



ekahau

Ekahau T101 Wi-Fi Tag User Guide

*For Real-Time Asset
and People Tracking*



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BEFORE YOU BEGIN

Introduction to T101 Developer Kit

The Ekahau T101 Developer Kit consists of the award-winning Ekahau Wi-Fi tags and Positioning Engine (EPE) software platform, enabling real-time people and asset tracking in any standard Wi-Fi network. The T101 tags can be attached to any mobile object or asset, and can be carried by people as well. The Ekahau Positioning Engine software continuously reports the tag coordinates, area, heading, and speed within the Wi-Fi coverage area both indoors and outdoors.

- Works with standard 802.11b and 802.11g Wi-Fi networks
- Configurable button, motion, and periodic location reporting parameters
- Status indication LED
- Intelligent battery-life management with motion sensor
- Ekahau Manager application for creating and testing location-specific Positioning Models for accurate tracking
- High-performance Positioning Engine for solving up to 100 locations per second
- Flexible Java™ and Ekahau YAX™ application interfaces for quickly integrating the location information with external party applications.

The T101 splash proof enclosure has a power / call button, status LED, serial configuration port, and a charger connector.



CHAPTER 1: Getting Started

Status Indication LED

Category	TAG Status	LED Indication
Scanning	Network data scanned and sent to EPE	Green flash after scanning and sending data to EPE
Button (Call Feature)	Button pressed (only if button detection is on)	Continuous green light indicates when the button is pressed down
Button (Power ON)	Button down for 3s	<ul style="list-style-type: none"> • Continuous green light after 3s (release the button for power on) • Flashing red light indicate too low battery to start
Button (Power OFF)	Button down for 3s	Continuous green light for 3s, then continuous red light (release the button for power off)
Battery	Charging	<ul style="list-style-type: none"> • Continuous green light • All other LED indications off
Battery	Charging complete	Returns from continuous green light (charging) to normal LED indications
Battery	Low	Continuous 3s red light every 30s
Battery	Empty	No light
EPE (Positioning Engine) error	<ul style="list-style-type: none"> • Authentication error • Connection refused • Connection timeout • Protocol error • EPE error response 	1 red flash when the error occurs
WLAN error	<ul style="list-style-type: none"> • Association error • No IP address from DHCP after 20s when scan data should be sent to EPE 	2 red flashes when the error occurs
TAG error	<ul style="list-style-type: none"> • Scan error • Other error 	3 red flashes when the error occurs.



System Requirements

1. Laptop or Tablet PC with at least Windows® XP or 2000, 1 GHz processor, 256 MB RAM, and 200 MB of disk space.
2. The laptop must provide a standard 9-pin serial connector for the tag's configuration cable. If your laptop has USB connectors only, purchase an external USB–serial cable (9-pin) adapter.
3. Supported Wi-Fi adapter (see <http://www.ekahau.com/devices> or Ekahau Client Release Notes) to create a Positioning Model. Communication with the tags can be facilitated via the Wi-Fi adapter, or Ethernet cable, provided that your Ethernet network is connected to your Wi-Fi network.
4. The Ekahau Positioning Engine (EPE) software, license keys, and license files, fully installed on the laptop PC.
5. At least 3 operational Wi-Fi access points (802.11b/g).
6. Map image of the facility or area (JPG or PNG). You can draw a map image yourself with any drawing tool, if necessary.

NOTE

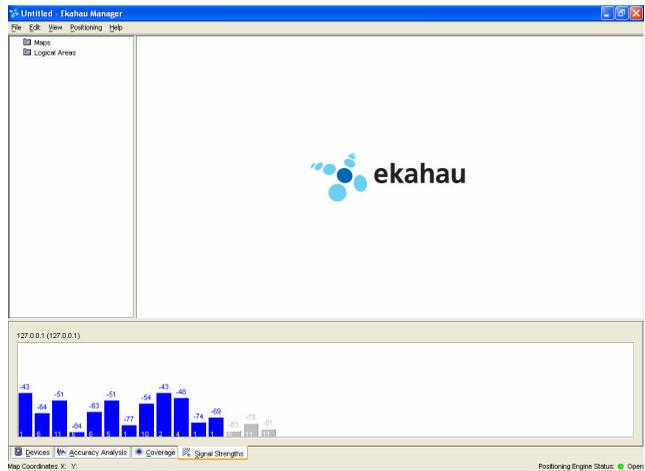
For quick evaluation and development setup, install all EPE components on the laptop PC and refer to the EPE User Guide on creating a Positioning Model using the Ekahau Manager. Test the Positioning Model by walking around the site with the laptop while observing your location on the map. Then save the model in the Positioning Engine.



