DATASHEET

RELEASED 10/18/16

Octal Precision Current Source w/Comparators

PCS5038

Features

- **Radiation Performance**
  - Total dose ≥100 krad(Si), Dose rate = 50-300 rads(Si)/s
- Designed for temperature monitoring with Thermistors and RTDs (Resistance Temperature Detectors)
- **Eight high precision current sources**
  - One external resistor to set source current
  - Source current range from 100uA to 2mA
  - Accuracy to less than ± 1.50% over full operating range
  - Sensor voltage monitoring comparator on each precision current source output
  - Turn all eight sources ON/OFF with ENA_PCS_H input pin
  - Long term stability
  - Low Drift
- **Internal Band Gap regulator**
  - High Precision 2.0V output
  - Provided for use to generate V_{REF} comparator inputs
- **Packaging** – Hermetic ceramic
  - 40 leads, 0.600"Sq x 0.120"Ht quad flat pack
  - Weight: 4.5 gm max
- **Radiation Hardness Assurance Plan: DLA Certified to MIL-PRF-38534, Appendix G**.
- **Eight voltage monitoring comparators**
  - High impedance sensor interface
  - Two groups of 4 comparators with separate V_{REF} and Enable input pins
  - Provided for built-in monitoring of the voltage generated by the current sources
  - Can be used as an octal comparator by turning off all current sources with ENA_PCS_H set to logic 0
- Zener protected inputs
- Single +5V supply voltage
- Low supply current
- Designed for aerospace and high reliability space applications

General Description

The PCS5038 contains eight precision current sources that can be set with a single external resistor connected to the R_Iset pin. The current source was designed for thermistor current monitor and resistive sensor applications.

The precision current source outputs can be set to source from 100uA to 2mA each. Two-to-eight of the current source outputs can be paralleled to produce multiple current source outputs levels. The output current of each current source will follow the current set by the external resistor and the precision voltage at the R_Iset pin. The output current precision is a function of the voltage at the R_Iset pin and the chosen resistor's characteristics. The comparator inputs will monitor the current source output voltage, with a trip point set by an external reference voltage or the internal reference voltage.

A precision internal 2.0V reference is provided. The comparators are arranged as two banks of four with separate Enable and voltage reference inputs. A Current Source Enable is also provided. See Figure 1. All Enable inputs are active high. All comparators are inverting with their outputs pulled-up internally by a nominal 10k ohm resistor. Any unused current source outputs can be left open circuit without affecting other I/O's. Each current source output will track the other seven current source outputs as long as the voltage generated by the resistor sensor does not exceed 2.0V below the supply voltage (V_{CC}-2.0V). Higher sensor voltages can be accommodated by increasing the supply voltage.

