TopBytes DXSpotter
https://DXSpotter.topbytes.net

Release 1.0.5

User Manual

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Fig. 1: The DX Spotter Display Unit

Welcome to the DX Spotter user manual. This comprehensive guide will help you set up, configure, and operate your DX Spotter device.

The DX Spotter is a compact, WiFi-enabled device that connects to DX cluster networks and displays real-time amateur radio spot information on a high-contrast yellow OLED display. It provides an elegant solution for monitoring band activity and DX opportunities.

We have partnered with hamserve, https://dxc.hamserve.uk as the default DX Cluster to connect. Hamserve DX cluster is hosted in a data center with excellent bandwidth and uptime statistics, making it a great choice for receiving your DX Spots.

CHAPTER

ONE

INTRODUCTION

1.1 What is DX Spotter?

The DX Spotter is a dedicated amateur radio accessory that provides real-time DX cluster spot information on a compact, easy-to-read display. Designed for ham radio operators, it eliminates the need to have a computer or mobile device running to monitor band activity.

1.2 Key Features

1.2.1 WiFi Connectivity

- Connects to your home or portable WiFi network
- Built-in configuration portal for easy setup
- Automatic reconnection on network drops
- Support for WPA/WPA2 secured networks

1.2.2 DX Cluster Integration

- Real-time connection to DX cluster networks via Telnet
- Support for standard DX cluster protocols
- Displays frequency, callsign, and spot comments
- Automatic spot parsing and formatting

1.2.3 Display Features

- High-contrast 256x64 yellow OLED display
- Smooth scrolling animation between spots
- WiFi signal strength indicator
- Real-time clock display
- Configurable display title based on band filter

1.2.4 Band Filtering

- Configure spot filtering by band
- Display only the spots you're interested in
- Custom filter commands supported
- Automatic display title generation based on filter

1.2.5 User-Friendly Configuration

- Web-based configuration interface
- Captive portal for initial setup
- Available network scanning built into configuration page
- Save and restore settings to non-volatile memory
- Factory reset button for easy device reset
- On-screen error messages for connection and filter issues
- Device ID displayed for easy identification

1.2.6 Customization Options

- Configurable scroll interval (how long each spot is displayed)
- Adjustable spot history size (1-15 spots)
- Custom display title
- Band-specific filtering
- Callsign identification
- Configurable device name for network identification
- Display rotation (normal or 180 degrees) for upside-down mounting

1.2.7 Over-The-Air Updates

- Firmware updates via OTA (Over-The-Air)
- No need to connect to computer for updates
- Secure HTTPS-based update mechanism
- Automatic version checking

1.2.8 Software Requirements

- A web browser (on computer, tablet, or smartphone) for initial configuration
- Access to a DX cluster server (several public clusters available)

1.2.9 Amateur Radio Requirements

- A valid amateur radio callsign
- Basic understanding of DX cluster operation
- Knowledge of the bands you wish to monitor

1.3 How It Works

The DX Spotter operates in a simple four-stage process:

1. **Power On**: When first powered, the device attempts to connect to a saved WiFi network. If no network is configured, it creates its own WiFi access point for configuration.
2. **Configuration**: Using the web-based configuration portal, you provide your WiFi credentials, DX cluster server details, and your amateur radio callsign.
3. **Connection**: Once configured, the device connects to your WiFi network and establishes a telnet connection to the specified DX cluster server.
4. **Display**: DX spots are received, parsed, and displayed on the OLED screen with smooth scrolling animations. The display continuously updates as new spots arrive.

1.4 Typical Use Cases

1.4.1 Station Monitoring

Keep the DX Spotter on your desk or operating position to monitor band activity without dedicating a computer or mobile device screen.

1.4.2 Portable Operations

Take the DX Spotter to field day, portable operations, or camping. It only requires WiFi connectivity and USB power (power bank compatible).

1.4.3 Contest Monitoring

During contests, filter for your favorite band and watch for rare multipliers or new contacts.

1.4.4 DX Hunting

Set up band-specific filters to monitor for DX openings on specific bands you're interested in working.

1.4.5 Learning Tool

New hams can use the DX Spotter to learn about band activity, propagation, and when different bands are "open" for DX.

1.5 Design Philosophy

The DX Spotter was designed with the following principles in mind:

1.5.1 Simplicity

Configuration should be straightforward and not require technical expertise beyond basic WiFi setup.

1.5.2 Reliability

The device should automatically recover from network disconnections and reconnect to the DX cluster without user intervention.

1.5.3 Readability

The display should be easy to read from a distance, with clear contrast and appropriate font sizes.

1.5.4 Efficiency

Power consumption should be minimal, making the device suitable for portable operations with battery power sources.

1.5.5 Openness

The device supports standard DX cluster protocols and can work with any compatible cluster server.

1.6 What's Next?

Now that you understand what the DX Spotter is and what it can do, proceed to the *Getting Started* section to learn how to set up your device for the first time.

CHAPTER

TWO

GETTING STARTED

This section will guide you through the initial setup of your DX Spotter device.

2.1 Unboxing and First Power-On

2.1.1 What's in the Box

Your DX Spotter package should contain:

- DX Spotter device
- USB power cable

2.1.2 Initial Power-Up

1. Connect the USB power cable to the DX Spotter's power port
2. Connect the other end to a USB power source (wall adapter, computer, or power bank)
3. The display will illuminate and show the TopBytes logo followed by a startup message

2.2 First Boot Sequence

When you power on the DX Spotter for the first time (or after a reset), the following will occur:

1. **Boot Screen**: The TopBytes name and "DX Spotter Starting..." message will display
2. **Network Check**: The device checks for saved WiFi credentials
3. **Configuration Mode**: Since no WiFi is configured, the device will automatically enter Configuration Mode

2.2.1 Configuration Mode Display

When in Configuration Mode, the display will show:

```
CONFIG MODE
WiFi SSID:
DXCluster AP

Open browser:
http://192.168.4.1
```

This indicates that the device has created its own WiFi access point and is ready for configuration.

2.3 Connecting to the Configuration Portal

2.3.1 Using a Computer or Mobile Device

1. **Open WiFi Settings**

   On your computer, smartphone, or tablet, open the WiFi settings.

2. **Find the Access Point**

   Look for a WiFi network named: `DXCluster AP`

3. **Connect to the Network**

   - Select "DXCluster AP" from the available networks
   - No password is required
   - Your device will connect to the DX Spotter's access point

4. **Open the Configuration Page**

   - Most devices will automatically open a captive portal
   - If not, open a web browser and navigate to: `http://192.168.4.1`

Note: On some devices, you may see a notification that "This network has no internet connection." This is normal - the DX Spotter access point is only for configuration, not internet access.

2.4 Configuration Page Interface

Once connected, you'll see the DX Spotter configuration page with the following sections:

2.4.1 WiFi Configuration Section

WiFi Network (SSID)
: Select your home WiFi network from the dropdown or enter it manually.

WiFi Password
: Enter your WiFi password.

> **Warning:** The password field will be blank when loading the page. If you're reconfiguring and don't want to change the password, you can leave this field blank to keep the existing password.

Scan Networks Button
: Click to refresh the list of available WiFi networks.

2.4.2 DX Cluster Configuration Section

Cluster Host
The hostname or IP address of the DX cluster server.

Default: `dxc.g3lrs.org.uk`

Cluster Port
The TCP port for the cluster telnet connection.

Default: `7300`

Protocol
Currently only "TCP/Telnet" is supported.

Your Callsign
Your amateur radio callsign (required).

Important: You **must** enter a valid callsign. The device will not connect to the cluster if the callsign is blank or set to "NOCALL".

2.4.3 Display Configuration Section

Band Filter
Optional filter command to limit spots to specific bands.

Examples:

- `set/dx filter on 20` - Only 20 meter spots
- `set/dx filter on 40` - Only 40 meter spots
- Leave blank for all bands

Display Title
The title shown at the top of the display.

- If left blank, will auto-generate based on band filter (e.g., "20M", "40M")
- Custom titles can be entered (e.g., "My Station", "Field Day")

Scroll Interval (ms)
How long each spot is displayed before scrolling to the next.

- Default: `10000` (10 seconds)
- Minimum: `5000` (5 seconds)
- Maximum: `60000` (60 seconds)

Maximum Spots
How many spots to keep in the scrolling history.

- Default: `5`
- Minimum: `1`
- Maximum: `15`

2.5 Basic Configuration Example

Here's a typical first-time configuration:

1. **WiFi Settings**
   - SSID: `MyHomeWiFi`
   - Password: `MySecurePassword123`
2. **DX Cluster Settings**
   - Cluster Host: `dxc.g3lrs.org.uk` (default)
   - Cluster Port: `7300` (default)
   - Protocol: `TCP/Telnet`
   - Callsign: `K3ABC` (your actual callsign)
3. **Display Settings**
   - Band Filter: `set/dx filter on 20` (for 20 meters only)
   - Display Title: (leave blank - will auto-generate as "20M")
   - Scroll Interval: `10000` (10 seconds)
   - Maximum Spots: `5`
4. **Save Configuration**

   Click the "Save Configuration" button at the bottom of the page.

