

# ELC4438: Embedded System Design

## Atmel ARM Cortex M3 GPIO and TWIM

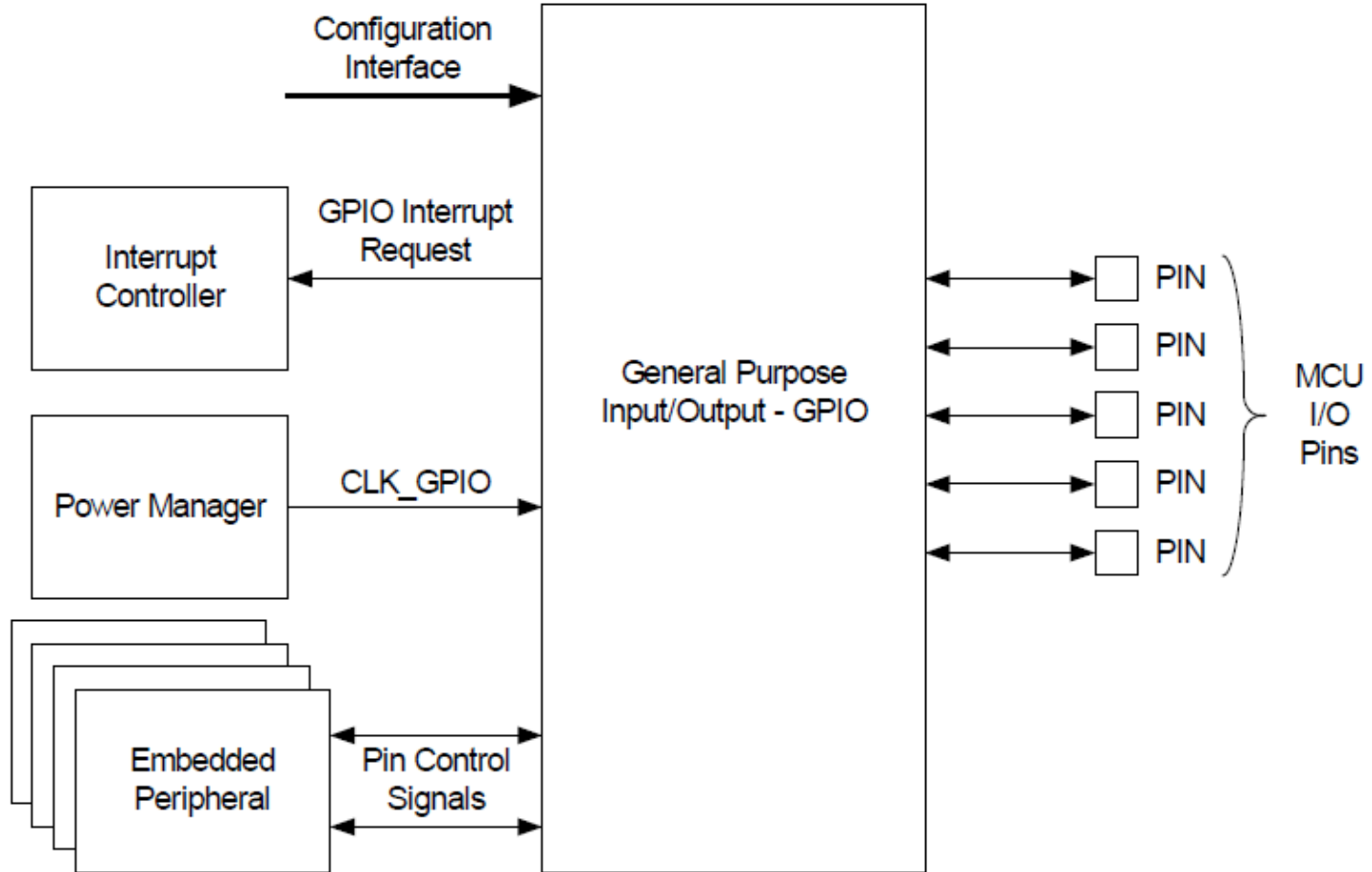
Liang Dong

Electrical and Computer Engineering  
Baylor University

# General-Purpose Input/Output (GPIO)

- GPIO is a generic pin on an IC whose behavior can be controlled by the user at run time.
- GPIO pins have no special purpose defined, and go unused by default.
  - GPIO pins can be configured to be input or output
  - GPIO pins can be enabled/disabled
  - Input values are readable (typically high=1, low=0)
  - Output values are writable/readable
  - Input values can often be used as IRQs

