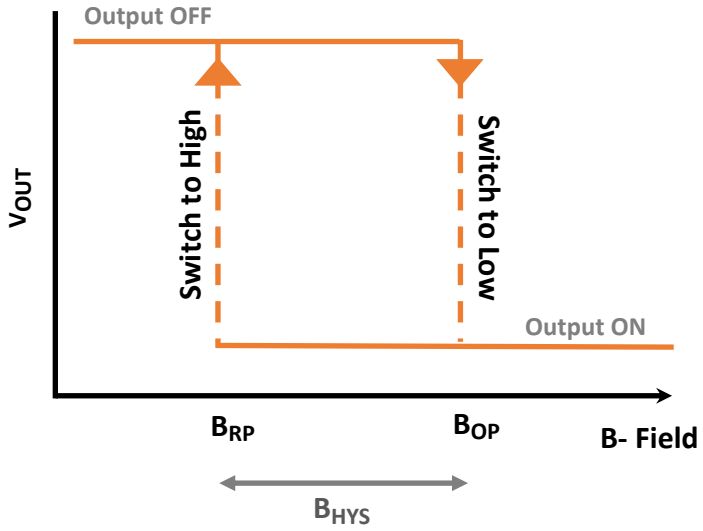


Figure 18. B_{RP} vs. Operating Temperature at V_{DD} = 3.0 V

Figure 19: Unipolar Magnetic Flux



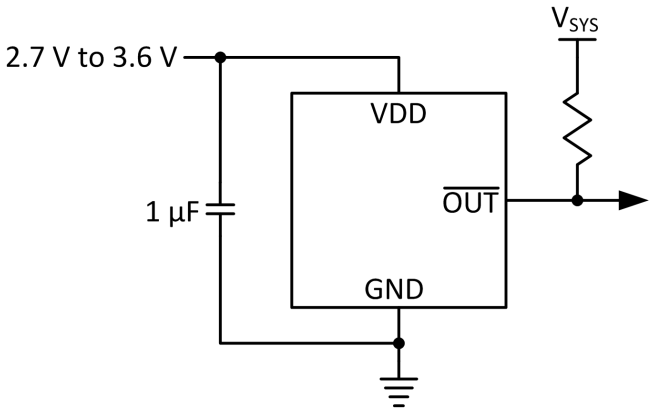
Output Behavior versus Magnetic Field

Characteristic	Conditions	Output
Positive Field	$B > B_{OP}$	High-Z (OFF)
Null or Weak Magnetic Field	$B < B_{RP}$	High-Z (OFF)
Negative Field	$B > B_{OP}$	Low (ON)

Figure 20: Application Circuits

A decoupling capacitor (C_{DD}) between the supply voltage and ground is required with placement close to the magnetic switch. A typical capacitor value of 1.0 µF (Ceramic) will suffice. For the open drain output, maximum V_{SYS} should not exceed 5.5 V.

