Questions and Answers Concerning Serial EEPROMs

Interfacing a serial EEPROM to a controller can be a confusing task, especially for first time users. Because communication with a parallel memory device is more straightforward, the advantages of serial devices are sometimes overlooked because of the time required to learn a different protocol. In order to minimize this time, Microchip provides many application notes on how to interface a controller to our serial memory products. Since every application is different, questions on different aspects of serial memories still arise. This application note provides answers to some of these commonly asked questions on using serial EEPROMs. This series of questions and answers covers a broad range of topics concerning both 2-wire and 3-wire serial EEPROMS, and covers material and/or circumstances that may not be provided in the data book.

QUESTIONS ON 2-WIRE DEVICES (24XXXX OR 85XXXX)

Q: What happens if a STOP bit is inadvertently sent to the device in the middle of a page write command?

A: It depends on which device you are using. The older 24Cxx devices will write any fully loaded bytes in the page to the device. For example if the stop bit occurs before all bits are loaded in the 5th byte, then the first 4 bytes will be written and the 5th byte will not. On the 24LCxxB or 24AAxx devices, if the stop bit occurs before all 8 bits in a byte are loaded, then the entire command will abort and no bytes will be written.

Q: What happens if a START bit is inadvertently sent to the device in the middle of command?

A: A start bit will always reset the part. It should be noted that if the device has control of the SDA line for an acknowledge bit or a read command, it may not be possible to send a start bit.

Q: I'm using interrupts in my controller code, and it is possible that I may jump out of my serial EEPROM communication routine to handle an interrupt. Is there any problem with leaving the device sitting in the middle of a command as long as the clock remains stable?

A: It is perfectly valid to leave a command in the middle indefinitely as long as the clock line remains stable.

Q: I'm using an interrupt routine in my controller code that may leave the serial EEPROM in the middle of a read command. When I return from the interrupt, is there any way to reset the part to make sure it is in a known state before I start sending it commands again?

A: If the part was in the process of outputting data, you can always get it back to standby mode by allowing the SDA line to float high and give it 9 clocks. This assures that the device will not receive the acknowledge bit at the end of the current byte and will abort the command and go to standby.

Q: I'm using a 24LCxxB in my application. What happens if the WP line goes from low (unprotected) to high (protected) in the middle of a write command?

A: The state of the WP pin is OR'ed with the write control circuitry inside the device. The state of the pin is not latched at any point of the command to see if the write should be done or not. Therefore, if the WP pin went high before the stop bit was sent to initiate the command, then the array would be protected. If the WP pin went high *after* the stop bit was sent, then the outcome is unpredictable, because the result would vary according to how far into command the WP pin went high.

Q: I'm attempting to use a serial EEPROM in an application for the first time, and am having problems getting it to work. I have followed all the timing diagrams in the databook but when I attempt to read data from the device I only read zeros.

A: When a read command is initiated and all the data is zeros, the problem is most likely one of two things:

1) A pull-up resistor on the SDA line is required for the device to operate correctly. Common values are 10K - 20K ohms. If this pull-up is not provided, then the device can only output zeros.

2) The controller is not releasing the bus to the device and is holding it low. Check the controller code and make sure that the SDA line has been set for input during the read command.

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Q: I had been using a 24C04A in my application and have switched to the 24LC04B so I can run at a lower voltage. Now the circuit is no longer working correctly. The read seems to work fine but the write seems to not work at all or only intermittently.

A: The problem is probably with the difference in write cycle times between the two devices. The write cycle time for the 24C04A is about 0.5ms per byte, while the cycle time for the 24LC04B is around 2-4ms per byte. Therefore, when you send consecutive write commands using the new device, it is ignoring all commands that occur while it is in the middle of a write cycle.

Q: I'm using a 24LC16B device in my application. Is there any way I can determine when the write cycle is complete instead of waiting the maximum 10ms?

A: Yes, you can determine when the write cycle is complete on any of our 2-wire devices by utilizing a simple technique called "data polling" or "acknowledge polling." Data polling is done after the stop bit has been sent to the device to initiate a write cycle. You simply send the device a start bit followed by a proper control byte with the R/W bit set low. You then check the status of the acknowledge bit. If the acknowledge bit is high, then the device is still busy writing. You can continue to send the start bit and control byte until the device acknowledges. When the acknowledge bit reads low, then the device has finished the write cycle. You can now send the address and data bytes if you are going to do a write command, or just send the address if you are going to do a read command. Of course you may also send a start bit and begin the next command from scratch.

