Wi-Fi 16 Relay Module

User Manual
Date: 21 Aug 2017
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Document Revision History

<table>
<thead>
<tr>
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</thead>
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1. Specification

Relays:
• 16 x SPDT relays - 10A / 250VAC, 15A / 120VAC, 10A / 28VDC;

Power supply requirement, selectable during purchase:
• 12V DC / 600mA
• 24V DC / 400mA

Wireless Wi-Fi IEEE 802.11 standard:
• Wireless Wi-Fi 802.11 b/g/n;
• External Wi-Fi antenna for better range;
• Supported modes: AP (Access Point), STA (Station) and AP+STA (Access Point + Station);
• Supported encryption modes:
  o WEP;
  o WPAPSK-TKIP;
  o WPAPSK-AES;
  o WPA2PSK-TKIP;
  o WPA2PSK-AES;

Web Interface:
• Configuration of system parameters;
• Secure login authorization;

Network Protocols:
• Standard protocols: DHCP, DNS, ICMP (ping);
• Control relays via TCP/IP, UDP or Virtual Serial Port;

PCB parameters:
• Led indicators: Relays, Power ON, Wi-Fi link, Ready Status;
• FR4 / 1.5mm / two layers / metalized holes / HAL / white stamp / solder mask /
  Extra PCB openings for better voltage isolation / Doubled PCB tracks for
  better voltage isolation;

Physical and Environment:
• Operating temperature range: from 0 ºC to +70 ºC;
• Offered in two versions: PCB only and with DIN RAIL BOX;
• Dimensions:
  • PCB: W=82mm x L=203mm x H=24mm
  • BOX: W=210mm x L=85mm x L=58mm
2. Applications examples

2.1. Control electrical devices wirelessly

The main feature of the module is to control electrical devices wirelessly. It carries 16 relay channels with minimum 7A / 250VAC current rating each. With our popular and free DRM Software and Relay Command Line Tool this module is turned in really cost effective solution for wireless control of electrical devices.

Figure 1. Wi-Fi Relay Module’s main feature is to provide wireless control for appliances
2.2. Control electrical devices via Internet

Usually the next step is to control the system via the Internet. The module supports simple ASCII commands via UDP, TCP/IP sockets and Virtual Serial Port as well. There are lot of software on the marked for TCP/IP and UDP control so it's really simple to be organized this scenario.

![Diagram of controlling electrical devices via Internet](image1)

**Figure 2. Access via Internet**

2.3. Control electrical devices via Virtual Serial (COM) Port

![Diagram of controlling electrical devices via Virtual Serial (COM) Port](image2)

**Figure 3. Virtual Serial (COM) Port**
3. Technical parameters

**Table 1. Physical parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box size, mm</td>
<td>210 x 85 x 58</td>
</tr>
<tr>
<td>PCB size, mm</td>
<td>203 x 82</td>
</tr>
<tr>
<td>Box weight, gr</td>
<td>420</td>
</tr>
<tr>
<td>PCB weight, gr</td>
<td>285</td>
</tr>
<tr>
<td>Operating temperature, °C</td>
<td>0 to 70</td>
</tr>
</tbody>
</table>

**Table 2. System parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage, VDC</td>
<td>12 or 24 (depends on the model) ± 5%</td>
</tr>
<tr>
<td>Maximum current consumption at 12VDC (when all relays are ON), mA</td>
<td>600</td>
</tr>
<tr>
<td>Maximum current consumption at 24VDC (when all relays are ON), mA</td>
<td>400</td>
</tr>
<tr>
<td>Protection against reverse polarity</td>
<td>Yes</td>
</tr>
<tr>
<td>Default settings button</td>
<td>Yes</td>
</tr>
<tr>
<td>Reset button</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Table 3. Relays**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relays maximum switchable current / voltage</td>
<td>10A / 250VAC, 15A / 120VAC, 10A / 28VDC</td>
</tr>
</tbody>
</table>

