

XtremeSense™ High-Linearity, High-Resolution TMR Current Sensor with FLAG Output in Miniature Form Factor

FEATURES AND BENEFITS

- AC or DC contactless current sensing
- Inherently high isolation
- Magnetic field (current) range:
 - ± 1.5 mT
 - ± 6.0 mT
 - ± 10.0 mT
 - ± 15.0 mT
- Stable performance over temperature
- Supply current: ~ 1.2 mA
- FLAG pin to indicate 90% and 10% of full field range
 - Active low digital output (push-pull)
- Supply voltage: 2.7 to 5.5 V
- Operating temperature ranges:
 - Industrial: -40°C to 85°C
 - Extended industrial: -40°C to 125°C
- Package: 5-lead SOT23

APPLICATIONS

- Contactless current sensing measurements
- Motor control
- Solar inverters
- Power-distribution units (PDUS)
- Universal power supplies (UPSs), switched-mode power supplies (SMPSs), and telecommunication (telecom) power supplies
- Smart appliances
- Internet of things (IoT) smart plugs and energy devices
- Battery-management systems
- Battery chargers
- Personal computers (PCs) and servers

DESCRIPTION

The CT220 is a high-linearity and high-resolution contactless current sensor from Allegro developed on its patented XtremeSense™ TMR technology. The CT220 measures the magnetic field of the current flowing through a busbar or printed circuit board (PCB) trace and converts it to an analog output voltage that represents the field and therefore current.

As a contactless current sensor, it has an inherently high isolation, making it an ideal solution for applications where product safety compliance is a requirement due to high operating voltages combined with human interaction with the product. The device supports a wide operating voltage range of 2.7 to 5.5 V.

The CT220 is an ideal contactless current-sensing solution for applications that must have excellent isolation and accurate current measurements. The four variants of the CT220 each sense a different magnetic field: ± 1.5 mT, ± 6 mT, ± 10 mT, or ± 15 mT. The device also integrates a FLAG output that is active low and indicates when the field is greater than 90% or less than 10% of the full field range.

The CT220 is available in an industry-standard five-lead small-outline transistor (SOT23) package.

PACKAGE:



5-lead SOT23-5

Not to scale

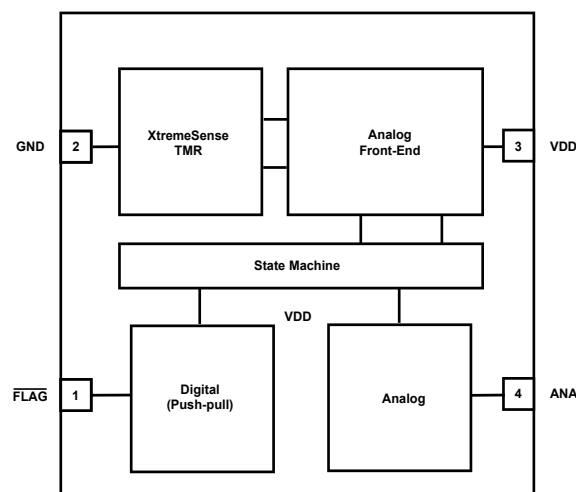


Figure 1: CT220 with Analog and FLAG Outputs in SOT23-5 Package Block Diagram

Table of Contents

Features and Benefits.....	1	Pinout Diagram and Terminal List.....	4
Description.....	1	Electrical Characteristics.....	5
Applications.....	1	Functional Description.....	11
Package.....	1	Calibration Guide.....	13
Functional Block Diagram.....	1	Applications Information.....	17
Selection Guide.....	2	Package Outline Drawing.....	20
Evaluation Board Ordering Information.....	2	Tape and Reel Pocket Drawings and Dimensions.....	21
Absolute Maximum Ratings.....	3	Package Information.....	22
Recommended Operating Conditions.....	3	Revision History.....	23

SELECTION GUIDE

Part Number	Magnetic Field Range (B _{ANA})	Sensitivity (mV/mT) V _{DD} = 5 V	Sensitivity (mV/mT) V _{DD} = 3.3 V	Operating Temperature Range (°C)
CT220BMV-IS5	±1.5 mT (±15 G)	1500	990	–40 to 85
CT220BMV-HS5				–40 to 125
CT220GMV-IS5	±6 mT (±60 G)	375	247.5	–40 to 85
CT220GMV-HS5				–40 to 125
CT220PMV-IS5	±10 mT (±100 G)	225	148.5	–40 to 85
CT220PMV-HS5				–40 to 125
CT220RMV-IS5	±15 mT (±150 G)	150	99	–40 to 85
CT220RMV-HS5				–40 to 125

EVALUATION BOARD ORDERING INFORMATION

Part Number	Current Range (mT)	Operating Temperature Range (°C)
EVB222-1.5A	±1.5	–40 to 125
EVB222-5.0A	±6	
EVB222-10A	±10	
EVB222-15A	±15	

ABSOLUTE MAXIMUM RATINGS [1]

Characteristic	Symbol	Notes	Rating	Unit
Supply Voltage Strength	V_{DD}		-0.3 to 6.0	V
Push-Pull Output (Active LOW)	$V_{FLAG\#_PP}$		-0.3 to $V_{DD} + 0.3$ [2]	V
Input/Output Pins Maximum Voltage	$V_{I/O}$		-0.3 to $V_{DD} + 0.3$ [2]	V
Magnetic Field [3]	B		35	mT
Electrostatic Discharge Protection Level	ESD	Human Body Model (HBM) per JESD22-A114	±2.0	kV
Junction Temperature	T_J		-40 to 150	°C
Storage Temperature	T_{STG}		-65 to 150	°C
Lead Soldering Temperature	T_L	10 seconds	260	°C

[1] A stress that exceeds the absolute maximum rating might damage the CT220, and the device might cease to function or operate. Any stress beyond the level listed is not recommended. In addition, extended exposure to a stress greater than the recommended operating condition might affect device reliability. The absolute maximum rating is a stress rating only.

[2] The lesser of $V_{DD} + 0.3$ V or 6 V.

[3] A magnetic field greater than the maximum rating can cause a permanent offset voltage drift.

RECOMMENDED OPERATING CONDITIONS [1]

Characteristic	Symbol	Notes	Min.	Typ.	Max.	Unit
Supply Voltage Range	V_{DD}		2.7	5.0	5.5	V
Output Voltage Range	V_{OUT}		0	–	V_{DD}	V
Output Current	I_{OUT}		–	–	±10	μA
Operating Ambient Temperature	T_A	Industrial	-40	25	85	°C
		Extended Industrial	-40	25	125	°C

[1] This table defines the conditions for actual operation of the CT220. The recommended operating conditions are specified to ensure optimal performance within the specifications. Allegro does not recommend exceeding them or designing to the absolute maximum ratings.

