
# Industrial Data Logger

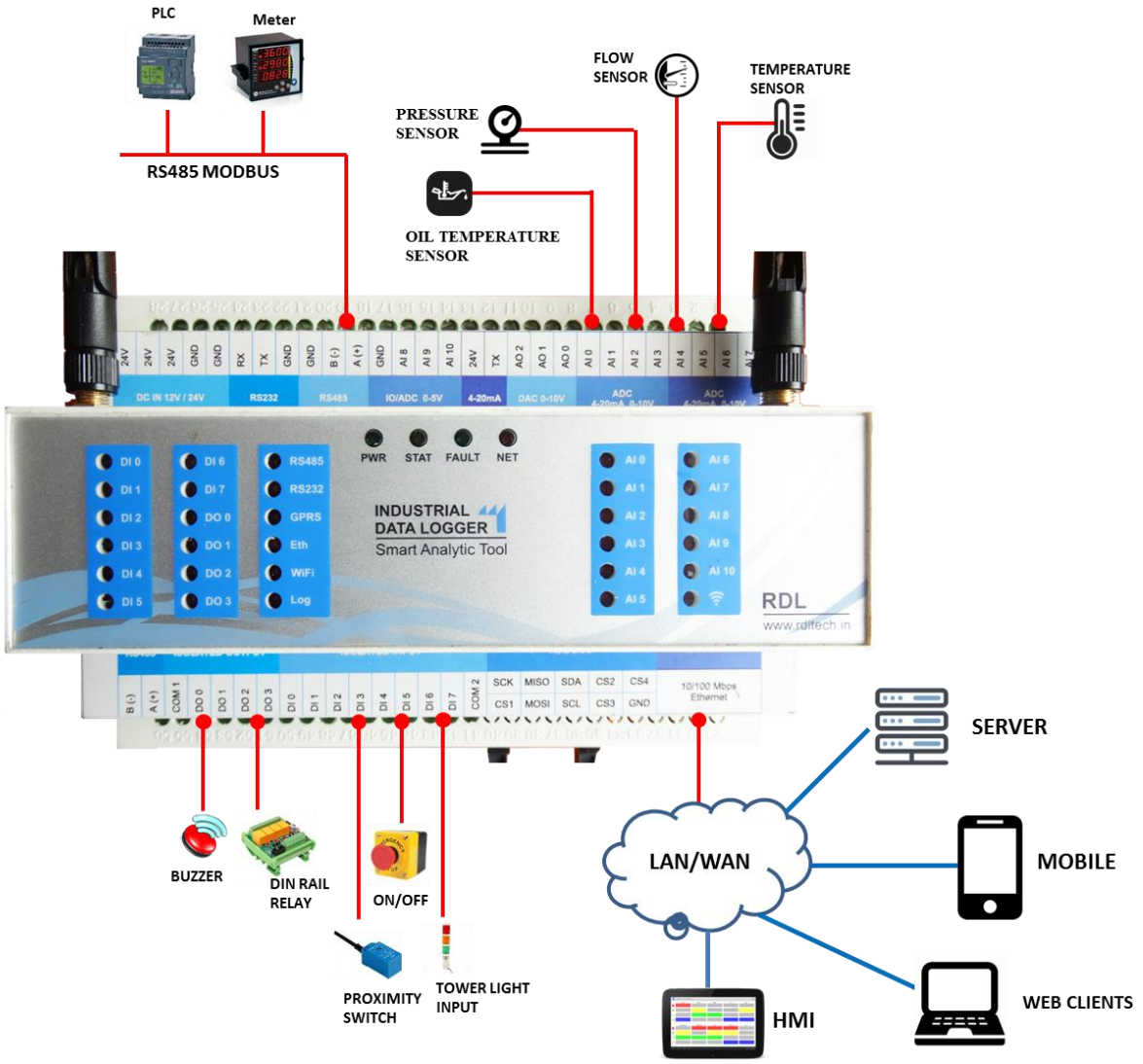
# IIoT 4.0

# Contents

# 1. Introduction

RDL data logger is a comprehensive real time industrial automation tool. The product is designed to seamlessly integrate with the IoT and Analytical processing systems. Supporting multiple I/O options, interfaces data logger is a perfect fit to build custom automation solutions.

The state of art design incorporates carefully selected devices with minimum power requirements, stable operation in industrial environment and up to date feature set. The product architecture incorporates functionally partitioned across multiple controllers to ensure minimum down-time and interruptions on the production lines.



## 2. Features

- 8x ADC 0 - 10V / 4 - 20mA
- 3x DAC 0-10V
- 1x 4-20ma Transmitter
- 3x ADC/IO 0-5v
- 8x DI 24v & 3x DO
- 2x RS485 Modbus*
- 10/100 MBPS Ethernet
- 1x RS232
- 1x Quad band GSM /GPRS Modem*
- 1x External PWDT
- 1x SD card , RTC ,FLASH & FRAM
- 1x XBee /ESP32/Lora/RS485*
- 12/24V DC to DC Converter
- RDL Extension BUS with SPI /I2C /IO
- Mega2560 Controller
- Enable with STM32F030RCTx Co-controller for Advanced programming

## 3. Benefits

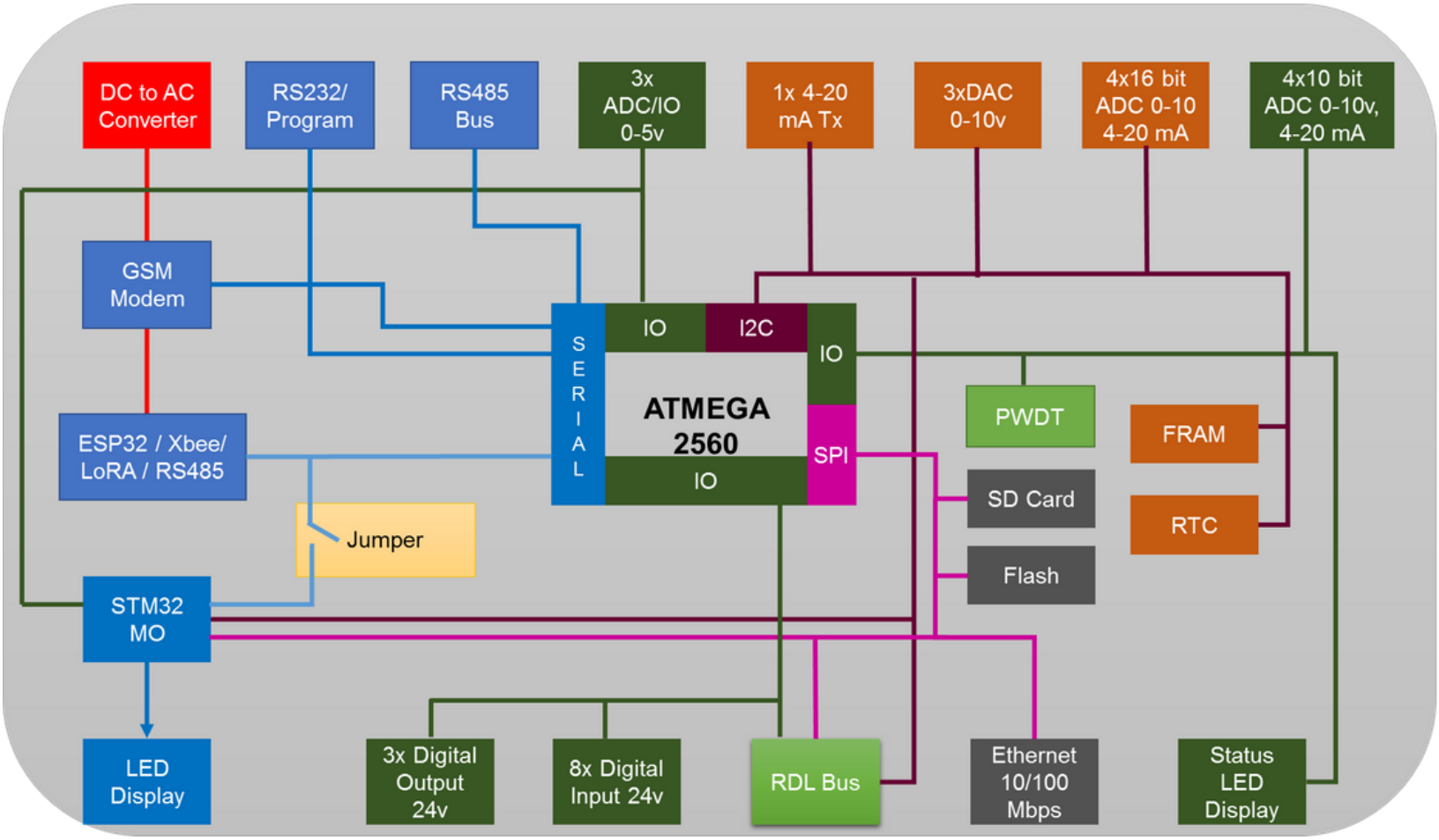
Reduce Supplier dependency and cost by complete ownership of the solution. Automation requirements keep increasing and changing with time, engaging external supplier is cost and loss of productive time. Open Platform Model allows to build custom solutions with minimal R&D cost. Our platform and tools will enable a base solution to be built and deployed with 1 person month of effort with basic programming skills.

