



**DesignNews**

Getting Started With LoRaWAN and Sensor IoT

# DAY 2 : Introduction to AT Commands

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## Dr. Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

LinkedIn Page:

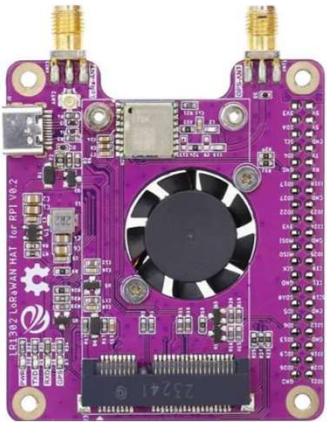
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Patreon Page:

<https://www.patreon.com/c/DrDon683>

## Course Kit and Materials

**Elecrow LR1302 LoRaWAN Pi Hat**



**Raspberry Pi 4 Single Board Computer**



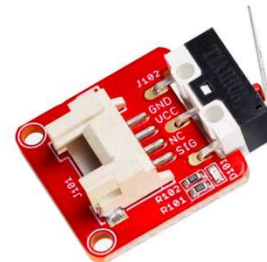
**USB-C Cable**



**Elecrow Crowtail LED 2.0**



**Elecrow Crowtail Collision Sensor**



**LR1302 Gateway Module**



**Elecrow LR1262 Node Board**



## Research Perspective

- “LoRaWAN is one of the promising technologies of the Low Power Wide Area Network (LPWAN) that provides communication with low power, low cost, long-range, and low data rate (Rahman et al., 2020).”

## Agenda:

- What are AT Commands?
- Examples of AT Commands
- LR1262 Node Board AT Commands
- Lab: Exploring AT Commands with the LR1262 Node Board

## What are AT Commands?



- AT commands are commonly used in LoRaWAN technology to interact with and configure:
  - a) LoRaWAN modules
  - b) or gateways
- These commands provide a simple text-based interface for users to manage the LoRaWAN stack:
  - a) configure device parameters
  - b) control communication with the network.

## What are AT Commands?...



### 1. Roles of AT Commands in LoRaWAN Technology

- Device Initialization and Configuration:
  - a) Join the LoRaWAN Network: AT commands set up the device to join a LoRaWAN network using either OTAA (Over-the-Air Activation) or ABP (Activation by Personalization).
- Set Device Credentials:

Configure keys like [DevEUI], [AppEUI], and [AppKey] for secure communication.

## Question 1

**What AT Commands are commonly used?**

- a) LoRaWANE modules and Gateways**
- b) LoRa modules and Gateways**
- c) LoRaWAN modules and Gateways**
- d) none of the above**



## What are AT Commands? . . .



### 2. Radio Communication Settings

- **Frequency Configuration:** Set the frequency band based on the region (e.g., EU868, US915).
- **Spreading Factor (SF) and Data Rate (DR):** Optimize communication range and data rate.
- **Power Settings:** Configure transmission power for efficient communication.

### 3. Data Transmission and Reception

**Send Uplink Data:** Transmit sensor data or commands to the LoRaWAN network.

## What are AT Commands?...



### 2. Radio Communication Settings

- **Frequency Configuration:** Set the frequency band based on the region (e.g., EU868, US915).
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### 3. Data Transmission and Reception

**Send Uplink Data:** Transmit sensor data or commands to the LoRaWAN network.

## What are AT Commands?...



Receive Downlink Data: Handle messages or commands from the LoRaWAN network.

### 4. Network Management

Check Network Status: Query the connection status of the device.

- Enable/Disable Adaptive Data Rate (ADR): Ensure the device dynamically adjusts its data rate and power for optimal performance.

## Question 2

**Which LoRaWAN frequency is used in the US?**

- a) 345 MHz**
- b) 433 MHz**
- c) 868 MHz**
- d) 915 MHz**



## What are AT Commands? . . .



### 5. Diagnostics and Debugging

- Signal Quality: Check the signal strength (RSSI) and signal-to-noise ratio (SNR) for network diagnostics.
- Error Handling: Retrieve error codes for debugging issues.

### 6. Power Management

- Sleep/Wake Up: Put the device into low-power mode to conserve energy.
- Battery Monitoring: Check the device's battery level (if supported).

## What are AT Commands?...



### 7. Over-the-Air Updates (OTA)

Some LoRaWAN modules support AT commands for initiating firmware updates or configuration changes over the air.

## What are AT Commands? . . .

Why AT Commands are Valuable in LoRaWAN Technology?

