Basics of I2C: Reserved Addresses

TIPL 6103
TI Precision Labs – Digital Communications

Prepared by Joseph Wu

Presented by Alex Smith

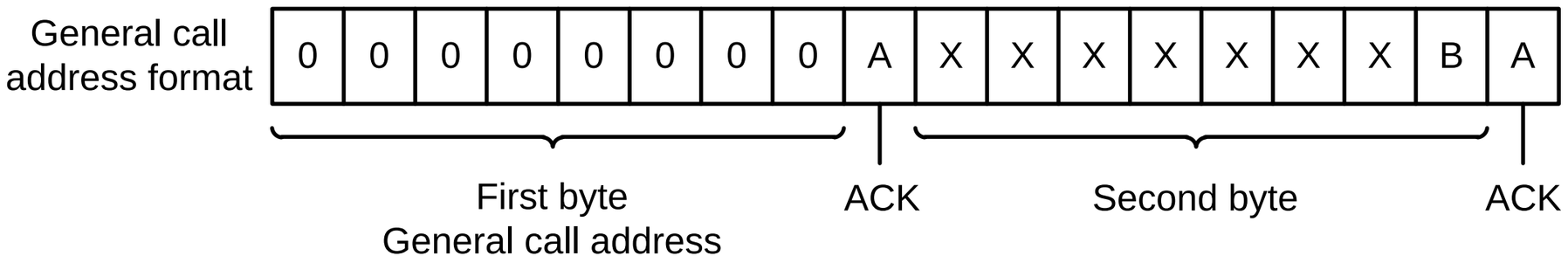
I2C Reserved Addresses

Target Address	R/$\overline{W}$ Bit	Description
000 0000	0	General call address
000 0000	1	START byte
000 0001	X	CBUS address
000 0010	X	Reserved for different bus format
000 0011	X	Reserved for future purposes
000 01XX	X	Hs-mode controller code
111 11XX	1	Device ID
111 10XX	X	10-bit target addressing

I2C Reserved Addresses – General Call

Target Address	R/$\overline{W}$ Bit	Description
000 0000	0	General call address
000 0000	1	START byte
000 0001	X	CBUS address
000 0010	X	Reserved for different bus format
000 0011	X	Reserved for future purposes
000 01XX	X	Hs-mode controller code
111 11XX	1	Device ID
111 10XX	X	10-bit target addressing

General call address
- Addressed as 0x00 write
- Communicates to all devices
- Second byte contains command
- Can be used for several functions including RESET



I2C Reserved Addresses – START Byte

Target Address	R/$\overline{W}$ Bit	Description
000 0000	0	General call address
000 0000	1	START byte
000 0001	X	CBUS address
000 0010	X	Reserved for different bus format
000 0011	X	Reserved for future purposes
000 01XX	X	Hs-mode controller code
111 11XX	1	Device ID
111 10XX	X	10-bit target addressing

START Byte

- Addressed as 0x00 read
- Used for devices that may be polling the SDA and SCL lines instead of using an integrated I2C controller
- Devices can poll at a slower rate until it detects a 0 on the bus.
- The device can then switch to higher polling rates to detect the I2C transaction
- Once the I2C transaction is completed, the device can resume slower polling

I2C Reserved Addresses – Other Protocols

Target Address	R/$\overline{W}$ Bit	Description
0000 000	0	General call address
0000 000	1	START byte
0000 001	X	CBUS address
0000 010	X	Reserved for different bus format
0000 011	X	Reserved for future purposes
0000 1XX	X	Hs-mode controller code
1111 1XX	1	Device ID
1111 0XX	X	10-bit target addressing

CBUS address
- Address 0x01
- Ignored by I2C bus devices
- CBUS no longer in use

Reserved for different bus format
- Address 0x02
- Allows for mixed protocols
- Only I2C devices than can work with different formats and protocols may respond to this address

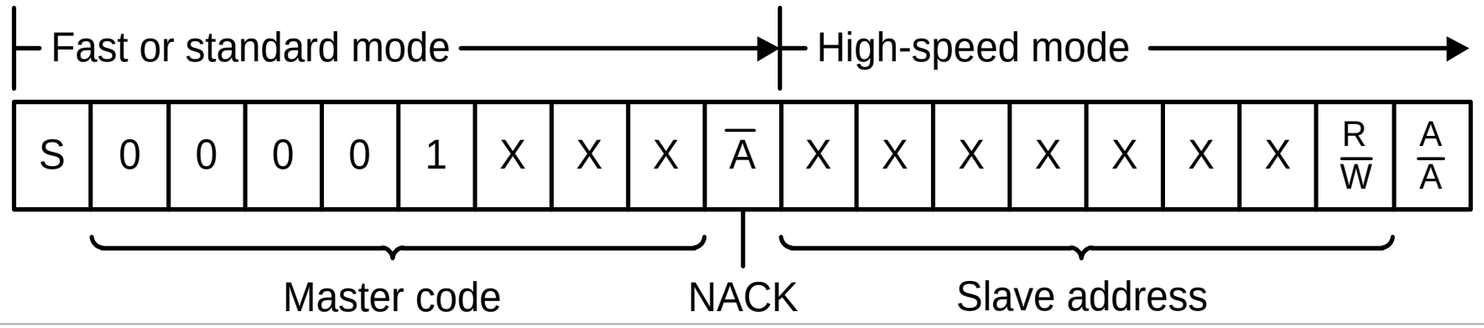
Reserved for future purposes
- Address 0x03

