Left (EN button) Side Pins:

1. RESET
   1. GPIO: N/A
   2. Purpose: Resets the ESP32 and GPS module
   3. Connections:
      1. Reset test point
      2. Reset pin (pin 8) of GPS module (NEO-M8M)
   4. Libraries: N/A
2. CELL1
   1. GPIO: 36
   2. Purpose: Analog input for cell 1 battery voltage from op-amp circuit
   3. Connections:
      1. CELL1 test point
      2. CELL1 pin (pin 1) of op-amp (LM124DR)
   4. Libraries: N/A
3. CELL2
   1. GPIO: 39
   2. Purpose: Analog input for cell 2 battery voltage from op-amp circuit
   3. Connections:
      1. CELL2 test point
      2. CELL2 pin (pin 7) of op-amp (LM124DR)
   4. Libraries: N/A
4. CELL3
   1. GPIO: 34
   2. Purpose: Analog input for cell 3 battery voltage from op-amp circuit
   3. Connections:
      1. CELL3 test point
      2. CELL3 pin (pin 8) of op-amp (LM124DR)
   4. Libraries: N/A
5. SENSOR
   1. GPIO: 35
   2. Purpose: Analog input for 3-pin sensor (i.e. potentiometer or pressure-variable resistor)
   3. Connections:
      1. SENSOR test point
      2. SENSOR pin (pin 1) of J8 connector (JST-XA type)
   4. Libraries: N/A
6. GATE\_SIGNAL
   1. GPIO: 32
   2. Purpose: Digital output to control 12V power supply to the LEDs
   3. Connections:
      1. GATE\_SIGNAL test point
      2. Gate pin (pin 2) of Q1 MOSFET through R16
      3. Gate pin (pin 2) of Q2 MOSFET through R17
      4. GATE\_SIGNAL pin (pin 8) of level shifter (TXS0104ED)
   4. Libraries: N/A
7. SW
   1. GPIO: 33
   2. Purpose: Digital input for the button switch on rotary encoder
      1. Note: We assume a normally HIGH switch (3.3V through R18). For a normally LOW switch, remove R18
   3. Connections:
      1. SW test point
      2. SW pin (pin 3) of J9 connector (JST-XA type) for 5-pin rotary encoder
   4. Libraries: N/A
8. DT
   1. GPIO: 25
   2. Purpose: Digital input for circuit “A” of biphase rotary encoder
   3. Connections:
      1. DT test point
      2. DT pin (pin 2) of J9 connector (JST-XA type) for 5-pin rotary encoder
   4. Libraries: <Encoder.h>
9. CLK
   1. GPIO: 26
   2. Purpose: Digital input for circuit “B” of biphase rotary encoder
   3. Connections:
      1. CLK test point
      2. CLK pin (pin 1) of J9 connector (JST-XA type) for 5-pin rotary encoder
   4. Libraries: <Encoder.h>
10. SD\_SW
    1. GPIO: 27
    2. Purpose: Digital input for detecting an SD card in the card socket
    3. Connections:
       1. SD\_SW test point
       2. SD\_SW pin (pin 10) of micro-SD card socket (DM3AT-SF-PEJM5)
    4. Libraries: N/A
11. DATA\_3
    1. GPIO: 14
    2. Purpose: Digital output for LED data on the 3rd data wire
    3. Connections:
       1. DATA\_3 test point
       2. DATA\_3 pin (pin 4) of the level shifter (TXS0104ED)
          1. Signal output from the level shifter (pin 11) at 5V to pin 3 of J7 connector (JST-XA type)
    4. Libraries: <Adafruit\_NeoPixel.h>
12. DATA\_1
    1. GPIO: 12
    2. Purpose: Digital output for LED data on the 1st data wire
    3. Connections:
       1. DATA\_1 test point
       2. DATA\_1 pin (pin 2) of the level shifter (TXS0104ED)
          1. Signal output from the level shifter (pin 13) at 5V to pin 1 of J7 connector (JST-XA type)
    4. Libraries: <Adafruit\_NeoPixel.h>
13. DATA\_2
    1. GPIO: 13
    2. Purpose: Digital output for LED data on the 2nd data wire
    3. Connections:
       1. DATA\_2 test point
       2. DATA\_2 pin (pin 3) of the level shifter (TXS0104ED)
          1. Signal output from the level shifter (pin 12) at 5V to pin 2 of J7 connector (JST-XA type)
    4. Libraries: <Adafruit\_NeoPixel.h>
14. GND
    1. GPIO: N/A
    2. Purpose: Ground pin of ESP32
    3. Connections: GND of PCB
    4. Libraries: N/A
15. x
    1. GPIO: N/A
    2. Purpose: VIN pin of ESP32 (not used here, as we supply 3.3V directly)
    3. Connections: N/A
    4. Libraries: N/A