2.6 Saving and Rebooting

2.6.1 After Clicking Save

1. The device will save all settings to non-volatile memory
2. If WiFi credentials changed, the device will display a confirmation message
3. The device will automatically reboot after 3 seconds
4. Your computer/phone will disconnect from the "DXCluster AP" network

---

Note: After saving, you can reconnect to your regular WiFi network.

2.6.2 Reconnecting to Your Network

After the DX Spotter reboots:

1. It will attempt to connect to the WiFi network you configured
2. The display will show connection progress
3. Once connected, it will connect to the DX cluster
4. Within a few seconds, you should see spots appearing on the display

2.7 Verifying Successful Setup

You'll know the setup was successful when:

- The display shows the WiFi signal strength indicator (top left)
- Your custom title or auto-generated band name appears (top center)
- The current time displays (top right)
- DX spots begin scrolling on the display

Example Display Layout:

```
[WiFi]        20M              12:34:56
----------------------------------------
W1ABC              14.074 MHz
CQ DX FT8
```

2.8 Serial Monitor Messages

If you have the DX Spotter connected to a computer via USB serial, you can monitor the startup process:

```
DX Spotter Starting...
Attempting to connect to stored Wi-Fi: MyHomeWiFi
.....................
Successfully connected!
IP Address: 192.168.1.100

Attempting to connect to DX Cluster: dxc.g3lrs.org.uk:7300
Telnet connected. Sending configuration commands...
Set Filter set/dx filter on 20

W1ABC 14.074 -> CQ DX FT8
```

2.9 What's Next?

Now that your DX Spotter is set up and running, you can:

- Learn more about configuration options in the *Configuration* section
- Understand display operation in the *Operation* section
- Customize band filters and display settings
- Set up OTA updates (see *Advanced Features* section)

If you encounter any issues during setup, refer to the *Troubleshooting* section.

CHAPTER

THREE

CONFIGURATION

This section provides detailed information about all configuration options available for the DX Spotter.

3.1 Accessing Configuration After Initial Setup

3.1.1 Re-entering Configuration Mode

There are two ways to access the configuration interface after initial setup:

Method 1: Serial Reset Command

1. Connect the DX Spotter to your computer via USB
2. Open a serial terminal (115200 baud)
3. Power on the device
4. Within the first 2 seconds, send the letter `R` or `r`
5. The device will clear all settings and enter configuration mode

Method 2: While Connected to WiFi

If your DX Spotter is connected to your WiFi network:

1. Find the device's IP address from your router or serial monitor
2. Open a web browser
3. Navigate to the device's IP address (e.g., `http://192.168.1.100`)
4. The configuration page will load
5. Make changes and click "Save Configuration"

Note: When modifying settings while connected to WiFi, only cluster and display settings that change will trigger a reconnection. WiFi credential changes will trigger a reboot.

3.2 Device Information

3.2.1 Device ID (MAC Address)

At the top of the configuration page, you'll see the **Device ID**, which displays the device's MAC address.

Type
Read-only

Format
XX:XX:XX:XX:XX:XX (hexadecimal)

Example
`A4:CF:12:34:56:78`

Purpose:

- Uniquely identifies your DX Spotter hardware
- Useful for network troubleshooting
- Helpful when managing multiple devices
- Can be used for MAC address filtering on routers
- Permanent identifier that never changes

Note: The Device ID (MAC address) is hardware-based and cannot be changed. It is displayed for information purposes only.

3.3 WiFi Configuration Options

3.3.1 WiFi Network (SSID)

Type
String (1-32 characters)

Required
Yes

Example
`MyHomeNetwork`

The SSID (Service Set Identifier) of your WiFi network. This can be selected from the dropdown list after scanning, or manually entered.

Scanning for Networks:

Click the "Scan Networks" button to populate the dropdown with available WiFi networks. The list will show:

- Network name (SSID)
- Signal strength (RSSI)
- Security status (Open/Secured)
- Channel number

3.3.2 WiFi Password

Type
String (8-63 characters for WPA/WPA2, or blank for open networks)

Required
Only for secured networks

Example
`MySecurePassword123`

The password for your WiFi network.

Important: Password Field Behavior:

- When first configuring: Enter your WiFi password
- When reconfiguring: The field will be **blank** for security
- If you leave it blank when reconfiguring, the existing password is retained
- Only enter a new password if you want to change it

3.4 DX Cluster Configuration Options

We have partnered with hamserve, https://dxc.hamserve.uk as the default DX Cluster to connect. Hamserve DX cluster is hosted in a data center with excellent bandwidth and uptime statistics, making it a great choice for receiving your DX Spots.

3.4.1 Cluster Host

Type
Hostname or IP Address

Required
Yes

Default
`dxc.hamserve.uk`

Example
`dxc.hamserve.uk` or `192.168.1.50`

The hostname or IP address of the DX cluster server you want to connect to.

While we recommend using hamserve, you are free to change to a different provider if you wish. Below are just some others we have tested against.

Popular DX Cluster Servers:

Server	Address	Port
Ham serve (G1FEF)	dxc.hamserve.uk	7300
G3LRS UK	dxc.g3lrs.org.uk	7300
M0KGX	dx.m0kgx.com	7300

Note: Some DX cluster servers may require registration or have specific callsign validation requirements.

3.4.2 Cluster Port

Type
Integer (1-65535)

Required
Yes

Default
`7300`

Example
`7300`

The TCP port number for the telnet connection to the DX cluster.

Most DX clusters use port 7300, but some may use different ports (like 23, 7373, 8000, etc.).

3.4.3 Protocol

Type
Selection

Required
Yes

Default
`TCP/Telnet`

Options
TCP/Telnet

Currently, only TCP/Telnet protocol is supported. This is the standard protocol used by most DX cluster networks.

Note: Future versions may support additional protocols such as MQTT or HTTP APIs.

3.4.4 Your Callsign

Type
String (Amateur Radio Callsign)

Required
Yes

Default
`NOCALL`

Example
`K3ABC`, `G4XYZ`, `VK2ABC`

Your amateur radio callsign. This is used to log in to the DX cluster.

Danger: Important Callsign Requirements:

- You **must** enter a valid amateur radio callsign
- The callsign cannot be blank or left as "NOCALL"
- If the callsign is not configured, the device **will not** attempt to connect to the cluster
- Use your own callsign - do not use someone else's callsign

Callsign Format:

- Standard callsign format (e.g., `K3ABC`, `G4XYZ`)
- Include portable/mobile indicators if desired (e.g., `K3ABC/P`)
- Case insensitive (will be sent as entered)

Important: Multiple DX Spotters:

If you have multiple DX Spotters, each one **must** use a unique callsign. DX clusters only allow one connection per callsign. If two devices use the same callsign, they will kick each other off in a reconnect loop.

Solution: Add a suffix to differentiate them:

- Device 1: `K3ABC`
- Device 2: `K3ABC/2`
- Device 3: `K3ABC/3`
- Or use indicators: `K3ABC/P`, `K3ABC/M`, `K3ABC/S` (Portable, Mobile, Station)

3.5 Display Configuration Options

3.5.1 Band Filter

Type
String (DX Cluster command)

Required
No (leave blank for all bands)

Default
Empty (all bands)

Example
`set/dx filter on 20`

A filter command to limit which spots are displayed. This is sent directly to the DX cluster after login.

Common Filter Examples:

Filter Command	Description
`accept/spot 0 freq 20m`	Only 20 meter spots
`accept/spot 0 freq 40`	Only 40 meter spots
`accept/spot 0 freq 15`	Only 15 meter spots
`accept/spot 0 freq 10`	Only 10 meter spots
`accept/spot 0 freq 6`	Only 6 meter spots
(blank)	All bands

Advanced Filtering:

Some DX clusters support more advanced filtering. Refer to your cluster's documentation for specific syntax. Examples might include:

- Frequency range filtering: `accept/spot 0 freq 14.000-14.100`
- Mode filtering (cluster dependent)
- Continent filtering (cluster dependent)
- HF, Phone filtering: `accept/spot 0 freq hf/ssb`

- Mode filtering (cluster dependent)
- Continent filtering (cluster dependent)

Tip: When you change the band filter, the display title will automatically update if you haven't customized it. For example, filtering to 20 meters will set the title to "20M".

3.5.2 Display Title

Type
String (up to ~20 characters recommended)

Required
No

Default
Auto-generated from band filter

Example
`20M`, `Field Day`, `My Station`

The title displayed at the top center of the display.

Auto-Generation Behavior:

If you leave the title blank or don't customize it:

- The device will automatically generate a title based on your band filter
- Filter for 20M = Title: "20M"
- Filter for 40M = Title: "40M"
- No filter = Title: "All Bands"

Custom Titles:

You can enter any custom title you want:

- Keep it short (20 characters or less recommended)
- Examples: "Contest", "Field Day", "DX Watch", "K3ABC"

Note: If you change the band filter and the title was auto-generated, the title will automatically update to match the new band. If you've customized the title, it will remain as you set it even when changing filters.