PINOUT DIAGRAM AND TERMINAL LIST

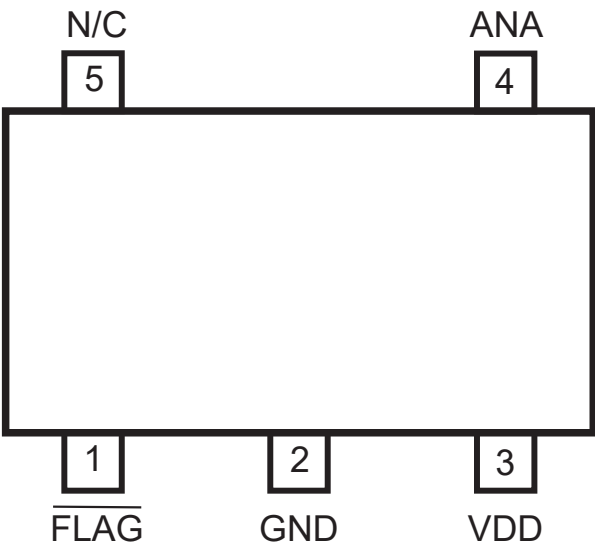


Figure 2: 5-Lead SOT23 Package, Top View

Terminal List

Number	Name	Function
1	FLAG	Outputs an active LOW flag signal to indicate when the current is greater than 90% or less than 10% of the full current range. It is a push-pull output.
2	GND	Ground
3	VDD	Supply voltage
4	ANA	Analog output voltage that represents the measured current.
5	NC	No connect

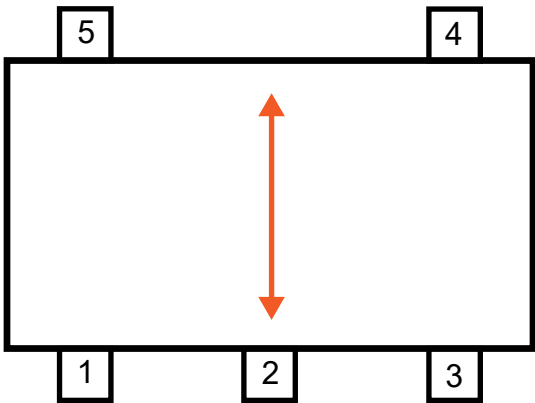


Figure 3: CT220 Axis of Sensitivity for Bipolar Magnetic Field with SOT23-5

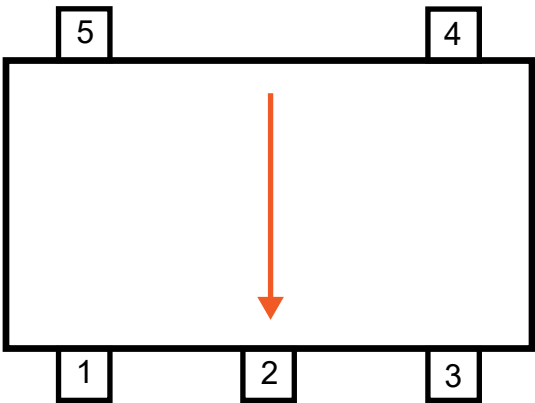


Figure 4: CT220 Recommended Axis of Sensitivity for Unipolar Magnetic Field with SOT23-5

ELECTRICAL CHARACTERISTICS: Valid for $V_{DD} = 2.7$ to 5.5 V, $C_{BYP} = 1$ μ F, and $T_A = -40^\circ\text{C}$ to 125°C , typical values are $V_{DD} = 5$ V and $T_A = 25^\circ\text{C}$, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Average Supply Current	$I_{DD(AVG)}$	$t \geq 10$ seconds	–	1.2	2.5	mA
Sampling Frequency	f_S		150	200	250	kHz
Idle Mode Time	t_{IDLE}		4	5	6.7	μ s
ANALOG OUTPUT (ANA)						
Maximum Drive Capability	$I_{DRV(MAX)}$	$\Delta V_{OUT} \leq 150$ mV, $V_{DD} \geq 3.3$ V	–10	–	10	μ A
Analog Output Voltage Range	V_{ANA}		$0.05 \times V_{DD}$	–	$0.95 \times V_{DD}$	V
Voltage Output Quiescent	V_{OQ}		48.5	50	51.5	% V_{DD}
Rise Time [1]	t_{RISE}	$B_{ANA} = B_{ANA(MAX)}$, $t_{VANA_{90\%}} - t_{VANA_{10\%}}$	–	15.5	–	μ s
Propagation Delay [1]	t_{DELAY}	$B_{ANA} = B_{ANA(MAX)}$, $t_{BANA} - t_{VANA}$ at 20% of output value	–	4.6	–	μ s
Response Time [1]	t_{RESP}	$B_{ANA} = B_{ANA(MAX)}$, $t_{BANA} - t_{VANA}$ at 90% of output value	–	20	–	μ s
Input Referred Noise Density [1]	e_{ND}	$f_{BW} = 10$ Hz, $V_{DD} = 5$ V	–	0.15	–	$\mu\text{T}_{RMS}/\sqrt{\text{Hz}}$
Output Capacitive Load	C_L		–	–	10	pF
FLAG PUSH-PULL OUTPUT (FLAG)						
FLAG Voltage LOW	V_{FLAG_OL}	Unipolar and bipolar fields	–	$0.9 \times V_{DD}$	–	V
		Bipolar field	–	$0.1 \times V_{DD}$	–	V
FLAG Voltage HIGH	V_{FLAG_OH}	Unipolar and bipolar fields	–	$0.86 \times V_{DD}$	–	V
		Bipolar field	–	$0.14 \times V_{DD}$	–	V
Current for FLAG	$I_{FLAG\#}$		–	± 2	–	mA
TIMINGS						
Power-On Time	t_{ON}	$V_{DD} \geq 2.7$ V	–	50	75	μ s
Active Mode Time	t_{ACTIVE}		–	2.5	–	μ s
PROTECTION						
Undervoltage Lockout	V_{UVLO}	Rising V_{DD}	–	2.3	2.5	V
		Falling V_{DD}	2	2.2	–	V
UVLO Hysteresis	V_{UV_HYS}		–	100	–	mV

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

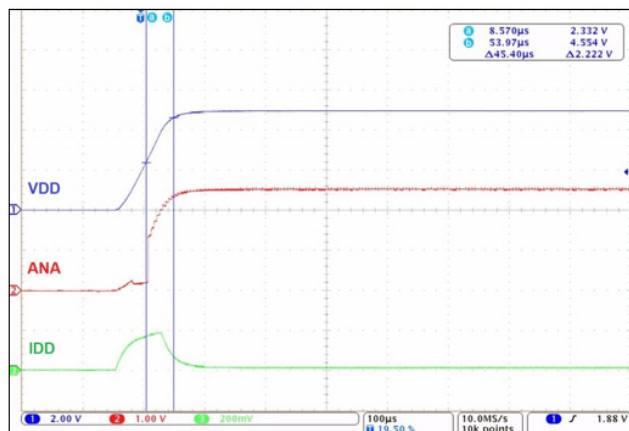
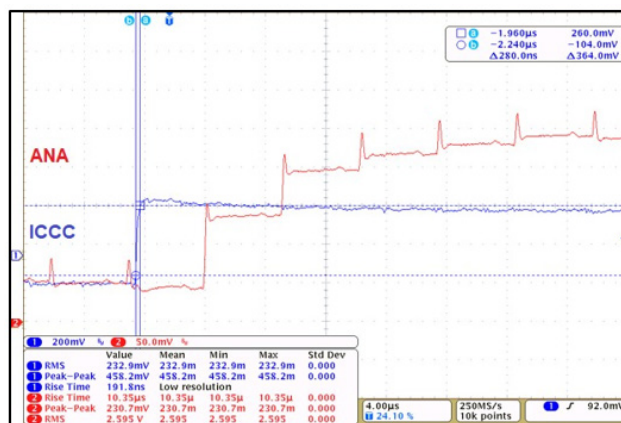
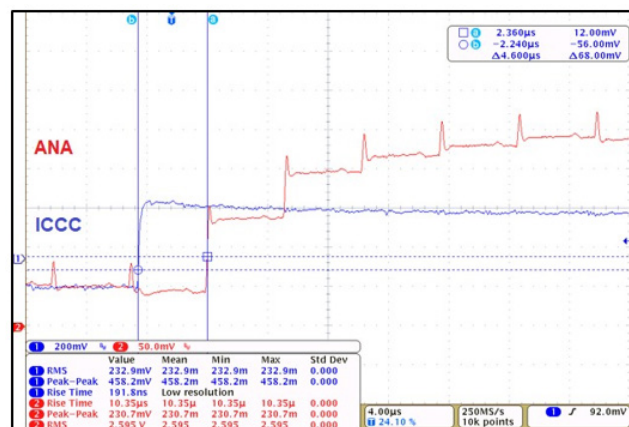
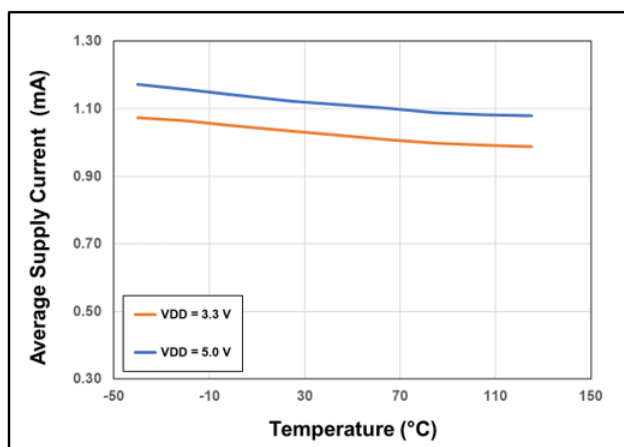
TYPICAL TIMING AND ELECTRICAL CHARACTERISTICS
 $V_{DD} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, and $C_{BYP} = 1\text{ }\mu\text{F}$ (unless otherwise specified)