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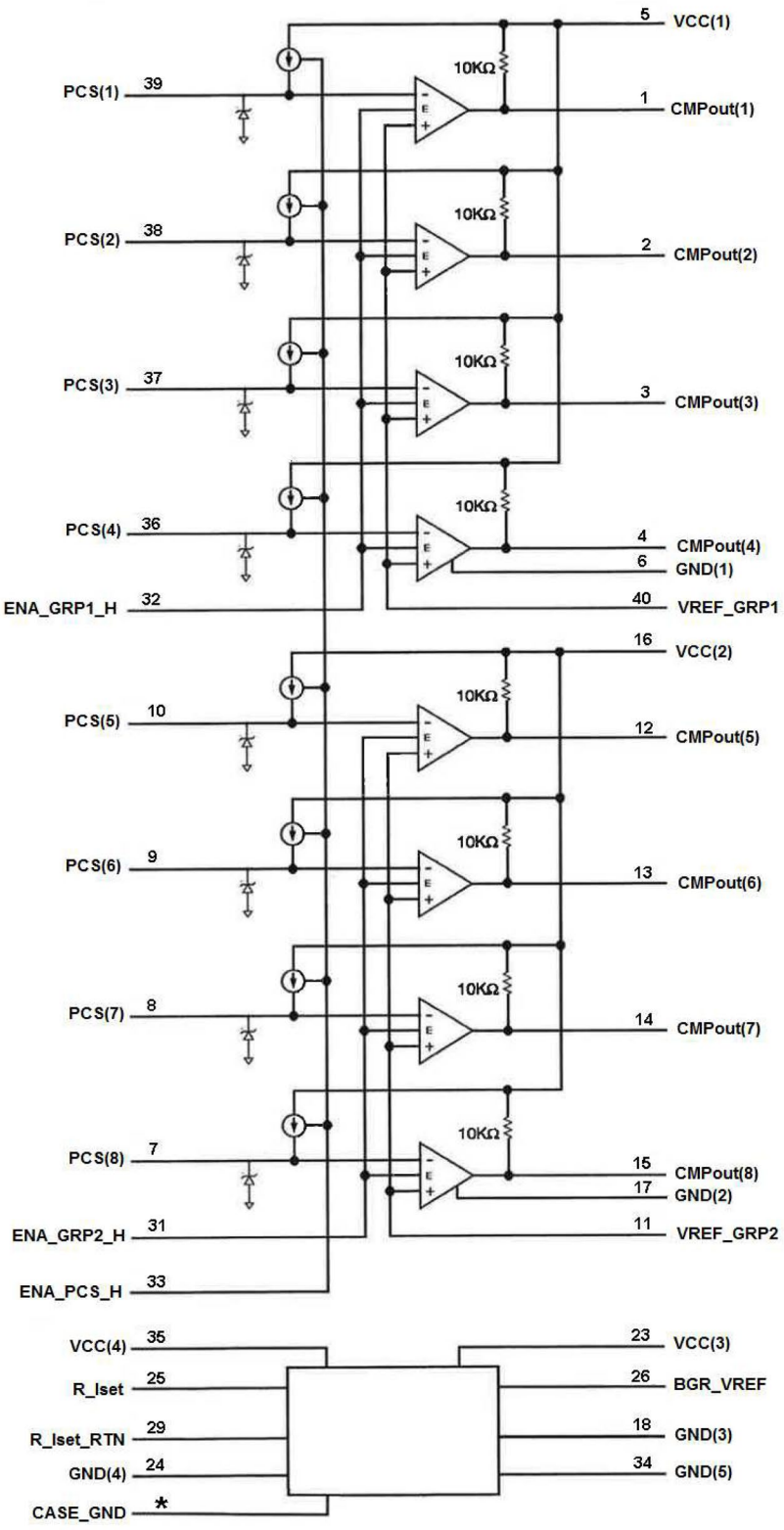

Figure 1- Block Diagram

Note:

*I/O Pins 19, 20, 21, 22, 27, 28 and 30 are connected to CASE and should be grounded

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Absolute Maximum Ratings

Parameter	Rating
Operating Case Temperature	-55°C to +125°C
Storage Case Temperature	-65°C to +150°C
Power Supply Voltages (V_{CC})	+7.0 V_{DC}

Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress rating only; functional operation beyond the "Operation Conditions" is not recommended and extended exposure beyond the "Operation Conditions" may affect device reliability.

Electrical Characteristics

(V_{CC} = +5.0V_{DC} ±5%, T_C = -55°C To +125°C, Unless otherwise specified)

Parameter	Symbol	Condition		MIN	MAX	Unit
Precision Current Source Out (1-8) I_{PCS} = 100ua	$I_{PCS_{ON}}$	External Set Resistor Tolerance = +/- 0.1% TC ≤ +/- 10ppm ENA_PCS_H = Hi ENA_GRP1_H = Hi ENA_GRP2_H = Hi 1/	+25°C	98	102	uA
			+125°C	97.5	102	
			-55°C	96	104	
			4/	96	104	
Precision Current Source Out (1-8) I_{PCS} = 2ma			+25°C	1.965	2.025	mA
			+125°C	1.955	2.025	
			-55°C	1.915	2.065	
			4/	1.92	2.08	
Precision Current Source Out (1-8) 100ua ≤ I_{PCS} ≤ 2ma	$I_{PCS_{OFF}}$	ENA_PCS_H = Lo ENA_GRP1_H = Hi ENA_GRP2_H = Hi 1/, 4/		-	1100	nA
Current Source Matching Accuracy	I_{MATCH}	Relative to Mean of $I_{PCS_{ON}}$(1:8) 4/	+25°C	-1.50	1.50	%
Comparator In Voltage	V_{IN}	Input or Reference, 2/		0	3.0	V
Comparator Ref In Current	I_{REF}	VREF_GRP1 = 0V VREF_GRP2 = 0V	ALL	-	2.15	uA
			4/	-	10	
Enable Input Voltage Low ENA_PCS_H (pin 33) ENA_GRP1_H (pin 32) ENA_GRP2_H (pin 31)	V_{IL}			-	0.8	V
Enable Input Voltage High ENA_PCS_H (pin 33) ENA_GRP1_H (pin 32) ENA_GRP2_H (pin 31)	V_{IH}			2.0	-	V
Output Voltage Low CMPout (1:8) (pins 1-4 and 12-15)	V_{OL}	Isink ≤ 2.0mA, 4/		-	0.5	V
Output Voltage High CMPout (1:8) (pins 1-4 and 12-15)	V_{OH}	No Load, 2/, 4/		4.4	-	V
		10kΩ Load		2.2	-	
Internal Output Pull-Up Resistor	R_{INT}	2/		8	12	KΩ
Input Open Circuit Voltage	V_{INOC}	2/, 4/			V_{CC}	V

