

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

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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.

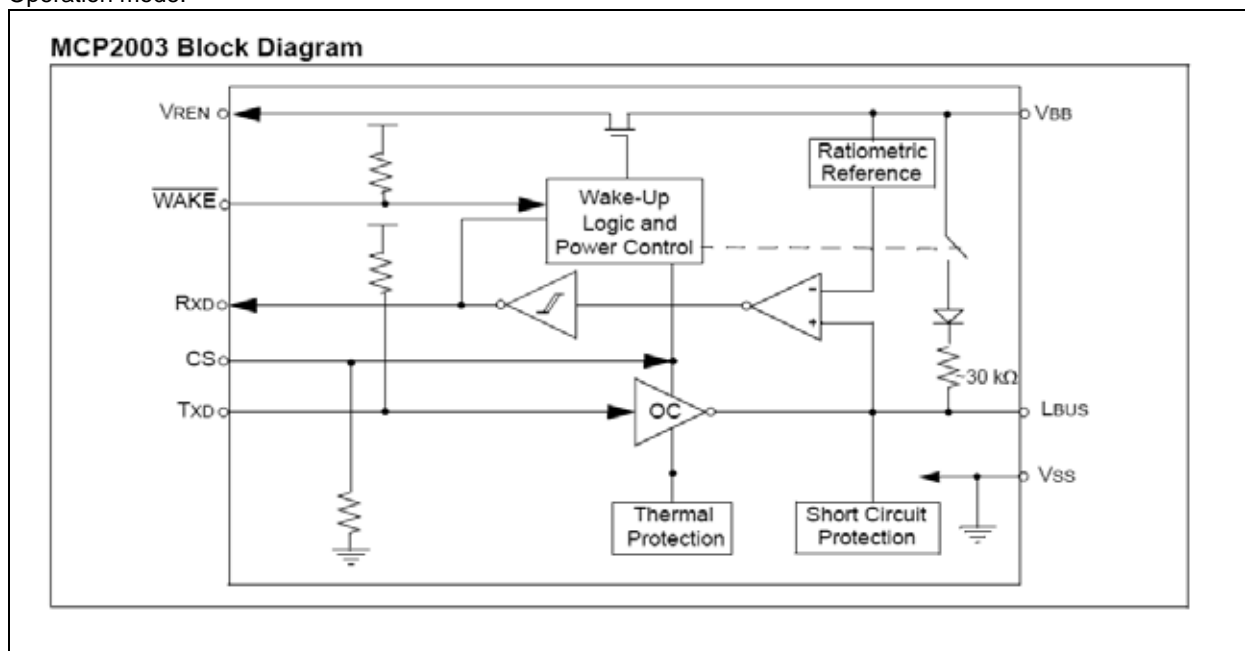
### INTRODUCTION

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<sub>BUS</sub> falls down to V<sub>IL</sub>. 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<sub>OFF</sub> 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<sub>BUS</sub> voltage has dropped down to V<sub>IL</sub> for longer than the Bus Activity Debounce time (t<sub>BDB</sub>).

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<sub>BUS</sub> 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.