CT811DK & CT811BK Open Drain Output



CT812BK Digital Output

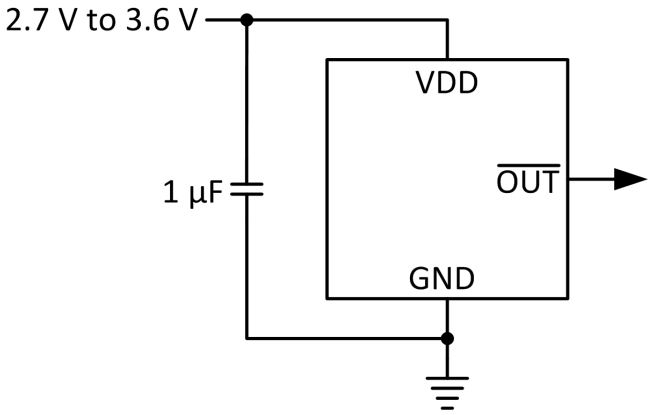
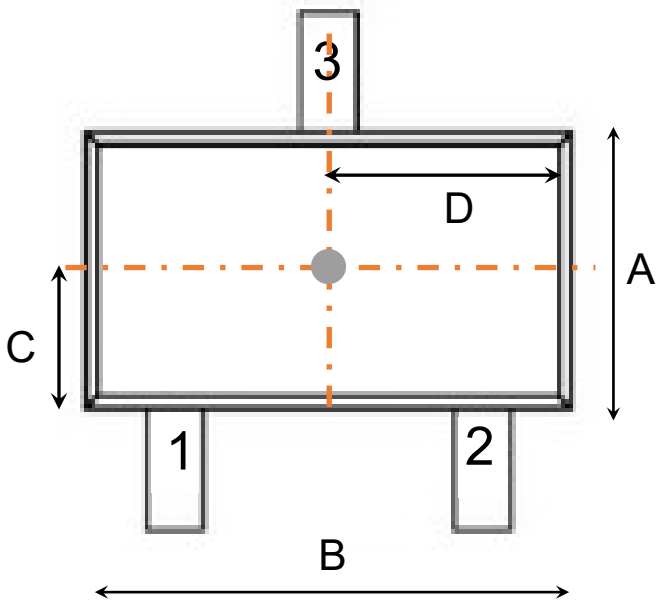
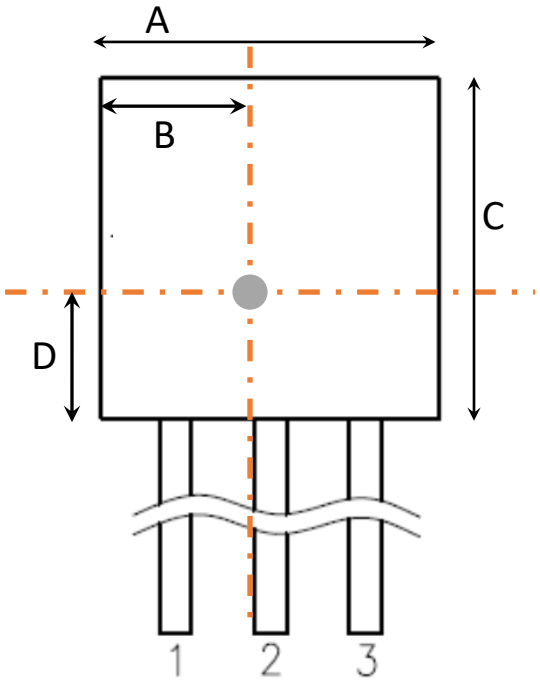


Figure 21: MLU Sensor Location



SOT23 Package



TO-92S Package

Symbols	Nominal Dimensions (mm)
A	1.60
B	2.90
C	0.80
D	1.45

Symbols	Nominal Dimensions (mm)
A	4.52
B	1.90
C	4.57
D	1.30

Table 8: Order Guide

Part Number	Polarity	Output Type	B_{OP}	B_{RP}	$I_{DD(AVG)}$	Switching Frequency	Description
CT811BK-IT3	Unipolar	Open Drain	3.0 mT	2.0 mT	230 nA	10 Hz	Unipolar magnetic latch TO-92S Package, Tape & Reel packaging
CT811DK-HS3 CT811DK-IS3	Unipolar	Open Drain	1.5 mT	1.0 mT	230 nA	10 Hz	Unipolar magnetic latch SOT-23 Package, Tape & Reel packaging
CT812BK-HS3 CT812BK-IS3	Unipolar	Push-pull	3.0 mT	2.0 mT	230 nA	10 Hz	Unipolar magnetic latch SOT-23 Package, Tape & Reel packaging
CT812BK-IT3							Unipolar magnetic latch TO-92S Package, Tape & Reel packaging
CT812DK-IS3	Unipolar	Push-pull	1.5 mT	1.0 mT	230 nA	10 Hz	Unipolar magnetic latch SOT-23 Package, Tape & Reel packaging