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Parameter		Symbol	Conditions		MIN	MAX	Units
R_Iset pin Voltage		V_{SET}		+25°C	1.985	2.015	V
				4/	1.92	2.08	
R_Iset Temp Coefficient		V_{SET-TC}			-0.75	0.75	%
Band Gap Output Voltage BGR_VREF (pin 26)		V_{BG}		+25°C	1.985	2.015	V
				+125°C	1.935	2.050	
				-55°C	1.975	2.020	
				4/	1.920	2.080	
Band Gap Load Regulation 2/ BGR_VREF (pin 26)		$\frac{\Delta V_{BG}}{\Delta I_{BG}}$	BG Iout ≤ 2mA		-	5	mV
Comparator Pulse Delay 3/		t_{DLH1}	C_L = 30pF, Vref = 1.0Vdc Vin overdrive ≥ 50mV See Figure 2		-	1500	nS
		t_{DHL1}			-	300	nS
Comparator Enablet Delay 3/		t_{DLH2}	C_L = 30pF, Vref = 1.0Vdc Vin = 1.05vdc See Figure 2		-	2500	nS
		t_{DHL2}			-	750	nS
I_{PCS} Enable Delay 3/		t_{DLH3}	C_L = 30pF, Vref = 1.0Vdc Rin = 1KΩ, R_Iset = 1KΩ I_{PCS}=2mA, See Figure2		-	5.0	uS
		t_{DHL3}			-	750	nS
Short Circuit Current 2/		I_{SC}	R_Iset = 0Ω, PCS and Comparator Groups Enabled @ 25°C			60	mA
Output Current Noise @ 1KHz 2/ See Curve		Inoise 1	I_{PCS} = 100uA @ 25°C, Typ = 11.5		-	-	pA/√Hz
		Inoise 2	I_{PCS} = 2mA @ 25°C, Typ = 63.0		-	-	
Supply current	PCS and Comparator Groups Disabled 1, 4//	I_{CCq}	ENA_PCS_H = Lo ENA_GRP1_H = Lo ENA_GRP2_H = Lo		-	10	mA
	PCS and Comparator Groups Enabled 1/, 4/	I_{CC}	R_Iset = 1KΩ I_{PCS} = 2mA ENA_PCS = Hi ENA_GRP1_H = Hi ENA_GRP2_H = Hi CMPout (1:8) = Hi			35	mA

Notes:

1) Hi ≥ V_{IH}, Lo ≤ V_{IL}.
2) Guaranteed by design, but not production tested.
3) Test fixture node capacitance plus 10pF scope capacitance.
4) Tested to 100 krad(Si).