Setting up the Developer Kit

1. Make sure you have a supported, working Wi-Fi adapter on the laptop. Visit <http://www.ekahau.com/devices> or see the Ekahau Client software Release Notes for supported adapters and drivers.
2. Double-click the **Install_Engine_win32.exe** to install all Ekahau Positioning Engine (EPE) software components on the laptop PC.
3. In case of CD installation, place the CD in the drive. If the installation does not start automatically, browse the CD contents and double-click **Install.exe**.
4. Follow the on-screen instructions and select the components you wish to install. **It is highly recommended to install the included Wi-Fi adapter drivers during installation.**
5. Start **Ekahau Manager** and notice the blue, changing signal strength bars in the **Signal Strengths** Tab of the Bottom View. If you cannot see the signal strengths, make sure you are using a supported Wi-Fi adapter and driver. To update the driver, see the EPE User Guide.

Your Wi-Fi adapter and driver are OK if you can see the blue signal strength bars in Ekahau Manager's Bottom View.



6. Refer to the EPE User Guide to learn how to use the Ekahau Manager for:
 - Loading a floor-plan and setting its map scale
 - Recording network data to create a Positioning Model.
 - Testing the Positioning Model by walking around with the laptop while observing your location on the map screen
 - Saving the tested model to the Positioning Engine.

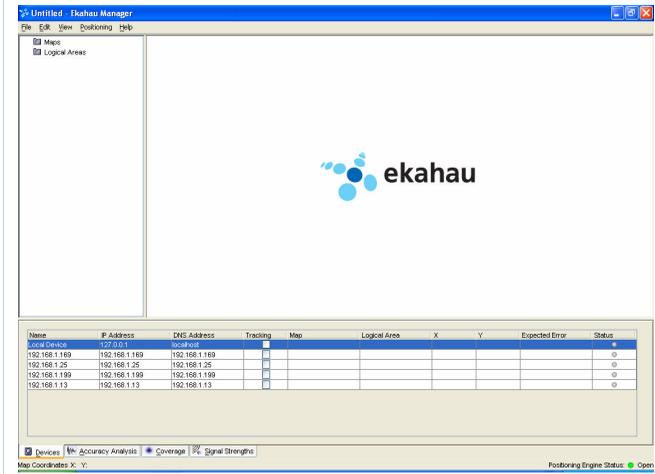
NOTE

For the best location accuracy Ekahau recommends using similar devices for creating positioning model and tracking. Please see EPE User Guide (Chapter 3: Ekahau Manager) to learn how to configure T101 tag as a **calibration client** when creating positioning model with Ekahau Manager.

7. After you have saved a Positioning Model in the Positioning Engine (**File > Save to Positioning Engine**), the Engine is ready to start locating T101 tags, PDAs, and laptops.
8. If you want to locate PDAs or laptops, install the included **Ekahau Client** software on the devices (with a supported Wi-Fi adapter) and make sure the Client is running.
9. Refer to the next chapters on how to charge and configure the T101s to operate on your Wi-Fi network. The tag's network settings are similar to any Wi-Fi device configuration, and you can optionally modify also the tag's motion, button, and periodic scan behavior.
10. After configuring the tags, click Ekahau Manager's **Device Tab** to make sure the tag IP addresses or friendly names (if configured in the tags) appear on the device list. This verifies that your Wi-Fi network and the T101 tags are properly configured.
11. Right-click a device on the list and select **Properties...** to display all device properties such as T101 hardware serial numbers.



Your Wi-Fi network and the T101 tags are properly configured when tag IP addresses or names appear on Ekahau Manager's Devices Tab.



12. To test T101 tracking in Ekahau Manager, double-click a suitable map image in the Browser View to display it, and click each device's **tracking** checkbox on the Devices Tab. You should see the current T101 tag locations on the map screen.
13. Refer to EPE Developer Guide on how to read location information using Ekahau Java SDK or YAX™ protocol.

Charging T101 Tags

T101 internal battery needs to be charged before use.