I2C Reserved Addresses – Hs controller Code

Target Address	R/$\overline{W}$ Bit	Description
000 0000	0	General call address
000 0000	1	START byte
000 0001	X	CBUS address
000 0010	X	Reserved for different bus format
000 0011	X	Reserved for future purposes
000 01XX	X	Hs-mode controller code
111 11XX	1	Device ID
111 10XX	X	10-bit target addressing

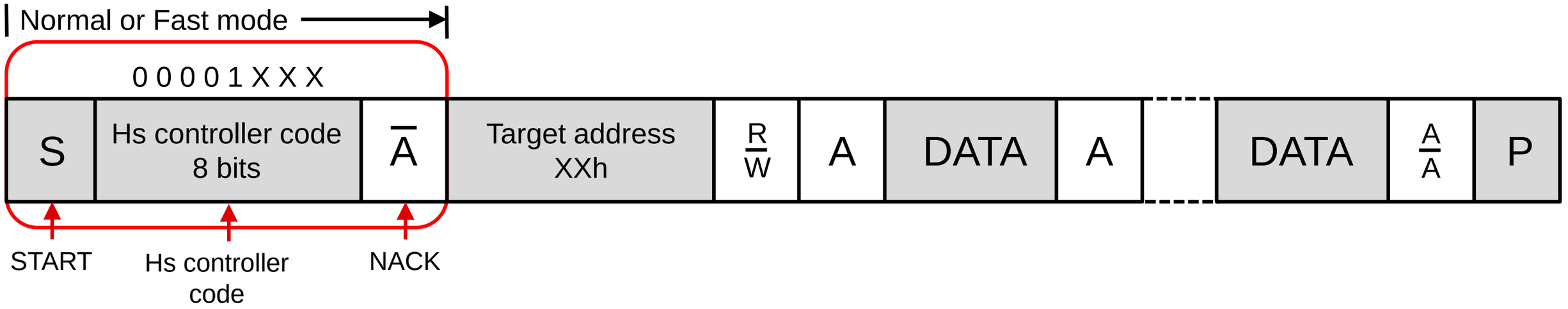
Hs-Mode controller code

- Code 0x04 to 0x07, not address
- Followed by mandatory NACK
- Last four bits used to identify the I2C controller
- Enables circuitry that allows for high-speed transfers
- A repeated start continues high-speed mode data transmission
- A STOP condition returns the I2C bus to fast or standard mode



I2C Reserved Addresses – Hs controller Code

High-Speed Mode

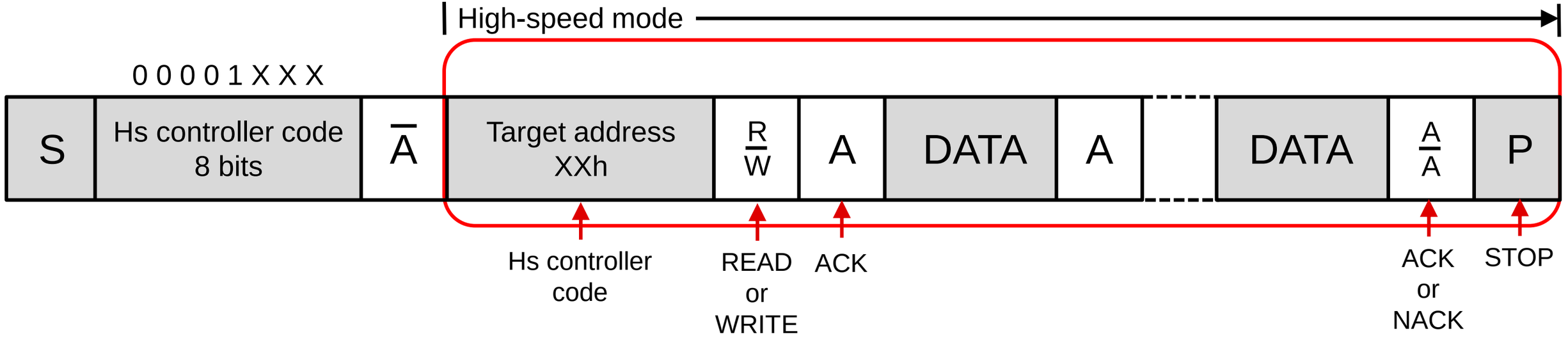


High-speed mode communication

- Controller sends a START condition
- Controller then sends the bits for the high-speed controller code (reserved address 04h to 07h)
- Since these bits are not an address, this communication is NACKed