- Simplified logging network as RDL Data Logger supports multiple features
- Paper-less Production environment
- Production count, rejections
- Machine availability and Downtimes
- Preventive maintenance
- Performance Forecasting
- Enable Management by IT

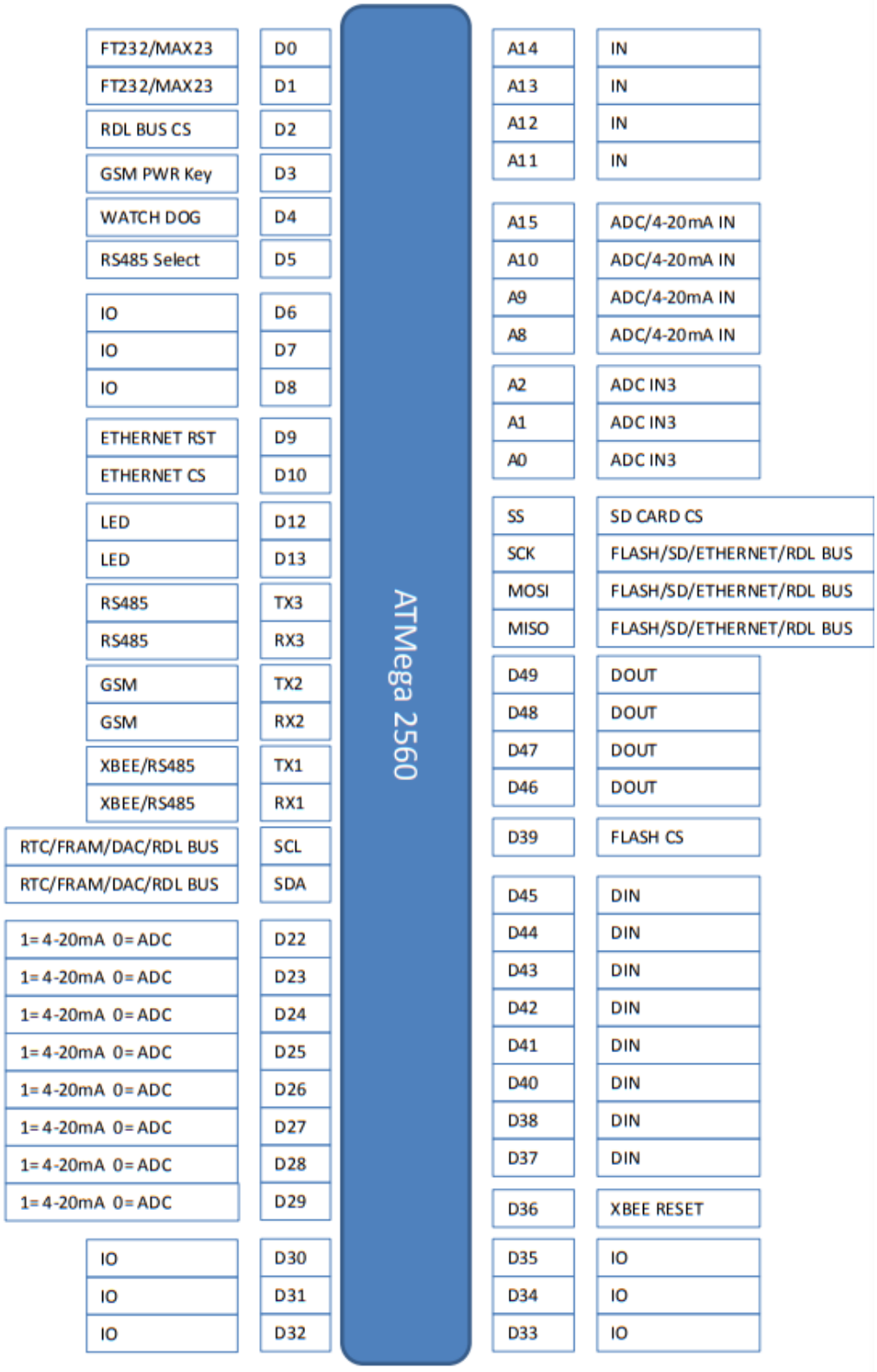
## 4. Applications

- Production and process monitoring.
- Utilities monitoring.
- Condition monitoring.
- Environment monitoring.
- Industrial Smart grid
- Leakage detection.
- Cold storage monitoring.
- District metering.
- Water treatment.
- Generator monitoring.
- Green House.
- Warning message in case of calamities.
- Standard SCADA Applications

## 5. Block Diagram



## 6. Pin-out


FT232/MAX23 D0
FT232/MAX23 D1
RDL BUS CS D2
GSM PWR Key D3
WATCH DOG D4
RS485 Select D5
IO D6
IO D7
IO D8
ETHERNET RST D9
ETHERNET CS D10
LED D12
LED D13
RS485 TX3
RS485 RX3
GSM TX2
GSM RX2
XBEE/RS485 TX1
XBEE/RS485 RX1
RTC/FRAM/DAC/RDL BUS SCL
RTC/FRAM/DAC/RDL BUS SDA
1=4-20mA 0=ADC D22
1=4-20mA 0=ADC D23
1=4-20mA 0=ADC D24
1=4-20mA 0=ADC D25
1=4-20mA 0=ADC D26
1=4-20mA 0=ADC D27
1=4-20mA 0=ADC D28
1=4-20mA 0=ADC D29
IO D30
IO D31
IO D32
ATMega 2560
A14 IN
A13 IN
A12 IN
A11 IN
A15 ADC/4-20mA IN
A10 ADC/4-20mA IN
A9 ADC/4-20mA IN
A8 ADC/4-20mA IN
A2 ADC IN3
A1 ADC IN3
A0 ADC IN3
SS SD CARD CS
SCK FLASH/SD/ETHERNET/RDL BUS
MOSI FLASH/SD/ETHERNET/RDL BUS
MISO FLASH/SD/ETHERNET/RDL BUS
D49 DOUT
D48 DOUT
D47 DOUT
D46 DOUT
D39 FLASH CS
D45 DIN
D44 DIN
D43 DIN
D42 DIN
D41 DIN
D40 DIN
D38 DIN
D37 DIN
D36 XBEE RESET
D35 IO
D34 IO
D33 IO

| Pins | Functionality |
|---|---|
| D0, D1 | Serial Pins. To which either FT232 can be connected or a MAX232 can be connected. |
| D2 | RDL Bus chip select Pin |
| D3 | RDL chip select or slave select pin |
| D4 | GSM power key (Software Switch). High-to-Low on this pin powers ON the GSM. |
| D5 | RS485 select (control) pin for serial communication. |
| D6 – D8, D30 – D35 | Left open to the user and can be configured either as an input or output. |
| D9 | Reset pin for Ethernet |
| D10 | Chip select or slave select pin for Ethernet |
| D12, D13 | LED pins which could be programmed for status indication as required. |
| TX3, RX3 | RS485 serial communication |
| TX2, RX2 | GSM serial communication |
| TX1, RX1 | Can either be connected to RD485 or XBEE for serial communication |
| SCL, SDA | Can be connected to I2C based RTC, FRAM, DAC and RDL bus |
| D22 – D29 | Control pins to select ADC as a 0-10V Voltage reading channel or 4-20mA Current reading channel. |
| D36 | XBEE reset pin |
| D37, D38 | Digital input pins |
| D39 | Chip select or slave select pin for Flash |
| D40 – D45 | Digital input pins |
| D46 – D49 | Digital Output pins |
| MISO, MOSI, SCK | SPI pins to where number of devices could be connected |
| SS | Chip select or slave select pin for SD Card |
| A0 – A2 | Analog Input Pins left open to the user |
| A8, A9, A10, A15 | Analog Input Pins which could be configured (using pins d22-d29) to read either voltage or current. |
| A11 – A14 | Analog Input Pins left open to the user |

# 7. Programming IDE

The hardware supports various Open Source Programming IDE including Arduino IDE, Atmel Studio and Arduino Compatible Compiler for LabView. For more information on this follow "**Open Source Programming IDE"** section of the following link.

https://rdltech.in/data-logger-iiot-4-0

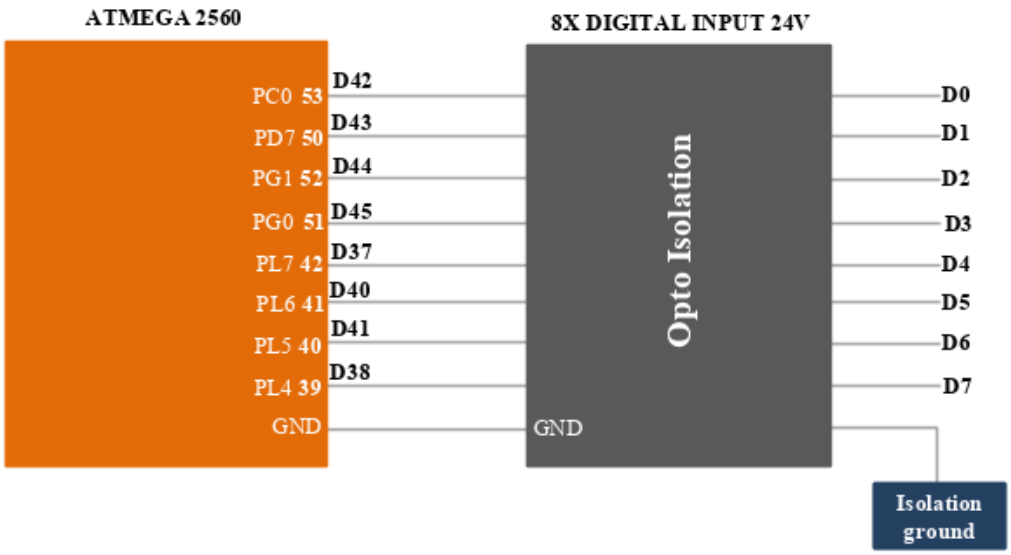
# 8. Product Specification

## 8.1. Digital Input

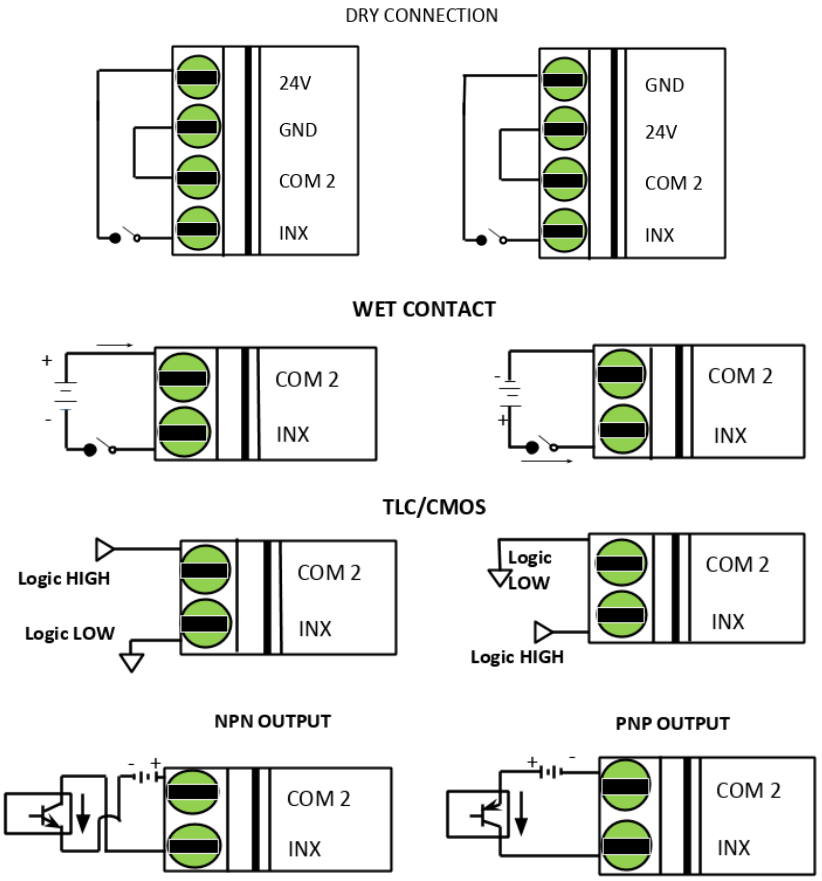
### Specification

- Channels: 8
- Input Voltage: 0-24V
  - Logic High: >11V
  - Logic Low: <3V
- Isolation : 3750 VRMS
- Supports Inverted DI Status
- Supported Connection: Dry and Wet both
- Maximum Frequency : 200Hz