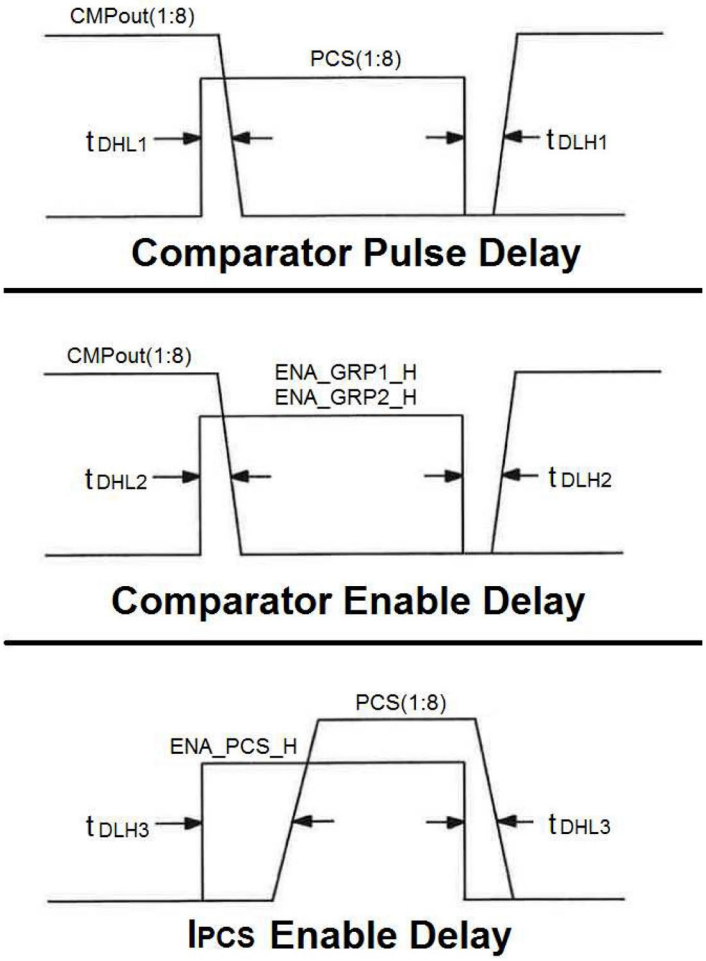

Figure 2 - Timing Diagram

One primary application for the PCS5038, as shown in Figure 3 below, would be to monitor the temperature of different electronic bay areas in a Satellite, and report when any bay area has exceeded a maximum temperature limit.

Thermistors with defined temperature characteristics are used as the sensors, and by providing a constant stable current to the external Thermistor (Temp T1 to Temp T8), an accurate analog voltage of a specific temperature trip point can be established. The comparator voltage reference input can be tailored to set the trip point for the characteristic of the particular thermistor sensor used. The on-board precision 2 Volt reference can be used directly for voltages of 2 Volts or less, or can be scaled with an external operational amplifier to provide a voltage between 2 Volts and the maximum input of 3.0 Volts, for a +5v supply. Various temperature trip points could be accomplished by using thermistors with different temperature characteristics.