I2C Reserved Addresses – Hs controller Code

High-Speed Mode



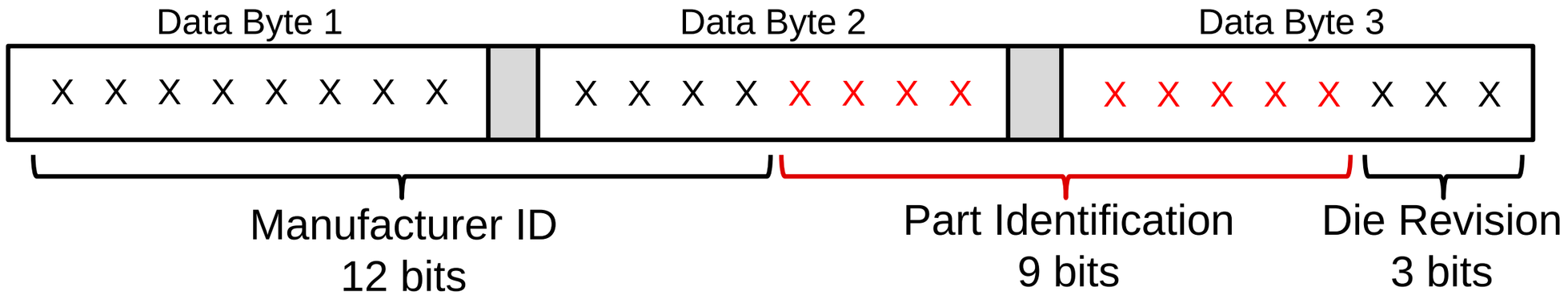
- Controller sends target address of high-speed mode device
- READ or WRITE bit is sent for communication
- Data is transmitted by controller or target device, with ACK for each data byte
- Target device stays in communication with controller until it receives a STOP
- A repeated START with a different target address will also stop communication, and start communication with the new address

I2C Reserved Addresses – Device ID

target Address	R/$\overline{W}$ Bit	Description
000 0000	0	General call address
000 0000	1	START byte
000 0001	X	CBUS address
000 0010	X	Reserved for different bus format
000 0011	X	Reserved for future purposes
000 01XX	X	Hs-mode controller code
111 11XX	1	Device ID
111 10XX	X	10-bit target addressing

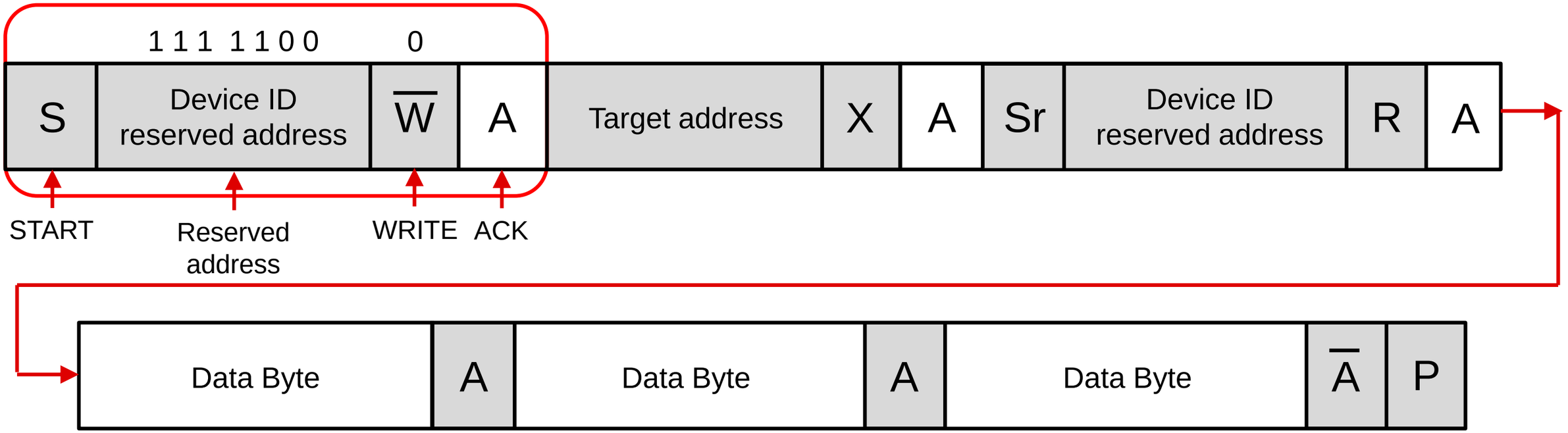
Device ID

- Addresses 0x7C – 0x7F
- Optional three byte (24 bit), read only word used for manufacturer information
- Fields:
  - 12 bits: Manufacturer ID
  - 9 bits: Part Identification
  - 3 bits: Die Revision