**Table 4. Network**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHCP</td>
<td>Yes</td>
</tr>
<tr>
<td>DNS</td>
<td>Yes</td>
</tr>
<tr>
<td>ICMP</td>
<td>Yes</td>
</tr>
<tr>
<td>Network parameters</td>
<td>IP/Mask/Default gateway</td>
</tr>
<tr>
<td>Web server for configuration/access</td>
<td>Yes</td>
</tr>
<tr>
<td>Control Relays via WEB server</td>
<td>No</td>
</tr>
<tr>
<td>TCP/IP socket support</td>
<td>Yes</td>
</tr>
<tr>
<td>UDP socket support</td>
<td>Yes</td>
</tr>
</tbody>
</table>
4. Connectors, ports and led indicators

Figure 4. Device overview
5. Installation

- This device must be installed by qualified personnel;
- This device must not be installed directly outdoors;
- Installation consists of mounting the device, connecting to an IP network, connecting the relays, providing power and configuring via a web browser.

5.1. Box mounting

![Mounting the device to DIN rail](image)

*Figure 5. Mounting the device to DIN rail*

**WiFi 16 Relay Module** (DIN BOX version) can be mounted to a standard (35mm by 7.55mm) DIN rail. Attach the module to the DIN rail by hooking the hook on the back of the enclosure to the DIN rail and then snap the bottom hook into place.
5.2. Power supply

![Image of WiFi 16 Relay Module power supply](image.png)

**Figure 6.** Power supply

Depending on the selected model during purchase the power supply source for *WiFi 16 Relay Module* must be with voltage either 12VDC or 24VDC stabilized and filtered. After power on, the power led must be on and *ready led indicator* must on as well.

⚠️ Please keep the polarity and supply voltage range!

⚠️ *WiFi 16 Relay Module* does not accept AC supply voltage. It is highly recommended to check the power supply source parameters before supply the module.

⚠️ The power supply equipment shall be resistant to short circuit and overload in secondary circuit.

⚠️ When in use, do not place the equipment so that it is difficult to disconnect the device from the power supply.
5.3. Relay connection

The module carries 16 SPDT relays with parameters specified in the technical parameters section. Every relay channel has normally open (NO) and normally closed (NC) contacts connected directly to the terminals.

![Connecting a lamp to relay](image)

*Figure 7. Connecting a lamp to relay*
5.4. WiFi connection for very first time

The module is shipped with set Wi-Fi mode AP (Access Point). The default SSID is WiFi16_Relay and there is not password. When the module is powered on and the Ready Led is ON as well, it should appear in your Wi-Fi scanned networks list.

![WiFi connection screenshot]

**Figure 8.** Default AP network name

Next is to connect to this network.

⚠️ Please note DHCP of your Wi-Fi network adapter must be turned ON in order to receive IP address from the board.

After successful connection, the Link Led is turned ON.
5.5. Set-up the module via web browser

Open web browser and type in address bar: http://10.10.100.254

Login to the web server, the default username/password is admin/admin. Now it should appear the bellow welcome page:

Figure 9. Web server welcome page
Go to "Sockets" tab and be sure the following settings are entered (they are for the software communication):

![Figure 10. Sockets settings](image)

Now a reboot is required in order the new settings take effect.

5.6. **Control with DRM Software**

Download and install DRM Software from this link: [http://denkovi.com/drm-software](http://denkovi.com/drm-software)

Run the software and open the device with name "WiFi 16 Relay Brd"

![Figure 11. DRM device settings](image)
It will be created new instance of this device type with the following settings:

![Denkovi Relay Manager](image)

**Figure 12. DRM settings**

Please check the following settings:

- **DRM Software IP/URL** must be the IP address of the module;
- **DRM Software Port** must be the Port ID from the module webserver -> Network -> SOCKET_A SETTINGS or SOCKET_B SETTINGS;
- **DRM Software Protocol** must be tcp / udp depending on parameter Protocol = "TCP-Server" / "UDP-Server" from the module webserver -> Network -> SOCKET_A SETTINGS or SOCKET_B SETTINGS;

⚠️ Please note DRM software will work with the relay module only if the Protocol parameter is "TCP-Server" or "UDP-Server" from webserver -> Network -> SOCKET_A SETTINGS or SOCKET_B SETTINGS

Now, click the "Open" button. The relays are available for controlling.
6. Default settings

6.1. List with factory settings

<table>
<thead>
<tr>
<th>Settings group</th>
<th>Parameter (according Web pages)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WiFi Settings</td>
<td>WiFi Work Mode</td>
<td>AP (Access Point)</td>
</tr>
<tr>
<td></td>
<td>SSID</td>
<td>WiFi16_Relay</td>
</tr>
<tr>
<td></td>
<td>Wireless AP Security Setting</td>
<td>Disable</td>
</tr>
<tr>
<td>Network Settings</td>
<td>DHCP</td>
<td>Enabled</td>
</tr>
<tr>
<td></td>
<td>IP Address</td>
<td>10.10.100.254</td>
</tr>
<tr>
<td></td>
<td>Gateway</td>
<td>10.10.100.254</td>
</tr>
<tr>
<td></td>
<td>Subnet Mask</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td>Communication Sockets</td>
<td>Socket_A Protocol</td>
<td>TCP-Server</td>
</tr>
<tr>
<td></td>
<td>Port ID</td>
<td>8899</td>
</tr>
<tr>
<td></td>
<td>Server Address</td>
<td>10.10.100.254</td>
</tr>
<tr>
<td></td>
<td>TCP Time Out Setting</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Socket_B</td>
<td>enable</td>
</tr>
<tr>
<td></td>
<td>Protocol</td>
<td>UDP-Server</td>
</tr>
<tr>
<td></td>
<td>Port ID</td>
<td>8899</td>
</tr>
<tr>
<td></td>
<td>Server Address</td>
<td>10.10.100.254</td>
</tr>
<tr>
<td></td>
<td>TCP Time Out Setting</td>
<td>8899</td>
</tr>
<tr>
<td>Web Server Settings</td>
<td>Server Port</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>User name</td>
<td>admin</td>
</tr>
<tr>
<td></td>
<td>Password</td>
<td>admin</td>
</tr>
</tbody>
</table>

Table 5. Default (Factory) settings

6.2. Procedure for loading the factory settings

The default (factory) settings can be loaded if button Default (or DFT) is pressed and hold for more than 3 seconds at any time.
7. Web access

To access the setup pages, run a web browser (Internet Explorer, Mozilla Firefox or similar), and enter the WiFi 16 Relay Module IP address, for example: http://10.10.100.254

![Figure 16. Open via browser](http://10.10.100.254)

**Note:** You will need to have JavaScript enabled in your browser.

7.1. Home

The welcome page is shown below.

![Figure 17. Home page](http://10.10.100.254)

From this page it is possible to make fast scan of the Wi-Fi networks within the range and to connect the module to this network.
7.2. System
This page displays general information for the module.

![Figure 18. System page](image)

- **MID**: Module ID, for this device it is WiFi_16_Relay_Module;
- **Software Version**: The firmware version of the Wi-Fi interface;
- **Small Version**: The minor firmware version of the Wi-Fi interface;
- **Wi-Fi Work Mode**: The working mode of the Wi-Fi interface - it may be AP (Access Point), STA (Station) or APSTA (Access Point and Station at the same time);
- **AP Mode**: In this mode the current module creates network and acts like access point. If this mode is active it will display the below settings:
  - **SSID**: The SSID of the AP network;
  - **IP Address**: The IP of the AP network;
  - **MAC Address**: The MAC address of the AP network;
- **STA Mode**: In this mode the current module connects to another network. If this mode is active it will display the below settings:
  - **Router SSID**: The SSID of the network, to which is connected the current module (usually router);
  - **Signal Strength**: This signal strength of the network;
  - **IP Address**: The IP address of the network (usually this is the AP router IP address) to which is connected the current module;
  - **MAC Address**: Usually the MAC address of the router or AP;
7.3. STA Settings

These are the settings for STA mode. In this mode the relay module is connected to another Wi-Fi network - usually created by AP router.