### Functional Diagram

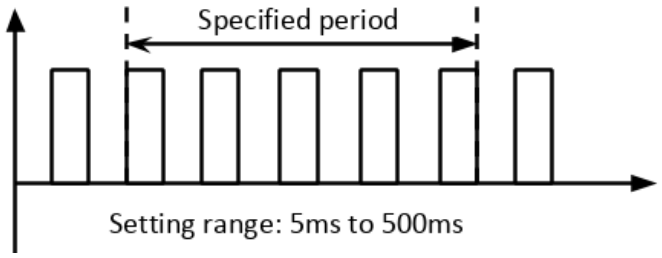


## Application Wiring




## Use Case

### 1. Measuring Frequency




## Example Code

You may look into the following link for example on reading a digital pin.

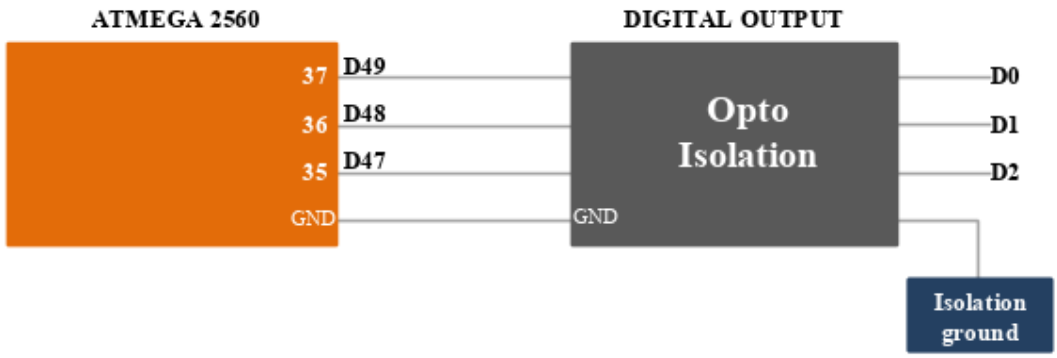
https://www.arduino.cc/reference/en/language/functions/digital-io/digitalread/

## 8.2. Digital Output

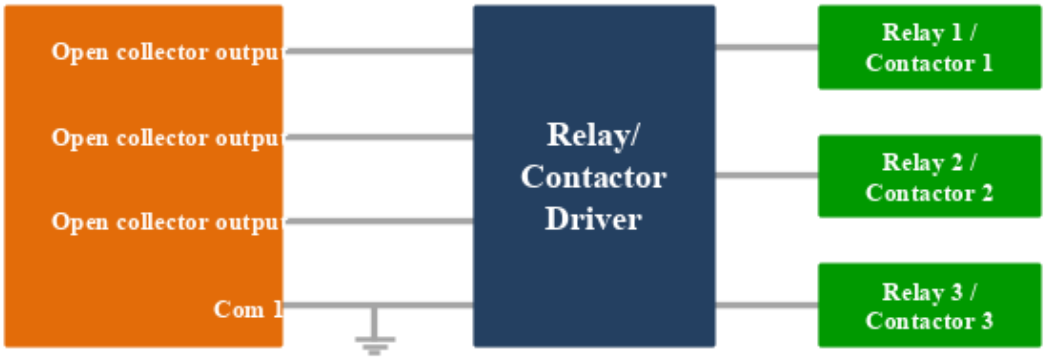
### Specification

- Channels: 3
- Open Collector
- Isolation : 3750 VRMS
- Absolute maximum voltage - 35V, Current - 100mA
- Cut-Off Frequency : 10KHz

### Functional Diagram




### Application Wiring




### Example Code

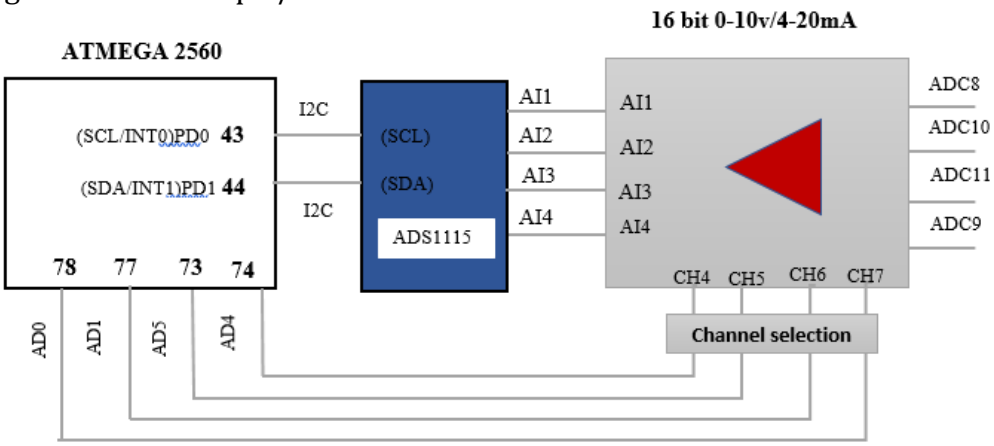
You may look into the following link for more details on writing to digital pin.

https://www.arduino.cc/en/Reference.digitalWrite

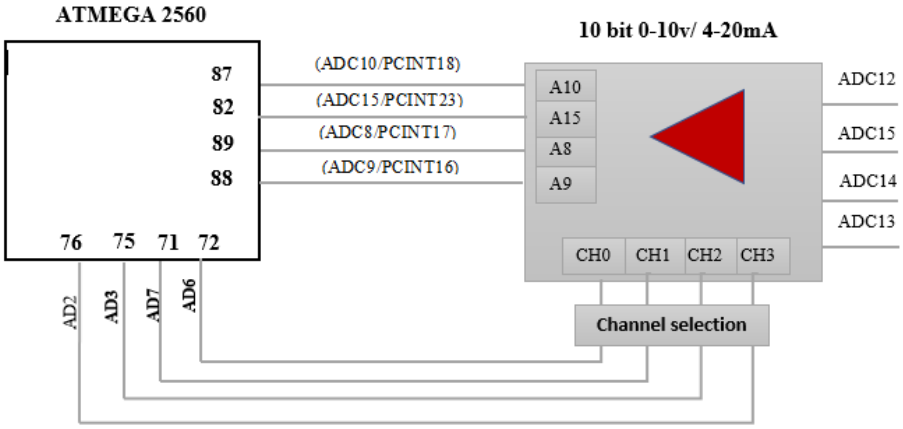
## 8.3. Analog Input

### Specification

- Channels: 8+3
- **Group 1 :**
  - Channel : 4
  - Input : Voltage(0-10V) / Current(4-20mA)
  - Resolution : 16 bits
  - Sampling Rate – 860 sample/sec

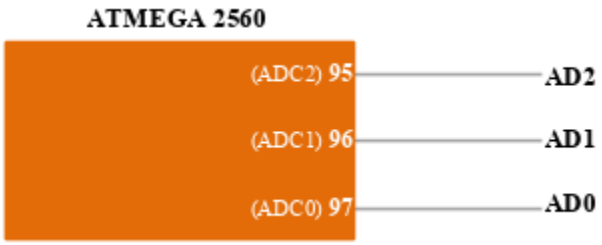



- **Group 2 :**
  - Channel : 4
  - Input : Voltage(0-10V) / Current(4-20mA)
  - Resolution : 10 bits
  - Sampling Rate – 9.6KHz (13 clocks)



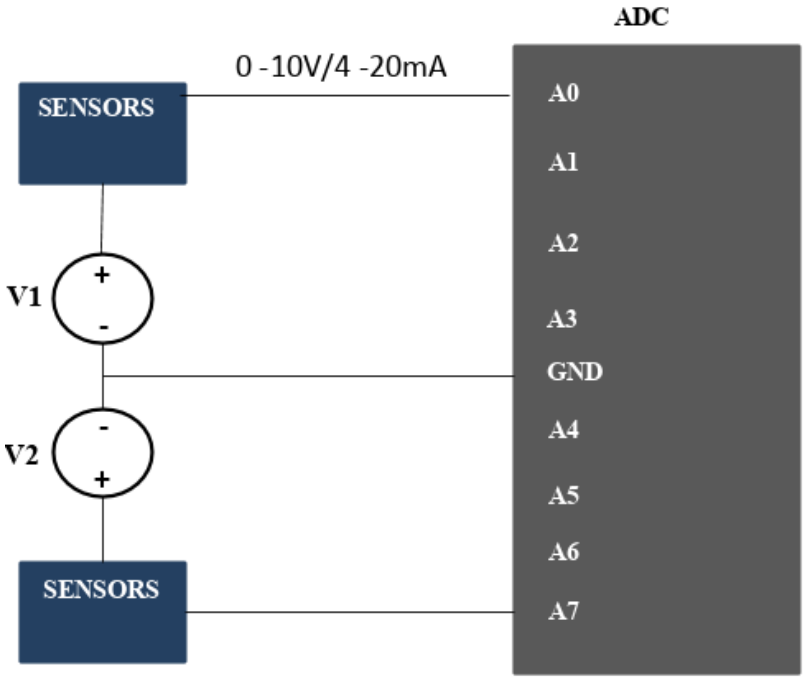

- **Group 3 :**

- Channel : 3
- Input : Voltage(0-5V)
- Resolution : 10 bits
- Sampling Rate – 9.6KHz (13 clocks)




## Application Wiring

1. Interfacing ADC with Sensor




## Example Code

You may look into the following link for more details on reading analog pin.

