CROCUS TECHNOLOGY
Intelligence in Sensing™

CT310

XtremeSense® 2D TMR Angular Sensor

Features

- Angular Error less than 0.30° (After Compensation) Over Full Temperature Range
- Dual Full-Bridge Resistor Network
- Operating Magnetic Field: 25 mT to 90 mT
- Differential Outputs for SIN and COS Axes
- Supply Voltage: 1.0 V to 5.5 V
- Package Options:
  - 8-lead TSSOP
  - 8-lead DFN, 2.00 × 2.00 × 0.45 mm

Applications

- Angular Measurements
- Rotary and Angular Sensors
- BLDC Motors

Product Description

The CT310 is a 2D angular sensor in a dual full-bridge configuration from Crocus Technology developed on its patented XtremeSense® 2D TMR technology. The operating magnetic field for this 2D sensor is 25 mT to 90 mT and has an angular error less than 0.30° after compensation over the full operating temperature range. It has differential outputs for both sine (SIN) and cosine (COS) axes and operates with a supply voltage range from 1.0 V to 5.5 V.

It is packaged in an 8-lead TSSOP package and for applications where space is critical, a low profile, small form factor 8-lead DFN package that is 2.00 × 2.00 × 0.45 mm in size.

Ordering Information

Part Number	Operating Temperature Range	Angular Error (1)	Output Type	Package	Packing Method
CT310LS-IT8-M	-40°C to +85°C	0.30°	Differential	8-lead TSSOP 6.40 x 3.05 x 1.10 mm	Tape & Reel
CT310LS-HT8-M	-40°C to +125°C				
CT310LS-ID8-M	-40°C to +85°C	0.30°	Differential	8-lead DFN 2.00 x 2.00 x 0.45 mm	Tape & Reel
CT310LS-HD8-M	-40°C to +125°C				