# GPIO Block Diagram

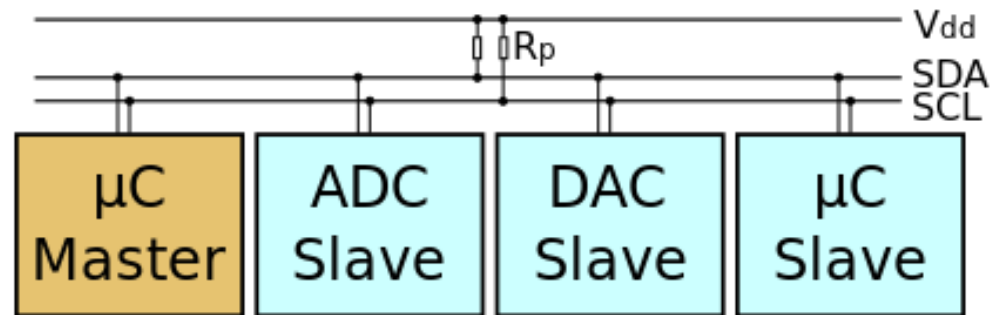
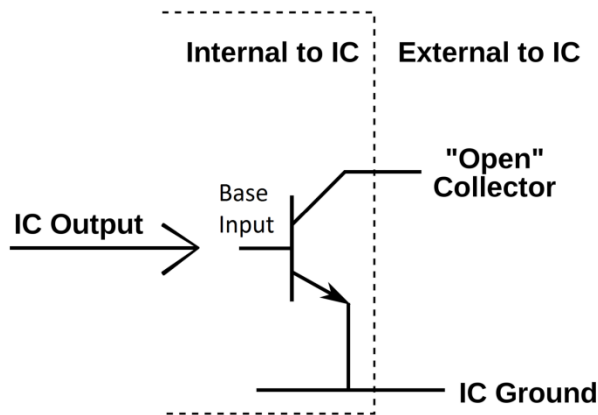


# Two-wire Master Interface (TWIM)

- I<sup>2</sup>C – Inter-Integrated Circuit
- Multi-master, multi-slave, single-ended, serial computer bus attaching lower-speed peripheral ICs to microcontrollers
- System Management Bus (SMBus) is a single-ended two-wire bus for the purpose of lightweight communication.
- SMBus is a subset of I<sup>2</sup>C

# I<sup>2</sup>C

- I<sup>2</sup>C uses only two bidirectional open-drain lines, Serial Data Line (SDA) and Serial Clock Line (SCL), pulled up with resistors.