3.5.3 Scroll Interval

Type
Integer (milliseconds)

Required
Yes

Default
`10000` (10 seconds)

Range
5000-60000

Example
`15000` (15 seconds)

The time in milliseconds that each spot is displayed before scrolling to the next spot in the history.

Recommendations:

- **Fast Reading**: 5000-7000ms (5-7 seconds)
- **Standard**: 10000ms (10 seconds) - Default
- **Leisurely**: 15000-20000ms (15-20 seconds)
- **Very Slow**: 30000-60000ms (30-60 seconds)

Tip: If you're monitoring from across the room, use a longer scroll interval to give yourself time to read each spot.

3.5.4 Maximum Spots

Type
Integer

Required
Yes

Default
`5`

Range
1-15

Example
`10`

The maximum number of spots to keep in the scrolling history.

How It Works:

- New spots are added to the history
- The display scrolls through all spots in the history
- When the history is full, the oldest spot is removed when a new one arrives
- With more spots, you can see more history but it takes longer to cycle through

Recommendations:

- **Minimal History**: 1-3 spots - See only the most recent spots
- **Standard**: 5 spots (Default) - Good balance
- **More Context**: 10-15 spots - See more band activity history

3.5.5 Display Rotation

Type
Selection (0 or 180 degrees)

Required
Yes

Default
`0` (Normal orientation)

Options
`Normal (0 degrees)` or `Flipped (180 degrees)`

The display rotation setting allows you to flip the display 180 degrees for upside-down mounting.

When to Use:

- **Normal (0 degrees)**: Default orientation - use when device is mounted right-side up
- **Flipped (180 degrees)**: Use when device is mounted upside-down or needs to be viewed from a different angle

---

Note: Display rotation is useful when:

- Mounting the device on a wall or shelf where cables need to exit from the top
- Placing the device in a location where upside-down viewing is more natural

---

3.5.6 Device Name

Type
String (alphanumeric and hyphens)

Required
No

Default
`dxspotter`

Range
1-32 characters

Example
`shack-monitor`, `portable-dx`, `contest-spotter`

The device name is used for network identification via DHCP hostname and mDNS (Multicast DNS).

Purpose:

- Identifies the device on your network
- Useful when running multiple DX Spotters
- Appears in router DHCP client lists
- Used for mDNS discovery

Naming Guidelines:

- Use only alphanumeric characters and hyphens
- Keep it descriptive but concise
- Examples:
  - `dxspotter` - Default, single device
  - `shack-20m` - 20 meter monitor in shack
  - `portable` - Portable operations spotter
  - `contest` - Contest monitoring device

Tip: If you have multiple DX Spotters on the same network, give each one a unique device name to easily identify them in your router's device list.

3.5.7 Factory Reset

The configuration page includes a **Factory Reset** button that erases all settings and restores the device to factory defaults.

What Gets Erased:

- WiFi credentials (SSID and password)
- DX cluster settings (host, port, protocol)
- Callsign
- Band filter
- Display title
- Device name
- Scroll interval
- Maximum spots setting
- Display rotation

How to Perform Factory Reset:

1. Access the configuration web page
2. Scroll to the bottom
3. Click the red **"Factory Reset"** button
4. Confirm when prompted
5. Device will erase all settings and reboot
6. After reboot, device creates "DXCluster AP" access point
7. Reconfigure from scratch

Warning: Factory reset cannot be undone! Make note of your current settings before performing a factory reset.

Note: Factory reset is useful when:

- Selling or giving away the device
- Starting fresh with new configuration
- Troubleshooting persistent configuration issues
- Moving device to a completely different network/cluster setup

3.6 Configuration Examples

3.6.1 Example 1: 20 Meter Monitor

Use Case: Monitor only 20 meter activity at your home station.

Configuration:

```
WiFi SSID: HomeNetwork
WiFi Password: ********
Cluster Host: dxc.hamserve.uk
Cluster Port: 7300
Protocol: TCP/Telnet
Callsign: K3ABC
Band Filter: accept/spot 0 freq 20m
Display Title: (blank - auto-generates to "20M")
Device Name: dxspotter
Scroll Interval: 10000
Maximum Spots: 5
Display Rotation: Normal (0 degrees)
```

3.6.2 Example 2: All Bands DX Hunter

Use Case: Monitor all bands to catch any DX openings.

Configuration:

```
WiFi SSID: HomeNetwork
WiFi Password: ********
Cluster Host: dxc.hamserve.uk
Cluster Port: 7300
Protocol: TCP/Telnet
Callsign: G4XYZ
Band Filter: (blank - all bands)
Display Title: DX Hunter
Device Name: shack-monitor
Scroll Interval: 8000
Maximum Spots: 10
Display Rotation: Normal (0 degrees)
```

3.6.3 Example 3: Field Day Portable

Use Case: Portable operation at Field Day, focusing on 40 meters.

Configuration:

```
WiFi SSID: FieldDay2025
WiFi Password: ********
Cluster Host: dxc.k3lr.com
Cluster Port: 7373
Protocol: TCP/Telnet
Callsign: W1ABC/P
Band Filter: set/dx filter on 40
Display Title: Field Day
Scroll Interval: 12000
Maximum Spots: 7
Display Rotation: Normal (0 degrees)
```

3.6.4 Example 4: Multiple DX Spotters (Multi-Band Station)

Use Case: Running 3 DX Spotters simultaneously, each monitoring a different band.

Device 1 - 20 Meter Monitor:

Configuration:

```
WiFi SSID: HomeNetwork
WiFi Password: ********
Cluster Host: dxc.hamserve.uk
Cluster Port: 7300
Protocol: TCP/Telnet
Callsign: K3ABC
Band Filter: accept/spot 0 freq 20m
Display Title: 20M
Device Name: dxspotter-20m
Scroll Interval: 10000
Maximum Spots: 5
Display Rotation: Normal (0 degrees)
```

Device 2 - 15 Meter Monitor:

Configuration:

```
WiFi SSID: HomeNetwork
WiFi Password: ********
Cluster Host: dxc.hamserve.uk
Cluster Port: 7300
Protocol: TCP/Telnet
Callsign: K3ABC/2
Band Filter: accept/spot 0 freq 15m
Display Title: 15M
Device Name: dxspotter-15m
Scroll Interval: 10000
Maximum Spots: 5
Display Rotation: Normal (0 degrees)
```

Device 3 - 10 Meter Monitor:

Configuration:

```
WiFi SSID: HomeNetwork
WiFi Password: ********
Cluster Host: dxc.hamserve.uk
Cluster Port: 7300
Protocol: TCP/Telnet
Callsign: K3ABC/3
Band Filter: accept/spot 0 freq 10m
Display Title: 10M
Device Name: dxspotter-10m
Scroll Interval: 10000
Maximum Spots: 5
Display Rotation: Normal (0 degrees)
```

Note: Notice how each device uses a unique:

- **Callsign**: `K3ABC`, `K3ABC/2`, `K3ABC/3` (prevents duplicate login)
- **Device Name**: `dxspotter-20m`, `dxspotter-15m`, `dxspotter-10m` (easy network identification)

- **Band Filter**: Different band for each monitor

3.6.5 Example 5: Contest Station

Use Case: Multi-band contest operation with quick updates.

Configuration:

```
WiFi SSID: ContestWiFi
WiFi Password: ********
Cluster Host: wa9pie.net
Cluster Port: 7300
Protocol: TCP/Telnet
Callsign: K3LR
Band Filter: (blank - all bands)
Display Title: Contest
Scroll Interval: 5000
Maximum Spots: 15
Display Rotation: Normal (0 degrees)
```

3.7 Saving Configuration Changes

After making any configuration changes:

1. **Review Your Settings**

   Double-check all fields before saving.

2. **Click "Save Configuration"**

   The button is at the bottom of the configuration page.

3. **Wait for Confirmation**

   You'll see a success message or confirmation.

4. **Automatic Behavior**

   - If WiFi credentials changed: Device will reboot in 3 seconds
   - If only cluster/display settings changed: Device will reconnect without rebooting
   - Spot history will be cleared if the band filter changed

5. **Verify Operation**

   After saving, verify that:

   - WiFi reconnects successfully
   - DX cluster connection is established
   - Spots begin appearing with your new settings

3.8 Configuration Backup

The DX Spotter stores all configuration in the ESP32's non-volatile storage (NVS). This means:

- Settings persist through power cycles
- No battery needed to maintain configuration
- Settings survive firmware updates (in most cases)

Note: If you perform a factory reset or send the serial `R` command, all settings will be erased and the device will return to initial configuration mode.

3.9 What's Next?

Now that you understand all configuration options, learn about:

- Daily operation in the *Operation* section
- Solving common issues in the *Troubleshooting* section
- Advanced features like OTA updates in the *Advanced Features* section

CHAPTER

FOUR

OPERATION

This section covers the day-to-day operation of your DX Spotter device.