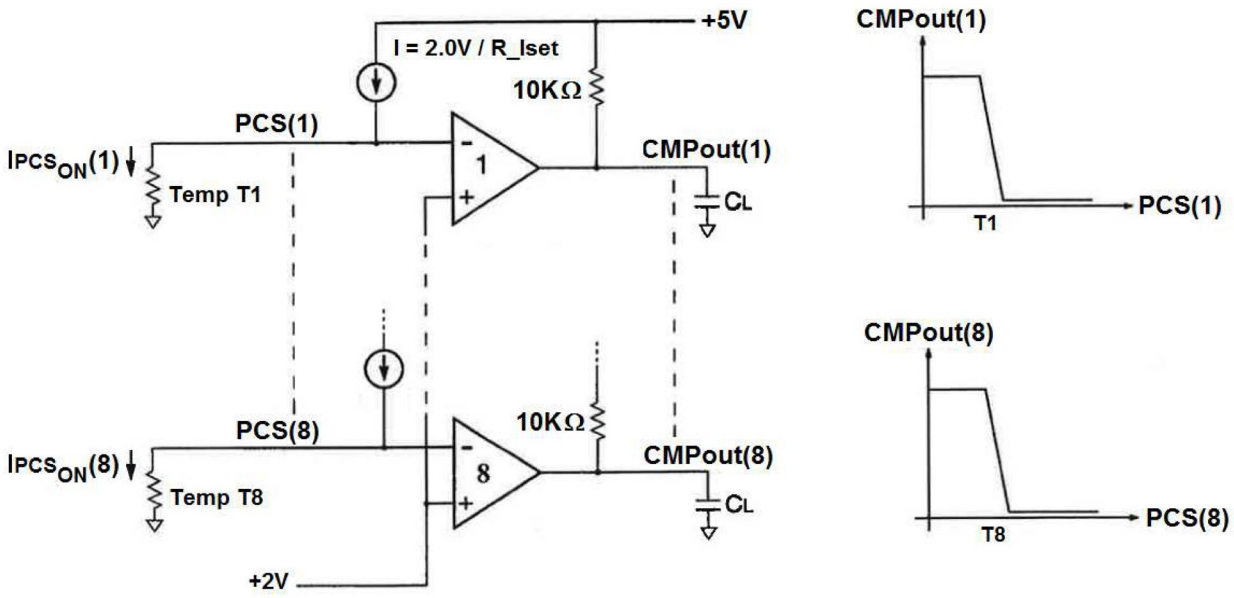

Figure 3 - Typical Temperature Sensing Application

When more "Temperature Sensing" inputs are needed, two PCS5038s can be used as shown below in Figure 4.

The output of the two PCS5038s can be wired together to produce a wired "OR" function. Each bank of 8 inputs can then be separately controlled by its associated Enable input.

One application of the multiple input arrangements would be circuit board temperature monitoring using the temperature characteristics of a PN (diode) junction. With a constant current to the diode sensor, the diode voltage can be a calibrated function of temperature. Diodes can be placed on or near vital electronic components to monitor their case temperatures so that they can be shutdown before a catastrophic temperature failure occurs.

