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Daryanani

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(54) **TEMPERATURE SENSOR INTEGRATED IN A TRANSISTOR ARRAY**

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CPC ***G01K 7/16*** (2013.01); ***G01K 7/01*** (2013.01); ***H10D 86/00*** (2025.01); ***H10D 86/80*** (2025.01); *G01K 2217/00* (2013.01)

(58) **Field of Classification Search**

CPC G01K 7/16; G01K 7/01; G01K 2217/00; H01L 27/0248; H01L 29/1608; H01L 29/7803; H01L 29/7838; H10D 86/00; H10D 86/80; H10D 84/141

USPC 257/470

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,760,434	A *	7/1988	Tsuzuki	H01L 23/34 257/470
5,304,837	A *	4/1994	Hierold	H01L 27/0248 257/341
5,821,599	A	10/1998	Rupp	257/467
2004/0090726	A1 *	5/2004	Ball	H02H 9/001 361/93.9
2007/0176212	A1 *	8/2007	Zundel	G01K 7/186 374/E7.023

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion, Application No. PCT/US2022/035071, 13 pages, Oct. 14, 2022.

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(57) **ABSTRACT**

A temperature sensor integrated in a transistor array, e.g., metal-oxide-semiconductor field-effect transistor (MOSFET) array, is provided. The integrated temperature sensor may include a doped well region formed in a substrate (e.g., SiC substrate), a resistor gate formed over the doped well region, first and second sensor terminals conductively coupled to the doped well region on opposite sides of the resistor gate. The integrated temperature sensor includes a gate driver to apply a voltage to the resistor gate that affects a resistance of the doped well region below the resistor gate, and temperature analysis circuitry to determine a resistance of a conductive path passing through the doped well region, and determine a temperature associated with the transistor array.

21 Claims, 13 Drawing Sheets