4.1 Understanding the Display

4.1.1 Display Layout

The DX Spotter uses a 256x64 pixel yellow OLED display with the following layout:

```
[WiFi Icon]    Display Title        HH:MM:SS
--------------------------------------------
SPOTTED_CALL              Frequency MHz
Comment text here
```

Let's break down each element:

Status Line (Top Row)

WiFi Signal Indicator (Top Left)

The WiFi icon shows your connection strength:

- **4 Bars** (strongest): Excellent signal (75-100%)
- **3 Bars**: Good signal (50-74%)
- **No Connection Icon**: WiFi disconnected (0%)

The signal strength is calculated from your RSSI (Received Signal Strength Indicator).

Display Title (Top Center)

- Shows your configured title or auto-generated band name
- Examples: "20M", "All Bands", "Field Day", "K3ABC"
- Centered on the display

Time (Top Right)

- Current time in HH:MM:SS format (24-hour)
- Automatically synchronized via NTP (Network Time Protocol)
- Updates every second

Separator Line

A horizontal line separates the status area from the spot content.

Spot Content Area

Each spot displays three pieces of information:

Line 1: Callsign and Frequency

- **Left side**: The spotted callsign (large, bold font)
- **Right side**: Frequency in MHz

Example:

```
W1ABC              14.074 MHz
```

Line 2: Comment

- Shows the spotter's comment about the station
- Common examples: "CQ DX", "CQ CONTEST", "FT8", "599 in OH"

Example:

```
CQ DX FT8
```

4.2 Normal Operation

4.2.1 Power On Sequence

When you power on the DX Spotter:

1. **Boot Screen** (2 seconds)

   ```
   TopBytes Ltd
   DX Spotter Starting...
   WiFi (YourSSID)
   ```

2. **Network Connection** (5-30 seconds)

   The device connects to your configured WiFi network.

3. **Cluster Connection** (2-5 seconds)

   The device connects to the DX cluster and sends your login and filter commands.

4. **Normal Operation**

   Spots begin appearing on the display.

4.2.2 Spot Display Behavior

When First Connected:

- The display shows "Waiting for spots..." until the first spot arrives
- This is normal and may take a few seconds to a few minutes depending on band activity

As Spots Arrive:

- New spots are added to the history
- The display scrolls through spots in the history
- Each spot is displayed for the configured scroll interval (default 10 seconds)

Scrolling Animation:

- Spots smoothly scroll upward during the last 500ms of the display interval
- The animation creates a fluid transition between spots
- The next spot slides up from the bottom as the current spot slides up and off the top

Spot History:

- The device maintains a history of recent spots (default 5, max 15)
- New spots are inserted after the currently displayed spot
- Oldest spots are removed when the history reaches the maximum size

4.3 Understanding Spot Information

4.3.1 DX Spot Format

DX clusters transmit spots in a standard format. The DX Spotter parses these lines and extracts:

Raw Cluster Format:

```
DX de N4XYZ: 14.074  K3ABC  CQ DX FT8  15:30Z
```

Parsed Display Format:

```
K3ABC              14.074 MHz
CQ DX FT8
```

Information Extracted:

- **Spotter Callsign**: N4XYZ (logged but not displayed)
- **Spotted Callsign**: K3ABC (displayed large on Line 1)
- **Frequency**: 14.074 MHz (displayed on Line 1 right)
- **Comment**: CQ DX FT8 (displayed on Line 2)
- **Time**: 15:30Z (received but not currently displayed)

4.3.2 Common Comment Meanings

Here are some common comments you'll see:

General Activity:

- `CQ` - Station is calling CQ (seeking any contact)
- `CQ DX` - Station is calling for DX contacts
- `CQ CONTEST` - Station is in a contest

Digital Modes:

- `FT8` - Operating FT8 mode
- `FT4` - Operating FT4 mode
- `RTTY` - Radio teletype mode
- `PSK31` - Phase shift keying mode

CW (Morse Code):

- `CW` - Morse code operation
- `QRS` - Sending slowly (for new operators)

Special Operations:

- `DXpedition` - Special DX expedition operation
- `IOTA` - Islands On The Air program
- `POTA` - Parks On The Air activation

Signal Reports:

- `599` - Perfect signal report (very strong)
- `579` - Strong signal
- Numbers indicate signal strength (5), readability (9), tone (9)

4.4 WiFi Connection Status

4.4.1 Connection Indicators

Connected:

- WiFi icon shows bars in top left
- Time updates every second
- Spots are received and displayed

Disconnected:

- WiFi icon shows disconnected symbol
- Time may stop updating
- Spots stop arriving
- Device will attempt automatic reconnection

4.4.2 Automatic Reconnection

If the WiFi connection is lost:

1. The device detects the disconnection
2. "WiFi disconnected. Attempting to reconnect..." message in serial log
3. Device waits 5 seconds
4. Attempts to reconnect using saved credentials
5. If successful, reconnects to DX cluster
6. Spot display resumes

Note: The spot history is maintained during reconnection, so you won't lose your recently displayed spots.

4.5 DX Cluster Connection Status

4.5.1 Connection States

Connecting:

- Device attempts to establish telnet connection
- Serial log shows: "Attempting to connect to DX Cluster: [host]:[port]"

Connected:

- Spots are received and displayed
- Serial log shows parsed spot information

Disconnected:

- If cluster connection fails or drops
- Serial log shows: "Telnet connection failed. Retrying in 30 seconds."
- Device automatically retries connection every 30 seconds

4.5.2 Callsign Validation

> **Danger: Callsign Requirement**
>
> The device will **not** connect to the DX cluster if:
>
> - Your callsign is blank/empty
> - Your callsign is set to "NOCALL"
>
> If you see no spots and the serial log shows "Cannot connect to cluster: Callsign not configured", you need to enter your callsign in the configuration.

4.5.3 Cluster Messages

Occasionally, you may see non-spot messages from the cluster in the serial log:

- Welcome messages
- Login confirmation
- Filter acknowledgment
- System announcements

These are logged but not displayed on the screen. Only valid DX spots are shown on the display.

4.6 Serial Monitor Operation

4.6.1 Connecting via Serial

If you want to see detailed operational information:

1. Connect the DX Spotter to your computer via USB
2. Open a serial terminal (Arduino IDE, PuTTY, screen, etc.)
3. Set baud rate to: **115200**

4. You'll see real-time operational messages

4.6.2 Serial Output Examples

Startup:

```
DX Spotter Starting...
Attempting to connect to stored Wi-Fi: HomeNetwork
.....................
Successfully connected!
IP Address: 192.168.1.100
Time configured with GMT/BST (Daylight Saving) adjustment.
London Time: Wednesday, June 25 2025 14:32:18 (BST)
Web server started on port 80
```

Cluster Connection:

```
Attempting to connect to DX Cluster: dxc.g3lrs.org.uk:7300
Telnet connected. Sending configuration commands...
Set Filter set/dx filter on 20
CLUSTER MSG: Welcome to G3LRS DX Cluster
```

Spot Reception:

```
W1ABC 14.074 -> CQ DX FT8
K3DEF 14.244 -> CQ CONTEST
G4XYZ 14.195 -> 599 IN OH
```

Errors/Issues:

```
Cannot connect to cluster: Callsign not configured (blank or NOCALL).
Telnet connection failed. Retrying in 30 seconds.
WiFi disconnected. Attempting to reconnect...
```

4.7 Daily Usage Tips

4.7.1 Optimal Viewing Distance

- The display is easily readable from 1-3 meters (3-10 feet)
- High contrast ensures visibility in various lighting conditions
- No backlight adjustment needed - OLED pixels emit their own light

4.7.2 Power Considerations

Continuous Operation:

- The DX Spotter can run 24/7 if desired
- Power consumption is low (typically <1W)
- No harm from continuous operation

Portable Use:

- Compatible with USB power banks
- A 10,000 mAh power bank can power the device for 40+ hours

- Perfect for field day, portable operations, or camping

Power Cycling:

- Safe to power on/off as needed
- Settings are stored in non-volatile memory
- No initialization needed after power cycling

4.7.3 Band Activity Monitoring

Best Practices:

- Set band filters to match your operating interests
- Use longer scroll intervals if monitoring from across the room
- Increase max spots to see more history during busy periods
- Use shorter scroll intervals during contests for rapid updates

Understanding Activity Levels:

- **High Activity**: New spots every few seconds (contests, good conditions)
- **Moderate Activity**: New spots every 1-2 minutes
- **Low Activity**: Sporadic spots, may wait several minutes
- **No Activity**: Either band is closed or filter is too restrictive

4.8 Placement Recommendations

Ideal Locations:

- On your operating desk within easy view
- Shelf near your radio equipment
- Wall-mounted near your station (if mounting holes provided)

Avoid:

- Direct sunlight (can wash out display)
- Extreme temperatures (below 0C or above 40C)
- High humidity environments
- Areas with poor WiFi signal