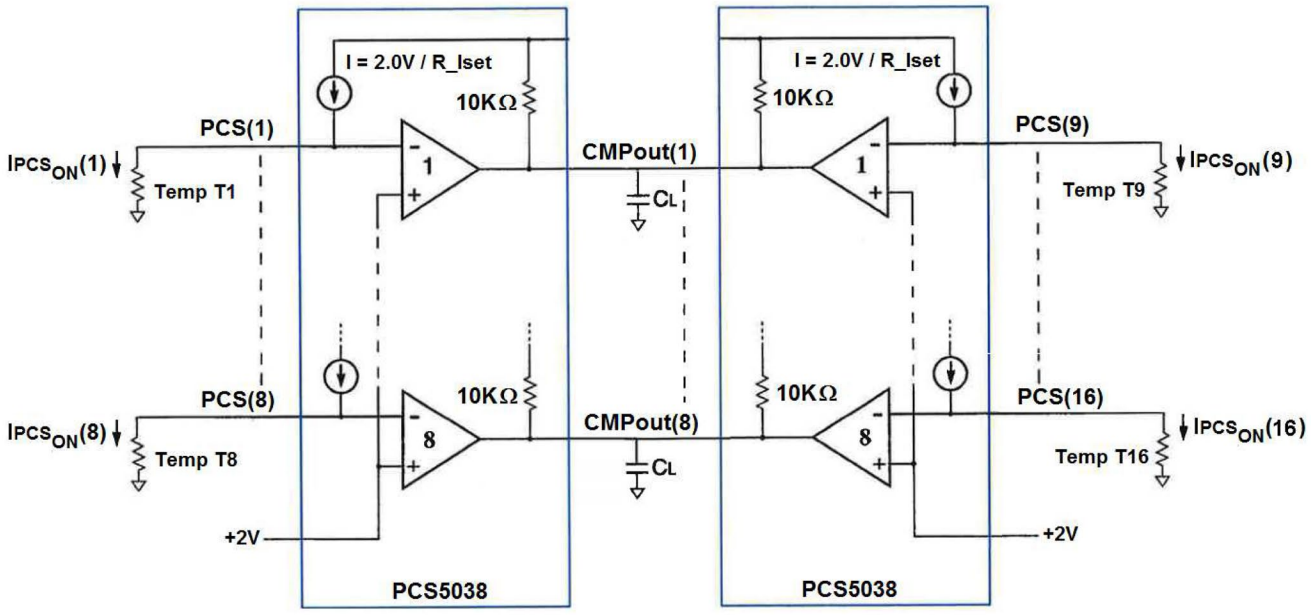

Figure 4 - 16 Input, 8 Output Wired "OR" Application

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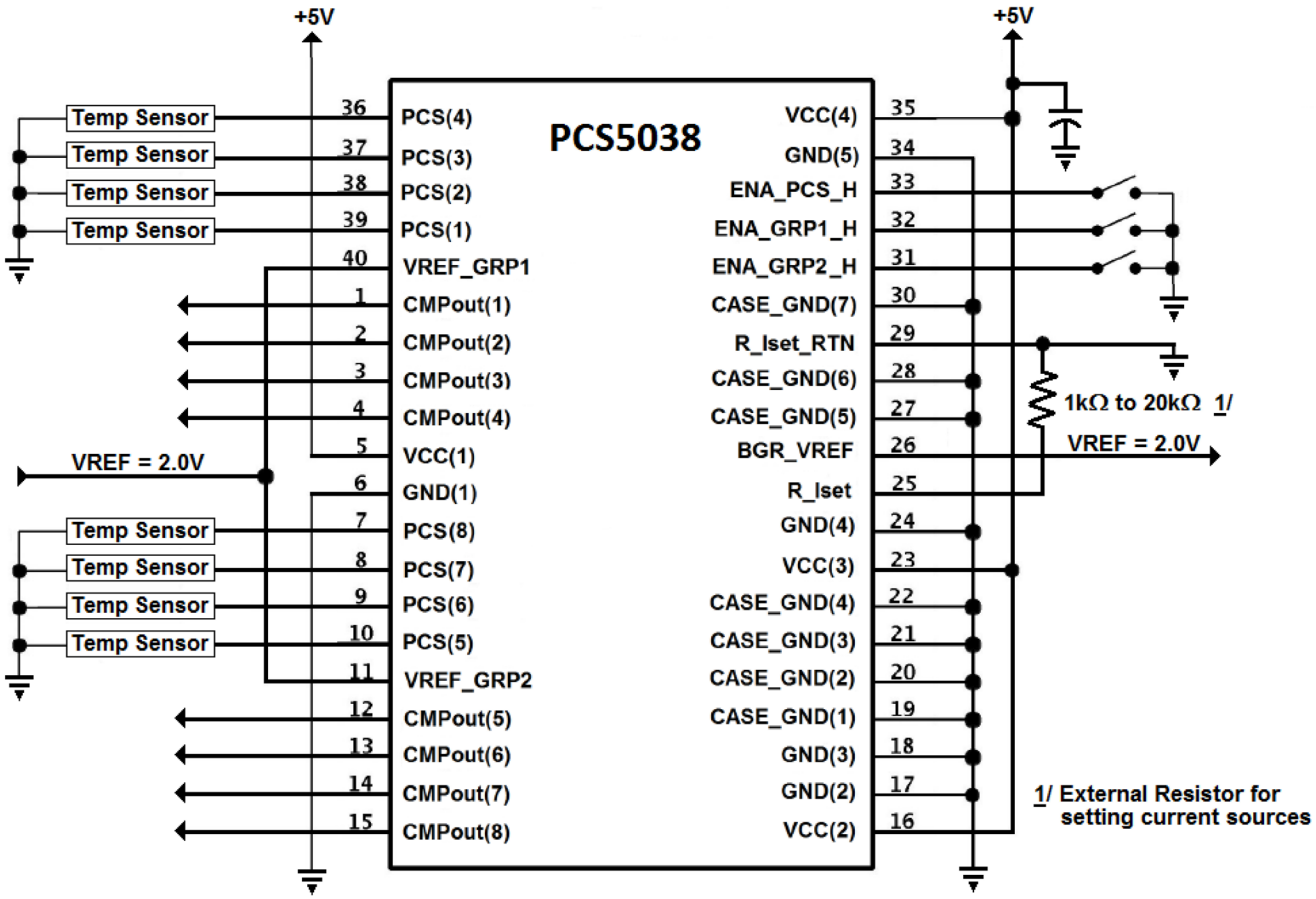