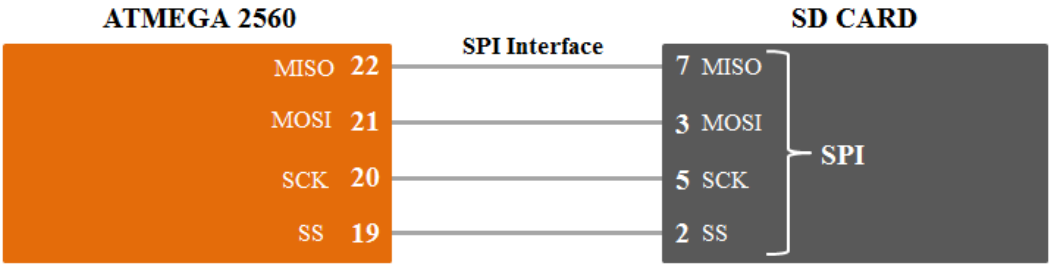
https://www.arduino.cc/en/Tutorial/ReadAnalogVoltage#toc5

## 8.4. SD Card

### Specification

- SPI Serial Interface
- Supports Fat File system

### Functional Diagram




### Example Code

You may look into the following link for example on SD Card.

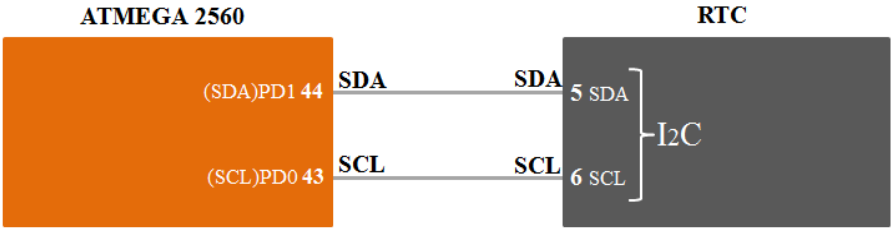
https://www.arduino.cc/en/Reference/SD

## 8.5. RTC

### Specification

- DS1307 with I2C Serial Interface
- Counts Seconds, Minutes, Hours, Date, Month, Day, and Year with Leap-Year Compensation.
- 56-Byte, Battery-Backed, NV RAM for Data Storage
- Consumes <500nA in Battery Backup Mode with Oscillator Running

### Functional Diagram



### Example Code

You may look into the following link for example code on RTC.

https://www.arduino.cc/en/Reference/RTC

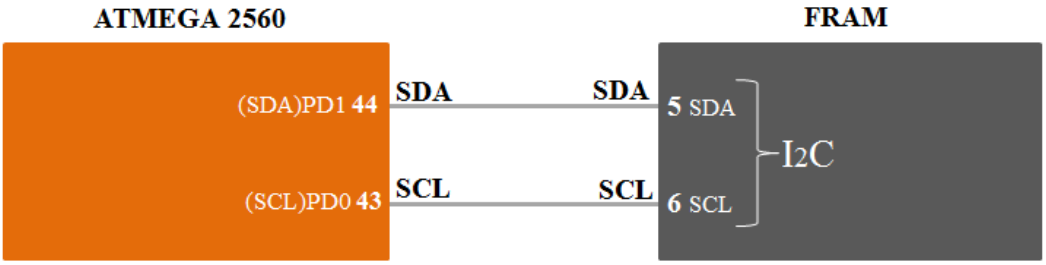
## 8.6. FRAM

FRAM is specifically used for applications such as production counting, production rejection where variable subjected to continuous write cycle

### Specification

- MB85RC256V, I2C compatible with Bit configuration : 32,768 words × 8 bits
- Operating frequency : 1 MHz (Max)
- Read/write endurance : 1012 times / byte
- Number of write cycles: 100 Trillion times
- Operating power supply voltage : 2.7V to 5.5V, current 200 µA
- Data Retention: 10 years (+85°C), 95 years (+55°C), over 200 years (+35°C).

### Functional Diagram




### Example Code

You may look into the following link for example on RTC

https://github.com/adafruit/Adafruit_FRAM_I2C/blob/master/examples/MB85RC256V/MB85RC256V.ino

## 8.7. PWDT (Physical Watch Dog Timer)

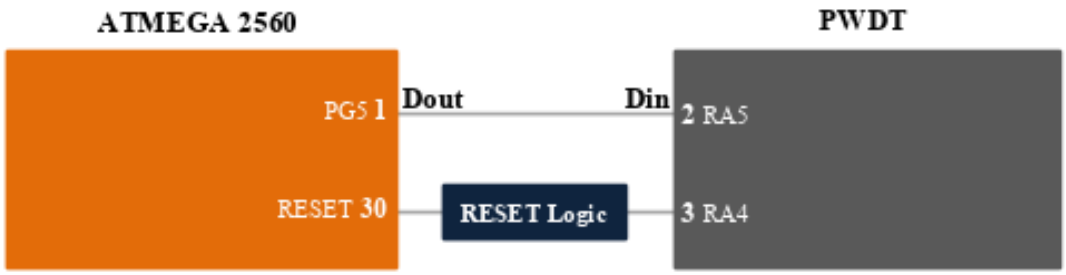
External physical watchdog is connected along with inbuilt watchdog timer. There are many instances where we need to set watch dog time for more than 8 seconds (typically bulk file upload takes in minutes). As inbuilt WDT is limited to maximum of 8Sec, we have gone a step further to support watch dog time up to 3 minutes.

Note: User must program PWDT to refresh before the timer (3 min) expires.

### Specification

- PWDT supports up to 3minutes.
- PIC12F1840 used for PWDT
- Refresh time : 1 pulse in every 3 minutes
- Operating temperature range: –40 to 125 °C

### Functional Diagram




### Example Code

You may look into the following link for examples on watchdog timer.

https://folk.uio.no/jeanra/Microelectronics/ArduinoWatchdog.html

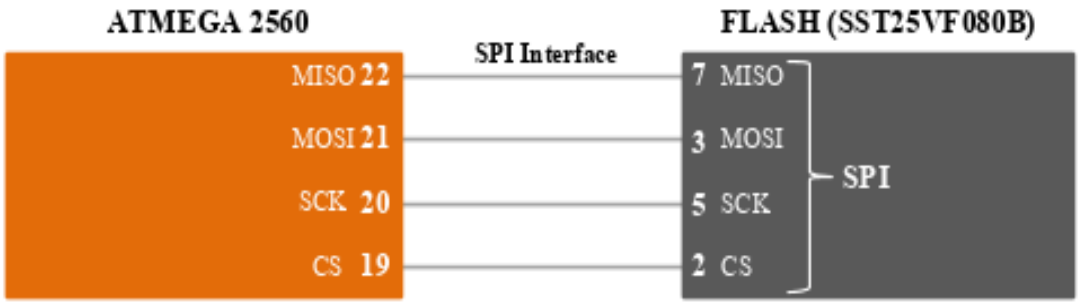
## 8.8. Flash

Flash is specifically used for embedded server.

### Specification

- SST25VF080B - SPI Compatible: Mode 0 and Mode 3
- Memory: 8MBit
- High Speed Clock Frequency – 50 MHz
- Single Voltage Read and Write Operations – 2.7-3.6V
- Endurance: 100,000 Cycles (typical) – >100 years Data Retention
- Low Power Consumption: – Active Read Current: 10 mA (typical)
- Flexible Erase Capability – Uniform 4KB, 32KB overlay blocks and 64KB overlay blocks
- Software Write Protection

### Functional Diagram




### Example Code

You may look into the following link for example on how to use flash.

https://github.com/nullboundary/SST25VF

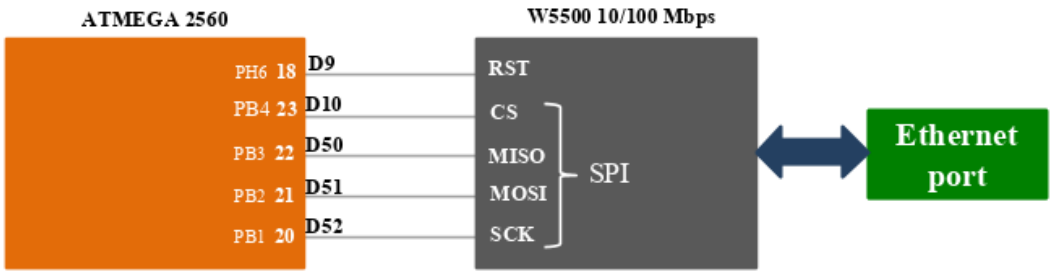
## 8.9. Ethernet

Ethernet is specifically used for establishing secured physical network connectivity with local network infrastructure

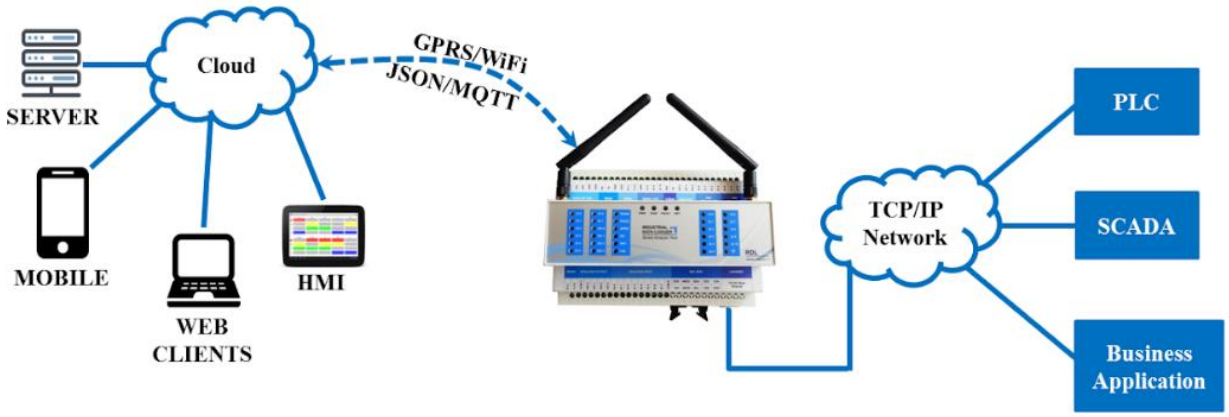
### Specification

- W5500 IC with SPI serial interface
- IEEE 802.3 Gigabit Ethernet Compliant
- Communication protocols: TCP/IP, HTTP, FTP, MQTT, UDP,JSON….
- 3.3V operation with 5V I/O signal tolerance
- Low Power Consumption <200mW at 1.25Gbps.