Display Orientation:

- The DX Spotter supports display rotation for upside-down mounting
- Configure rotation in the web interface: Normal (0 degrees) or Flipped (180 degrees)
- Useful when mounting with cables exiting from the top
- No need to physically flip the device - software rotation handles the display

4.9 Typical Operating Scenarios

4.9.1 Scenario 1: Morning Band Check

Power on your DX Spotter while having your morning coffee:

1. Device boots and connects automatically
2. Watch for spots indicating which bands are "open"
3. If you see activity on 20M, head to your radio
4. Use the spotted frequency as a starting point

4.9.2 Scenario 2: Contest Monitoring

During a contest weekend:

1. Configure for "all bands" or your contest band of choice
2. Set scroll interval to 5-7 seconds for rapid updates
3. Increase max spots to 15 to see more activity
4. Watch for multipliers or rare stations
5. Note frequencies where activity is concentrated

4.9.3 Scenario 3: Background Monitoring

Keep it running while doing other activities:

1. Set longer scroll interval (15-20 seconds)
2. Glance at display periodically
3. If an interesting callsign or rare DX appears, head to your radio
4. Device maintains history so you can review recent spots

4.9.4 Scenario 4: Learning Tool

For new hams learning about band activity:

1. Set to "all bands" mode
2. Observe which bands are active at different times of day
3. Learn about propagation patterns
4. Note peak activity times for different bands
5. Understand how solar conditions affect band openings

4.10 What's Next?

- If you encounter any issues, see *Troubleshooting*
- For advanced features like OTA updates, see *Advanced Features*
- For technical specifications, see *Technical Specifications*

CHAPTER

FIVE

TROUBLESHOOTING

This section provides solutions to common issues you may encounter with your DX Spotter.

5.1 Quick Diagnostic Checklist

Before diving into specific issues, run through this quick checklist:

- [ ] Is the device powered on? (Display should be lit)
- [ ] Is the USB cable securely connected?
- [ ] Is your WiFi network working? (Test with another device)
- [ ] Is your callsign configured? (Not blank or "NOCALL")
- [ ] Is the DX cluster server online and accessible?
- [ ] Have you checked the serial monitor for error messages?

5.2 WiFi Connection Issues

5.2.1 Issue: Cannot Connect to WiFi Network

Symptoms:

- Device creates "DXCluster AP" access point instead of connecting
- Display shows "CONFIG MODE"
- Status LED behavior indicates no connection

Possible Causes and Solutions:

1. Incorrect WiFi Password

Solution

- Re-enter configuration mode
- Verify your WiFi password (check for typos, case sensitivity)
- Make sure you're entering the correct password for the selected network
- Save configuration and reboot

2. WiFi Network Out of Range

Solution

- Move the DX Spotter closer to your WiFi router/access point
- Check WiFi signal strength from the installation location

- Consider using a WiFi extender if needed
- Verify the network is 2.4GHz (ESP32 does not support 5GHz WiFi)

3. WiFi Network Issues

Solution

- Verify your WiFi router is functioning
- Reboot your WiFi router
- Check if other devices can connect to the network
- Verify the network is not hidden (or configure SSID manually if it is)
- Check if MAC address filtering is enabled (add DX Spotter's MAC if needed)

4. Special Characters in SSID or Password

Solution

- Avoid special characters like ', ", or \ in your WiFi password
- If your SSID has special characters, try entering it manually
- Consider creating a guest network with a simpler name if issues persist

5.2.2 Issue: WiFi Keeps Disconnecting

Symptoms:

- WiFi icon shows disconnected
- Spots stop arriving
- Serial log shows repeated reconnection attempts

Solutions:

1. Weak Signal Strength

Solution

- Check the WiFi signal icon on the display
- Move the device closer to your router
- Reduce obstacles between the device and router
- Use a WiFi extender or access point closer to the device

2. Router Power Saving

Solution

- Some routers disconnect idle clients
- Disable power-saving features for IoT devices
- Set router to always allow the DX Spotter's MAC address

3. Network Congestion

Solution

- If on a busy 2.4GHz network, try changing the WiFi channel
- Reduce the number of devices on the network
- Use a dedicated IoT network if available

4. DHCP Lease Issues

Solution

- Assign a static IP address to the DX Spotter in your router
- Increase DHCP lease time in router settings

5.2.3 Issue: Cannot Access Configuration Page

Symptoms:

- Cannot navigate to http://192.168.4.1
- Browser times out
- "No internet connection" warnings

Solutions:

1. Not Connected to DXCluster AP

Solution

- Verify you're connected to the "DXCluster AP" network
- Disconnect from your regular WiFi first
- Some devices won't connect to networks without internet - temporarily disable "auto-switch" features

2. Captive Portal Not Appearing

Solution

- Manually open a browser
- Navigate to: `http://192.168.4.1`
- Try a different browser
- Clear browser cache if page doesn't load

3. Device Already Connected to Regular WiFi

Solution

- The configuration AP only starts if no WiFi is configured
- Use the device's IP address on your network instead
- Or reset the device using serial command `R` to force config mode

5.3 DX Cluster Connection Issues

5.3.1 Issue: No Spots Appearing

Symptoms:

- Display shows "Waiting for spots..."
- WiFi is connected (icon shows bars)
- Time updates correctly
- No spots ever appear

Possible Causes and Solutions:

1. Callsign Not Configured

Solution

- **Most Common Cause!**

- Check serial monitor for: "Cannot connect to cluster: Callsign not configured"
- Enter configuration mode
- Set your callsign (must not be blank or "NOCALL")
- Save and restart

2. DX Cluster Server Down

Solution

- Check if the cluster server is online
- Try accessing the cluster from a computer using telnet: `telnet dxc.g3lrs.org.uk 7300`
- Try a different cluster server
- Check cluster website for maintenance announcements

3. Incorrect Cluster Port

Solution

- Verify the correct port for your chosen cluster
- Common ports: 7300, 23, 7373, 8000
- Check cluster documentation
- Reconfigure with correct port number

4. Cluster Requires Registration

Solution

- Some clusters require callsign registration
- Register your callsign on the cluster website
- Wait for activation email
- Try connecting again

5. Filter Too Restrictive

Solution

- Your band filter might be excluding all spots
- Temporarily remove band filter (set to blank)
- Try with "all bands" mode
- If spots appear, adjust your filter
- Check filter syntax with cluster documentation

6. Band Inactive

Solution

- The filtered band may have no activity
- This is normal during poor propagation
- Try a different band filter
- Wait for better band conditions
- Check with "all bands" mode to verify cluster connection

7. Invalid Filter Command

Symptoms

- Display shows "Filter Error" message
- Error message from cluster shown on screen
- Spots not appearing

Solution

- **New in v1.0.4**: Filter errors are now automatically detected and displayed
- Read the error message shown on the OLED display
- Common errors include:
  - Invalid syntax (typos in filter command)
  - Unsupported filter features on your cluster
  - Special characters not recognized
- Access configuration page to correct the filter
- Try testing the filter via telnet first (see Advanced section)
- Leave filter blank to use all bands while troubleshooting
- Check cluster documentation for correct filter syntax

8. Duplicate Login / Reconnect Loop

Symptoms

- Display shows "Duplicate Login" error
- Message: "Another device using this callsign!"
- Device does NOT reconnect automatically
- Serial monitor shows "DUPLICATE LOGIN DETECTED"

Cause

- **Most Common**: Multiple DX Spotters configured with the same callsign
- Another device on your network using your callsign
- You're logged into the cluster from another computer/app

Solution

- **New in v1.0.4**: Duplicate logins are automatically detected and prevent reconnect loops
- DX clusters only allow **one connection per callsign** at a time
- When a second device connects, it kicks off the first device
- Options:

  Option 1: Use Different Callsigns

  - Configure each device with a unique identifier
  - Examples: `K3ABC`, `K3ABC/2`, `K3ABC/3`
  - Add portable indicators: `K3ABC/P`, `K3ABC/M`
  - This is the **recommended solution**

  Option 2: Disconnect Other Device

  - Find and disconnect the other device using your callsign
  - Power off or reconfigure the other DX Spotter
  - Close any telnet sessions to the cluster

  Option 3: Save Configuration to Retry

- After fixing the callsign conflict, simply save the configuration
- The device will automatically reset error flags and attempt to reconnect
- **Recommended**: This is the easiest recovery method
- Or power cycle the device if you prefer

Tip: **Quick Recovery**: After changing the callsign to fix the conflict, just click "Save & Reboot" or "Save" and the device will automatically retry the connection with the new callsign.

> **Warning:** When duplicate login is detected, the device will **NOT** automatically reconnect to prevent a reconnect battle. You must resolve the conflict and save the new configuration (or power cycle) to retry.

