CT430

XtremeSense® TMR Ultra-Low Noise, <1% Total Error Current Sensor

Features

- Integrated Contact Current Sensing for Low to Medium Current Ranges:
    - 0 A to +20 A
    - -20 A to +20 A
    - 0 A to +30 A
    - -30 A to +30 A
    - 0 A to +50 A
    - -50 A to +50 A
- Integrated Current Carrying Conductor (CCC)
- Linear Analog Output Voltage
- Total Error Output ≤ ±1.0% FS, -40°C to +125°C
- 1 MHz Bandwidth
- Response Time < 1.0 µs
- Reference Voltage Output for AC/DC Current Measurements
- VOUT – VREF < 1.0% (Typical)
- Low Noise Performance
- Immunity to Common Mode Fields: >50 dB
- Over-Current Detection (OCD™)
    - Out of Range Currents
- 16-Lead SOIC-Wide Package

Applications

- Solar/Power Inverters
- UPS, SMPS and Telecom Power Supplies
- Battery Management Systems
- Motor Control
- White Goods
- Power Utility Meters
- Over-Current Fault Protection

Product Description

The CT430 is a high bandwidth and ultra-low noise integrated contact current sensor that uses Crocus Technology's patented XtremeSense® TMR technology to enable high accuracy current measurements for many consumer, enterprise, and industrial applications. It supports six (6) current ranges where the integrated current carrying conductor (CCC) will handle up to 50 A of current and generates a current measurement as a linear analog output voltage. It achieves a total output error of less than ±1.0% full-scale (FS) over voltage and the full temperature range.

It has less than 1.0 µs output response time while the current consumption is about 6.0 mA and is immune to common mode fields. The CT430 has an integrated over-current detection (OCD) circuitry to identify out of range currents (OCD) with the result outputted to the fault-bar ($\overline{FLT}$) pin. The $\overline{FLT}$ is an open drain, active LOW digital signal that is activated by the CT430 to alert the microcontroller that a fault condition has occurred.

The CT430 is offered in an industry standard 16-lead SOIC-Wide package that is "green" and RoHS compliant.

Part Ordering Information

Part Number	Operating Temperature Range	Current Range	Package	Packing Method
CT430-ESWF20DR	-40°C to +85°C	0 A to +20 A	16-lead SOIC-Wide 10.20 x 10.31 x 2.54 mm	Tape & Reel
CT430-HSWF20DR	-40°C to +125°C			
CT430-ESWF20MR	-40°C to +85°C	-20 A to +20 A		
CT430-HSWF20MR	-40°C to +125°C			
CT430-ESWF30DR	-40°C to +85°C	0 A to +30 A		
CT430-HSWF30DR	-40°C to +125°C			
CT430-ESWF30MR	-40°C to +85°C	-30 A to +30 A		
CT430-HSWF30MR	-40°C to +125°C			
CT430-ESWF50DR	-40°C to +85°C	0 A to +50 A		
CT430-HSWF50DR	-40°C to +125°C			
CT430-ESWF50MR	-40°C to +85°C	-50 A to +50 A		
CT430-HSWF50MR	-40°C to +125°C			

Evaluation Board Ordering Information

Part Number	Current Range	Operating Temperature Range
CTD430-20DC	0 A to +20 A	-40°C to +85°C
CTD430-20AC	-20 A to +20 A	
CTD430-30DC	0 A to +30 A	
CTD430-30AC	-30 A to +30 A	
CTD430-50DC	0 A to +50 A	
CTD430-50AC	-50 A to +50 A	

