Resistor-Programmable Temperature Switch

1 Features

- Threshold Accuracy:
  - ±0.5°C Typical
  - ±3°C Maximum (60°C to 100°C)
- Temperature Threshold Set By 1% External Resistor
- Low Quiescent Current: 33µA Typical
- Open-Drain, Active-Low Output Stage
- Pin-Selectable 2°C or 10°C Hysteresis
- Reset Operation Specified at V_{CC} = 0.8V
- Supply Range: 2.7 V to 5.5 V
- Package: 5-Pin SOT-23, 6-Pin DFN6L

2 Applications

- Computers (Laptops and Desktops)
- Servers
- Industrial and Medical Equipment
- Storage Area Networks
- Automotive

3 Description

The GD30TS709N is a fully-integrated, resistor-programmable temperature switch with a temperature threshold that is set by just one external resistor within the entire operating range. The GD30TS709N provides an open-drain, active-low output and has a 2.7V to 5.5V supply-voltage range.

The temperature threshold accuracy is typically ±0.5°C, with a maximum of ±3°C (60°C to 100°C). The quiescent current consumption is typically 33µA. Hysteresis is pin-selectable to 2°C or 10°C.

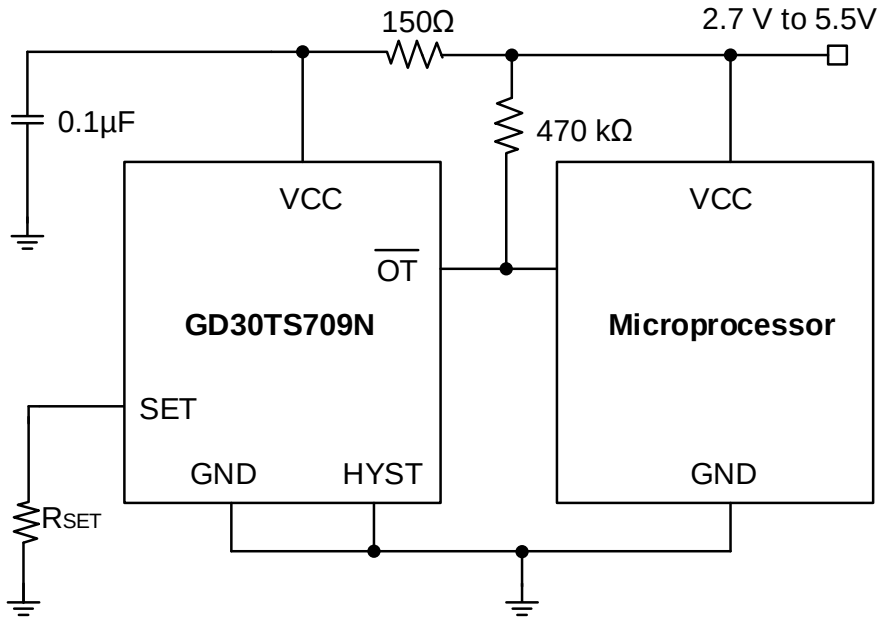
The GD30TS709N is available in a 5-pin, SOT23 package and 6-pin, DFN6L package.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
GD30TS709N	SOT23-5	2.90mm × 1.60mm
	DFN6L	1.50mm × 1.50mm