1. Apply the charger provided with the T101. If you want to use your own charger, see Chapter 3: Technical Specifications.
2. Plug the cable into T101's charging connector located in the left side of the tag, opposite to the status LED.
3. The green status LED will turn off once the charging is complete. This may take up to 6 hours depending on charger. You can use the tag normally while it is being charged, but the LED status lights are not displayed during charging.



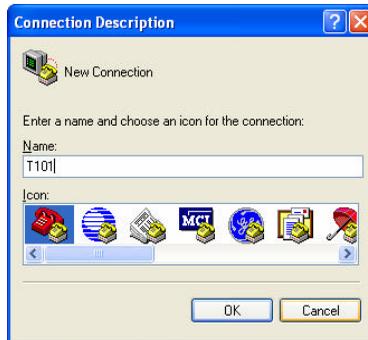
CHAPTER 2: Configuration

Accessing the Configuration Interface (CLI)

The T101 tag provides a Command Line Interface (CLI) for configuring its settings. The CLI can be accessed with the included serial cable. You need to configure at least each tag's communication settings to let it associate with your Wi-Fi network and communicate with the Positioning Engine software. To configure a tag, follow these steps:

1. Plug the included serial cable between the tag and your laptop.
2. Open any terminal program, such as Windows HyperTerminal. Click **Start > Programs > Accessories > Communications > HyperTerminal**.

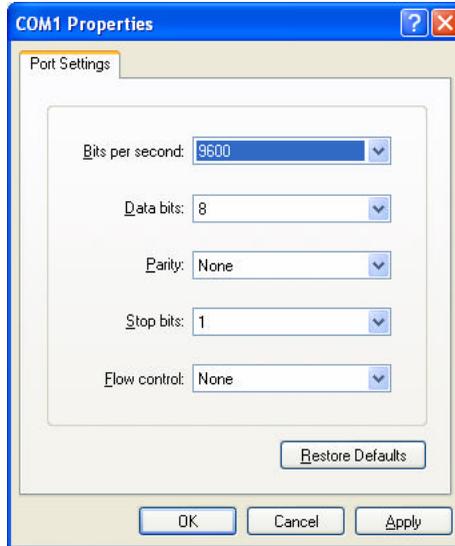
Creating a New Connection with HyperTerminal on Windows® XP.



3. Name a New Connection, such as “T101”, and connect using a COM port, such as COM1. If you cannot access the tag's CLI, try another COM port number until you find the correct port.
4. Select the communication parameters. The acceptable line parameters are 9600,8,N,1, meaning 9600 bits/s, 8 data bits, no parity bit, and 1 stop bit. **Flow Control must be set to “None”**.



The correct COM port settings. If you cannot access the CLI, try a different COM port number, such as COM2 or COM3.



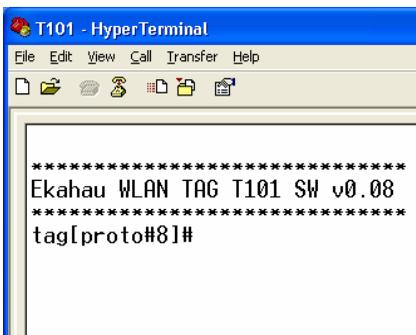
5. Switch on the tag by keeping the call / on-off button **pressed down for 3 seconds**. Release when green status LED appears. It may take up to 10 seconds until the tag displays its CLI prompt. If the battery is too low or empty, you will get red status LED or no light at all. Then plug the power cable in and try again.

NOTE

If the tag is already switched on, you may need to press the **Enter** key once or twice to bring up the CLI prompt.



The CLI prompt displays the Ekahau tag software version and serial number (or friendly name).



```
*****
Ekahau WLAN TAG T101 SW v0.08
*****
tag[proto#8]#
```

Using the Configuration Interface

- Execute CLI commands with the **Enter** key.
- When you execute CLI commands, they are **activated immediately** without asking for confirmation.
- List all configuration parameters by typing **config**<Enter>.
- Save the configuration changes to permanent memory by typing **save**<Enter>. Any unsaved changes will be lost during the next tag sleep or power-off period.
- The command line is editable. You can move the cursor freely left and right and delete single characters from the line.
- The command history is 10 previous input lines. You can scroll through the command history with **up** and **down arrow** keys
- You can complete commands with the **Tab** key.
- Type **help**<Enter> to display the list of available commands.
- Successfully executed commands will not generate any output.
- Invalid commands will display an error message.
- The command prompt format is **tag[serial number OR name]#**



Setting Parameter Value

Parameter values are set by typing the full parameter string and its value to the command line. E.g. setting the associated network's name (SSID) to "test-wlan" and saving it to tag's permanent memory:

```
tag[00001]# wlan ssid "test-wlan"<Enter>
```

```
tag[00001](unsaved)# save<Enter>
```

Any unsaved changes will be lost during the next tag sleep or power-off period. Successful execution gives no feedback to the user.

