LuaNode

This project is an improved `Lua` SDK, based on ESP-IDF/ESP8266_RTOS_SDK, for Esp32 (compatible with Esp8266).

NEW UPDATE FOR ESP32:

New version of LuaNode32 is developed based on esp-idf and compatible with

`Esplorer`.

How To Build LuaNode32

- Download prebuild toolchain :

https://github.com/jmattsson/nodemcu-prebuilt-toolchains

you can also build the tools from source

- Export build tools' directory by executing the following command on terminal, `export PATH=/your_path/toolchains/esp32/bin:$PATH`, where the `your_path` is the path the toolchains stored.
- Export `esp-idf` path by the following command: `export IDF_PATH=the_esp-idf_path`
- Change current directory to `LuaNode32`, then input `make` to build firmware.

LUA PROGRAMMING

Programming with Lua is easy, some samples are as follow:

```
-- create file on file system
file.open("myfile.lua", "w+");
file.write("hello world");
file.close();
-- read file from file system
file.open("myfile.lua", "r");-- read 1024 bytes from myfile.lua and save
them-- to content
content=file.read(1024);print(content);
```

```
file.close();
-- remove file
file.remove("myfile.lua");
-- restart device
node.restart();
```

You can add your own Lua modules to LuaNode at will.

LuaNode is compatible with `Esplorer` now, you can edit and download Lua Code to ESP32 with `Esplorer` conveniently.

Get Esplorer :https://github.com/4refr0nt/ESPlorer

HOW TO BUILD For **ESP32/ESP8266**:

For details, see LuaNode wiki page :https://github.com/Nicholas3388/LuaNode/wiki/How-to-build-for-ESP8266-ESP32

HOW TO FLASH THE FIRMWARE:

See LuaNode wiki page :https://github.com/Nicholas3388/LuaNode/wiki/How-to-flash-the-firmware

HOW TO DEBUG:

See wiki page ： https://github.com/Nicholas3388/LuaNode/wiki/How-to-debug

APPS:

- `task`: This is a sample to show how to create an os task. Build the example by executing the gen_misc.sh.

How to create a task:

```
void task1(void *pvParameters) {
    // do something
}
void user_init(void) {
    xTaskCreate(task1, (signed char *)"tsk1", 256, &mainqueue, 2, NULL);
}
```

`Note: There is a task to receive uart input. You'd better alloc more than 512k memory for this task, since the lua command handler will be called in this task, more memory is required for lua handler.`

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`luaapp`: A lua app.

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`wifikiller`: An wifi sample. Set baud rate to 115200pbs, using UART0. It will disconnect WiFi connection.

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`wifilister`: List all APs, along with clents connected to them, near your device. The list info then sent to Android device via OTG, and display on Android.

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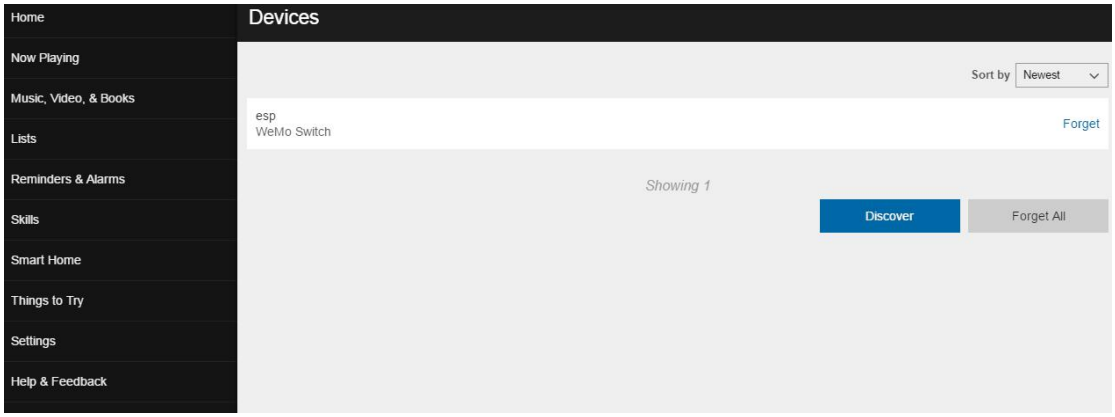
APPLICATIONS:

Amazon Alexa for ESP32

This is an awesome application that using Amazon Echo Dot to turn on/off the blue LED on DOIT ESP32 dev-board via voice control service. You can find the source code, named `alexa_esp32`, within the `examples` directory. The `alexa_esp32` sample can control only one pin, if you want to control more pins or to use more resource on ESP32 to do more things, you can learn the `alexa_multi_esp32` sample. The sample will let Alexa to do more things with ESP32.