Figure 5: Power-On Time for CT220

Figure 6: Rise Time for CT220

Figure 7: Propagation Delay Time for CT220

Figure 8: Response Time for CT220

Figure 9: CT220 Average Supply Current vs. Temperature vs. Supply Voltage

CT220BMx (± 1.5 mT) ELECTRICAL CHARACTERISTICS: Valid for $V_{DD} = 2.7$ to 5.5 V, $C_{BYP} = 1$ μ F, and $T_A = -40^\circ\text{C}$ to 125°C , typical values are $V_{DD} = 5$ V and $T_A = 25^\circ\text{C}$, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ. ^[1]	Max.	Unit
ANALOG OUTPUT						
Gain	G	V _{DD} = 5 V, T _A = 25°C	–	1500	–	mV/mT
		V _{DD} = 3.3 V, T _A = 25°C	–	990	–	mV/mT
Operating Magnetic Field	B _{ANA}		–1.5	–	1.5	mT
ERROR COMPONENTS						
Nonlinearity Error	e _{LIN}	Within the output full-scale range	–	±1	–	% FS
Sensitivity Error	E _{Sens}	T _A = 25°C	–	±3.5	–	%
Sensitivity Drift Over Temperature	E _{Sens_T}	T _A = 25°C to 125°C	–	±2.5	–	%
		T _A = –40°C to 25°C	–	4 ±2.5	–	%
QVO Error	V _{QVO_E}	T _A = 25°C	–	±110	–	mV
QVO Drift Over Temperature	V _{QVO_T}	T _A = 25°C to 125°C	–	30 ±40	–	mV
		T _A = –40°C to 125°C	–	–50 ±60	–	mV
NOISE						
Input Referred Noise	e _N	f _{BW} = 1 Hz to 30 kHz, V _{DD} = 5 V	–	1.76	–	μT _{RMS}
			–	2.64	–	mV _{RMS}

^[1] Typical values are the mean ± 3 sigma of the production distributions. These are formatted as mean ± 3 sigma.

CT220GMx (± 6 mT) ELECTRICAL CHARACTERISTICS: Valid for $V_{DD} = 2.7$ to 5.5 V, $C_{BYP} = 1$ μ F, and $T_A = -40^\circ\text{C}$ to 125°C , typical values are $V_{DD} = 5$ V and $T_A = 25^\circ\text{C}$, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Unit
ANALOG OUTPUT						
Gain	G	V _{DD} = 5 V, T _A = 25°C	–	375	–	mV/mT
		V _{DD} = 3.3 V, T _A = 25°C	–	247.5	–	mV/mT
Operating Magnetic Field	B _{ANA}		–6	–	6	mT
ERROR COMPONENTS						
Nonlinearity Error	e _{LIN}	Within the output full-scale range	–	±1	–	% FS
Sensitivity Error	E _{Sens}	T _A = 25°C	–	±3.5	–	%
Sensitivity Drift Over Temperature	E _{Sens_T}	T _A = 25°C to 125°C	–	±2.5	–	%
		T _A = –40°C to 25°C	–	4 ±2.5	–	%
QVO Error	V _{QVO_E}	T _A = 25°C	–	±110	–	mV
QVO Drift Over Temperature	V _{QVO_T}	T _A = 25°C to 125°C	–	30 ±20	–	mV
		T _A = –40°C to 125°C	–	–50 ±30	–	mV
NOISE						
Input Referred Noise	e _N	f _{BW} = 1 Hz to 30 kHz, V _{DD} = 5 V	–	1.76	–	μT _{RMS}
			–	2.64	–	mV _{RMS}

[1] Typical values are the mean ± 3 sigma of the production distributions. These are formatted as mean ± 3 sigma.

CT220PMx (±10 mT) ELECTRICAL CHARACTERISTICS: Valid for $V_{DD} = 2.7$ to 5.5 V, $C_{BYP} = 1$ μ F, and $T_A = -40^\circ\text{C}$ to 125°C , typical values are $V_{DD} = 5$ V and $T_A = 25^\circ\text{C}$, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Unit
ANALOG OUTPUT						
Gain	G	V _{DD} = 5 V, T _A = 25°C	–	225	–	mV/mT
		V _{DD} = 3.3 V, T _A = 25°C	–	148.5	–	mV/mT
Operating Magnetic Field	B _{ANA}		–10	–	10	mT
ERROR COMPONENTS						
Nonlinearity Error	e _{LIN}	Within the output full-scale range	–	±1	–	% FS
Sensitivity Error	E _{Sens}	T _A = 25°C	–	±3.5	–	%
Sensitivity Drift Over Temperature	E _{Sens_T}	T _A = 25°C to 125°C	–	±2.5	–	%
		T _A = –40°C to 25°C	–	4 ±2.5	–	%
QVO Error	V _{QVO_E}	T _A = 25°C	–	±110	–	mV
QVO Drift Over Temperature	V _{QVO_T}	T _A = 25°C to 125°C	–	30 ±20	–	mV
		T _A = –40°C to 125°C	–	–50 ±30	–	mV
NOISE						
Input Referred Noise	e _N	f _{BW} = 1 Hz to 30 kHz, V _{DD} = 5 V	–	1.76	–	μT _{RMS}
			–	2.64	–	mV _{RMS}

[1] Typical values are the mean ±3 sigma of the production distributions. These are formatted as mean ±3 sigma.

CT220RMx (±15 mT) ELECTRICAL CHARACTERISTICS: Valid for $V_{DD} = 2.7$ to 5.5 V, $C_{BYP} = 1$ μ F, and $T_A = -40^\circ\text{C}$ to 125°C , typical values are $V_{DD} = 5$ V and $T_A = 25^\circ\text{C}$, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Unit
ANALOG OUTPUT						
Gain	G	V _{DD} = 5 V, T _A = 25°C	–	150	–	mV/mT
		V _{DD} = 3.3 V, T _A = 25°C	–	99	–	mV/mT
Operating Magnetic Field	B _{ANA}		–15	–	15	mT
ERROR COMPONENTS						
Nonlinearity Error	e _{LIN}	Within the output full-scale range	–	±1	–	% FS
Sensitivity Error	E _{Sens}	T _A = 25°C	–	±3.5	–	%
Sensitivity Drift Over Temperature	E _{Sens_T}	T _A = 25°C to 125°C	–	±2.5	–	%
		T _A = –40°C to 25°C	–	4 ±2.5	–	%
QVO Error	V _{QVO_E}	T _A = 25°C	–	±110	–	mV
QVO Drift Over Temperature	V _{QVO_T}	T _A = 25°C to 125°C	–	30 ±20	–	mV
		T _A = –40°C to 125°C	–	–50 ±30	–	mV
NOISE						
Input Referred Noise	e _N	f _{BW} = 1 Hz to 30 kHz, V _{DD} = 5 V	–	1.76	–	μT _{RMS}
			–	2.64	–	mV _{RMS}

[1] Typical values are the mean ±3 sigma of the production distributions. These are formatted as mean ±3 sigma.