Q: I'm confused about when the acknowledge bit from the device actually occurs; can you clarify this?

A: The device will attempt to take over the SDA line for the acknowledge bit on the falling edge of the clock for the last bit in the byte. It will then release the SDA line on the falling edge of the clock given for the acknowledge bit. For example, when the control byte is sent to the device, it will take the SDA line low on the falling edge of the clock for the R/W bit. It will then release the SDA line on the next falling edge of the clock (the acknowledge bit). The same sequence occurs for sending the device a byte of data or address.

Q: I am using a 24LC01B in my application which has an 8 byte page buffer. What happens if I load more than 8 bytes into the device before giving it the stop bit?

A: For all 24LCxxB products, the 24C04A and the 85C92, the page buffer will wrap around to the beginning of the buffer and begin to overwrite the data that has previously been loaded For the 24C01A/02A and 85C72/82, the write command will abort if more bytes than the page buffer will hold are loaded.

Q: Can I send a stop bit and a start bit with the same clock pulse?

A: Yes, this is valid as long as setup and hold times for both the start and stop bits are obeyed.

Q: What happens if I give the device a start bit and then a stop bit in the same clock pulse?

A: The 24Cxx devices will ignore the stop bit, the 24LCxxB products will accept the stop bit and go to standby mode.

Q: Does the address pointer get incremented after a current address read command?

A: A current address read command can be halted by sending a stop bit or by sending a high acknowledge bit after the data has been sent by the device. On the 24Cxx devices, ending the read command with a stop bit will increment the address pointer to the next address. Ending the command with a high ack bit will not increment the address.

For the 24LCxxB products, ending the command with either the stop bit or the high ack bit will increment the address pointer.

Q: I am using the 24LC16B and want to write to the part using the page write mode. Can I start a page write at any location in the device?

A: You can start a page write at any location in the device, but you need to be aware that the part is arranged in 16-byte pages and you cannot cross a page boundary. If you attempt a page write that goes beyond the end of the current page, data loaded will 'roll around' to the beginning of the current page instead of going to the next one. For example; the first page in the device starts at address 0x00 and ends at 0x0F. If you start a page write at address 0x0E, the first byte loaded will be written at address 0x0E, the second at 0x0F and the third byte loaded will roll around to the beginning of the page and be written to address 0x00.

QUESTIONS AND ANSWERS FOR 3-WIRE DEVICES (93XXXX)

Q: What would happen if during a write command I inadvertently sent either too many or too few clocks to the device before dropping the CS line?

A: If you send too many clocks to the device and then drop the CS line to initiate the write cycle, the extra clocks will be ignored but the command will execute. If you do not send enough clocks and then drop the CS line, then the command will abort and no write will take place.

Q: I am using a 93LC56 device in my application and am having problems getting it to work correctly. The read sequence seems to work fine but I unable to write any data to the part.

A: A problem such as this is usually caused by either not giving the part the required number of bits for the command before dropping the CS line, or not drop ping the CS line at all. The write command will not commence until the CS line is brought low.

Q: I am currently using a 93C46 device and am looking to go to the 93LC46 device so I can run at a lower voltage. What are the main differences between these devices?

A: There are several operational differences between these devices that you should be aware of:

1) The 93LC46 operates in both x8 and x16 modes; the 94C46 is x16 only.

2) The 93LC46 supports the sequential read function, the 93C46 does not.

3) The write cycle on the 94LC46 begins on the falling edge of the CS line; the write cycle for the 93C46 begins on the rising edge of the last clock.

Q: Is the 93LC46 drop-in compatible with the 93C46 or would I be better off using the 93LC46B?

A: The 93LC46 and 93LC46B are the same device with one exception; the ORG pin on the 93LC46B is internally tied so it will only operate in the x16 mode. This allows the user to leave pin 7 floating, just like you would on the 93C46. For this reason, the 93LC46B is a closer match than the 93LC46. Please note the other operational differences described in the previous question.

Q: I am confused as to whether I have to toggle the CS line low in-between every command.

A: Yes, the CS line must go low for at least 250 ns between each command. If you are doing a write command and you bring CS low to activate the data polling mode, you must toggle CS low *again* after the ready signal has been given by the device before the next start bit can be sent.

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NOTES:

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- The PICmicro family meets the specifications contained in the Microchip Data Sheet.
- Microchip believes that its family of PICmicro microcontrollers is one of the most secure products of its kind on the market today, when used in the intended manner and under normal conditions.
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- Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our product.

If you have any further questions about this matter, please contact the local sales office nearest to you.

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