

MCP2003 Power-Down Mode and Wake-Up Handling in the Case of LIN Bus Loss

Author: Frank Ziegenhorn
Microchip Technology Inc.

Holding the MCP2003 in power down in the case of LIN bus loss is called "Forced Power-Down mode" in the further description of this document.

INTRODUCTION

This technical brief gives a description of how to set the MCP2003 in Power-Down mode in the case of a LIN bus loss, which means the voltage level on L_{BUS} falls down to V_{IL}. This situation could happen if the bus Master microcontroller disconnects the termination pull-up resistor (typically 1 kΩ) from the bus to reduce the current consumption in the bus Power-Down state.

Additionally, this technical brief describes the wake-up procedure when the Master puts the LIN bus back into Operation mode.

THEORY OF OPERATION

The MCP2003 is a bidirectional, half-duplex communication physical interface for automotive and industrial LIN systems to meet the LIN bus specification Revision 2.1 and SAE J2602. The MCP2003 provides a physical interface between a microcontroller and LIN bus.

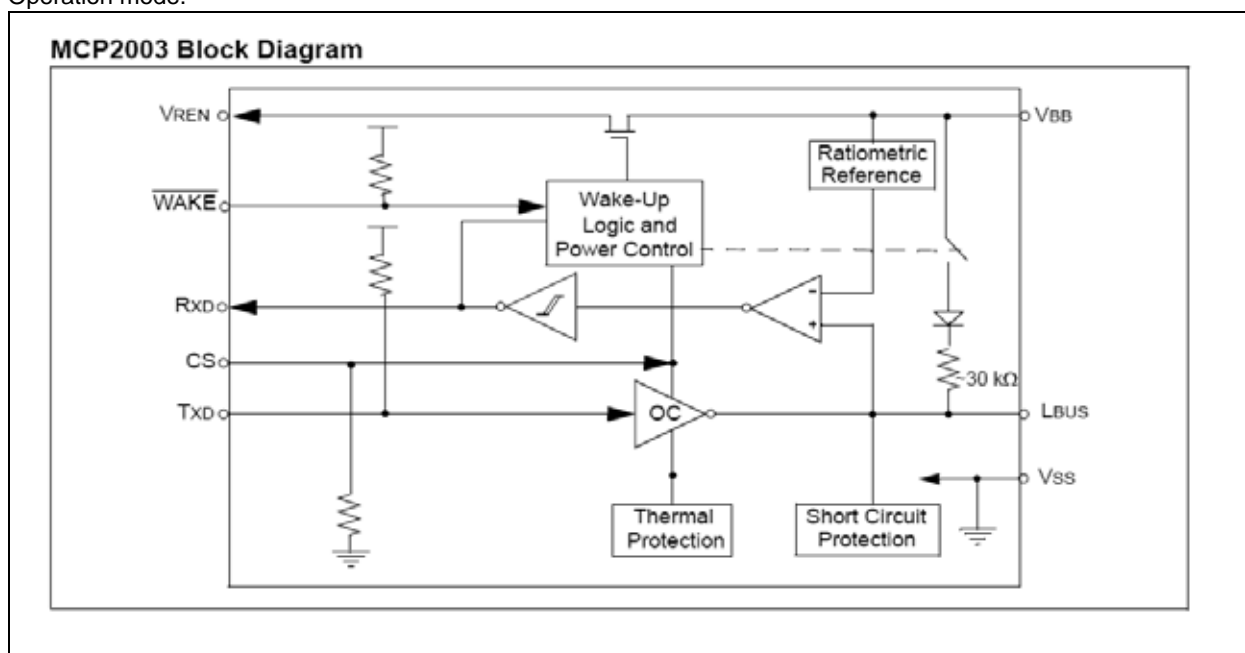


FIGURE 1: MCP2003 Block Diagram.

The MCP2003 can be put in Power-Down mode from Operation mode or Transmitter-Off mode (T_{OFF} Mode) on the falling edge on CS.

On bus activity, or when CS is set to '1', the device will immediately wake up from Power-Down mode and enter Ready mode.

Bus activity means that L_{BUS} voltage has dropped down to V_{IL} for longer than the Bus Activity Debounce time (t_{BDB}).

This could be caused by the following events:

- Loss/short to GND
- Wake-up sequence
- Sync break

This behavior is necessary to react immediately on a LIN bus disconnection or L_{BUS} short circuit to ground (e.g. cable break or wrong plug-in). Additionally, the device also wakes up on a LIN bus loss situation, which could be an undesired behavior in certain LIN bus systems.

TB3067

To prevent an undesired wake-up scenario in a LIN bus loss situation, the Power-Down mode has to be entered via the Transmitter-Off mode observing specific timings and the switching sequence outlined below (“Forced Power-Down mode”).

The following state machine diagram shows the paths to enter the MCP2003 Power-Down mode from Operation mode or Transmitter-Off mode.