When you build the `alexa_esp32` within the examples folder and flash the firmware to ESP32 board, then you can ask Echo Dot to discover device by telling her "Alexa, discover device". She will answer you "Discovery starting...". After about 20 seconds, if She does find device, she will answer you "I found 1 device...". Plus, you can search device via Alexa App or via this page: `alexa.amazon.com`. When Echo Dot find ESP32, you will see the found device named "esp" on `alexa.amazon.com`, show as the following
figure:

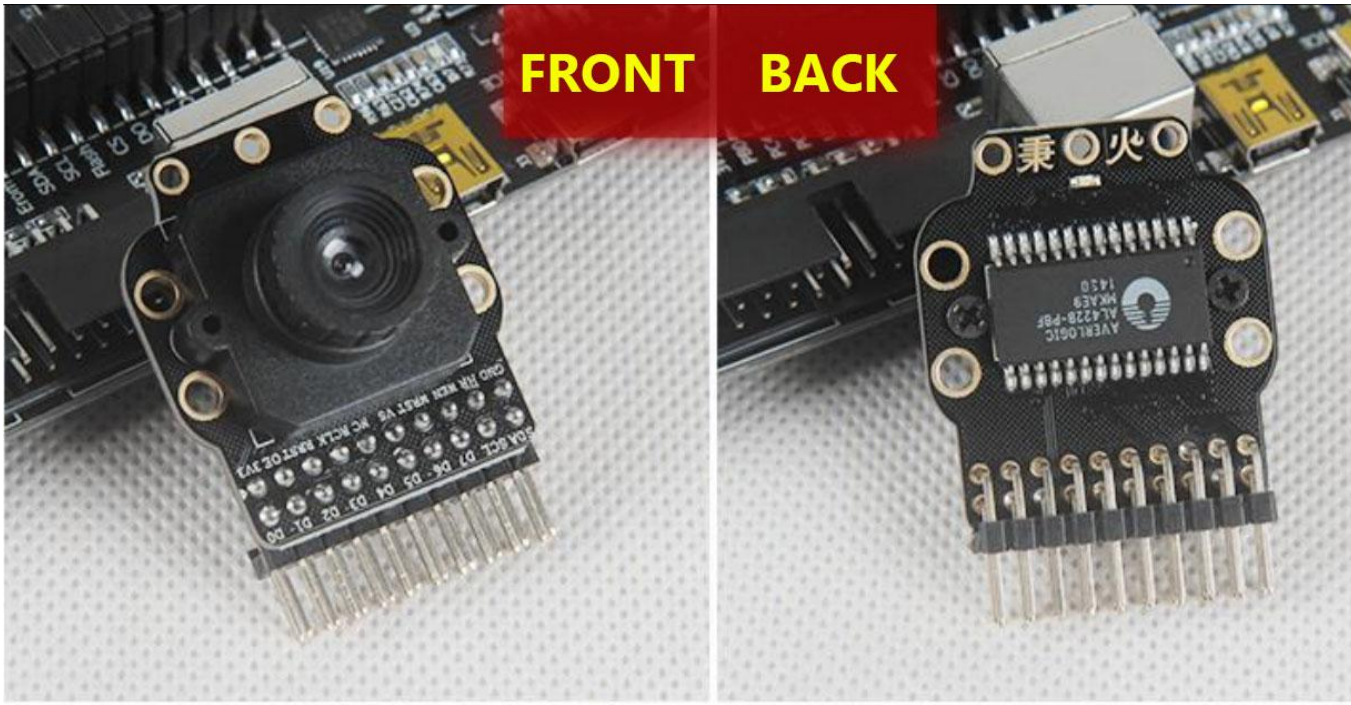


When Alexa find ESP32 device successfully, you can ask Echo Dot "Alexa, turn on ESP" to turn on the blue LED on ESP32 borad. Ask "Alexa, turn off ESP" to turn off the LED. The following link is a video to show the ESP32 voice control via Amazon Echo Dot: https://youtu.be/Eg1dApUHIBc