(1) After Compensation

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Block Diagram

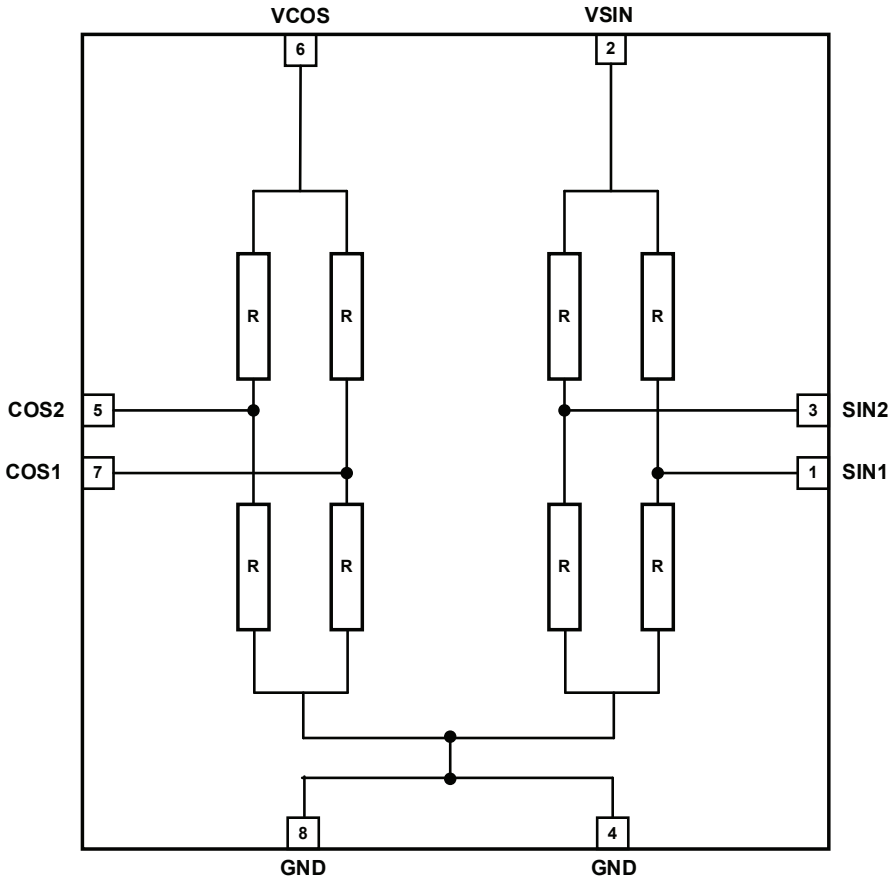


Figure 1. CT310 Functional Block Diagram

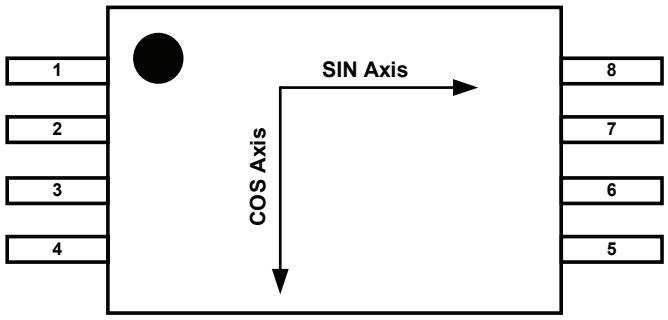


Figure 2. CT310 Axes of Sensitivity for TSSOP-8

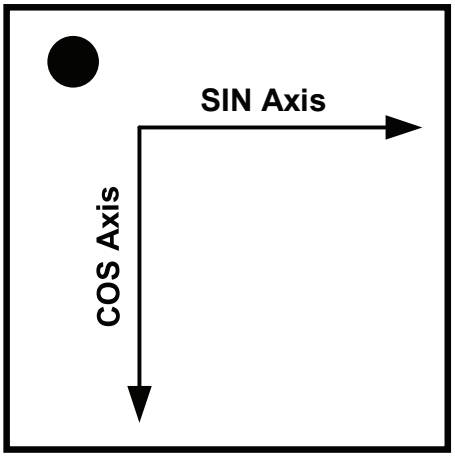
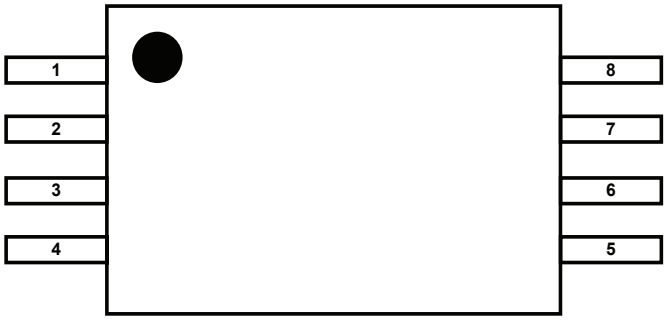


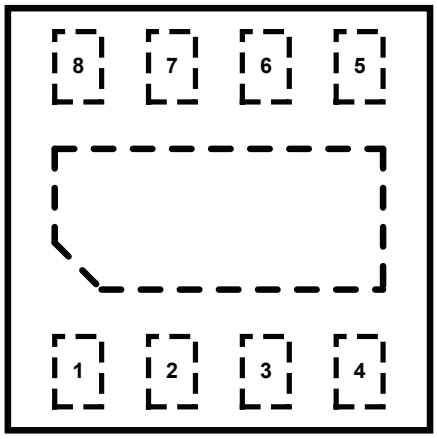
Figure 3. CT310 Axes of Sensitivity for DFN-8

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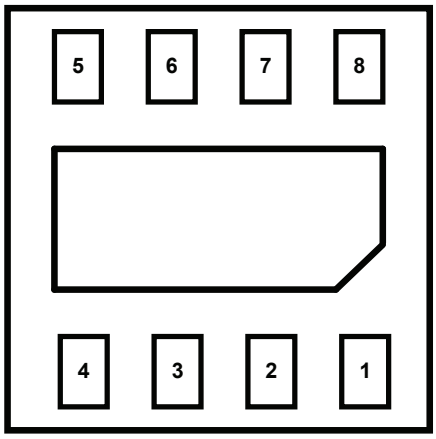
Pin Configurations



TSSOP-8 – Top Down View



DFN-8 – Top Down View



DFN-8 – Bottoms Up View

Figure 4. CT310 Pin-out Diagrams

Pin Definitions

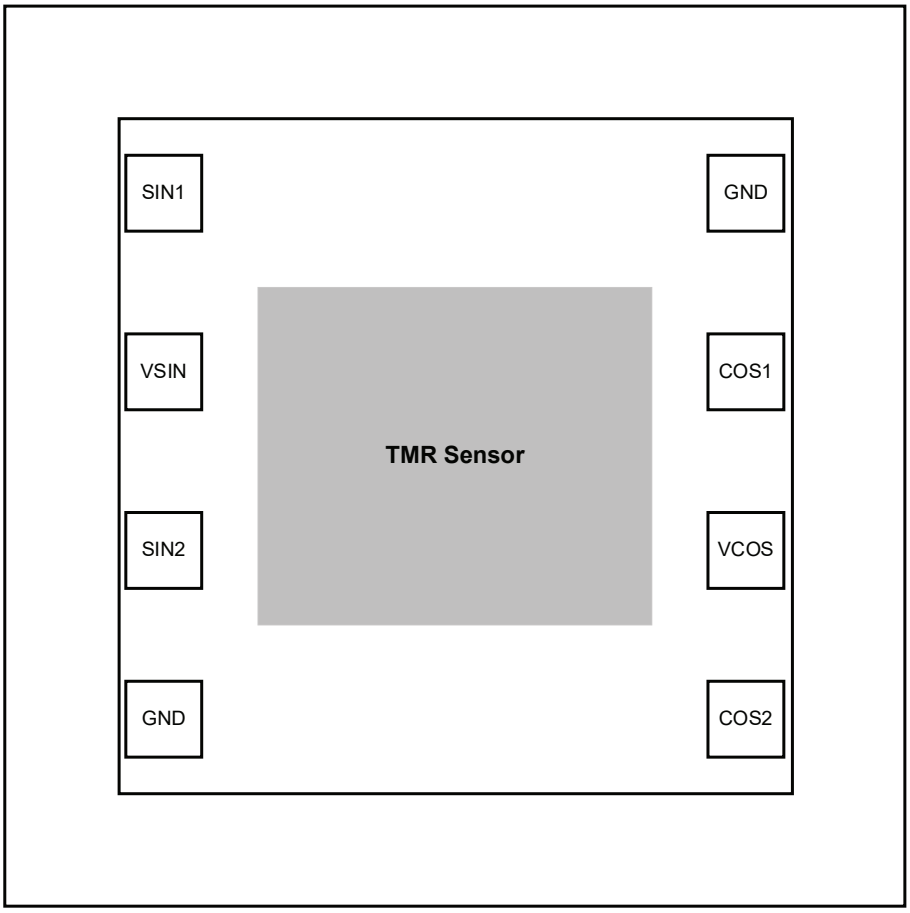
TSSOP-8 Pin #	DFN-8 Pin #	Pin Name	Pin Description
1	1	SIN1(1)	Differential output #1 for sine.
2	2	VSIN	Supply voltage for sine
3	3	SIN2(1)	Differential output #2 for sine.
4	4	GND	Ground for sine.
5	5	COS2(2)	Differential output #2 for cosine.
6	6	VCOS	Supply voltage for cosine
7	7	COS1(2)	Differential output #1 for cosine.
8	8	GND	Ground for cosine.