Table 9. Packaging Information

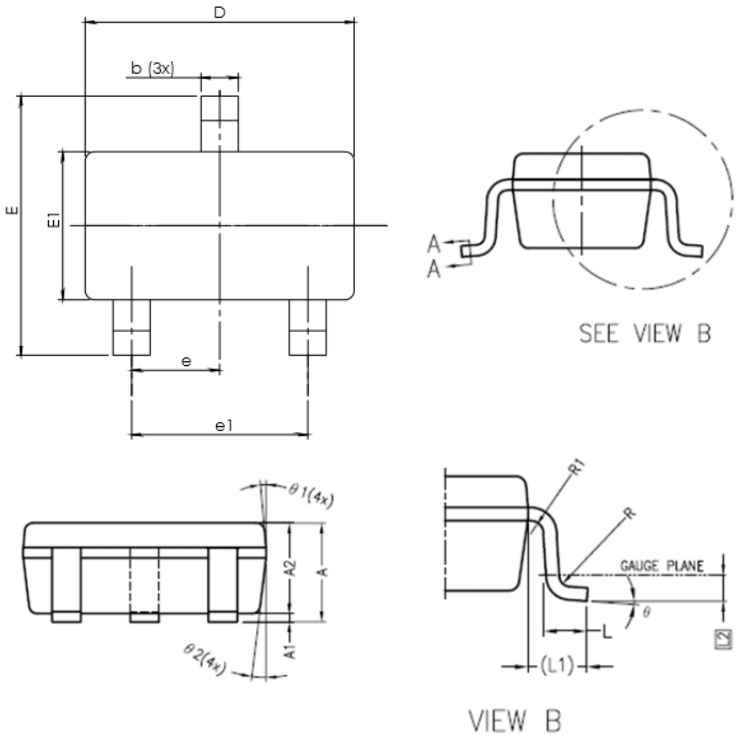
Orderable Part Number	Package Type	Pins	Package Quantity	Lead Finish	Eco Plan(1)	MSL Rating(2)	Operating Temperature(4)	Device Marking(3)
CT811BK-IT3	TO-92S	3	1,000	Sn	Green & RoHS	N/A	-40°C to +85°C	EH YWWZ
CT811DK-HS3	SOT-23	3	3,000	Sn	Green & RoHS	1	-40°C to +125°C	EG YWWS
CT811DK-IS3	SOT-23	3	3,000	Sn	Green & RoHS	1	-40°C to +85°C	EG YWWS
CT812BK-HS3	SOT-23	3	3,000	Sn	Green & RoHS	1	-40°C to +125°C	DH YWWS
CT812BK-IS3	SOT-23	3	3,000	Sn	Green & RoHS	1	-40°C to +85°C	DH YWWS
CT812BK-IT3	TO-92S	3	1,000	Sn	Green & RoHS	N/A	-40°C to +85°C	DH YWWZ
CT812DK-IS3	SOT-23	3	3,000	Sn	Green & RoHS	1	-40°C to +85°C	DG 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 industry standard classifications.