ESP32-Camera

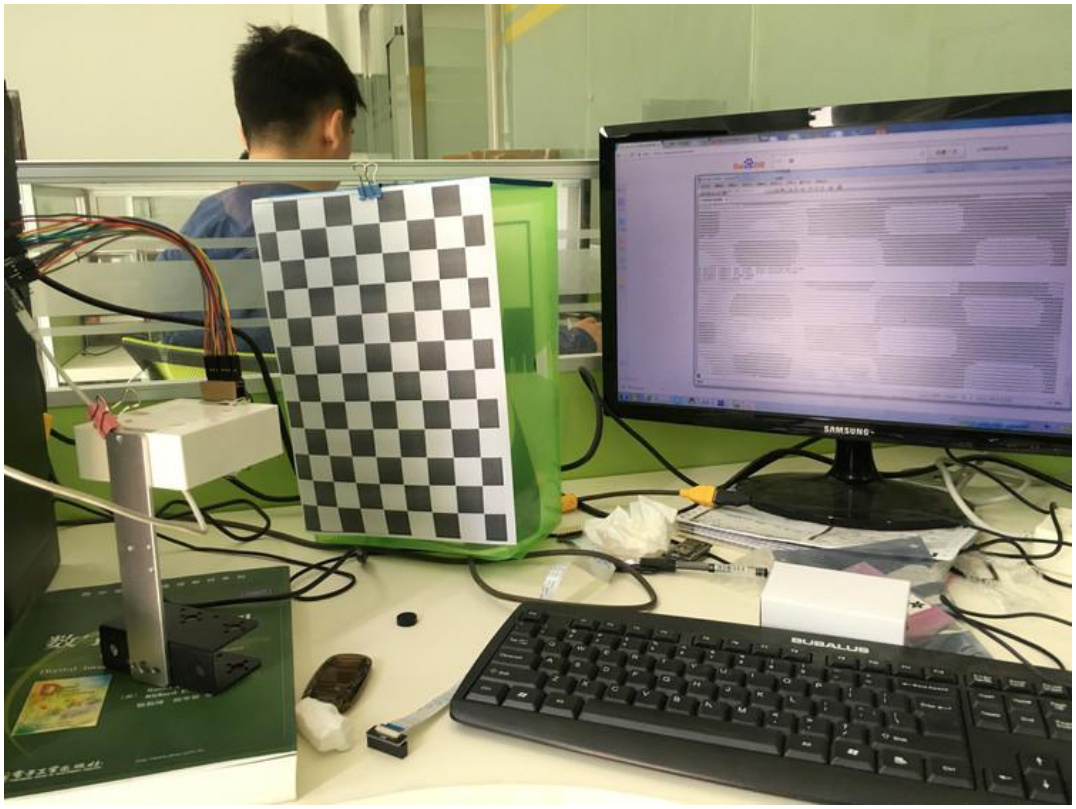
This simple application is to use ESP32 to controll a Camera. You can find the source code from the following diretory: *LuaNode_Esp32/LuaNode32/examples/camera*

There is another ESP32 camera demo create by *igrr*, find it from the link: https://github.com/igrr/esp32-cam-demo. We also utilize OV7725 for our camera test, but the hardware is a little different from *igrr*'s project. My camera is extended with a RAM, which is AL422B, with 390KB RAM. So the camera can cache 2 frames, if the resolution is set to 320x240 pixel. The following figure is my camera, called "Yehuo", a Chinese name.



The following figures is my ESP32-Camera.

I learn *igrr*'s project, and do the same test as *igrr*'s. For instance, I use the camera to scan the board, and then you can see the output from the uart terminal.



ESP32 Drives Nokia5110 LCD

This is an application to show how to drive Nokia5110 LCD. It is easy for ESP32 to drive the LCD. You don't even need to use SPI to drive the LCD. The LCD is very cheap, and easy to buy from taobao or eBay.

Pin connections:

Interface	Nokia5110 Pin	DOIT ESP32 dev-board Pin
RESET	RST	D4
LCD Enable	CE	D2
DC	DC	D5
Data Input	Din	D18
Clock	Clk	D19

Interface	Nokia5110 Pin	DOIT ESP32 dev-board Pin
Back Light	BL	D21
Power Supply 3.3V	Vcc	3V3
Ground	Gnd	GND

For more details, view the *lcd_nokia5110_driver* sample within the **examples** folder.

ESP32 BLE LED controller

This is a sample to show how to create BLE client and BLE server, and create connection between them. To test this sample, you have to prepare two ESP32 dev-board. Then build the sources within the `LuaNode_ESP32/examples/ble_led_controller`, and flash the client and server firmware to the two ESP32 dev-boards, respectively. you will see the blue LED on the server board is turned on/off each 2 seconds. You can see the test from the following video: https://youtu.be/UnzXCB5EYGU

In this sample, when the client connect to server, it will send BLE notify to the server each 2 seconds. When the server recieves the notification, the server will turn on/off the blue LED on board according to the notification value. If the value is 0x1, the server will turn on the LED, otherwise, the LED will be turned off.

ESP32 communicate with nRF51822 via BLE

This is a example to show how to create BLE connection between ESP32 and nRF51 device (nRF51822 inside). In this sample, ESP32 write "on"/"off" string to the characteristic `6e400002-b5a3-f393-e0a9-e50e24dcca9e`, which provided by nRF51 device. When the nRF51 device receives the content sent by ESP32, the nRF51 will turn on/off the LED on board according to the received string. The ESP32 will write "on"/"off" to the characteristic each 2 seconds, so you will see that the LED on nRF51 device blink each 2 seconds.