(1) SIN2 – SIN1 = SIN
(2) COS2 – COS1 = COS

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Pad Configuration



CT310 Die Layout
Top Down View

Figure 5. CT310 Pad Diagram

Pad Definitions

Pad #	Pad Name	Pad Description
1	SIN1(1)	Differential output #1 for sine.
2	VSIN	Supply voltage for sine
3	SIN2(1)	Differential output #2 for sine.
4	GND	Ground for sine.
5	COS2(2)	Differential output #2 for cosine.
6	VCOS	Supply voltage for cosine
7	COS1(2)	Differential output #1 for cosine.
8	GND	Ground for cosine.

(1) SIN2 – SIN1 = SIN
(2) COS2 – COS1 = COS

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Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the CT310 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.

Symbol	Parameter		Min.	Max.	Unit
V_{COS}, V_{SIN}	Supply Voltage		-0.3	6.0	V
V_{OUT}	Analog Output Pins Maximum Differential Voltage			±1.5	V
ESD	Electrostatic Discharge Protection Level	Human Body Model (HBM) per JESD22-A114	±4.0		kV
		Charged Device Model (CDM) per JESD22-C101	±1.0		
B_{MAX}	Maximum Magnetic Field, ≤ 5 minutes at T_A = +25°C			±200	mT
B_{SHIFT}	Life-time Shift			TBD	°
T_{STG}	Storage Temperature		-65	+165	°C
T_L	Lead Soldering Temperature, 10 Seconds			+260	°C

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual operation of the CT310. Recommended operating conditions are specified to ensure optimal performance to the specifications. Crocus Technology does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter		Min.	Typ.	Max.	Unit
V_{COS}, V_{SIN}	Supply Voltage Range		1.0		5.5	V
V_{COS_D}, V_{SIN_D}	COS and SIN Differential Output Voltage Range		-1.37		+1.37	V
$B_{OPERATING}$	Operating Magnetic Field		25		90	mT
T_A	Operating Ambient Temperature	Industrial	-40	+25	+85	°C
		Extended Industrial	-40	+25	+125	

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Electrical & Magnetic Specifications

Unless otherwise specified: V_{DD} = 1.0 V to 5.5 V, C_{BYP} = 0.1 µF, $B_{OPERATING}$ = 25 mT to 90 mT and T_A = -40°C to +150°C. Typical values are V_{DD} = 3.0 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Magnetic						
$B_{OPERATING}$	Operating Magnetic Field		25	60	90	mT
Electrical						
R_{BRIDGE}	Bridge Resistance	T_A = +25°C	3.0	4.5	6.0	kΩ
TCR	Temperature Coefficient of Resistance (1)			500		ppm/°C
Differential Outputs						
θ_{ERR}	Angular Error (2)	After Compensation		0.30	0.60	°
θ_{ERR_20mT}	Angular Error @ 20 mT (1), (2)	After Compensation, $B_{OPERATING}$ = 20 mT			0.90	°
θ_{ERR_HYST}	Angle Error due to Hysteresis		No Hysteresis			°
V_{SIN_D}, V_{COS_D}	SIN, COS Differential Output Voltage Peak-to-Peak	T_A = +25°C	0.35	0.45	0.50	V/V
TCV_{OUT}	Temperature Coefficient of Differential Output (1)			-1600		ppm/°C
V_{OFF_SIN}, V_{OFF_COS}	SIN, COS Voltage Offset			±1	±5	mV/V
k	SIN, COS Amplitude Synchronism Ratio		97	100	103	%
TCk	Temperature Coefficient of Amplitude Synchronism (1)			3.0		ppm/°C
OE_{SIN}, OE_{COS}	SIN, COS Orthogonality Error		88	90	92	°
$t_{RESPONSE}$	SIN, COS Response Time (1)	C_L = 22 pF		1.0		µs
e_N	Noise (1)	f_{BW} = 1 Hz to 10 kHz, V_{DD} = 3.0 V		2.4		$\mu V_{RMS}/V$

(1) Guaranteed by design and characterization.
(2) Hysteresis error and output noise are included in the Angular Error specification.