### Functional Diagram




### Use Case




### Example Code

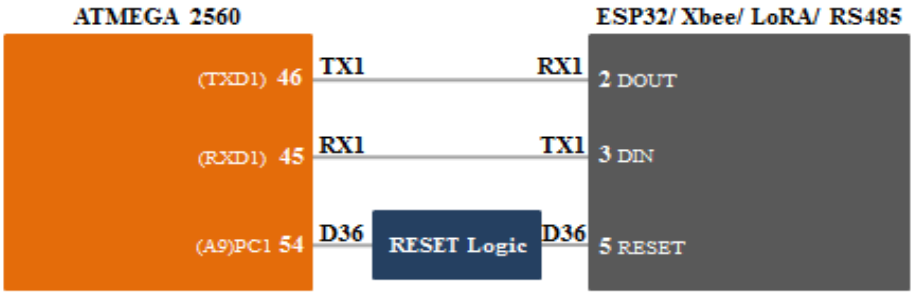
You may look into the following link for examples on Ethernet.
https://www.arduino.cc/en/Reference/Ethernet

## 8.10. ESP32/XBEE/LoRA/RS485

This is Add-On pluggable module. One among ESP32, XBEE, LoRA or RS485 is comes with the product. For more details on this, look into Order Information Table.

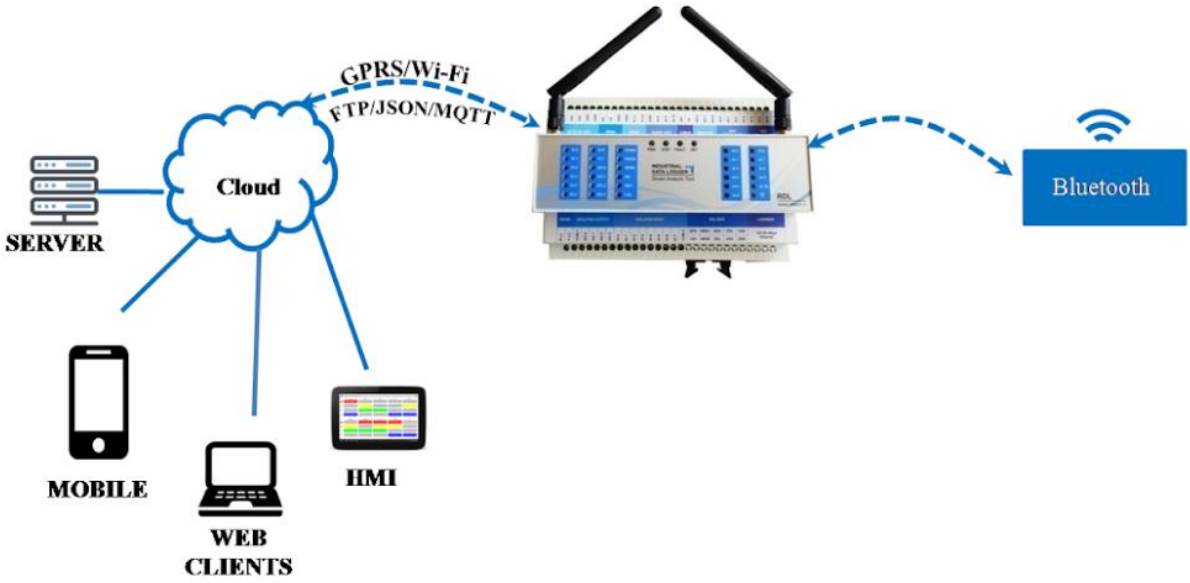
This is specifically used for wireless connectivity with existing infrastructure.

### Functional Diagram

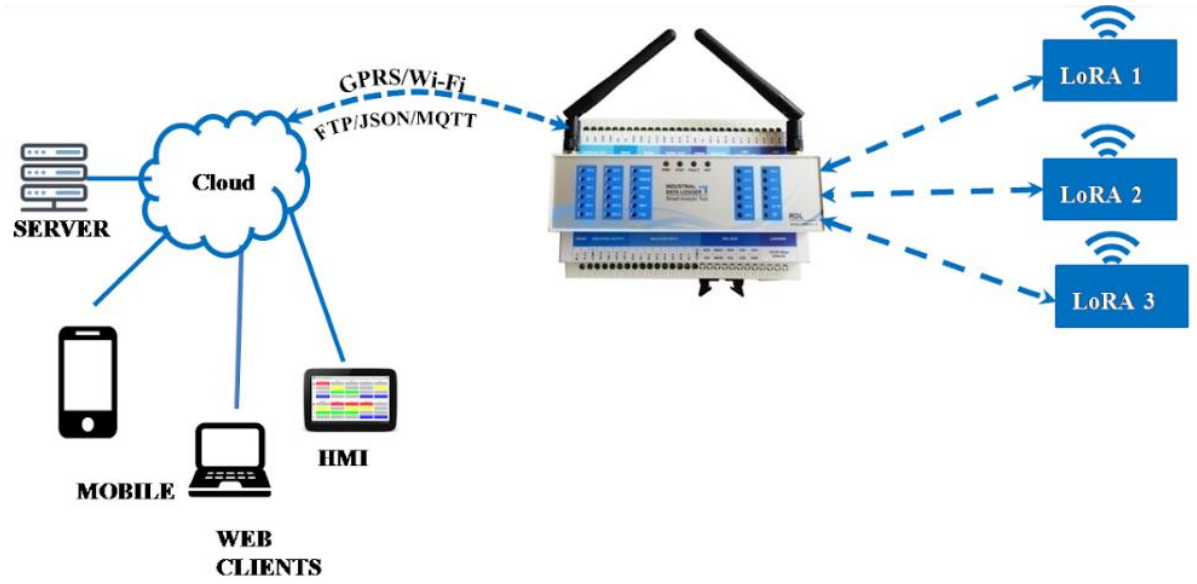



### Use Case

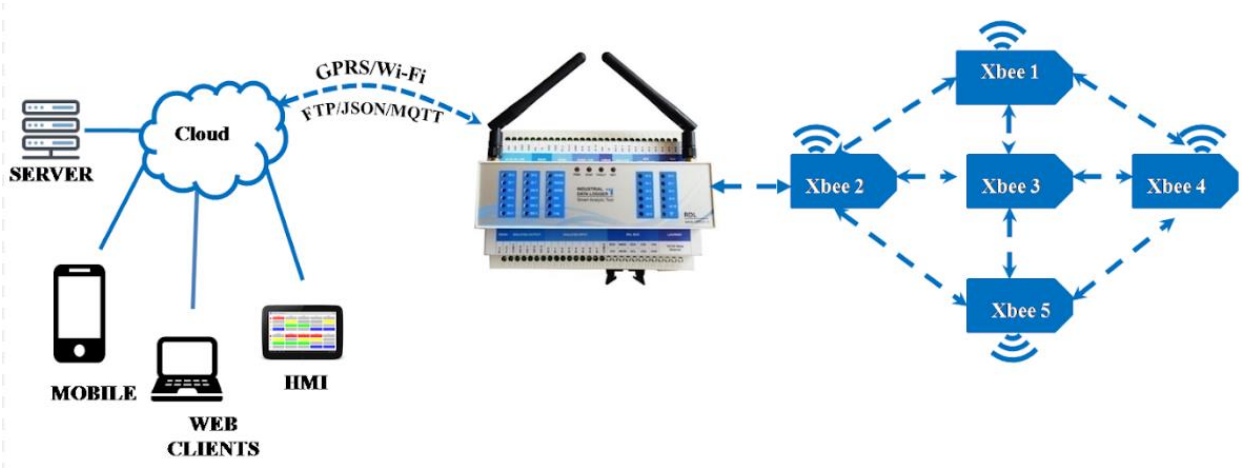
1. **Interfacing Industrial Data Logger with Bluetooth**



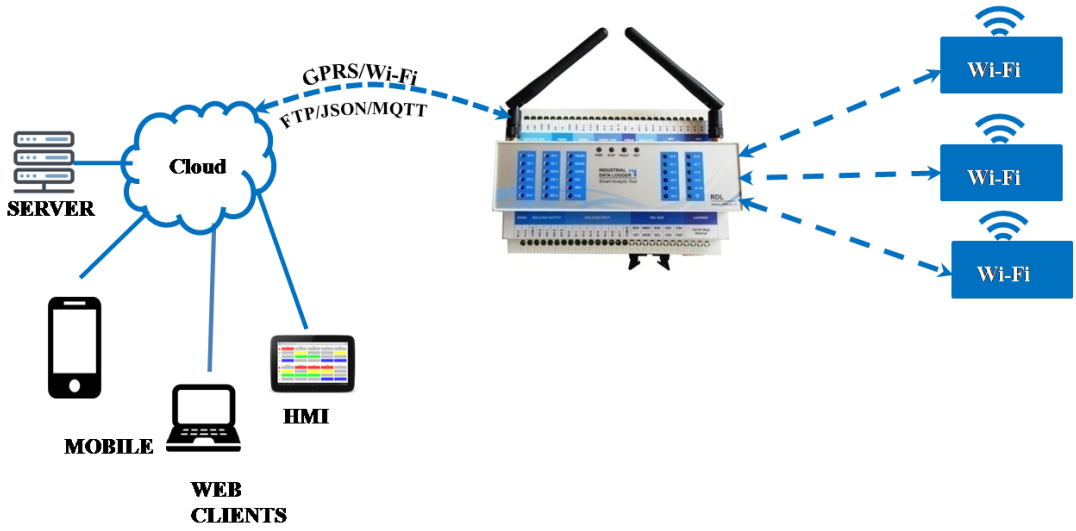
## 2. Interfacing Industrial Data Logger with LoRA




## 3. Interfacing Industrial Data Logger with Xbee



4. **Interfacing Industrial Data Logger with Wi-Fi (ESP32)**




### Example Code

You may look into the following link for examples on esp8266.

https://www.arduino.cc/en/Reference/WiFiServer

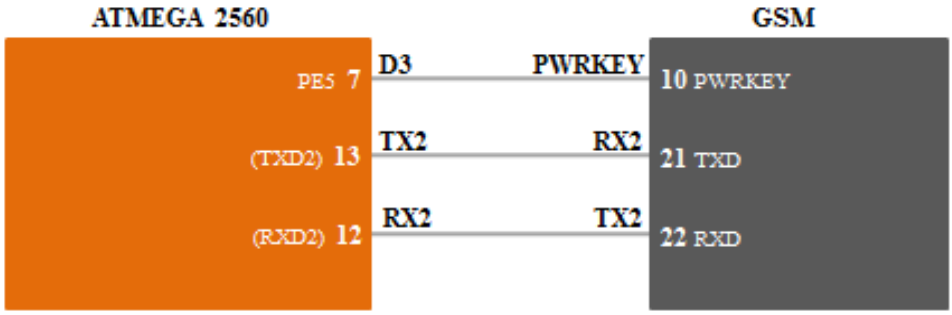
## 8.11. GSM

This is specifically used for M2M and remote data logging and control applications.