Block Diagram

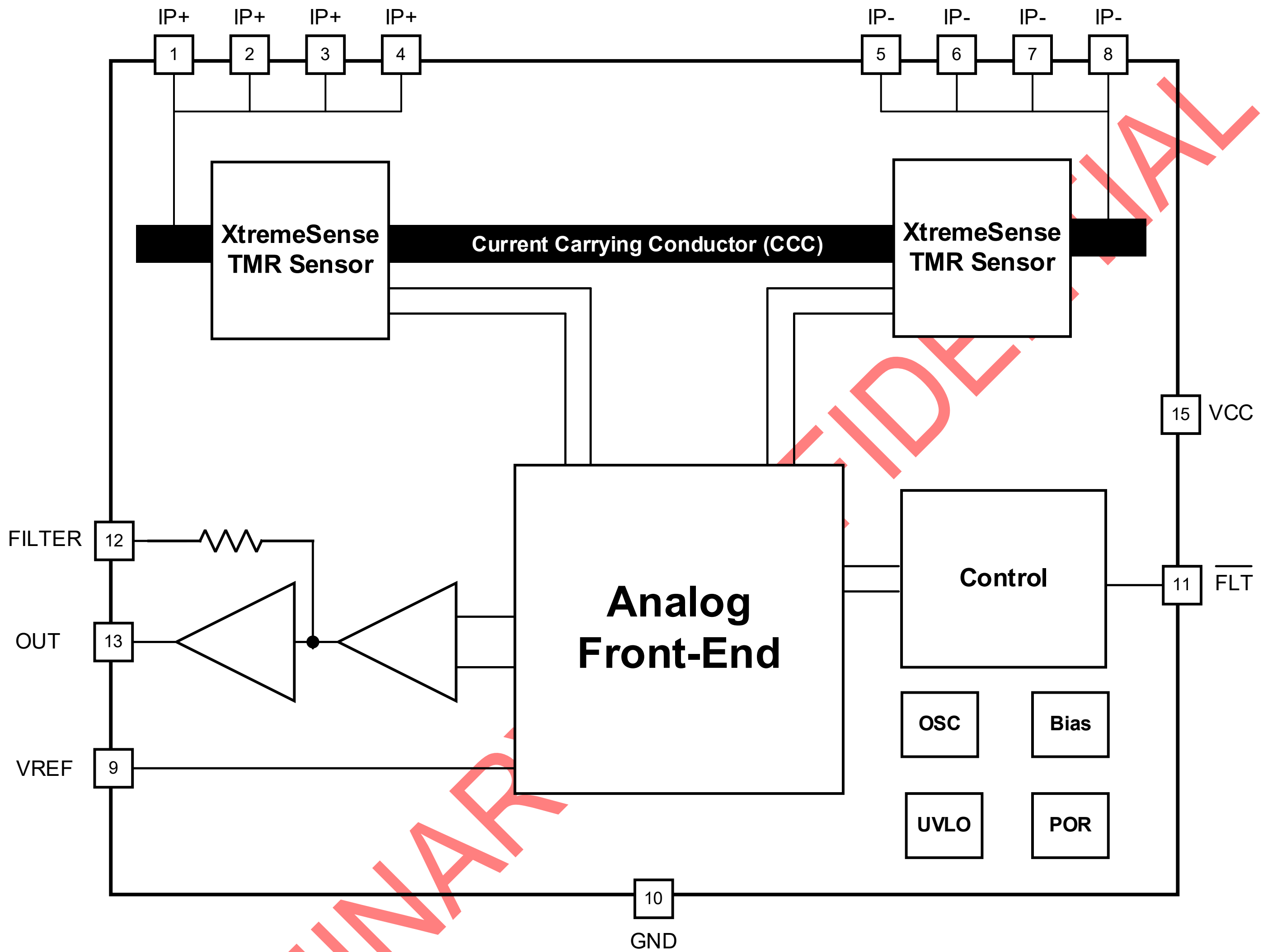


Figure 1. CT430 Functional Block Diagram for 16-lead SOIC-Wide Package

Application Diagram

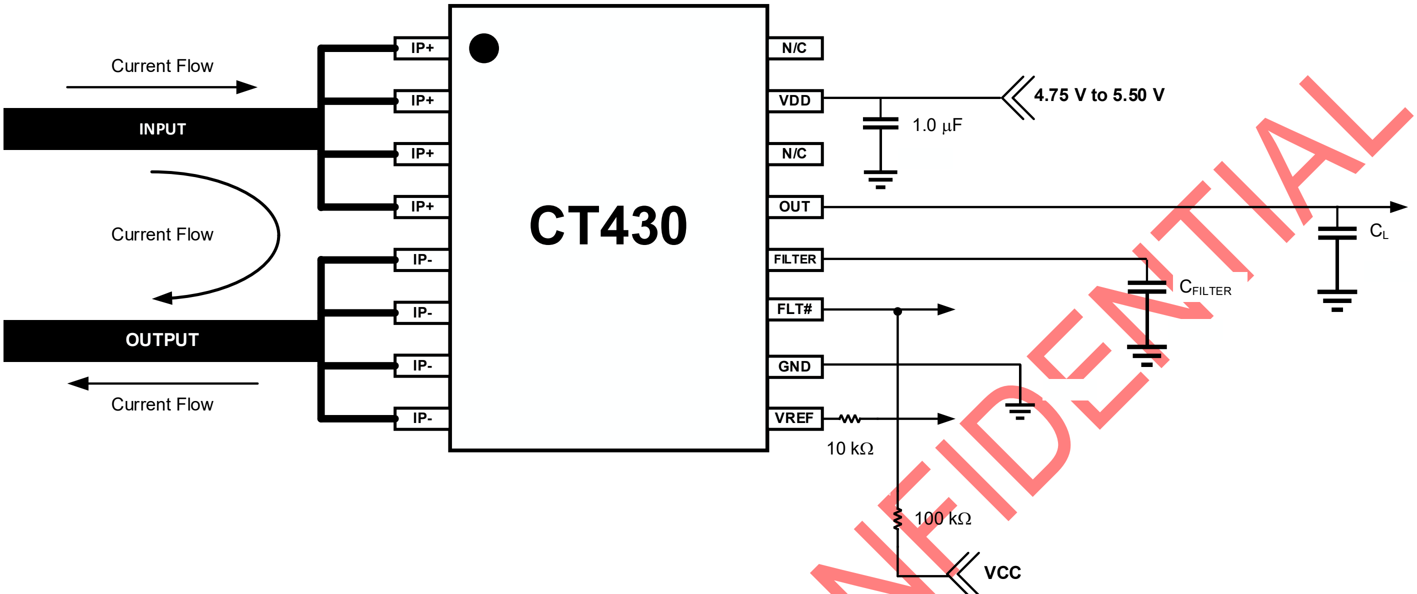


Figure 2. CT430 Application Block Diagram

Table 1. Recommended External Components

Component	Description	Vendor & Part Number	Parameter	Min.	Typ.	Max.	Unit
C_{BYP}	1.0 µF, X5R or Better	Murata GRM155C81A105KA12	C		1.0		µF
$R_{FLT\#}$	100 kΩ Pull-up Resistor	Various	R1		100		kΩ
R_{VREF}	10 kΩ Resistor	Various	R2		10		kΩ

CT430 Pin Configuration

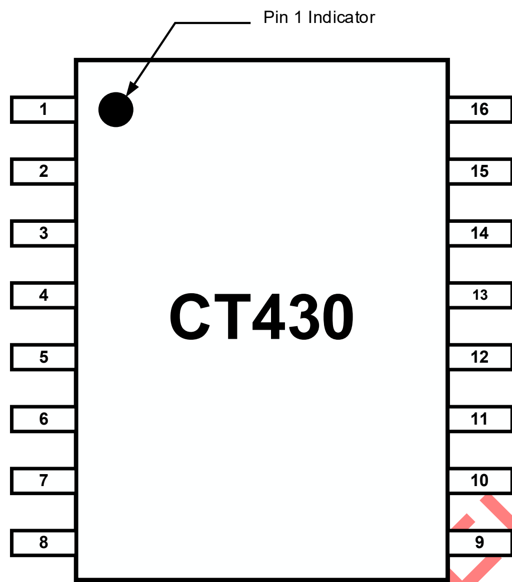


Figure 3. CT430 Pin-out Diagram for 16-lead SOIC-Wide Package (Top Down View)

Pin Definition

Pin #	Pin Name	Pin Description
1	IP+	Input primary conductor (positive).
2		
3		
4		
5	IP-	Output primary conductor (negative).
6		
7		
8		
9	VREF	Reference voltage output. If not used, then do not connect.
10	GND	Ground.
11	$\overline{FLT}$	Active LOW output fault signal (open drain output) to indicate that the following parameters are outside of normal operational bounds: • Over-Current Detection • UVLO If not used, then do not connect.
12	FILTER	Filter pin to improve noise performance by connecting an external capacitor to set the cut-off frequency.
13	OUT	Analog output voltage that represents the measured current.
14	N/C	No connect.
15	VCC	Supply voltage.
16	N/C	No connect