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Electrical Characteristics

V_{DD} = 3.0 V and T_A = +25°C

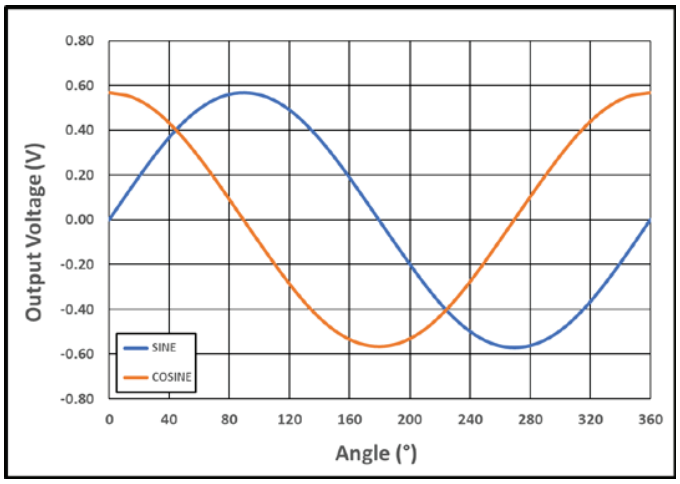


Figure 6. Output Voltage vs. Angle at B_{OP} = 25 mT

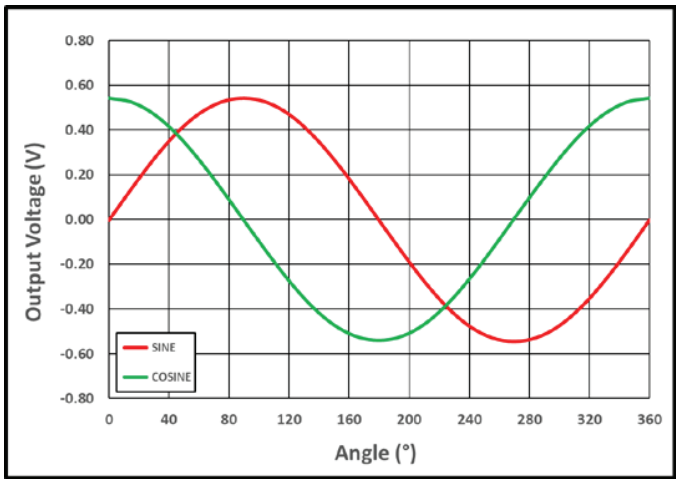


Figure 7. Output Voltage vs. Angle at B_{OP} = 90 mT

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Recommended Application Circuit