To enter Power-Down mode from Ready mode, the MCP2003 has two different paths:

- Passing through Transmitter-Off mode (T_{OFF}), which is shown in red in [Figure 2](#)
- Passing through Operating mode, which is shown in blue in [Figure 2](#)

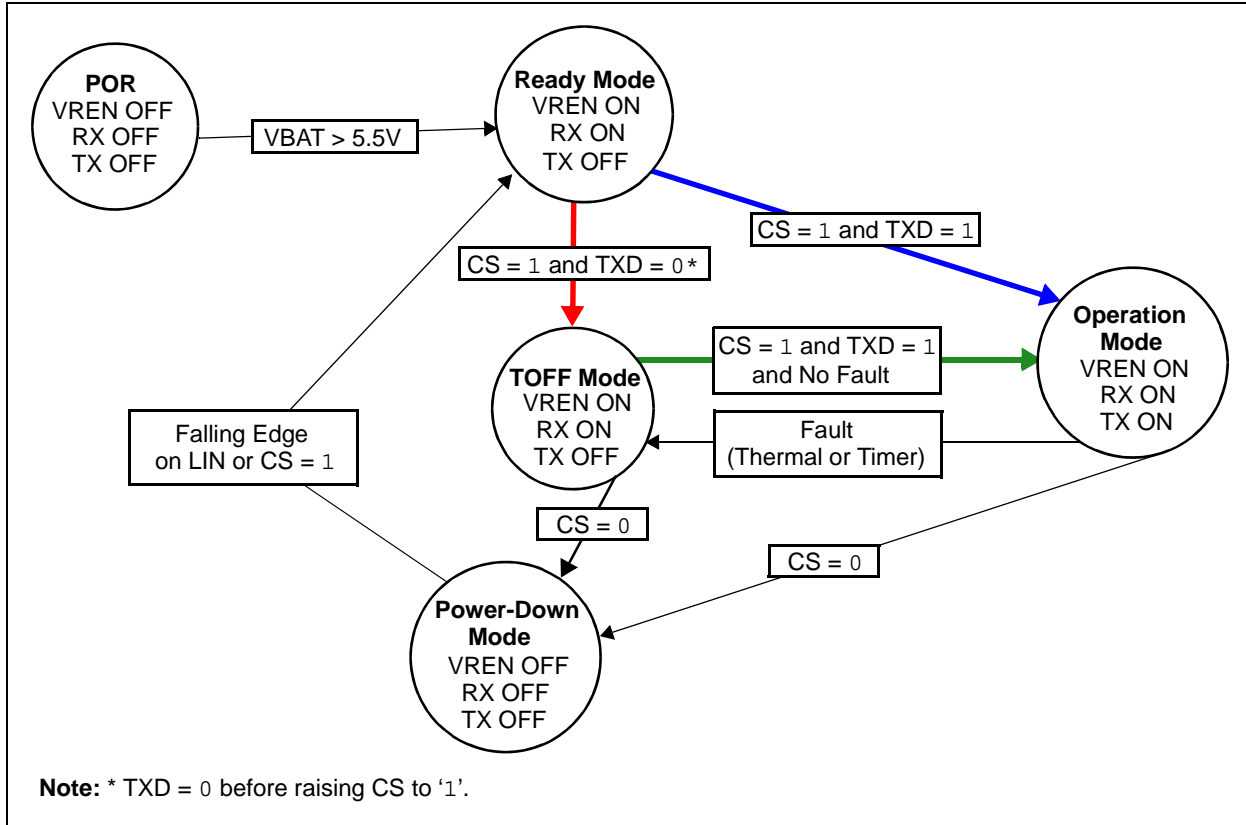


FIGURE 2: Entering MCP2003 Power-Down Mode From Operation Mode or Transmitter-Off Mode.

The Forced Power-Down mode sequence is used to enter Power-Down mode without activating the transceiver to reduce the current consumption of the transceiver. After the device is in Ready mode, this path could be selected by holding TXD and CS in low state for t_{TX2CS} , and then setting CS to '1' for $t_{CSactive}$ before resetting CS to '0'. This results in all functionality being disabled in the transceiver until CS goes high or a falling edge on LIN bus had been detected.