- **Ease of Use:** AT commands abstract the complexity of LoRaWAN protocols, making them accessible for developers and integrators.
- **Modularity:** They allow microcontrollers or host systems to communicate with LoRaWAN modules using simple serial commands, enabling integration into diverse applications.
- **Flexibility:** AT commands can handle everything from basic setup to advanced features like data encryption and adaptive data rate.



## What are AT Commands?...



By simplifying the interaction with LoRaWAN modules, AT commands make it easier to develop and deploy IoT applications in

- a) smart cities
- b) agriculture
- c) healthcare
- d) industrial automation.

## Question 3

**Which statement is correct?**

- a) AT Commands complicate the interaction with LoRaWAN modules.**
- b) AT Commands simplify the interaction with LoRaWAN modules.**
- c) AT Commands allow interaction with LoRA modules.**
- d) none of the above**



## Examples of AT Commands?



The following examples illustrate some of the AT Commands for LoRaWAN devices.

Join LoRaWAN Over-the-Air Activation:

```
AT+MODE=LWOTAA
OK
AT+JOIN
OK
```

## Examples of AT Commands...

Set Device Credentials:

```
AT+DEVEUI=0004A30B001C0123
```

```
AT+APPEUI=70B3D57ED00000B5
```

```
AT+APPKEY=8A2B7E151628A59A4B7C1D0A0D1E4F4C
```

Power Settings:

```
AT+POWER=14
```



## Examples of AT Commands...



Frequency Configuration:

```
AT+BAND=EU868
```

Spreading Factor (SF) and Data Rate (DR):

```
AT+DR=5
```

## Examples of AT Commands...



Send Uplink Data:

```
AT+SEND=1,5,HELLO
```

Receive Downlink Data:

```
+RECV: 1,4,DATA
```

## Question 4

**What is LWOTTA?**

- a) LoRaWANE Over-the-Air Activation**
- b) LoRaWEN Over-the-Air Activation**
- c) LoRaWAN Over-the-Air Activation**
- d) none of the above**



## LR1262 Node Board AT Commands



Like the generic AT Commands presented, there are specific ones for the LR1262 Node Board. These commands align with the field of the Internet of Things. These AT commands allow the following tasks to be performed on the board.

- a) configuration
- b) operation
- c) data sending and receiving

# LR1262 Node Board AT Commands...

## LR1262 Node Board AT Command Syntax



LR1262 Node Board AT  
Command Description  
Document found here!



[https://www.elecrow.com/wiki/LR1262\\_LoRaWAN\\_AT\\_Command\\_Description.html](https://www.elecrow.com/wiki/LR1262_LoRaWAN_AT_Command_Description.html)

domain	clarification
AT+	command message prefix
CMD	command string
Op	Command Operator. It can be the following: "=": indicates a parameter setting. "?" : Indicates the current value of the query parameter. " ": indicates the execution of the command. "=?" : Indicates the parameter of the query setting command.
para-1,para-2,.....para-n	Indicates the value of the parameter to be set, or specifies the parameter to be queried
\R	Carriage return terminator, ASCII code 0x0D

## LR1262 Node Board AT Commands...

### LR1262 Node Board Example AT Commands



Command	Parameter	Explanation
AT+RESET	None	//Reset command
AT+RFS	None	//Clear Flash Data
AT++SAVE	None	//Save to flash memory
AT+VL	[=verb_lvl], verb_lvl = [0:3]	//Set the level of detail for obtaining information
AT+LTIME	[=?]	//Get the local time in UTC format.

## LR1262 Node Board AT Commands...

### LR1262 Node Board Example AT Commands



Command	Parameter	Explanation
AT+VER	[=class] where class = [A, B or C]	// Get the version of the LoRa WAN
AT+ADR	[=duty cycle] where duty cycle = 0 or 1	//Set/Get Adaptive Data Rate Function
AT+BAND	[=5,0] (Parameter 1 is band selection selectable (5 or 8), Parameter 2 is channel selection 868 (3), 915 (8)) (For multiple channels, only the first parameter is needed)	//Set/Get band area
AT+DR	[=delay] where delay in ms (need to turn off AT+ADR=0 before setting, parameters 0-7)	//Set/Get Data Rate

# Lab: Exploring AT Commands with the LR1262 Node Board



COM7

AT+BAT=?

Send

APPLICATION\_VERSION: V1.2.0  
MW

A photograph of the LR1262 Node Board on a green grid mat. The board is connected to a USB-to-UART adapter via a multi-colored ribbon cable. A black probe is connected to the board's pins. Two other small red modules are connected to the board's headers.