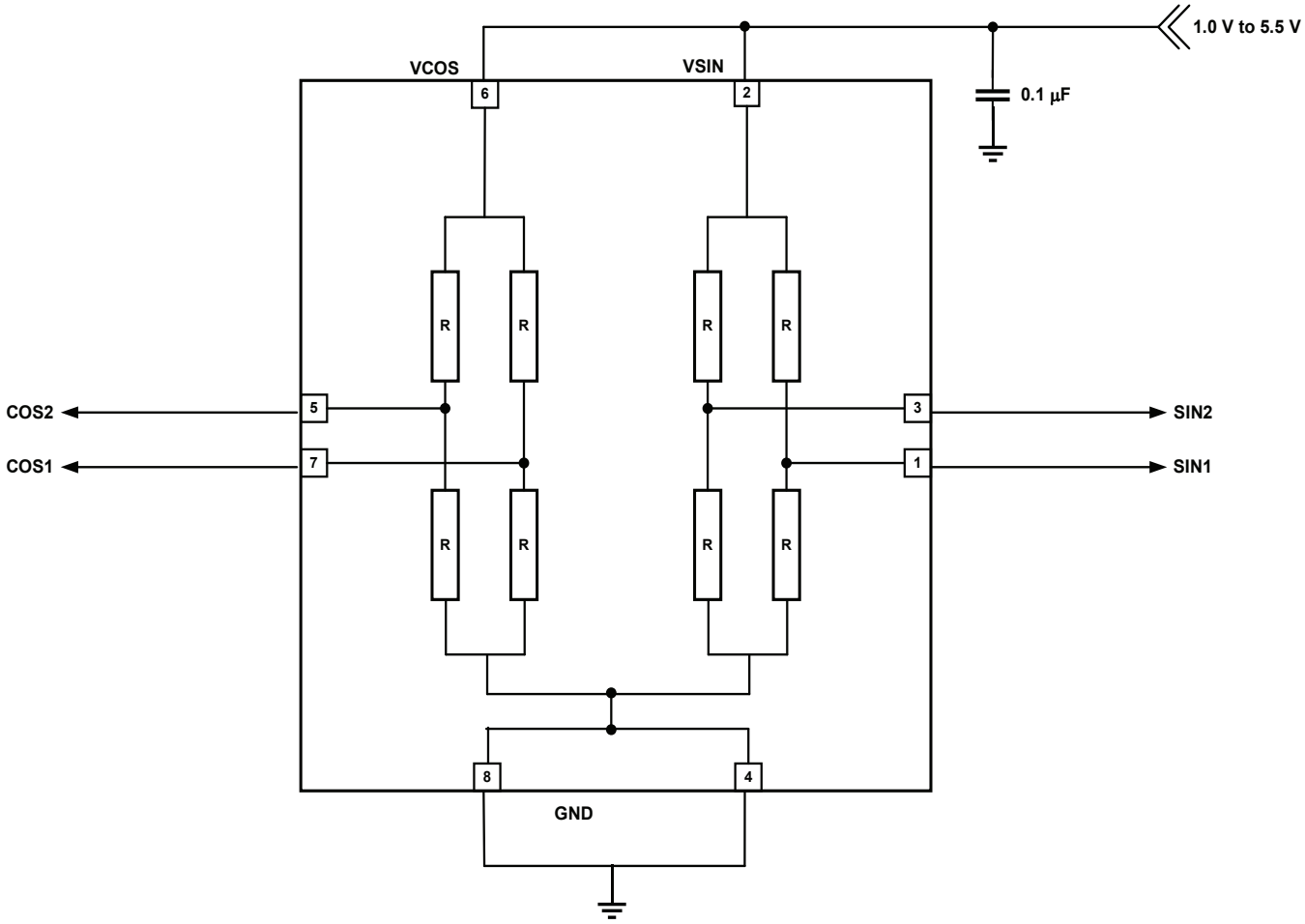


Figure 8. CT310 Application Diagram

Table 1. Recommended External Components

Component	Description	Vendor & Part Number	Parameter	Min.	Typ.	Max.	Unit
C_{BYP}	0.1 µF, X7R	Murata GRM033Z71A104KE14	C		0.1		µF
		Others					

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Applications Information

The XtremeSense TMR sensor location for the CT310 for the x, y dimensions are shown in Figure 9 and Figure 10 for the TSSOP-8 and DFN-8 packages respectively. Figure 11 and Figure 12 illustrates the location of the CT310's XtremeSense TMR sensor from the z dimension. All dimensions in the figures below are nominal.

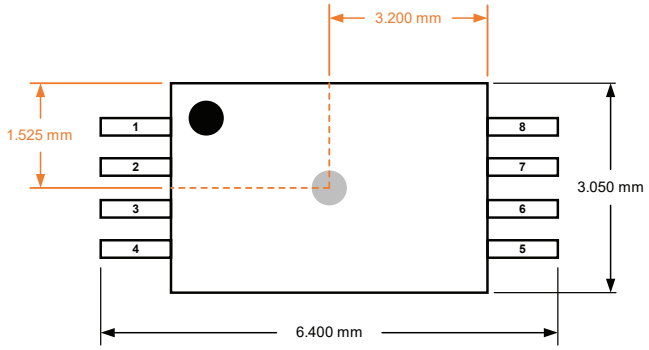


Figure 9. XtremeSense TMR Sensor Location in x-y Plane for CT310 in TSSOP-8 Package

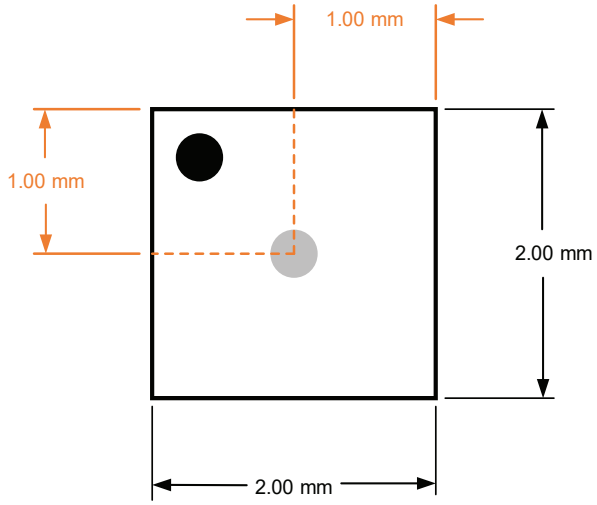


Figure 10. XtremeSense TMR Sensor Location in x-y Plane for CT310 in DFN-8 Package

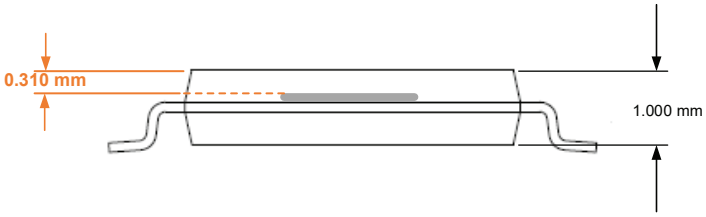


Figure 11. XtremeSense TMR Sensor Location in z Dimension for CT310 in TSSOP-8 Package