Most text parameters such as **SSID** and **Engine password** can be set without double quotes (" ") if the text does not contain empty spaces. **WEP** key however always requires the double quotes, when typed in as plain text. The text itself cannot contain double quotes (").

Displaying Parameter Value

Parameter values are displayed by typing the full parameter name string to the command line. E.g. displaying the motion scan rate:

```
tag[00001]# motion scan rate<Enter>
```

```
tag[00001]# motion scan rate = 2 seconds
```

Error Messages

If the user enters an invalid command, one of the two error messages may appear:

- Parameter name not valid
- Invalid parameter value

E.g. setting an invalid parameter value

```
tag[00001]# periodic scan interval -1<Enter>
```

Error: Invalid parameter value



Configuring Multiple Tags

To configure tags faster, it is helpful to create a text file that contains the preferred configuration settings, and send the file to the CLI with any terminal program.

1. Open Windows Notepad or similar plain text tool, and write a configuration parameter on each row. For example:

```
wlan ssid test-net<Enter>
```

```
engine ip 192.168.1.1<Enter>
```

```
wlan wep 26:4d:29:42:34:28:4d:69:44:30:24:4d:29<Enter>
```

```
save<Enter>
```

2. Save the file for example as T101_settings.txt.
3. Connect a T101 tag to your computer and open a terminal program, such as HyperTerminal (see the previous chapters).
4. Select **Transfer > Send Text File...** If your terminal program supports several file transfer protocols, select ASCII.
5. Browse for the T101_settings.txt and click **Send**.

Type **config**<Enter> to verify the new configuration.



Communication Parameters

These parameters are required to let the tag associate with the Wi-Fi network and communicate with the Positioning Engine. You must configure at least the **SSID**, the tag's **IP address** (automatic DHCP or manual configuration), and Positioning Engine's **IP address**.

Parameter	Syntax	Factory	Min	Max	Type
WLAN SSID	wlan ssid test-net	test-net	-	-	R/W
WLAN WEP	wlan wep "key" OR xx:xx:xx:xx OR off <ul style="list-style-type: none"> • apply strings ("") around plain text • apply colons (:) between hex bytes • use exactly 5 or 13 characters (or hex bytes) for 40/104 bit encryption 	wep off	-	-	R/W
IP method	ip method dhcp OR static	dhcp	-	-	R/W
IP address	ip address 10.10.10.10	10.10.10.10	-	-	R/W
IP netmask	ip netmask 255.255.255.0	255.255.255.0	-	-	R/W
IP gateway	ip gateway off	off	-	-	R/W
Positioning engine IP	engine ip 192.168.0.2	192.168.0.2	-	-	R/W
Positioning engine port	engine port 8548	8548	-	-	R/W
Password	engine password Llama	Llama	-	-	R/W



Engine Retries	engine retries 1 <ul style="list-style-type: none"> number of retries (if WLAN or EPE connection drops) before giving up 	1	1	10	R/W
Scanned channels	scan channels 1-14	1-14	-	-	R/W
Scan mode	scan mode active OR passive	passive	-	-	R/W
Scan send limit	scan send limit 1 <ul style="list-style-type: none"> how many Wi-Fi scans are sent to EPE per message 	1	1	50	R/W

Limiting the Scanned Channels

Make sure that the **scan channels** setting complies with your national 802.11b channel restrictions:

- Channels 1-11 are allowed in the US
- Channels 1-13 are allowed in Europe, Middle-East, and Africa
- Channels 1-14 are allowed in Japan

You can also limit the channels if certain channels are not used at all in your network.

Set the allowed channels for example as: **scan channels 1-3, 6-11.**



Periodic Parameters

These parameters allow the tag to ‘wake up’ periodically, for example every 2 minutes, perform a network scan, communicate the results to the Positioning Engine, and go back to ‘sleep’ to save battery.