Autoscroll  Show timestamp

Newline

9600 baud

Clear output

## Lab: Exploring AT Commands with the LR1262 Node Board...



### Participant Learning Objectives:

- Participants will learn to set up the LR1262 Node Board.
- Participants will learn to test and program the LR1262 Node Board using the Arduino IDE.
- Participants will learn to verify the operation of the LR1262 Node Board with AT Command LED Indicator code.

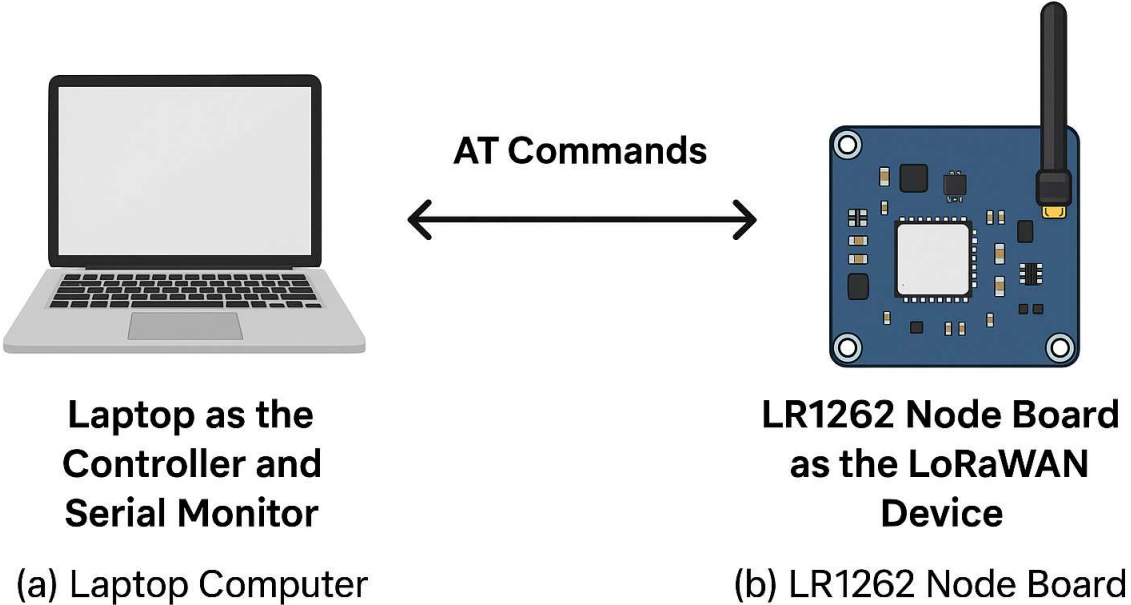
# Lab: Exploring AT Commands with the LR1262 Node Board...



## LoRaWAN Setup Made Simple

### Concept Diagram

Image: ChatGPT



## Lab: Exploring AT Commands with the LR1262 Node Board...



### Programming the LR1262 Node Board

#### 1. Install the Arduino IDE:

If you haven't already, download and install the Arduino IDE from the official website.

#### 2. Add the LR1262 Board Package:

- Open the Arduino IDE.
- Go to File > Preferences.
- In the "Additional Boards Manager URLs" field, add the following URL: [https://github.com/earlephilhower/arduino-pico/releases/download/global/package\\_rp2040\\_index.json](https://github.com/earlephilhower/arduino-pico/releases/download/global/package_rp2040_index.json) (This URL is for the RP2040, which is often associated with similar LoRa boards like the LR1262).
- Click "OK."

#### 3. Install the Board Package:

- Go to Tools > Board > Boards Manager.
- Search for "RP2040" or a similar term related to the LR1262 board.
- Install the board package, but avoid the latest version. It is recommended to choose version 2.6.0.

## Lab: Exploring AT Commands with the LR1262 Node Board...



### Programming the LR1262 Node Board

#### 4. Select the LR1262 Board:

- After installing the board package, go to Tools > Board > ... (expand the menu) and select the specific LR1262 board from the list (e.g., "RP2040").

#### 5. Connect the Board:

Connect your LR1262 Node board to your computer using a USB cable.

#### 6. Select the Port:

Go to Tools > Port and select the COM port that corresponds to your LR1262 board.

#### 7. Upload Code:

Open or create a sketch in the Arduino IDE.

Click the "Upload" button to compile and upload your code to the LR1262 board.