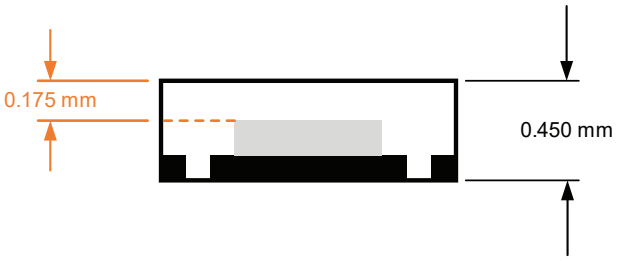


Figure 12. XtremeSense TMR Sensor Location in z Dimension for CT310 in DFN-8 Package

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TSSOP-8 Package Drawing and Dimensions

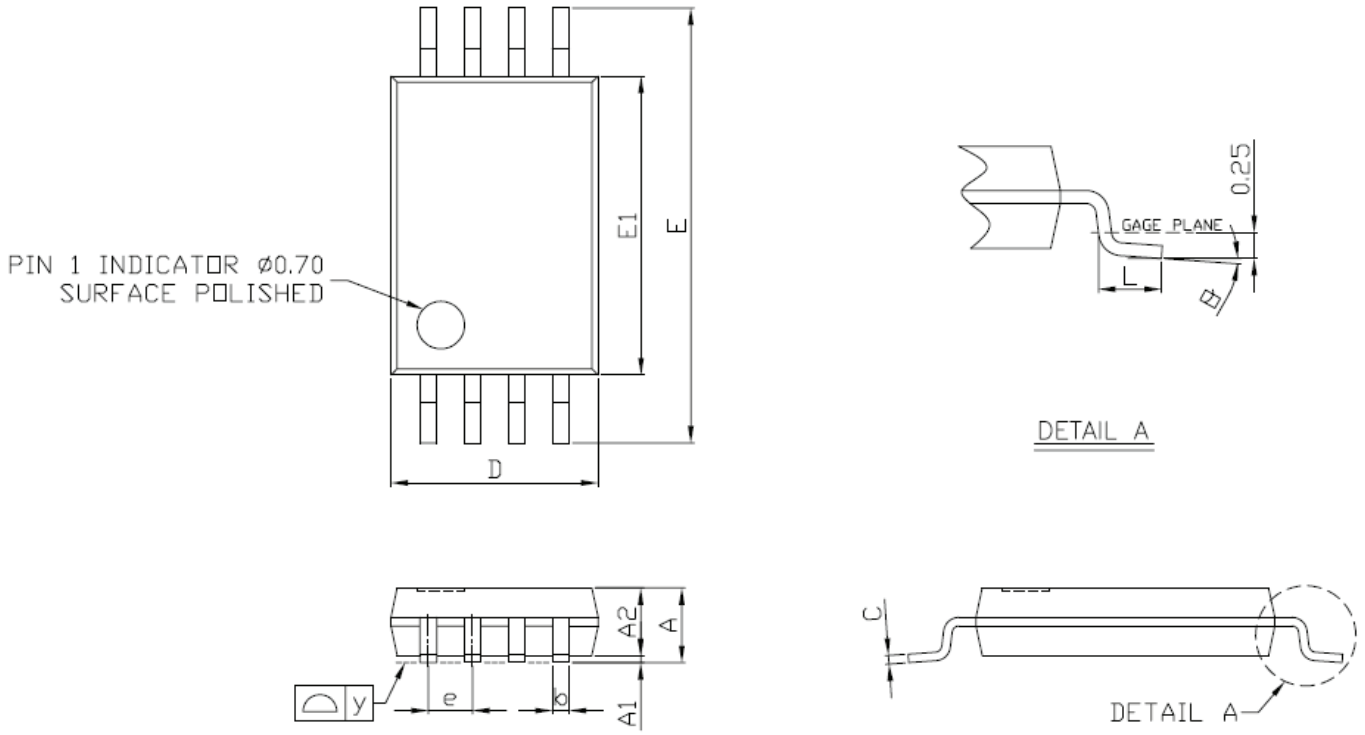


Figure 13. TSSOP-8 Package Drawing

Table 2. CT310 TSSOP-8 Package Dimensions

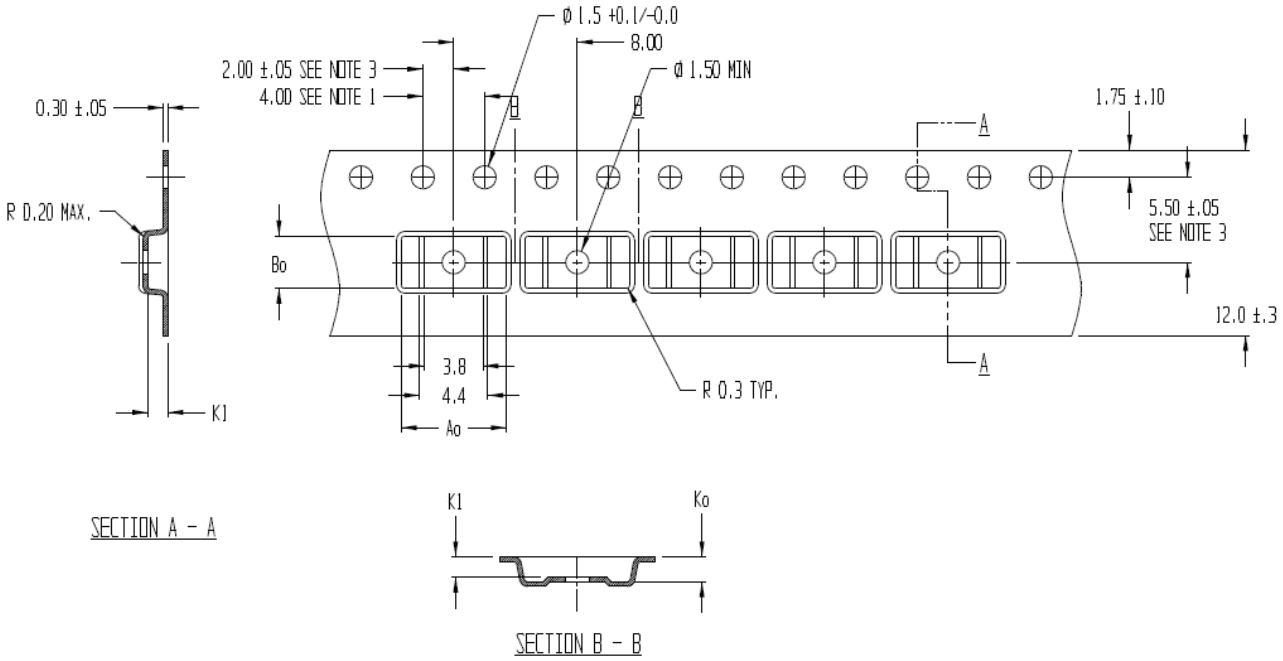
Symbol	Dimensions in Millimeters (mm)		
	Min.	Typ.	Max.
A	1.05	1.10	1.20
A1	0.05	0.10	0.15
A2	-	1.00	1.05
b	0.25	-	0.30