I2C Reserved Addresses – Device ID

READ the reserved address Device ID:

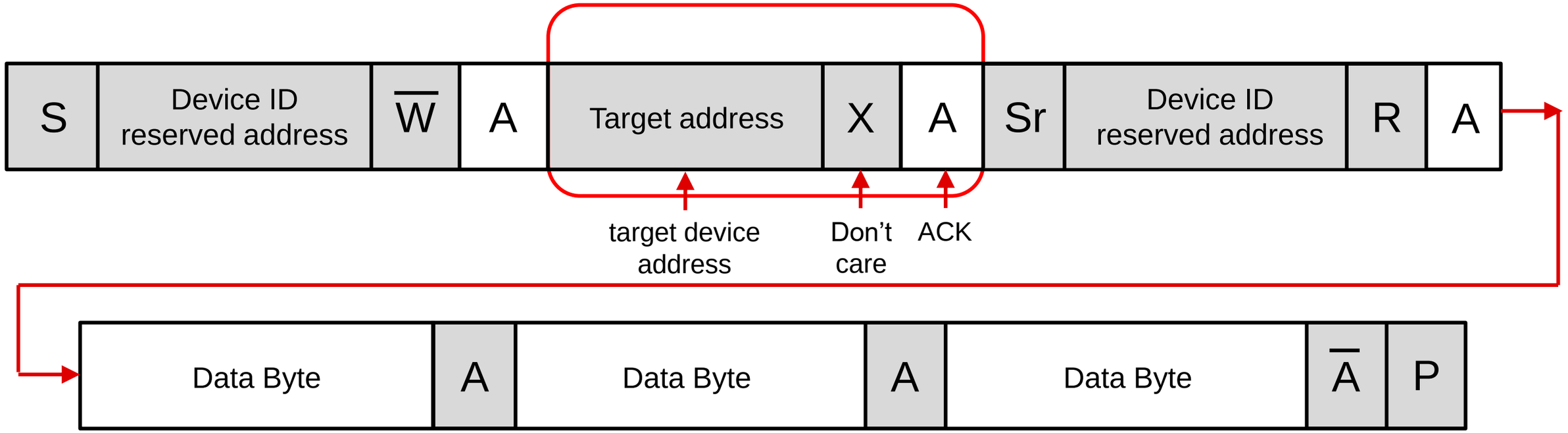


Using the reserved address:

- controller sends a START condition
- controller then sends the reserved address for Device ID
- The 8th bit is a 0 for write
- Any target device that recognizes Device ID sends ACK

I2C Reserved Addresses – Device ID

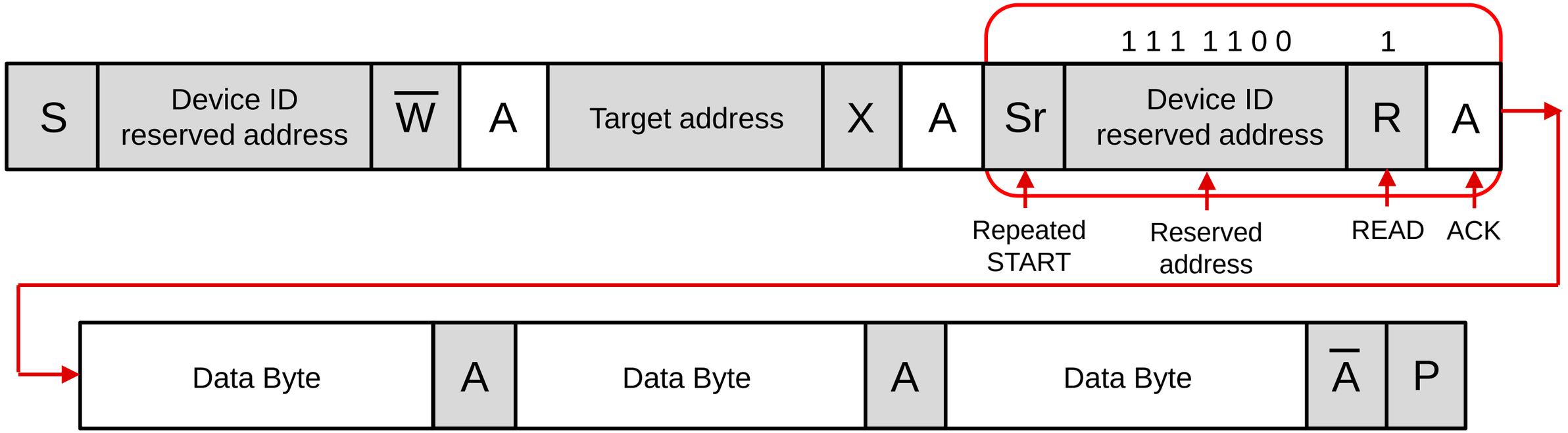
READ the reserved address Device ID:



- Controller then sends the address for the device it wants to ID
- The read write bit is then a don't care
- The target device responds with an ACK

I2C Reserved Addresses – Device ID

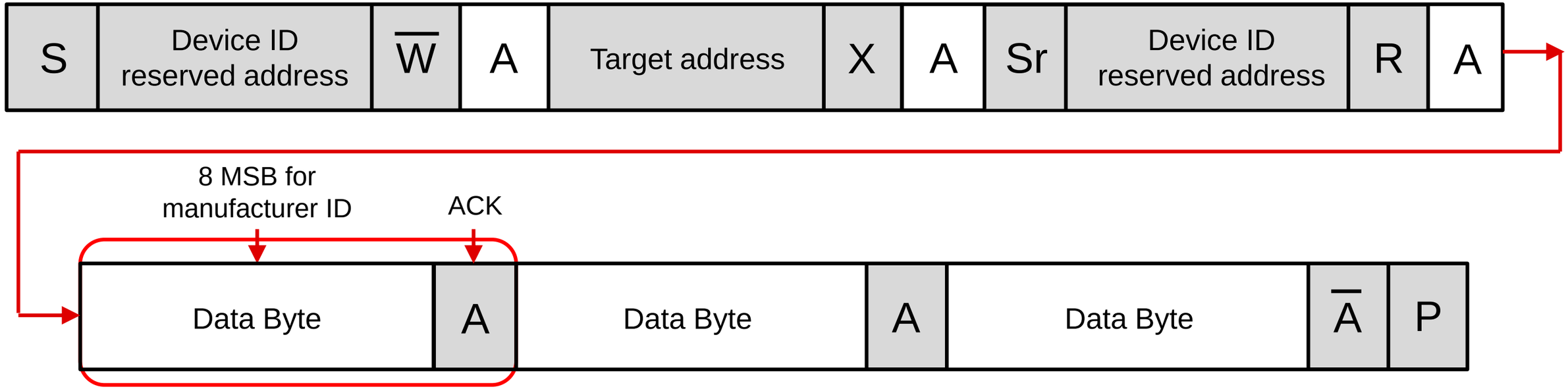
READ the reserved address Device ID:



- Controller then sends a repeated START
- Controller then sends the reserved address for Device ID
- The 8th bit is a 1 for read
- target device sends ACK

I2C Reserved Addresses – Device ID

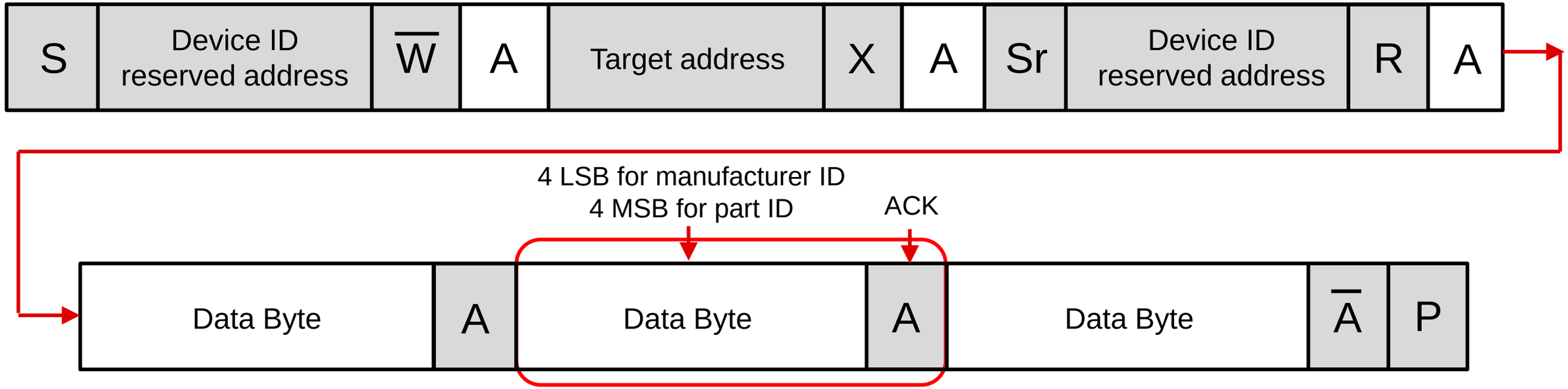
READ the reserved address Device ID:



- The target device then sends the Device ID
- The first data byte is the eight MSB for the 12-bit manufacturer ID
- Controller sends ACK that the data is received