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the CT430 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_{CC}	Supply Voltage		-0.3	6.0	V
$V_{I/O}$	Analog Input/Output Pins Maximum Voltage		-0.3	V_{CC} + 0.3*	V
$I_{CCC(MAX)}$	Current Carrying Conductor, T_A = +25°C			60	A
V_{ISO}	Rated Isolation Voltage per IEC 60950-1:2005 (includes AMD1:2009 and AMD2:2013) and UL1577		TBD		kV_{RMS}
V_{WORK_ISO}	Working Voltage for Basic Isolation per IEC 60950-1:2005 (includes AMD1 :2009 and AMD2 :2013)		TBD		V_{PK}
			TBD		V_{RMS}
ESD	Electrostatic Discharge Protection Level	Human Body Model (HBM) per JESD22-A114	2.0		kV
		Charged Device Model (CDM) per JESD22-C101	0.5		
T_J	Junction Temperature		-40	+150	°C
T_{STG}	Storage Temperature		-65	+155	°C
T_L	Lead Soldering Temperature, 10 Seconds			+260	°C

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

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual operation of the CT430. 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_{CC}	Supply Voltage Range		4.75	5.00	5.50	V
V_{OUT}	OUT Voltage Range		0		V_{CC}	V
I_{OUT}	OUT Current				±1.0	mA
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 not to exceed junction temperature $T_{J(MAX)}$ at a given ambient temperature T_A.

Symbol	Parameter	Min.	Typ.	Max.	Unit
θ_{JA_SOICW}	Junction-to-Ambient Thermal Resistance, SOICW-16		TBD		°C/W

Electrical Specifications

General Parameters

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Power Supplies						
I_{CC}	Supply Current	f_{BW} = 1 MHz No load, I_P = 0 A		6.0	9.0	mA
I_{OUT}	OUT Maximum Drive Capability (1)	OUT covers 10% to 90% of V_{CC} span.	-1.0		+1.0	mA
C_{L_OUT}	OUT Capacitive Load (1)				100	pF
R_{L_OUT}	OUT Resistive Load (1)			100		kΩ
I_{VREF}	VREF Maximum Drive Capability (1)		-50		+50	µA
C_{L_VREF}	VREF Capacitive Load (1)				10	pF
R_{L_VREF}	VREF Resistive Load (1)			100		kΩ
R_{FILTER}	Internal Filter Resistance (1)			15		kΩ
R_{IP}	Primary Conductor Resistance (1)			0.5		mΩ
Analog Output (OUT)						
V_{OUT}	OUT Voltage Linear Range	V_{SIG_AC} = ±2.00 V V_{SIG_DC} = +4.00 V	0.50		4.50	V
V_{OUT_SAT}	Output High Saturation Voltage	V_{OUT}, T_A = +25°C,	V_{CC} - 0.30	V_{CC} - 0.25		V
CMR	Common Mode Rejection (1)			50		dB
TCS	Temperature Coefficient of Sensitivity	Absolute Value T_A = -40°C to +125°C		10	40	ppm/°C
TCO	Temperature Coefficient of Offset (1)	Absolute Value T_A = -40°C to +125°C		0.16		% FS
Reference Voltage (VREF)						
V_{REF}	Reference Voltage	DC Current (Unipolar)		0.50		V
		AC Current (Bipolar)		2.50		
Fault Output ($\overline{FLT}$)						
$V_{FLT\#\_OL}$	$\overline{FLT}$ Voltage LOW	$I_{FLT\#\_OUT} \leq$ 20 mA	0		0.5	V
$I_{LEAK\_FLT\#}$	High Impedance Output Leakage Current	$V_{FLT\#\_OH}$ = V_{CC}		5		µA
RPU	$\overline{FLT}$ Pull-up Resistor			100		kΩ
Timings						
t_{ON}	Power-On Time (1)	$V_{CC} \geq$ 2.50 V		100	200	µs
t_{RISE}	Rise Time (1)	I_P = $I_{RANGE(MAX)}$, T_A = +25°C		0.7	1.0	µs
$t_{RESPONSE}$	Response Time (1)			0.7	1.0	µs
t_{DELAY}	Propagation Delay (1)			0.3		µs

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Protection						
V_{UVLO}	Under-Voltage Lockout	Rising V_{CC}		2.50		V
		Falling V_{CC}		2.45		V
V_{UV_HYS}	UVLO Hysteresis			50		mV
I_{OCD_U}	Over-Current Detection for DC Current (Unipolar)	Rising I_P		$1.1 \times I_{RANGE(MAX)}$		A
		Falling I_P		$0.9 \times I_{RANGE(MAX)}$		
I_{OCD_B}	Over-Current Detection for AC Current (Bipolar)	Rising I_P		$\pm 1.1 \times I_{RANGE(MAX)}$		A
		Falling I_P		$\pm 0.9 \times I_{RANGE(MAX)}$		
I_{OCD_HYS}	Over-Current Detection Hysteresis			$0.2 \times I_{RANGE(MAX)}$		A

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

CT430-xSWF20DR: 0 A to +20 A

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RANGE}	Current Range		0		+20	A
V_{OQ}	Voltage Output Quiescent	T_A = +25°C, I_P = 0 A	0.495	0.500	0.505	V
V_{OUT} - V_{REF}	OUT – VREF Offset Voltage	V_{CC} = 5.0 V T_A = -40°C to +125°C			TBD	mV
S	Sensitivity	$I_{RANGE(MIN)} < I_P < I_{RANGE(MAX)}$		200		mV/A
E_{OUT}	Total Output Error	$I_P = I_{P(MAX)}$		±1.0		% FS
E_{LIN}	Non-Linearity Error	I_P = 0 A to +20 A		±0.3		% FS
f_{BW}	Bandwidth (1)	Small Signal = -3 dB C_{FILTER} = 5 pF		1.0		MHz
e_N	Noise (1)	T_A = +25°C, f_{BW} = 100 kHz		TBD		mA_{RMS}

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

CT430-xSWF20MR: -20 A to +20 A

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RANGE}	Current Range		-20		+20	A
V_{OQ}	Voltage Output Quiescent	T_A = +25°C, I_P = 0 A	2.495	2.500	2.505	V
V_{OUT} - V_{REF}	OUT – VREF Offset Voltage	V_{CC} = 5.0 V T_A = -40°C to +125°C			TBD	mV
S	Sensitivity	$I_{RANGE(MIN)} < I_P < I_{RANGE(MAX)}$		100		mV/A
E_{OUT}	Total Output Error	$I_P = I_{P(MAX)}$		±1.0		% FS
E_{LIN}	Non-Linearity Error	I_P = -20 A to +20 A		±0.3		% FS
f_{BW}	Bandwidth (1)	Small Signal = -3 dB C_{FILTER} = 5 pF		1.0		MHz
e_N	Noise (1)	T_A = +25°C, f_{BW} = 100 kHz		TBD		mA_{RMS}