![Figure 19. STA Settings page]

- **Mode**: The working mode of the Wi-Fi interface. It can be:
  - **STA**: In this mode the board connects to another Wi-Fi network (usually created by AP router);
  - **AP+STA**: The above mode plus additional Wi-Fi network created by the module. Here it is AP and client at the same time.
  - **Network Name (SSID)**: The name (SSID) of the network to which must be connected the module;
- **Scan button**: Starts scanning the available Wi-Fi networks within the range;
- **Encryption Method**: The encryption method for the Wi-Fi network (OPENWEP, SHAREDWEP, WPAPSK, WPA2PSK);
- **Encryption Algorithm**: AES or TKIP;
- **Encryption Type**: HEX or ASCII;
- **Password**: password for the network. When method is OPENWEP or SHAREDWEP length must be 10 or 26 symbols (for HEX encryption type) and 5 or 13 symbols (for ASCII encryption type). For rest of cases when password is required it may be maximum 64 symbols and minimum 8 symbols;
- **Obtain an IP address automatically**: Enable or disable DHCP. When disabled, the bellow settings will be active to be set;
- **IP Address**: The IP address of the module;
- Subnet Mask: The mask;
- Gateway Address: The gateway IP address (usually the address of the AP or router);
- DNS Server Address: The DNS IP address (usually the address of the AP or router);
- Save button: Once you have changed the settings as required, click this button.

When the Scan button is pressed, the scanning will begin and the below screen will appear asking for select the Wi-Fi network to connect to.

![List with available Wi-Fi networks within the range](image)

**Figure 20.** List with available Wi-Fi networks within the range

⚠️ You have to reboot the device for these settings to apply.
7.4. **AP Settings**

These are the settings for AP (Access Point) mode.

![AP Settings](image)

- **Mode**: The working mode of the Wi-Fi interface. It can be:
  - **AP**: In this mode the board works as Access Point only;
  - **AP+STA**: Access Point and station at the same time;
  - **Network Name (SSID)**: The name of the Wi-Fi network which will be created by the module;

- **Module MAC Address**: The MAC address of the AP interface;

- **Radio Channel**: Select the radio channel for the Wi-Fi network;

- **Wireless AP Security Setting**: It may be either disabled either WPA2-PSK;

- **WPA Encryption**: If security setting is WPA2-PSK, it may be TKIP, AES or TKIPAES;

- **Password**: If security setting is WPA2-PSK, this is the AP Wi-Fi network. May be max 20 characters;

- **IP Address (DHCP Gateway Setting)**: The IP address of the module in this mode;

- **Subnet Mask**: The network mask;

- **DHCP Server**: Enable or disable the DHCP setting of the module in AP mode;

- **Save button**: Once you have changed the settings as required, click this button.

⚠️ You have to reboot the device for these settings to apply.
7.5. Sockets

From the below page it is possible to be adjusted the communication sockets parameters. The sockets are used for communication between software (computer, mobile apps) and the relay module.