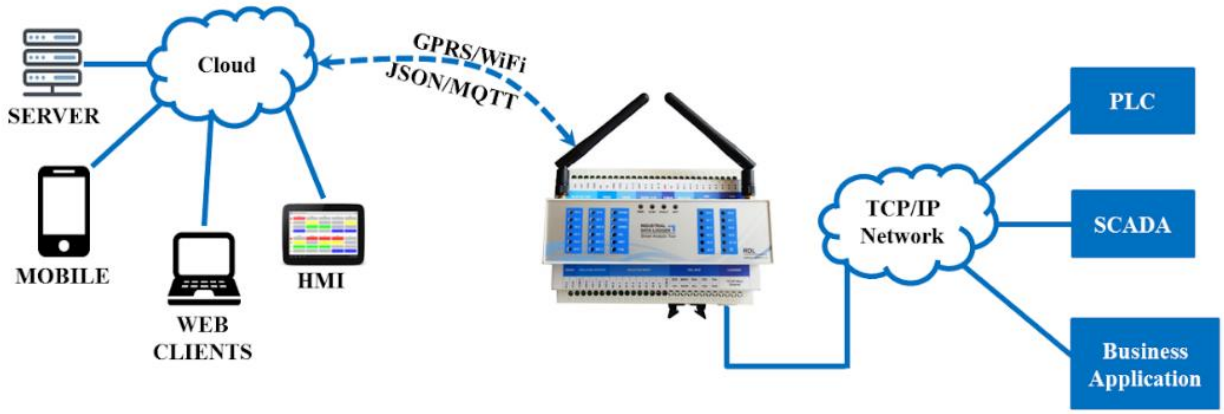
### Specification

- Quectel M95, Quad-Band 850/900/1800/1900MHz.
- Serial interface for direct communication with PC or MCU.
- Configurable baud rate.
- Power controlled using 29302WU IC.
- ESD Compliance.
- Enabled with Audio jack.
- With push pull SIM card holder.
- With Stub antenna and SMA connector.
- Input Voltage: 12V DC.

## Functional Diagram




## Use Case




## Example Code

You may look into the following link for examples on GSM.

https://www.arduino.cc/en/Tutorial/GSMExamplesSendSMS

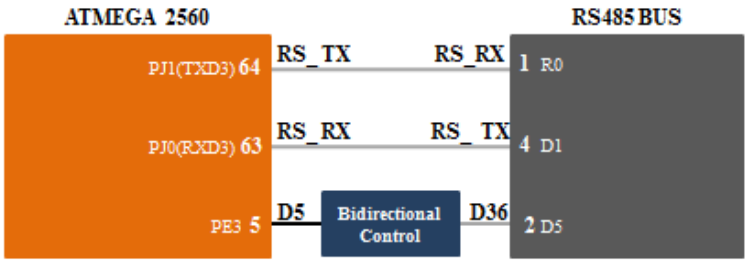
## 8.12. RS485 Modbus

- Modbus is an Industrial standard serial communication protocol.
- Open protocol
- Information is stored in the Slave device in four different tables.
  Two tables store on/off discrete values (coils) and two store numerical values (registers). The coils and registers each have a read-only table and read-write table.
- Each table has 9999 values.
  Each coil or contact is 1 bit and assigned a data address between 0000-270E.
  Each register is 1 word = 16 bits = 2 bytes and also has data address between 0000 and 270E.
- Supported Functions are
  - Coils
  - Discrete inputs
  - Input Registers
  - Holding Registers.

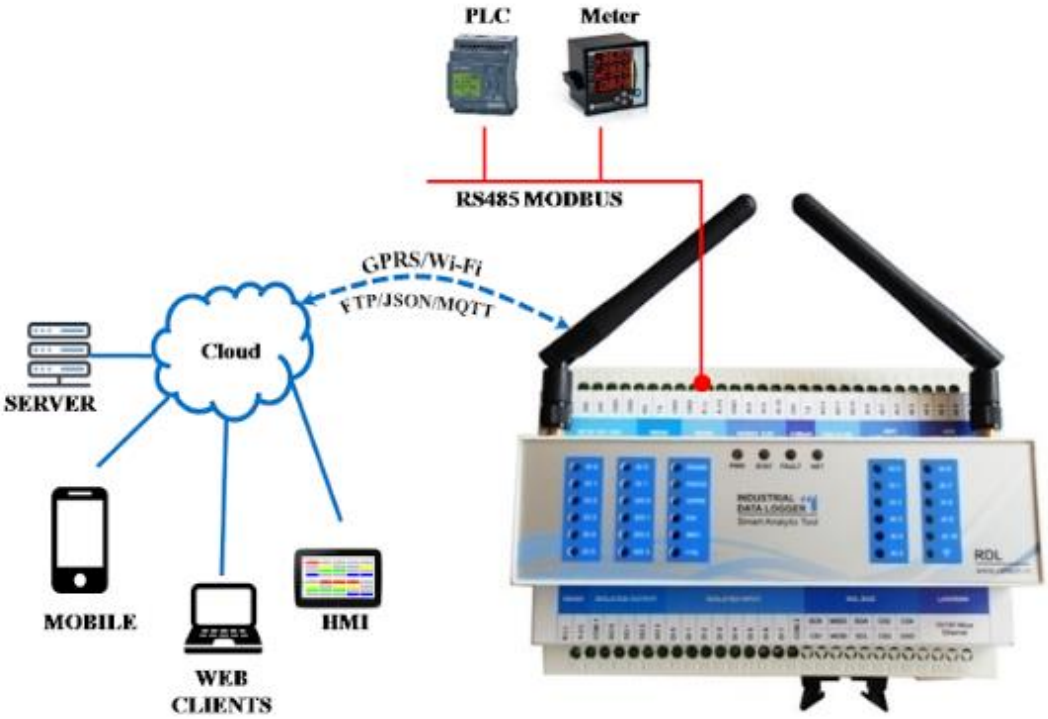
### Specification

- LTC485 IC.
- Supports slave address up to 32.
- Supports Modbus protocol with RTU and ASCII formats.
- Configurable baud rate from 4800 to 115200.
- Configurable packet format (data bits, parity bit, stop bits)

### Functional Diagram



## Use Case




## Example Code

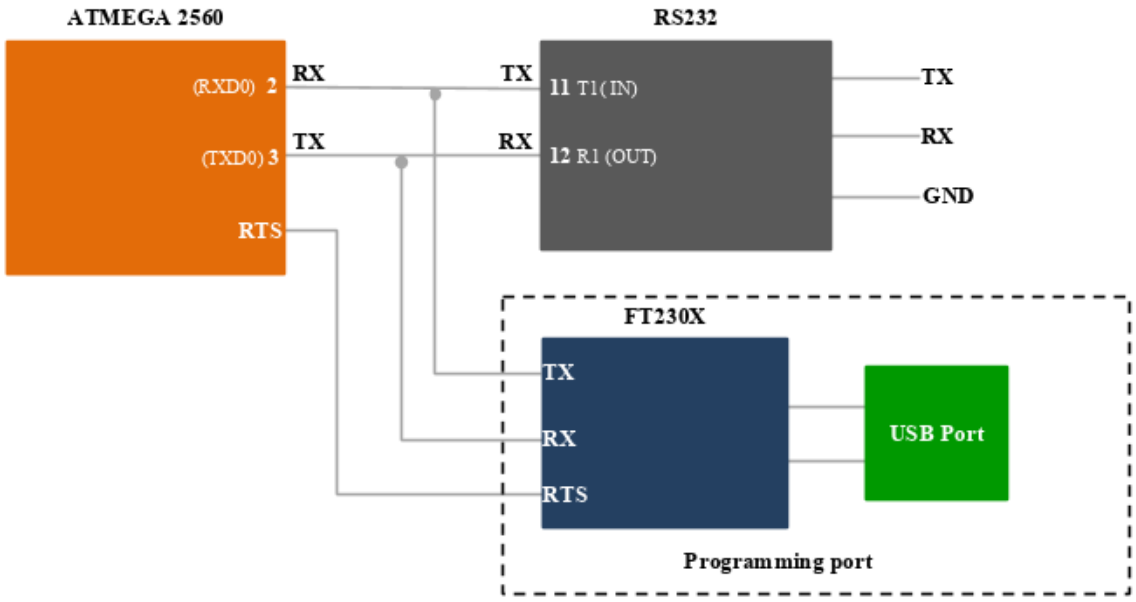
You may look into the following link for examples on Modbus examples.

https://playground.arduino.cc/Code/ModbusMaster

## 8.13. RS232/FT232/Program

Used for programming the board. When in user mode, the port could be used for data communication.

### Functional Diagram




**Note:** When programming the board, it is recommended to remove any connection made to the RS232 serial pins in order to ensure proper functioning of the system.