FUNCTIONAL DESCRIPTION

Overview

The CT220 is a high-resolution and low-noise contact current sensor with isolation and a FLAG output that operates from 2.7 to 5.5 V assembled in an industry-standard 5-lead SOT23 package. The chip measures the magnetic field of the current through the package and converts it to an analog signal that is equivalent to the current flowing through the printed circuit board (PCB) trace. If the CT220 observes an overcurrent condition during operation, the FLAG output asserts and alerts the host system.

Analog Output Measurement

The CT220 provides a continuous (sample and hold) linear analog output voltage that represents the measured magnetic field. The output voltage range of that ANA pin is 5% to 95% of V_{DD} , which represents the magnetic field from the minimum of the range (-1.5 to -15 mT) to the maximum of the range (1.5 to 15 mT), respectively. The output sample frequency is 200 kHz. To further lower the noise, a resistor-capacitor (RC) filter can be implemented on the ANA pin. The output voltage range of the ANA pin is illustrated as a function of the measured field for the maximum gain variant and the minimum gain variant in Figure 10 and Figure 11, respectively.

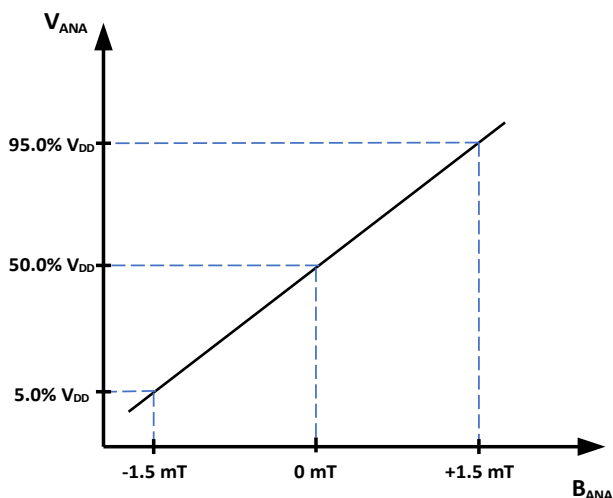


Figure 10: Linear Output Voltage Range vs. Measured Current for $G = 300 \text{ mV/V/mT}$ and Current Range of +1.5 mT.

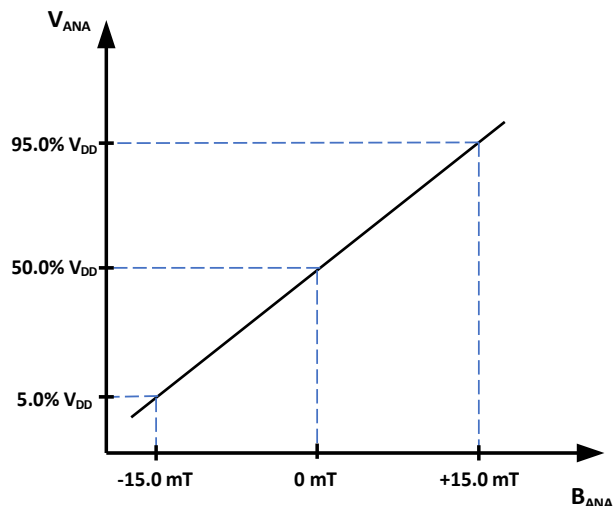


Figure 11: Linear Output Voltage Range vs. Measured Current for $G = 30 \text{ mV/V/mT}$ and Current Range of +15 mT.

Overcurrent Detection Flag

The overcurrent detection circuitry detects when the magnetic field is greater than 90% or less than 10% of the full range. As a result, it translates to greater than 90% of V_{DD} and 10% of V_{DD} on the ANA pin. This generates a flag signal via the FLAG pin to the host system microcontroller as an active LOW signal. Once V_{ANA} reduces to less than 86% or increases to greater than 14% of V_{DD} , the FLAG signal becomes high.

Rise Time (t_{RISE})

The CT220 rise time, t_{RISE} , is the duration between when the voltage reaches 10% of its full-scale output and when it reaches 90% of its full-scale output. The t_{RISE} of the CT220 is 15.5 μs .

Propagation Delay (t_{DELAY})

The propagation delay, t_{DELAY} , is the duration measured between the time the magnetic field reaches 20% of its final value and the time the CT220 reaches 20% of its full-scale output voltage. Its propagation delay is 4.6 μs .

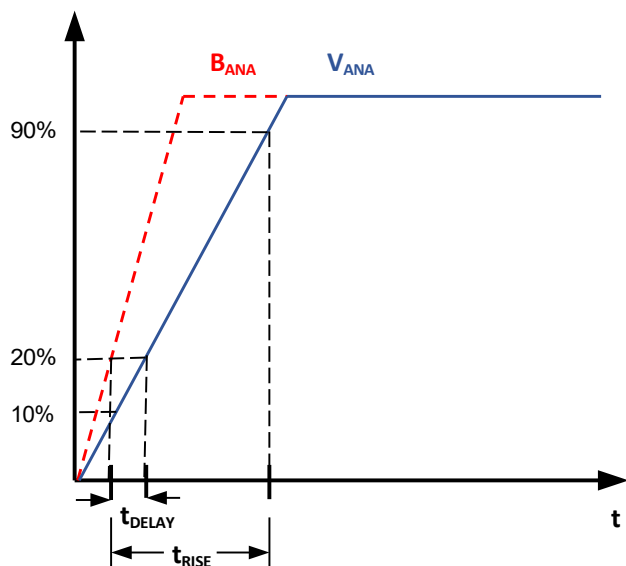


Figure 12: CT220 Propagation Delay and Rise Time Curve

Response Time (t_{RESP})

The response time, t_{RESP} , is the difference in time from when the magnetic field reaches 90% of its final value and when V_{ANA} attains 90% of its final value. The CT220 response time is typically 20 μ s.

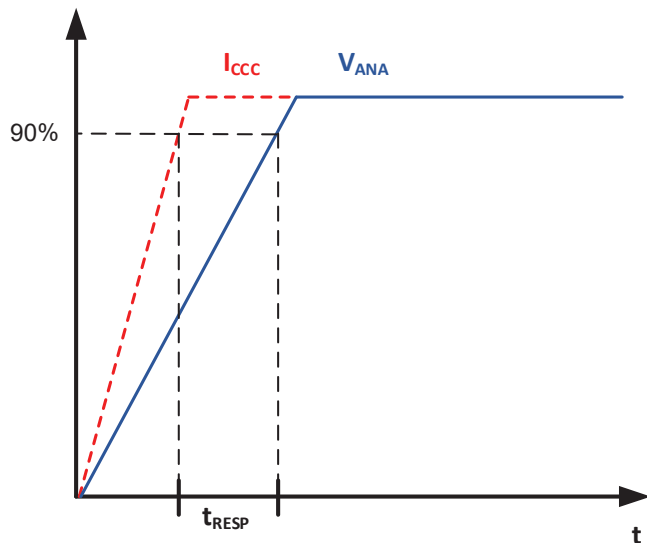


Figure 13: CT220 Response Time Curve

Power-On Time (t_{ON})

The power-on time (t_{ON}) of 50 μ s is the amount of time required by the CT220 to start up, power-on, and acquire the first sample. The chip is fully powered up and operational from the moment the supply voltage exceeds the rising UVLO point (2.3 V). This time includes ramp-up time and settling time after the power supply reaches the minimum V_{DD} .