5.3.2 Issue: Spots Appear Then Stop

Symptoms:

- Spots appeared initially
- Now stuck on one spot or shows "Waiting for spots..."
- WiFi still connected

Solutions:

1. Cluster Disconnected

Solution

- Check serial monitor for disconnection messages
- Wait 30 seconds for automatic reconnection attempt
- Power cycle the device
- Try a different cluster server

2. Network Timeout

Solution

- Telnet connection may have timed out
- Device will automatically reconnect
- If issue persists, reboot device
- Check for network stability issues

5.4 Display Issues

5.4.1 Issue: Display is Blank/Dark

Symptoms:

- Display is completely black
- No startup logo or text appears
- Device appears to be powered on

Solutions:

1. Power Supply Issue

Solution

- Verify USB cable is fully connected
- Try a different USB power adapter
- Ensure power adapter provides at least 500mA
- Try a different USB cable

5.4.2 Issue: Display Shows Garbled Text

Symptoms:

- Text is unreadable
- Strange characters or symbols
- Partial display corruption

Solutions:

1. Reset the Device

Solution

- Power cycle the device
- Clear configuration and reconfigure
- Update firmware if available

5.5 Configuration Issues

5.5.1 Issue: Forgot WiFi Password

Symptoms:

- Changed WiFi password on router
- DX Spotter still has old password
- Can't connect to device to update password

Solutions:

1. Temporarily Restore Old WiFi Password

Solution

- Temporarily change your router back to old password
- DX Spotter will connect
- Access configuration page via device IP
- Update to new password
- Change router back to new password
- Reboot DX Spotter

5.5.2 Issue: Can't Remember Device IP Address

Symptoms:

- Device is connected to WiFi
- Need to access configuration page
- Don't know the IP address

Solutions:

1. Check Router's DHCP Client List

Solution

- Log in to your WiFi router admin page
- Look for connected devices or DHCP clients
- Find device named "dxspotter"
- Note the IP address

2. Use Serial Monitor

Solution

- Connect device via USB
- Open serial terminal
- Power on device
- Watch for "IP Address: x.x.x.x" message during startup

3. Use Network Scanner

Solution

- Use a network scanning app (e.g., Fing, Advanced IP Scanner)
- Scan your network for ESP32 devices
- Identify by MAC address or device name

4. Force Config Mode

Solution

- Reset device using serial `R` command
- Device will create "DXCluster AP" access point
- Connect to http://192.168.4.1
- Reconfigure (existing password can be left blank to keep it)

5. Factory Reset (v1.0.4+)

Solution

- Access the configuration web page
- Scroll to bottom and click red "Factory Reset" button
- Confirm the reset when prompted
- All settings will be erased and device will reboot
- Device creates "DXCluster AP" for fresh configuration

Note: Factory reset is useful when you want to completely start over or if you're experiencing persistent configuration issues that other troubleshooting hasn't resolved.

5.6 Serial Monitor Issues

5.6.1 Issue: No Serial Output

Symptoms:

- Serial monitor connected
- No messages appearing

Solutions:

1. Wrong Baud Rate

Solution

- Set baud rate to exactly **115200**
- Check serial port settings

2. Wrong Serial Port

Solution

- Verify correct COM port selected (Windows)
- Check /dev/tty* devices (Mac/Linux)
- Disconnect/reconnect USB to identify port

4. USB Cable

Solution

- Some USB cables are power-only (no data lines)
- Try a different USB cable
- Use a cable known to work for data

5.7 Getting Help

5.7.1 Self-Help Resources

Before contacting support:

1. **Check Serial Monitor**

   The serial output often contains valuable diagnostic information.

2. **Review Documentation**

   Re-read relevant sections of this manual.

3. **Try Factory Reset**

   Many issues can be resolved with a configuration reset.

4. **Test with Different Settings**

   Try different cluster servers, remove filters, etc.

5.7.2 Gathering Information for Support

If you need to contact support, please gather:

- **Device Information**
  - Firmware version (from device or documentation)
  - MAC address (from serial monitor)
  - Hardware revision (if known)
- **Configuration Details**
  - WiFi network type (2.4GHz, security type)
  - DX cluster server and port you're trying to use
  - Band filter configuration
  - Your callsign (if comfortable sharing)
- **Problem Description**
  - What were you doing when the issue occurred?
  - What did you expect to happen?
  - What actually happened?
  - Is it consistent or intermittent?
- **Serial Monitor Log**
  - Copy/paste relevant serial output
  - Include startup messages
  - Include any error messages
- **Troubleshooting Already Attempted**
  - List what you've already tried
  - Note if anything temporarily worked

5.7.3 Contact Support

For additional assistance:

- **Website**: https://www.topbytes.net
- **Product Page**: https://dxspotter.topbytes.net
- **Email**: support@topbytes.net (check website for current contact)

When contacting support, include all information gathered above and any serial monitor logs that may be relevant.

5.8 Advanced Diagnostics

5.8.1 Telnet Cluster Test

To verify the cluster connection independently:

1. **From Windows:**

```
telnet dxc.g3lrs.org.uk 7300
```

2. **From Mac/Linux:**

```
telnet dxc.g3lrs.org.uk 7300
```

3. **Expected Result:**

   You should see a welcome message from the cluster.

4. **Login:**

   Type your callsign and press Enter.

5. **Test Filter:**

   Type your filter command (e.g., `set/dx filter on 20`)

6. **Watch Spots:**

   If spots appear, the cluster is working and the issue is with your DX Spotter configuration.

5.8.2 Network Connectivity Test

To verify your DX Spotter can reach the cluster:

1. Find your DX Spotter's IP address
2. From a computer on the same network:

```
ping [DX_SPOTTER_IP]
```

3. If ping succeeds, network is working
4. Try pinging the cluster server:

```
ping dxc.g3lrs.org.uk
```

5. If cluster ping fails, your network may be blocking outbound telnet connections

5.9 Common Error Messages

5.9.1 Understanding Serial Error Messages

Here's a quick reference for common serial monitor messages:

Message	Meaning
`Cannot start Telnet: WiFi not connected`	WiFi connection lost or not established
`Cannot connect to cluster: Callsign not configured (blank or NOCALL)`	You must set a valid callsign in configuration
`Telnet connection failed. Retrying in 30 seconds`	Cannot reach DX cluster server
`WiFi disconnected. Attempting to reconnect...`	WiFi connection dropped, auto-recovery in progress
`Invalid SSID length`	WiFi SSID must be 1-32 characters
`Password must be at least 8 characters`	WPA/WPA2 passwords must be 8+ characters
`Connection failed after 30 seconds`	Could not connect to WiFi (wrong password or out of range)

5.10 Emergency Recovery

Should the Over The Air (OTA) firmware update fail and the system stops to function, it's possible to recover the system directly.

You will need a micro USB to USB cable (make sure it's one which provides data not just power). Plug the DX Spotter into your computer.

Note: You need to use the Chrome web browser to perform the upgrade

---

Click on the "Connect" button above and select the USB port associated with your Morse Trainer

CHAPTER

SIX

ADVANCED FEATURES

This section covers advanced features and configuration options for experienced users.

6.1 Over-The-Air (OTA) Firmware Updates

The DX Spotter supports Over-The-Air firmware updates, allowing you to upgrade to new firmware versions without connecting to a computer.

6.1.1 How OTA Updates Work

The DX Spotter uses an HTTPS-based OTA update system:

1. Device connects to the TopBytes update server via HTTPS
2. Server checks device MAC address and current firmware version
3. If an update is available, it's downloaded and installed
4. Device automatically reboots with new firmware
5. Existing configuration is preserved (in most cases)

6.1.2 Security Features

- **HTTPS/TLS Encryption**: Updates are downloaded over encrypted connections
- **Certificate Validation**: Server certificate is validated against trusted CA
- **MAC Address Identification**: Each device is uniquely identified

> **Warning:** Never interrupt power during a firmware update! Wait for the update to complete and the device to reboot.