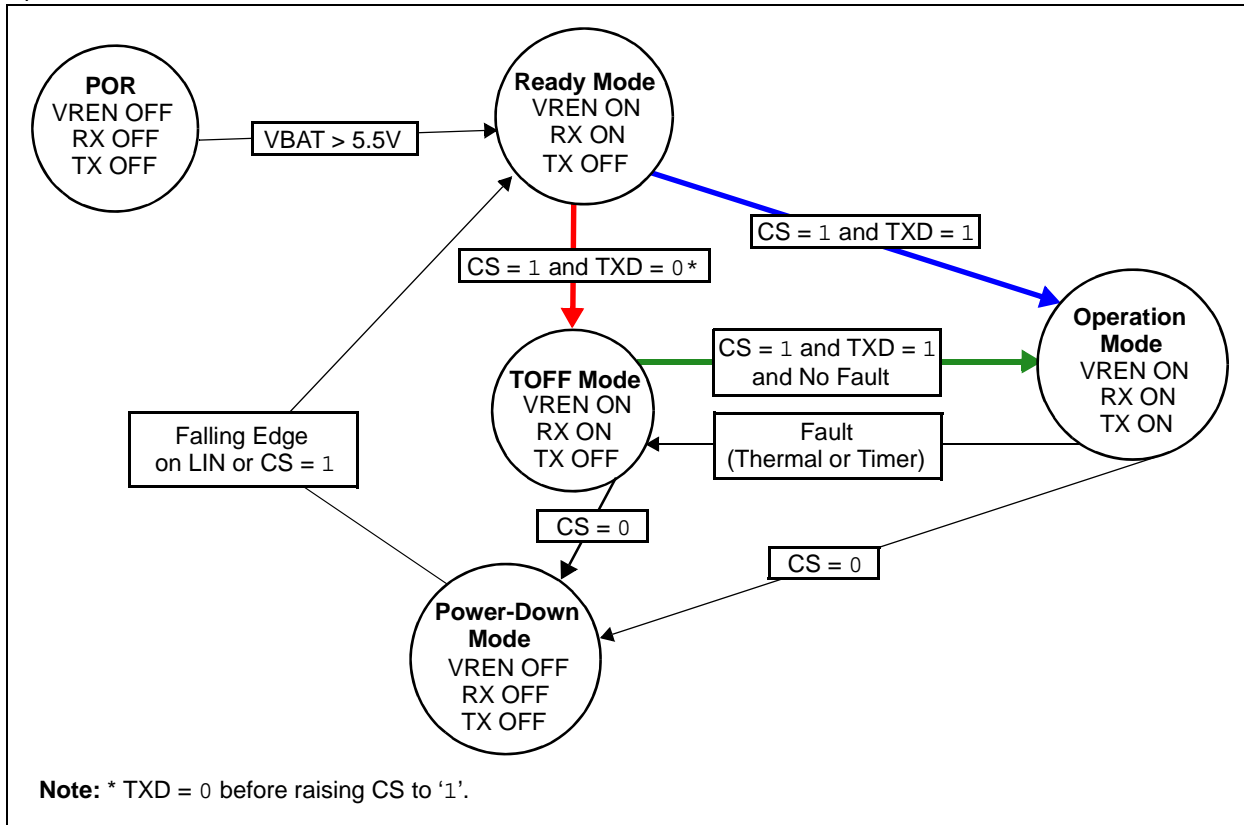
# TB3067

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.

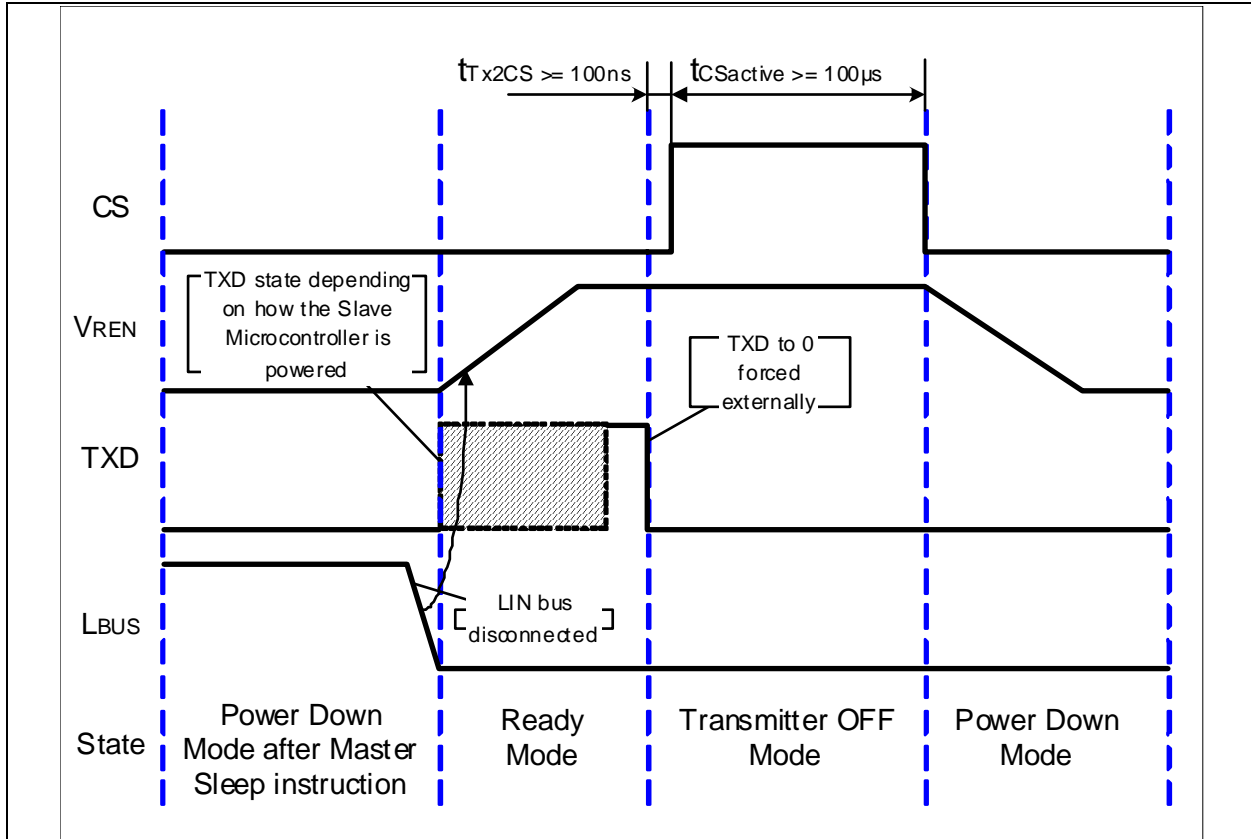
To enter Power-Down mode from Ready mode, the MCP2003 has two different paths:

- 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<sup>®</sup> Microcontroller Code Example for Forced Power-Down Mode.

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