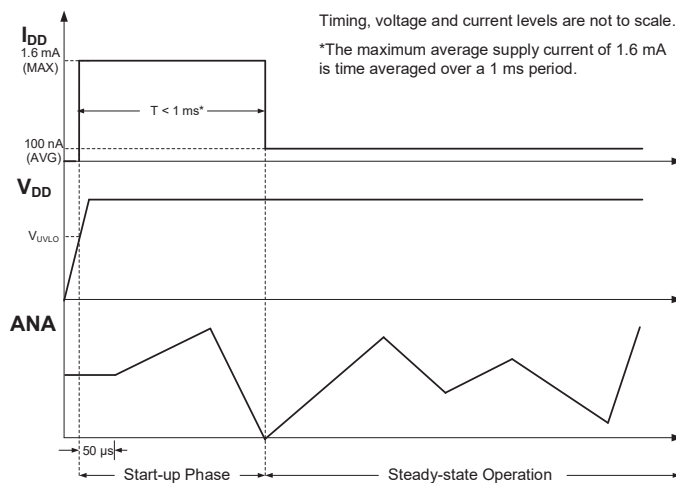


Figure 14: CT220 Power-On Timing Diagram

Undervoltage Lockout (UVLO)

The undervoltage lockout protection circuitry of the CT220 is activated when the supply voltage (V_{DD}) reduces to less than 2.1 V. The CT220 remains in a low quiescent state and the ANA output is not valid until V_{DD} increases to greater than the UVLO threshold (2.3 V).

CALIBRATION GUIDE

Introduction

A current sensor is subject to deviations from its ideal transfer line regardless of cost, construction, or factory calibration. To achieve the maximum measurement accuracy, system-level calibration is recommended. This section describes the sources of sensor error and three calibration methods of increasing complexity.

Ideal Transfer Line

The sensor output voltage is related to the applied current by a linear equation of the form:

Equation 1:

$$I_{MEAS} = (V_{OUT} - b)/a$$

where:

- V_{OUT} is the measured sensor output voltage
- a is the slope (gain coefficient)
- b is the offset coefficient

For the ideal condition, a and b are fixed constants that can be derived directly from datasheet parameters. In practice, manufacturing variations and operating conditions introduce errors in both coefficients.

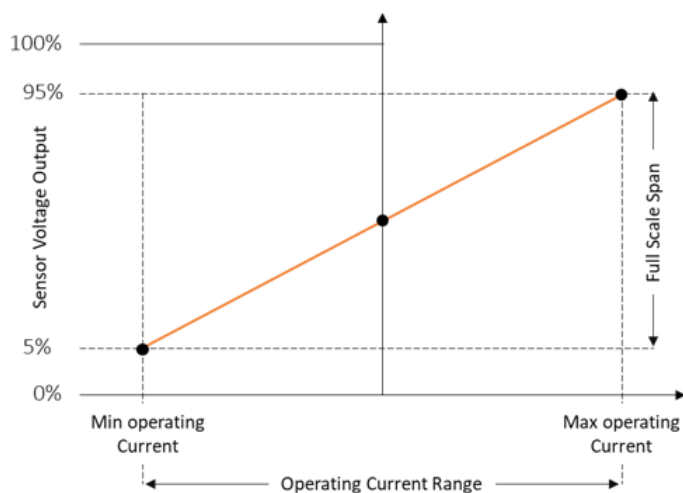


Figure 15: Ideal Transfer Line

Accuracy Errors

A deviation from the ideal transfer line is categorized as either an offset error or a gain error.

OFFSET ERROR

At zero applied current, the sensor output voltage ideally equals 50% of V_{DD} . An offset error shifts the entire transfer line up or down along the voltage axis, introducing a fixed error across all current measurements.

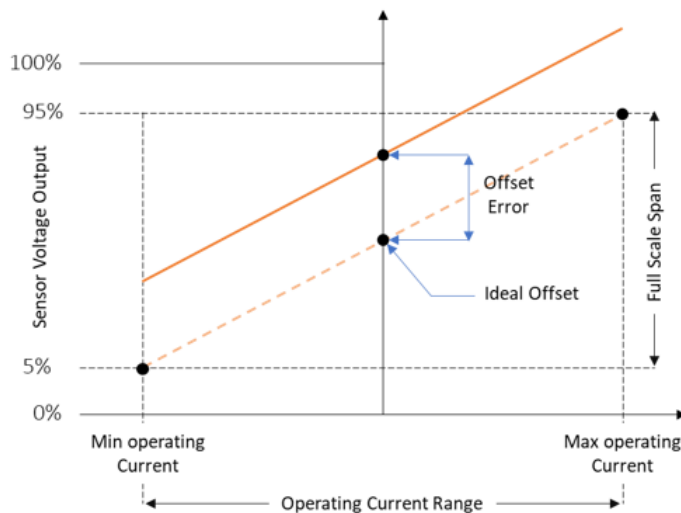


Figure 16: Offset Error (Exaggerated)

GAIN ERROR

The ideal transfer line reaches 95% of V_{DD} at the maximum rated current, and 5% of V_{DD} at the minimum rated current. A gain error changes the slope of the transfer line, producing a measurement error that increases proportionally with applied current magnitude.

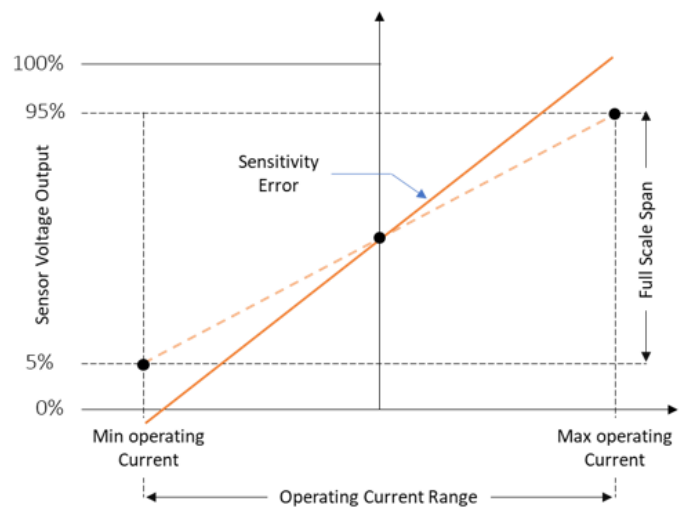


Figure 17: Gain Error (Exaggerated)

Calibration Methods

This section describes three calibration methods. Method complexity increases from Method 1 to Method 3, as does the degree of error correction achieved. The calibration method should be selected as appropriate for the accuracy requirements of the application.

METHOD 1—OFFSET CORRECTION ONLY

Use this method when gain error is negligible or when only a coarse correction is required.

1. With zero current applied to the sensor, measure and record the sensor output voltage. This measured value becomes the offset coefficient, b :

Equation 2:

$$b = V_{\text{OFFSET}}$$

2. Apply this correction to all subsequent measurements using:

Equation 3:

$$I_{\text{MEAS}} = (V_{\text{OUT}} - b)/a$$

where a is taken directly from the datasheet sensitivity parameter.

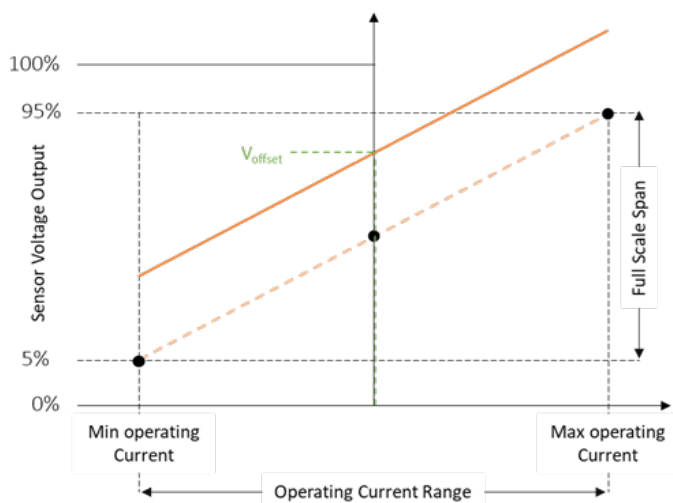


Figure 18: Method 1—Offset Correction

METHOD 2—SINGLE-POINT GAIN AND OFFSET CORRECTION

Use this method when both gain and offset errors must be corrected, and only a single-calibration current source is available.