1. For packaging details, see *Package Information* section.

Typical Application Schematic



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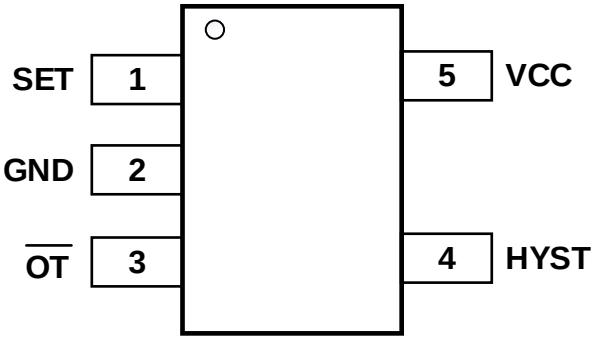
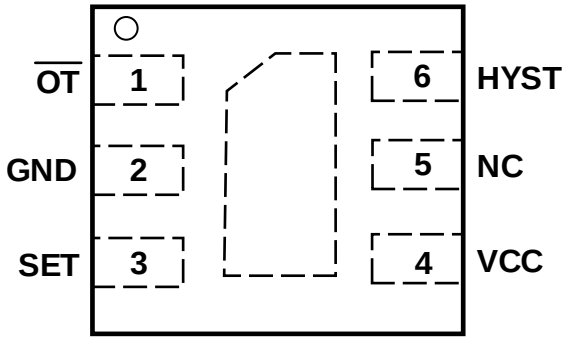
4.1 Pinout and Pin Assignment

SOT23-5
Top View



DFN6L
Top View



4.2 Pin Description

PIN NUM			PIN TYPE[1]	FUNCTION
NAME	SOT23-5	DFN6L		
SET	1	3	I	Temperature set point. Connect an external 1% resistor between SET and GND.
GND	2	2	G	Device ground.
$\overline{OT}$	3	1	O	Open-drain, active low output.
HYST	4	6	I	Hysteresis selection. For 10°C, HYST = V_{CC}; for 2°C, HYST = GND.
VCC	5	4	P	Power-supply voltage (2.7 V to 5.5 V)
NC		5		Not Connect

1. P = power, G = Ground, I = input, O = Output.

5 Parameter Information

5.1 Absolute Maximum Ratings

Exceeding the operating temperature range (unless otherwise noted)[1]

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Power supply	−0.3	6	V
V_{OT}	Output Voltage at $\overline{OT}$	−0.3	6	V
V_{IO}	Intput Voltage at SET and HYST	−0.3	V_{CC} +0.3	V
T_J	Junction temperature		150	°C
T_A	Operating temperature	−40	125	°C
T_{stg}	Storage temperature	−65	150	°C

1. Over operating free-air temperature range (unless otherwise noted). Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

5.2 Recommended Operation Conditions

SYMBOL[1]	PARAMETER	MIN	TYP	MAX	UNIT
V_{CC}	Supply voltage	2.7	3.3	5.5	V
T_{RANGE}	Setting Temperature Range	0		125	°C

1. Unless otherwise stated, over operating free-air temperature range.

5.3 Electrical Sensitivity

SYMBOL[1]	CONDITIONS	VALUE	UNIT
$V_{ESD(HBM)}$	Human Body Mode (HBM), per ANSI/ESDA/JEDEC JS-001	±5000	V
$V_{ESD(CDM)}$	Charge-device model (CDM), per ANSI/ESDA/JEDEC JS-002-20222	±2000	V
$V_{ESD(MM)}$	Machine Mode (MM), per JEDEC-STD Classification	200	V