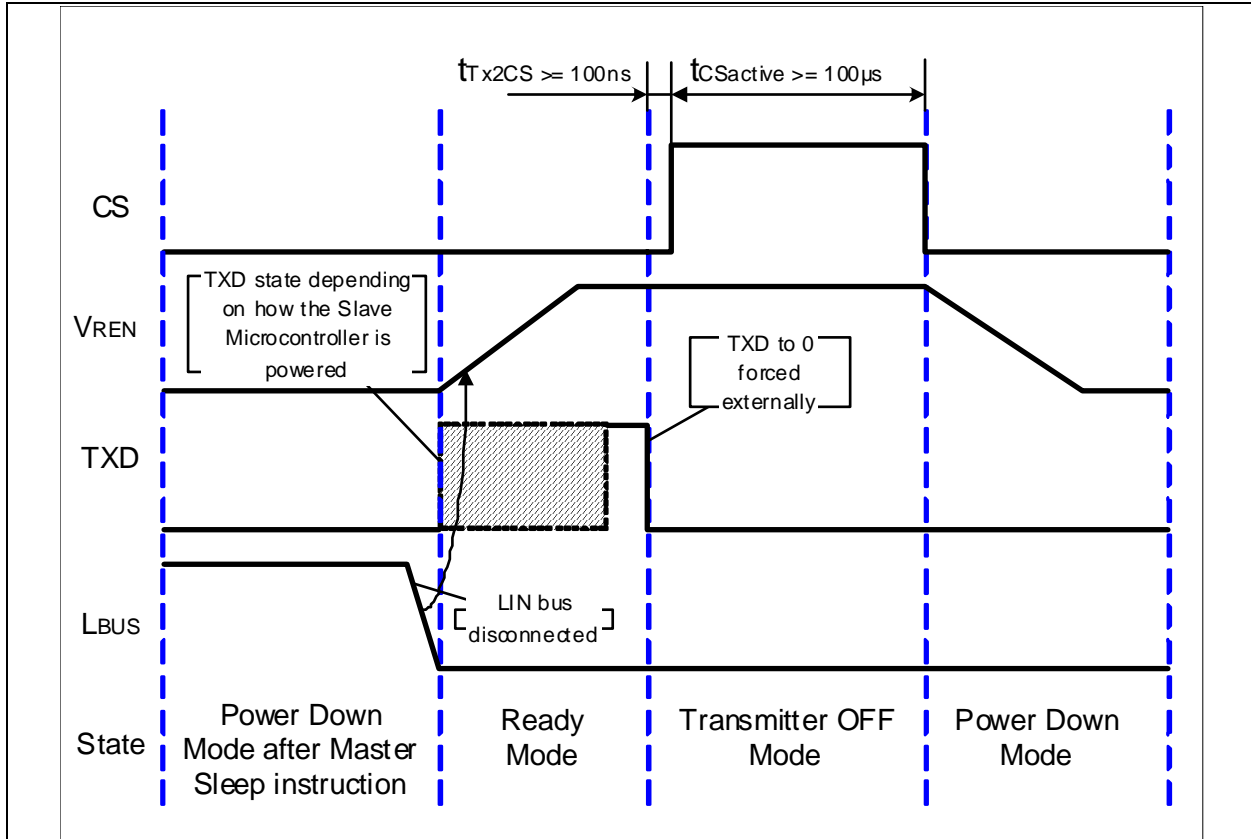


FIGURE 3: Switching Timing Diagram for the Forced Power-Down Mode Sequence.

```
/* design specific */

#define TXPINLATCbits.LATC6
#define CSPINLATCbits.LATC0

/* please refer to data sheet regarding maximum values */

#define WaitTimeTx2CS()      Nop(); Nop();Nop(); Nop();
#define WaitTimeCSactive()   unsigned char dly; dly = 55; while(--dly);

/*****
/*****

void ForcedSleepMCP200x(void)
{

/* set LATregister of corresponding IOpin for TX -> 0 */

    TXPIN = 0;

/* depending if TXEN in TXSTA register allows the use of the
/* corresponding IOpin for TX as a normal IO when TXEN = 0 then set */
/* TXPIN = 0 otherwise reset the whole UART module. Please refer to */
/* controller specific data sheet and review the UART section */

#if defined (TXEN_FREE_IO)          /* TX also usable as IO */
    TXEN = 0;
#else
    RCSTA = 0;
#endif
    WaitTimeTx2CS();                /* refer to data sheet */
    CSPIN = 1;                      /* CS = 1 -> transceiver activated but TX = 0 */
    WaitTimeCSactive();             /* refer to data sheet */
    CSPIN = 0;                      /* CS = 0 -> transceiver in SLEEP mode */
}

/*****
/*****/
```

FIGURE 4: PIC[®] Microcontroller Code Example for Forced Power-Down Mode.

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC³² logo, rPIC and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MXDEV, MXLAB, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscient Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICkit, PICTail, REAL ICE, rLAB, Select Mode, Total Endurance, TSHARC, UniWinDriver, WiperLock and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

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.

© 2011, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

ISBN: 978-1-60932-840-5

Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC[®] MCUs and dsPIC[®] DSCs, KEELOQ[®] code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

**QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
== ISO/TS 16949:2002 ==**



MICROCHIP

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:
<http://support.microchip.com>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-6578-300
Fax: 886-3-6578-370

Taiwan - Kaohsiung
Tel: 886-7-213-7830
Fax: 886-7-330-9305

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

08/04/10

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- ⊖ [View MCP2003-E/MD on WIN SOURCE](#)
- ⊖ [Microchip Technology](#) Information

Optimize Your Supply Chain with WIN SOURCE Solutions

- ✓ Global Sourcing Solution
- ✓ Obsolete Management
- ✓ Cost Control Management
- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management