1. With zero current applied, measure and record the sensor output voltage, b :

Equation 4:

$$b = V_{\text{OFFSET}}$$

2. Apply a known calibration current A_1 and record the corresponding sensor output voltage V_1 .

3. Calculate the slope coefficient, a :

Equation 5:

$$a = (V_1 - b)/A_1$$

4. Apply both coefficients in:

Equation 6:

$$I_{\text{MEAS}} = (V_{\text{OUT}} - b)/a$$

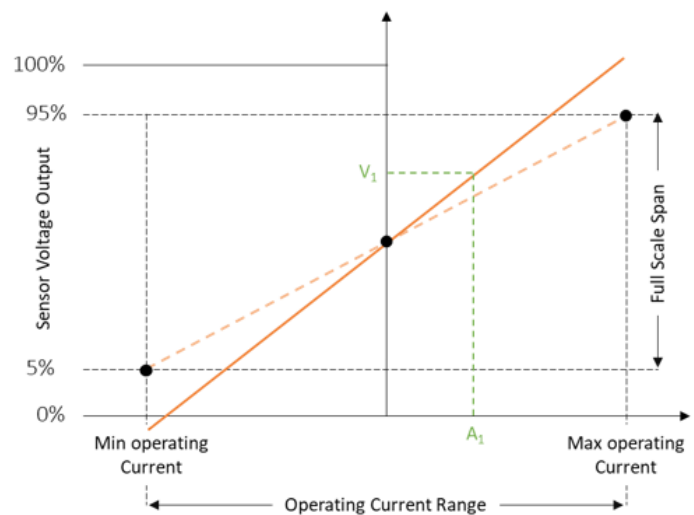


Figure 19: Method 2—Single-Point Gain Correction

METHOD 3—TWO-POINT GAIN AND OFFSET CORRECTION (RECOMMENDED)

Use this method when the maximum accuracy is required, particularly in bidirectional current-sensing applications.

This method uses two calibration points to simultaneously correct both gain and offset errors. This method eliminates the need for a separate zero-current measurement.

1. Apply a known calibration current, A_1 , and record the sensor output voltage, V_1 .
2. Apply a second known calibration current, A_2 , and record the sensor output voltage, V_2 .
3. Calculate the slope and offset coefficients:

Equation 7:

$$a = (V_1 - V_2)/(A_1 - A_2)$$

Equation 8:

$$b = [(V_1 + V_2)/2] - a \times [(A_1 + A_2)/2]$$

NOTE: For the best results, set A_1 and A_2 to the maximum and minimum expected operating currents, respectively. For bidirectional applications, select $A_1 = -A_2$.

4. Apply both coefficients in:

Equation 9:

$$I_{MEAS} = (V_{OUT} - b)/a$$

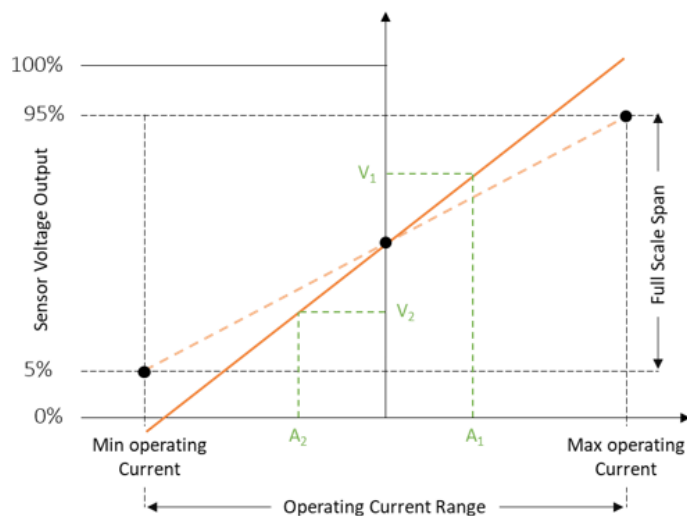


Figure 20: Method 3—Two-Point Gain and Offset Correction

APPLICATIONS INFORMATION

Overview

The CT220 measures current by sensing the magnetic field generated by current flowing through a PCB trace or busbar, requiring no electrical contact with the current-carrying conductor. This contactless architecture provides galvanic isolation between the high-current path and the signal circuitry, eliminating the need for an external isolation amplifier.

The application circuit requires a 1 μF bypass capacitor on the VDD pin. A resistor-capacitor (RC) low-pass filter on the ANA pin is recommended to reduce output noise. For the recommended circuit, refer to Figure 21; for recommended cutoff frequencies, refer to Table 2.

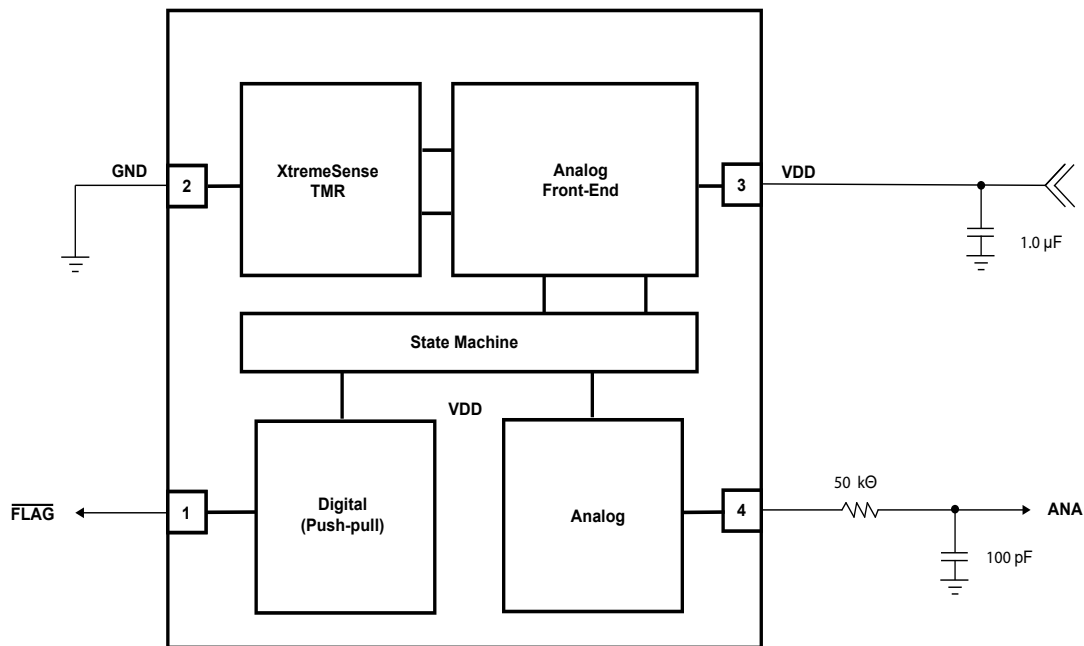


Figure 21: CT220 with Analog and FLAG Outputs
Application Block Diagram

Table 1: Recommended External Components for CT220

Component	Description	Min.	Typ.	Max.	Unit
C_{BYP}	1.0 μF , X5R or Better	—	1.0	—	μF
R_{FILTER}	50 k Ω , $\pm 5\%$	—	50	—	k Ω
C_{FILTER}	100 pF, X5R or Better	—	10	—	pF