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

CT430-xSWF30DR: 0 A to +30 A

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RANGE}	Current Range		0		+30	A
V_{OQ}	Voltage Output Quiescent	T_A = +25°C, I_P = 0 A	0.495	0.500	0.505	V
V_{OUT} - V_{REF}	OUT – VREF Offset Voltage	V_{CC} = 5.0 V T_A = -40°C to +125°C			TBD	mV
S	Sensitivity	$I_{RANGE(MIN)} < I_P < I_{RANGE(MAX)}$		133.3		mV/A
E_{OUT}	Total Output Error	$I_P = I_{P(MAX)}$		±0.5	±1.0	% FS
E_{LIN}	Non-Linearity Error	I_P = 0 A to +30 A		±0.3	±0.5	% FS
f_{BW}	Bandwidth (1)	Small Signal = -3 dB C_{FILTER} = 5 pF		1.0		MHz
e_N	Noise (1)	T_A = +25°C, f_{BW} = 100 kHz		5.1		mA_{RMS}

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

CT430-xSWF30MR: -30 A to +30 A

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RANGE}	Current Range		-30		+30	A
V_{OQ}	Voltage Output Quiescent	T_A = +25°C, I_P = 0 A	2.495	2.500	2.505	V
V_{OUT} - V_{REF}	OUT – VREF Offset Voltage	V_{CC} = 5.0 V T_A = -40°C to +125°C			TBD	mV
S	Sensitivity	$I_{RANGE(MIN)} < I_P < I_{RANGE(MAX)}$		66.7		mV/A
E_{OUT}	Total Output Error	$I_P = I_{P(MAX)}$		±0.5	±1.0	% FS
E_{LIN}	Non-Linearity Error	I_P = -30 A to +30 A		±0.3	±0.5	% FS
f_{BW}	Bandwidth (1)	Small Signal = -3 dB C_{FILTER} = 5 pF		1.0		MHz
e_N	Noise (1)	T_A = +25°C, f_{BW} = 100 kHz		6.7		mA_{RMS}

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

CT430-xSWF50DR: 0 A to +50 A

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RANGE}	Current Range		0		+50	A
V_{OQ}	Voltage Output Quiescent	T_A = +25°C, I_P = 0 A	0.495	0.500	0.505	V
V_{OUT} - V_{REF}	OUT – VREF Offset Voltage	V_{CC} = 5.0 V T_A = -40°C to +125°C			TBD	mV
S	Sensitivity	$I_{RANGE(MIN)} < I_P < I_{RANGE(MAX)}$		80		mV/A
E_{OUT}	Total Output Error	$I_P = I_{P(MAX)}$		±0.5	±1.0	% FS
E_{LIN}	Non-Linearity Error	I_P = 0 A to +50 A		±0.3	±0.5	% FS
f_{BW}	Bandwidth (1)	Small Signal = -3 dB C_{FILTER} = 5 pF		1.0		MHz
e_N	Noise (1)	T_A = +25°C, f_{BW} = 100 kHz		TBD		mA_{RMS}

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

CT430-xSWF50MR: -50 A to +50 A

Unless otherwise specified: V_{CC} = 4.75 V to 5.50 V, T_A = -40°C to +125°C, C_{BYP} = 1.0 µF. Typical values are V_{CC} = 5.00 V and T_A = +25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RANGE}	Current Range		-50		+50	A
V_{OQ}	Voltage Output Quiescent	T_A = +25°C, I_P = 0 A	2.495	2.500	2.505	V
V_{OUT} - V_{REF}	OUT – VREF Offset Voltage	V_{CC} = 5.0 V T_A = -40°C to +125°C			TBD	mV
S	Sensitivity	$I_{RANGE(MIN)} < I_P < I_{RANGE(MAX)}$		40		mV/A
E_{OUT}	Total Output Error	I_P = -50 A to +50 A		±0.5	±1.0	% FS
E_{LIN}	Non-Linearity Error	Small Signal = -3 dB C_{FILTER} = 10 pF		±0.3	±0.5	% FS
f_{BW}	Bandwidth (1)	Small Signal = -3 dB		1.0		MHz
e_N	Noise (1)	T_A = +25°C, f_{BW} = 100 kHz		TBD		mA_{RMS}

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

Circuit Description

Overview

The CT430 is a very high accuracy contact current sensor with an integrated current carrying conductor (CCC) that handles up to 50 A. It has very high sensitivity and a wide dynamic range with excellent accuracy (very low total output error) across temperature. This current sensor supports six (6) current ranges:

- 0 A to +20A
- -20 A to +20 A
- 0 A to +30 A
- -30 A to +30 A
- 0 A to +50 A
- -50 A to +50 A

When current is flowing through the CCC, the XtemeSense TMR sensors inside the chip senses the field which in turn generates a differential voltage signals that then goes through the Analog Front-End (AFE) to output a current measurement with less than ±1.0% full-scale (FS) total output error (E_{OUT}).

The chip is designed to enable a very fast response time of 0.7 µs for the current measurement from the OUT pin as the bandwidth for the CT430 is 1.0 MHz. Even with a high bandwidth, the chip consumes a minimal amount of power.

Linear Output Current Measurement

The CT430 provides a continuous linear analog output voltage which represents the current measurement. The output voltage range of OUT is from 0.50 V to 4.50 V with a V_{OQ} of 0.50 V and 2.50 V for unidirectional and bidirectional currents, respectively. Figure 4 illustrates the output voltage range of the OUT pin as a function of the measured current.

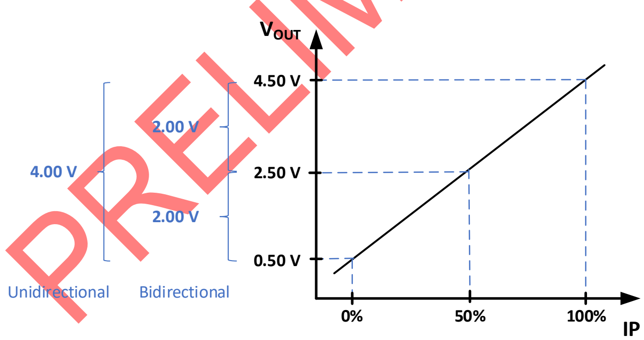


Figure 4. Linear Output Voltage Range (OUT) vs. Measured Current (IP)

Filter Function (FILTER)

The CT430 has a pin for the FILTER function which will enable it to improve the noise performance by changing the cut-off frequency. The bandwidth of the CT430 is 1.0 MHz however by adding a capacitor to the FILTER pin which will be in series with an internal resistance of approximately 15 kΩ will set the cut-off frequency to reduce the noise.