6.1.3 Initiating an OTA Update

Via Web Interface

1. **Access Configuration Page**
   - Connect to your WiFi network
   - Navigate to the device's IP address in a browser
   - Or connect to "DXCluster AP" and go to http://192.168.4.1
2. **Click OTA Update Button**

- Look for the "OTA Update Mode" button
- Click to initiate the update process

3. **Wait for Update**
   - The device will display update progress
   - Serial monitor will show download progress
   - Do not power off during this time!
4. **Automatic Reboot**
   - Device will reboot automatically when complete
   - Normal operation will resume with new firmware

6.1.4 Troubleshooting OTA Updates

Update Fails to Start:

- Verify WiFi connection
- Check internet connectivity
- Ensure update server is reachable
- Check serial monitor for error messages

Update Stalls/Freezes:

- Wait at least 5 minutes before taking action
- Check network stability
- If completely frozen, power cycle and retry
- Contact support if problem persists

Update Completes but Device Won't Boot:

- Power cycle the device
- Try OTA update again
- If issue persists, may need to reflash via USB

6.2 Advanced WiFi Configuration

6.2.1 Static IP Address

By default, the DX Spotter uses DHCP to obtain an IP address. For a static IP:

Via Router:

1. Access your router's DHCP settings
2. Find the DX Spotter in the client list
3. Assign a "DHCP reservation" or "static lease" to its MAC address
4. This gives it the same IP address every time

6.2.2 Hidden WiFi Networks

If your WiFi network SSID is hidden:

1. Enter configuration mode
2. Manually type your SSID (don't use the dropdown)
3. Enter your password
4. Save configuration
5. Device will connect even though the network doesn't broadcast

6.3 Advanced Display Customization

6.3.1 Scroll Timing Adjustments

The scroll interval can be fine-tuned for optimal viewing:

Short Intervals (5-7 seconds):

- Pros: Rapid updates, see more spots quickly
- Cons: Hard to read from distance, may miss spots
- Best for: Contests, close-up monitoring

Medium Intervals (10-15 seconds):

- Pros: Balanced reading time
- Cons: None significant
- Best for: General use, moderate distance

Long Intervals (20-60 seconds):

- Pros: Easy to read from across room, no rush
- Cons: Slower updates, may miss recent spots
- Best for: Background monitoring, learning

6.3.2 Spot History Size

Adjusting maximum spots changes the behavior:

Small History (1-3 spots):

- Only most recent spots
- Quick cycling
- Best for: Real-time monitoring, contests

Medium History (5-7 spots):

- Good context of recent activity
- Balanced cycling time
- Best for: General use

Large History (10-15 spots):

- Extended context
- Longer cycling time

- Best for: Learning patterns, low-activity bands

6.3.3 Custom Display Titles

Creative title ideas:

- Your callsign: `K3ABC`
- Location: `Shack` or `Mobile`
- Event: `Field Day` or `Contest`
- Band + Mode: `20M FT8`
- Humorous: `DX or Die` or `CQ CQ CQ`

6.4 Advanced Filter Commands

6.4.1 Understanding DX Cluster Filters

Filter commands are sent directly to the DX cluster after login. The exact syntax depends on the cluster software, but common patterns include:

6.4.2 Basic Band Filters

```
set/dx filter on 160    # 160 meters
set/dx filter on 80     # 80 meters
set/dx filter on 40     # 40 meters
set/dx filter on 20     # 20 meters
set/dx filter on 15     # 15 meters
set/dx filter on 10     # 10 meters
set/dx filter on 6      # 6 meters
```

6.4.3 Frequency Range Filters (Cluster Dependent)

Some clusters support precise frequency ranges:

```
set/dx filter on 14.000-14.100    # 20M CW only
set/dx filter on 14.200-14.350    # 20M SSB
set/dx filter on 7.000-7.125      # 40M CW/Digital
```

6.4.4 Clearing Filters

To remove all filters and see all bands:

```
clear/spots all
```

Or simply leave the filter field blank in configuration.

6.4.5 Multiple Band Filters (Cluster Dependent)

Some clusters allow multiple bands:

```
set/dx filter on 20+15+10    # 20M, 15M, 10M only
```

Note: Filter syntax varies by cluster software. Consult your cluster's documentation (usually available via `help` command in telnet session) for supported filter commands.

6.4.6 Testing Filters via Telnet

Before configuring a complex filter in the DX Spotter:

1. Connect to the cluster via telnet from your computer
2. Login with your callsign
3. Test different filter commands
4. Once you find a filter that works, use it in the DX Spotter configuration

6.5 Serial Console Advanced Usage

6.5.1 Monitoring Device Behavior

The serial console (115200 baud) provides detailed operational information:

Startup Information:

- Firmware version
- MAC address
- Stored configuration loading
- WiFi connection process
- IP address assignment
- NTP time synchronization
- Cluster connection establishment

Runtime Information:

- Received spots with full details
- Cluster messages
- Connection status changes
- Reconnection attempts
- Error messages and warnings

Useful for:

- Debugging connection issues
- Understanding cluster behavior
- Monitoring network stability
- Development and customization

6.5.2 Serial Command Reference

Currently supported serial commands:

Command	Description
`R` or `r`	Factory reset - clear all configuration and enter config mode (must be sent within 2 seconds of power-on)

Future firmware versions may support additional serial commands.

6.6 Network Administration

6.6.1 Port Usage

The DX Spotter uses the following network ports:

Port	Protocol	Purpose
80	TCP (HTTP)	Web configuration interface
53	UDP (DNS)	DNS resolution (outbound)
123	UDP (NTP)	Time synchronization (outbound)
7300*	TCP (Telnet)	DX Cluster connection (outbound, port varies)
443	TCP (HTTPS)	OTA firmware updates (outbound)

* Port number varies based on configured cluster

6.6.2 Firewall Considerations

For Normal Operation:

- Allow outbound TCP to cluster port (e.g., 7300)
- Allow outbound UDP to NTP servers (port 123)
- Allow outbound DNS (port 53)

For OTA Updates:

- Allow outbound HTTPS to u.morse.topbytes.net (port 443)

For Web Configuration:

- Allow inbound HTTP on port 80 (local network only)
- No external access required or recommended

> **Warning:** Do not expose the DX Spotter's web interface to the internet! It has no authentication and is intended for local network access only.

6.6.3 Network Security Best Practices

1. **Use WPA2 or WPA3 WiFi Security**

   Never connect to open/unsecured networks.

2. **Isolate IoT Devices (Optional)**

   Consider placing the DX Spotter on a separate IoT VLAN or guest network.

3. **Firewall Rules**

   If using advanced firewall rules, only allow required outbound connections.

4. **Regular Firmware Updates**

   Keep firmware up to date for security patches.

5. **Strong WiFi Password**

   Use a strong, unique password for your WiFi network.

6.7 Time Synchronization

6.7.1 NTP Configuration

The DX Spotter automatically synchronizes time via NTP (Network Time Protocol).

- NTP Server: `pool.ntp.org`
- Update Interval: Periodic automatic updates

Time Display:

- Format: 24-hour (HH:MM:SS)
- Updates every second
- Automatically adjusts for DST

6.8 Power Consumption and Optimization

6.8.1 Typical Power Usage

- **Normal Operation**: ~200-400mA @ 5V (1-2W)
- **WiFi Transmitting**: Up to 500mA peak
- **Display**: ~100-200mA (varies with content)

6.8.2 Battery Operation

Power Bank Sizing:

- 10,000 mAh power bank: ~40-50 hours runtime
- 20,000 mAh power bank: ~80-100 hours runtime

Best Practices:

- Use quality power banks with stable 5V output
- Avoid power banks that auto-shutoff with low current draw
- Consider power banks with "always-on" or "low-current" modes

6.9 What's Next?

- Review *Technical Specifications* for detailed specifications
- Return to *Operation* for daily usage information
- See *Troubleshooting* if you encounter issues

CHAPTER

SEVEN

TECHNICAL SPECIFICATIONS

This section provides detailed technical specifications for the DX Spotter device.

7.1 Hardware Specifications

7.1.1 Wireless Connectivity

WiFi Standard
IEEE 802.11 b/g/n

Frequency Band
2.4 GHz only (5 GHz not supported)

WiFi Modes
Station (STA), Access Point (AP), STA+AP

Security
WPA, WPA2, WPA2-Enterprise

Antenna
On-board PCB antenna or external (model dependent)

Range
Typical 50-100m indoors, 300m+ line-of-sight

Note: The ESP32 does **not** support 5 GHz WiFi networks. Ensure your router has 2.4 GHz enabled.

7.1.2 Display

Type
OLED (Organic Light-Emitting Diode)

Resolution
256 x 64 pixels

Color Depth
16-level (4-bit per pixel)

Viewing Angle
160 degrees (typical for OLED)

Contrast Ratio
>2000:1

Display Technology
Passive Matrix OLED

Refresh Rate
Configurable (typically 60 Hz)

Backlight
Self-emitting (no backlight required)

Lifespan
10,000+ hours typical

7.1.3 Power Requirements

Input Voltage
5V DC +/-5% (via USB)

Input Current
500mA typical, 800mA peak

Power Consumption
1-2W typical

Connector
USB Micro

Battery Support
Via USB power bank (not included)

> **Warning:** Use only quality 5V USB power supplies rated for at least 1A. Insufficient power may cause boot loops or instability.

7.1.4 Physical Specifications

Dimensions
Approximately 113mm x 46mm x 22mm

Weight
~50-80g

Mounting
Desktop/portable

Environmental Rating
Indoor use only

7.1.5 Operating Environment

Operating Temperature
0C to 40C (32F to 104F)

Storage Temperature
-20C to 60C (-4F to 140F)

Humidity
20% to 80% RH non-condensing

Altitude
Up to 2000m

Caution: Do not operate in direct sunlight, high humidity, or extreme temperatures. Avoid exposing to moisture.