I2C Reserved Addresses – Device ID

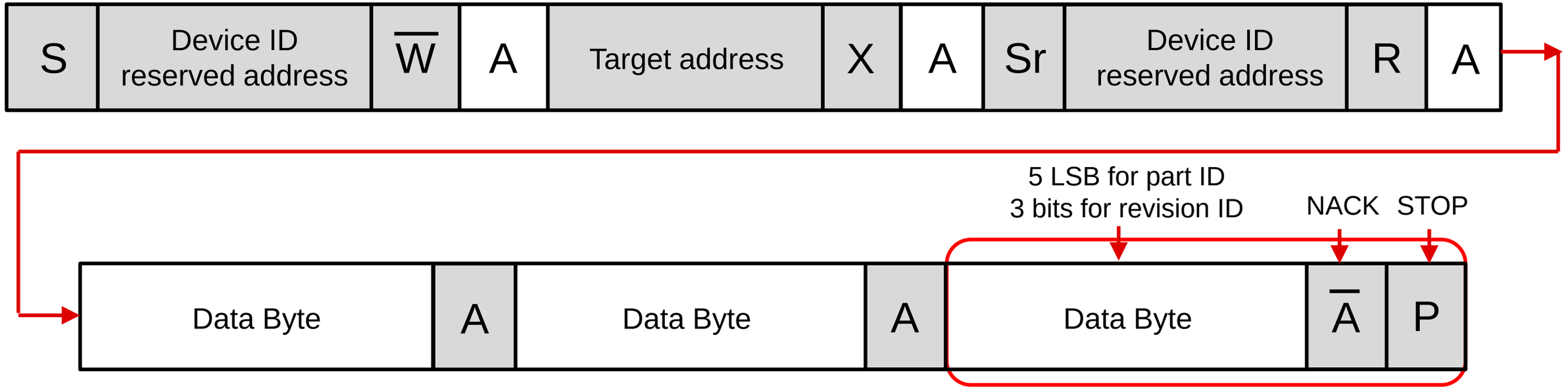
READ the reserved address Device ID:



- The second data byte starts with the four LSB for the 12-bit manufacturer ID
- The second data byte follows with the four MSB of the part ID
- Controller sends ACK that the data is received

I2C Reserved Addresses – Device ID

READ the reserved address Device ID:



- The third data byte starts with the five LSB for the 9-bit part ID
- The third data byte concludes with three bits for the revision ID
- Controller NACKs that the final byte and concludes the device ID data read with a STOP

I2C Reserved Addresses – 10-Bit target Addressing

target Address	R/W Bit	Description
000 0000	0	General call address
000 0000	1	START byte
000 0001	X	CBUS address
000 0010	X	Reserved for different bus format
000 0011	X	Reserved for future purposes
000 01XX	X	Hs-mode controller code
111 11XX	1	Device ID
111 10XX	X	10-bit target addressing

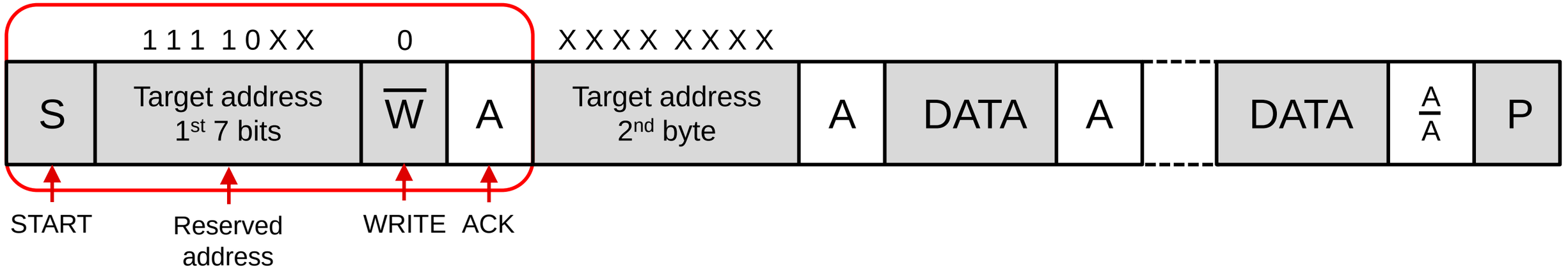
These two bits and the following byte make a total of 10 bits for addressing

10-Bit target Addressing

- Addresses 0x78 – 0x7B
- Expands I2C address to 10 bits with two bytes
- The 8th bit of the first byte still acts as the read/write
- The second byte completes the 10-bit address

I2C Reserved Addresses – 10-Bit target Addressing

WRITE with 10-bit address:

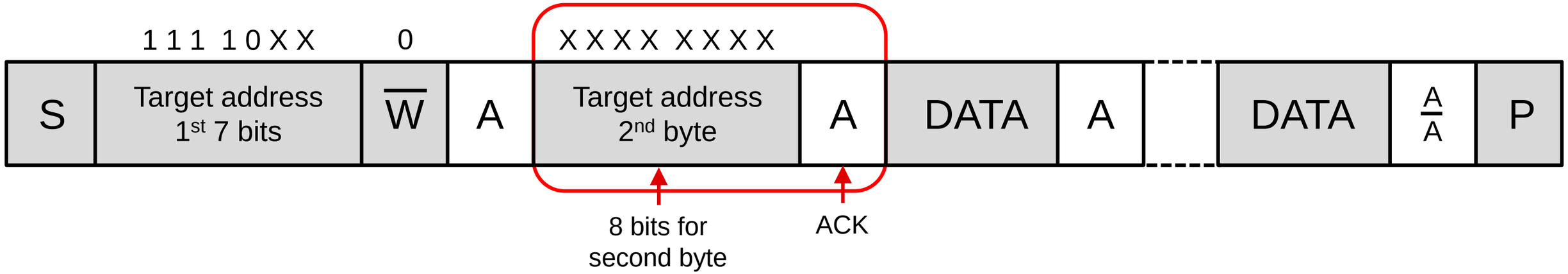


10-Bit target Addressing (WRITE):

- Controller sends a START condition
- Controller then send the 7 bits of the reserved address 78h to 7Bh
- The 8th bit of the first byte still acts as the read/write, here 0 for write
- Any 10-bit addressed target device that recognizes this address sends ACK

I2C Reserved Addresses – 10-Bit target Addressing

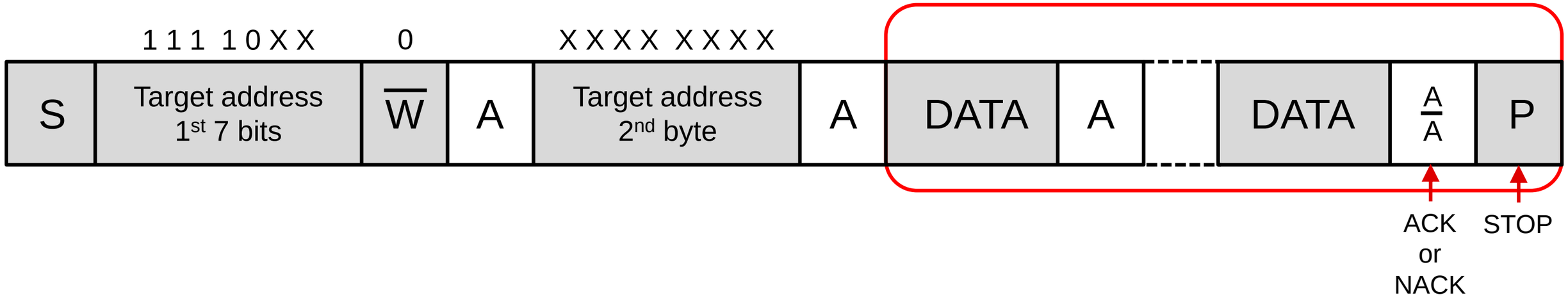
WRITE with 10-bit address:



- Controller then sends the second byte of the target address (8 bits)
- If correctly addressed, there should only be one device to ACK
- With the two bits of the reserved address and the eight bits of the second byte target address, this totals 10-bits of addressing.

I2C Reserved Addresses – 10-Bit target Addressing

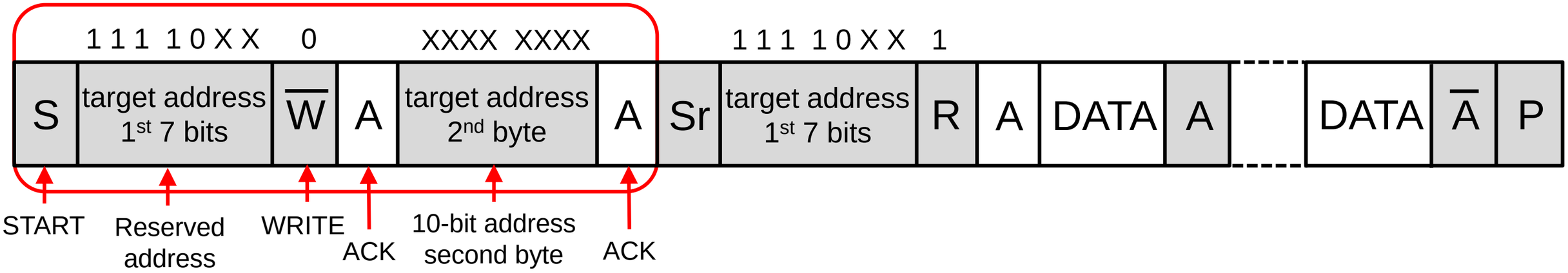
WRITE with 10-bit address:



- I2C communication continues normally with data byte transactions
- Target device stays in communication with controller until it receives a STOP
- A repeated START with a different target address will also stop communication, and start communication with the new address.