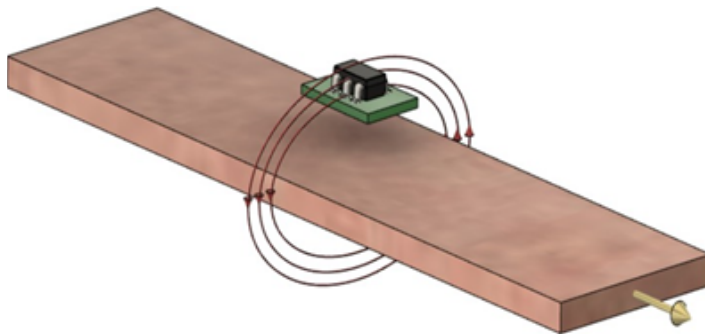
Table 2: Recommended Cutoff Frequencies for CT220 and its Resistor-Capacitor Values

Cutoff Frequency (kHz)	Resistor Value (k Ω)	Capacitor Value (pF)
1	105	1,500
10	105	150
30	50	100

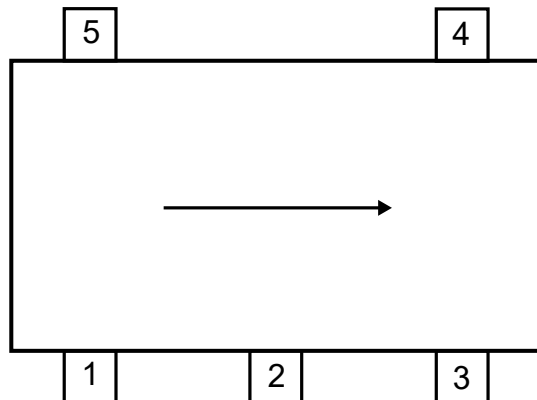
Unipolar Current Measurement

The CT220 must be placed in the correct orientation on the PCB to ensure accurate current measurement. The device axis of sensitivity is perpendicular to the package surface, directed toward Pin 1. Current flow through the conductor induces a magnetic field along this axis, which the CT220 detects.

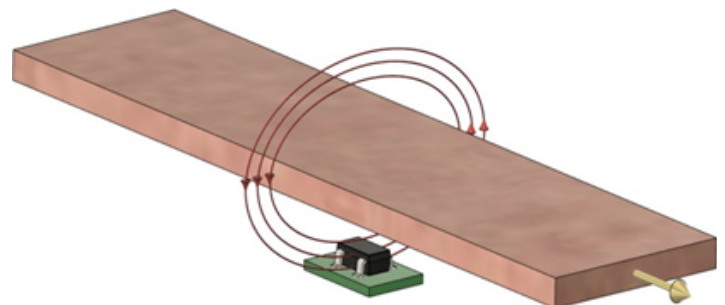
The required current direction depends on the conductor configuration. For a PCB trace on the top or bottom layer, or for a busbar positioned below the CT220, current must flow from left to right as shown in Figure 22. For a busbar positioned above the CT220, current must flow from right to left as shown in Figure 23. These directions follow from the right-hand rule applied to the geometry of each configuration.



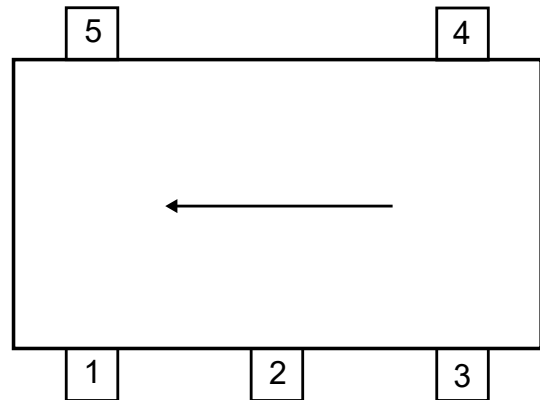
(A)



(B)



(A)



(B)

Figure 22: CT220 measuring unipolar current in a busbar below it where (A) indicates the unipolar current and magnetic field directions, and (B) is the direction of unipolar current flow that the CT220 must be oriented.

Figure 23: Measuring unipolar current of a busbar placed above the CT220 where (A) shows the direction of the unipolar current and magnetic field, and (B) is the direction of unipolar current flow with respect to the CT220 package.

TMR Sensor Location

The locations of the X and Y dimensions of the CT220 XtremeSense TMR sensor in a 5-lead SOT23 are shown in Figure 24, and the Z dimension is illustrated in Figure 25; for both, all dimensions are nominal and in millimeters (mm).

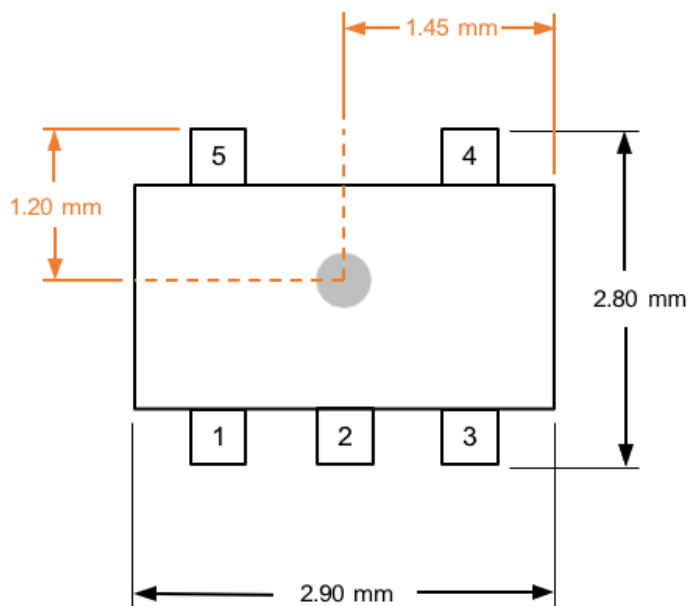


Figure 24: XtremeSense TMR Sensor Location in X and Y Dimensions for CT220 in SOT23-5 Package

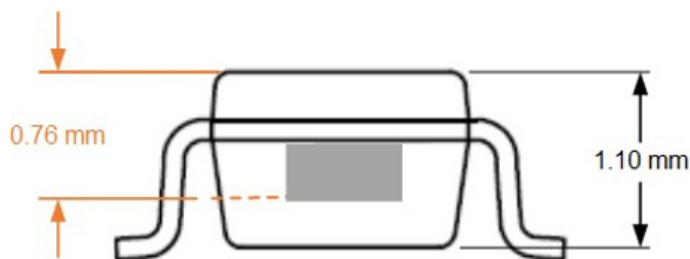


Figure 25: XtremeSense TMR Sensor Location in Z Dimension for CT220 in SOT23-5 Package