1. Unless otherwise stated, over operating free-air temperature range.

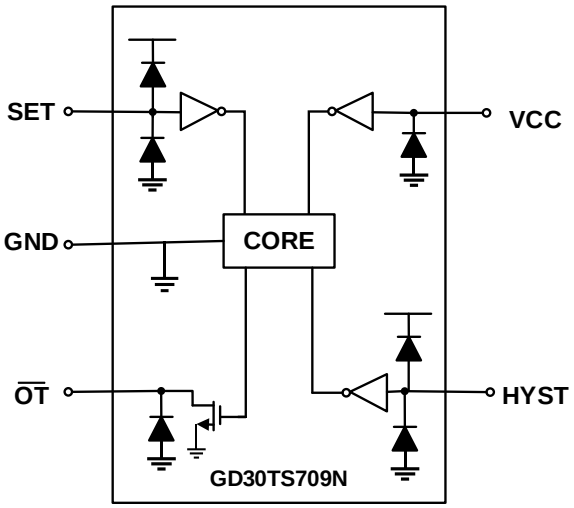


Figure 1. Equivalent Internal ESD Circuitry

5.4 Thermal Resistance

SYMBOL[1]	CONDITIONS	PACKAGE	VALUE	UNIT
Θ_{JA}	Natural convection, 2S2P PCB	SOT23-5	217.9	°C/W
Θ_{JB}	Cold plate, 2S2P PCB		44.6	°C/W
Θ_{JC}	Cold plate, 2S2P PCB		86.3	°C/W
Ψ_{JB}	Natural convection, 2S2P PCB		43.8	°C/W
Ψ_{JT}	Natural convection, 2S2P PCB		4.4	°C/W

1. Thermal characteristics are based on simulation, and meet JEDEC document JESD51-7.

5.5 Electrical Characteristics

Electrical characteristics of devices at T_A = +25°C and V+ = 1.4 V to 3.6 V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
V_{CC}	Power Supply Voltage		2.7		5.5	V
I_{CC}	Supply Current	V_{CC} = 5V		33	55	uA
		V_{CC} = 2.7V		33	55	uA
TEMPERATURE						
T_{RANGE}	Operating Temperature Range		0		125	°C
T_{ERROR}	Accuracy (Temperature Error)	T_A=+60°C to +100°C		±0.5	±3	°C
DIGITAL INPUT (HYST)						
V_{IH}	High-level input voltage		0.7 x V_{CC}			V
V_{IL}	Low-level input voltage				0.3 x V_{CC}	V
C_{IN}	Input capacitance			10		pF
ANALOG INPUT (SET)						
V_{IN}	Input voltage range		0		V_{CC}	V
I_{lkg_in}	Input leakage current			1		uA
DIGITAL OPEN-DRAIN OUTPUT (OT)						
I_{OT_SINK}	Output sink current	V_{OT} = 0.3V	5	12		mA
I_{OT_lkg}	Output leakage current	V_{OT} = V_{CC}		1		uA

6 Functional Description

6.1 Overview

The GD30TS709N is a fully-integrated, resistor-programmable temperature switch that incorporates two temperature-dependent voltage references and one comparator. One voltage reference exhibits a positive temperature coefficient (tempco), and the other voltage reference exhibits a negative tempco. The temperature at which both voltage references are equal determines the temperature trip point.

The GD30TS709N temperature threshold is programmable from 0°C to 125°C and is set by an external 1% resistor from the SET pin to the GND pin. The GD30TS709N has an open-drain, active-low output structure that easily interfaces with a microprocessor.

6.2 Hysteresis Input

The HYST pin is a digital input that allows the input hysteresis to be set at either 10°C (when HYST = V_{CC}) or 2°C (when HYST = GND). The hysteresis function keeps the $\overline{OT}$ pin from oscillating when the temperature is near the threshold. Thus, always connect the HYST pin to either VCC or GND. Other input voltages on this pin can cause abnormal supply currents or a device malfunction.

7 Application Information

7.1 Typical Application Circuit

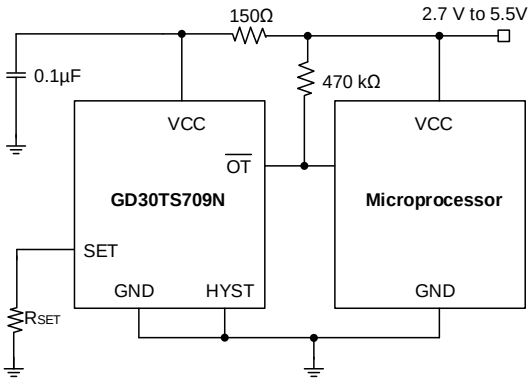


Figure 2. Typical Connections of the GD30TS709N

7.2 Set-Point Resistor(R_{SET})

Set the temperature threshold by connecting R_{SET} from the SET pin to GND. The value of R_{SET} is determined using either Equation(1):

$$R_{SET}(k\Omega) = 0.0012T^2 - 0.9308T + 96.147 \quad (1)$$

where：

T = temperature threshold in degrees Celsius.