Figure 5 - Typical Connection

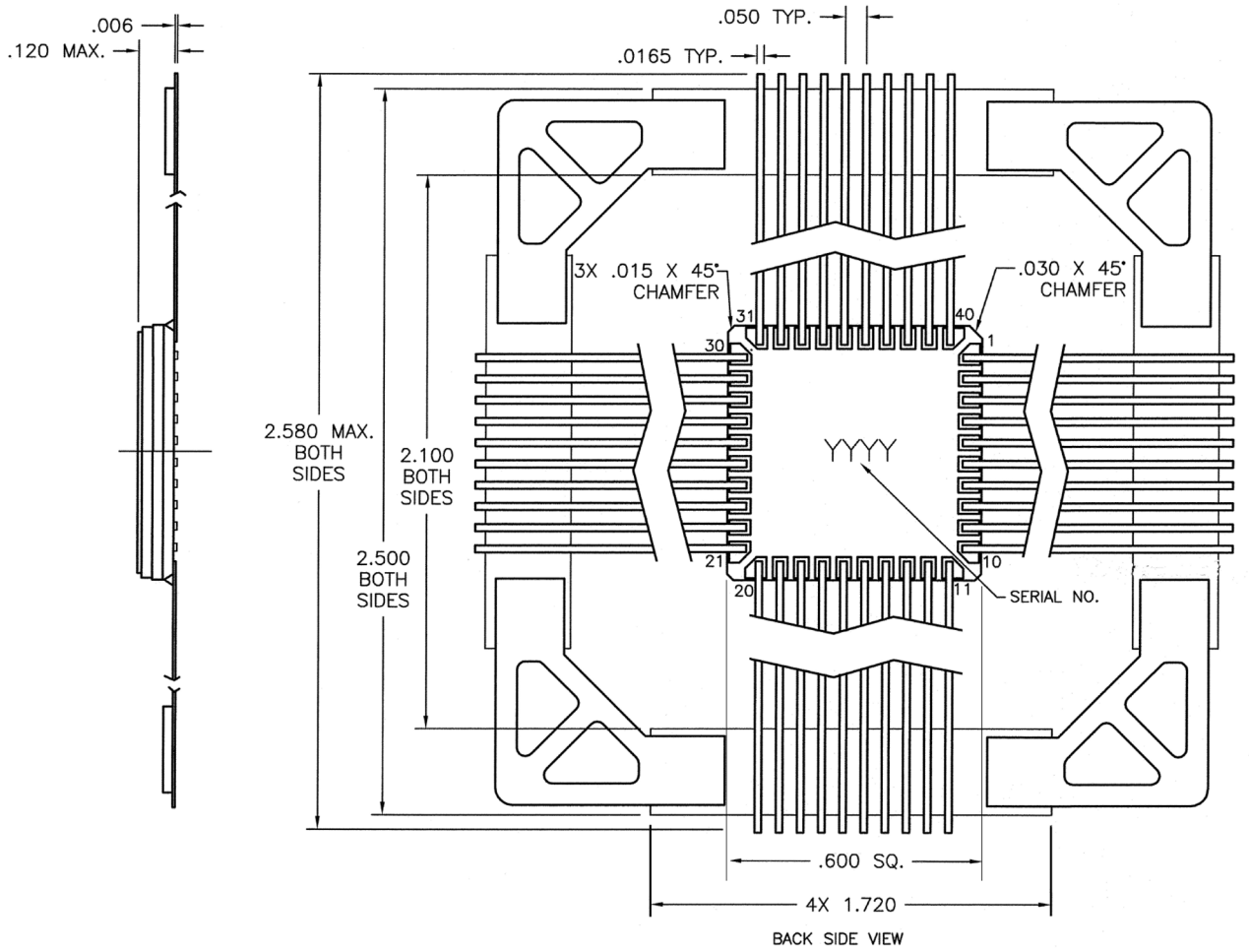

Figure 6 - Package Outline

Pin Descriptions

Signal Name	Pin#	Type	Description
PCS(1:8) PCS(1) PCS(2) PCS(3) PCS(4) PCS(5) PCS(6) PCS(7) PCS(8)	39 38 37 36 10 9 8 7	I/O I/O I/O I/O I/O I/O I/O I/O	Eight Precision Current Sources. Output currents are settable from 100uA to 2.0mA with one external resistor connected between R_Iset pin (25) and R_Iset_RTN pin (29). Each precision current source has a voltage monitoring comparator that will trigger the associated CMPout(1:8) when the sensor voltage increases to greater than VREF_GRP1 for CMPout (1:4) and VREF_GRP2 for CMPout (5:8).
ENA_GRP1_H ENA_GRP2_H ENA_PCS_H	32 31 33	Input Input Input	Logic 1 state on ENA_GRP1_H enables CMPout (1:4). Logic 1 state on ENA_GRP2_H enables CMPout (5:8). Logic 1 state input on the ENA_PCS_H enables all eight precision current sources. Logic 0 state input on the ENA_PCS_H places PCS (1:8) in high impedance state. The sensor voltage monitoring comparators all remain functional.
VREF_GRP1	40	Input	External Voltage Reference Input to sensor monitoring comparators for PCS (1:4).
VREF_GRP2	11	Input	External Voltage Reference Input to sensor monitoring comparators for PCS (5:8).
R_Iset	25	Input	Connect to the External Resistor to set the current level for PCS (1:8).
R_Iset_RTN	29	Input	Return for the External Resistor. Must be grounded close to pin.
CMP_{OUT}(1:8) CMPout(1) CMPout(2) CMPout(3) CMPout(4) CMPout(5) CMPout(6) CMPout(7) CMPout(8)	1 2 3 4 12 13 14 15	Output Output Output Output Output Output Output Output	Sensor voltage monitoring comparator output for each precision current source PCS (1:8). The CMPout (1:8) outputs are active low and trigger to a logic 0 state when sensor voltage on the respective PCS (1:8) pin increases to greater than the associated VREF comparator input voltage.