7.5.1. SOCKET_A Settings

- **Protocol**: This parameter may be:
  - **TCP-Server**: In this mode the socket works like TCP/IP server;
  - **TCP-Client**: In this mode the socket works like TCP/IP client;
  - **UDP-Server**: In this mode the socket works like UDP server;
  - **UDP-Client**: In this mode the socket works like UDP client;

- **Port ID**: The port number of the socket (1...65535);
- **Server Address**: Valid only if socket is server;
- **TCP Time Out Setting**: timeout (in seconds), only if TCP mode is selected (0...600 sec);
7.5.2. SOCKET_B Settings

- **Enable/Disable**: Enable or disable the second socket;
- **Protocol**: This parameter may be:
  - **TCP-Client**: In this mode the socket works like TCP/IP client;
  - **UDP-Server**: In this mode the socket works like UDP server;
  - **UDP-Client**: In this mode the socket works like UDP client;
- **Port ID**: The port number of the socket (1...65535);
- **Server Address**: Valid only if socket is server;
- **TCP Time Out Setting**: timeout (in seconds), only if TCP mode is selected (0...600 sec);

⚠️ You have to reboot the device for these settings to apply.

7.5.3. Sockets Mechanism

Socket A supports four modes: TCP Server, TCP Client, UDP Client and UDP Server. The software developed by Denkovi A. E. LTD usually works with sockets setup like TCP Server or UDP Server.

When Socket A is configured as TCP Server, it supports "Multi-TCP link" connection and maximum 5 TCP clients are permitted to connect. "Multi-TCP link" connection works in this way:

- All data from different TCP connections or clients will be transmitted to the module as a sequence.
- The answer from the module will be duplicated and broadcasted to every TCP connection or client (it doesn't matter if it is Socket A or Socket B).

Socket B supports three modes: TCP Client, UDP Client and UDP Server.
7.6. Account
Set the username and password for web server access.

![Figure 23. Account page](image)

The maximum length for the username and password is 20 characters and the minimum is 1 character.

⚠ You have to reboot the device for these settings to apply.
7.7. **Restart**
From this page it is possible to restart the module (only the Wi-Fi interface).

![Restart Device](image)

*Figure 24. Restart page*
7.8. Defaults
Loads the default (factory) settings.

![Restore Factory Setting](image)

Figure 25. Defaults page
8. Protocol description

The Wi-Fi 16 Relay Module supports simple custom synchronous protocol for setting/getting the relays status. The communication may be used over TCP/IP or UDP sockets or Virtual Serial Port (Virtual Com Port) technology.

8.1. Command for receiving relay status

Command format

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>'a'</td>
<td>'s'</td>
<td>'k'</td>
<td>'/'</td>
<td>'/'</td>
</tr>
</tbody>
</table>

Expected answer

The answer is 2 bytes. If the bit is 0, relay is OFF, if the bit is 1 relay is ON.
- Byte1.Bit7 represents relay 1
- Byte1.Bit0 represents relay 8
- Byte2.Bit7 represents relay 9
- Byte2.Bit0 represents relay 16

Example:
- answer 1: 00 -> relays from 1 to 16 are OFF.
- answer 2: 255(dec) 255(dec) -> relays from 1 to 16 are ON.
- answer 3: 81(dec) 81(dec) -> Relays 1,8,9,16 - ON, the rest are OFF.

Please note that data received from this command is not always in printable ASCII format!

- Command for setting single relay ON/OFF

Command format

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address1</td>
<td>Address2</td>
<td>Sign</td>
<td>'/'</td>
<td>'/'</td>
</tr>
</tbody>
</table>

- Address1 and Address2 represent the relay number - from '0' '1' up to '1' '6' (for 16 relays)
- Sign is '+' for relay ON and '-' for relay OFF.
Expected answer - if the command is successful, the answer is exactly the same like the command.

Example:
- "01-//" - Relay 1 is switched OFF
- "12+//" - Relay 12 is switched ON

- **Command for setting all relays ON**

Command format

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>'o'</td>
<td>'n'</td>
<td>'/'</td>
<td>'/'</td>
</tr>
</tbody>
</table>

Expected answer - if the command is successful, the answer is exactly the same like the command i.e. "on///".