7.3 Thermal Considerations

The GD30TS709N quiescent current is typically 33µA。The device dissipates negligible power when the output drives a high-impedance load. Thus, the die temperature is the same as the package temperature. In order to maintain accurate temperature monitoring, provide a good thermal contact between the GD30TS709N package and the device being monitored. The rise in die temperature as a result of self-heating is given by Equation(2):

$$\Delta T_J = P_{DISS} \times \theta_{JA} \quad (2)$$

where：

P_{DISS} = power dissipated by the device.

θ_{JA} = package thermal resistance. Typical thermal resistance for SOT-23 package is 217.9°C/W.

To limit the effects of self-heating, keep the output current at a minimum level.

7.4 Power Supply Recommendations

The GD30TS709N low supply current and supply range allow this device to be powered from many sources. Any significant noise on the V_{CC} pin can result in a trip-point error. Minimize this noise by low-pass filtering the device supply (V_{CC}) using a 150Ω resistor and a 0.1µF capacitor.

7.5 Typical Application Curves

T_A = 25°C and V_{CC}=2.7V to 5.5V, unless otherwise noted.

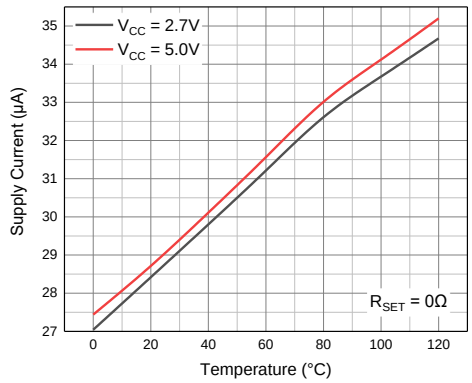


Figure 3. Supply Current vs Temperature

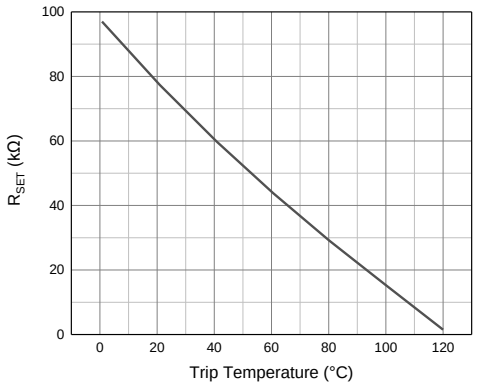


Figure 4. R_{SET} vs Trip Temperature

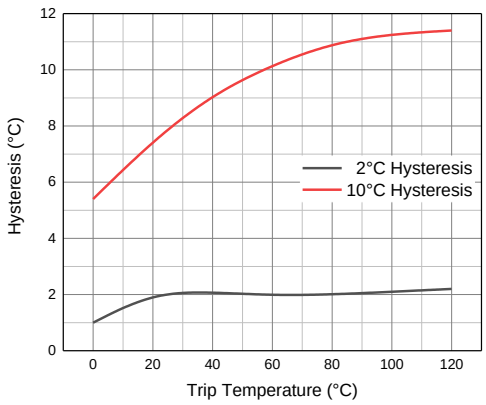


Figure 5. Hysteresis vs Trip Temperature

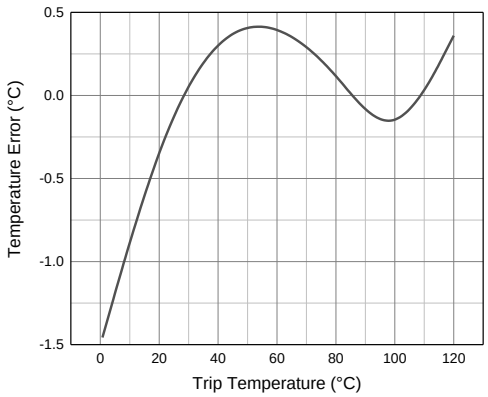
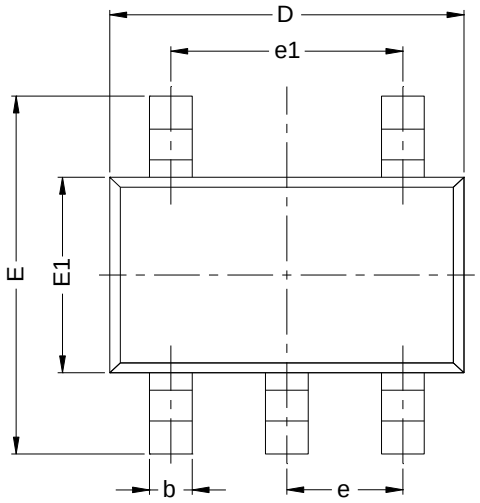