Table 2 shows the capacitor values required to achieve four (4) cut-off frequencies.

$$f_{Cut-off} = \frac{1}{2\pi RC}$$

Table 2. R-C Filter Options for FILTER Pin

Cut-off Frequency	C_{FILTER} (pF)	Capacitor Part Number
100 kHz	47	GRM0225C1C470JA02
250 kHz	20	GRM0225C1C200JA02
500 kHz	10	GRM0225C1C100JA03
1.0 MHz	5	GRM0225C1C5R0CA03

Voltage Reference Function (VREF)

The CT430 has a reference voltage (VREF) pin that may be used as an output voltage reference for AC or DC current measurements. The VREF pin should be connected to a buffer circuit.

If the VREF is not used, then it should be left unconnected.

Sensitivity

The Sensitivity (S) is a change in CT430's output in response to a change in 1 A of current flowing through the CCC. It is defined by the product of the magnetic circuit sensitivity (G/A, where 1.0 G = 0.1 mT) and the chip's linear amplifier gain (mV/G). Therefore, the result of this gives a sensitivity unit of mV/A. The CT430 is factory calibrated to optimize the sensitivity for the full scale of the device's dynamic range.

Total Output Error

The Total Output Error is the difference between the current measured by CT430 and the actual current, relative to the actual current. It is equivalent to the ratio between the difference of the ideal and actual voltage to the ideal sensitivity multiplied by the current flowing through the primary conductor (CCC). The following equation defines the Total Output Error (E_{OUT}) for the CT430:

$$E_{OUT} = \frac{V_{IOUT\_IDEAL}(I_P) - V_{IOUT}(I_P)}{S_{IDEAL}(I_P) \times I_P}$$

The E_{OUT} incorporates all sources of error and is a function of the sensed current (I_P) from CT430. At high current levels, the E_{OUT} will be dominated by the sensitivity error whereas at low current, the dominant characteristic is the offset voltage. Figure 5 shows the behavior of E_{OUT} versus I_P. When I_P goes to 0 from both directions, the curves exhibit asymptotic behavior i.e. E_{OUT} approaches infinity.

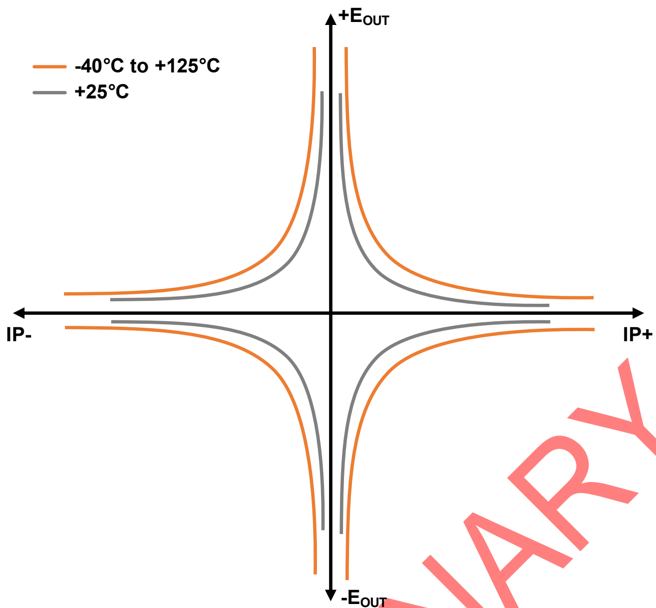


Figure 5. Total Output Error (E_{OUT}) vs. Sensed Current (IP)

The CT430 achieves a total output error (E_{OUT}) that is less than ±1.0% of Full-Scale (FS) over supply voltage and temperature. It is designed with innovative and proprietary TMR sensors and circuit blocks to provide very accurate current measurements regardless of the operating conditions.

Power-On Time (t_{ON})

The Power-On Time (t_{ON}) of 100 µs is the amount of time required by CT430 to start up, fully power the chip and becoming fully operational from the moment the supply voltage is applied to it. 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 has reached the minimum V_{CC}.

Response Time ($t_{RESPONSE}$)

The Response Time ($t_{RESPONSE}$) of 0.7 µs for the CT430 is the time interval between the following terms:

1. When the primary current signal reaches 90% of its final value,
2. When the chip reaches 90% of its output corresponding to the applied current.

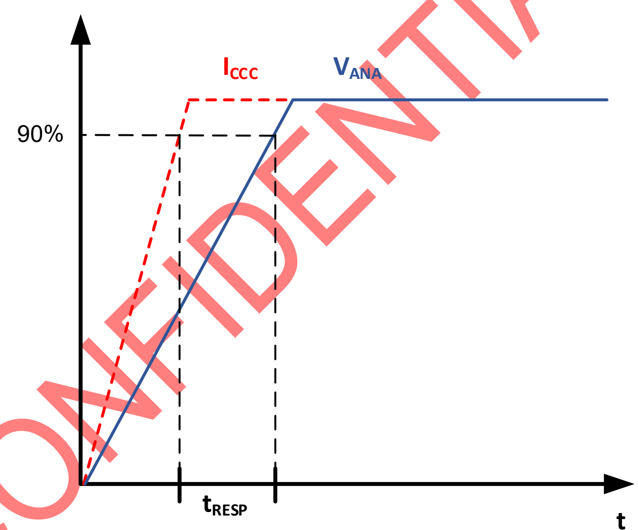


Figure 6. CT430 Response Time Curve

Rise Time (t_{RISE})

The CT430's rise time, t_{RISE}, is the time interval of when it reaches 10% and 90% of the full-scale output voltage. The t_{RISE} of the CT430 is 0.7 µs.

Propagation Delay (t_{DELAY})

The Propagation Delay (t_{DELAY}) is the time difference between these two events:

1. When the primary current reaches 20% of its final value
2. When the chip reaches 20% of its output corresponding to the applied current.

The CT430 has a propagation delay of 0.3 µs.