The folloing video is a test for this example: https://youtu.be/hXuCXh5lEew

The nRF51 device is a nRF51822 dev-board, you can buy it from Taobao China. You can download the sources and build firmware for the nRF51 device from the following link: https://github.com/Nicholas3388/nRF51822_ESP32_communicate

BLE debug tool (LuaNode_BLE_Client)

This is an App (including iOS & Android) for ESP32 as well as other BLE device. The app named `LuaNode_BLE_Client`. You can use this app to connect to ESP32 and then control the LED on DOIT ESP32 dev board. Plus, you can scan BLE devices around your phone and then view the services, characteristics, and descriptors provided by the devices. Download LuaNode_BLE_Client sources from the following repository: https://github.com/Nicholas3388/LuaNode_BLE_Client

To control the LED on ESP32 board, you have to build the example `esp32_ble_gatt_server_led_control_for_phone`, and then download the firmware. Run the `LuaNode_BLE_Client` and then toggle the LED switch on app to turn on/off the LED on board. The following video is a test for ESP32: https://www.youtube.com/watch?v=LhvA33yf7P8

Wifilister

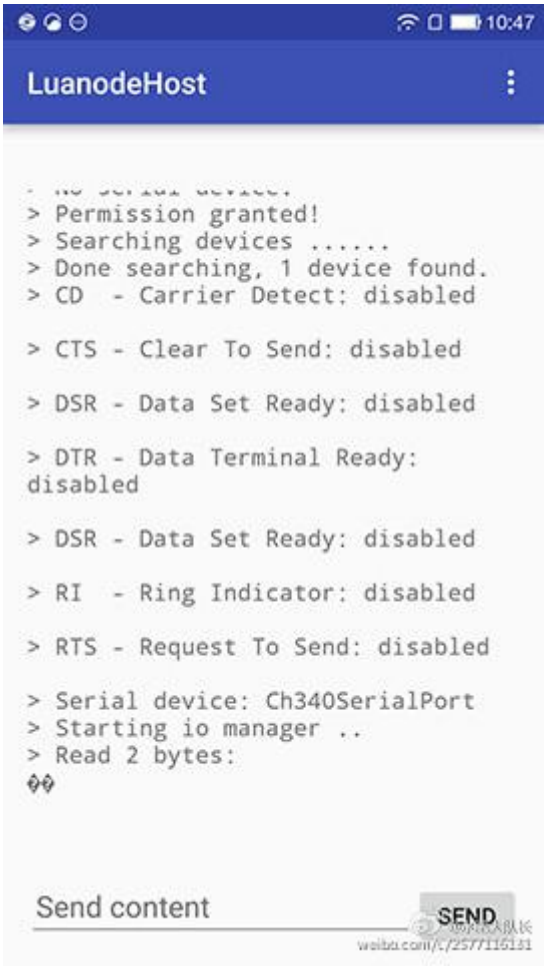
Another interesting application is the `Wifilister` app. The app scans all APs along with the clients connected to them around device, and scan results are sent to Android device via OTG, then you can see the result displayed on Android device.

To test this app, you have to install the `LuanodeUsbHost` Android app to your Android phone (device). `LuanodeUsbHost` is an Android USB Host app for ESP8266/ESP32. The Android device receive messages, sent from ESP8266, via OTG. Then the messages display on this app.

Download the `LuanodeUsbHost` source :

https://github.com/Nicholas3388/LuanodeUsbHost

Compile `Wifilister` provided in Luanode, flash it to ESP8266/ESP32, and then connect your ESP8266/ESP32 with Android phone. You can see the scanning results.



FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other

antenna or transmitter.
The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.
The firmware setting is not accessible by the end user.
The final end product must be labelled in a visible area with the following:
“Contains Transmitter Module “2A6GS-ESP32”

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See alsoSection 2.10 below concerning the need to notify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 15C (15.247).it Specifically identified AC Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions, Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The product antenna uses an irreplaceable antenna with a gain of 1dBi

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer isresponsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited

module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited

module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is a single module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna); b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered); c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout; d) Appropriate parts by manufacturer and specifications; e) Test procedures for design verification; and f) Production test procedures for ensuring compliance

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design, FCC ID : 2A6GS-ESP32

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.

The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The product antenna uses an irreplaceable antenna with a gain of 1dBi

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This

includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2A6GS-ESP32.

2.9 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

Explanation: Shenzhen Ai-Thinker Technology Co., Ltd. can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product

as being Part 15
Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.