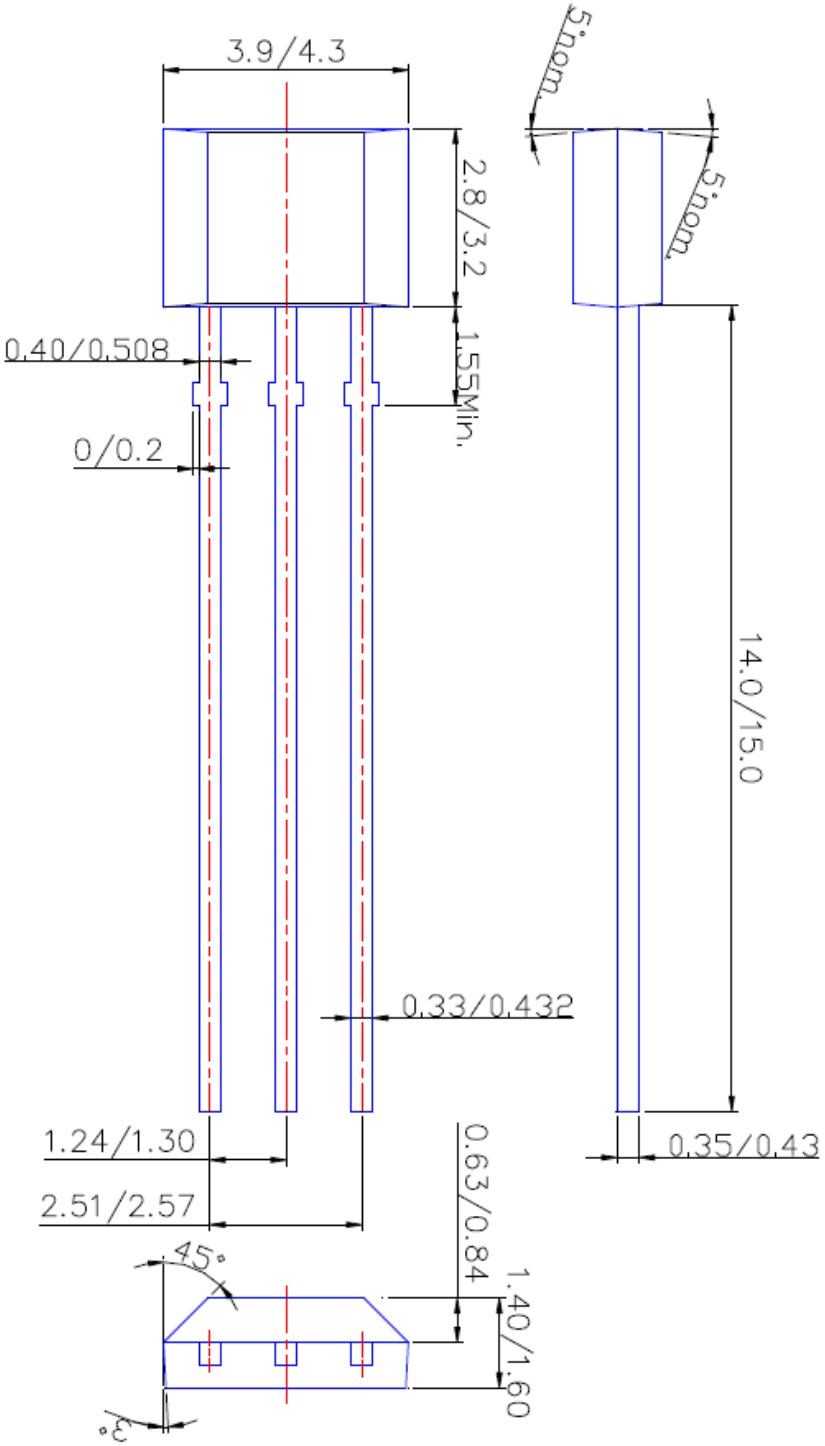
(3) Device Marking for SOT23 is defined as Ex (or Dx) YWWS where Ex = part number, Y = year, WW = work week and S = sequential number. Device Marking for TO-92S is defined as Ex (or Dx) YWWZ where Ex = part number, Y = year, WW = work week and Z = sequential number.