Figure 6. Temperature Error vs Trip Temperature

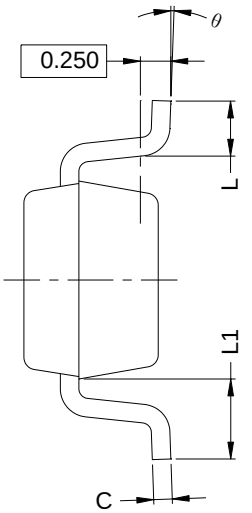
8 Package Information

8.1 Outline Dimensions

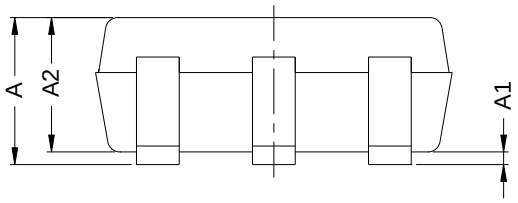
SOT23-5 Package Outline



TOP VIEW



SIDE VIEW



FRONT VIEW

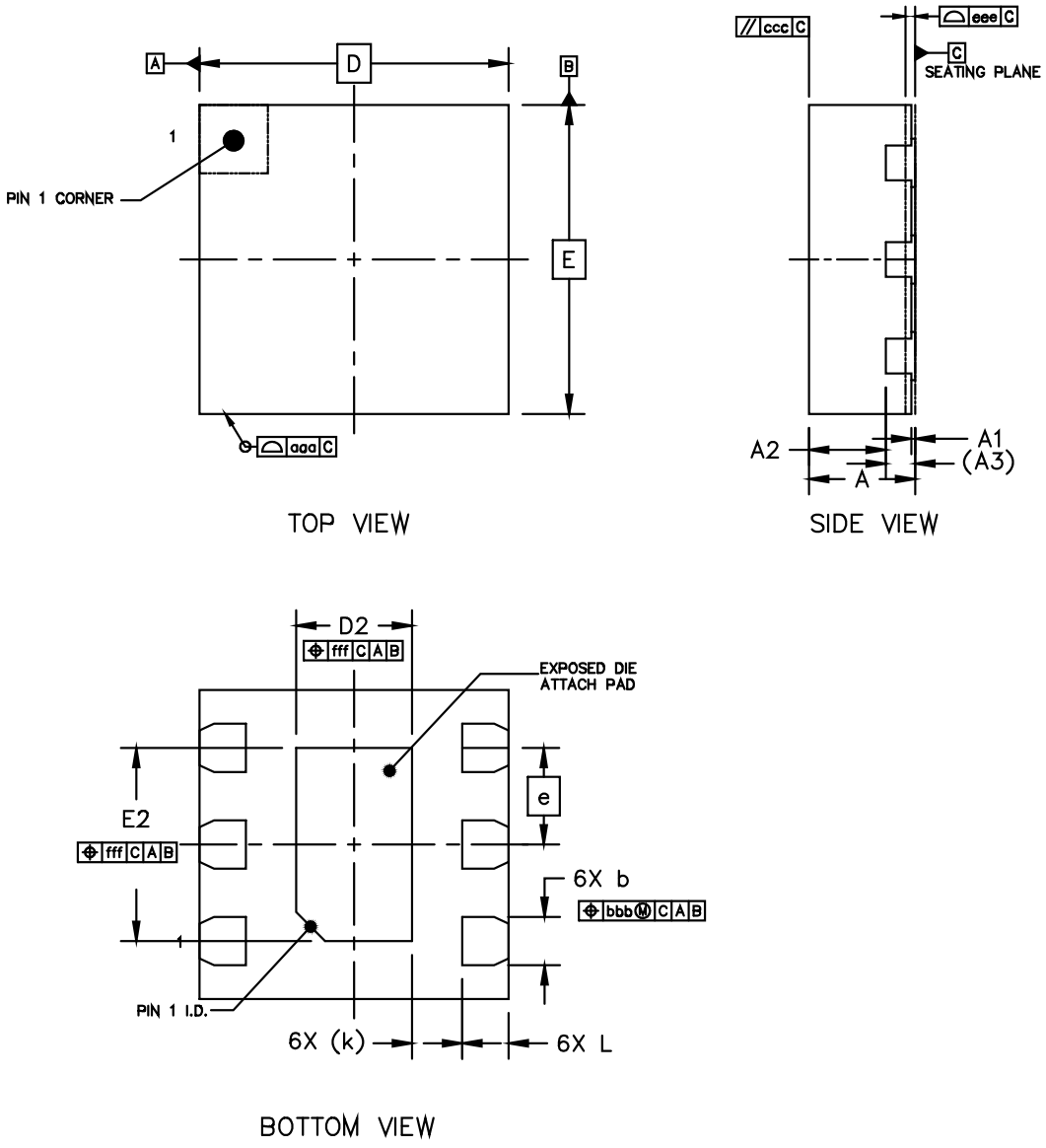
NOTES:

1. All dimensions are in millimeters.
2. Package dimensions does not include mold flash, protrusions, or gate burrs.
3. Refer to the *Table 1. SOT23-5 dimensions(mm)*.

Table 1. SOT23-5 dimensions(mm)

SYMBOL	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0.00	0.05	0.10
A2	1.05	1.10	1.15
b	0.30	0.40	0.50
c	0.10	0.15	0.20
D	2.82	2.92	3.02
E1	1.50	1.60	1.70
E	2.65	2.80	2.95
e	0.950(BSC)		
e1	1.80	1.90	2.00
L	0.30	0.45	0.60
L1	0.60REF		
θ	0°		8°

DFN6L Package Outline



NOTES:

1. All dimensions are in millimeters.
2. Package dimensions does not include mold flash, protrusions, or gate burrs.
3. Refer to the *Table 2. DFN6L dimensions(mm)*.

Table 2. DFN6L dimensions(mm)

SYMBOL	MIN	NOM	MAX
A	0.5	0.55	0.6
A1	0	0.02	0.05
A2		0.40	
A3		0.152 REF	
b	0.2	0.25	0.3
D		1.5 BSC	
E		1.5 BSC	
e		0.5 BSC	
D2	0.36	0.46	0.56
E2	0.9	1.0	1.1
L	0.20	0.25	0.30
K		0.27 REF	

9 Ordering Information

Ordering Code	Package Type	ECO Plan	Packing Type	MOQ	OP Temp(°C)
GD30TS709NNSTR-I	SOT23-5	Green	Tape & Reel	3000	0°C to +125°C
GD30TS709NSETR-I	DFN6L	Green	Tape & Reel	4000	0°C to +125°C

10 Revision History

REVISION NUMBER	DESCRIPTION	DATE
1.0	Initial release and device details	2024

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