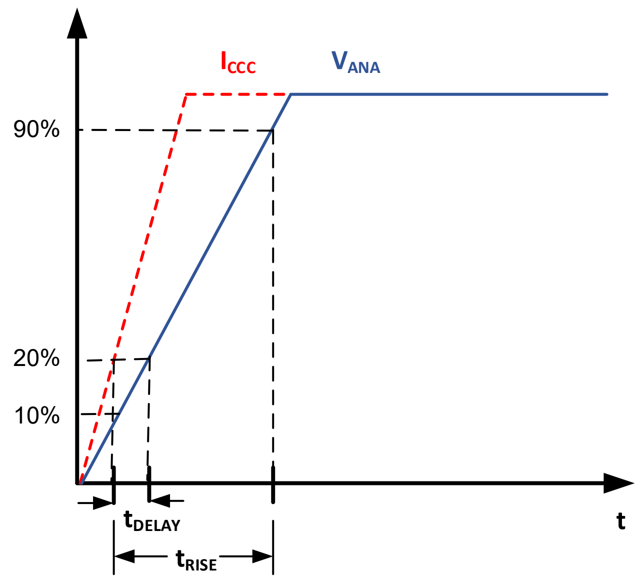


Figure 7. CT430 Propagation Delay and Rise Time Curve

Over-Current Detection (OCD)

The Over-Current Detection (OCD) circuitry detects measured current values that are 110% above the maximum current range value of the CT430 for the unipolar (DC current) variant. For the bipolar (AC current) variant of the CT430 it is greater than ±110% of the maximum current range. This will generate a fault signal via the Fault# Interrupt ($\overline{\text{FLT}}$) pin (LOW) to the host system's microcontroller. Once the measured current falls to 90% of the maximum current range for the DC current variant or ±90% for the AC current version then the fault will be cleared, and the $\overline{\text{FLT}}$ pin will go HIGH.

Under-Voltage Lockout (UVLO)

The Under-Voltage Lock-out protection circuitry of the CT430 is activated when the supply voltage (V_{CC}) falls below 2.45 V. The CT430 remains in a low quiescent state until V_{CC} rises above the UVLO threshold (2.50 V). In this condition where the V_{CC} is less than 2.45 V and UVLO is triggered, the output from the CT430 is not valid and the $\overline{\text{FLT}}$ pin will go LOW. Once the V_{CC} rises above 2.50 V then the UVLO is cleared and the $\overline{\text{FLT}}$ pin will be HIGH.

Fault# Interrupt ($\overline{\text{FLT}}$)

The CT430 generates an active LOW digital fault signal via the $\overline{\text{FLT}}$ pin to interrupt the microcontroller to indicate a fault event has been triggered. It is an open drain output and requires a pull-up resistor with a value of 100 kΩ tied to V_{CC}. A fault signal will interrupt the host system for these events:

- OCD
- UVLO

The $\overline{\text{FLT}}$ signal will be asserted LOW whenever one of the above fault events occur. In the case of an UVLO event, the $\overline{\text{FLT}}$ pin will stay LOW until the fault is cleared and then go HIGH.

If the $\overline{\text{FLT}}$ is not used, then it should be left unconnected.

Immunity to Common Mode Fields

The CT430 is housed in custom plastic packages that utilize a "U-shaped" lead-frame to reduce the common mode fields generated as current flows through the CCC. With the "U-shaped" lead-frame, the stray fields cancel one another thus reducing electro-magnetic interference (EMI).

Also, good PCB layout of the CT430 will optimize performance and reduce EMI. Please see the Applications Information section in this data sheet for recommendations on PCB layout.

Applications Information

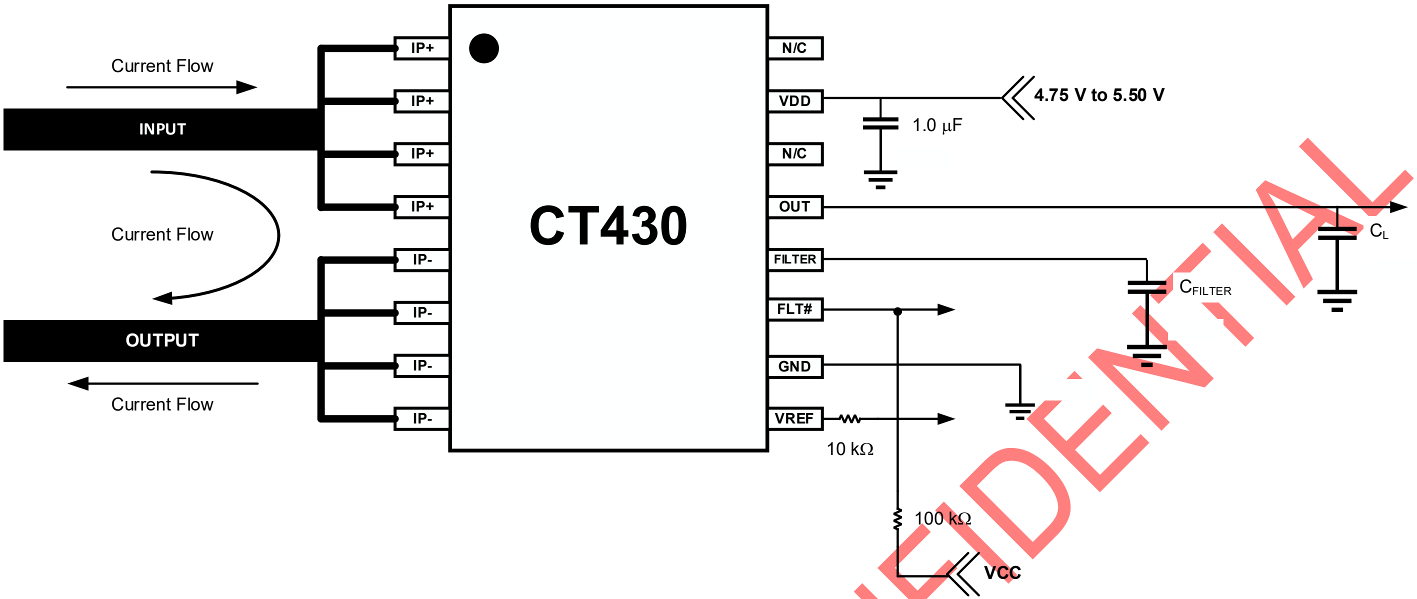


Figure 8. CT430 Application Block Diagram

Application

The CT430 is an integrated contact current sensor that can be used in many applications from measuring current in power supplies to motor control to over-current fault protection. It is a plug-and-play solution in that no calibration is required and it outputs to a microcontroller a simple linear analog output voltage which corresponds to a current measurement value. A second output called FLT# alerts the host system to any fault event that may occur in the CT430. Figure 8 is an application diagram of how CT430 would be implemented in a system. The third output is the VREF which provides the output reference voltage of the CT430.