### Example Code

You may look into the following link for examples on FT232/MAX232 serial communication.

https://www.arduino.cc/reference/en/language/functions/communication/serial/

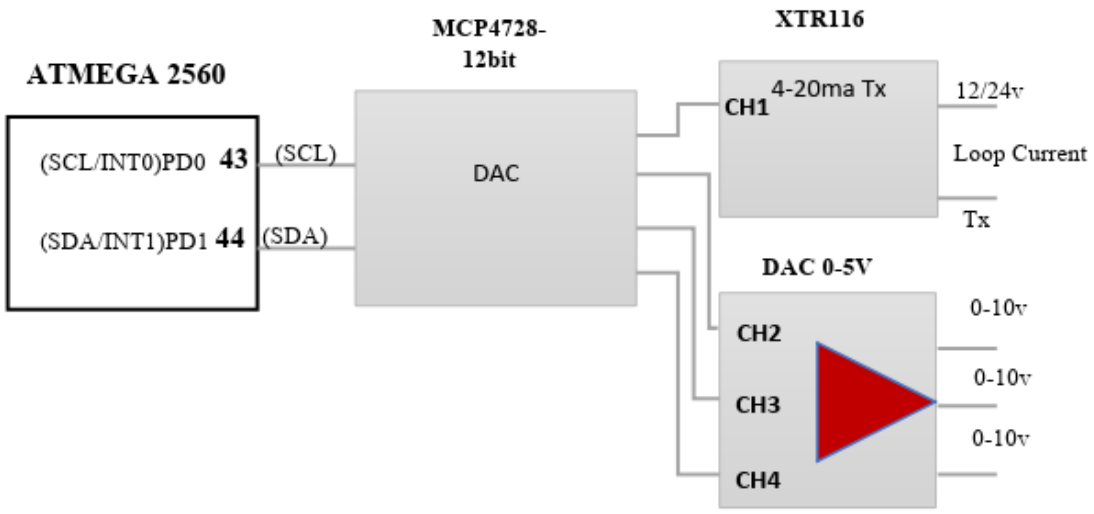
https://www.arduino.cc/en/Tutorial/SoftwareSerialExample

## 8.14. DAC

### Specification

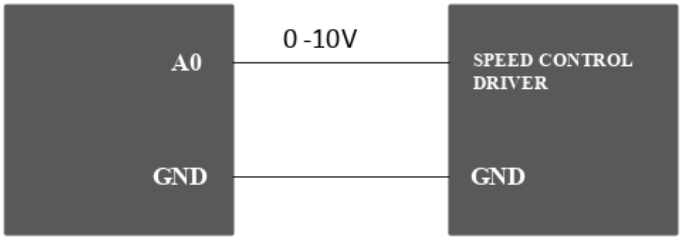
- MCP4768 with I2C serial interface
- Quad, 12-bit voltage output
- Channel: 4 (buffered outputs)
- Internal Voltage Reference
- Output Voltage Range using 0-10V

### Functional Diagram

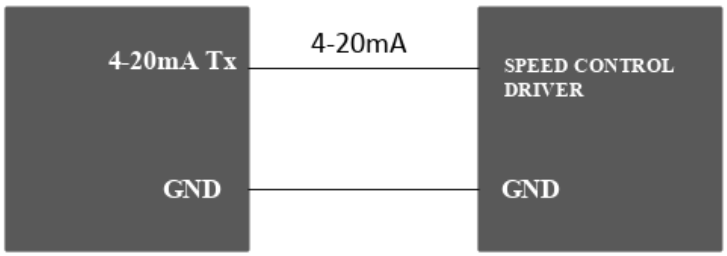



### Application Wiring

1. **Interfacing DAC with Motor Speed Control Module**

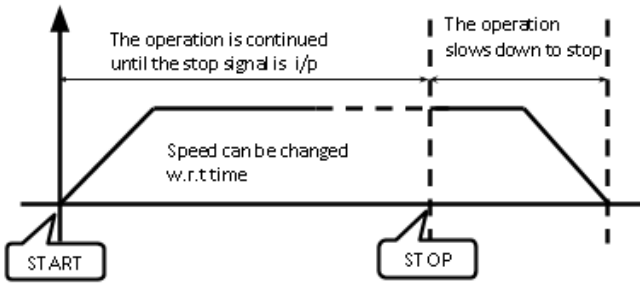


## 2. Interfacing DAC with Motor Speed Control Module usi ng Loop Current

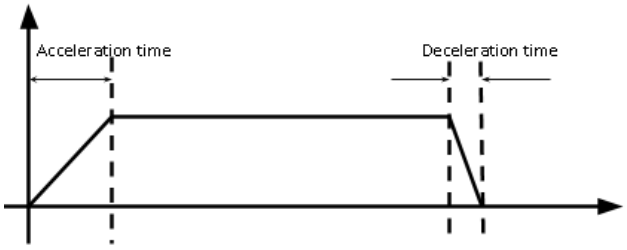



## Use Case

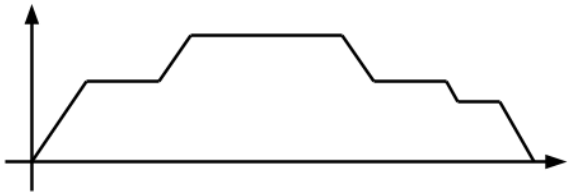
### 1. Motion Control




### 2. Acceleration and Deceleration




### 3. Jog Operation and Trapezoidal Control Operation



The speed can be freely changed until the operation starts to decelerate to stop

## Example Code

You may look into the following link for the Arduino library and example on DAC.

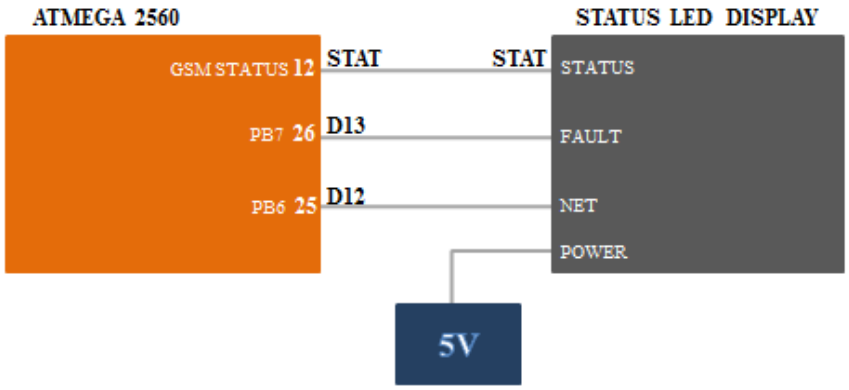
https://github.com/hideakitai/MCP4728

## 8.15. Status LED Display

Status LED's can be programmed as per used needs for visual indication of an event.

Refer Digital Output Section

### Functional Diagram




### Example Code

You may look into the following link for more details on programming LED pins.

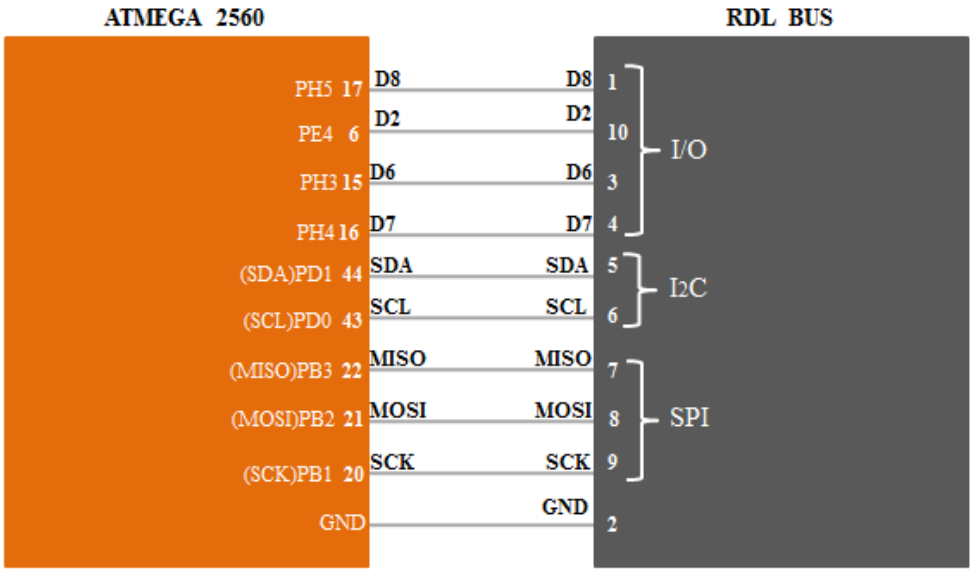
https://www.arduino.cc/en/Reference.digitalWrite

## 8.16. RDL Bus

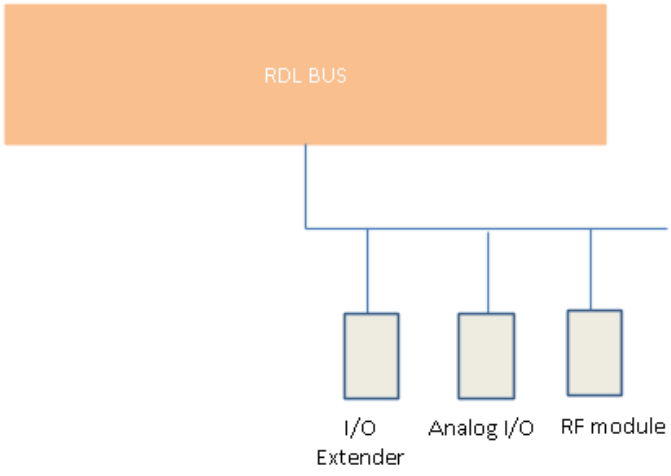
### Specification

- Extend I/O pins for communicating with external devices.
- Extends SPI pins, I2C pins, UART pins and Digital I/O pins.

### Functional Diagram




### Application Wiring



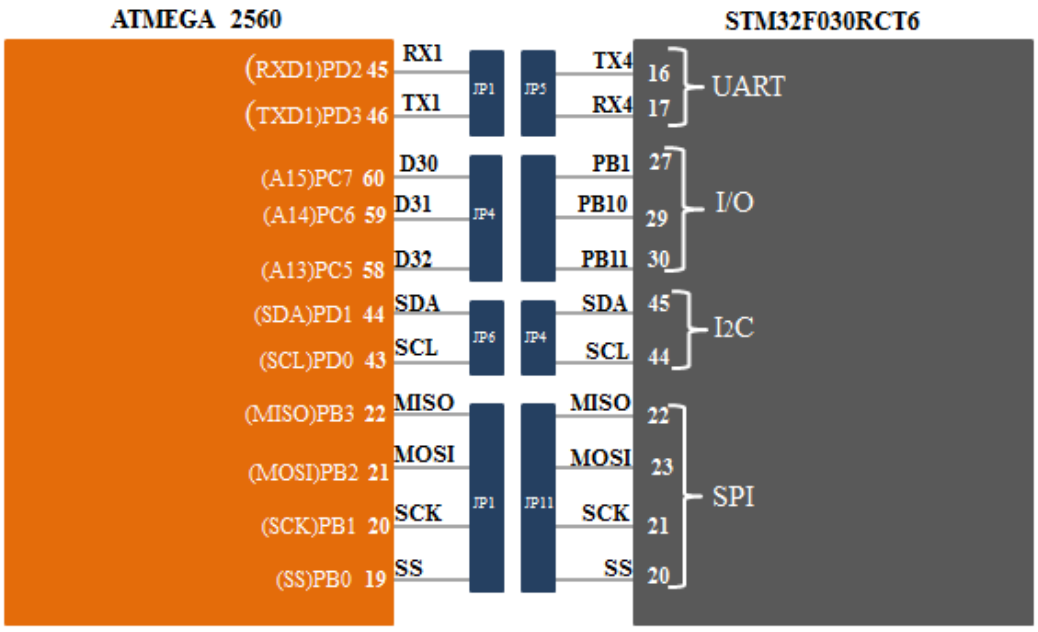
## 8.17. STM32

Extend I/O pins for complex controller operations so as to reduce load on AVR. For example Complex math operations can be assigned to STM32 controller by establishing physical connection with AVR controller.
Currently, some I/O pins are used for LED status indication as per commands received from AVR as shown in the figure below. But user can assign complex task on STM32 controller.