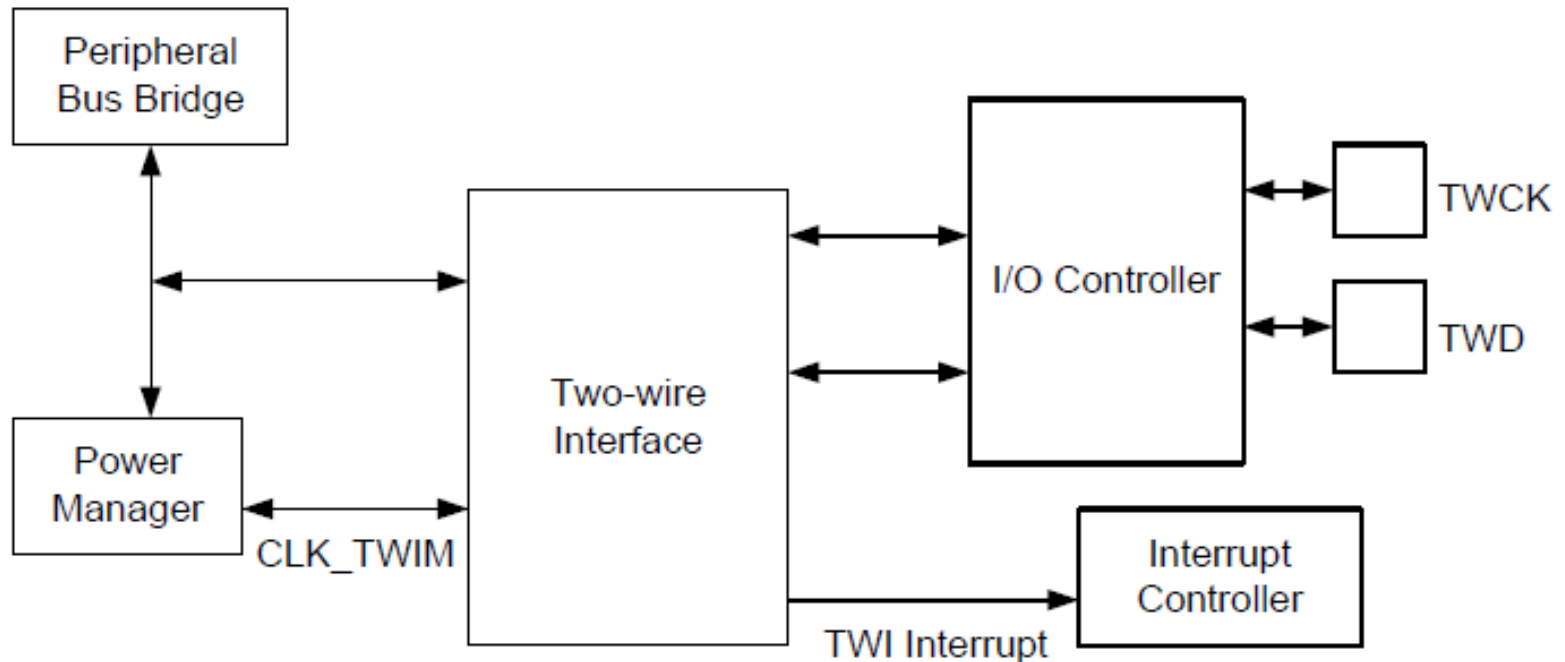
- "Pulled up" - When the bus is free, both lines are high.
- An open-drain or open-collector connection to perform the wired-AND function.

# TWIM Compatibility

**Table 27-1.** Atmel TWIM Compatibility with I<sup>2</sup>C Standard

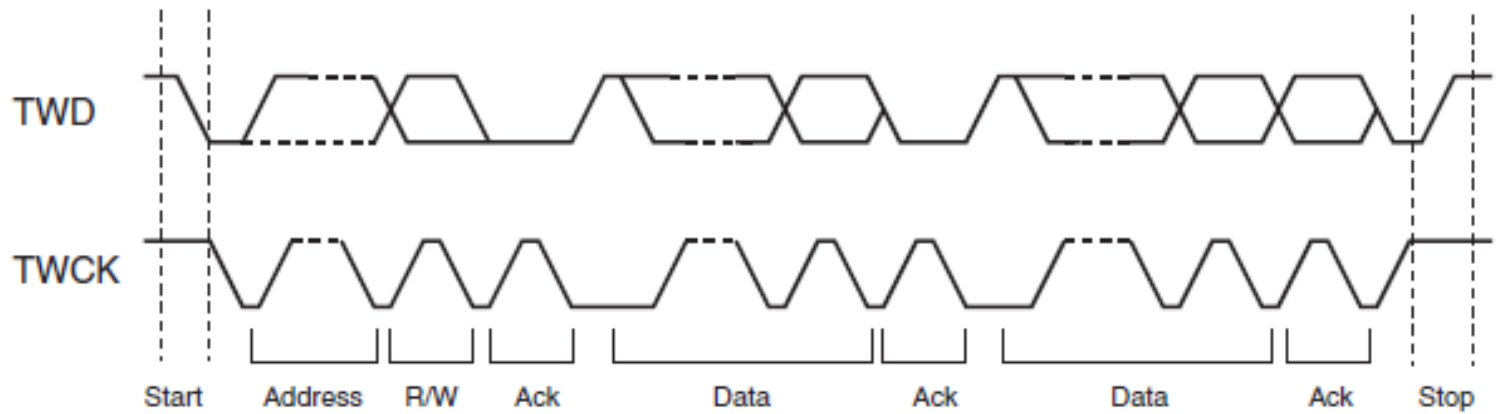
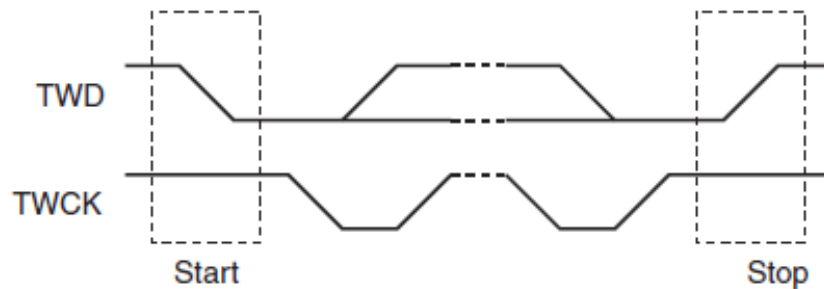
I <sup>2</sup> C Standard	Atmel TWIM
Standard-mode (100 kbit/s)	Supported
Fast-mode (400 kbit/s)	Supported
Fast-mode Plus (1 Mbit/s)	Supported
High-speed-mode (3.4 Mbit/s)	Supported
7- or 10-bits Slave Addressing	Supported
START BYTE <sup>(1)</sup>	Not Supported
Repeated Start (Sr) Condition	Supported
ACK and NACK Management	Supported
Slope Control and Input Filtering (Fast mode)	Supported
Clock Stretching	Supported