Parameter	Syntax	Factory	Min	Max	Type
Periodic Active	<code>periodic active 1 OR 0</code> "0" = no periodic wakeups	1	0	1	R/W
Periodic Wakeup	<code>periodic wakeup 120</code> <ul style="list-style-type: none">time between the periodic wakeups	120 (s)	0	86400	R/W
Periodic Scan Count (after waking up)	<code>periodic scan count 3</code> <ul style="list-style-type: none">number of scans per periodic wakeup	3	0	50	R/W
Periodic Scan Interval (after waking up)	<code>periodic scan interval 2</code> <ul style="list-style-type: none">time between the scan(s) during a wakeup	2 (s)	1	10	R/W

Motion Parameters

These parameters allow the tag to react to movement. Using these settings wisely can significantly extend the tag’s battery life. It also removes the need to query the tag location, as the tag will automatically report its location whenever it is moved.



Parameter	Syntax	Factory	Min	Max	Type
Motion Active	<p><code>motion active 1 OR 0</code></p> <p>"0" = no motion detection</p>	1	0	1	R/W
Motion Sensitivity	<p><code>motion sensitivity 10</code></p> <ul style="list-style-type: none"> 1 = most sensitive 100 = least sensitive 	10	1	100	R/W
Motion Poll Interval	<p><code>motion poll interval 100</code></p> <ul style="list-style-type: none"> time between accelerometer polls 	0.1 (s)	0	10	R/W
Motion Threshold	<p><code>motion threshold 1</code></p> <ul style="list-style-type: none"> how many sequential positive accelerometer polls are determined as a motion event 	1	1	10	R/W
Motion Dead Time	<p><code>motion dead time 5</code></p> <ul style="list-style-type: none"> after a motion event accelerometer is not polled until dead time has elapsed. Used to reduce too frequent motion events 	5 (s)	0	3600	R/W
Motion Scan Count	<p><code>motion scan count 3</code></p> <ul style="list-style-type: none"> number of scans triggered by a single motion event 	3	0	50	R/W
Motion Scan Interval	<p><code>motion scan interval 1.5</code></p> <ul style="list-style-type: none"> scan interval for the motion-triggered scans (if more than 1) 	1.5 (s)	1	10	R/W



Call / On-Off Button Parameters

These parameters allow the tag to react to call button press. The button can be used for example as a call or alarm feature. **Press the button down for 5 seconds** to switch the tag on/off.

Parameter	Syntax	Factory	Min	Max	Type
Button Active	<code>button active yes OR no</code> <ul style="list-style-type: none">no = no call button feature, on/off still works	yes	-	-	R/W
Button Scan Interval	<code>button scan interval 2</code> <ul style="list-style-type: none">time between scans based on button-activation	2 (s)	1	10	R/W
Button Scan Count	<code>button scan count 3</code> <ul style="list-style-type: none">number of button-activated scans	3	0	50	R/W



Other Parameters

These optional configuration parameters allow for example adding user-defined value-key pairs that are available from the Positioning Engine's application interface.

Parameter	Syntax	Factory	Min	Max	Type
name	name mytagname <ul style="list-style-type: none"> This is the device name displayed in Ekahau Manager Name can be read via Ekahau SDK and YAX protocol from device property GENERAL.NAME 	None	-	-	R/W
Low Battery Limit	alarm battery low 3.4	3.4 (volts)	3.2	4.0	R/W
WLAN Powersave	wlan powersave on OR off <ul style="list-style-type: none"> NOTE: Enabling this option may improve battery life up to 50% 	off			R/W
Sleep WLAN	sleep wlan 1 OR off <ul style="list-style-type: none"> After this period of time has elapsed without event, the WLAN module may be put to sleep WLAN module will not sleep in case of upcoming periodic, motion, or button event off = never sleep 	off	off	10	R/W



Sleep CPU	<p><code>sleep cpu 20</code></p> <ul style="list-style-type: none"> • after this period of time has elapsed without event, the CPU may be put to sleep • However, CPU will not sleep in case of upcoming periodic, motion, or button event • <code>off</code> = never sleep 	20 (s)	off	3600	R/W
User defined keys	<p><code>user key=value</code> OR <code>user clear <key></code></p> <ul style="list-style-type: none"> • These device properties are displayed in Ekahau Manager and can be read via Ekahau Java SDK and YAX 	(empty)	-	-	R/W



Commands

The tag commands are used for saving settings, displaying status, statistics, help screen, etc.