Figure 22: 3-Lead SOT-23 Package Dimensions



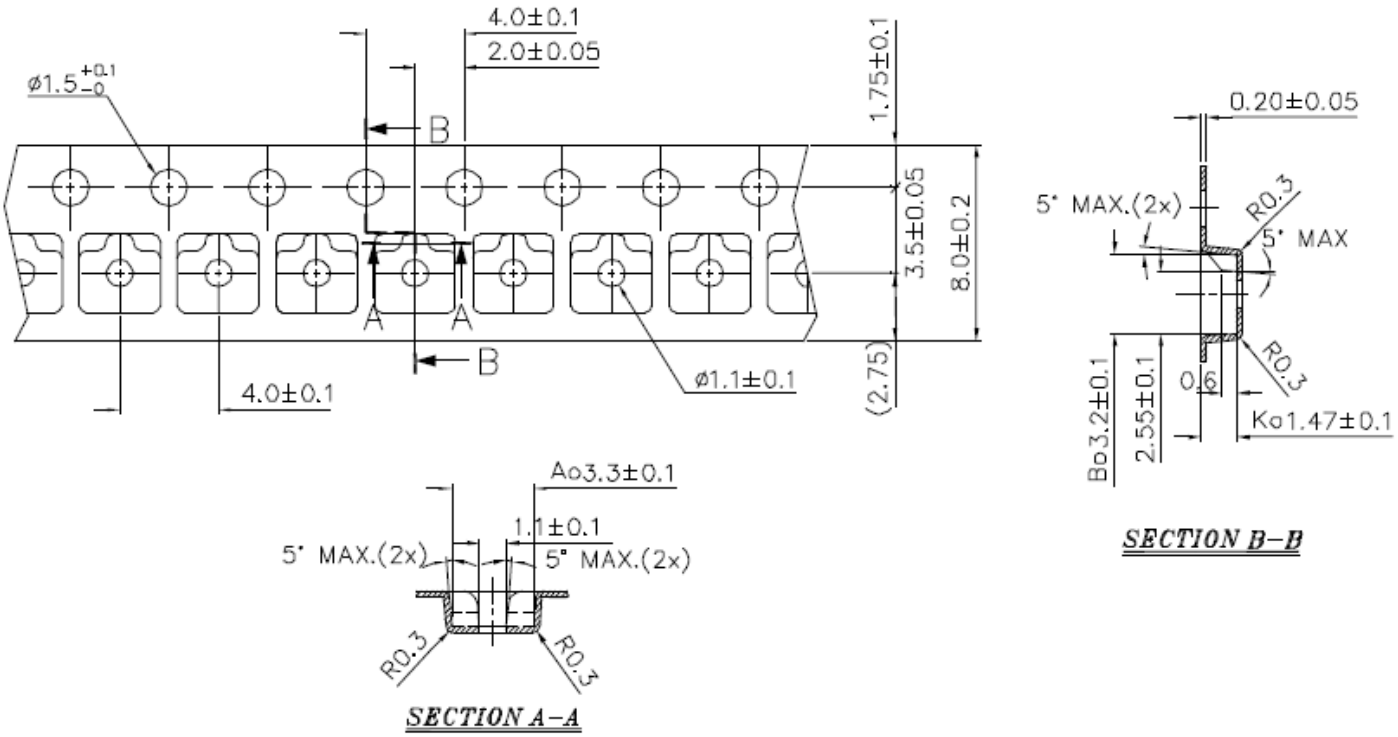
SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.05	1.20	1.35
A1	0.00	0.10	0.15
A2	1.00	1.10	1.20
b	0.30	———	0.50
b1	0.30	0.35	0.45
c	0.08	———	0.22
c1	0.08	0.13	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95 BSC		
e1	1.90 BSC		
L	0.35	0.43	0.60
L1	0.60 REF		
L2	0.25 BSC.		
R	0.10	———	———
R1	0.10	———	0.25
θ	0°	4°	8°
θ1	5°	6°	15°
θ2	5°	8°	15°

Figure 23: 3-Lead TO-92S Package Dimensions



All Dimensions in mm.

Figure 24: Tape & Pocket Dimensions for SOT23 Package



Notes:

1. Material: Conductive Polystyrene
2. Dimensions in mm.
3. 10 sprocket hole pitch cumulative tolerance ±0.2.
4. Camber not to exceed 1 mm in 100 mm.
5. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.
6. (S.R. Ω/sq) means surface electric resistivity of the carrier tape.

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