It is designed to support an operating voltage range of 4.75 V to 5.50 V, but it is ideal to use a 5.0 V power supply where the output tolerance is less than ±5%.

Bypass Capacitor

A single 1.0 µF capacitor is needed for the VCC pin to reduce the noise from the power supply and other circuits. This capacitor should be placed as close as possible to the CT430 to minimize inductance and resistance between the two devices.

Filter Capacitor

A capacitor may be added to the FILTER pin of the CT430 if there is a requirement to improve the noise performance. The capacitor will be connected to an internal resistor of 15 kΩ inside the chip to form a R-C filter. This R-C filter produces a cut-off frequency that will reduce the noise over this lower bandwidth.

$\overline{\text{FLT}}$ and VREF Resistors

For the CT430, the FLT# pin is an open drain output. It requires a pull-up resistor value of 100 kΩ to be connected from the pin to V_{CC}.

In designs where the VREF pin is used, a 10 kΩ resistor must be connected as close to the pin as possible in series with a load.

If the FLT# and/or VREF pins are not needed in the application, then these pins should not be connected and be left floating.

Recommended PCB Layout

Since the CT430 can measure up to 50 A of current, special care must be taken in the printed circuit board (PCB) layout of the CT430 and the surrounding circuitry. It is recommended that the CCC pins be connected to as much copper area as possible. It is also recommended that 2 oz. or heavier copper be used for PCB traces when the CT430 is used to measure 50 A of current. Additional layers of the PCB should also be used to carry current and be connected using the arrangement of vias.