Command	Syntax	Description
Save configuration	<code>save</code>	Saves unsaved configuration to permanent memory
Configuration	<code>config</code>	Shows all configuration parameters
Calibrate	<code>calibrate</code>	Starts quick network scanning and sending for calibration purposes <ul style="list-style-type: none">• Select the corresponding T101 tag as the calibration client from Ekahau Manager's File > Preferences dialog• Exit the calibration mode by pressing ESC in the terminal
Status	<code>status</code>	Displays TAG-status information <ul style="list-style-type: none">• IP-address• battery charge
Info	<code>info</code>	Displays static information <ul style="list-style-type: none">• MAC-address• Serial number
Help	<code>help</code>	Displays CLI-help
Ping	<code>ping <IP-address></code>	PING-utility
Debug level	<code>debug level <n></code> <code>n = 0 OR 1, 2, 3</code>	Debug display level for error messages. Please note that the setting cannot be saved.
Reset	<code>reset</code>	Resets the factory default settings



CHAPTER 3: Technical Specifications

Enclosure

- Outside Dimensions (mm): 65 x 65 x 27
- Power switch with configurable Call button function
- Tag and battery status indication with 2-color LED
- Operating Temperature: 0 to 60 °C [32...140°F]
- Storage Temperature: -20 to 70 °C[-4...158°F]
- Humidity: Up to 95 % non-condensing
- Environmental Protection: IP53/NEMA12, protected against dust and spraying water

Wi-Fi

- Supported IEEE Standards: 802.11b/g
- Supported Wi-Fi Specification: v1.1
- Modulation Scheme: Direct Sequence Spread Spectrum (DSSS)
- Media Access: CSMA/CA
- Receiver Sensitivity: -82dBm@11Mbps
- Frequency Range: 2.4 - 2.485 GHz
- Supported Networking Protocols: TCP/IP, DHCP
- Security: WEP Encryption 40/128 Bit
- Antenna Type: Internal omni-directional ceramic multilayer
- Average Antenna Gain: -3dBi

NOTE

The T101's 802.11b chipset works with 802.11g access points, but, as any standard 11b device, will decrease the associated 802.11g access point's data rate to the maximum of 11 Mbps.

Operating Ranges from an Access Point

- Open Space: 100m (330ft)
- Typical Office: 30m (100ft)



Configuration

- Command Line Interface (CLI)
- Connectivity: Serial cable (included)
- Terminal Emulation: VT100
- Line Parameters: 9600 bps, 8 data bits, no parity bit, and 1 stop bit
- Minimum Configuration: SSID, tag IP method, Engine IP address
- Optional Configuration: WEP, motion/button/periodic scan on/off, scan intervals, sensitivity to motion, etc.

Battery Life

- Can be used with external power source (3-12V DC)
- Battery: Integrated 1400mAh rechargeable (Developer Kits are provided with rechargeable battery only)
- The T101 prototype has power for approximately 1000-1500 wakeups, network scans, and data deliveries, depending on network load, using the WLAN powersave option
- Expected 3-5 day battery life with 5 min periodic wakeup
- Expected 24 hour battery life with 1 min periodic wakeup

Application Interface (EPE)

- Ekahau Positioning Engine 3.0 (EPE) provides a flexible Java™ and Ekahau YAX™ application interfaces for reading the location information

Certifications

- CE Mark
- FCC: Part 15 and 22 (Assembled from Tested Components, Complete System Not Tested)
- Optional ATEX/FM: Intrinsically Safe Class 1, Div 1 Environment
- Channels 1-11 (IEEE 802.11b): North America
- Channels 1-13 (IEEE 802.11b): Europe, Middle-East, Africa
- Channels 1-14 (IEEE 802.11b): Japan



Limited Warranty

The Ekahau T101 Wi-Fi Tag comes with a limited 90-day warranty. The warranty period starts from the date of receiving the Tag. Ekahau warrants that each Tag is free from defects in materials and workmanship. The warranty does not cover the included battery or any software shipped with the T101 Wi-Fi Tag. The warranty is void if the Tag has been opened by non-Ekahau personnel.

If the Tag does not function as documented during the warranty period, contact Ekahau support (support@ekahau.com) and explain the defect. In case the Tag is defective you will be provided with a replacement Tag.



Legal Notice

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The enclosed software contains implementations of Ekahau's patent pending inventions.

Under no circumstances shall Ekahau or Ekahau be responsible for any loss of data, income, or any direct, special, incidental, consequential or indirect damages howsoever caused.

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