C	-	0.127	-
D	2.90	3.05	3.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	-	0.65	-
L	0.50	0.60	0.70
y	-	-	0.076
θ	0°	4°	8°

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TSSOP-8 Tape & Pocket Drawing and Dimensions



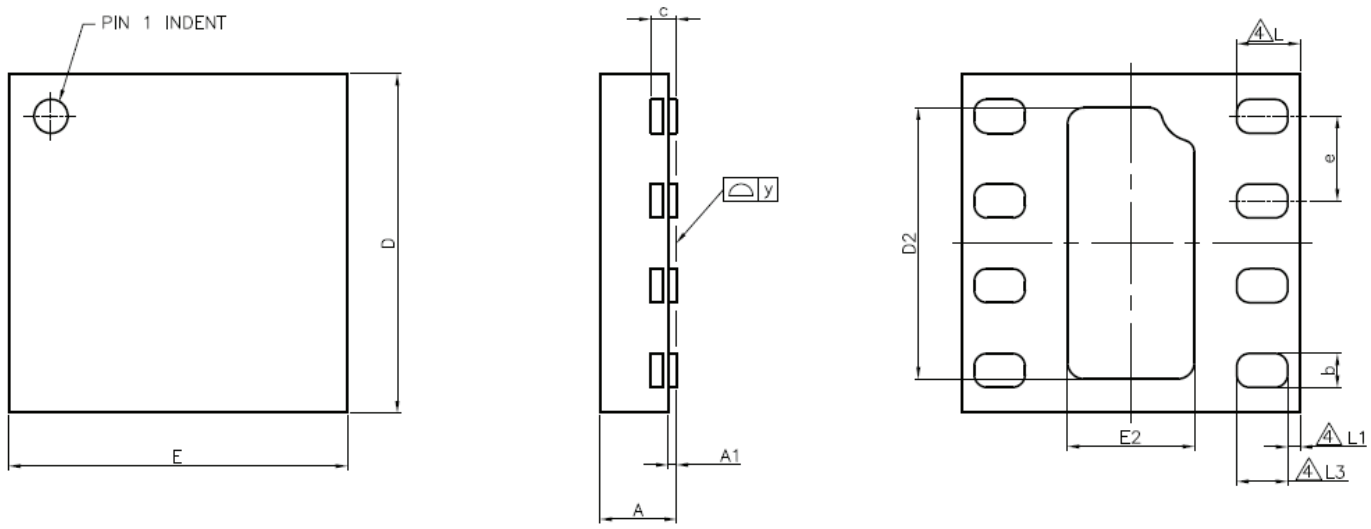
NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

Ao = 6.80
Bo = 3.40
Ko = 1.60
K1 = 1.30

Figure 14. TSSOP-8 Tape and Pocket Drawings

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DFN-8 Package Drawing and Dimensions



NOTE:

1. The terminal #1 identifier is a laser marked feature.

Figure 15. DFN-8 Package Drawing

Table 3. CT310 DFN-8 Package Dimensions

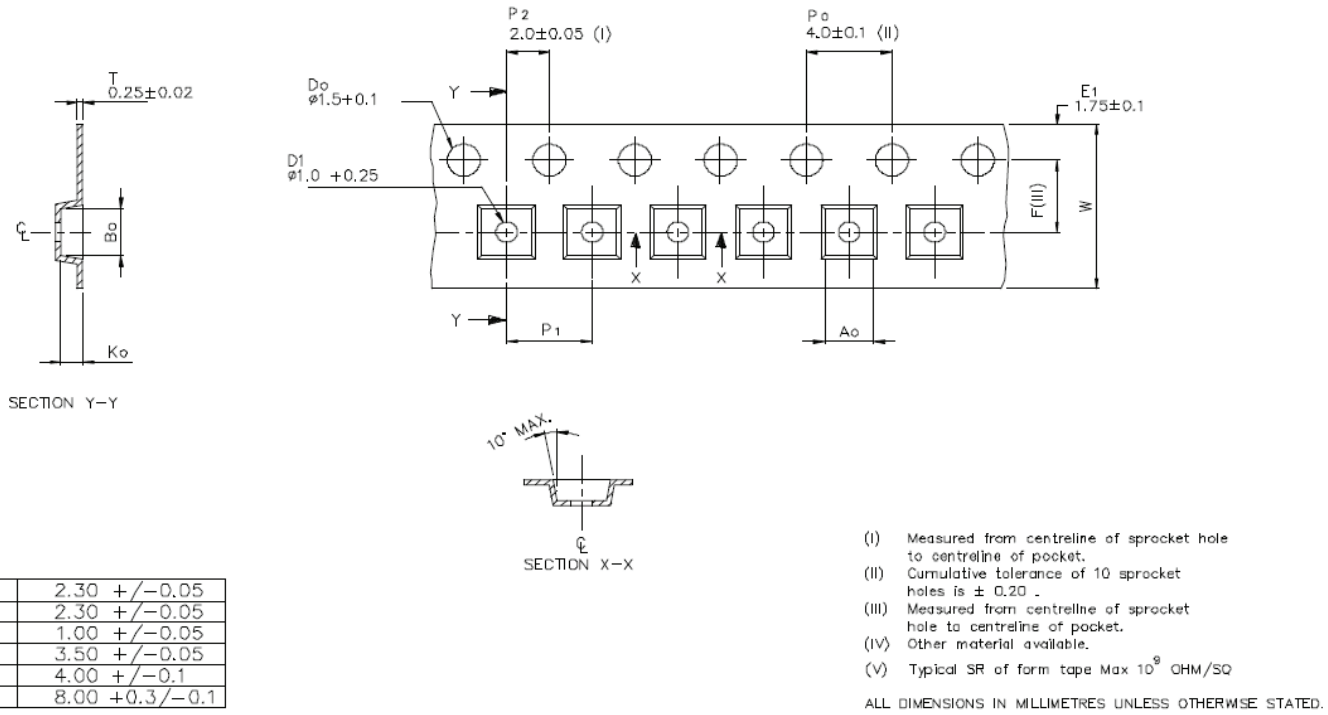
Symbol	Dimensions in Millimeters (mm)		
	Min.	Typ.	Max.
A	0.40	0.45	0.50
A1	0.00	0.02	0.05
b	0.15	0.20	0.25
c	-	0.150 REF	-
D	1.925	2.000	2.075
D2	1.550	1.600	1.650
E	1.925	2.000	2.075
E2	0.700	0.750	0.800
e	-	0.500	-
L ④	0.325	0.375	0.425
L1 ④	-	0.075	-
L3 ④	0.250	0.300	0.350
y	0.000	-	0.075

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DFN-8 Tape & Pocket Drawing and Dimensions



Ao	2.30 +/−0.05
Bo	2.30 +/−0.05
Ko	1.00 +/−0.05
F	3.50 +/−0.05
P1	4.00 +/−0.1
W	8.00 +0.3/−0.1

(I) Measured from centreline of sprocket hole to centreline of pocket.
(II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .
(III) Measured from centreline of sprocket hole to centreline of pocket.
(IV) Other material available.
(V) Typical SR of form tape Max 10^9 OHM/SQ

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

Figure 16. DFN-8 Tape and Pocket Drawings

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Package Information

Table 4. CT310 Package Information

Part Number	Package Type	# of Leads	Package Quantity	Lead Finish	Eco Plan (1)	MSL Rating (2)	Operating Temperature (3)	Device Marking
CT310LS-IT8-M	TSSOP	8	3,000	Sn	Green & RoHS	1	-40°C to +85°C	CT310LS-IT8 YYWWSS
CT310LS-HT8-M	TSSOP	8	3,000	Sn	Green & RoHS	1	-40°C to +125°C	CT310LS-HT8 YYWWSS
CT310LS-ID8-M	DFN	8	3,000	Sn	Green & RoHS	1	-40°C to +85°C	310I YWWS
CT310LS-HD8-M	DFN	8	3,000	Sn	Green & RoHS	1	-40°C to +125°C	310H 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 +165°C.

(4) Device Marking for TSSOP is defined as CT310LS-XT8 YYWWSS where CT310LS = base part number, X = temperature code, T8 = TSSOP-8 package, YY = year, WW = work week and SS = sequential number. DFN is defined as 300X where X = temperature code and Y = year, WW = work week and S = sequential number.

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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.

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