Migrating Designs from MCP201 to MCP2021A

Author: *Bo Liu*
Microchip Technology Inc.

DEVICE MIGRATIONS

The original MCP201 LIN (Local Interconnect Network) transceiver was designed to comply with LIN 1.2 and 1.3 physical layer specifications. The MCP2021A is designed to be pin- and functionally-compatible with the earlier MCP201, and to meet the latest LIN 2.x specifications. In addition, there are numerous enhancements in the MCP2021A, including that the part meets the most current automotive requirements for ESD and EMC, with ESD levels exceeding +/-15 kV. The MCP2021A also has an enhanced voltage regulator with 70 mA output capability and extremely low current consumption (refer to the "MCP2021A/2A - LIN Transceiver with Voltage Regulator" data sheet, DS22298).

For most applications, the MCP2021A can be used as a replacement for existing MCP201 designs, without printed circuit board modifications.

When evaluating an upgrade to the MCP2021A, there are several considerations to take into account.

HARDWARE DIFFERENCES

The only differences exist on three pins.

CS/LWAKE

The CS/LWAKE input of the MCP2021A is level sensitive, rather than edge-triggered like the MCP201. A low-to-high transition is no longer necessary to enter the 'Operational' mode on power-up, or to toggle CS/LWAKE to clear a fault condition. Any existing firmware that implements toggling will work for the MCP2021A without modification.

$\overline{\text{FAULT}}$/TXE

On the MCP201, this pin was designated FAULT/SLPS. During power-on, this pin was sampled to select between fast and slow voltage slope rate control. This function is not required in the MCP2021A, due to its time-based slew-rate waveshaping. The Transmit Enable (TXE) function has taken its place. For existing designs that utilized this function with an external pull-up or pull-down resistor, the resistor will need to be removed.

The pin should be routed to a microcontroller port pin to take advantage of the new TXE power-down function. If the TXE function is not required, this pin may be left floating. Refer to Section 1.2.8 in the MCP2021A/2A data sheet for more information on the TXE function. The FAULT output definition is the same. Bus contention detect has been debounced.

STATE TRANSITION COMPARISON (Note 1)

State Transition	Transition Conditions	
	MCP201	**MCP2021A**
POR to Ready	V_{REG} established and CS/WAKE = 0, stays in Ready	V_{REG} established if CS/LWAKE = 0, stays in Ready; ***if CS/LWAKE = 1, proceed to* Operation or TX-OFF**
Ready to Operation	CS/LWAKE = 1	CS/LWAKE = 1 and ***$\overline{\text{FAULT}}$/TXE = 1 and TXD = 1***
Operation to Power-down	CS/WAKE = 0	CS/LWAKE = 0
Power-down to Operation	CS/WAKE = 1	CS/LWAKE = 1 and ***$\overline{\text{FAULT}}$/TXE = 1 and TXD = 1* (go through Ready mode)**
Power-down to Ready	Bus activity: Falling edge on LBUS	Bus activity: Rising edge on LBUS

Note 1: Words in bold type show the state transition differences between the MCP201 and MCP2021A.

LBUS

The MCP2021A has two different features:

- Pull-up resistor: On the MCP201, the pull-up resistor is always connected. During Power-down mode, the LBUS is pulled up to a recessive state (High). On the MCP2021A, the pull-up resistor is connected only in Operation mode; in all other modes, the pull-up resistor is disconnected and the LBUS may be floating
- Permanent dominant detection: This functionality minimizes system power consumption. An internal timer in the MCP2021A deactivates the LBUS transmitter if a dominant status (Low) on the LIN bus or TXD pin lasts longer than 20 ms (approximately).

STATES AND STATE TRANSITION DIFFERENCES

The state transitions of the MCP201 and MCP2021A are compared in Table 1. Only common modes for both the MCP201 and MCP2021A are compared in Table 1 (refer to Figure 1-1 in the MCP2021A/2A data sheet).

Most state transitions are controlled only with the CS/WAKE pin in the MCP201. But for the MCP2021A, most state transitions are controlled with CS/LWAKE, $\overline{\text{FAULT}}$/TXE and TXD. (see Figure 1-1 in the MCP2021A/2A data sheet).

Table 1 shows that if $\overline{\text{FAULT}}$/TXE = 1 and TXD = 1 in the MCP2021A, by changing CS/LWAKE (or float), the MCP2021A and MCP201 have the same state transitions.

Remote Wake-up

LIN bus activities can wake up both the MCP201 and the MCP2021A.

For the MCP201, during Power-down mode, the LIN bus is pulled up to recessive (High). A falling edge on the LIN bus will cause the mode transition from Power-down mode to Ready mode.

For the MCP2021A, during Power-down mode, the LIN bus is floating. A rising edge on the LIN bus will cause the mode transition from Power-down mode to Ready mode.

SOFTWARE DIFFERENCES

- To keep similar state transitions from the MCP201 to the MCP2021A, the firmware should set the pins as follows:
  - Keep CS/LWAKE low or floating at start up, so the device goes to Ready mode.
  - Keep $\overline{\text{FAULT}}$/TXE and TXD high (or float), so the state transitions are the same as the MCP201, when CS/LWAKE is changed.
- Remote Wake-up. As previously described, a falling edge wakes up the MCP201, while a rising edge on LIN bus wakes up the MCP2021A. Firmware designers need to be aware of this difference.

Voltage Regulator

The input filter capacitor no longer needs to be as much as 10 times larger than the output load capacitor. In fact, they can both be 1.0uF if the battery connection is good enough and appropriate load capacitor is selected (see Section 1.4 Internal Voltage Regulator, and Section 1.5.3 CBAT CAP**,** in the MCP2021A/2A data sheet). The regulator will be stable over the whole temperature range, if the Equivalent Series Resistance (ESR) of the output capacitor is approximately two ohms. The quiescent current of the regulator is typically 20% that of the MCP201. With the transmitter off, this drops to below 100 µA.

The output voltage is 4.85V to 5.15V over full load range, and V_{BB} is from 6.5V to 18V over temperature range. The time to V_{REG} Ready, after POR, is less than 1.2 ms for the MCP2021A, while for the MCP201 it is 2.5 ms. Thermal shutdown temperature is typically 150°C.

For the MCP201, V_{REG} turns on between 5.5V and 6V on V_{BB}, and shuts down when V_{BB} is below 4V.

For the MCP2021A, V_{REG} turns on between 5.25V and 6V, and shuts down when V_{BB} is below 4.5V on the V_{BB} pin.

REFERENCES

MCP201 Data Sheet*, "LIN Transceiver with Voltage Regulator"*, DS21730

MCP202XA Data Sheet*, "LIN Transceiver with Voltage Regulator"*, DS22298

Chuck Simmers: Migration Guide*,* "Migrating Designs from MCP201 to MCP2021-500", DS01075

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