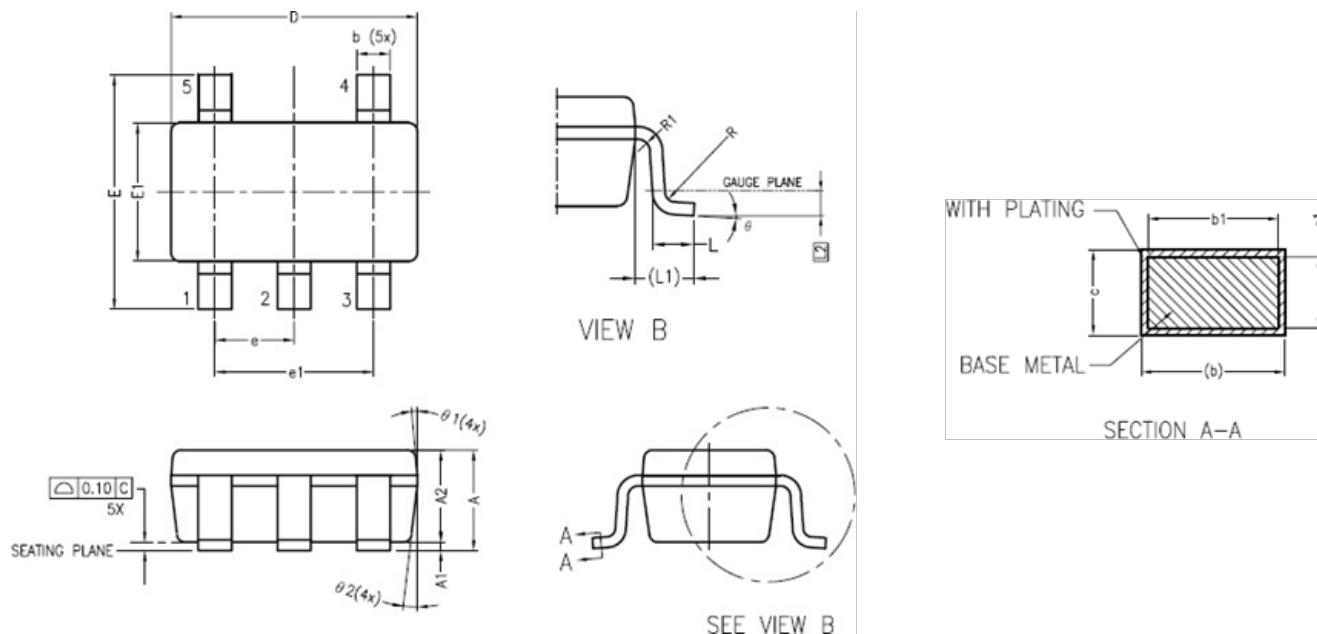
PACKAGE OUTLINE DRAWING

For Reference Only – Not for Tooling Use

Dimensions in millimeters – NOT TO SCALE

Dimensions exclusive of mold flash, gate burs, and dambar protrusions

Exact case and lead configuration at supplier discretion within limits shown



NOTES:

1. Dimension e represents the basic terminal pitch. It specifies the geometric position of the terminal axis.
2. Dimension b applies to the metalized terminal pads.
3. Dimension A includes package warpage.
4. Exposed metalized pads are Cu (Copper) pads with OSP surface.
5. All dimensions are in millimeters (mm).

Figure 26: SOT23-5 Package Drawing and Dimensions

Table 3: CT220 SOT23-5 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	—	1.20
b	0.40	—	0.50
b1	0.40	0.40	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	0.60 REF		
L2	0.25 BSC		
R	0.10	—	—
R1	0.10	—	0.25
0	0°	4°	8°
01	5°	6°	15°
02	5°	8°	15°

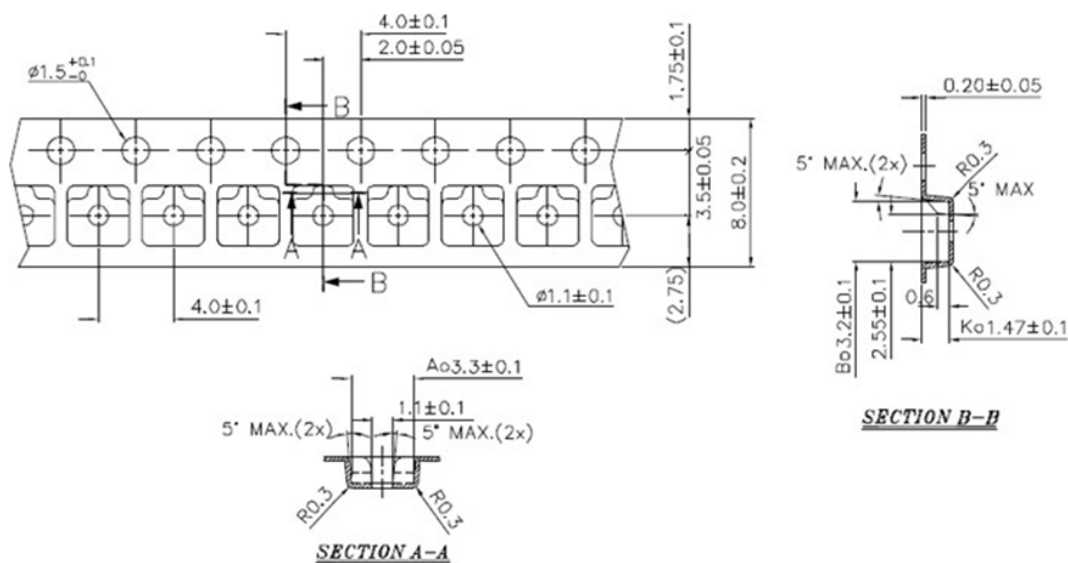
TAPE AND REEL POCKET DRAWING AND DIMENSIONS

For Reference Only – Not for Tooling Use

Dimensions in millimeters – NOT TO SCALE

Dimensions exclusive of mold flash, gate burs, and dambar protrusions

Exact case and lead configuration at supplier discretion within limits shown



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. 0/sq) means surface electric resistivity of the carrier tape.

Figure 27: Tape and Pocket Drawing for SOT23 Package

PACKAGE INFORMATION

Table 4: CT220 Package Information

Part Number	Package Type	# of Leads	Package Quantity	Lead Finish	Eco Plan ^[1]	MSL Rating ^[2]	Operating Temperature ^[3]	Device Marking ^[4]
CT220BMV-IS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 85°C	ACY WWS
CT220BMV-HS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 125°C	ACY WWS
CT220GMV-IS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 85°C	AGY WWS
CT220GMV-HS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 125°C	AGY WWS
CT220PMV-IS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 85°C	AQY WWS
CT220PMV-HS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 125°C	AQY WWS
CT220RMV-IS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 85°C	ASY WWS
CT220RMV-HS5	SOT23	5	3000	Sn	Green & RoHS	1	–40°C to 125°C	ASY WWS

^[1] RoHS is defined as a semiconductor product that complies with the current EU RoHS requirements. It also meets the requirement that the RoHS substances do not exceed 0.1% by weight in the homogeneous materials. Green is defined as the content of chlorine (Cl), bromine (Br), and antimony trioxide-based flame retardants satisfying JS709B low-halogen requirements of $\leq 1,000$ ppm.

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

^[3] Package withstands ambient temperature range of –40°C to 150°C and storage temperature range of –65°C to 160°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
1	December 15, 2023	Document rebranded and minor editorial updates.
2	March 12, 2024	Updated Selection Guide (page 2), Total Output Error Performance (pages 7, 9, 11, and 13) and Package Information (page 24).
3	May 21, 2024	Corrected Terminal List table (page 4) and minor editorial updates.
4	June 4, 2024	Added notes to package drawings (pages 22 and 23).
5	September 10, 2024	Modified description (page 1), modified electrical characteristics (pages 7, 9, 11, and 13), and corrected date of -4 revision
6	July 15, 2025	Updated magnetic field current range (page 1), Selection Guide and Evaluation Board Ordering Information tables (page 2), Electrical Characteristics table (page 9), removed CT220GMx Typical Electrical and Magnetic Characteristics section (page 10)
7	July 14, 2026	Modified description (page 1), selection guide and evaluation board ordering tables (page 2), absolute maximum rating table (page 3), device-specific electrical characteristics graphs and tables (modified tables and removed graphs; pages 7 – 10), functional description (pages 11 and 12), calibration description (pages 13 – 16), applications information (pages 17 – 19), and made minor editorial corrections throughout

Copyright 2026, Allegro MicroSystems.

Allegro MicroSystems reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the performance, reliability, or manufacturability of its products. Before placing an order, the user is cautioned to verify that the information being relied upon is current.

Allegro's products are not to be used in any devices or systems, including but not limited to life support devices or systems, in which a failure of Allegro's product can reasonably be expected to cause bodily harm.

The information included herein is believed to be accurate and reliable. However, Allegro MicroSystems assumes no responsibility for its use; nor for any infringement of patents or other rights of third parties which may result from its use.

Copies of this document are considered uncontrolled documents.

For the latest version of this document, visit our website:

www.allegromicro.com