
Improving the Accuracy of the TC1066/TCM1617/TC1068 Thermal Diode Temperature Sensor IC

Author: *Abid Hussain,
Microchip Technology, Inc.*

INTRODUCTION

The TC1066/TCM1617/TC1068 is optimized for use with modern CPUs and ASICs that have integrated thermal diodes on-chip. This temperature proportional signal is acquired remotely via the D+ and D- inputs. It also has an on-board solid state sensor for acquiring the temperature of its own die (usually ambient temperature).

Any temperature sensing circuit will have some finite error components. Normally, for digital temperature sensors, it is fairly convenient to factor out, via software compensation, any systematic errors. For example, if it is known that the sensor will read +2.5°C high under a certain electrical or thermal condition, the user can apply a consistent offset in software to correct for it. This application note will show how to apply a compensation scheme to the TC1066/TCM1617/TC1068 to improve its accuracy under certain conditions.

SOFTWARE COMPENSATION

In a typical application, it may be possible that the TC1066/TCM1617/TC1068 die temperature is significantly lower than that of the remote P-N junction diode. This would be true if the TC1066/TCM1617/TC1068 is mounted on a PC motherboard a significant distance away from the CPU. Such a condition can increase the error associated with the external diode. This error manifests itself as an offset to the *remote* temperature reading. Depending on the magnitude of the temperature delta, it is possible to subtract the induced error and produce an accurate result. In the case of the TC1066/TCM1617/TC1068 (rev. 01), the relationship of error vs. delta is described below.

$$T_{ERR-REMOTE} = 0.0855 \times (T_{REMOTE-READ} - T_{LOCAL-READ}) - 0.4$$

Where $T_{REMOTE-READ}$ is the raw data read for the remote or external sensor. $T_{LOCAL-READ}$ is the raw data read for the local or internal sensor.

After $T_{ERR-REMOTE}$ is calculated for any given set of readings, it should be subtracted from $T_{REMOTE-READ}$ to arrive at the corrected remote temperature.

$$T_{REMOTE-CORRECTED} = T_{REMOTE-READ} - T_{ERR-REMOTE}$$

TC1066/TCM1617/TC1068

Unlike some competing devices, the TC1066/TCM1617/TC1068 has a provision for detecting its presence, identity, and hardware revision. This is accomplished via the MFR_ID and MFR_REV registers (see TC1066/TCM1617/TC1068 datasheet). The MFR_ID register will contain 01010100b (ASCII for "T"). The MFR_REV register will contain 00000001b for rev. 01. This application note applies to hardware **revision 01 only**. Future revisions of the TC1066/TCM1617/TC1068 may not require this compensation scheme. However, it will not require software updates in the host system if MFR_REV is checked.

Also, if alternative temperature sensor devices are to be used in the same system, the MFR_ID (unique to Microchip) can differentiate between them and the TC1066/TCM1617/TC1068 and the host software can branch accordingly.

RECOMMENDATIONS

With this software compensation scheme it is possible to obtain remote sensing performance that is superior to that specified in the datasheet. Additionally, if this socket is multiple sourced, the software has a means to differentiate and apply the compensation scheme only to those applicable versions (Microchip TC1066/TCM1617/TC1068) which can benefit.

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, PIC, PICmicro, PICMASTER, PICSTART, PRO MATE, KEELOQ, SEEVAL, MPLAB and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

Total Endurance, ICSP, In-Circuit Serial Programming, Filter-Lab, MXDEV, microID, *Flex*ROM, *fuzzy*LAB, MPASM, MPLINK, MPLIB, PICC, PICDEM, PICDEM.net, ICEPIC, Migratable Memory, FanSense, ECONOMONITOR, Select Mode and microPort are trademarks of Microchip Technology Incorporated in the U.S.A.

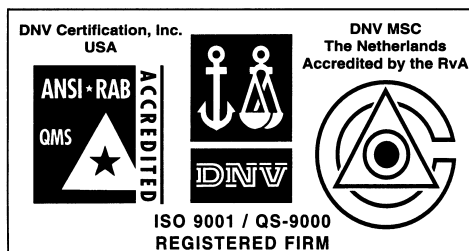
Serialized Quick Term Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2001, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.



Printed on recycled paper.



Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs and microperipheral products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.



WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta

500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Austin - Analog

13740 North Highway 183
Building J, Suite 4
Austin, TX 78750
Tel: 512-257-3370 Fax: 512-257-8526

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Boston - Analog

Unit A-8-1 Millbrook Tarry Condominium
97 Lowell Road
Concord, MA 01742
Tel: 978-371-6400 Fax: 978-371-0050

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Dayton

Two Prestige Place, Suite 130
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York

150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing

Microchip Technology Consulting (Shanghai)
Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu

Microchip Technology Consulting (Shanghai)
Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-6766200 Fax: 86-28-6766599

China - Fuzhou

Microchip Technology Consulting (Shanghai)
Co., Ltd., Fuzhou Liaison Office
Rm. 531, North Building
Fujian Foreign Trade Center Hotel
73 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7557563 Fax: 86-591-7557572

China - Shanghai

Microchip Technology Consulting (Shanghai)
Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen

Microchip Technology Consulting (Shanghai)
Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

Hong Kong

Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaughnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan

Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark

Microchip Technology Denmark ApS
Regus Business Centre
Lautrup hof 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Arizona Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Arizona Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Germany - Analog

Lochamer Strasse 13
D-82152 Martinsried, Germany
Tel: 49-89-895650-0 Fax: 49-89-895650-22

Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

08/01/01