# ATSAM4L block diagram



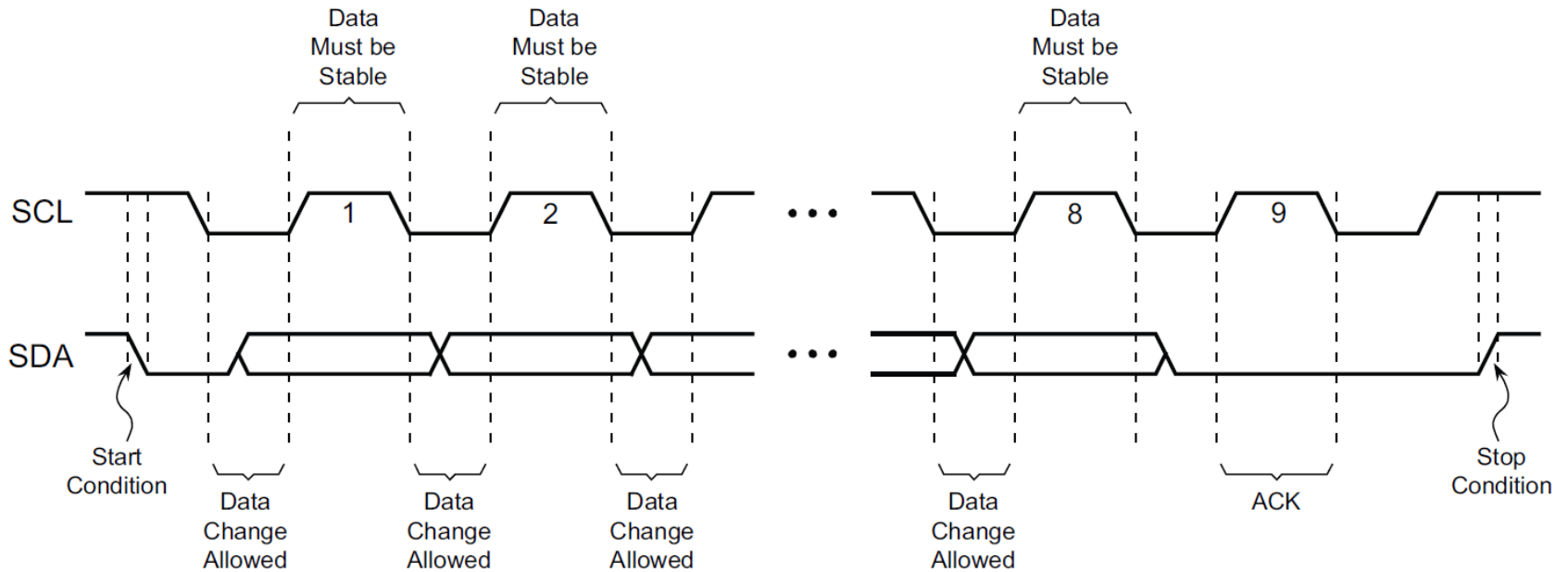
# Transfer Format

## START and STOP Conditions





# Start, Data Change, ACK, Stop



- There are 4 TWI interfaces on SAM4L.
- TWI0 and TWI1 can be master and slave while TWI2 and TWI3 can only be master.

# Digital Temp Sensor Chip