Example:
- "on///" - all relays ON

- **Command for setting all relays OFF**

Command format

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>'o'</td>
<td>'f'</td>
<td>'f'</td>
<td>'/'</td>
<td>'/'</td>
</tr>
</tbody>
</table>

Expected answer - if the command is successful, the answer is exactly the same like the command i.e. "off///".

Example:
- "off///" - all relays OFF

- **Command for setting all relays at a time**

Command format

- Byte2.Bit7 is the state of Relay 1
- Byte2.Bit0 is the state of Relay 8
- Byte3.Bit7 is the state of Relay 9
- Byte3.Bit0 is the state of Relay 16
- If bit is 0, the relay state is OFF, if bit is 1 the relay state is ON
Expected answer - if the command is successful, the answer is exactly the same like the command sent.

Example:

Send: 'x' 1A 05 '/\' '/\'
1A(hex)=00011010(bin)
05(hex)=00000101(bin)
Relays 1,2,3,6,8,9,10,11,12,13,15 - switched OFF
Relays 4,5,7,14,16 - switched ON

Please note that State1 and State2 are not always printable ASCII chars. These bytes are binary representation of the relays.
9. Communication methods

9.1. TCP/IP or UDP Sockets

There are really lot of software for sending messages via TCP/IP or UDP sockets. Our DRM Software uses exactly this communication method. We also provide several examples demonstrating the communication with the module.

For example one such free tool for Windows and Linux (there is and command line support) is Packet Sender:

![Packet Sender](image)

Figure 26. Packet Sender

Of course there is lot of mobile apps as well. For Android a good tool is Socket Control Widget:

![Socket Control Widget](image)

Figure 27. Android software
9.2. Virtual Serial (COM) Port

This method is also communication via TCP/IP or UDP socket, but this time the end software works with serial (com) port mapped to the certain socket. We assume the settings of the Wi-Fi Relay Module in that example are:

![Figure 28. Sockets settings for Virtual Com Port](image)

9.2.1. Windows

There are many applications for Windows OS for creating Virtual Com Port connected to TCP/UDP socket. For example one such tool is VSP Manager which is part of Tibbo Device Server Toolkit. It is available for download from here, or here:

- 32 bit Windows installation: download
- 64 bit Windows installation: download

![Figure 29. VSP Manager](image)
To create virtual com port, you have to do the following settings. Make sure the IP, Port, and TCP/IP or UDP settings are the same with the Wi-Fi 16 Relay Module. Here the Routing mode must be "client" because the relay module is the server.

Figure 30. VSP Manager settings

After that, there should be created new com port in Device Manager (COM10):

Figure 31. COM port shown in device manager
Sending and receiving data from PuTTY to and from COM10 in such case is simple.

![Figure 32. Sending and receiving data via PuTTY](image.png)

💡 If somewhere is required baud rate setting, it must be 9600.

### 9.2.2. Linux

In Linux, a very simple way to interact between serial port and TCP/UDP is using `socat` tool.

Firstly, you will need to crate link (map) between the virtual serial port and Wi-Fi Relay Module. In the example the module is with IP address 10.10.100.254, port 8899 for UDP and TCP.

```
socat pty,link=/dev/virtualcom0,raw tcp:10.10.100.254:8899&
```

or
```
socat pty,link=/dev/virtualcom0,raw udp:10.10.100.254:8899&
```

Then, you have to just send the commands to /dev/virtualcom0:

```
echo -e "on//" > /dev/virtualcom0
echo -e "off//" > /dev/virtualcom0
echo -e "01+/" > /dev/virtualcom0
echo -e "16-//" > /dev/virtualcom0
```

In order to send hex data when needed to set all relays at a time, you can use this command:

```
echo -e "x\x00\xFF/" > /dev/virtualcom0
echo -e "x\xFF\xFF/" > /dev/virtualcom0
echo -e "x\x12\x34/" > /dev/virtualcom0
```
10. Appendix 1. PCB dimensions
11. Appendix 2. BOX dimensions