I2C Reserved Addresses – 10-Bit target Addressing

READ with 10-bit address:

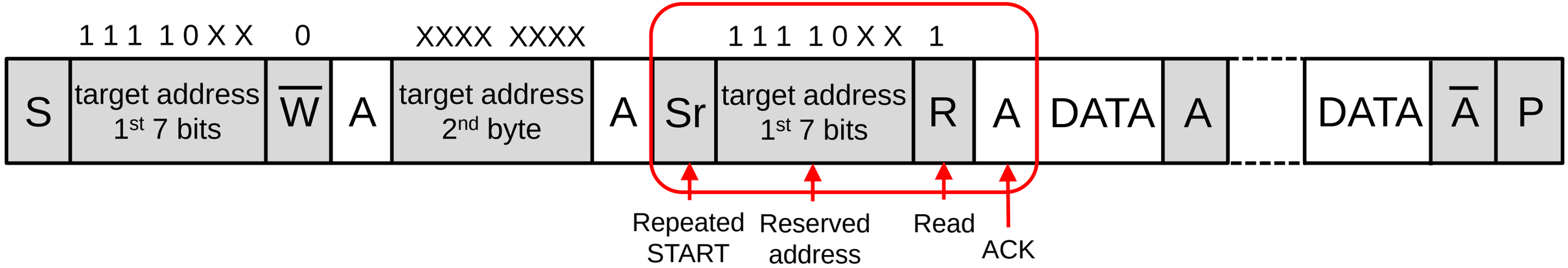


10-Bit target Addressing (READ):

- Starts exactly the same as a WRITE for 10-bit target addressing
- controller sends a START condition, then reserved address first 7 bits (78h to 7Bh)
- Then sends the WRITE (0) (same as a 10-bit write)
- Controller then sends target address 2nd byte for full 10-bit address

I2C Reserved Addresses – 10-Bit target Addressing

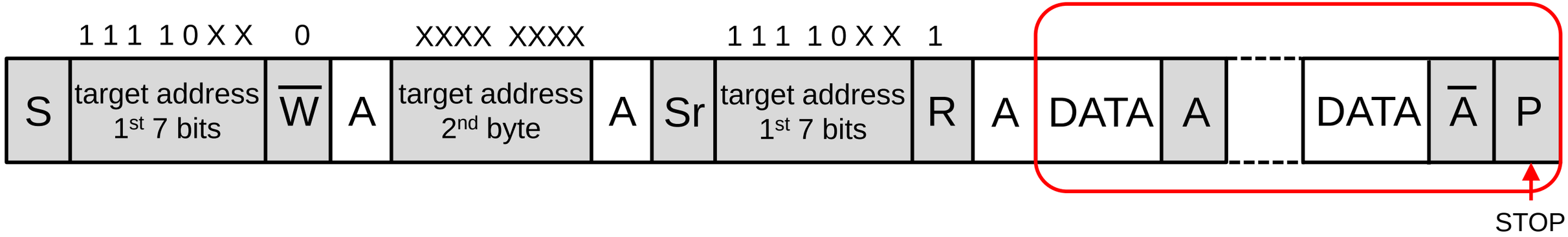
READ with 10-bit address:



- Controller then issues a repeated START and sends the same reserved address
- Controller then sends the READ bit (1)
- Device then ACKs the communication

I2C Reserved Addresses – 10-Bit target Addressing

READ with 10-bit address:



- I2C communication continues normally with data byte transactions
- Target device stays in communication with controller until it receives a STOP
- A repeated START with a different target address will also stop communication, and start communication with the new address.

Thanks for your time!
Please try the quiz.

Quiz: Basics of I2C: Reserved Addresses

1. Which of the following does not use a I2C reserved address?
   a. General call
   b. Device Acknowledge (ACK)
   c. High-speed controller code
   d. 10-bit addressing

Quiz: Basics of I2C: Reserved Addresses

1. Which of the following does not use a I2C reserved address?
   a. General call
   b. Device Acknowledge (ACK)
   c. High-speed controller code
   d. 10-bit addressing

Quiz: Basics of I2C: Reserved Addresses

2. How is I2C high-speed mode started?
   a. Write to the device's I2C address and the device's configuration byte
   b. Start by sending a high-speed mode controller code
   c. No special configuration is required for setting the device in high-speed mode
   d. Use the 10-bit address to set the high-speed mode

Quiz: Basics of I2C: Reserved Addresses

2. How is I2C high-speed mode started?
   a. Write to the device's I2C address and the device's configuration byte
   b. Start by sending a high-speed mode controller code
   c. No special configuration is required for setting the device in high-speed mode
   d. Use the 10-bit address to set the high-speed mode

Quiz: Basics of I2C: Reserved Addresses

3. Which of the following is not identified by Device ID data
   a. Device function
   b. Manufacturer ID
   c. Part identification
   d. Die Revision

Quiz: Basics of I2C: Reserved Addresses

3. Which of the following is not identified by Device ID data
   a. Device function
   b. Manufacturer ID
   c. Part identification
   d. Die Revision

Thanks for your time!