SOIC W-16 Package Drawing and Dimensions

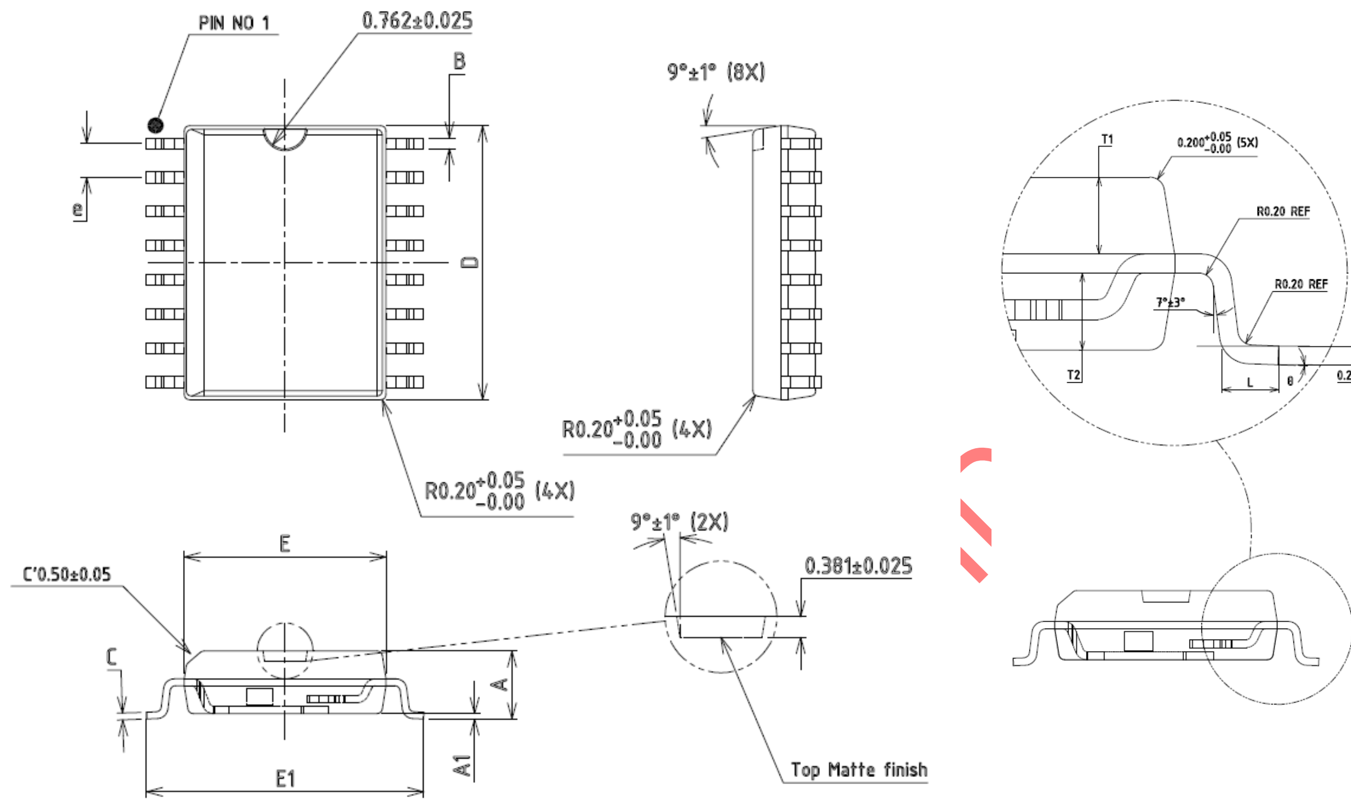


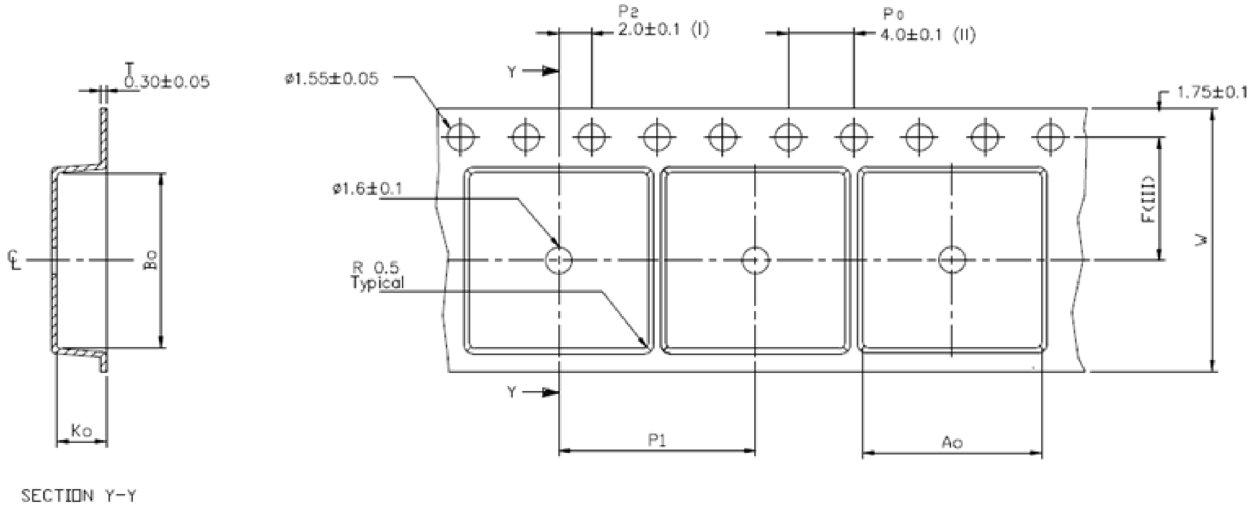
Figure 9. SOICW-16 Package Drawing

Table 3. CT430 SOICW-16 Package Dimensions

Symbol	Dimensions in Millimeters (mm)		
	Min.	Typ.	Max.
A	2.490	2.540	2.590
A1	0.150	0.200	0.250
B	0.350	0.400	0.450
C	0.204	0.254	0.304
D	10.175	10.200	10.225
E		7.50	7.525
E1	10.210	10.310	10.410
e		1.27 BSC	
L	0.660	0.760	0.860
N		16	
T1	1.015	1.040	1.065
T2	1.015	1.040	1.065
θ	-2°	2°	4°

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.

SOICW-16 Tape & Pocket Drawing and Dimensions



Ao	10.90 +/− 0.1
Bo	10.70 +/− 0.1
Ko	3.00 +/− 0.1
F	7.50 +/− 0.1
P1	12.00 +/− 0.1
W	16.00 +/− 0.3

(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 10. SOICW-16 Package Drawing

CT430 Tape Pocket Orientation

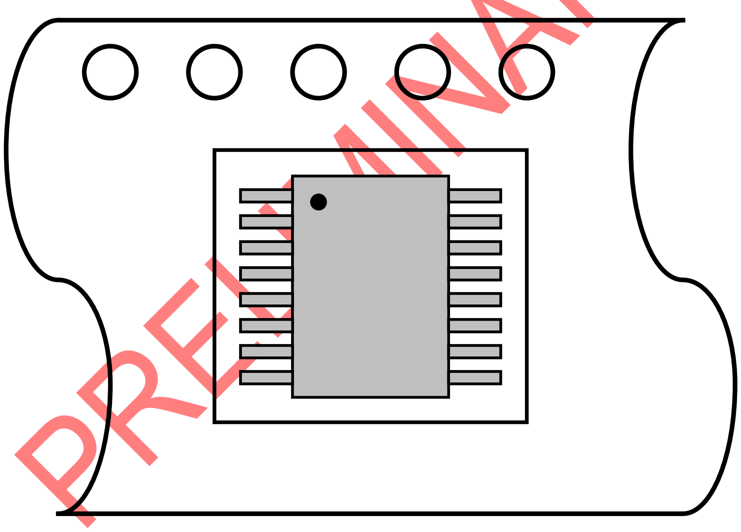


Figure 11. SOICW-16 Orientation in Tape Pocket

Package Information

Table 4. CT430 Package Information

Part Number	Package Type	# of Leads	Package Quantity	Lead Finish	Eco Plan (1)	MSL Rating (2)	Operating Temperature (3)	Device Marking
CT430-ESWF20DR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +85°C	CT430 ESWF20DR
CT430-HSWF20DR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +125°C	CT430 HSWF20DR
CT430-ESWF20MR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +85°C	CT430 ESWF20MR
CT430-HSWF20MR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +125°C	CT430 HSWF20MR
CT430-ESWF30DR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +85°C	CT430 ESWF30DR
CT430-HSWF30DR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +125°C	CT430 HSWF30DR
CT430-ESWF30MR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +85°C	CT430 ESWF30MR
CT430-HSWF30MR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +125°C	CT430 HSWF30MR
CT430-ESWF50DR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +85°C	CT430 ESWF50DR
CT430-HSWF50DR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +125°C	CT430 HSWF50DR
CT430-ESWF50MR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +85°C	CT430 ESWF50MR
CT430-HSWF50MR	SOIC-W	16	1,500	Sn	Green & RoHS	1	-40°C to +125°C	CT430 HSWF50MR

(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 +125°C and storage temperature range of -65°C to +150°C.

Device Marking

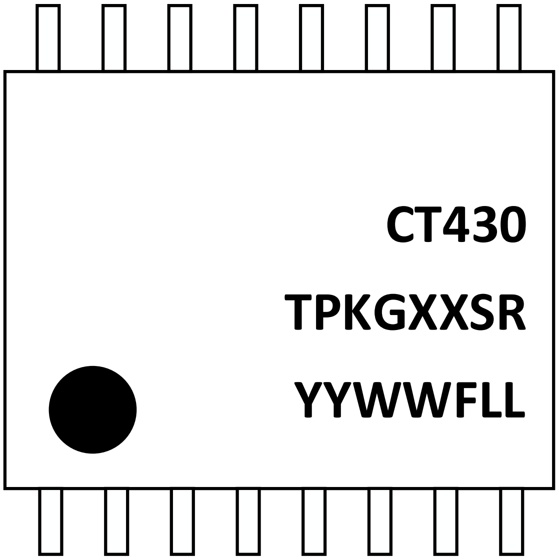


Figure 12. CT430 Device Marking for 16-lead Package

Row No.	Code	Definition
3	•	Pin 1 Indicator
1	CT430	Crocus Part Number
2	T	Temperature
2	PKG	Package Type
2	XX	Maximum Current Rating
2	SR	Current Range
3	YY	Calendar Year
3	WW	Work Week
3	F	Factory Code
3	LL	Lot Code

Table 5. CT430 Device Marking Definition for 16-lead SOIC-W Package

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.