BGR_VREF	26	Output	Band Gap Regulator. Precision Output 2.0V_{DC}.
VCC(1:4) VCC(1) VCC(2) VCC(3) VCC(4)	5 16 23 35	Power Power Power Power	+5 Volt power supply connections.
GND(1:5) GND(1) GND(2) GND(3) GND(4) GND(5)	6 17 18 24 34	Power Power Power Power Power	Power supply return connections
CASE_GND(1:7)CASE_GND(1) CASE_GND(2) CASE_GND(3) CASE_GND(4) CASE_GND(5) CASE_GND(6) CASE_GND(7)	19 20 21 22 27 28 30	Case Case Case Case Case Case Case	All case CASE_GND pins shall be connected together and grounded. The CASE_GND pins are connected to the cover to prevent static charge build-up.

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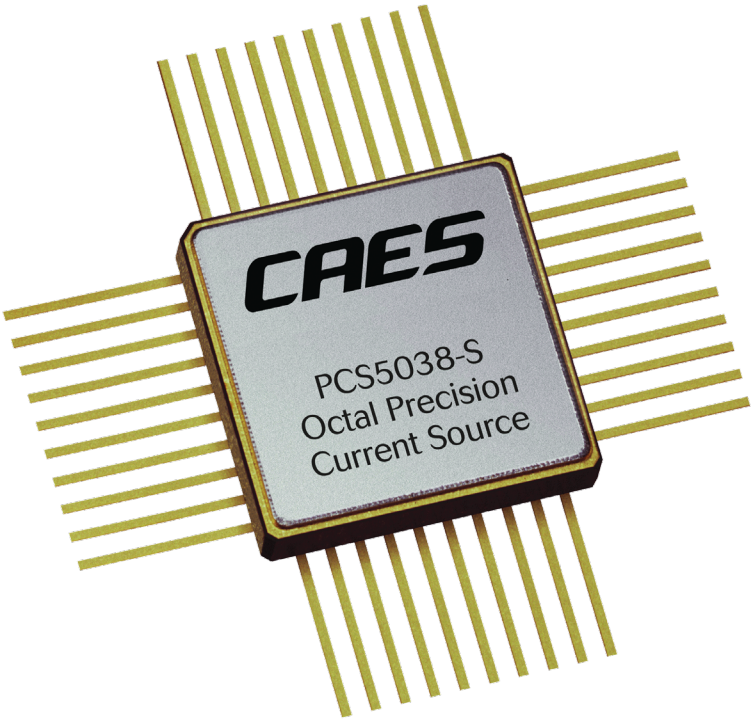
Ordering Information

Model	DLA SMD #	Screening	Package
PCS5038-7	-	Commercial Flow, +25°C testing only	40-lead Ceramic Quad Flat Pack
PCS5038-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
PCS5038-201-1S	5962-1223201KXC	In accordance with DLA SMD	
PCS5038-901-1S	5962R1223201KXC	In accordance with DLA Certified RHA Program Plan to RHA Level "R", 100 krad(Si)	

Revision History

Date	Revision	Change Description
10/18/2016	D	Import into CAES format, Update limits per latest characterization.



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Datasheet Definitions

	DEFINITION
Advanced Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is still in the development stage and the datasheet **is subject to change**. Specifications can be **TBD** and the part package and pinout are **not final**.
Preliminary Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is in the characterization stage and prototypes are available.
Datasheet	Product is in production and any changes to the product and services described herein will follow a formal customer notification process for form, fit or function changes.

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