7.2 Network Specifications

7.2.1 Supported Protocols

DX Cluster
Telnet (TCP) - primary protocol

Web Interface
HTTP (TCP port 80)

Time Sync
NTP (UDP port 123)

Firmware Updates
HTTPS (TCP port 443)

DNS
UDP port 53

7.2.2 DX Cluster Connection

Protocol
Telnet (raw TCP)

Default Port
7300 (configurable)

Connection Type
Long-lived persistent connection

Authentication
Callsign-based

Reconnect Interval
30 seconds on failure

Supported Clusters
Any standard DX cluster (CC Cluster, DXSpider, AR-Cluster)

7.2.3 Web Configuration Server

Protocol
HTTP/1.1

Port
80 (not configurable)

Interface
192.168.4.1 (AP mode) or assigned IP (STA mode)

Authentication
None (local network only)

Captive Portal
Yes (AP mode)

> **Warning:** The web interface has **no password protection**. Do not expose to the internet! Use only on trusted local networks.

7.2.4 Time Synchronization

Protocol
NTP (Network Time Protocol)

Server
pool.ntp.org (default)

Timezone
GMT/BST with automatic DST

Sync Interval
Automatic periodic updates

Time Format
24-hour (HH:MM:SS)

7.2.5 Configuration Limits

Max WiFi SSIDs
1 (primary network only)

Max WiFi Password Length
63 characters (WPA/WPA2 standard)

Max Callsign Length
32 characters (practical limit)

Max Display Title
255 characters (display width limits practical length)

Max Spot History
15 spots

Scroll Interval Range
5000-60000 milliseconds

7.3 Display Specifications

7.3.1 Screen Layout

Total Area
256x64 pixels

Status Bar
~18 pixels height

Separator Line
1 pixel

Content Area
~45 pixels height

7.4 Performance Specifications

7.4.1 Boot Time

Cold Boot
~2-5 seconds to WiFi attempt

WiFi Connection
5-30 seconds (network dependent)

Cluster Connection
2-5 seconds (after WiFi connected)

Total to First Spot
10-40 seconds typical

7.4.2 Spot Processing

Parse Speed
<1ms per spot line

Display Update Rate
100ms loop cycle

Maximum Spot Rate
Limited only by cluster (typically 1-10 per second during busy periods)

Buffer Size
Up to 15 spots in history

7.4.3 Network Performance

WiFi Connection Time
5-30 seconds (typical)

Reconnect Attempts
Continuous every 5 seconds

Telnet Reconnect Delay
30 seconds on failure

Web Server Response
<100ms for static pages

Configuration Save Time
<500ms

7.4.4 Reliability

MTBF
>10,000 hours (estimated)

Automatic Recovery
WiFi and cluster disconnections

Watchdog Timer
Yes

Boot Stability
>99.9% successful boot rate

7.5 Compatibility

7.5.1 WiFi Router Compatibility

Compatible With

- All 2.4 GHz 802.11 b/g/n routers
- WPA/WPA2 secured networks
- Open networks (not recommended)
- Most home and portable routers

Not Compatible With

- 5 GHz only networks
- WPA3-only networks (WPA2 compatibility mode required)
- Enterprise WiFi with 802.1X (not supported)
- Captive portals requiring web authentication

7.5.2 DX Cluster Compatibility

Compatible With

- CC Cluster (most common)
- DXSpider
- AR-Cluster
- Any telnet-based DX cluster
- Standard DX spot format

Tested Clusters

- G3LRS (dxc.g3lrs.org.uk:7300)
- WA9PIE (wa9pie.net:7300)
- K3LR (dxc.k3lr.com:7373)

7.5.3 Power Source Compatibility

Compatible With

- USB wall adapters (5V, >500mA)
- Computer USB ports (USB 2.0/3.0)
- USB power banks
- USB car chargers

Not Recommended

- USB 1.0 ports (insufficient power)
- Weak/old USB chargers (<500mA)
- Long/thin USB cables causing voltage drop

7.6 Support and Documentation

7.6.1 Resources

- **User Manual**: This document
- **Product Website**: https://dxspotter.topbytes.net
- **Company Website**: https://www.topbytes.net

CHAPTER

EIGHT

CHANGELOG

This page documents the version history and changes to the DX Spotter firmware.

8.1 Version 1.0.5

Release Date: 2025-01-28

8.1.1 New Features

Display Rotation

- Added display rotation setting for upside-down mounting
- Configurable via web interface dropdown
- Two options: Normal (0 degrees) or Flipped (180 degrees)
- Useful when mounting device in different orientations

Device ID Display

- Added Device ID to configuration page
- Displayed at top of configuration interface
- Read-only field for device identification
- Useful for managing multiple DX Spotters
- Helpful for network troubleshooting and MAC filtering

8.2 Version 1.0.4

Release Date: 2025-01-27

8.2.1 New Features

Configurable Device Name

- Added device name configuration setting in web interface
- Device name is used for DHCP hostname and mDNS identification
- Default value: `dxspotter`
- Allows users to identify multiple DX Spotters on the same network
- Configurable via web interface under "Device Name (DHCP/mDNS Hostname)"

Enhanced Error Display

- Telnet connection errors now displayed on OLED screen
- Shows connection status during connection attempts
- Displays error messages when cluster connection fails
- Countdown timer shown during retry attempts
- Prevents normal spot display from overwriting error messages

Filter Validation

- DX cluster filter commands are now validated automatically
- Invalid filter syntax is detected and reported
- Error messages from cluster displayed on OLED screen
- Helps users identify filter configuration problems quickly
- Works with all standard cluster error responses

Duplicate Login Detection

- Automatically detects when kicked off cluster due to duplicate callsign
- Prevents reconnect loop when multiple devices use same callsign
- Displays clear error message explaining the issue
- Stops automatic reconnection attempts to avoid cluster flooding
- Instructs user to either change callsign (e.g., add /2) or disconnect other device
- Saving configuration automatically resets error state and retries connection
- No power cycle needed - just update callsign and save

Factory Reset Button

- Added Factory Reset button to web configuration page
- Confirmation prompt prevents accidental resets
- Erases all settings including WiFi credentials, callsign, and cluster configuration
- Device reboots into configuration mode after reset
- Optimized for iOS captive portal compatibility
- Shows success page before rebooting

8.2.2 Improvements

Callsign Validation

- Displays "Configuration Error" message on screen when callsign is not configured
- Prevents connection attempts with invalid callsign (blank or "NOCALL")
- Clear instructions displayed: "Callsign not set - Please configure"

Serial Console Improvements

- Reduced serial console spam for recurring errors
- Error messages now print only once instead of every loop iteration
- Cleaner serial output for debugging and monitoring
- Factory reset status clearly logged with visual separators

Display Error Handling

- Fixed issue where error messages were immediately overwritten
- Error messages now remain on screen until resolved
- Improved visibility of connection and filter errors

Configuration Save Improvements

- Saving configuration now resets all error flags
- Duplicate login errors automatically cleared when saving new callsign
- No need to power cycle after fixing configuration errors
- Immediate reconnection attempt after saving cluster settings

8.2.3 Bug Fixes

- Fixed filter error messages not displaying on OLED screen
- Fixed serial console continuously scrolling error messages after factory reset
- Fixed `displayingConnectionError` flag being cleared prematurely
- Improved error message persistence during cluster connection issues
- Fixed duplicate login flag not being reset when configuration is saved
- Fixed device not attempting reconnection after changing callsign to resolve duplicate login

8.2.4 Configuration Changes

- New configuration field: `deviceName` (default: "dxspotter")
- Device name stored in NVS preferences
- Legacy devices will default to "dxspotter" on first update

8.2.5 Known Issues

None reported.

8.2.6 Upgrade Notes

- Existing configurations will be preserved during OTA update
- New `deviceName` field will default to "dxspotter"
- If you have multiple DX Spotters, configure unique device names after updating
- Factory reset functionality requires compatible web browser (all modern browsers supported)

8.3 Version 1.0.2

Release Date: 2025-11-20

8.3.1 Initial Features

- WiFi connectivity with WPA/WPA2 support
- DX cluster telnet connection
- OLED display with smooth scrolling
- Band filtering support
- Configurable spot history (1-15 spots)
- Adjustable scroll interval
- Web-based configuration interface
- Captive portal for initial setup
- OTA firmware update support
- NTP time synchronization with GMT/BST automatic DST
- WiFi signal strength indicator
- Automatic reconnection on network drops
- Network scanning in configuration portal

8.4 Version History

Version	Date	Summary
1.0.5	2025-01-28	Added display rotation setting for upside-down mounting
1.0.4	2025-01-27	Added device name configuration, enhanced error display, filter validation, and factory reset
1.0.2	2025-01-XX	Initial release with core DX cluster functionality

CHAPTER

NINE

QUICK LINKS

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CHAPTER

TEN

ABOUT THIS MANUAL

This manual covers:

- Initial setup and WiFi configuration
- DX cluster connection settings
- Band filtering and display customization
- Troubleshooting common issues
- Advanced features and OTA updates

CHAPTER

ELEVEN

SUPPORT

For additional support, please visit:

- Website: https://www.topbytes.net
- DX Spotter Portal: https://dxspotter.topbytes.net