## Lab: Exploring AT Commands with the LR1262 Node Board...



```
1  #define LED_PIN 3
2  #define BLINK_DURATION 1000 // milliseconds
3
4  void setup() {
5      // Initialize serial communication
6      Serial.begin(9600);
7      Serial1.setRX(1);
8      Serial1.setTX(0);
9      Serial1.begin(9600);
10
11     // Set up LED pin
12     pinMode(LED_PIN, OUTPUT);
13     digitalWrite(LED_PIN, LOW);
14 }
```

## AT\_Command\_LED Indicator Code

## Lab: Exploring AT Commands with the LR1262 Node Board...



```
16 void loop() {
17     static String command = "";
18
19     if (Serial.available()) {
20         char c = Serial.read();
21         Serial1.write(c);
22
23         // Build the command string
24         if (c != '\n' && c != '\r') {
25             command += c;
26         } else {
27             // Command is complete, check if it's an AT command
28             if (command.startsWith("AT")) {
29                 blinkLED();
30             }
31             command = ""; // Reset the command string
32         }

```

### AT\_Command\_LED Indicator Code

## Lab: Exploring AT Commands with the LR1262 Node Board...



### AT\_Command\_LED Indicator Code

```
33     }
34
35     if (Serial1.available()) {
36         Serial.write(Serial1.read());
37     }
38 }
39
40 void blinkLED() {
41     digitalWrite(LED_PIN, HIGH);
42     delay(BLINK_DURATION);
43     digitalWrite(LED_PIN, LOW);
44 }
```

Congratulations: The LED should turn on after the AT Command is entered in the Serial Monitor.

## Lab: Exploring AT Commands with the LR1262 Node Board...



```
COM7
AT+VER=?
Send
COM7
AT+BAT=?
APPLICATION_VERSION: V1.2.0
MW
```

Autoscroll  Show timestamp Newline 9600 baud Clear output

**AT\_Command\_LED  
Indicator Code: Entered  
AT Command, Output  
Response**

Congratulations: The LED should turn on after the AT Command is entered in the Serial Monitor.

## Lab: Exploring AT Commands with the LR1262 Node Board...



The screenshot shows a serial monitor window titled 'COM7'. The input field contains the command 'AT+BAT=?' and a 'Send' button. The output area displays the following text:

```
APPLICATION_VERSION: V1.2.0
MW
APPLICATION_VERSION: V1.2.0
MW3306
OK
```

At the bottom of the window, there are checkboxes for 'Autoscroll' (checked) and 'Show timestamp' (unchecked). On the right side, there are dropdown menus for baud rate (set to '9600 baud') and a 'Clear output' button.

**AT\_Command\_LED  
Indicator Code: Entered  
AT Command, Output  
Response**

Congratulations: The LED should turn on after the AT Command is entered in the Serial Monitor.

## Lab: Exploring AT Commands with the LR1262 Node Board...



```
COM7
AT+BAND=?
APPLICATION_VERSION: v1.2.0
MW3306

OK
2:CN470

OK
```

Autoscroll  Show timestamp

Newline 9600 baud Clear output

**AT\_Command\_LED  
Indicator Code: Entered  
AT Command, Output  
Response**

Congratulations: The LED should turn on after the AT Command is entered in the Serial Monitor.

## Question 5

**In reviewing slide 34, which line of code blinks the LED?**

- a) 19**
- b) 14**
- c) 28**
- d) none of the above**



## Thank you for attending

Please consider the resources below:

Rahman, H.U., Ahmad, H., Ahmad, M., & Asif Habib, M. (2020). *LoRaWAN: State of the art, challenges, protocols, and research issues*.

[https://www.researchgate.net/publication/348637291\\_LoRaWAN\\_State\\_of\\_the\\_Art\\_Challenges\\_Protocols\\_and\\_Research\\_Issues](https://www.researchgate.net/publication/348637291_LoRaWAN_State_of_the_Art_Challenges_Protocols_and_Research_Issues).

Sani Danladi, M.& Baykara, M. (2022). Design and implementation of temperature and humidity monitoring system using lpwan technology. *Ingenierie des Systemes d'Information*, 27(4), 521-529.

[https://www.researchgate.net/publication/363810711\\_Design\\_and\\_Implementation\\_of\\_Temperature\\_and\\_Humidity\\_Monitoring\\_System\\_Using\\_LPWAN\\_Technology](https://www.researchgate.net/publication/363810711_Design_and_Implementation_of_Temperature_and_Humidity_Monitoring_System_Using_LPWAN_Technology)

Wilcher, D. (2025). *Introduction to at commands*. GitHub. [https://github.com/DWilcher/DesignNews-WebinarCode/blob/main/June\\_25\\_Webinar\\_Code.zip](https://github.com/DWilcher/DesignNews-WebinarCode/blob/main/June_25_Webinar_Code.zip)



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