### Specification

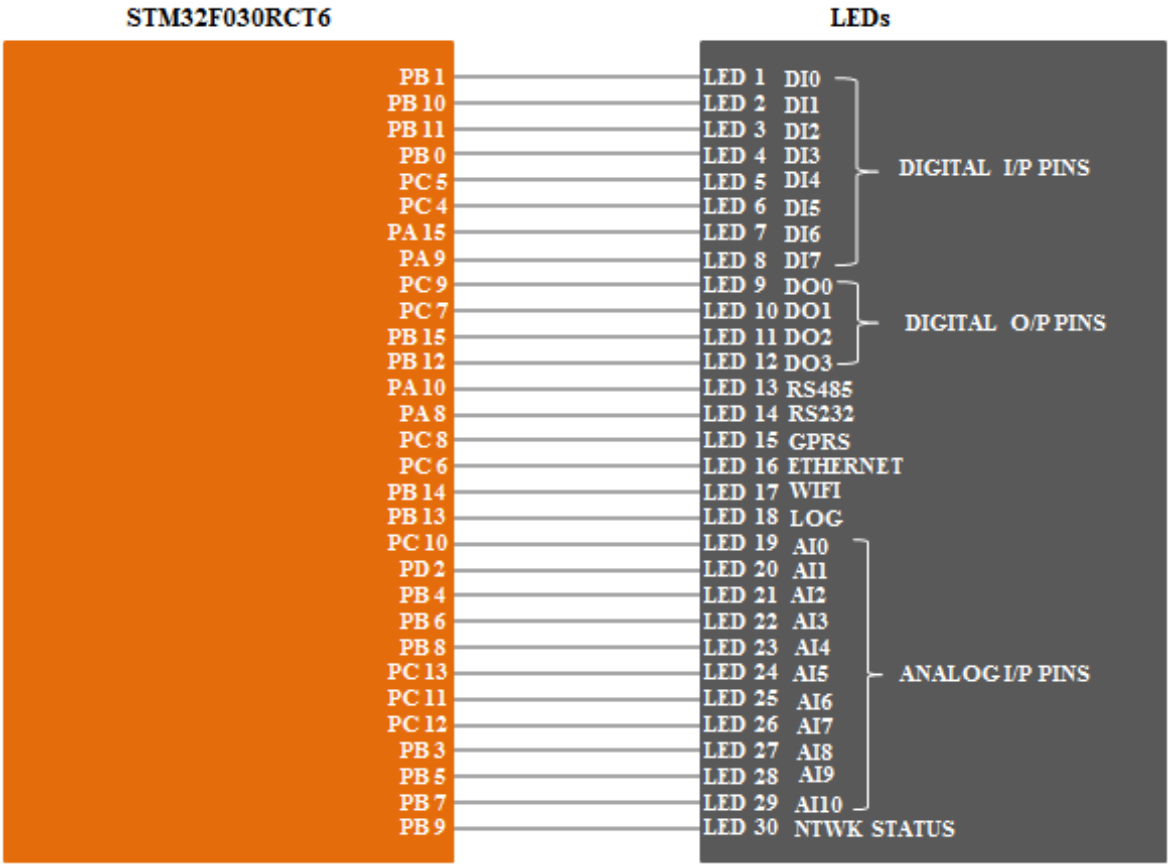
- Controller: STM32F030RCT6
- Core: ARM®32-bit Cortex®-M0 CPU with frequency 48 MHz
- 256KB flash, 32KB RAM, 51 IO pins.
- CRC calculation unit
- One 12-bit, 1.0µs ADC (up to 16 channels)
- 2 I2C, 6 USART, 2 SPI, 11 timers.

### Functional Diagram




**Note:** Physical Connection must be enabled through jumpers to establish communication between ATMega2560 and STM32

## Application Diagram

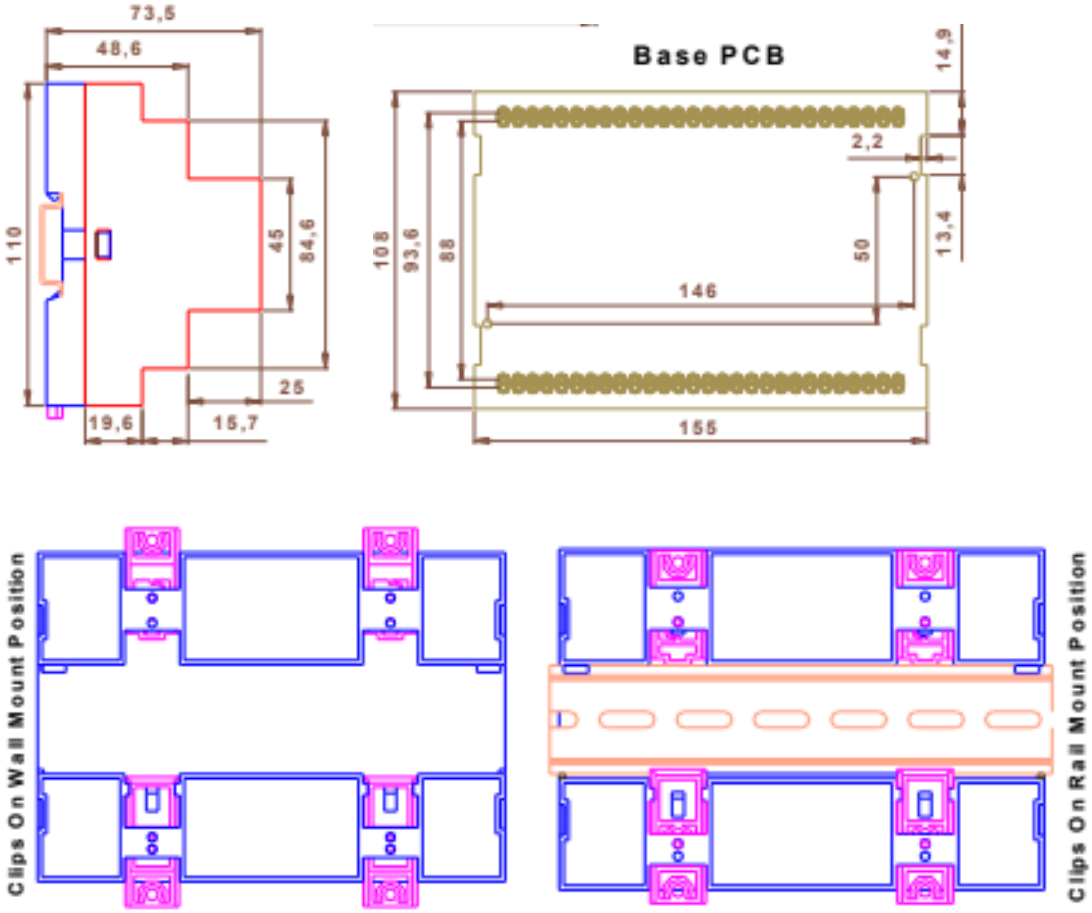



# 9. Power Supply

| Model | Input Voltage | Vmin | Vmax |
|---|---|---|---|
| 7000 - 7004 | 12V - 36V | 12V | 30V |
| 7004 - 7008 | 12V - 15V | 12V | 15V |

Note: Before board power ON make sure that voltage given and model number are proper, else you would end up damaging the module.

## 10. Mounting and Mechanical Dimensions



# 11. Order Information Table

**Table-I:**

| Model | RDL7000 | RDL7001 | RDL7002 | RDL7003 | RDL7004 | RDL7005 | RDL7006 | RDL7007 | RDL7008 |
|---|---|---|---|---|---|---|---|---|---|
| DI | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| DO | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| ADC/4-20ma | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| DAC | x | x | x | x | x | x | 3 | 3 | 3 |
| 4x20ma Tx | x | x | x | x | x | x | 1 | 1 | 1 |
| GPRS | x | x | x | x | x | 1 | 1 | 1 | 1 |
| Ethernet 10/100mbps | x | x | x | x | 1 | 1 | 1 | 1 | 1 |
| RS485 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| RS232 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Ordering Information:**

Model No + Custom Configuration

- WI-Wi-Fi
- BT-Bluetooth
- LO-LoRA
- RS-RS485

Example:

RDL7008WI - It comes with all the above features listed in Table-I with Wi-Fi enabled.
RDL7008BT - It comes with all the above features listed in Table-I with Bluetooth enabled
RDL7008LO - It comes with all the above features listed in Table-I with LoRA enabled.
RDL7008RS - It comes with all the above features listed in Table-I with RS-485 bus.
RDL7008 - It comes with the only features listed in Table-I

## 12. References and Datasheets


1. http://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-2549-8-bit-AVR-Microcontroller-ATmega640-1280-1281-2560-2561_datasheet.pdf
2. http://www.ti.com/lit/ds/symlink/max232.pdf
3. http://ww1.microchip.com/downloads/en/DeviceDoc/40001441F.pdf
4. http://ww1.microchip.com/downloads/en/DeviceDoc/20005685A.pdf
5. http://www.ti.com/lit/ds/symlink/lm2576hv.pdf
6. https://www.vishay.com/docs/83513/tcmd1000.pdf
7. http://www.analog.com/media/en/technical-documentation/data-sheets/485fm.pdf
8. http://www.ti.com/lit/ds/symlink/lm317.pdf
9. http://www.ti.com/lit/ds/symlink/ads1115.pdf
10. http://ww1.microchip.com/downloads/en/DeviceDoc/20005045C.pdf
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