Right (BOOT button) Side Pins:

1. MOSI
   1. GPIO: 23
   2. Purpose: VSPI serial output (from ESP32 to RAM and SD card)
   3. Connections:
      1. MOSI pin (pin 5) of RAM (Adafruit 4677)
      2. MOSI test point
      3. MOSI pin (pin 3) of micro-SD card socket (DM3AT-SF-PEJM5)
   4. Libraries:
      1. RAM: Needed
      2. SD card: Needed
2. SCL
   1. GPIO: 22
   2. Purpose: I2C serial clock
   3. Connections:
      1. SCL pin (pin 5) of power monitor (INA220BIDGSR)
      2. SCL test point
      3. SCL pin (pin 23) of IMU (MPU-6050)
   4. Libraries:
      1. Power monitor: Needed
      2. IMU: Needed
3. x
   1. GPIO: 1
   2. Purpose: not used, UART 0 TX
   3. Connections: N/A
   4. Libraries: N/A
4. x
   1. GPIO: 3
   2. Purpose: not used, UART 0 RX
   3. Connections: N/A
   4. Libraries: N/A
5. SDA
   1. GPIO: 21
   2. Purpose: I2C serial data line
   3. Connections:
      1. SDA pin (pin 4) of power monitor (INA220BIDGSR)
      2. SDA test point
      3. SDA pin (pin 24) of IMU (MPU-6050)
   4. Libraries:
      1. Power monitor: Needed
      2. IMU: Needed
6. MISO
   1. GPIO: 19
   2. Purpose: VSPI serial input (from RAM and SD card to ESP32)
   3. Connections:
      1. MISO pin (pin 2) of RAM (Adafruit 4677)
      2. MISO test point
      3. MISO pin (pin 7) of micro-SD card socket (DM3AT-SF-PEJM5)
   4. Libraries:
      1. RAM: Needed
      2. SD card: Needed
7. SCLK
   1. GPIO: 18
   2. Purpose: VSPI serial clock for RAM and SD card
   3. Connections:
      1. SCLK pin (pin 6) of RAM (Adafruit 4677)
      2. SCLK test point
      3. SCLK pin (pin 5) of micro-SD card socket (DM3AT-SF-PEJM5)
   4. Libraries:
      1. RAM: Needed
      2. SD card: Needed
8. CS\_SD
   1. GPIO: 5
   2. Purpose: SD card chip selection for VSPI serial communication
   3. Connections:
      1. CS\_SD test point
      2. CS\_SD pin (pin 2) of micro-SD card socket (DM3AT-SF-PEJM5)
   4. Libraries: Needed
9. TX
   1. GPIO: 17
   2. Purpose: UART output (from ESP32 to GPS)
   3. Connections:
      1. TX test point
      2. TX pin (pin 21) of GPS module (NEO-M8M-0)
   4. Libraries: <TinyGPS++.h> & <SoftwareSerial.h>
10. RX
    1. GPIO: 16
    2. Purpose: UART input (from GPS to ESP32)
    3. Connections:
       1. RX test point
       2. RX pin (pin 20) of GPS module (NEO-M8M-0)
    4. Libraries: <TinyGPS++.h> & <SoftwareSerial.h>
11. INT
    1. GPIO: 4
    2. Purpose: Digital interrupt input (from IMU to ESP32)
       1. The MPU-6050 can be configured to give an interrupt signal for:
          1. Clock generator switching oscillator frequency
          2. New data available
          3. Accelerometer events
          4. Secondary I2C bus communication failure
    3. Connections:
       1. INT test point
       2. INT pin (pin 12) of IMU (MPU-6050)
    4. Libraries: N/A
12. CS\_RAM
    1. GPIO: 2
    2. Purpose: RAM chip selection for VSPI serial communication
    3. Connections:
       1. CS\_RAM test point
       2. CS\_RAM pin (pin 1) of RAM (Adafruit 4677)
    4. Libraries: Needed
13. x
    1. GPIO: 15
    2. Purpose: Not used
    3. Connections: N/A
    4. Libraries: N/A
14. GND
    1. GPIO: N/A
    2. Purpose: Ground pin of ESP32
    3. Connections: GND of PCB
    4. Libraries: N/A
15. +3V3
    1. GPIO: N/A
    2. Purpose: 3.3V input of ESP32
    3. Connections: 3.3V rail of PCB
    4. Libraries: N/A